Republic of Kenya

Hydrologists Registration Board
Enhancing Professionalism & Competence

HYDROLOGISTS REGISTRATION BOARD

CONTINUOUS PROFESSIONAL DEVELOPMENT
COURSE CURRICULUM

(DRAFT)

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1.0 Background

1.1 Introduction

The Hydrologists Registration Board is a Regulatory State Corporation formed under the Hydrologists Act No 19 of 2017. The Board was established vide Kenya Gazette Notice No. of 19th July, 2019 and falls under the State Department for Water and Sanitation, Ministry of Water, Sanitation and Irrigation (MWSI).

Pursuant to Section 4(a) and (b) of the Hydrologists Act, 2017 the Board has the mandate of development and implementation of a Continuous Professional Development (CPD) Policy which guides the overall process of enhancing the capacity of hydrology professionals registered under it.

To implement the Policy, the Board has developed this curriculum that contains the list of preferred courses that will be offered to hydrology professionals to enhance their skills and knowledge on a continuous basis, thereby ensuring that they deliver effective and efficient hydrological services in Kenya. In implementing the Policy and curriculum, professionals will earn CPD points that will facilitate the renewal of their practicing licenses in subsequent years.

1.2 Objectives

The objective of the CPD courses curriculum is to:

i. Improve professional competence of hydrology professionals

ii. Keep abreast of changing procedures and standards.

iii. Improve established processes and procedures for hydrological work

iv. Identify mechanisms to improve and promote quality, apply feedback to improve performance

v. Understand and apply advances in technology, job skills and knowledge.

vi. Better serve the hydrology professionals, community and environment.

vii. Assist graduate hydrologists to increase capacity for learning so as to be more capable, confident and adaptable when faced with change.

viii. Broaden into related fields, such as those covering management, financial or legal aspects in order to improve work performance and enhance career prospects.

ix. Maintain, improve or expand technical skills and knowledge. It is generally accepted that a person's ability to maintain high levels of professional competence is achieved by continually upgrading his/her skills and knowledge.

1.3 Significance

The Continuous Professional Development Courses Curriculum has the following benefits;

i. fosters excellence in the professions.

ii. Provides a mechanism through which hydrology professionals are accountable for remaining current in their practice thus improving the hydrology profession's credibility with the public.

iii. Enhances and/or expands the domain of practice.

iv. Enhances professional image.

v. Facilitates practice mobility.

vi. Facilitates upward movement in the value chain to clients and employers.

vii. Improves marketability.

2.0 General Requirements

i. Every practicing Hydrology Professional shall be required to acquire professional development points through undertaking Hydrological Activities and Trainings. The CPD Course Curriculum provides an array of courses to earn the CPD points upon training.

ii. To earn CPD points through trainings, the Registered Hydrology Professional shall be required to submit certificate to the Hydrologists Registration Board (HRB)

3.0 Continuous Professional Development Course Curriculum

The proposed Courses have been categorized into the following classes:

3.1 Application of GIS & Remote Sensing in Hydrology

GIS is an effective tool for storing, managing, and displaying spatial data often encountered in hydrology and water resources management related studies. Remote sensing provides observations of changes in hydrological states and variables over both time and space that can be used to monitor hydrological conditions and changes. The training will include access and utilization of ready Earth observation (EO) images, products, open and online source tools for subsequent analysis. The course incorporates the EO retrievals into studies of water balance components, including tools of hydro-GIS like geometric delineation from digital elevation models (DEMs) and water modelling approaches.

3.2 Hydrological Assessment

The training will expose the participants to the various Hydrological Studies such as Hydrological Assessment for; water supply projects,
hydropower projects and reservoirs.

3.3 Hydrological Analysis

The proposed Courses will equip the participants with skills in Data Science, Data Managements, Data Analysis Tools, Internet of Things and Analysis of hydro-meteorological and flow data

3.4 Application of Hydrological Models

Under this course the participants will be exposed to; Application and Utilization of specific models, Pre- processing data, adding data, linking data, baseflows, Calibration, Summary tables, optimizing uncertainty analysis. The Course will leverage on models utilized for Hydrological analysis and Emerging Technologies.

