

# WATER RESOURCES, WATER SERVICES AND SANITATION MANAGEMENT PRINCIPLES

**UNIT CODE:** CON/CU/CET/CC/08/6/A

## **Relationship to Occupational Standards**

This unit addresses the Unit of Competency: apply water resources, water services and sanitation management principles

**Duration of Unit:** 120 Hours

## **Unit Description**

This unit describes the competencies required to apply water resource management principles. It involves determination of hydrological processes, quantification of surface water, mapping of rock types and aquifers, establishment of suitable site for wells. It also involves conservation of environment and development of water harvesting structures. It also involves application of water and environmental law in water resource management and application of integrated water resources management (IWRM) principles.

## **Summary of Learning Outcomes**

- 1) Determine hydrological processes
- 2) Quantify surface water
- 3) Map rocks and aquifers
- 4) Establish well sites
- 5) Conserve the Environment
- 6) Develop water harvesting structures
- 7) Apply water and environmental law in water resource management
- 8) Apply Integrated Water Resources Management ( IWRM) Principles

## **Learning Outcomes, Content and Suggested Assessment Methods**

<b>Learning Outcome</b>	<b>Content</b>	<b>Suggested Assessment Methods</b>
1. Determine Hydrological Processes	<ul style="list-style-type: none"> <li>• Concepts of hydrology</li> <li>• Hydrological cycle</li> <li>• Hydrological processes, principles and application in each case:                             <ul style="list-style-type: none"> <li>▪ Precipitation- types, forms, areal rainfall, causes</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Written tests</li> <li>• Observation</li> <li>• Interviewing</li> <li>• Oral questioning</li> </ul>

	<p>of errors of rainfall data, filling missing rainfall data</p> <ul style="list-style-type: none"> <li>▪ Evaporation</li> <li>▪ Infiltration</li> <li>▪ Percolation</li> <li>▪ Condensation</li> <li>▪ Surface run-off</li> </ul>	<ul style="list-style-type: none"> <li>• Third party report</li> </ul>
2. Quantify surface water	<ul style="list-style-type: none"> <li>• Precipitation measurement-types of rain gauges</li> <li>• Evaporation measurement from US class A pan</li> <li>• Stream flow measurement-selection of a regular gauging station site, River gauging, Computation of stream discharge(mean section method, mid-section method; Stage discharge relationship)</li> <li>• Personal safety in hydrometry</li> </ul>	<ul style="list-style-type: none"> <li>• Written tests</li> <li>• Interviewing</li> <li>• Observation</li> <li>• Oral questions</li> <li>• Third party report</li> </ul>
3. Map rocks and aquifers	<ul style="list-style-type: none"> <li>• Geologic time scale (Eons, Eras, Periods, Series)</li> <li>• Earth origin theories</li> <li>•</li> <li>• Internal structure of the earth ( crust, mantle, core)</li> <li>• Earth processes (weathering, volcanism, isostasy, magmatism)</li> <li>• Rock types and their characteristics: ( sedimentary, metamorphic, igneous,)</li> <li>• Rock structures</li> </ul>	<ul style="list-style-type: none"> <li>• Written tests</li> <li>• Interviewing</li> <li>• Observation</li> <li>• Oral questions</li> <li>• Third party report</li> </ul>

