



ZAMBIA
QUALIFICATIONS
AUTHORITY

DNOS.HG.01
FIRST EDITION

NATIONAL OCCUPATIONAL STANDARD FOR HYDROGEOLOGIST

APPROVING AUTHORITY

This National Occupational Standard has been prepared and published under the authority of the Zambia Qualifications Authority Board on [insert date when NOS was approved by the ZAQA Board].

ZAMBIA QUALIFICATIONS AUTHORITY

The Zambia Qualifications Authority Act No. 8 of 2024 was enacted by the Government of the Republic of Zambia to ***“continue the existence of the Zambia Qualifications Authority and redefine its functions; provide for the development and implementation of a national qualifications framework; provide for registration of qualifications on the national qualifications framework; provide for verification and evaluation of qualifications; constitute the board of the Zambia Qualifications Authority and redefine its functions; and provide for matters connected with, or incidental to, the foregoing”***. Among other functions, ZAQA is responsible for ***determining national standards for any occupation***, through various sector specific National Occupational Standards Development Teams (NOSDTs).

REVISION OF NATIONAL OCCUPATIONAL STANDARDS

National Occupational Standards shall be revised every after **5 years**, or whenever necessary, by the issue of either amendments or of revised editions. It is important that users of National Occupational Standards (NOS) should ascertain that they are in possession of the latest amendments or editions.

NOS DEVELOPMENT TEAM RESPONSIBLE

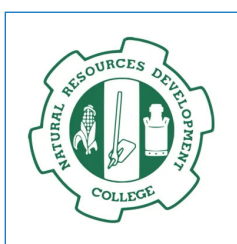
This National Occupational Standard was prepared by the Water National Occupational Standards Development Team, upon which the following organisations were represented:



Engineering Institution
of Zambia



Ministry of Water
Development and
Sanitation



Natural Resources
Development College



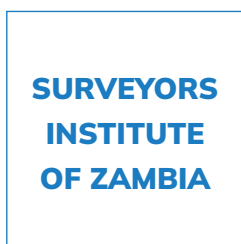
Zambia Environmental
Management Agency



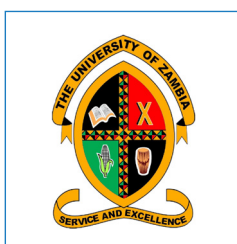
Ministry of Green
Economy



Quanta Horizon
Limited | Water
resource consulting



Surveyors Institute of
Zambia



University of Zambia



Water Resources
Management Authority
(WARMA)



Zambia Qualifications
Authority – Secretariat

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Contents

APPROVING AUTHORITY	i
ZAMBIA QUALIFICATIONS AUTHORITY	i
REVISION OF NATIONAL OCCUPATIONAL STANDARDS	i
NOS DEVELOPMENT TEAM RESPONSIBLE	i
ACKNOWLEDGEMENT	ii
FOREWORD	iv
JUSTIFICATION	iv
ACRONYMS AND ABBREVIATIONS	v
GLOSSARY OF TERMS	vi
1.0 OVERVIEW	01
2.0 SCOPE	02
3.0 PERSONAL ATTRIBUTES (VALUES, ETHICS AND ATTITUDES)	02
4.0 UNITS AND ELEMENTS	02
5.0 EQUIPMENT, TOOLS AND CONSUMABLE MATERIALS	27
6.0 DILEMMAS/CHALLENGES AND COMPLEXITIES FOR A JOB HOLDER	27
7.0 WORKING CONDITIONS/ENVIRONMENT	27
8.0 PARTIES INVOLVED/INTERACTING WITH THE JOB HOLDER OR TRAINEE	28
8.1 Internal/Within the Organisation	29
8.2 External/Outside the Organisation	28
9.0 PHYSICAL DEMANDS ON THE BODY	28
ANNEX A Criteria for Assessments based on this NOS	29
ANNEX B NOS Version Control	30

FOREWORD

The Zambia Qualifications Authority (ZAQA) is a statutory body under the Ministry of Higher Education established by ZAQA Act No. 8 of 2024 to ***“provide for the development and implementation of a national qualifications framework; provide measures to ensure that standards and registered qualifications are internationally comparable; and provide for matters connected with, or incidental to the foregoing”***.

Among other functions, ZAQA is responsible for “*determining national standards for any occupation*”, through various sector specific National Occupational Standards Development Teams (NOSDTs) of experts composed of representation from appropriate authorities, government departments, industry, academia, regulators, consumer associations and non-governmental organizations, etc.

This National Occupational Standard (NOS) has been developed by the Water National Occupational Standards Development Team in accordance with the procedures and guidelines of ZAQA. All users should ensure that they have the latest edition of this publication as National Occupational Standards are revised from time to time.

This NOS shall be used by, among others, industry, employers, quality assurance bodies, awarding and professional bodies and education and training institutions, as a benchmark to identify training needs, develop job profiles/descriptions, develop curricula and learning programme, in various sectors where the occupation exists. In the Water sector, demonstration of competence against this NOS may be required to run a business or practice a craft or profession.

JUSTIFICATION

Zambia can be classified among countries endowed with abundant surface and underground water resources. Despite this abundance, the country is currently encountering water related challenges due to a growth in competing demands. Some of these challenges include: high population growth resulting in increased demand for water for domestic, industrial and municipal uses, agriculture/irrigation, tourism, mining, manufacturing, water transport, energy/hydropower, and ecological sustenance (National Water Policy, 2010). As a result, the available water resources are under considerable pressure. This poses a big challenge for the social economic development of the country as water is at the core of sustainable development. Therefore, with the increasing pressure on the available known water resources in the country, there is an urgent need for exploring additional water resources and also prudently managing those that are available. This requires well trained and skilled human capacity that is conversant with all key aspects of groundwater resources in order to assist the country to find solutions to the very dynamic water-environment-society complex terrain.

