BOARD FOR

PROFESSIONAL ENGINEERS,

LAND SURVEYORS, AND GEOLOGISTS

CERTIFIED HYDROGEOLOGIST (CHG)

EXAMINATION OUTLINE

August 2013

Certified Hydrogeologist Examination Outline

I. PROJECT PLANNING (36%): This area assesses the candidate's knowledge of establishing objectives and developing a scope of work for hydrogeologic projects.			
A. Problem Definition (17%)			
Job Task		***Associated Knowledge Statement***	
1.	Determine needs for water supply planning and water quality protection.	1.	Knowledge of major components of groundwater supply systems.
2.	Assess potential immediate threat to environment or human health associated with hydrogeology-related investigations.	16.	Knowledge of the effects of groundwater on soil and rock stability.
		18.	Knowledge of risks to human health and the environment from exposure to various chemicals.
4.	Examine potential off-site/on-site contaminant sources.	98.	Knowledge of the effects of natural and human activities on groundwater quality and quantity.
5.	Determine potential coastal issues related to seawater intrusion.	93.	Knowledge of dynamic relationship between fresh water and saline water in aquifers.
		154.	Knowledge of the effects of barometric pressure and ocean tides.
6.	Assess needs for water supply restoration/remediation.	118.	Knowledge of the purposes of different types of wells.
7.	Determine legal and regulatory requirements for contamination assessments.	5.	Knowledge of effects of federal, State, and local water quality standards on evaluation of water quality data.
		24.	Knowledge of the standards of practice for site investigation and remediation.
9.	Evaluate potential sources of water supply.	40.	Knowledge of water supply management requirements.
10.	Determine potential impact of water resource on designated beneficial use.	4.	Knowledge of "beneficial use" as designated by State law.
11.	Investigate consequences of contamination on land ownership, liability, land values, and water rights.	112.	Knowledge of the types and sources of contaminants associated with various categories of land use and industrial processes.
12.	Assess issues and consequences of groundwater management decisions on existing/future land and water uses.	181.	Knowledge of potential impacts from long-term land use and water management plans.
14.	Develop and refine a conceptual hydrogeologic model.	3.	Knowledge of the hydrologic cycle.
		54.	Knowledge of data gap analysis.
		150.	Knowledge of the elements of preparing a conceptual site model.

Certified Hydrogeologist Examination Outline

A. Problem Definition (17%)			
Job Task		***Associated Knowledge Statement***	
15.	Develop an investigation approach to achieve project objectives.	10. 11.	Knowledge of the effects of existing site conditions on field studies. Knowledge of the advantages and disadvantages of different site investigation methods.

B. Project Approach (19%)			
Job Task		***Associated Knowledge Statement***	
16.	Determine need to control groundwater flow direction or head.	106.	Knowledge of the principles of groundwater flow pertaining to confined and unconfined aquifers under pumping and steady state conditions.
17.	Develop a site health and safety plan.	27.	Knowledge of environmental and safety regulations pertaining to exploration and sampling of contaminated soil, soil gas, and groundwater.
		35.	Knowledge of exposure pathways for risk assessment and worker health/safety.
18.	Examine consequences of changes to water table or potentiometric surface.	81.	Knowledge of the use of climate data for hydrogeologic studies.
		155.	Knowledge of the sources and quality of climate data related to hydrogeologic analysis.
20.	Formulate preliminary well design based on existing site data.	70.	Knowledge of techniques for well placement.
		71.	Knowledge of the purposes of different types of wells.
21.	Develop schedules and locations for soil and/or groundwater remediation.	96.	Knowledge of procedures for scheduling and locating remediation systems.
22.	Determine type, collection methods, and quantity of data needed to achieve project objectives.	13.	Knowledge of the advantages and disadvantages of different sampling methods.
		17.	Knowledge of procedures to validate hydrogeologic, hydrologic, and water quality data.
		19.	Knowledge of the advantages and disadvantages of laboratory methods to determine physical properties and chemical concentrations of soil, rock, water, gas, and waste samples.
		32.	Knowledge of the advantages and disadvantages of field testing methods for vapor intrusion.
		46.	Knowledge of aquifer testing methods and procedures, including their uses and limitations.
23.	Develop a groundwater investigation work plan.	85.	Knowledge of techniques to obtain water, soil, and gas samples.
		183.	Knowledge of regional and local hydrogeological conditions that may constrain investigation approaches.

