PROGRAMME IN BUILDING SURVEYING

DEPARTMENT OF BUILT ENVIRONMENT STUDIES AND TECNOLOGY

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

UNIVERSITI TEKNOLOGI MARA

PERAK BRANCH

SERI ISKANDAR CAMPUS

REQUIREMENT FOR IMPLEMENTATION OF RAINWATER HARVESTING SYSTEM (RWHS) FOR ISSUANCE OF CERTIFICATE OF COMPLETION AND COMPLIANCE (CCC)

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(REQUIREMENT FOR IMPLEMENTATION OF RAINWATER HARVESTING SYSTEM (RWHS) FOR ISSUANCE OF CERTIFICATE OF COMPLETION AND COMPLIANCE)

FEBRUARY 2021

This practical training report is fulfilment of the practical training course.

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ABSTRACT

This report will look through the requirement for installation of rainwater Harvesting System for freestanding buildings with roof area more than 100 square meter in order for issuance for CCC as part of Selangor's State Government new policy gazetted on 2011. Rainwater Harvesting System (RWHS) is made as mandatory requirement for buildings of certain category in order for the issuance of Certificate of Compliance and Completion (CCC) by Local Authority throughout the State of Selangor. The detail of the categorized building that is declared by the government, the standard or guidelines provided for the system as well as date of enforcement by local authority. This report also contains the details of requirement and enforcement process of RWHS plans and are analyzed thoroughly with reference of the original guideline of the system provided by the Kementerian Kesejahteraan Bandar, Perumahan dan Kerajaan Tempatan (KPKT) in 2011. Next, based on few chosen case studies, the ways of implementation by consultants and owners on site and during planning are examine and recorded as random examples of effectiveness of the new government policy. The method of installation of the RWHS on site are carefully recorded and inspected focusing on the aspect of compliance to the approved plan and functionality of the system. Lastly, problems that arise due to the new policy are analyzed in order to provide best possible solution and recommendation regardless the nature of the problems either technical or general.

CHAPTER 1 – INTRODUCTION

1.0 – INTRODUCTION.

For final semester as a Bachelor in Building Surveying (AP229) student we were instructed to go for our practical session at our own chosen company or organization. We were provided with syllabus/scope of work that is relevant with our studies which includes :

I. Building control administration.
II. Facilities management and maintenance.
III. Building works and appraisals.
IV. Development and construction management.
V. Insurance.
VI. Heritage and building conservation.

However the employer are allowed to instruct students to carry out any other relevant works during our practical session.

As for me, Zairul Azri Zuhairi Matric no. 2019814566. I have chosen a Local authority organization as my internship location or organization. I have been assigned under the Building Control Department of Majlis Perbandaran Hulu Selangor. The director of the department, Encik Rizal have given me a short brief during my first day which includes the explanation on the scope of work of the department which include 3 out of 5 scopes stated by the faculty which are :

i. Building control administration.
    - The process of approving building plans including new and alterations plan on a building and the issuance of approval.
    - Inspection of building works during construction.
    - The action taken to ensure the compliance of plans and building works with act and statutory requirements.

ii. Building works.
    - Preparation for plans and drawings.
    - Advice on alteration, extensions and refurbishment of building.

iii. Development and construction management.

- Project/site meeting.
- Site supervision including quality control of works and materials.
- Preparation and checking of plans drawing.

1.1 - ORGANIZATION BACKGROUND

Figure 1.0 – Logo of Majlis Perbandaran Hulu Selangor.

NO.	BACKGROUND	DESCRIPTION
1.	Name of organization.	Majlis Perbandaran Hulu Selangor
2.	Year of establishment.	1st January 1975
3.	Address	Majlis Perbandaran Hulu Selangor, Jalan Bukit Kerajaan, 44000 Kuala Kubu Bharu, Selangor Darul Ehsan.
3.	Act implemented during establishment.	Section 4 Local Government Act 1976 (Act171)

4.	Area under administration.	Consist of 13 Mukims : 1. Hulu Bernam. 2. Kalumpang. 3. Kerling. 4. Kuala Kubu Bharu. 5. Rasa. 6. Batang Kali. 7. Ulu Yam. 8. Serendah. 9. Sg.Choh. 10. Bandar Baru Bukit Beruntung. 11. Bandar Baru Bukit Sentosa. 12. Bandar Baru Sg. Buaya. 13. Bandar Lembah Beringin.
5.	Total area under administration.	174,047 hectares.

Table 1.0 – Background of Majlis Perbandaran Hulu Selangor.

1.2 - VISION, MISSION AND OBJECTIVE.

Local authority is the local government that responsible to serve and execute the economy, social, physical and environment developments toward the city in the administration area that have been given.

Vision	Hulu Selangor Progressive, Dynamic and Prosperity.
Mission	To provide municipal service and Develop Socio-Economic For Improving Quality of Life.
Objective	To give and provide municipal services to all residence in the Hulu Selangor District Council area.

Table 1.1 – Vision, Mission and Objective of Majlis Perbandaran Hulu Selangor.

1.3 – ORGANIZATION CHART.

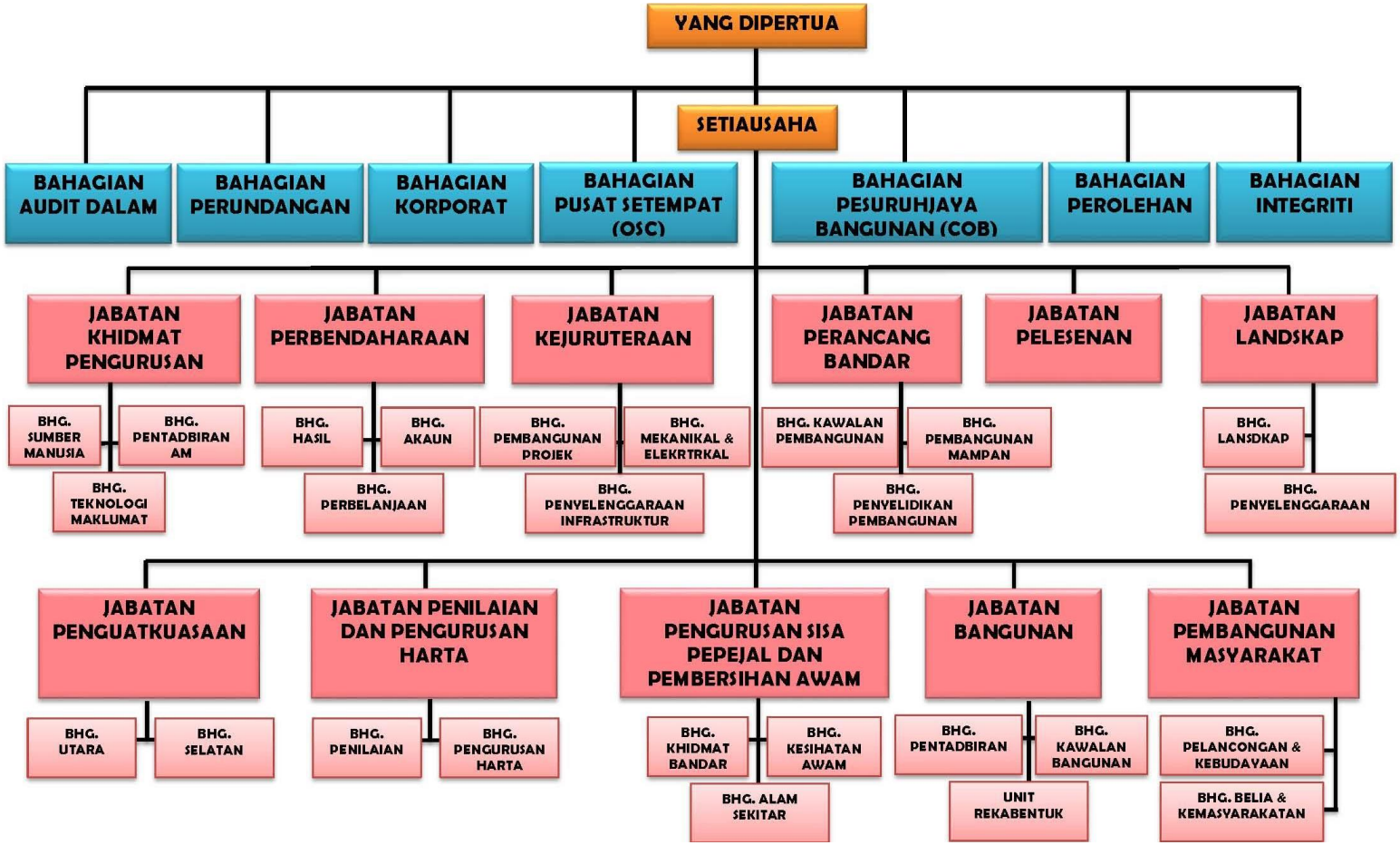


Figure 1.1 – Organization Chart of Majlis Perbandaran Hulu Selangor.

1.4 - SCOPE OF WORK.

1.4.1 – SCOPE OF WORK OF MAJLIS PERBANDARAN HULU SELANGOR.

Local authority is the local government that responsible to serve and execute the economy, social, physical and environment developments toward the city in the administration area that have been given.

Beside the responsibility toward the state government, the local government also act to give these services:

1. Service Provider
2. Local Plan Authority.
3. Social and Economy Development.
4. City Environment.
5. Tax Revenue Collector.

1.4.2 – SCOPE OF WORK OF BUILDING CONTROL DEPARTMENT.

NO.	ACTIVITIES.
1.	Processing plan and issuance of approval for all kind of building categories.
2.	Manage the approval of any extensions and renovations works on residential buildings.
3.	Manage the approval of application of temporary permit.
4.	Process the application of license review.
5.	Manage, process and issuance of Certificate of Compliance & Completion (CCC)
6.	Manage and process the application for return of “Wang Cagaran”
7.	Manage the approval of application of temporary permit for telecommunication (Telco).
8.	Manage the application of “Buku Panduan (Pelan Setara)”
9.	Manage the application for billboard.
10.	Accept, review and attend any report.

Table 1.2 – Scope of work for Building Control Department of Majlis Perbandaran Hulu Selangor.

1.5 - LOCATION PLAN.

Figure 1.2 – Location plan of Majlis Perbandaran Hulu Selangor.

CHAPTER 2 – RAINWATER HARVESTING SYSTEM

2.0 – INTRODUCTION.

Rain water harvesting system are the system that functions as a system where rainwater are harvested, channelled, stored and distributed throughout the building for specific purpose usually for landscapes and sanitary uses. The system is applied in order to reduce the rate of clean water usage of the building. For specific places, where water are limited the system helps stabilise and reduce clean water usage for activities that does not require the usage of treated water.

The application of Rain Water Harvesting System (RWHS) involved a few elements which is catchments (gutter), a storage tank, filter and a distribution system. These are considered as the main elements of the RWHS. The captured water are flow to the storage tank passing through the filter and kept for usage. The water is then distributed by the distribution system usually piping system that flow the water to their specific places for usage.