A Hydrogeologist is a professional who studies the ways that groundwater moves through the sub-surface, its interaction with the environment and management. This NOS highlights the core knowledge, skills, competences, and personal attributes that Hydrogeologists must possess to be successful in their jobs.

This National Occupational Standard highlight core knowledge, skills, competences and personal attributes that a Geophysicist must possess to be successful in their jobs.

ACRONYMS AND ABBREVIATIONS

CS	Core Skill
DNOS	Draft National Occupational Standard
NOS	National Occupational Standard
NOSDT	National Occupational Standards Development Team
OK	Organizational Knowledge
PC	Performance Criteria
PS	Professional Skill
RPL	Recognition of Prior Learning
HG	Hydrogeologist
GP	Geophysicist
TK	Technical Knowledge
ZAQA	Zambia Qualifications Authority
ZQF	Zambia Qualifications Framework
OSHE	Occupational Safety, Health and Environment
QAQC	Quality Assurance and Quality Control

GLOSSARY OF TERMS

For the purposes of this NOS, the following terms and definitions shall apply:

Core Skills/Generic Skills:	are a group of skills that are key to learning and working in today's world. These skills are typically needed in any work environment. In the context of the NOS, these include communication related skills that are applicable to most job roles.
Disability:	Physical or mental impairment that substantially limits one or more major life activities.
Function:	is an activity necessary for achieving the key purpose of the sector, occupation, or area of work, which can be carried out by a person or a group of persons. Functions are identified through functional analysis and form the basis of NOS.
Job Title:	defines a unique set of functions that together form a unique employment opportunity in an organization.
Knowledge and Understanding:	are statements which together specify the technical, generic, professional and organizational specific knowledge that an individual need in order to perform to the required standard.
National Occupational Standards (NOS):	are statements of the standards of performance individuals must achieve when carrying out functions in the workplace, together with specifications of the underpinning knowledge and understanding. They are precise descriptions of what an individual is expected to be able to do in his/her work role.
National Occupational Standards (NOS) Code:	is a unique reference code that identifies a NOS.
National Occupational Standards Development Team (NOSDT):	means an established group of national stakeholders/experts responsible for the development of National Occupational Standards within a specific economic sector or occupation.
Occupation:	is a set of job roles, which perform similar/related set of functions in an industry.
Organisational Context:	includes the way the organisation is structured and how it operates, including the extent of operative knowledge that managers have in their relevant areas of responsibility.
Performance Criteria:	are statements that together specify the standard of performance required when carrying out a task.

Scope:	is the set of statements specifying the range of variables that an individual may have to deal with in carrying out the function which have a critical impact on the quality of performance required.
Sector:	is a conglomeration of different business operations having similar businesses and interests. It may also be defined as a distinct subset of the economy whose components share similar characteristics and interests.
Sub Sector:	is derived from a further breakdown based on the characteristics and interests of its components.
Technical Knowledge:	is the specific knowledge needed to accomplish specific designated responsibilities.
Unit Title:	gives a clear overall statement about what the incumbent should be able to do.

1.0 OVERVIEW

This is an introductory section providing a brief summary and specific information or commentary about the content of the NOS and the targeted sector and occupation to help the user judge whether it is relevant to them.

NOS Code	NOS.HG.01
Occupation	Hydrogeologist
Job Title	Hydrogeologist
Job Description	Hydrogeologist is responsible for: • Conducting field hydrogeophysical, hydrological, hydraulic, hydrochemistry investigations, analyzing data, and developing models to understand groundwater systems. • Develop and apply models to simulate groundwater flow for management purposes and assess contaminant transport. • Conducting research on groundwater resources and aquifers.
Job Purpose	To create and improve awareness of how/ where groundwater resources occur; To assess and determine parameters that govern the occurrence and flow of groundwater; To improve the level of integration between surface water and groundwater for its better development, utilization and management.
ZQF Level	7
Sector	Water
Sub sectors	Groundwater exploration development and assessment Groundwater Management and regulation.
Other Economic Sector(s) in which the Occupation is Practiced	Agriculture, Mining, Health, Education, Environmental
Other Similar Jobs that can be Performed in the Occupation	Geohydrologist, Groundwater Expert, Water Resource Officer, Hydrologist
Minimum Educational Job Entry Qualification(s)	Bachelor's degree in Geology/ Hydrogeology/ Hydrology / Water Resources Management / Earth Science or equivalent.

Practicing License Requirements (if any)	Membership with the Engineering Institution of Zambia (EIZ).
Training/RPL (Suggested)	Hydrological Modelling and Simulations, GIS and Remote Sensing, Data Science with Python & MATLAB, Project Management, Leadership and Ethics and Groundwater and hydrological , Wastewater, and Sanitation guidelines and standards
Minimum Job Entry Age	20 years
Prior Experience (Recommended)	1-2 years of experience working in an environment of various hydrogeological works from groundwater development to management.
Performance Criteria	As described in the Units under Section 4

2.0 SCOPE

This National Occupational Standard highlights core knowledge, skills, competencies and personal attributes that a Hydrogeologist must possess to be successful in their jobs.