3.5 Water Resources Management

Water Resources Management Courses will equip participants with skills and understanding on emerging and existing sustainable water resources for decision making. Science Based Application with Hydrological skills to support decision making on water

planning and allocation, flood and drought management, watershed management and rainwater harvesting.

3.6 Hydrological Field training

Exposure to practical field trainings through application of state of art technologies in the field is critical in hydrological studies. This entails practical skills on: acquisition and measurement of Hydrological parameters, installation, operation and maintenance of hydromet stations Hydrological surveys, River Morphology and Training.

3.7 Governance, Leadership & Management

Leadership Courses will enhance the ability of Hydrology Professionals and HRB to Adapt, innovate, build relationships, negotiate and manage conflicts. This will also improve expert's and the Board's motivation, creativity and decision making.

4.0 Mode of Delivery

The following methods of offering the courses are proposed:

4.1 Online courses

Online courses will be conducted through online platform and augmented by take home assignments.

4.2 Webinars

This will be used to engage a large number of participants and are less personalized. They should cover topics that are more general.

4.3 Physical trainings

These are modules that require personal interaction with participants

4.4 Field Practical Trainings

Modules that require field experience will be undertaken on site through practicals.

Table 1: Course/sub-courses for CPD

S/No	COURSE	SUB-TOPICS/SUB-COURSES	DURATION	MODE OF DELIVERY	CPD POINTS
	Application of GIS & Remote Sensing in Hydrology				
	GIS & REMOTE SENSING FOR HYDROLOGICAL APPLICATION	• Quantum GIS –Spatial Data Analysis for Water Resources Management • Arc GIS – Spatial Data Analysis for Water Resources Management • Remote Sensing Using QGIS for Water Resources Management • Remote Sensing Using ArcGIS for Water Resources Management • ArcGIS & QGIS for Hydrological Application	3-7 days for tailored made short Courses	Physical/Virtual	1 per course
			7-90 days for certificate Courses	Physical/Virtual	5 per course

		(Preparing maps for hydrological studies) • Access to, processing and Application of Geo-Spatial data/products/tools/ technologies (Terrain analysis with DEM, hydro-geomorphology, Satellite Site access and data download) • Application of GIS and Remote Sensing for Flood and Drought Management. • Application of GIS and Remote Sensing for Change in Land Cover and Land Use Analysis, Water bodies, Vegetation Indices, Soil maps and soil parameters • Application of GIS for Demographic data and water demand estimates • Remote Sensing applications in hydrology • Application of Geo-Statistics Analysis using ArcGIS.			

		• Application of Google Earth Engine in Hydrology and Water Resources planning • Application of GIS and Remote Sensing in Water Bodies and Wetland Mapping • Earth Observation Applications in support of Water Resources • Remote Sensing for Agricultural Water Management • GIS for preparation and visualization of Hydrological data			
	Hydrological Assessment				

	Hydrological surveys	• Hydrological Assessment for water supply projects • Hydrological Assessment for Hydropower projects • Hydrological assessment of Reservoir • Hydrological assessment for sewage treatment plants in rivers and oceans • Hydrological assessment for Abstraction and pollution reports • Hydrological assessment for storm water drainage • Hydrological assessment for erosion and sedimentation studies • Water Resources Quality Assessment and Monitoring • Hydrography • Limnology	3-7 days for tailored made short Courses	Physical/Virtual	1 per course

