OREGON WATER RESOURCES DEPARTMENT

Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem Oregon 97301-1266
(503) 986-0900
www.wrd.state.or.us

Water Supply Well Constructor Exam Study Packet

Thank you for your interest in becoming a licensed Oregon Water Well Constructor. This online Study Packet includes the following:

- Examination Schedule and Directions
- Water Supply Well Constructor Application Form
- Map Reading Fact Sheet
- Classification of Rocks
- Understanding Well Hydraulics
- High Voltage Lines Fact Sheet

The Water Well Constructor examination is held the second Monday of January, April, July and October. To take the exam, you must be at least 18 years old, submit a completed application and pay the $20 exam fee. It is recommended that you submit the application and exam fee prior to the exam to reserve a seat for the exam.

The exam tests the applicant's knowledge of the following:

- Oregon Revised Statute (ORS) Chapter 537, specifically 537.505 through 537.795 and 537.992; and Oregon Administrative Rule (OAR) Chapters 690-200 through 690-230. These documents are available on the Department's website at https://www.oregon.gov/OWRD/programs/GWWL/WCC/resourcesforwellconstructors/Pages/Licensing-Examp-Information.aspx be sure you also download the Water Well Rules Appendices, Tables and Figures;
- Hydrogeology, the occurrence and movement of ground water and the design, construction and development of water supply wells;
- Types, uses, and maintenance of drilling tools and equipment, drilling problems and corrective procedures, repair of faulty water wells, sealing of water wells, and safety rules andpractices;
- Correctly completing the start card and well log;
- Plotting the location of a well using ¼, ¼, township, range and section;
- Identification of different rock types (based on igneous, metamorphic and sedimentary).

If special physical, language or other accommodations are needed, please advise Buffy M Gillis, at 503 986-0856. Contact as soon as possible, but no later than two (2) business days in advance of the exam.

WATER SUPPLY AND MONITORING WELL DRILLER EXAM SCHEDULE & DIRECTIONS

2019 Exam Dates:

- January 14, 2019
- April 8, 2019
- July 8, 2019
- October 14, 2019

All examinations will be held in Conference Room 124 at the Salem Office of the Water Resources Department, 725 Summer St NE, Suite A, Salem, Oregon 97301-1266. Exams start promptly at 9:00 a.m. You are allowed four (4) hours to complete the exam. You may bring a calculator and a straight edge.

From I-5

Take Exit 256 (Market Street). Heading west on Market, go approximately two miles to Summer Street, turn left on Summer Street. Go less than ½ mile to our building. Our building is located on your right between the Department of State Lands and the Employment Building.

Parking

Parking is located along Summer Street and also Winter Street (west side of the building). Parking along Summer and Winter Streets is metered. Please check parking signage for time restrictions. Parking is also available in the Yellow Lot which is located two blocks south of our building for a fee.

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725 Summer Street NE, Suite A
Salem Oregon 97301-1266
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www.oregon.gov/OWRD

Water Supply Well Constructor Application

This Application will become part of your Water Supply Well Constructor's file. Please complete the entire application and return it to the above address with your $20 exam fee prior to the exam date.

Name: ____________________

Mailing Address: ____________________

City:____________________State:__________Zip Code: ____________

Phone:____________County:____________Date of Birth: ____________

Email:____________________

If you require a trainee card, please provide the name and license number of the Oregon bonded Water Well Constructor who will endorse your trainee card:

Name:____________________License #: ____________

If special physical, language or other accommodations are needed, please advise Buffy M Gillis, at 503 986-0856. Contact as soon as possible, but no later than two (2) business days in advance of the exam.

Return with a $20 examination fee to:
Oregon Water Resources Department
Attn: Buffy M Gillis
725 Summer St NE, Suite A
Salem OR 97301-1266
(503) 986-0850

HISTORY OF WATER SUPPLY WELL DRILLING EXPERIENCE

List all periods of employment in the water supply well construction industry. If you need more space you may attach additional pages.