3.0 PERSONAL ATTRIBUTES (VALUES, ETHICS AND ATTITUDES)

This job requires the ability to do basic planning and prioritise, ability to work in a team, physique to sustain strenuous conditions, high technological exposure to handle various equipment, tools and materials, sensitivity towards safety for self, others and equipment, willingness to work across various locations in ground Water explorations, be well versed with tasks, functions, standards, specifications, codes of practice and safety norms applicable to Water works, be honest, team player and results oriented, etc.

4.0 UNITS AND ELEMENTS

This National Occupational Standard is divided into 7 Units representing the tasks that a jobholder should undertake in his/her day-to-day work. Each unit is further broken down into elements depicting the number of activities to be carried out for the successful execution of a particular task.

UNIT 1 [This Unit covers the skills and knowledge required by a Hydrogeologist in planning for development of groundwater systems.

Unit No.	01
Unit Title	Hydrogeological conceptual model development and planning
Description	This Unit describes the skills and knowledge required by a Hydrogeologist to plan for development of groundwater systems.
Scope	This Unit covers the following: • Conceptual development of different geological and hydrogeological models. • Problem identification with intent to provide solutions for groundwater resource development.
Performance Criteria (PC) with respect to the Scope	
Element	Performance Criteria (PC)
Conceptual development of different geological and hydrogeological models.	To be competent, the individual must be able to: PC1. Identify different geological units (lithological units) and produce geological maps. PC2. Classify different geological units in relation to groundwater occurrence. PC3. Identify different structural controls on groundwater storage and movement. PC4. Perform preliminary characterization of groundwater chemistry PC5. Design hydrogeological database.
Problem identification with intent to provide solutions for groundwater resource development.	To be competent, the individual must be able to: PC6. Develop problem statements and objectives for groundwater resource development projects. PC7. Perform site reconnaissance surveys (hydro census). PC8. Perform preliminary estimation of groundwater resource (groundwater potential). PC9. Perform environmental project briefs or impact assessments in relation to groundwater development.

Unit No.	01
Knowledge and Understanding (K)	
A. Organisational Context (knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: - OK1. Standard naming and coding of different geological and hydrogeological units for production of geological and hydrogeological maps and cross-sections. - OK2. Standard practices for naming and coding of different types of hydrogeological data for archiving and filing into the hydrogeological database. - OK3. Human resource structure and hierarchy; policies and procedures. - OK4. Values and ethics.
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: - TK1. Geological and hydrogeological environments. - TK2. Hydrochemistry analysis and ways of predicting groundwater chemistry signature from rock interactions. - TK3. GIS and remote sensing application tools used for evaluation of groundwater resources. - TK4. Standard procedures for estimating and evaluating groundwater resources - TK5. Industrial software (ArcGIS, Surpac, Geosoft, PhreacqC, etc), equipment and technologies used for groundwater development. - TK6. Planning tools, like Microsoft projects.
C. Regulatory Context (Knowledge of rules and regulations)	The individual on the job must demonstrate knowledge and understanding of: RK7. Laws and regulations related to environment and water.

Unit No.	01
Skills (S)	
A. Core Skills/ Generic Skills	Writing Skills The individual on the job must be able to: CS1. Prepare and provide concise reports. CS2. Prepare and produce geological and hydrogeological maps and cross sections.
	Reading Skills The individual on the job must be able to: CS3. Read English and be able to, or have the means to, give simple instructions in the local language. CS4. Read and interpret geological and hydrogeological maps and cross-sections.
	Oral Communication (Listening and Speaking skills) The individual on the job must be able to: CS5. Convey information clearly and concisely to co-workers
	Decision-Making The individual on the job must be able to: PS1. Adhere to the organisation's decision-making policies. PS2. Make independent and sound decisions based on hydrogeological judgement, and considering environmental and social impacts
B. Professional Skills	Plan and Organise The individual on the job should be able to: PS3. Plan work estimates, and organise required resources in coordination with team members.
	Customer Centricity The individual on the job should be able to: PS4. Manage expectations with stakeholders, with intent to complete required works/task with minimal downtime.

Unit No.	01
	Problem Solving
	The individual on the job should be able to:
	PS5. Identify groundwater related issues, develop practical solutions in relation to groundwater development and management
	PS6. Implement effective remediation strategies in contaminated sites.
	Analytical Thinking
	The individual on the job should be able to:
	PS7. Identify risks and manage them.
	PS8. Apply methodical step-by-step approaches to thinking, and break down complex problems into smaller and manageable components.
	Critical Thinking
	The individual on the job should be able to:
	PS9. Assess and manage potential hazards associated with exposure to contaminants in the environment.
	PS10. Observe and predict opportunities, threats, and solutions.

UNIT 2 [This Unit covers the skills and knowledge required by a WS Engineer to design water and sanitation systems]

Unit No.	02
Unit Title	Groundwater exploration and development
Description	This Unit describes the skills and knowledge required by a Hydrogeologist to conduct and lead fields activities involving groundwater exploration and development.
Scope	This Unit covers the following: • Geological mapping • Hydro-geophysical investigations. • Drilling supervision and well completion • Hydraulic testing
Performance Criteria (PC) with respect to the Scope	
Element	Performance Criteria (PC)
Geological and hydrogeological mapping	To be competent, the individual must be able to: PC1. Identify different rock types and classify them (sedimentary, metamorphic and igneous rocks). PC2. Perform field geological and structural mapping PC3. Prepare geological maps and sections PC4. Review existing data and conduct hydrogeological census to map aquifer units and boundaries. PC5. Prepare geological or hydrogeological mapping reports.
Hydro-geophysical investigations.	To be competent, the individual must be able to: PC6. Select appropriate geophysical techniques and design geophysical survey programme for borehole siting and other subsurface investigations. PC7. Perform geophysical data acquisition using various techniques like magnetic, gravity, resistivity, electromagnetic, seismic and borehole geophysical methods. PC8. Process and interpret geophysical data in relation to groundwater occurrence using various software RES2DInv, Geosoft, Surfer, Voxler, etc PC9. Prepare hydrogeophysical borehole siting reports or hydrogeophysical investigation reports according to prescribed standards.