B. Project Approach (19%)			
Job Task		***Associated Knowledge Statement***	
24.	Develop a groundwater monitoring program.	15.	Knowledge of various field methods, including their limitations, for measuring water quality parameters.
		23.	Knowledge of groundwater monitoring program elements.
		184.	Knowledge of groundwater procedures for measuring groundwater levels, free product thickness, and field water quality parameters from wells.
25.	Determine well development, purge, and sampling methods/equipment.	14.	Knowledge of the advantages and disadvantages of different well purging methods.
26.	Assess water resource management alternatives.	103.	Knowledge of techniques and procedures to evaluate water supply alternatives.
27.	Determine permitting requirements for regulatory compliance.	6.	Knowledge of various regulatory agencies that have jurisdictional authority over water (e.g., supply, quality, rights).
		22.	Knowledge of permit requirements for hydrogeologic investigations, water supply systems, and treatment systems.
		179.	Knowledge of on-site wastewater disposal.
28.	Determine regulatory requirements for testing and reporting.	66.	Knowledge of State and federal laws, regulations, and policies pertaining to groundwater testing and reporting.
30.	Select subsurface exploration methods and equipment approaches for anticipated geology.	12.	Knowledge of the advantages and disadvantages of various drilling methods for different geologic settings.
		57.	Knowledge of geologic logging methods.

II. DATA COLLECTION (17%): This area assesses the candidate's knowledge of surface and subsurface exploration. It includes documentation of groundwater conditions.			
Job Task		***Associated Knowledge Statement***	
31.	Assess current conditions and site features in the field.	29.	Knowledge of field evidence of land modification and past use.
		61.	Knowledge of site reconnaissance and field mapping techniques.
32.	Examine water resource boundaries and zones.	136.	Knowledge of the effects of boundary conditions on water levels during pumping.
33.	Evaluate the physical condition and construction of existing wells.	186.	Knowledge of procedures for well maintenance and rehabilitation.
34.	Evaluate lithology, stratigraphy, structure, changes in moisture, water levels, flow, and other properties based on field observations to interpret groundwater conditions.	41.	Knowledge of the relationship between geologic formations and their respective hydrostratigraphic units and characteristics.
		72.	Knowledge of techniques and equipment to measure water level in wells.
		86.	Knowledge of techniques to measure groundwater flow rates.
		89.	Knowledge of the limitations of field screening techniques for soil and groundwater samples.
35.	Map hydrogeologic features.	50.	Knowledge of characteristics of groundwater basins and depositional environments.
36.	Examine hydrogeologic structure from aerial photographs, remote sensing, and historical records.	2.	Knowledge of sources for hydrogeological data.
		26.	Knowledge of geologic and geomorphic conditions depicted in topographic and geologic maps.
		28.	Knowledge of sources for published and unpublished imagery and aerial photographs.
		30.	Knowledge of effects of historical land use on current site conditions.
		58.	Knowledge of interpretive techniques for aerial photographs and remote sensing imagery.

II. DATA COLLECTION (17%): This area assesses the candidate's knowledge of surface and subsurface exploration. It includes documentation of groundwater conditions.			
Job Task		***Associated Knowledge Statement***	
37.	Interpret surface/borehole geophysical and hydrogeologic testing to determine aquifer stratigraphy and characteristics.	60.	Knowledge of borehole geophysical investigation techniques.
		78.	Knowledge of techniques to measure in situ groundwater flow in wells.
		106.	Knowledge of the principles of groundwater flow pertaining to confined and unconfined aquifers under pumping and steady state conditions.
38.	Assess well performance.	43.	Knowledge of principles of well hydraulics.
		73.	Knowledge of techniques to measure well discharge and efficiency.
		80.	Knowledge of well bore storage and skin effects on aquifer test results.
46.	Obtain physical or chemical parameters from the laboratory to determine interaction between vadose zone and groundwater.	31.	Knowledge of the physical properties of chemicals migrating through the vadose zone.
		68.	Knowledge of methods to determine hydraulic properties of saturated and unsaturated earth materials.
48.	Apply quality control standards to the collection of data from well drilling, installation, development, or testing.	62.	Knowledge of procedures to decontaminate drilling equipment and sampling tools.
51.	Prepare boring logs and well construction details to illustrate subsurface conditions.	189.	Knowledge of techniques (e.g., boring logs) to illustrate subsurface conditions.