PRESENT OR MOST RECENT EMPLOYER

Company Name: ______________________________

Mailing Address: ______________________________

Telephone Number: ______________________________

Supervisor's Name and Telephone Number: ______________________________

Time Employed: from (month - year)______________to (month - year) ______________

Operator of Drilling Machine (type of drilling machine, number of wells and brief description):

PREVIOUS EMPLOYER:

Company Name: ______________________________

Mailing Address: ______________________________

Telephone Number: ______________________________

Supervisor's Name and Telephone Number: ______________________________

Time Employed: from (month – year)______________to (month - year) ______________

Operator of Drilling Machine (type of drilling machine, number of wells and brief description):

I, hereby **CERTIFY** that the information contained herein is true and complete to the best of my knowledge and contains no misrepresentations or falsifications. I understand any misstatement of material facts may disqualify me from receiving or be cause for revocation of an already issued Oregon Water Supply Well Constructor's License.

Signed______________________________Date: ______________________________

Please print your name: ______________________________

MAP READING FACT SHEET

Township, Range and Section:

Oregon has adopted the official system of land division which is based on measured distances from the Willamette Base Line and the Willamette Meridian. The Willamette Baseline runs east to the Idaho border and west to the Pacific Ocean. The Willamette Meridian runs north to Puget Sound and south to the California border. From these surveyed lines, Oregon is divided into townships six miles square (36 square miles) beginning at the Willamette Base Line numbering north or south and given a range beginning at The Willamette Meridian numbering east and west.

Each township is further subdivided into 36 sections, each containing about one square mile or 640 acres. Sections are always numbered consecutively starting with number one in the upper right hand comer and ending with number 36 in the lower right hand comer. See attached page.

A section is further subdivided by use of a quartering system. A section is divided into four equal parts, which are designated as the Northeast Quarter (NE 1/4), the Northwest Quarter (NW 1/4), the Southwest Quarter (SW 1/4), and the Southeast Quarter (SE 114). Each quarter is divided again into four equal parts and so on. Be aware that some counties use A, B, C, D designations for 1/4 1/4 rather than NE, NW, SW, and SE. The exam will text both methods of well locating. See attached page.

Topographic Maps:

Topographic (or "quadrangle") maps are an essential part of geologic and hydrologic research pertaining to the quantity and quality of groundwater. These maps aid in flood control, soil conservation, and reforestation studies. A good map will aid in describing the correct township, range, section, and quarter- quarter section. A topographic map also portrays the shape ofthe land surface by using of contour lines, roads, buildings, ridges, hills, valley, and river canyons which could be helpful in identifying the drill site.

As you review quadrangle maps it may be beneficial to note any change in the township and/or the range number designation along the margins of the map. Several areas in southern and eastern Oregon have half range and/or half township designations. For this reason, the range numbers at the top and bottom of a topographic map should be compared. The township numbers should also be checked on both the left and right side of the topographic map to be sure of the correct designation. Each township and range number is printed in red ink on the middle section lines of each township and range and are located along the margins of each topographic map.

In locating section lines there are several things that must be remembered. The first is donation land claim boundaries should not be confused with section lines. In most cases, the donation land claim boundaries are irregular lines that often make section boundaries difficult to distinguish. Section numbers can be distinguished from donation land claim numbers by the size of the numerical designation. Sections are numbered from 1 to 36. Any number above 36, designates a donation land claim number.

ONLINE MAPPING AIDS

There are several online site that can be very useful in determining the well location. Following are some of them and what they can be used for.

- http://www.esg.montana.edu/gl/xy-data2.html
  this can be used to convert latitude longitude readings to township, range and section;

- http://www.ormap.net/
  this can be used to obtain tax lot information in Oregon;

- https://www.portlandmaps.com/
  useful for obtaining location information for properties in the Portland metro area;

- https://www.terraserver.com/home
  can be used to convert a street address to a latitude longitude and/or to find a location on a topography map by using a street address, latitude longitude or township, range and section. Once you obtain the latitude longitude you can convert that to a township, range and section by going to the Montana website.