Unit No.	02
Drilling supervision and well completion	To be competent, the individual must be able to: PC10. Develop a drilling program. PC11. Select appropriate equipment for, and method of drilling PC12. Supervise borehole drilling and collect important data (such as litho-logs, penetration rate, water strikes, water quality, etc.) PC13. Select appropriate methods for well development for different geological conditions.
Hydraulic testing	To be competent, the individual must be able to: PC14. Develop hydraulic testing program for various aquifers and objectives. PC15. Select appropriate equipment for, and method of aquifer testing. PC16. Supervise aquifer hydraulic testing and collect important data (such as borehole yields, water levels, etc.) PC17. Process and interpret aquifer (hydraulic) testing data to determine aquifer parameters.
Groundwater development	To be competent, the individual must be able to: PC18. Design and construct well pumping systems. PC19. Develop groundwater management plans to ensure sustainable groundwater use. PC20. Implement groundwater conservation and protection measures.
Knowledge and Understanding (K)	
A. Organisational Context (knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of company: OK1. Procurement procedures. OK2. Human resource structure and hierarchy; policies and procedures. OK3. Operational safety, health, and environmental management guidelines and policies. OK4. Service charter. OK5. Values and ethics. OK6. Production reporting procedures. OK7. Maintenance policies and procedures. OK8. Performance evaluation. OK9. Change order management.

Unit No.	02
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: - TK1. Application of geophysical methods in hydrogeological investigations. - TK2. 1D and 2D processing and interpretation of geophysical data (potential, geo-electric, electromagnetic and seismic data) in terms of groundwater occurrence. - TK3. Borehole geological and hydrogeological logging (including preparation of borehole logs using software packages). - TK4. Aquifer parameters characterization from pumping test, packer test, etc. - TK5. Methods of estimation and quantification of groundwater resources. - TK6. Onsite and laboratory water quality testing and analysis using hydrochemistry software packages. - TK7. GIS and computer aided skills for production of maps and cross-sections. - TK8. Cost projects and prepare bill of quantities for hydrogeological works. - TK9. Safety, health, and the environment. - TK10. Drinking water standards (ZABS) and water treatment procedures.
C. Regulatory Content (knowledge of rules and regulation)	The individual on the job must demonstrate knowledge and understanding of: RK11. Laws and regulations related to environment, water, public health, biosafety, and occupation health and safety.
Skills (S)	
A. Core Skills/ Generic Skills	Writing Skills
	The individual on the job must be able to: CS1. Prepare concise technical reports and drawings, maps and cross sections.
	Reading Skills
	The individual on the job must be able to: - CS2. Read English and be able to, or have the means to, give simple instructions in the local language used at the site. - CS3. Read and interpret sketches, drawings or instructions provided for the required work.

Unit No.	02
B. Professional Skills	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to:
	CS4. Speak in English (at least working level), and be able to, or have the means to, give simple instructions in the local language used at the site.
	CS5. Listen attentively and interpret communication/ instructions from the supervisor and other co-workers.
	Decision-Making
	The individual on the job must be able to:
	PS1. Identify design risks, challenges, and provide solutions/ action points with minimal or no supervision.
	Plan and Organise
	The individual on the job should be able to:
	PS2. Discuss continuous feedback from teams and stakeholders, and applying the reviews.
	Customer Centricity
	The individual on the job should be able to:
	PS3. Manage relationships with customers with intent to satisfying their project requirements.
	Problem Solving
	The individual on the job should be able to:
	PS4. Resolve any conflicts within the team.
	Analytical Thinking
	The individual on the job should be able to:
	PS5. Analyse and convey to the superior, and carry out remedial action.
	Critical Thinking
	The individual on the job should be able to:
	PS6. Identify and deal with potential design challenges in different sites.

UNIT 3 [This Unit covers the skills and knowledge required by a Hydrogeologist to undertake procurement of engineering services, goods, and works]

Unit No.	03
Unit Title	Groundwater contamination and hydrochemistry
Description	This Unit describes the skills and knowledge required by a Hydrogeologist for performing hydrochemistry and groundwater contamination investigations and remedial measures.
Scope	This Unit covers the following: • Mapping groundwater contamination • Hydrochemistry analysis.
Performance Criteria (PC) with respect to the Scope	
Element	Performance Criteria (PC)
Mapping groundwater contamination	To be competent, the individual must be able to: PC1. Characterise sources of contaminants in groundwater PC2. Differentiate sources of contaminants between natural and anthropogenic. PC3. Assess impacts of groundwater contaminants on its portability. PC4. Formulate methods to remediate sources of contaminants.
Hydrochemistry Analysis	To be competent, the individual must be able to: PC5. Design groundwater sampling programs for hydrochemistry analysis. PC6. Perform groundwater chemical analyses and determine chemical and water quality signatures of groundwater. PC7. Data presentation and hydrochemistry statistical analysis. PC8. Demarcate groundwater protection zones from human activities.