There are two types of Rain Water Harvesting System which is Surface Runoff Harvesting and Rooftop Rainwater Harvesting. The only difference is on the placement of the storage tank, the catchment and the additional element in order for the system to functions properly. The first one are the system in which the storage tanks are located at the rooftop and this method does not requires a pump. However the second one requires a pump since the system has the storage tanks located underground. Rain Water Harvesting System are the kind of system that have a lot of advantages if applied to a building with a minimal cost since the system does not consume a very high cost for its installation and maintenance.

2.1 - ELEMENTS OF RAINWATER HARVESTING SYSTEM.

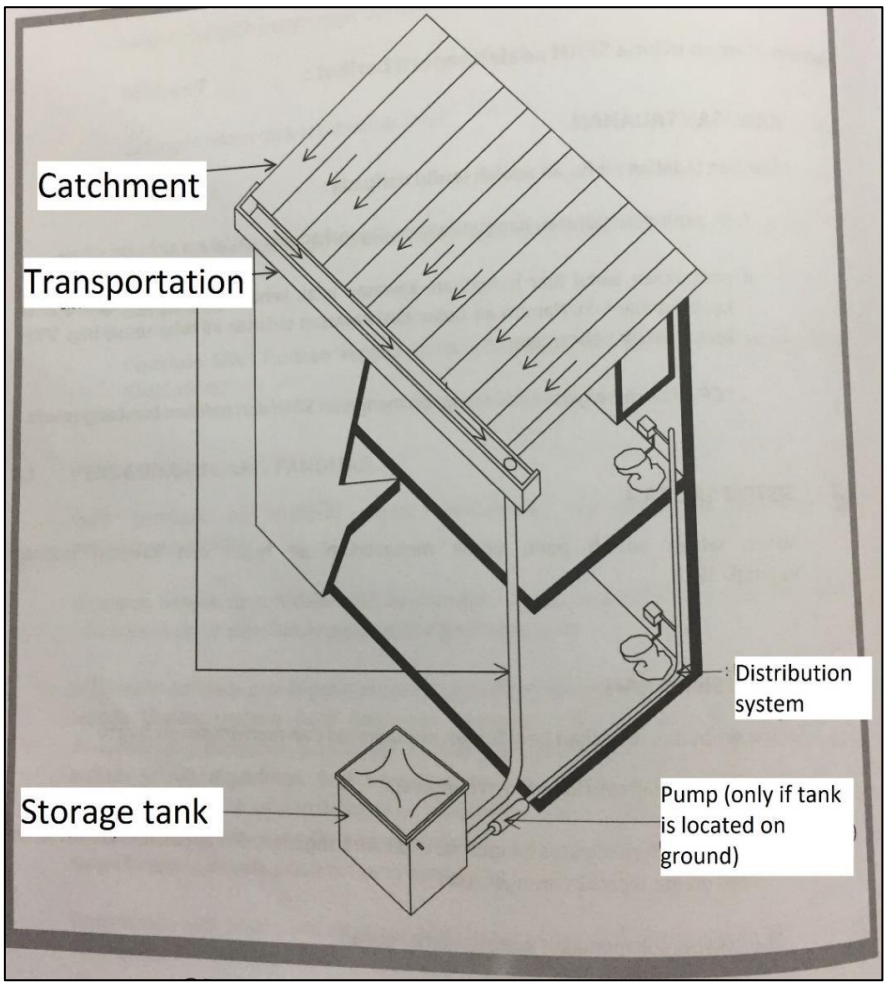


Figure 2.0 : Elements of RWHS.

Rainwater Harvesting System consist of 4 major elements in order for the system to work its function properly. The elements are the catchment, the transportation/conduit, storage tank and distribution system.

- The catchment are the area where the rainwater are collected. The catchment could be floor surface or roof surface but commonly are roof surface since the aspect of cleanliness and lower contamination chances.
- The transporter/conduit are a set of piping system that flows the water from the catchment to the storage tank. Example of transporter are gutter and rainwater downpipe.

- Storage tank are the tank provided specifically for rainwater harvested. The tank's capacity depends on the usage but preferably to be capable of storing as much as capacity for 4 days of usage.
- Distribution system are a set of piping system that helps distribute water from the tank to its specific usage throughout the building.

NO.	ELEMENTS	FUNCTIONS
1	CATCHMENTS	Catchment are the elements where rainwater are harvested from for example : • Roof • Gutter • Floor However floor are only use for Surface Runoff Harvesting and not widely used since the worries of contamination from the rain water harvested.
2	RAINWATER DOWN PIPE/ TRANSPORTATION	A set of pipe that channelled the harvested rainwater from the catchments area to the storage tanks.
3	STORAGE TANK	The tank specifically assigned for rainwater harvested to be stored before it is distributed to its uses.
4	DISTRIBUTION SYSTEM	A piping system that helps distribute the rainwater harvested from the tank to the areas of its uses.

Table 2.0 : Elements of RWHS

2.2 - IMPORTANCE OF RAINWATER HARVESTING SYSTEM.

NO.	IMPORTANCE
1	To reduce the usage of treated water source.
2	Helps reduce water bills and cost for the building.
3	Allow to control the treated water usage.
4	Provide sustainable method for the building in the aspect of water usage.
5	Minimise the usage of water for the activity that does not necessarily requires treated water.

Table 2.1 : Importances of RWHS.

2.2.1 – THE USAGE OF RAINWATER.

NO.	ACTIVITIES
1	Toilet flushing.
2	Gardening
3	Washing vehicles.
4	Outdoor Cleaning.
5	Swimming pool (after treatment).
6	Landscape works.

Table 2.2 : Activities suitable for RWHS.

2.3 - TYPES OF RAINWATER HARVESTING SYSTEM.

There are two types of Rainwater Harvesting System which is the **Surface Runoff Harvesting** and **Roof Water Harvesting**. But both method stands for the same purpose and concept in which both method functions to collect rainwater for usage of suitable activities such as gardening, and other other outdoor works. However, there are different in ways of collection and required elements between this two method.

Surface Runoff Harvesting are the method in which water from the surface/ground are collected and channelled to the storage tank located usually below ground level. This method however is not widely use since it involved more filtration system since the chance of contamination from the water collected from ground level are higher.

Roof Water Harvesting are the most common way of applying the system. Water are collected from the catchment in this method, roof. The water is the collected by gutter and rainwater downpipe and flowed to the storage tank in which usually placed on a roof level. This method requires less energy since the absence of pump and lower cahnces of contamination.

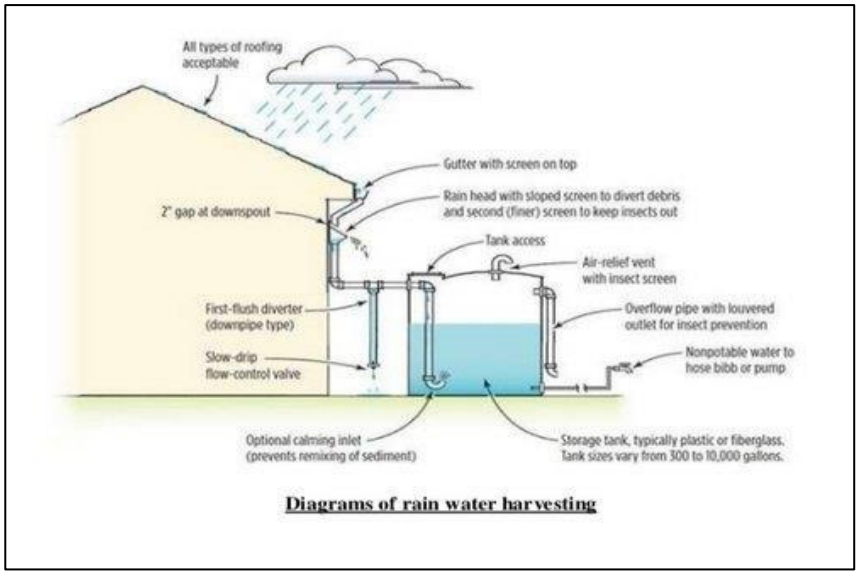


Figure 2.1 : Figure of the process of roof water harvesting.

2.4 - PROCESS OF RAINWATER HARVESTING SYSTEM.

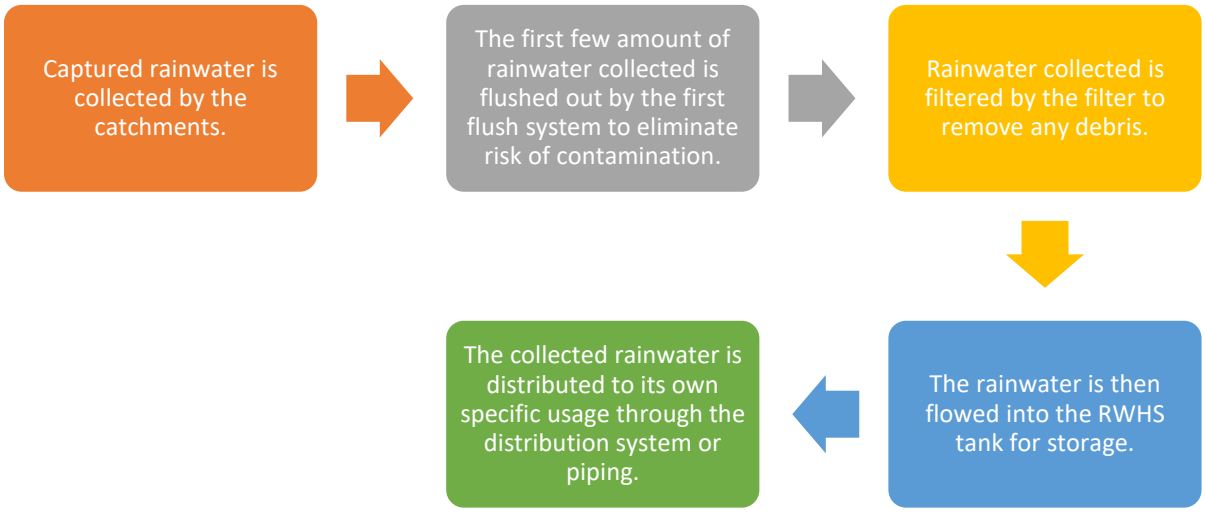


Figure 2.2 : Process of RWHS.

2.4.1 – COLLECTION OF RAINWATER FROM THE ROOF.

The roof are the most common element to be use as catchment for the system. The requirement for the element to be built so it is suitable to the system are :

1. Roof Surface.
    - Roof surface must be built by material that is not easily corroded by water such as ceramic tiles, and metal deck to avoid any future contamination to the water collected.
2. Gutter.
    - The gutter must also made of materials that is not easily corroded and must be installed with suitable gradient so that the water could easily flow and to avoid any stagnancy of water.

3. Rainwater Downpipe

    - The Rainwater Downpipe shall be made of material which is not easily corrode such as UPVC and galvanised metal to avoid negative effect on the water collected.

