WE1 Rainwater Harvesting

NRNC
Achieve the following percentage reduction of potable water consumption:
• 1 point: For 15% or more
• 2 points: For 30% or more

RNC
Achieve the following percentage reduction of potable water consumption:
• 1 point: For 10% or more
• 2 points: For 30% or more
• 3 points: For 40% or more
• 4 points: For 50% or more
NRNC

Shall include all potable water usage:

- Toilets
- Landscape irrigation
- F&B
- Cooling tower make-up
- Swimming Pools and Water Features

FAQ 12.1

Q Cooling tower make-up water is quite substantial for a non-residential building. For rainwater harvesting, can we exclude cooling tower make-up water when computing potable water consumption to arrive at the percentage reduction?

A Cooling tower make-up water shall be included if using treated (potable) water taken from the water mains. For buildings with water-cooled air conditioning system serving not less than 50% of the NLA, the percentage in reduction of potable water consumption as denoted under NRNC WE1, shall be halved; i.e. 1 point for 7.5% or more reduction, and 2 points for 15% or more reduction.
RNC
Shall include all potable water usage:
• Toilets
• Landscape irrigation
• F&B
• Swimming Pools and Water Features

For RNC with common management facilities
Water consumption shall apply to common area Water Consumption only and not to the Residential Units
Collectible Rainwater

With the defined catchment area, type of catchment and the rainfall data, the following Rainwater Collection Calculation formula can be used to estimate the amount of rainwater that can be captured.

\[
\text{Rainfall (mm)} \times \text{Catchment area (m}^2\text{)} \times \text{Run-off Coefficient (\%)} - \text{Amount diverted (L)} = \text{Litres of rainwater captured}
\]
Rainwater Harvesting

Rainfall Data

![Rainfall Data Chart]

RWH Equation
Rainwater Harvesting

Catchment

Pitched Tile Roof

Metal Roof

RC Flat Roof

Block Pavement
### Run-off coefficient of Various Roof Type

<table>
<thead>
<tr>
<th>Roof Type</th>
<th>Run-Off Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitched tile roof</td>
<td>0.9</td>
</tr>
<tr>
<td>Steel roof</td>
<td>0.8</td>
</tr>
<tr>
<td>Flat smooth roof</td>
<td>0.5</td>
</tr>
<tr>
<td>Flat gravel or turf roof</td>
<td>0.4</td>
</tr>
<tr>
<td>Asphalt/smooth/dense pavement</td>
<td>0.9</td>
</tr>
<tr>
<td>Block Pavement (Wide Joints)</td>
<td>0.7</td>
</tr>
<tr>
<td>Gravel Roadway</td>
<td>0.3</td>
</tr>
</tbody>
</table>

What about composite roof?
a) Building roof make up of the following:

a) Pitched tile roof - 200m²
b) RC flat roof - 50m²

What is the Run-off coefficient of the combined roof?

<table>
<thead>
<tr>
<th></th>
<th>Area (m²)</th>
<th>Run-off Coefficient</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitched tile roof</td>
<td>200</td>
<td>0.9</td>
<td>180</td>
</tr>
<tr>
<td>RC flat roof</td>
<td>50</td>
<td>0.5</td>
<td>25</td>
</tr>
<tr>
<td>Sum of product</td>
<td>205</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total roof area</td>
<td>250</td>
<td>m²</td>
<td></td>
</tr>
<tr>
<td>Resultant run-off coefficient</td>
<td>0.82</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
b) A building roof area is 2000m². However 800m² of the roof is covered with metal deck roof.

What is the resultant run-off coefficient of the roof?

<table>
<thead>
<tr>
<th>Area (m²)</th>
<th>Run-off Coefficient</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC roof</td>
<td>1200</td>
<td>0.5</td>
</tr>
<tr>
<td>Metal deck roof</td>
<td>800</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Sum of product: 1240

Total roof area: 2000 m²

Resultant run-off coefficient: 0.62
First flush diversion

First flush diverter to improve rainwater quality.

- Divert minimum 1mm of initial rainfall with first flush diverter or acceptable alternatives (Open field, no trees, no bird droppings, clean environment).
Rainwater Harvesting

a) Roof area: 300m$^2$
First flush diversion: 1mm
What is the First flush diversion amount?

First flush diversion = 300 m$^2$ $\times$ 1 mm

= 300 L

b) For the above diversion, if a 300mm diameter pipe is used, what is the length of pipe required?

For a 300mm diameter pipe, cross-sectional area of pipe is 0.0707 m$^2$

For every 1m run, the volume of water is 70.7 L

Thus for 300L first flush diversion, length of pipe required is $\frac{300}{70.7} = 4.2$ m
## Exercise

<table>
<thead>
<tr>
<th>Rainfall in (mm)</th>
<th>Catchment area (m²)</th>
<th>Run-off Coefficient (%)</th>
<th>Amount diverted (L)</th>
<th>Litres of rainwater captured</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.8 mm</td>
<td>2150 m²</td>
<td>0.5 (RC flat roof)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First flush diversion 1mm

First flush diverted amount \(= 2150 \text{ L}\)

Collectible rainwater \(= (8.8 \times 2150 \times 0.5) - 2150\)\)

\[= 7310 \text{ L}\]
Factors that influence Rainwater Harvesting Design

- Rainfall Intensity
- Catchment size
- Storage Capacity
- Rainwater Application
Rainfall Intensity

Yearly rainfall gives an indication of the total rainwater collectible only.