Unit No.	03
Knowledge and Understanding (K)	
A. Organisational Context (knowledge of the company/organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: - OK1. Relevant standards, procedures, and policies of the organisation relating to procurement. - OK2. Context of the organisation as determined by whether it is client/owner's body, consultancy or construction, as well as legal, financial, social, regulatory or cultural. - OK3. Internal factors, organisation structure, governance, and resource capabilities. - OK4. Roles and responsibilities. - OK5. Risk management. - OK6. Occupational health and safety, environmental, and quality management. - OK7. Performance evaluation. - OK8. Change order management.
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of, but not limited to the following: - TK1. Movement/transport processes of contaminants (Dispersion vs Diffusion and Use of Tracers). - TK2. Inorganic and organic sources of pollution (sources, behavior in the subsurface, sampling protocols, sample handling). - TK3. Chemical signature of groundwater as a result of contamination and its interaction with rocks and minerals. - TK4. Onsite and laboratory ways of analyzing various chemistry parameters of groundwater. - TK5. Carbonate system, Nitrate cycle and Redox reactions. - TK6. Isotope Hydrology - TK7. Groundwater protection zones from human activities - TK8. Remediation and pollution attenuation processes - TK9. Water Treatment. - TK10. Use of software like PhreeqC to analysis groundwater chemistry and prediction.
C. Regulatory Content (knowledge of rules and regulation)	The individual on the job must demonstrate knowledge and understanding of: - RK11. Laws and regulations related to environment and water. - RK12. Laws and regulations relating to urban and regional planning.

Unit No.	03
Skills (S)	
A. Core Skills/ Generic Skills	Writing Skills The individual on the job must be able to: - CS1. Produce evaluation report(s). - CS2. Prepare and provide clear and simple instructions, details, and sketches to co-workers/others. - CS3. Develop/review standard particular specifications. - CS4. Develop/review particular contract conditions. - CS5. Communicate effectively through writing as appropriate for the needs of the audience. - CS6. Use conversational communication methods, such as email, WhatsApp, etc. - CS7. Demonstrate good command of the English language.
	Reading Skills The individual on the job must be able to: - CS8. Read English and be able to, or have the means to, give simple instructions. - CS9. Read and cross check that tender documentation is responsive to the requirements. - CS10. Research, read, and interpret technical data from manuals, books, and any other relevant literature. - CS11. Read and comprehend written information or communication.
	Oral Communication (Listening and Speaking skills) The individual on the job must be able to: - CS12. Demonstrate active listening and interpret communication/ instructions from the supervisor, co-workers and tenderers. - CS13. Convey information clearly and concisely to co-workers and others. - CS14. Illustrate ideas using presentation skills and applications, such as PowerPoint, etc. - CS15. Manage pre-tender meetings and discussions. - CS16. Manage tender evaluation and negotiations meetings. - CS17. Provide feedback on technical works and reports.

Unit No.	03
B. Professional Skills	Decision-Making
	The individual on the job must be able to: PS1. Adhere to the organisation decision-making policies. PS2. Make independent and sound decisions based on engineering judgement, and considering public safety and interests of other stakeholders. PS3. Make prompt decisions on feedback of tender documentation evaluations. PS4. Demonstrate impartiality in deciding the responsive tenderer. PS5. Demonstrate high ethical standards.
	Plan and Organise
	The individual on the job should be able to: PS6. Plan, organise, lead, and control organisation activities in line with the applicable deadlines. PS7. Schedule tasks and complete them within time and budget. PS8. Work to achieve set goals. PS9. Evaluate tender documentation in line with the tender procurement plan.
	Customer Centricity
	The individual on the job should be able to: PS10. Manage relationships with customers with intent to satisfying their project requirements.
	Problem Solving
	The individual on the job should be able to: PS11. Demonstrate ability to identify problems, brainstorm, and analyse possible answers, with the view of implementing optimal solutions. PS12. Consult widely and identify possible remedies. PS13. Escalate when required in line with the organisation's procedures and protocols.

Unit No.	03
	Analytical Thinking
	The individual on the job should be able to:
	PS14. Apply domain knowledge, observations, and data to perform tasks related to the assignment.
	PS15. Apply methodical step-by-step approaches to thinking, and break down complex problems into smaller and manageable components.
	PS16. Demonstrate creativity, interpersonal, and organisational skills.
	PS17. Employ data analysis, logical thinking, and research and communication skills.
	Critical Thinking
	The individual on the job should be able to:
	PS18. Observe and predict opportunities, threats, and solutions.
	PS19. Collect, understand, and interpret data and other information.
	PS20. Demonstrate ability to draw inferences based on relevant data, and personal knowledge and experience.
	PS21. Communicate resulting information with others verbally, nonverbally, and in writing.