2.4.2 - FIRST FLUSH PROCESS.

The First Flush process are the process of removing the amount of water from the first shower of the rain due to the worries of contamination of the water from the roof surface. the process involved the installation of the element called First Flush tank on the rainwater downpipe connected to the storage tank.

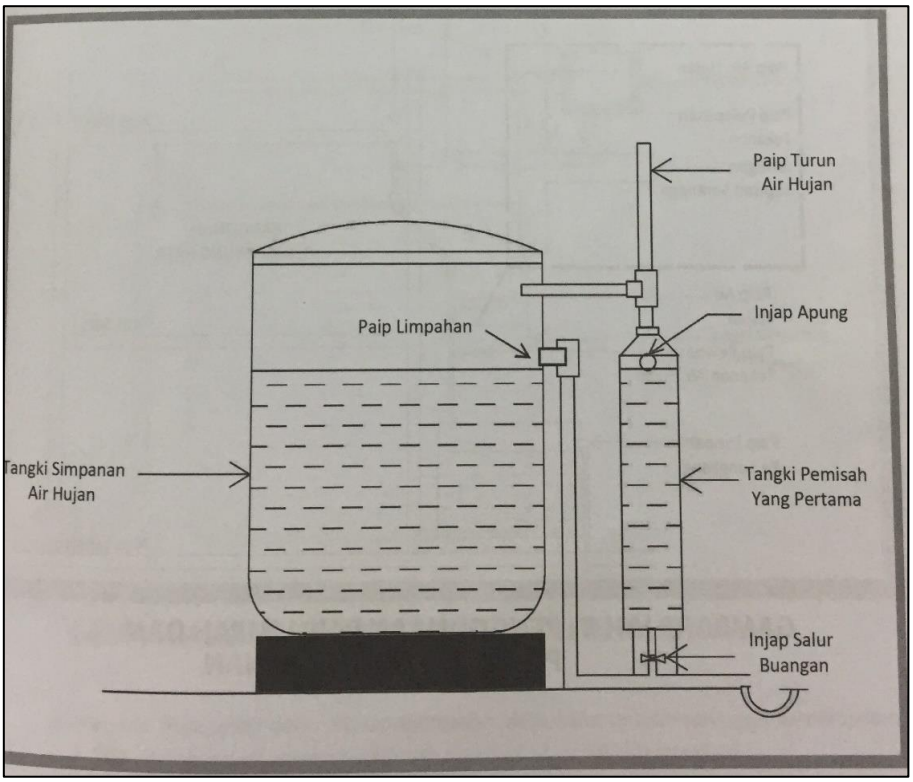


Figure 2.3 : Process of RWHS

2.4.3 - THE USAGE OF FILTER.

The rainwater consist of any other impurities such as sand, dust and any other particles needed to filtered to avoid effect on the quality of the water. The alternative way of preventing these problem are by installing filter or netting.

The filter or netting needed to be made of material that is not easily corroded to prevent water quality depletion. This is a vital component since it helps to discard any solid substances from entering the storage tank.

Figure 2.4 : Photograph of filter.

2.4.4 - RAINWATER HARVESTING SYSTEM TANK.

The tank used for storing harvested rainwater must have a cover/lid in order to avoid any unwanted substance to mix with the water stored. The tank and its component must also be designed in a way where it will be easily maintain. The component that must be installed on a rainwater harvesting tank are :

- An overflow pipe with a suitable diameter.
- Overflow pipe and waste pipe that is connected to the drainage.
- A distribution system in which applies gravity or using pump or using both gravity and pump.
- Indication device. This device is not compulsory however it helps in determining the volume of water in tank.

Figure 2.5 : Example of RWHS tank concept.

RWHS tank shall be made of material that is water resistant and approved by authority for the purpose of clean water storage. Designers and contractors could design their own RWHS tank or build an In-situ tank depending on the needs of the building. However the designed tank must be approved by Malaysian Standard regulations. Material that could be used in the process of making RWHS Tank are Galvanised metal and reinforced polymer as well as reinforced concrete. The usage of any soluble/easily corroded material should be avoid for maintaining the quality of water stored.

The tank capacity is recommended to be as much as the volume to be able to support for a 4 days of usage of rainwater. Next the location of the RWHS tank also plays a very important roles throughout the system's process. There are 2 classified location where RWHS tank could be located around the building which is :

1. Inside a roof space or on roof level.

    • By locating the tank on this area, the distribution system does not need a pumping system since the gravity force is enough for the distribution process, however if the tank is located in the roof space, pumping system maybe needed to pump the water from the suction tank on the ground level to the RWHS tank.

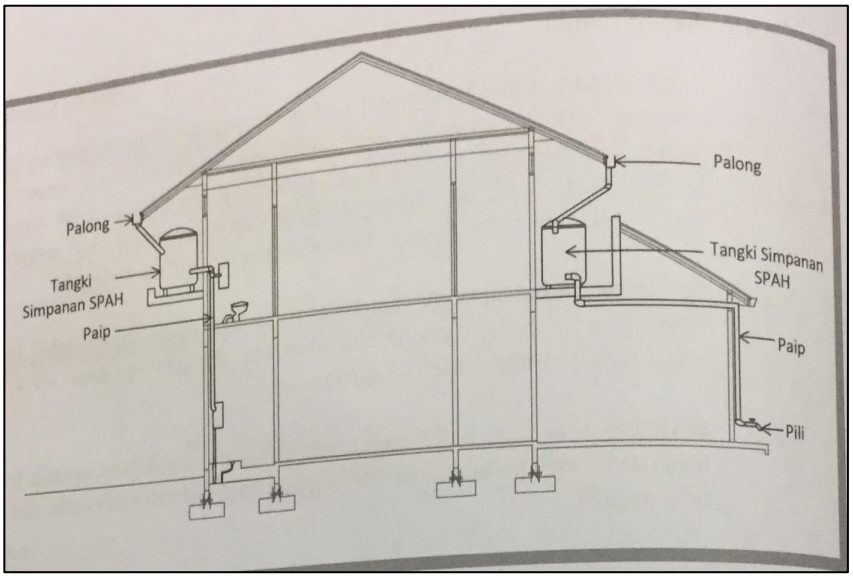


Figure 2.6 : RWHS tank on roof level/below roof level.

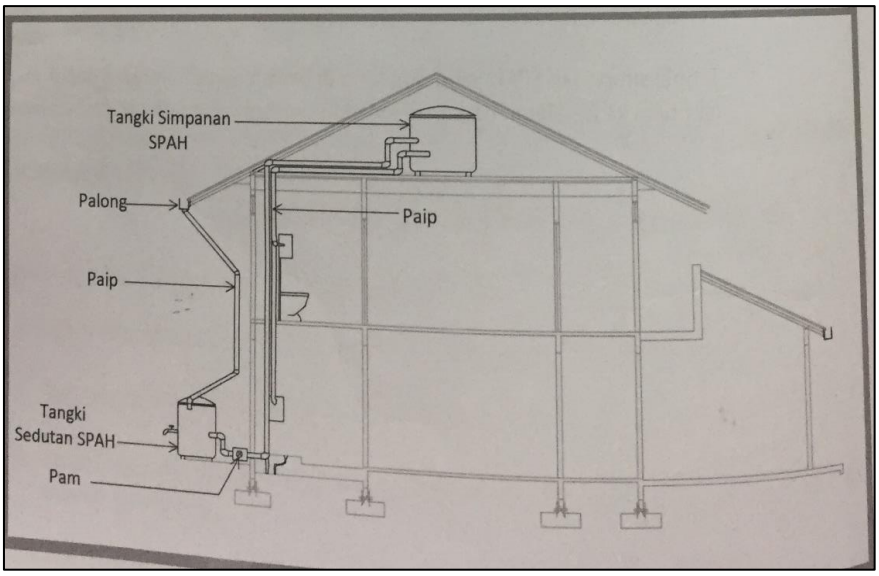


Figure 2.7 : RWHS tank on roof space with suction tank on ground level.

2. Underground/ ground level.

- For this method, pump is compulsory because gravity is not in effect since the tank are placed lower. This method consume more energy with the usage of pump however save space for the placement of RWHS tank if located underground.

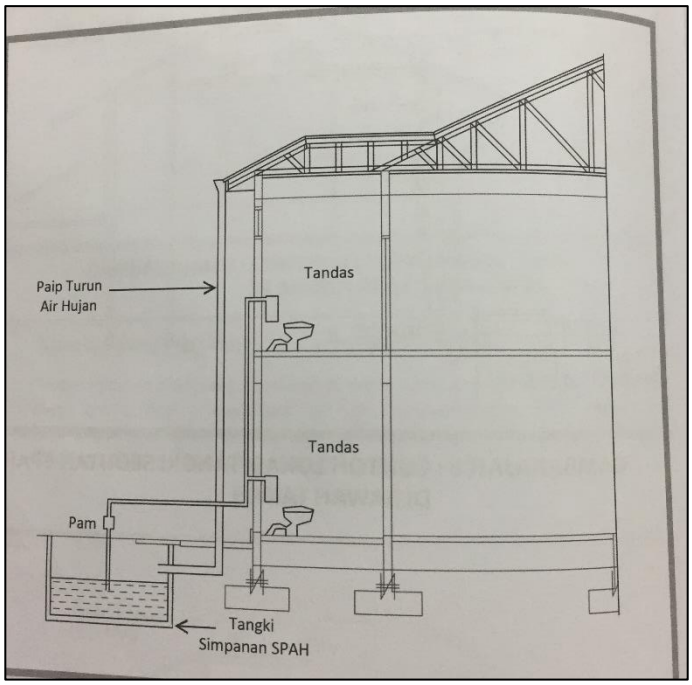


Figure 2.8 : RWHS tank located on underground level.

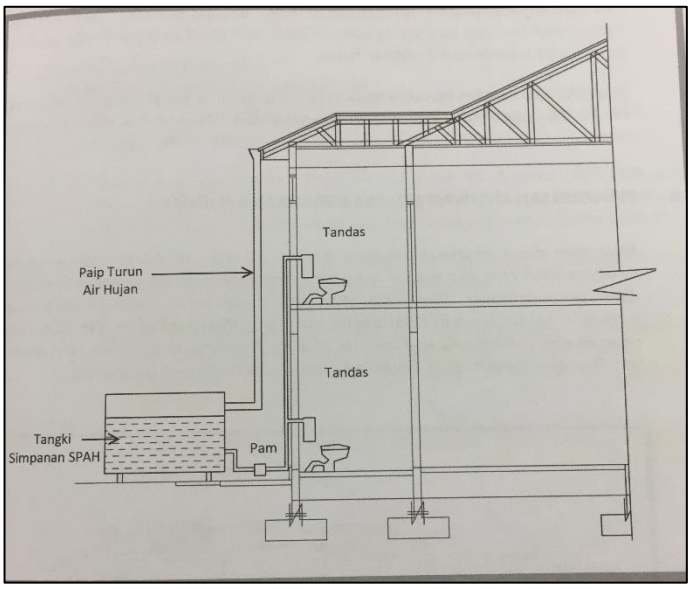


Figure 2.9 : RWHS tank on ground level.