		• Flood and Drought Risk Assessment	7-90 days for certificate Courses	Physical/Virtual	5 per course
	River Assessment and monitoring	• River Assessment and monitoring (Stream			

		channel stability, Potential versus existing stream conditions, influence of riparian vegetation on channel stability, Streambank erosion, Sediment competence/entrainment) • Sediment yield Analysis (collection and analysis of bed load and suspended sediment, transport capacity, overall sediment supply ratings related to specific sources, processes, and locations) • Monitoring and validation methods to improve prediction models and to better understand river processes and response.			
	Isotope Hydrology	• Fundamentals of isotope hydrology and overview of			

		stable isotopes in the hydrologic cycle; • Field sampling for stable isotopes and designing sampling programs; • Radioactive isotopes and groundwater dating; • Environmental Isotopes applications • Nitrogen Isotopes applications • Advanced Isotope Hydrology and case studies.			
	Dam Breach & Safety Analysis	• Estimation of the dam-break outflow hydrograph			

		• Routing of the dam-break hydrograph through the downstream valley. • Estimation of inundation levels and damages to downstream structures. • Estimation of dam breach dimensions • Estimation of dam breach peak discharge. Computational methods for routing of dam break flood			
	Hydrological Analysis				
1.	Hydrological Data Management	• Hydrological Data Acquisition – satellite, in-situ measurements	3-7 days for tailored made short Courses	Physical/Virtual	1 per course

		• Hydrological data; Pre-processing tools, Storage & Retrieval. • Hydrological data Presentation, Quality test (Homogeneity tests) and Gap Filling. • Management of hydromet data • Simple statistical summaries. • Comparing rainfall data from different sources.	7-90 days for certificate Courses	Physical/Virtual	5 per course

	Hydrological Data Analysis Tools	• Statistical Analysis (Mean, Mode, Median, Standard Deviation, Regression, correlation, Anova, Regional Curve) • Application of Software R in Hydrological Analysis, • Application of Python Hydrological Analysis • Application of ENVI Hydrological Analysis • Application of Excel Hydrological Analysis • Application of Macros Hydrological Analysis • Application of Java Script Hydrological Analysis • Application of Hydrognomon Hydrological Analysis			
	Data science and Internet of Things	• AI tools for Hydrological assessment • IoT based Hydrological Monitoring • Machine Learning application in hydrology			

	Analysis of hydro-metrological and flow data and its applications	• Hydrograph analysis and base flow separation • Low flow frequency analysis • Flood flow frequency analysis • Flow duration curves • Analysis of rainfall extremes (dry spells, droughts, peaks) • IDF curves, design storm, Probable Maximum Precipitation • Environmental Flow Assessment (EFA) • Characterising flow in intermittent and ephemeral streams • Time series analysis, detection of climate change • Hydro-geostatistics.			
	Application of Hydrological Models				
	Computer modelling for surface water	Application of Rainfall-Runoff Models • Thornthwaite			

	(Lumped conceptual rainfall-runoff models, Semi- and fully distributed, physically based rainfall-runoff models Stochastic hydrological models Storm water models for built-up areas Reservoir Simulation and Optimization)	• HEC-HMS, • BANCS Model (BEHI/NBS) FLOWSED and POWERSED, • SWAT, • HYSIM, • GR4J model, • WMS (Application of specific models, model overview and utilization, pre- processing data, adding data, linking data, base flows, calibration, summary tables, optimizing uncertainty analysis)	3-7 days for tailored made short Courses	Physical/Virtual	1 per course
			7-90 days for certificate Courses	Physical/Virtual	5 per course
		Application of Flood & Drought forecasting Models • GR4J model (CEMAGREF-IRSTEA), • VIC – Model, • WMS, • HEC-RAS (Application of specific models, Model overview and utilization, Pre- processing data, adding data, linking data, base flows,			

		Calibration, Summary tables, optimizing uncertainty analysis)			
		Application of Water Balance Models/ Watershed Modelling • GR4J model (CEMAGREF-IRSTEA), • VIC – Model • WMS, • HEC-RAS • WEAP (Application of specific models, Model overview and utilization, Pre- processing data, adding data, linking data, base flows, Calibration, Summary tables, optimizing uncertainty analysis)			
	Computer models for subsurface water	• Basic hydrogeology • Groundwater models incl. groundwater contaminant transport modelling • Groundwater recharge estimation			
	Hydrological forecasting	• Flood and drought forecasting and early warning systems			