UNIT 5 [This Unit covers the skills and knowledge required by a hydrogeologist to manage water resources in an integrated manner]

Unit No.	05
Unit Title	Manage Water resources in an Integrated way
Description	This Unit describes the skills and knowledge required by a Hydrogeologist in managing water resources in an integrated manner.
Scope	This Unit covers the following: Stakeholder engagement, Sustainable water resources utilization.
Performance Criteria (PC) with respect to the Scope	
Element	Performance Criteria (PC)
Stakeholder Engagement	To be competent, the individual must be able to: PC1. Identify key stakeholders, etc. PC2. Should able map the key stakeholders. PC3. Know the water needs of the different stakeholder. PC4. Engage and communicate with different stakeholders. PC5. Know about ethical issues and power relationships
Sustainable water resources utilisation	To be competent, the individual must be able to: PC6. Knowledge of methods to reduce water consumption and waste, such as rainwater harvesting, drip irrigation, and xeriscaping. PC7. Competence in identifying pollution sources and implementing strategies to protect water quality. PC8. Ability to develop and implement sustainable water management policies and practices.
Knowledge and Understanding (K)	
A. Organisational Context (knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. Organizational structure, including key departments (such as environmental compliance, project management, engineering, and community relations) and their functions. OK2. Mission and vision of the organization in the hydrogeological context. OK3. Organization's standard operating procedures for project execution, data collection, and reporting. OK4. Environmental assessments, data management, and compliance with regulatory frameworks OK5. Organization's climate change policies, goals, and commitments.

Unit No.	05
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding: - TK1. Hydrogeological processes and their impact on water quality - TK2. Water quality standards and regulations - TK3. Water pollution control technologies - TK4. Ecological principles and aquatic ecosystems health - TK5. Environmental impact assessment methodologies - TK6. Climate change science and its implications for the water resources - TK7. Global Climate change models e.g. Shared Socioeconomic pathways (SSPs) etc.
C. Regulatory Content (knowledge of rules and regulation)	The individual on the job must demonstrate knowledge and understanding of: - RK1. Laws and regulations related to environment, water, public health, biosafety, construction legislation, and occupational safety and health. - RK2. Laws and regulations relating to urban and regional planning.
Skills (S)	
A. Core Skills/ Generic Skills	Writing Skills
	The individual on the job must be able to: - CS1. write in English (at least working level) and be able to or have the means to give simple instructions in the local language used at the site - CS2. prepare and provide clear and simple instructions, details and sketches to co-workers.
	Reading Skills
	The individual on the job must be able to: CS3. Read and interpret internal/external documents related to hydrogeology.

Unit No.	05
B. Professional Skills	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to:
	CS4. speak in English (at least working level) and be able to or have the means to give simple instructions in the local language used at the site
	CS5. listen attentively and interpret communication/instructions from the supervisor and other co-workers
	CS6. convey information clearly and concisely to co-workers
	Decision-Making
	The individual on the job must be able to:
	PS1. determine and report to the superior whether the working space is safe for working
	Plan and Organise
	The individual on the job should be able to:
	PS2. Plan work and organise required resources in coordination with team members and superiors.
	Customer Centricity
	The individual on the job should be able to:
	PS3. Manage relationships with customers.
	Problem Solving
	The individual on the job should be able to:
	PS3. Resolve any conflicts within the team.
	Analytical Thinking
	The individual on the job should be able to:
	PS6. Analyse and convey to the superior, and carry out remedial action.
	Critical Thinking
	The individual on the job should be able to:
	PS7. Identify and deal with or report violation of any safety norms which may lead to accidents.
	PS8. Identify and deal with or report any vandalism to the hydrogeological system.

UNIT 6 [This Unit covers the skills and knowledge required by a Hydrogeologist to model groundwater systems]

Unit No.	06
Unit Title	Groundwater Modelling
Description	This Unit describes the skills and knowledge required for by a hydrogeologist in groundwater modeling skills of Water resources systems.
Scope	This Unit covers the following: Conceptual modeling, Mathematical modelling, Model design, Calibration, Validation, Prediction, Sensitive analysis and Decision making
Performance Criteria (PC) with respect to the Scope	
Element	Performance Criteria (PC)
Conceptual modeling	To be competent, the individual must be able to: PC1. Represent the groundwater system in a simplified or pictorial form. PC2. Identifying the boundaries, sources of recharge, and locations of wells PC3. Identify the sources of discharge of the groundwater system
Mathematical Modelling	To be competent, the individual must be able to: PC4. Select the appropriate equations to simulate groundwater flow PC5. Select the appropriate equations to simulate the transport processes. PC6. Build common types of mathematical models these include analytical, finite difference, and finite element models.
Model Design:	To be competent, the individual must be able to: PC7. Set up the model with the collected data PC8. Chose the right model grid resolution PC9. Chose the right mathematical equations for the model.
Calibration:	To be competent, the individual must be able to: PC10. Identifying Model key parameters PC11. Adjust the model parameters to match observed data PC12. Ensure the model accurately represents the real system

Unit No.	06
Validation	To be competent, the individual must be able to PC13. Testing the model with independent data sets to verify its accuracy. PC14. Assessing model predictive accuracy PC15. Improving the model performance
Prediction:	To be competent, the individual must be able to PC16. Use the model to Forecast outcome PC17. Using the calibrated and validated model to predict future groundwater conditions under various scenarios PC18. Identify potential risks and uncertainties to mitigate negative impacts.
Sensitivity Analysis:	To be competent, the individual must be able to PC19. Evaluate how changes in model parameters affect the output PC20. Understand the uncertainty PC21. Understand reliability of the model.
Decision-Making:	To be competent, the individual must be able to PC22. Use the model predictions to inform water management PC14 Use the model to make decisions and policies PC23. Use the model for planning purpose.
Knowledge and Understanding (K)	
A. Organisational Context (knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. Organizational structure, including key departments (such as environmental compliance, project management, engineering, and community relations) and their functions. OK2. Mission and vision of the organization in the hydrogeology context. OK3. Organization's standard operating procedures for project execution, data collection, and reporting. OK4. Environmental assessments, data management, and compliance with regulatory frameworks OK5. Organization's climate change policies, goals, and commitments.