2.5 – MAINTENANCE OF RAINWATER HARVESTING SYSTEM.

Just like any other system and building services, RWHS needs to maintain in order for it to work properly and meets all the requirement of its function. Maintenance on its major elements are important to reduce cost for replacement and avoid any chances of contamination of the collected rainwater. Maintenance work shall be specified for each element inclusive of its frequency for example :

NO.	ELEMENT	WORKS	FREQUENCY
1	CATCHMENT/ROOF	Cleaning and removing any solid waste on the surface of the catchment.	Every year.
2	TRANSPORTER/GUTTER	Cleaning and removing any solid waste and clear any blockage.	Every 2 years.
3	FILTER	Removing leaves and solid waste.	Every 2 years.
4	STORAGE TANK	Inspection on the tank and removing waste.	Every 2 years.
5	PUMP	Inspection.	Every 2 years.

Table 2.3 : Example of Maintenance program for RWHS.

2.6 – CONCLUSION.

The rainwater harvesting system is a system in which it helps collects rainwater from the catchments such as roof and ground surface and transport it to the system for the water to be reuse for a suitable activity. The system consist of 4 major elements which is the catchment, the transportation or conduit, the storage tank and lastly the distribution system. The process of the system is simple however is effective in the act of reusing rainwater in order to help reduce the usage of treated water.

There are two types of RWHS which is surface runoff harvesting and roof water harvesting. Both system applies a different approach of water collection and elements needed for distribution. However the roof water harvesting method are more widely used compare to the other one considering the aspect of cost and contamination prevention. The placement of RWHS tank also plays a very important roles in determining the progress of the system whether the cost for installation and maintenance will be high or low.

The system is a beneficial system that requires low cost and effort due to its design nature that is considered low in complexity. The system does not only benefit the owner but also proven to contribute to the preservation of nature and the community around it. This system shall be install and should be applied to any suitable building since the benefit it provides.

CHAPTER 3 – APPLICATION OF RAINWATER HARVESTING SYSTEM AS REQUIREMENT FOR CCC AT MAJLIS PERBANDARAN HULU SELANGOR.

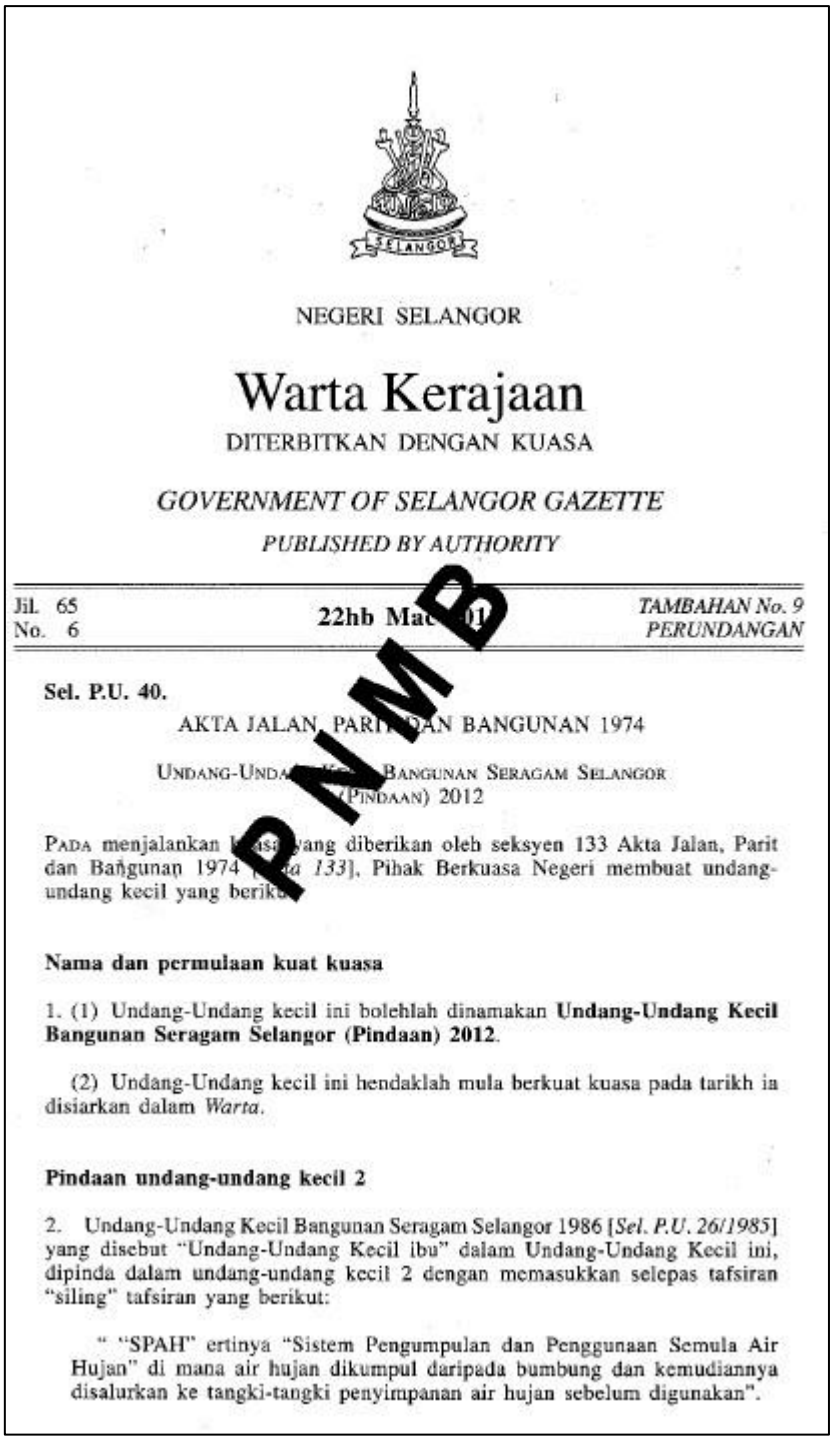
3.0 – ENFORCEMENT OF THE GOVERNMENT POLICY/REQUIREMENT.

The policy/requirement was first introduced by Kementerian Kesejahteraan Bandar, Perumahan dan Kerajaan Tempatan (KPKT) in 2011 and gazette by the government of Selangor which automatically effect immediately to all local authority throughout the state of Selangor. The policy been stated as Selangor Uniform Building By-Law (Amendment) 2012.

The policy involve the amendment on by-laws 2, 10, 25 and 115 of Uniform Building By-Laws (1984). Therefore the application of Rainwater Harvesting System (RWHS) is mandatory to all new building category stated by the government of Selangor. The enforcement however was only approved by the state council on 23rd May 2011.

The inspection of RWHS will also be done during the Certificate of Compliance and Completion (CCC) inspection by Local Authority specifically Building Control Department. In any case of the absence of RWHS on the structure, the CCC for the structure will be hold and not be issued until the installation of the system. The installation of the system is vital in the issuance of CCC.

Figure 3.0 : Selangor Uniform Building By-Law



NEGERI SELANGOR

Warta Kerajaan

DITERBITKAN DENGAN KUASA

GOVERNMENT OF SELANGOR GAZETTE

PUBLISHED BY AUTHORITY

Jil. 65 No. 6 | **22hb Mac [illegible]** | *TAMBAHAN No. 9 PERUNDANGAN*

Sel. P.U. 40.

AKTA JALAN, PARIT DAN BANGUNAN 1974

UNDANG-UNDANG KECIL BANGUNAN SERAGAM SELANGOR (PINDAAN) 2012

PADA menjalankan kuasa yang diberikan oleh seksyen 133 Akta Jalan, Parit dan Bangunan 1974 [*Akta 133*], Pihak Berkuasa Negeri membuat undang-undang kecil yang berikut:

Nama dan permulaan kuat kuasa

1. (1) Undang-Undang kecil ini bolehlah dinamakan **Undang-Undang Kecil Bangunan Seragam Selangor (Pindaan) 2012**.

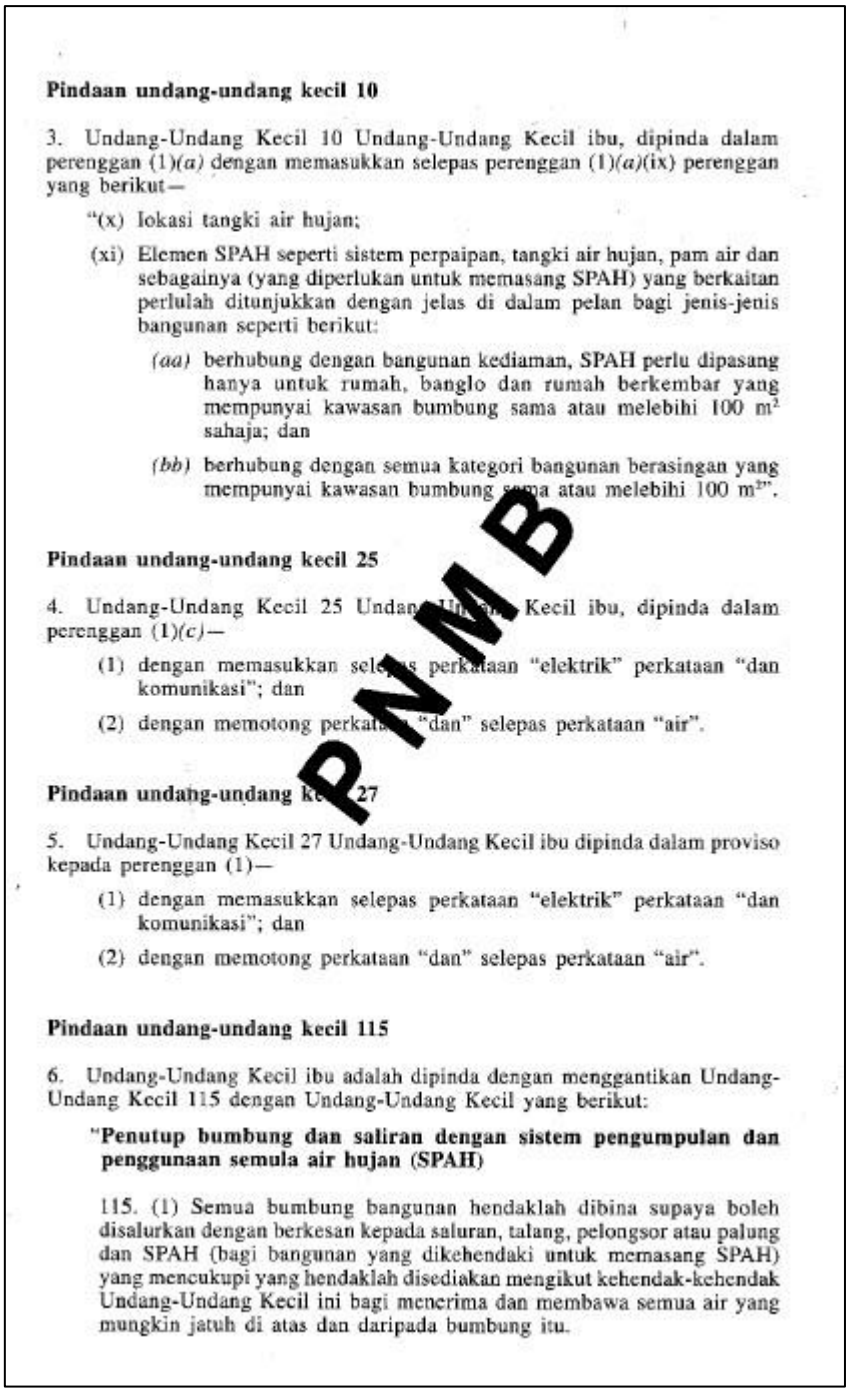
(2) Undang-Undang kecil ini hendaklah mula berkuat kuasa pada tarikh ia disiarkan dalam *Warta*.