		• Forecasting future water supplies • Forecasting water levels/Discharge in Water Bodies			
	Erosion, sediment and contaminant transport modelling	• Simple erosion models for hillslopes using USLE • GIS based erosion models for watersheds • Reservoir sedimentation models and SDR estimates • Land slide and gully erosion susceptibility • Water quality models (nutrients and other contaminants)			
	Hydrodynamic flow modelling	• Modelling flow in natural river channels • Modelling runoff in built-up areas • Reservoir Routing • Physical Limnology			
	Water Resources planning & allocation modelling	• Use of a water resources system model (WEAP) for water allocation. • To Develop, run and evaluate a model, including scenario analysis, water			

		balances, assess impact of changing priorities among users, and impacts on water shortage. • Water Resources Planning under Changing Climate and Environment			
	Water Resources Management				
	Flood & Drought Risk Management,	• Flood and drought Disaster risk, Exposure and impact • Risk assessment - estimating the impacts of floods and droughts • Disaster Risk Reduction - building resilience • Governance of flood and drought risks	3-7 days for tailored made short Courses	Physical/Virtual	1 per course
			7-90 days for certificate Courses	Physical/Virtual	5 per course
	Integrated Water Monitoring Assessment Across Time and Scale	• **isotope hydrology:** to trace groundwater recharge processes and age; • **Basic hydrogeology:** to identify groundwater flow paths and support geochemical pieces of evidence on water-rock interaction and mixing processes with surface water to			

		complement vulnerability assessments; • **socio-hydrogeology:** to assess the socio-economic impact of mineral and thermal waters, and to understand how to effectively translate scientific outcomes to the water users.			
	Rain water harvesting	• Rainwater harvesting potential for roof catchment, surface and subsurface storage, sizing and design of reservoir			
	Water Conservation and Management	• Efficient Technologies in Domestic, Industrial, Agricultural and Commercial Water Use • Best Practices and Emerging Technologies • Managed Aquifer Recharge			
	Watershed Management / Integrated Water Resources Management/	• Adaptive Catchment Management Strategies • Participatory watershed management and planning • Disaster risk management			

	Integrated River Basin Management	• Green Infrastructure and nature-based solutions • Payment for Ecosystems Services • Ecological Sustainability • Water Resources Governance • Inter basin Water Transfer • Impact of Land use change on Aquatic ecosystem • Climate change Effect on Water Resources and Adaptation • Water Security			
	Water Economics	• Characterization of water resource issues using economic concepts and theory • Principles of economics and efficiency concept and relevance to water management • Economic analysis of water related decision-making • Economic instruments for water management			

		• Economic valuation of water uses and decision-making.			
	Advanced Water Cycle Management	• Catchment water balance, Lake and reservoir water balance • Wetland hydrology			
	Urban storm water management in changing climate	• The Urban Water Cycle and Rainfall (The urban water cycle, Design rainfall) • Storm water control measures (Storm water control measures, Choosing/comparing storm water control measures) • Storm water, Flooding and Urban Planning (Flooding vulnerability, Urban Flood mapping, Integrating storm water into urban planning)			

	Water Policy	• Water Policy changes and stability • Water Policy theories (including multiple streams, punctuated equilibrium, advocacy coalitions) • Assessing Water Policy Plans • Water Policy formulation and implementation • Water Policy evaluation for impacts • Water Policy translation and transfer			