Unit No.	06
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: - TK1. Hydrogeology and groundwater flow principles - TK2. Drilling and well construction methods - TK3. Groundwater modeling techniques - TK4. Water quality assessment and management - TK5. Environmental impact assessment - TK6. Water resource management policies and regulations
C. Regulatory Content (knowledge of rules and regulation)	The individual on the job must demonstrate knowledge and understanding of: RK1. Laws and regulations related to groundwater and water.
Skills (S)	
A. Core Skills/ Generic Skills	Writing Skills
	The individual on the job must be able to: - CS1. write in English (at least working level) and be able to or have the means to give simple instructions in the local language used at the site - CS2. prepare and provide clear and simple instructions, details and sketches to co-workers
	Reading Skills
	The individual on the job must be able to: - CS6. Read English and be able to, or have the means to, give simple instructions. - CS7. Research, read, and interpret technical data from manuals, books, and any other relevant literature. - CS8. Read and comprehend written information or communication.
	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to: - CS9. Demonstrate active listening and interpret communication/ instructions from the supervisor, co-workers. - CS10. Convey information clearly and concisely to co-workers and others. - CS11. Illustrate ideas using presentation skills and applications, such as PowerPoint, etc. - CS12. Provide feedback on delegated tasks.

Unit No.	06
B. Professional Skills	Decision-Making The individual on the job must be able to: PS1. Adhere to the organisation's decision-making policies. PS2. Make independent and sound decisions based on engineering judgement, and considering public safety, subordinates, and interest of other stakeholders. PS3. Make prompt decisions on feedback on delegated tasks PS4. Demonstrate high ethical standards.
	Plan and Organise The individual on the job should be able to: PS5. Plan, organise, lead, and control organisation activities in line with the applicable deadlines. PS6. Schedule training tasks. PS7. Work to achieve set goals. PS8. Employ SWOT Analysis to evaluate the performance of the delegated tasks, training, mentorship, and team building activities.
	Customer Centricity The individual on the job should be able to: PS9. Provide leadership and supervision roles with the aim to enhance relationships with customers and satisfying their project requirements.
	Problem Solving The individual on the job should be able to: PS10. Demonstrate ability to identify problems, brainstorm, and analyse possible answers with the view of implementing optimal solutions. PS11. Consult widely and identify possible remedies. PS12. Escalate when required in line with the organisation's procedures and protocols.

Unit No.	06
	Analytical Thinking
	The individual on the job should be able to:
	PS13. Apply domain knowledge, observations, and data to perform tasks related to the assignment.
	PS14. Apply methodical step-by-step approaches to thinking and breaking down complex problems into smaller and manageable components.
	PS15. Demonstrate creativity, interpersonal and organisational skills.
	PS16. Employ data analysis, logical thinking, research, and communication skills.
	Critical Thinking
	The individual on the job should be able to:
	PS17. Demonstrate ability to observe and predict threats, opportunities, and solutions.
	PS18. Collect, understand, and interpret data and other information.
	PS19. Demonstrate ability to draw inferences based on relevant data, and personal knowledge and experience.
	PS20. Communicate resulting information with others verbally, nonverbally, and in writing

UNIT 7 [This Unit covers the skills and knowledge required by a Hydrogeologist to ensure safety, health, and environmental management]

Unit No.	08
Unit Title	Ensure Safety, Health, and Environmental Management
Description	This Unit describes the skills and knowledge required by a Hydrogeologist in maintaining safety, health, and environment in the work environment.
Scope	This Unit covers the following: • Ensure safety and health regulations are followed by the jobholder as well as other employees. • Ensure operations at the establishment conform to the requirements for environmental protection.
Performance Criteria (PC) with respect to the Scope	
Element	Performance Criteria (PC)
Ensure Safety and Health Regulations are Followed by the Jobholder as Well as Other Employees	To be competent, the individual must be able to: PC1. Implement organizational safety and health policies. PC2. Implement environmental policies of the organisation. PC3. Identify, through troubleshooting, the bottlenecks and efficiency problems at the drilling site. PC4. Assess risk and possible safety hazards of all aspects of operations. PC5. Guide other employees on the safe operation of machinery, tools, and equipment, and apply them in the formulation of standard operating procedures (SOPs).
Ensure Operations at the Establishment Conform to the Requirements for Environmental Protection	To be competent, the individual must be able to: PC6. Implement the overall environmental policies of the organisation and the country. PC7. Guide other employees on the safe operations of equipment/machinery, and apply them in formulation of SOPs.
Knowledge and Understanding (K)	

Unit No.	08
A. Organisational Context (knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of company: OK1. Policies on safety, health, and environmental protocols. OK2. Procedures and guidelines on safety, health, quality, and environment.
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Safety risk assessment. TK2. EIA processes. TK3. Toolbox talk. TK4. Material safety data sheets (MSDS).
C. Regulatory Content (knowledge of rules and regulation)	The individual on the job must demonstrate knowledge and understanding of: RK1. Laws and regulations related to environment, water, public health, biosafety, and occupational health and safety.
Skills (S)	
A. Core Skills/ Generic Skills	Writing Skills
	The individual on the job must be able to: CS1. Prepare health, safety, and environment SOPs.
	Reading Skills
	The individual on the job must be able to: CS2. Read and interpret internal/external documents related to health, safety, and environmental management.
	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS3. Communicate health, safety, and environmental information to subordinates and other stakeholders.