Pindaan undang-undang kecil 2

2. Undang-Undang Kecil Bangunan Seragam Selangor 1986 [*Sel. P.U. 26/1985*] yang disebut "Undang-Undang Kecil ibu" dalam Undang-Undang Kecil ini, dipinda dalam undang-undang kecil 2 dengan memasukkan selepas tafsiran "siling" tafsiran yang berikut:

" "SPAH" ertinya "Sistem Pengumpulan dan Penggunaan Semula Air Hujan" di mana air hujan dikumpul daripada bumbung dan kemudiannya disalurkan ke tangki-tangki penyimpanan air hujan sebelum digunakan".

Figure 3.1 : The "Government Warta"



Pindaan undang-undang kecil 10

3. Undang-Undang Kecil 10 Undang-Undang Kecil ibu, dipinda dalam perenggan (1)*(a)* dengan memasukkan selepas perenggan (1)*(a)*(ix) perenggan yang berikut—

"(x) lokasi tangki air hujan;

(xi) Elemen SPAH seperti sistem perpaipan, tangki air hujan, pam air dan sebagainya (yang diperlukan untuk memasang SPAH) yang berkaitan perlulah ditunjukkan dengan jelas di dalam pelan bagi jenis-jenis bangunan seperti berikut:

(aa) berhubung dengan bangunan kediaman, SPAH perlu dipasang hanya untuk rumah, banglo dan rumah berkembar yang mempunyai kawasan bumbung sama atau melebihi 100 m^2 sahaja; dan

(bb) berhubung dengan semua kategori bangunan berasingan yang mempunyai kawasan bumbung sama atau melebihi 100 m^2".

Pindaan undang-undang kecil 25

4. Undang-Undang Kecil 25 Undang-Undang Kecil ibu, dipinda dalam perenggan (1)*(c)*—

(1) dengan memasukkan selepas perkataan "elektrik" perkataan "dan komunikasi"; dan

(2) dengan memotong perkataan "dan" selepas perkataan "air".

Pindaan undang-undang kecil 27

5. Undang-Undang Kecil 27 Undang-Undang Kecil ibu dipinda dalam proviso kepada perenggan (1)—

(1) dengan memasukkan selepas perkataan "elektrik" perkataan "dan komunikasi"; dan

(2) dengan memotong perkataan "dan" selepas perkataan "air".

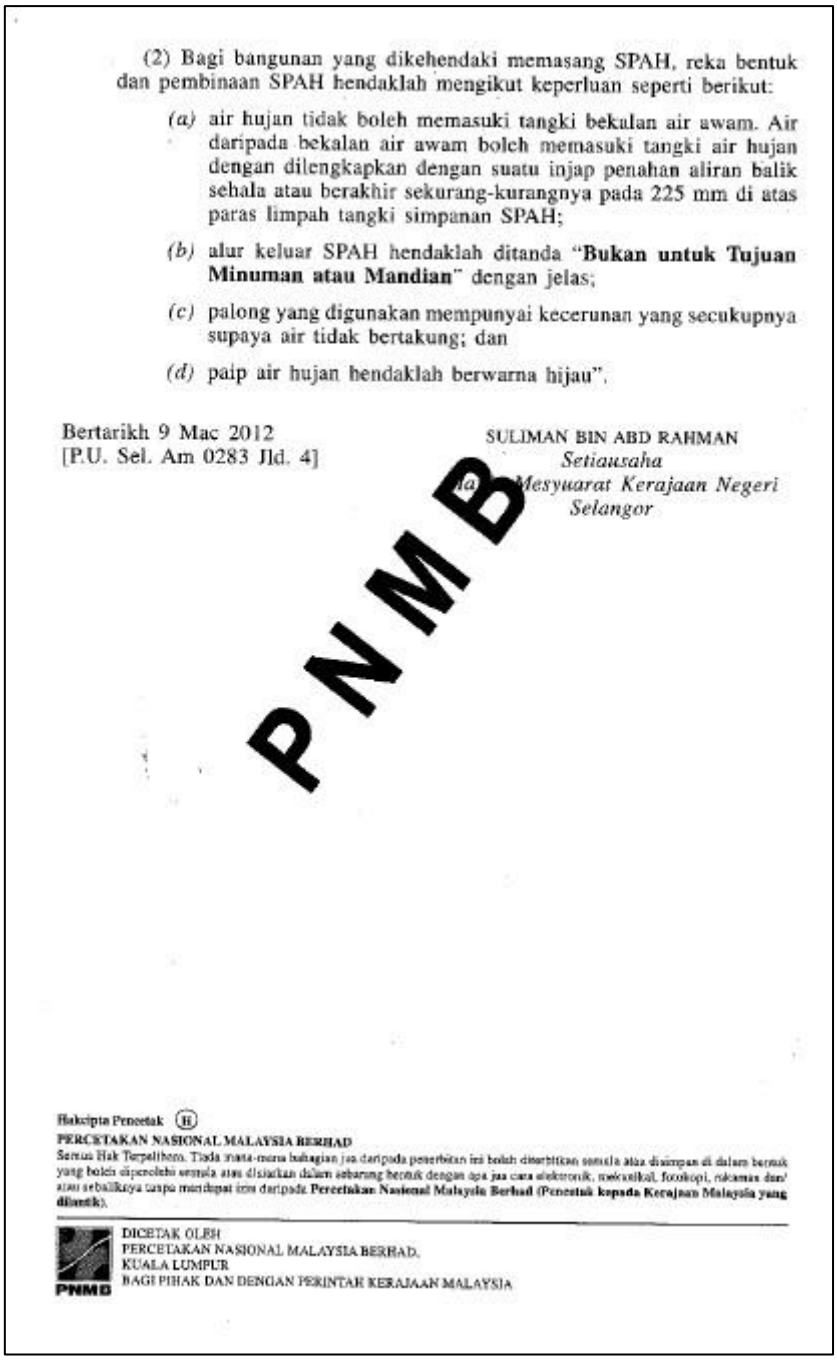
Pindaan undang-undang kecil 115

6. Undang-Undang Kecil ibu adalah dipinda dengan menggantikan Undang-Undang Kecil 115 dengan Undang-Undang Kecil yang berikut:

"**Penutup bumbung dan saliran dengan sistem pengumpulan dan penggunaan semula air hujan (SPAH)**

115. (1) Semua bumbung bangunan hendaklah dibina supaya boleh disalurkan dengan berkesan kepada saluran, talang, pelongsor atau palung dan SPAH (bagi bangunan yang dikehendaki untuk memasang SPAH) yang mencukupi yang hendaklah disediakan mengikut kehendak-kehendak Undang-Undang Kecil ini bagi menerima dan membawa semua air yang mungkin jatuh di atas dan daripada bumbung itu.

Figure 3.2 : The "Government Warta"



(2) Bagi bangunan yang dikehendaki memasang SPAH, reka bentuk dan pembinaan SPAH hendaklah mengikut keperluan seperti berikut:

(a) air hujan tidak boleh memasuki tangki bekalan air awam. Air daripada bekalan air awam boleh memasuki tangki air hujan dengan dilengkapkan dengan suatu injap penahan aliran balik sehala atau berakhir sekurang-kurangnya pada 225 mm di atas paras limpah tangki simpanan SPAH;

(b) alur keluar SPAH hendaklah ditanda "**Bukan untuk Tujuan Minuman atau Mandian**" dengan jelas;

(c) palong yang digunakan mempunyai kecerunan yang secukupnya supaya air tidak bertakung; dan

(d) paip air hujan hendaklah berwarna hijau".

Bertarikh 9 Mac 2012
[P.U. Sel. Am 0283 Jld. 4]

SULIMAN BIN ABD RAHMAN
Setiausaha
Mesyuarat Kerajaan Negeri
Selangor

PNMB

DICETAK OLEH
PERCETAKAN NASIONAL MALAYSIA BERHAD,
KUALA LUMPUR
BAGI PIHAK DAN DENGAN PERINTAH KERAJAAN MALAYSIA

Figure 3.3 : The "Government Warta"

3.1 – BUILDING CATEGORY

Referring to the approved amendment on by-laws 2, 10 and 115 in Uniform Building By-Laws 1984, the usage of Rainwater Harvesting System is compulsory for the building in which :

I. Any bungalow or semi-detached residential building that consist of roof area of more than 100 square meter; and
II. All freestanding building such as office, school, police station, hospital, academic institution, factory, shopping complex and any other structure that consist of roof area more than 100 square meter.

3.2 – APPROVAL FOR RAINWATER HARVESTING SYSTEM PLAN.

Rainwater Harvesting System should be designed with best engineering and maybe include the installation of internal piping system. This is because the system are mostly identical to the cold/treated water distribution system. All the process of approval of RWHS must be strictly obey and compliance to the Uniform Building By-Laws 1984.

In case of any future renovation or extension, Majlis Perbandaran Hulu Selangor will consider whether the RWHS system need upgrading or still relevant for use after the extension/renovation. The application of RWHS are only demand on new building after the date of enforcement of the regulation. All existing building that have already been issued with Certificate of Fitness (CF) or Certificate of Compliance and Completion (CCC) would not be demand to install the RWHS to their building but however is still encourage to apply the system into their building.

3.3 – CASE STUDY.

Since the implementation of Rainwater Harvesting System is compulsory for the buildings that is stated in the category throughout the State of Selangor, all new building are demanded to install RWHS in order to obtain their Certificate of Compliance and Completion (CCC). However the only reference provided for owner and consultants are solely the “Garis Panduan Sistem Pengumpulan Dan Penggunaan Semula Air Hujan”, a guideline which is issued by the Kementerian Kesejahteraan Bandar, Perumahan dan Kerajaan Tempatan.

Three case studies were chosen to be the example of the variation on the way of implementation, issues that occurs due to the implementation and improvement that could be considered to help the process of implementation of the system becoming more convenience. The case studies are :

1. Industrial Quality Management Sdn. Bhd. which is a factory with double-storey office located at Bukit Beruntung.
2. Tip Top Meat Sdn. Bhd. a factory with mezzanine floor for office in located in Mukim Serendah.
3. Riverstone Resources Sdn. Bhd. a factory in Bukit Beruntung.