- Daily rainfall amount never the same
- Rain events not evenly spread throughout a year
Excess/overflow from heavy downpour or continuous rainy days (affected by the size of storage tank provided)

Rainfall (mm)

Unaccounted potable water use during prolonged dry spells

Source: Jabatan Pengairan dan Saliran Malaysia
Storage Capacity

Bigger does not necessary mean better!

Small tank → Insufficient usage of rainwater

Big tank → Not economically viable
Under utilized/oversized
Rainwater Harvesting

Roof Catchment 100m²; 1m³ usage/day

Storage tank size

Day 1
30 mm

Day 2
0 mm

Day 3
30 mm

Day 4
0 mm

Day 5
0 mm

Day 6
0 mm

6 m³

4 m³

6 m³
Rainwater Application

- Landscape Irrigation
- Toilet flushing
- Laundry
- Others
  - pools/ponds
  - cooling tower make-up
  - general washing
    - floor cleaning
    - car washing
Rainwater Harvesting

Exercise
### Illustration for different WE strategies

<table>
<thead>
<tr>
<th>Use of WE Fittings</th>
<th>No</th>
<th>No</th>
<th>No</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved AC system design</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Potable Water Consumption</td>
<td>40,190</td>
<td>40,190</td>
<td>40,190</td>
<td>27,333</td>
<td>27,333</td>
<td>22,789</td>
<td>22,789</td>
</tr>
<tr>
<td>Greywater Recycling</td>
<td>2,349</td>
<td>2,349</td>
<td>3,132</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resultant PW Consumption</td>
<td>40,190</td>
<td>40,190</td>
<td>37,841</td>
<td>27,333</td>
<td>24,984</td>
<td>22,789</td>
<td>19,657</td>
</tr>
<tr>
<td>RWH Tank Size (m³)</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>150</td>
<td>60</td>
</tr>
</tbody>
</table>

#### Rainwater Usage

| Landscape irrigation | 844 | - | - | 123 | - | 160 | 177 |
| AC make-up | - | 2,885 | 2,885 | 2,762 | 2,885 | 2,869 | 2,852 |
| Toilets (flushing) | - | - | - | - | - | - | - |
| Total RW usage | 844 | 2,885 | 2,885 | 2,885 | 2,885 | 3,029 | 3,029 |
| Savings through RWH | 2.1% | 7.2% | 7.6% | 10.6% | 11.5% | 13.3% | 15.4% |
| Point Score under WE1 | 0 | 0 | 1 | 1 | 1 | 1 | 2 |

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*a Point score based on air conditioned building with cooling tower make-up water requirement  
*b Annual consumption in m³
Impact of RW Harvesting is limited if:

- building baseline consumption is not addressed

    Low Water Usage  ➡️  High RWH ratio

- harvested rainwater is not effectively used

    Increased Usage  ➡️  High RWH ratio
For a RW Harvesting system to have any significance:

Baseline potable water consumption has to be improved

- Use of water efficient fittings
- Improve air conditioning system design to reduce AC make-up water requirement
- Waste water recycling
- AC condensate water recovery
Rainwater Harvesting

PROCEDURES

- Identify rainwater application
- Obtain rainfall data of location nearest to site
- Identify area and type of catchment
- Run rainwater harvesting simulation
How much rainwater to harvest?

Water demand is dependent on the following:

- Building type
  - residential (7 days a week)
  - Office (5 days a week)

- Type of application
  - Toilet flushing
  - Air conditioning make-up
  - Landscape irrigation (except rain event days)
  - Others (laundry, general washing)
Common mistakes in RWH design

• Neglecting run-off coefficient
• Not accounting for first-flush diversion
• All the rainwater could be harvested
• Assumption of even rainfall distribution over 365 days
• Amount of rainwater harvested does not match usage
• Landscape irrigated on rain event days
## WE 1: RAINWATER HARVESTING

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual rainfall</td>
<td>2495mm</td>
</tr>
<tr>
<td>Roof area</td>
<td>2700m²</td>
</tr>
<tr>
<td>Roof run-off coefficient</td>
<td>0.9</td>
</tr>
<tr>
<td>First flush diversion</td>
<td>112000L</td>
</tr>
</tbody>
</table>

Rainfall collected per year

\[
2495 \times 2700 \times 0.9 - 112000 = 5950850
\]

Total rainwater harvest per year = 5951m³

**All the rainwater could be harvested!**
Summary Result of Rainwater Harvesting

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Fixture Water Consumption</td>
<td>18000 m³</td>
</tr>
<tr>
<td>Total Irrigation</td>
<td>1300 m³</td>
</tr>
<tr>
<td>Total</td>
<td>19300 m³</td>
</tr>
<tr>
<td>Total rainwater harvest</td>
<td>5951 m³</td>
</tr>
<tr>
<td>Total Percentage</td>
<td>31%</td>
</tr>
</tbody>
</table>

Note: This project uses rainwater for landscape irrigation only!

Total potable water consumption = 18000 + 1300 = 19300 m³

Claimed percentage = 5951 / 19300 = 30.8%! (2 points)

Actual percentage = 1300 / 19300 = 6.7%! (0 point)

Rainwater harvested is the amount of Rainwater utilized
Landscape irrigation = 1500 litres/day

Annual landscape watering required = 1500 x 365
= 547.5 m³

Plants do not need watering on rain event days!
Intentions that are not acted upon or properly implemented are never good intentions!

RWH Tank

Common Mistakes

L1  Tank Empty
L2  Make-up Water
L3  Tank Full

Observed water level
Thank you

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