	Drainage and Flood Mitigation	• Drainage and Flood Mitigation and Management (Scope and Nature of Water Management: Water Movement in Soils, Managing Water at the Source, Managing Surface, Sub-surface and Storm Drainage)			
	Surface and groundwater hydrology	• Precipitation, measurement of precipitation amounts and intensity, spatial analysis. Interception and depression storage. Evapotranspiration, Penman approach, actual evapotranspiration. Runoff processes; overland flow, interflow, base flow, • Runoff measurement; velocity area methods. Structures; hydraulic principles of weirs and			

		flumes. Stage measurement. Rating curves and other methods, • Groundwater occurrence: porosity, permeability, water holding formations, aquifers, aquicludes, aquifer types, aquifer boundaries, springs and streams in relation to groundwater, • Aquifer properties: transmissivity, storage coefficient, significance and typical magnitudes of these properties • Groundwater recharge: processes, main methods of estimation.			
	Water Salinity control	Water Salinity Assessment Control (Causes and Indicators of Salinity, Types of Salinity, Prevention, Control			

		and Management, Mapping of Salinity, Water Quality Assessment)			
	Hydrology and Hydraulics	• Drainage Design and Flood Management • Design Storms for (Bridge/Culverts), • Water Availability for (Water Supply and Irrigation), • Reservoir Sizing (Flood Management and Water Supply) • Kinetics of Water Flow - Open Channel & Closed Hydraulics, Fluvial Hydraulics			
	Impacts of Climate change, Land Use/Cover Change on water resources	• Land use/cover change and impacts on water resources • Climate change and impacts on water resources • Abstraction and water pollution impacts • Estimation of naturalized flows			

		• Eco-hydrology • Environmental Impact Assessment			
	Hydrological Field training				
	Measurements in hydrology (including exposure to state-of-art technologies)	• Land surveying using Real-Time Kinematics(RTK), drones and station levelling checks • Hydromet site selection, Hydrological controls and Installation • Telemetry - Calibration & Instrumentation of Telemetric Stations • Stream flow discharge measurements (Flow measurements with current meters, Flow measurements using acoustic methods) • Safety in Field Measurements • Rainfall Data Collection Using (Rainfall gauges, satellite, radar)	3-7 days for tailored made short Courses	Physical/Virtual	1 per course
			7-90 days for certificate Courses	Physical/Virtual	5 per course

		• Water level recording – manual and Automatic recording gauges • Operation and Maintenance of Hydrometric Stations • Evaporation (actual and potential), evapotranspiration, water consumption Soil moisture measurements • Water quality sampling and testing • Soil measurement for hydrological parameters (Texture Infiltration, saturated hydraulic conductivity-KSat). • Bathymetric surveys – multi-frequency echo sounder • Sedimentation surveys and sediment sampling • Field methods to properly measure morphological variables and develop dimensionless ratios for assessment and design			

	River Morphology and Training /River Restoration and Natural Channel Design	• Mapping fluvial landscapes and valley types, Integrating fluvial geomorphology concepts with problem-solving techniques • Pre-mapping landscapes and stream types on aerial photos and topographic maps • River restoration design by integrating physical, ecological, and aesthetic objectives and understanding the nature and cause of instability and poor habitat. • Channel capacity and sediment transport calculations. • Streambank stabilization techniques • Stream diversion structure design • Riparian area improvement and function		Physical/Virtual	1 per course
				Physical/Virtual	5 per course

		• Field supervision, construction methods and equipment selection. • Collection and analysis of bed load and suspended sediment.			
	Governance, Leadership & Management				
	Governance & Leadership	Contract Management	3-7 days for tailored made short Courses	Physical/Virtual	1 per course
		Leadership skills	7-90 days for certificate Courses	Physical/Virtual	5 per course
		Procurement of Goods and Services			
		Financial management & Wealth Creation			
		Risk Management			
		Effective Communication Skills			
		Project Planning & Management			
		Database Management			
		Policy Formulation			
		Strategic Planning			
		Performance Management			
		Corporate Governance			

	Project proposal Development	• Writing proposals • Writing journal articles • Writing policy briefs • Presentation in conferences • Research Skills			
	Professional Ethics	Code of Ethics and Conduct for Hydrology Professionals.			