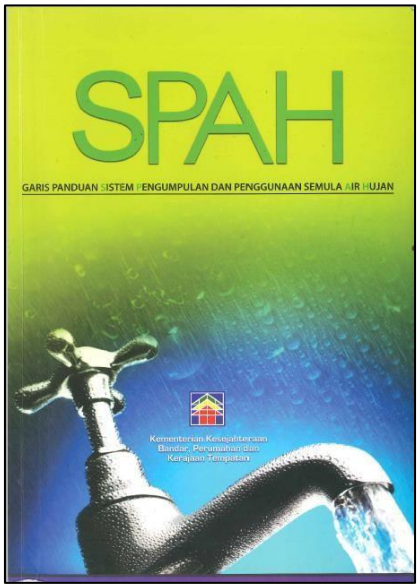


Figure 3.4 : Front page of the Guideline from KPKT.

3.3.1 – Case Study 1 : Industrial Quality Management Sdn. Bhd.

Figure 3.5 : View of the case study.

NO.	DETAILS	DESCRIPTION
1	Owner	Industrial Quality Management Sdn. Bhd.
2	Address	PT 7133 & PT 7134, Jalan Kenanga 9, Kawasan Perindustrian Bukit Beruntung, Hulu Selangor.
3	Type Of Building	Factory/Warehouse with double-storey management office and basement parking.
4	Function of Building	Production of automotive parts.

Table 3.0 : Case study background.

Rainwater Harvesting System of the case study.

Based on Certificate of Completion and Compliance Inspection by technical officer of Building Department from MPHS, the installation of RWHS is found to be installed on the structure. The installation of the RWHS is compliance to the approved plan by the MPHS.

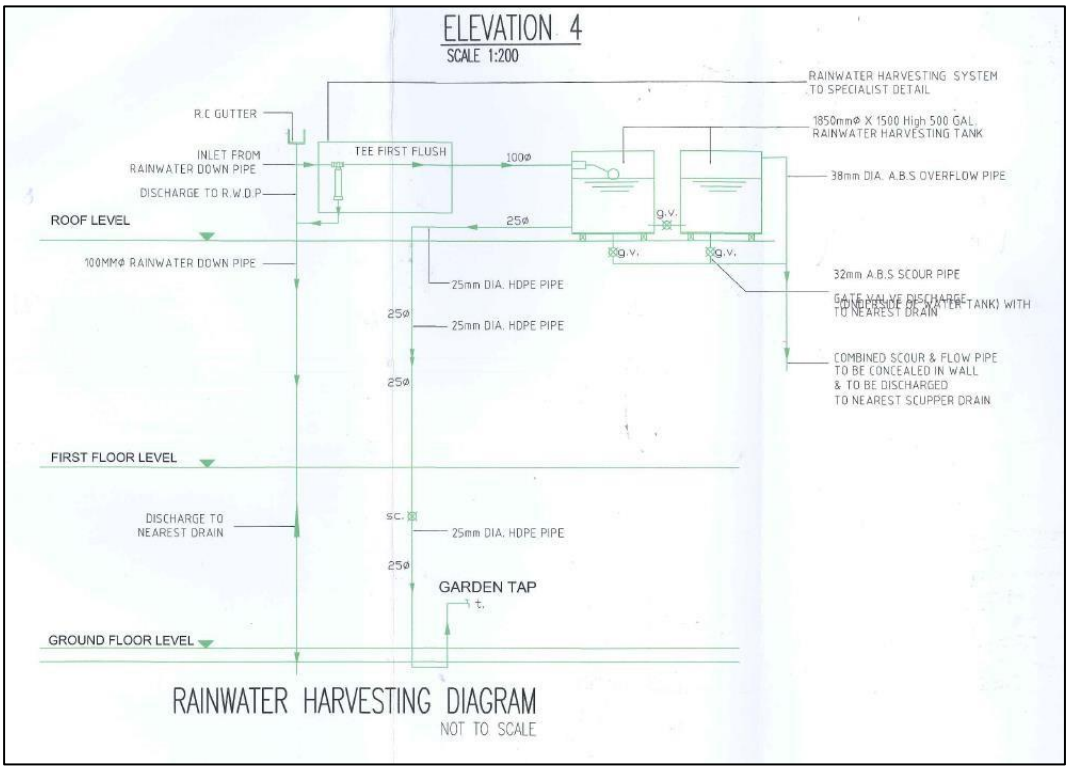


Figure 3.6 : Rainwater Harvesting Diagram extracted from the approved plan.

The rainwater is first catch by the gutter and flow through the rainwater downpipe passing through the tee first flush and into the RWHS tank. Once the tank is full, the excess water is remove through the 38mm overflow pipe to be discharged to the nearest drainage. The water in the tank is distributed by the 25mm diameter distribution pipe to a garden tap on the ground level for usage.

Elements.

NO.	ELEMENTS	SIZE	PICTURE
1	Rainwater Harvesting Tank	1850mmX1500mm 50GAL.	 *Figure 3.7 : Rainwater harvesting tank.*
2	Rainwater downpipe	100mm diameter	 *Figure 3.8 : Rainwater downpipe.*

Table 3.1 : Elements of RWHS.

The system on the building involved the usage of two 1850mmX1500mm 50GAL. rainwater harvesting tank, a tee first flush, 100mm diameter rainwater down pipe as transporter/conduit and 25mm diameter pipe as distribution pipe. The system does not requires any pump since the water is solely transported and distributed via gravity.

Comments on RWHS system by MPHS officer.

- To install a “No Drinking/Showering” on the outlet of the Rainwater Harvesting System.
    - This comment is given since it is compulsory for any structure that is equipped with RWHS to publish such sign on the outlet as stated in the 2012 Selangor Amended Uniform Building By-Laws 115(2)(b).
- To label the rainwater harvesting tank.
    - This is to avoid confusion for the future between domestic water tank and rainwater harvesting tank.

3.3.2 – Case Study 2 : Tip Top Meat Sdn. Bhd.

Figure 3.9 : View of the case study.

NO.	DETAILS	DESCRIPTION
1	Owner	Tip Top Meat Sdn. Bhd.
2	Address	Lot 19586 (PT17840), Mukim Serendah, Hulu Selangor.
3	Type Of Building	Factory/Warehouse with mezzanine for office.
4	Function of Building	Meat Processing.

Table 3.2 : Case study background.

Rainwater Harvesting System of the case study.

Through the Certificate of Compliance and Completion inspection on the case study, the rainwater harvesting system were found to be properly installed on the building. The system applied here however does not consist of distribution system due to the method implemented for the RWHS.

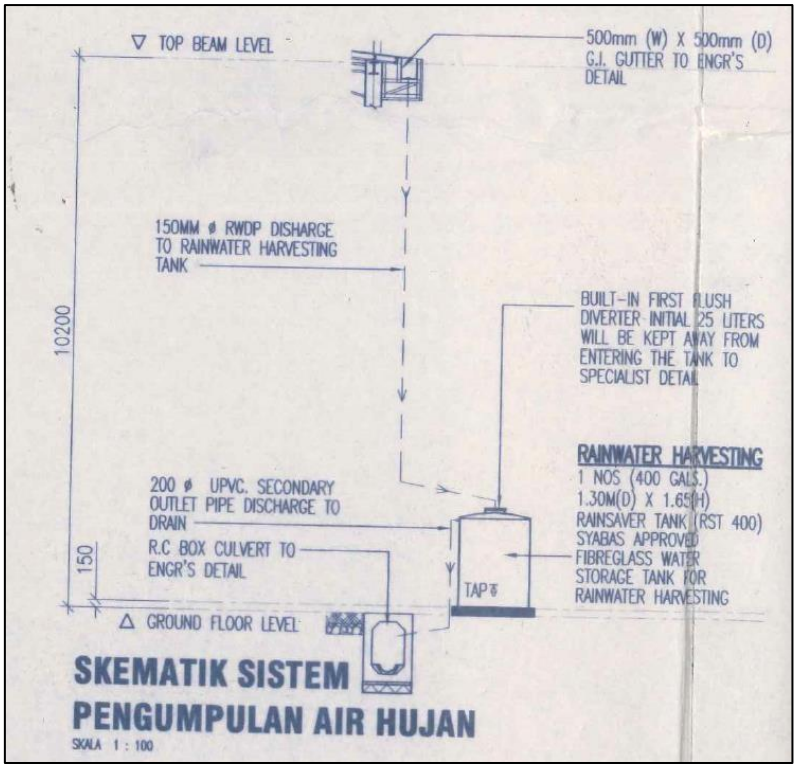


Figure 3.10 : Rainwater Harvesting Diagram extracted from the approved plan.

The method of RWHS applied on the case study differs from the first case study, the RWHS tank in this case study is located on the ground level. However the same concept applies since both does not requires pumping system since the water flow via gravity is enough. This method does not consist of the fourth main element of RWHS, the distribution system. The RWHS designed here is using simple alternatives where the installed tank is equipped with a tap. By applying this method, the cost for installing and material for distribution system could be reduce however the function/usage of the stored water is limited.

Elements.

NO.	ELEMENTS	SIZE	PICTURE
1	Rainwater Harvesting Tank	1300mmX1650mm 40GAL.	 *Figure 3.11 : Rainwater harvesting tank.*
2	Rainwater downpipe	150mm diameter	 *Figure 3.12 : Rainwater downpipe.*
3	First flush	-	 *Figure 3.13 : First flush*

Table 3.3 : Elements of RWHS.

The system involve the usage of only one 1300mmX1650mm 40GAL. located on the ground level. A 150mm diameter rainwater downpipe as the conduit/transporter, a built-in first flush and a tap installed directly on the tank for usage or as water outlet.

Comments on RWHS system by MPHS officer.

- To install a “No Drinking/Showering” on the outlet of the Rainwater Harvesting System.
    - This comment is given since it is compulsory for any structure that is equipped with RWHS to publish such sign on the outlet as stated in the 2012 Selangor Amended Uniform Building By-Laws 115(2)(b).

3.3.3 – Case Study 3 : Riverstone Sdn. Bhd.

Figure 3.14 : View of the case study.

NO.	DETAILS	DESCRIPTION
1	Owner	Riverstone Resources Sdn. Bhd.
2	Address	Lot PT 7117 (HSD 8195) No.15 Jalan Jasmine 3 Seksyen BB10 Bukit Beruntung.
3	Type Of Building	1 storey Factory/Warehouse.
4	Function of Building	Glove and rubber materials production.

Table 3.4 : Case study background.

Rainwater Harvesting System of the case study.

Through the inspection, the factory is installed with rainwater harvesting system, however the installation method of the RWHS is not compliance the approved plan. The approved plan of RWHS implement different method of installation and involved different component from the on-site RWHS. However the installed system were installed properly and the only issue is that the RWHS system does not comply to the approved plan.