Each Oregon county also has a website. Many county websites have map functions that will give the location information. For example:

- http://www.co.linn.or.us/assessorshomep/maps.htm

- http://www.rlid.org

A section of land = 640 acres/80 chains/320 rods/5280 feet

40 CHAINS

7.92 inches are 1 link
25 links are 1 rod
4 rods or 100 links are 1 chain
A rod is 16.5 feet
A pole is 16.5 feet
A chain is 66 feet or four rods
A mile is 320 rods, 80 chains or 5,280 feet
A square rod is 272.25 square feet
An acre contains 160 square rods
An acre is 208.7 [plus] feet square
An acre is 8 rods wide by 20 rods long, or any two numbers [of rods] whose product is 160
25x125 feet equals .0717 of an acre

(160 ACRES)

40 chains equal 160 rods or 2640 feet

20 CHAINS

(80 ACRES

80 Rods or 1320 feet

10 CHAINS

(20 AC)
40 Rods or 660 Feet

5 Chains
5 Acres
20 Rods or 330 Feet

5 Chains
5 Acres
20 Rods or 330 Feet

(10 AC)

40 Rods or 660 Feet

(40 AC)
80 Rods or 1320 Feet

36	31	32	33	34	35	36	31
1	6	5	4	3	2	1	6
12	7	8	9	10	11	12	7
13	18	17	16	15	14	13	18
24	19	20	21	22	23	24	19
25	30	29	28	27	26	25	30
36	31	32	33	34	35	36	31
1	6	5	4	3	2	1	6

NW NW **B** 40 Ac.	NE NW **A** 40 Ac.	NW NE **B** 40 Ac.	NE NE **A** 40 Ac.
SW NW **C** 40 Ac.	SE NW **D** 40 Ac.	SW NE **C** 40 Ac.	SE NE **D** 40 Ac.
NW SW **B** 40 Ac.	NE SW **A** 40 Ac.	NW SE **B** 40 Ac.	NE SE **A** 40 Ac.
SW SW **C** 40 Ac.	SE SW **D** 40 Ac.	SW SE **C** 40 Ac.	SE SE **D** 40 Ac.

NW	NE
SW	SE

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

CLASSIFICATION OF ROCKS

Following is a description of the three main classes into which rocks are divided:

I. **IGNEOUS:** Rocks formed by the cooling of a molten mass, and therefore, are usually massive. They vary from a glassy to a coarsely-crystalline texture depending upon the rate of cooling of the magma.

EXAMPLES OF IGNEOUS ROCKS:

BASALT	A fine-grained volcanic rock dominated by dark-colored minerals, resulting in a dark gray to black appearance. Gas bubbles are present near the top and bottom of individual flows and contacts are generally marked by cinder beds, thin deposits of sediments, and reddish
CINDERS	Glassy, vesicular ('holey'/bubbly) volcanic fragments ranging from 4 to 32 mm in diameter that fall to the ground in a solid condition. Generally black or red in color. In reporting cinders, describe the color and degree of coarseness, e.g. coarse red cinders, fine black cinders. (Can also be sedimentary in form)
GRANITE	Coarse-grained igneous rock dominated by light-colored minerals. Generally light to dark gray or pinkish in color. Mineral crystals are well developed and are generally even in size.
OBSIDIAN	A black or dark-colored volcanic glass, usually ofrhyolite composition, characterized by conchoidal (a type of rock or mineral fracture that gives a smoothly curved surface) fracture.
PUMICE	A light colored cellular glassy rock. Its color is generally light gray or white and is often so light that it will float on water.
RHYOLITE	Gray, white, red, or purplish in color. Often highly fractured, commonly exhibits flow texture. Contains grains of quartz, mica, and sometimes pumice fragments. Often associated with obsidian flows.
SCORIA	A vesicular cindery crust on the surface of lava flows, the cellular nature of which is due to the escape of volcanic gases before solidification; it is heavier , darker, and more crystalline than pumice.