Unit No.	08
B. Professional Skills	Decision-Making
	The individual on the job must be able to:
	PS1. Plan and organise departmental health, safety, and environment talks/meetings.
	PS2. Carry out departmental health, safety, and environmental risk assessment (in conjunction with the Safety Officer).
	Plan and Organise
	The individual on the job should be able to:
	PS3. Determine the implications of failure to comply with health, safety, and environmental regulations on the individual and the company.
	Customer Centricity
	The individual on the job should be able to:
	PS4. Manage relationships with customers on health, safety, and environment issues.
	Problem Solving
	The individual on the job should be able to:
	PS5. Identify and solve problems with minimal or no supervision.
	PS6. Make decisions during emergency situations.
	Analytical Thinking
	The individual on the job should be able to:
	PS7. Analyse and convey to the superior, and carry out remedial action.

5.0 EQUIPMENT, TOOLS AND CONSUMABLE MATERIALS

Equipment, tools, and consumable materials used by the jobholder include, but are not limited to:

Hydrogeological equipment: Magnetometers, gravimeters, resistivity meters, Electrical Resistivity Tomography (ERT), electromagnetic meters, borehole logging equipment (winch and logging tools), Laser level, Total station, Handheld GPS, Measuring tape, Geological hammer, water level meter, Water dip meter, Water quality multi-meter (portable lab).

Electronic equipment: Computer and software, printer, etc.

TOOLS:

Discharge measuring devices, Distance measuring device, etc.

CONSUMABLES AND GENERAL REQUIREMENTS:

Personal Protective Equipment: Steel capped boots, Safety helmet, Safety goggles, Reflective vest and work suit

6.0 DILEMMAS/CHALLENGES AND COMPLEXITIES FOR A JOB HOLDER

Dilemmas associated with the job of hydrogeologist include: electrical power supply, working around the bush with wildlife, Carrying heavy equipment, walking long distances, working long hours, working in extreme weather such as hot and cold conditions, working in noisy, wet and dusty environments, exposure to bugs ie wasps, lifting/pulling/pushing heavy materials, long working hours, pressure from supervisors and colleagues, pressure from government regulators, etc.

6.1 Alternative Choices (Solutions) to Dilemmas and Complexities

Solutions to dilemmas include wearing protective clothing and ensuring their availability and use by other employees, exercising regularly to maintain physical fitness, exercising proper work ergonomics, participating in workplace safety sensitization and awareness meetings/training sessions, always adhering to organizational safety and standard operating procedures, consulting extensively within and outside one's department/team on water safety issues, planning and prioritizing work, etc.

7.0 WORKING CONDITIONS/ENVIRONMENT

Working conditions include indoor, mostly outdoor in the remote field water sites that include but not limited to; factories, communities of rural areas and mining industries. Geophysicist may also work in commercial buildings or private homes, working in conditions that may be dirty and noisy, exposure to seasonal heat and cold or adverse weather conditions, emergency call-outs, standing or squatting for long hours and lifting relatively heavy equipment's. In most cases, the job involves working long hours. The job also requires wearing suitable protective clothing such as works suits, ear protectors, safety visors or goggles, gloves and hardhats, raincoats, sunscreen especially for low melanin skins etc.

8.0 PARTIES INVOLVED/INTERACTING WITH THE JOB HOLDER OR TRAINEE

8.1 Internal/Within the Organization

Parties involved/interacting with the job holder who are internal to the organization include but not limited to.

1. Supervisors/superiors, trainers, occupational health and safety team, other colleagues.

8.2 External/Outside the Organization

Parties involved/interacting with the job holder who are external to the organization include.

Government regulators, trainers, clients, suppliers of equipment/ tools/ consumables, fellow hydrogeologist from other companies, labour unions/ occupational health and safety associations, locals for rural water works, mining teams and hauling machines on mining sites. etc.

9.0 PHYSICAL DEMANDS ON THE BODY

- Ability to sustain strenuous conditions such as walking long survey profiles.
- Walk and stand for long periods of time;
- Bend, stretch, twist, or reach out.
- Eyes sunlight intensity effects
- Lift, carry, push and pull heavy objects.
- And willing to work in remote areas and be able to camp.
- Use fingers, hands and feet with ease to complete the assigned task (dexterity);
- Strenuous works that may cause musculoskeletal disorders; Etc.

ANNEX A

Criteria for Assessments based on this NOS

A.1 Guidelines for Assessment

A.1.1 Criteria for assessment for curricula and learning programmes based on this NOS will be created by curricula and programmes developers. Each Performance Criteria (PC) will be assigned marks proportional to its importance in the NOS. Curricula and programmes developers will also lay down proportion of marks for theory and practical skills for each performance criteria, giving more weight to practical skills.

There shall be allocated the 'Total Mark', which will be the sum of all marks in each Unit, distributed across the number of PCs in that particular Unit. The 'out of' mark will be the mark allocated to each PC, which will be shared between theory and skills practical assessments.

A.1.2 Individual awarding/assessment bodies or institutions and other users of the NOS will create unique question papers for the theory part and evaluations for skill practical part for their respective candidates.

ANNEX B

NOS Version Control

This Annex gives details necessary for the tracking of the NOS versions based on the number of revisions.

NOS Code	DNOS.HG.01		
ZQF Level	7	Version Number	01
Sector	Water	Date of Approval	
Sub Sector		Date of Last Review	N/A
Occupation	Hydrogeologist	Date of Next Review	



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