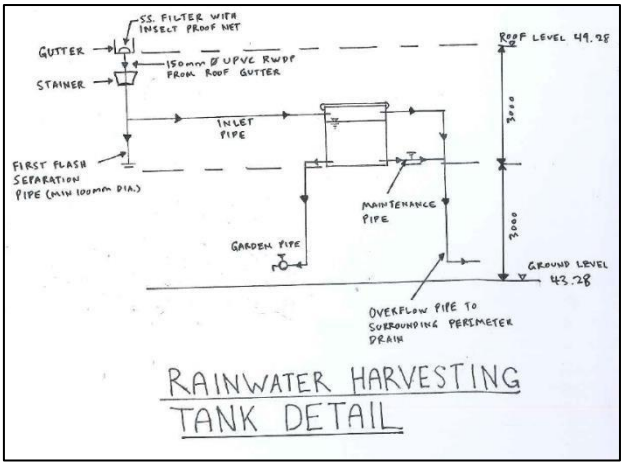


Figure 3.15 : Rainwater Harvesting Diagram extracted from the approved plan.

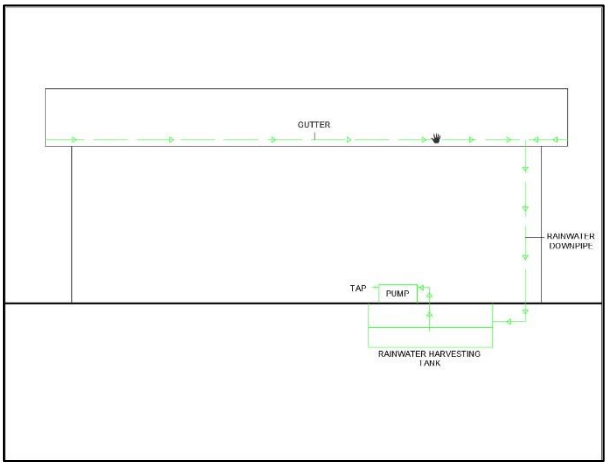


Figure 3.16 : Case study Rainwater Harvesting Diagram. (on-site)

As stated in the RWHS detail approved by MPHS, the system should be implemented on site uses the method of where all distribution should and only be done by via gravity. However through the inspection on site, the method of RWHS implemented differs. The tank is located underground, and the system uses pump/booster pump in order to help stabilize water pressure. The catchment and the transporter however uses the same specifications as in

the approved plan. Thus, different method of implementation resulted in the needs of another components, in this case a pump. Pump is needed for the process of stabilizing water pressure since the storage tank is placed lower than the water outlet.

Since the RWHS installed on site were differs from the approved plan, some elements specifications could be defined since the schematic diagram of the system is not available or declared by the consultants/person in charge. Elements such as first flush system, the exact size of the tank and specification for the pump could not be determine.

Elements.

NO.	ELEMENTS	SIZE	PICTURE
1	Rainwater Harvesting Tank	-	 *Figure 3.17 : Rainwater harvesting tank.*
2	Rainwater downpipe	150mm diameter	 *Figure 3.18 : Rainwater downpipe.*
3	Pump	-	 *Figure 3.19 : Pump*

Table 3.5 : Elements of RWHS.

The system involve roof as catchment, gutter and rainwater downpipe as transporter, an underground reinforced concrete tank and a pump to help control water pressure. There is no any distribution system needed because as the second case study, the water outlet which is a tap is installed directly on the pump.

Comments on RWHS system by MPHS officer.

- To prepare/amend the Rainwater Harvesting Diagram.
    - It is necessary for the owner/consultant to resubmit the amended plan to MPHS in order for the issuance of CCC. However, by MPHS courtesy, no compound is issued to the owner eventhough the system installed is considered as illegal structure since it does not comply to the approved plan and the issue is considered minor.
- To install a “No Drinking/Showering” on the outlet of the Rainwater Harvesting System.
    - This comment is given since it is compulsory for any structure that is equipped with RWHS to publish such sign on the outlet as stated in the 2012 Selangor Amended Uniform Building ByLaws 115(2)(b).

3.4 - CONCLUSION.

Base on the chosen case studies, it could be stated that the implementation of the rainwater harvesting system is widely used on MPHS area. This may due to the fact that RWHS is a mandatory requirement in order for a certain building to obtain their CCC. Eventhough the policy only applies on new building, the expected benefit to be gained by people and community around the area is very high. This could provide a good example or role model to the older building to follow the step of the building that installed RWHS due to the benefit obtained from the system installation.

In order for the system to functions properly and benefit the owner, the system must be properly install or in other words obey/compliance to the rules and regulations as stated in the Uniform Building By law 1984. The publishment of “Garis Panduan Sistem Pengumpulan Dan Penggunaan Semula Air Hujan” by KPKT is a very good initiative by the government to encourage the installation of RWHS. This act as an official reference for the system itself and turning the installation of RWHS which should be assumed complicated to be easier comprehended and more convenience to building owners.

The installation however could be consider tricky, this is due to the method of the installation of RWHS that is too much in variation. This is proved by the inspection the three case studies. Some implemented a simple method which does not involved any pump or distribution system as implemented by Tip Top Meat Sdn. Bhd. and some follows the exact stated guideline which is organized and reaches the system’s peak functionality. However there were also such cases where the installation of RWHS on site differs from the approved plan. This is vital to be overcome since the installation of the system is a good thing for the owner and the environment but issues that occurs with it preventing the benefit to the owner and showcast to others that installation of the system is contribute more difficulties than the benefit it offers.

CHAPTER 4 – PROBLEM AND RECOMMENDATION

4.0 - INTRODUCTION.

After six years of the implementation of rainwater harvesting system (RWHS) since 2017 throughout the MPHS area, there are a few problems encountered in order to maximize the use of RWHS. Problems that occurred are mostly from many aspects regardless from the owners, consultants or even the local authority themselves. Issues occurred on every stages whether on planning stage, construction or even on the maintenance stage.

Issues regarding the benefit of RWHS towards the owner, owners limiting functions of the system or even simply installing it just because it is mandatory for Certificate of Compliance and Completion (CCC) and not considering the long term usage of the system. MPHS had been struggling to solve these issues since the issues are mostly considered complicated with some owners actually installed the RWHS, however does not comply to the right guidelines or their approved plans.

The system could be classified as illegal structure if it is installed differently from the approved plan and could be issued with warning notice and compound. The real issue is that the owner already obey the new policy which is installing RWHS, and application of enforcement on them might seems unreasonable since MPHS does not provide any initiative or financial aid in the installation of the system and the mindset of owners that the installation of RWHS is providing more benefit to the MPHS than it is providing for them.

4.1 – LIST OF PROBLEMS AND RECOMMENDATIONS.

NO.	PROBLEM	RECOMMENDATION
1	Lack of exposure towards the new requirement among consultants & owners.	Application of more initiative and enforcement.
2	Design of the RWHS limited the system's functionality to only irrigation purpose.	Advice from MPHS officers to maximize the RWHS usage.
3	Minimum comprehension on the importance of RWHS and approval of the system.	Enforcement on the mandatory requirement and not issuing CCC unless the system is fully approved and compliance.
4	Owners tend to be more interested in saving money on the system installation by cutting/not installing some elements of RWHS.	• To emphasize the needs of a good RWHS to benefit from the system. • Providing more references/information for a better comprehension on long term benefit of RWHS in the aspect of monetary and surrounding community.
5	Poor management and maintenance on installed RWHS.	Providing more detail regarding maintenance of the RWHS in the KPKT guideline as reference for the consultants / owners / contractors.
6	No initiative from government in the aspect of monetary towards owners.	Implementation of initiative from government such as tax exemption on the owner.

Table 4.0 – List of problems and recommendations.

1. Problem : Lack of exposure towards the new requirement among consultants & owners.
    - Exposure on these requirements are creating problems towards MPHS since some consultants admit of not knowing of the RWHS as a requirement for CCC for the categorized building. This is due to the fact that this policy is only applied in the State of Selangor so new consultants/architects and consultants who are not based on Selangor are most likely to have lack of exposure on the requirement.
    - This causes the problems to occur later when the consultants are asked to submit an amendment plan just so they could include the installation of RWHS on the building and requires them to pay the additional fees which would cost them money and time.
    - It is important for consultants to know the policy since it involve the design, construction and maintenance method of the building. If this is not achieved or yet an adjustment need to be done on the design of the building, most likely that the RWHS will be design in a poor condition resulting in lower benefit of the system in which capable to contribute more.
    - For example as in case study 3 (Riverstone Resources Sdn. Bhd.) the consultant might not aware of the requirement and resulted in the needs of amendment plan.

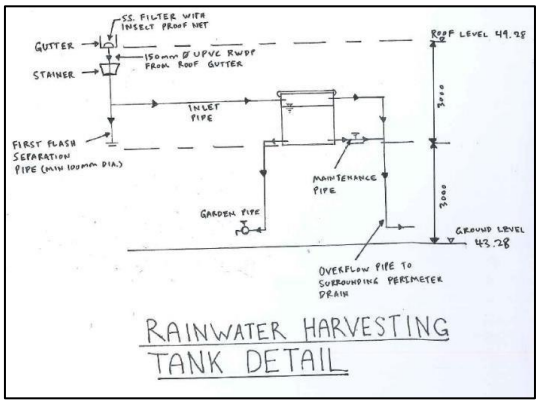


Figure 4.0 – The hand sketch of the RWHS diagram submitted.

Recommendations :

- Application of more action in order for the policy to be well-acknowledged by consultants such as banner or consistent notification/announcement regarding the new policy including on the official website of MPHS.

2. Problem : Design of the RWHS limited the system's functionality for only irrigation purpose.
    - None of any three chosen case studies applied the usage of harvested rainwater to other functions other than irrigation and landscapes. Sanitary uses especially for toilet flush are not widely used in MPHS area. This is because the owners assumed that the internal piping system consume a lot of cost and not worth the benefit.
    - Not all building in Hulu Selangor with installed RWHS did not assigned the purpose of the system for sanitary uses, however it is rare. This is an issue since by only using the harvested water for irrigation and landscape, it is simultaneously reduce the functions and limit the benefit the system could have provided. Water bills could be reduce in long-term usage.

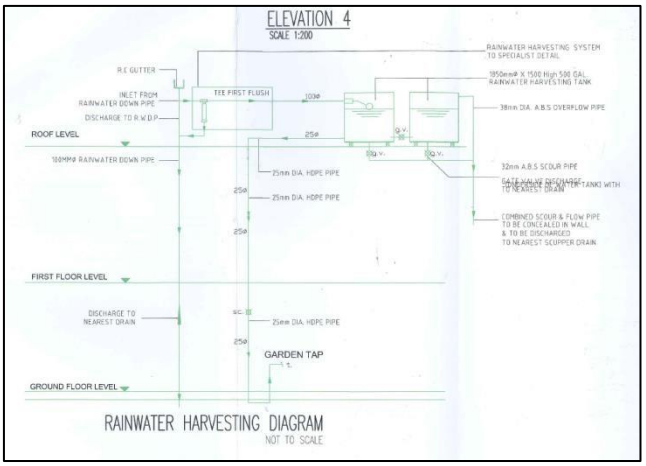


Figure 4.1 – RWHS diagram for case study 1 (IQM Sdn. Bhd.)