	<ul style="list-style-type: none"> <li>• Minerology: Physical properties of minerals, rock forming minerals, mineral groups.</li> <li>• Aquifer types and characteristics : confined, non-confined, leaky, perched</li> </ul>	
4. Establish well sites	<ul style="list-style-type: none"> <li>• Classifications of wells: dug, driven, drilled</li> <li>• Factors affecting well siting</li> <li>• Methods of well site establishment</li> <li>• Well site establishment report writing</li> </ul>	<ul style="list-style-type: none"> <li>• Written tests</li> <li>• Interviewing</li> <li>• Observation</li> <li>• Oral questions</li> <li>• Third party report</li> </ul>
5. Conserve the Environment	<ul style="list-style-type: none"> <li>• Water conservation</li> <li>• Soil conservation</li> <li>• Types of land degradation</li> <li>• Causes of land degradation</li> <li>• Effects of land degradation</li> <li>• Control measures of land degradation</li> </ul>	<ul style="list-style-type: none"> <li>• Written tests</li> <li>• Observation</li> <li>• Interviewing</li> <li>• Oral questioning</li> <li>• Third party report</li> </ul>
6. Develop water harvesting structures	<ul style="list-style-type: none"> <li>• Water harvesting techniques (roof catchment, rock catchment, surface water catchment)</li> <li>• Types of water harvesting reservoirs( water pans, water dams)</li> <li>• Site selection for water harvesting structures <ul style="list-style-type: none"> <li>✓ Hydraulic properties of rock units e.g. porosity, Permeability, compressibility</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Written tests</li> <li>• Interviewing</li> <li>• Observation</li> <li>• Oral questions</li> <li>• Third party report</li> </ul>

	<ul style="list-style-type: none"> <li>✓ Topography</li> <li>✓ Proximity</li> <li>• Design of simple water harvesting structures</li> <li>• Operation and maintenance of water harvesting structures</li> </ul>	
<p>7. Apply water policy, water and environmental laws, legislation in water resource management, water and sanitation services</p>	<ul style="list-style-type: none"> <li>• Water policy, water laws and legislation in Kenya</li> <li>• History of water reforms in Kenya (since 1999)</li> <li>• Implications of Constitution of Kenya on Water Resources Management and water services: National Government, County Governments</li> <li>• Legal and regulatory framework of Water Sector in Kenya: Laws, Policies, Water Act, EMCA, regulations (e.g. WRA, NEMA, WASREB) other sector Institutions e.g., WSTF, Water Harvesting Storage Authority(WHSA), WSBs WSPs,)</li> <li>• Water Law administration: mandates, roles of water sector regulators and institutions</li> <li>• Civil Laws: Law of tort, Law of contract, Law of evidence</li> <li>• Criminal Law basics and criminal procedure code</li> </ul>	<ul style="list-style-type: none"> <li>• Written tests</li> <li>• Observation</li> <li>• Interviewing</li> <li>• Oral questioning</li> <li>• Third party report</li> </ul>

<p>8. Apply Integrated Water Resources Management (IWRM) Principles</p>	<ul style="list-style-type: none"> <li>● Concepts of IWRM ( the water challenge, need for integration, sustainable development goals- SDGs e.g. Goal 6,11,12,14)</li> <li>● Principles of IWRM (Dublin principles)</li> <li>● IWRM and its relation to sub-sectors ( water for people, water for food, water for nature and other users)</li> <li>● Pillars of IWRM:</li> <li>● Enabling environment for IWRM( policies, legal framework, investment and financing)</li> <li>● Institutional arrangement in IWRM ( regulation and compliance, water supply and sanitation services, coordination and facilitation, capacity building)</li> <li>● Management instruments for IWRM( understanding water endowments, assessment, modelling and decision making, planning for IWRM, communication, efficiency in water use, economic instruments, promoting social change)</li> <li>● Gender mainstreaming in IWRM</li> <li>● Applications/Implications of IWRM in Kenyan Context</li> </ul>	<ul style="list-style-type: none"> <li>● Written tests</li> <li>● Observation</li> <li>● Interviewing</li> <li>● Oral questioning</li> <li>● Third party report</li> </ul>
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### **Suggested Methods of Instruction**

- Direct instruction
- Project
- Case studies
- Field trips
- Discussions
- Demonstration by trainer
- Practice by the trainee

### **Recommended Resources:**

- Computers
- Stationery
- Evaporation pan (Class A)
- Rain gauge
- Current meter
- Wading suit
- Tape measure
- Staff gauge
- Hand lens
- Clinometer
- GPS receiver
- Maps
- Steel file
- Steel knife
- Rock samples
- Minerals
- PPE

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