III. DATA EVALUATION AND FEASIBILITY STUDIES (34%): This area assesses the candidate's ability to interpret data from historic, field, and laboratory sources. It also assesses the candidate's knowledge of evaluating technical and economic feasibility of groundwater projects.

A. Data Interpretation (14%)

	Job Task		*Associated Knowledge Statement*
58.	Examine previous land uses/conditions and recharge/discharge areas from photographs, topographic maps, and other available historical sources.	98.	Knowledge of the effects of natural and human activities on groundwater quality and quantity.
		111.	Knowledge of the effects of human-related modifications on subsurface drainage and groundwater flow conditions.
		152.	Knowledge of land use and groundwater extraction.
59.	Interpret hydrogeologic boundaries, heterogeneity, and/or anisotropy from single- or multi-well tests.	41.	Knowledge of the relationship between geologic formations and their respective hydrostratigraphic units and characteristics.
		45.	Knowledge of principles of groundwater and well hydraulics.
		136.	Knowledge of the effects of boundary conditions on water levels during pumping.
61.	Interpret available subsurface information for hydrogeologic analysis by reviewing existing documents, records, maps, and well logs.	42.	Knowledge of basin hydrostratigraphy and aquifer characteristics.
		77.	Knowledge of the similarities and differences in fractured and porous groundwater flow systems.
		110.	Knowledge of the natural and human-related causes and effects of land subsidence.
		112.	Knowledge of the types and sources of contaminants associated with various categories of land use and industrial processes.
62.	Assess surface water/groundwater interactions.	59.	Knowledge of the interaction between groundwater and surface water.
63.	Prepare hydrologic inventory and water balance.	49.	Knowledge of methods for evaluating changes in groundwater storage.
		134.	Knowledge of techniques and procedures used for water budget evaluations.
64.	Characterize nature and extent of contamination based on analysis of samples.	187.	Knowledge of the standards of practice for site investigation and remediation.
		67.	Knowledge of the classification systems for soil and rock.
67.	Interpret trends from water level and/or quality data.	79.	Knowledge of procedures for assessing background conditions in soil and groundwater.
		92.	Knowledge of statistical methods to evaluate soil or groundwater data.

A. Data Interpretation (14%)			
Job Task		***Associated Knowledge Statement***	
68.	Prepare graphs and illustrations of hydrogeologic data.	76.	Knowledge of graphical and tabular techniques for analysis and presentation of hydrogeologic data.
116.	Assess potential for non-aqueous phase liquids.	184.	Knowledge of procedures for measuring groundwater levels, free product thickness, and field water quality parameters from wells.

B. Data Evaluation (10%)			
Job Task		***Associated Knowledge Statement***	
72.	Analyze infiltration/percolation data to calculate recharge rates and permeability.	190.	Knowledge of procedures for calculating recharge rates and permeability.
73.	Construct flow nets.	132.	Knowledge of methods to construct flow nets.
75.	Calculate hydraulic gradients from potentiometric maps.	125.	Knowledge of methods to determine groundwater flow directions and horizontal and vertical hydraulic gradients.
76.	Calculate hydraulic parameters from aquifer test data.	127.	Knowledge of methods to calculate groundwater flow rate and volume.
		129.	Knowledge of techniques to analyze aquifer test data.
		145.	Knowledge of analytical and numerical methods to determine hydraulic parameters for aquifers.
77.	Calculate fate and transport of contaminants in groundwater or vadose zones.	33.	Knowledge of unsaturated zone and vapor intrusion modeling principles, including chemical and physical properties of modeled constituents.
		34.	Knowledge of groundwater flow and solute transport modeling principles, including chemical and physical properties of modeled constituents.
		56.	Knowledge of the principles of vadose zone transport.
		113.	Knowledge of numerical models, including calibration, sensitivity analysis, and uncertainty analysis.
		115.	Knowledge of the chemical and biochemical transformation of organic and inorganic compounds.
78.	Prepare groundwater level/potentiometric and isoconcentration contour maps.	44.	Knowledge of hydraulic head distribution mapping.
80.	Evaluate hydrogeologic properties of engineered structures (e.g., containment walls, reactive barriers).	176.	Knowledge of hydrogeochemical effects on engineered structures.
82.	Characterize trends (e.g., well yields, water levels) for groundwater aquifer sustainability.	36.	Knowledge of methods for evaluation of available water supply and sustainable yield.
118.	Establish groundwater protection zones.	65.	Knowledge of State and federal laws, regulations, and policies pertaining to groundwater use and protection.
		185.	Knowledge of delineating wellhead protection areas.