- As shown in the diagram of the first case study, the water from two RWHS tanks are only specifically use for irrigation which is a waste since the amount of water collected for the two tanks may be enough to supply even for sanitary uses and toilet

flush. However the water is only designed to be use for irrigation only.

Recommendation :

- Consultants should be more aware and knowledgeable of modern technologies in order to benefit from it.
- MPHS officers could advise owners to maximize the usage of RWHS and highlight the benefit from the correct application of RWHS.

3. Problem : Minimum comprehension on the importance of RWHS and approval of the system.
    - Most consultants and owner owns a very little comprehension towards the RWHS. They questions the benefit they gained from it and complaint about the cost which could be consider high. As for the owners, they only consider on which provides them the lowest cost and as for consultants, the process of installing and inserting RWHS into their design means more works for them. They assumed that RWHS is more of a trouble than it will benefit them.
    - There are also consultants who assumed the approval of the RWHS is not as important and the inspection of the system is not as thorough as it is on the structure. Thus, they neglect the precision of the construction resulting in the difference between the approved plan and the on-site installed system. This could be referred to case study 3 (Riverstone Resources Sdn. Bhd.) where the approved plan and the system on site are very much different.

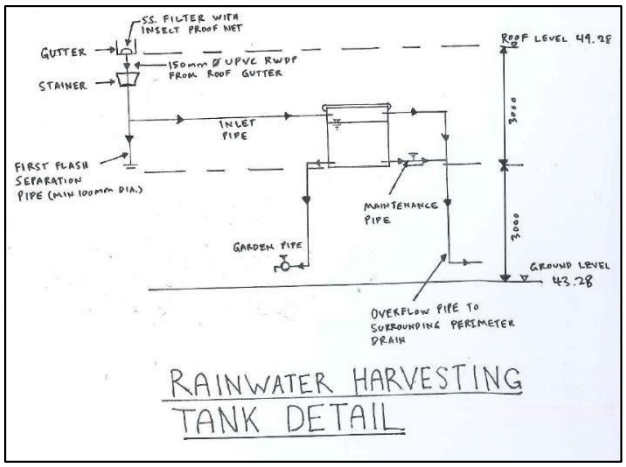


Figure 4.2 – Approved plan of RWHS for Riverstone Resources Sdn. Bhd.

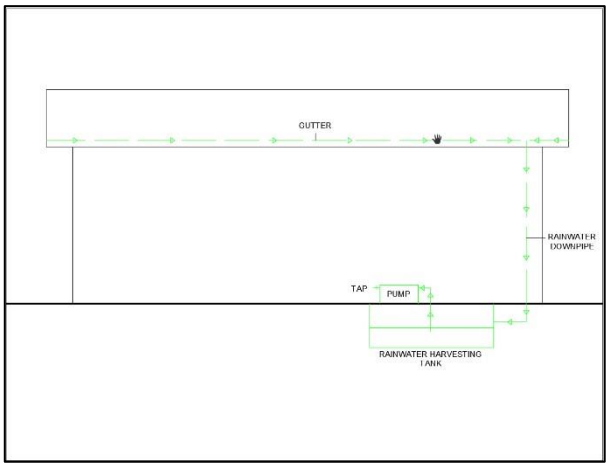


Figure 4.3 – The actual installation of RWHS on site.

Recommendation :

- Enforcement on the mandatory requirement and not issuing CCC unless the system is fully approved and compliance.

4. Problem : Owners tend to be more interested in saving money on the system installation by cutting/not installing some elements of RWHS.
    - Owners are mostly businessman and the only mindset of them is to reduce as much cost as they could. RWHS however consume quite a lot of cost and some owners with help and consultation with their consultants tend to cut/not installing some elements of RWHS which causes the system would not be able to reach their full function. Elements such as distribution system and first flush system are most commonly to be neglected since there is a cheaper alternative way. But it differs for first flush system. First flush system are vital and is mentioned as one of the basic element of RWHS in the “Garis Panduan Sistem Pengumpulan Dan Penggunaan Semula Air Hujan” by KPKT.
    - As in case study 2 (Tip Top Meat Sdn. Bhd.) the alternative distribution system used is that a tap that functions as the water outlet is installed directly to the RWHS tank and this limit the usage of the harvested water. There are no existence of first flush system on site at the third case study (Riverstone Resources Sdn. Bhd.).

Figure 4.4 – RWHS system without distribution system at case study 2.

Recommendation :

- To emphasize the needs of a good RWHS to benefit from the system.
- Providing more references/information for a better comprehension on long term benefit of RWHS in the aspect of monetary and surrounding community.

5. Problem : Poor management and maintenance on installed RWHS.
    - Most of the owner admits that their company/building does not consist of any maintenance department other than cleaners and technician for the machineries. RWHS consist of elements that needs maintenance for example the storage tanks and pumping system. The maintenance may not as frequent as other elements such as machineries, but it is vital in order for the system to continuously working properly. However, MPHS could only monitor the installation of RWHS, the maintenance and management of the system later after the building received their CCC is beyond MPHS jurisdiction.
    - Through inspection also reveals that the management of the RWHS is taken for granted by the owner. The fact that the system is newly installed since all the case studies are new buildings, it is clear that the management could not obey to some requirements stated such as in UBBLS 2012 115(2)(b)&(d) in which clearly stated that “no drinking” sign should be provided on RWHS water outlet and RWHS piping should be painted green. This gives a bad impression of how the management would later handle the system.

    Recommendation :

    - Providing more detail regarding maintenance of the RWHS in the KPKT guideline as reference for the consultants/owners/contractors.

Jadual 1 : Perancangan Penyenggaraan SPAH

Perkara	Cadangan Penyenggaraan	Jangka Masa
Bumbung	Membersih bumbung dari daun, dan bahan-bahan pepejal lain	1 x / tahun
Palong/paip turun air hujan	Membuang daun, bahan pejal lain dan membaiki kebocoran jika ada	2 x / tahun
Penapis kartrij dan jaring	mengeluarkan daun dan bahan pejal lain.	2 x / tahun
Tangki Pemendapan dan kebuk kersik	Memeriksa dan mengeluarkan bahan-bahan mendapan dan kotoran	2 x / tahun
Tangki SPAH	Memeriksa dan mengeluarkan bahan-bahan mendapan dan kotoran	2 x / tahun
Pam	Pemeriksaan berkala	2 x / tahun

Figure 4.5 – The maintenance programme provided in the RWHS guideline by KPKT.

6. <u>Problem : No initiative from government in the aspect of monetary towards owners.</u>

    - Eventhough the installation of RWHS is made to be one of the requirements for CCC, no initiative in the aspects of monetary or financial aid provided by the government. So it could be considered fair if owners and consultants to question the policy. The cost for installation of RWHS are fully covered by the owner. Yet most owners and consultant were asking the same question hoping that the government to provide them with something in reply to their cooperation of this government's policy such as tax exemption. This is however seems to be a good way to improve the usage of RWHS throughout the region.

    <u>Recommendation :</u>

    - Initiative such as tax exemption or reduction on companies and owners who installed their RWHS with compliance.

CHAPTER 5 – CONCLUSION

5.0 - CONCLUSION

Rainwater Harvesting System is a system that could be define as a system that harvest, channel, store and distribute rainwaters collected throughout the building for specific purpose usually for sanitary and outdoor works. The system help reduce the usage of treated water. The system involved few basic elements which are catchment (roof), transporter/conduit (gutter & rainwater downpipe), storage tank that is specifically for storing rainwater harvested and a distribution system to distribute the water to its function. There are two types of RWHS which is surface runoff harvesting and rooftop rainwater harvesting.

Government of the state of Selangor has created a government's policy in which specifically categorized building with roof area more than 100 meter square are required to install RWHS in order for their issuance of CCC. The policy/requirement was first introduced by Kementerian Kesejahteraan Bandar, Perumahan dan Kerajaan Tempatan (KPKT) in 2012 and gazette by the government of Selangor which automatically effect immediately to all local authority throughout the state of Selangor. However, the process was delayed due to issues and MPHS has only enforce the policy on 2017. The policy somehow only applies on new building and any existing building does not required to install RWHS.

Based on a few chosen case studies, it could be identified that there is variation of installation for RWHS. Indeed, it is widely used/applied on buildings in Hulu Selangor. This shows that it is a good step for Selangor in achieving a better environment since RWHS is widely accepted by buildings owners in the area. The enforcement on the installation are done during CCC inspection. Any building that is found to be not installing RWHS or with incompliance installation would not be issued with CCC until the system are install properly.

However MPHS are struggling with arising issues with the new policy. Problems such as lack of exposure and knowledge of the system creates chaotic situation for new consultants that is unfamiliar with the policy. The

owners attitude of only installing RWHS in order to get CCC for their building creates a scenario in which RWHS is not properly install and instead of giving benefit to the owner and community, the system itself creates more trouble than benefit. The owners and consultants demands for initiative from the government in reply for their cooperation. Maintenance also contributed to one of these issues since most owners does not intended in maintaining the system instead only installing RWHS solely just because it is mandatory to install it in order for issuance of CCC.

State government should play more effective role in helping local authorities in encouraging the installation of RWHS by providing initiative such as tax exemption to the building owners who installed RWHS with compliance. More enforcement by local authority should be done in order to encourage and to educate the community about the benefit of RWHS especially in long term. Owners and consultant also should plays a bigger role and start gaining more knowledge about the system instead of solely thinking of profit. RWHS provides a lot of benefit to the owner in the aspect of cost for utilities and to the community which helps creates a lower usage of treated water which will turn out to be a very good alternative or solution in the case of water crisis which is familiar with the State of Selangor.

REFERENCES

- Jabatan Kerajaan Tempatan Kementerian Kesejahteraan Bandar, Perumahan dan Kerajaan Tempatan (2013). *Garis Panduan Sistem Pengumpulan Dan Penggunaan Semula Air Hujan.*
- Laws of Malaysia (1986) Selangor's Uniform Building By-Law, 2012 Amendment.
- Kasimah, D. (2021, May). *Personal interview.*
- Heiri, A.B. (2021, May). *Personal interview & Site visit*
- Falkis, S. (2021, May). *Personal interview & Site visit*
- Hakimee, M. (2021, May). *Personal interview.*
- Unknown. (2013) *First Flush Process. Retrieved from* https://www.bluebarrelsystems.com/blog/first-flush-diverter/#targetText=A%20first%20flush%20diverter%20(also,collected%20since%20the%20last %20rain.
- Majlis Daerah Hulu Selangor (2021) *Organization Chart retrieved from* https://www.mdhs.gov.my/