C. Feasibility Studies (10%)			
Job Task		***Associated Knowledge Statement***	
83.	Evaluate remedial technology options.	99.	Knowledge of the advantages and disadvantages of soil and groundwater remediation systems.
84.	Estimate time frames for site remediation.	177.	Knowledge of methods to remediate contaminated soil and groundwater.
85.	Develop cleanup goals for soil or groundwater remediation.	105.	Knowledge of guidelines to establish cleanup goals.
86.	Develop criteria for a groundwater control/remediation system.	175.	Knowledge of comparative costs for hydrogeologic portions of remediation alternatives.
88.	Estimate potential impact of water resource development or use.	191.	Knowledge of procedures to estimate impact of water resource, development, or use.
89.	Estimate contaminant levels for risk assessment.	188.	Knowledge of exposure pathways for risk assessment.
90.	Evaluate intrinsic remediation, mass flux, and source zone depletion for remediation time frame estimates.	47.	Knowledge of principles and methods of natural attenuation.
		144.	Knowledge of mass flux calculations.
93.	Evaluate costs and benefits of various remediation (from passive to active) and water supply (from well reconditioning to new well fields) scenarios.	107.	Knowledge of methods to design and perform pilot tests for water supply or remediation.
94.	Evaluate potential impact of groundwater recharge on existing water quality.	153.	Knowledge of techniques to evaluate recharge rates.
95.	Evaluate potential impact of proposed new pumping on seawater intrusion.	109.	Knowledge of the effects of groundwater pumping on confined and unconfined aquifers.

IV. DESIGN, INSTALLATION, and IMPLEMENTATION (13%): This area assesses the candidate's knowledge of the design, operation, maintenance, and destruction of monitoring and water wells. It also assesses knowledge of the design of treatment and production systems.

Job Task		*Associated Knowledge Statement*	
100.	Design, install, and develop monitoring wells and piezometers.	51.	Knowledge of monitoring well (including piezometer) design, construction, development, and testing.
		64.	Knowledge of drilling techniques and construction practices for different types of wells and piezometers.
		160.	Knowledge of well construction materials that minimize impacts on water quality.
101.	Design, install, and develop vertical/horizontal groundwater production wells.	52.	Knowledge of supply well design, construction, development, and testing.
		63.	Knowledge of borehole drilling and well construction techniques to prevent cross-contamination.
		88.	Knowledge of techniques to select a filter pack and screen size based on sieve analysis.
117.	Design, install, and implement well rehabilitation programs.	119.	Knowledge of procedures for well maintenance and rehabilitation.
102.	Design monitoring plans for natural attenuation, aquifers, treatment and production systems, and waste management units.	100.	Knowledge of federal/State requirements pertaining to the investigation, location, and operation of waste disposal and treatment facilities.
		181.	Knowledge of potential impact from long-term land use and water management plans.
106.	Operate and maintain remedial systems.	165.	Knowledge of post-closure monitoring requirements and five-year remedy reviews for project sites.
107.	Develop plans for the destruction of wells and boreholes.	53.	Knowledge of well destruction requirements.
108.	Design dewatering or collection systems.	111.	Knowledge of the effects of human-related modifications on subsurface drainage and groundwater flow conditions.
109.	Design aquifer storage and recovery and/or groundwater replenishment systems.	38.	Knowledge of natural and artificial groundwater recharge.
110.	Design shallow collection systems for source or plume control.	177.	Knowledge of methods to remediate contaminated soil and groundwater.

IV. DESIGN, INSTALLATION, and IMPLEMENTATION (13%): This area assesses the candidate's knowledge of the design, operation, maintenance, and destruction of monitoring and water wells. It also assesses knowledge of the design of treatment and production systems.			
Job Task		***Associated Knowledge Statement***	
113.	Design site remediation systems.	25. 169.	Knowledge of the standards of practice for site remediation. Knowledge of well design criteria for vapor extraction wells.
115.	Design monitoring well networks to optimize remediation or water supply systems.	130.	Knowledge of methods to design well fields for groundwater production.