II. **METAMORPHIC:** Rocks that have been derived from rocks which were originally in another rock grouping by application of heat, pressure or chemically active solutions. Pertaining to an alteration in composition, texture, or structure of rock masses caused by great heat and/orpressure.

EXAMPLES OF METAMORPHIC ROCKS

GNEISS	Granitic appearing rocks with a banded appearance. Generally they are darker in color. Commonly feldspar and quartz rich.
QUARTZITE	A light colored, extremely hard sandstone consisting almost entirely of quartz. Formed by recrystallization of sandstone by regional or thermal metamorphism or cemented by secondary silica.
SLATE	A compact, fine-grained metamorphic rock possessing a very well developed cleavage (can be split into slabs and thin plates). Most slate was f01med by shale. Common in Southwestern Oregon.

III. **SEDIMENTARY:** Rock formed by layers of material that has accumulated and hardened over time. Rocks formed from materials, including debris or organic origin, deposited as sediment by water, wind or ice and then compressed and cemented together by pressure. Sedimentary rocks have a layered appearance.

EXAMPLES OF SEDIMENTARY ROCKS:

CLAY	A detrital (meaning having been broken or eroded from a parent rock) mineral particle of any composition having a diameter less than 11256 mm. An earthy, extremely fine-grained sediment or soft rock composed primarily of clay-size or colloidal particles, having high plasticity and a considerable content of clay minerals.
COBBLE	A rock fragment between 64 and 256 mm in diameter, thus larger than a pebble and smaller than a boulder, rounded or otherwise abraded in the course of aqueous, eolian or glacial transport.
CLAYSTONE	A hardened clay having the texture and composition of shale, but lacking its fine layering or fissility.
CONGLOMERATE	A coarse-grained rock, composed of rounded to subangular fragments larger than 2 mm in diameter derived from pre-existing rock that has been transported and deposited and set in a fine-grained matrix of sand or silt, and cemented with other minerals. Color varies. Hardness varies widely with the degree of cementation.
DIATOMITE	A soft, white to gray, fine-grained rock composed of the tiny shells of diatoms. It has high surface area, absorptive capacity and is chemically stabile. Common throughout many parts of Eastern Oregon.
GRAVEL	An unconsolidated natural accumulation of rounded rock fragments, mostly of particles larger than sand such as boulders, cobbles, pebbles, granules, or any combination of these. The unconsolidated equivalent of conglomerate.
LIMESTONE	Compacted and cemented limy mud, calcareous sand, and/or shell fragments. Thin to thickly bedded. Generally light to dark gray in color. Rock will fizz when weak hydrochloric (Muriatic) acid is put on it.

LOESS	Wind deposited material composed chiefly of silt but may contain subordinate amounts of very fine sand and clay, buff colored. Loess can be found in Northeastern Oregon.
SAND	A detrital particle smaller than a granule and larger than a silt grain, having a diameter in the range of 1/16 to2 mm. A loose aggregate of such particles, most commonly of quartz.
SANDSTONE	A elastic (a clast is a rock or mineral fragment) sedimentary rock composed of grains of sand set in a matrix of silt or clay and more or less firmly united by cementing materials (commonly silica, iron oxide or calcium carbonate); the consolidated equivalent of sand. Buff, yellow, brown, and gray in color.
SHALE	A fine-grained detrital sedimentary rock, formed by the compaction of clay, silt or mud. Ithas a finely laminated structure which gives it a fissility along which the rock splits readily , especially on weathered surfaces. Itmay be red, brown, black, or gray in color.
SILT	A detrital particle finer than fine sand and coarser than clay, commonly in the range of 1/16 mm to 11256 mm. A loose aggregate of rock or mineral particles of silt size, commonly with a high content of clay minerals. Mud or fine earth in suspension in water.
SILTSTONE	An indurated (rock or soil hardened or consolidated by pressure , cementation, or heat) sedimentary rock composed predominantly of silt size grains more or less firmly united by cementing materials (commonly silica, iron oxide, clay or calcium carbonate). Layered, generally gray in color. Having the texture and composition of shale but lacking its fine lamination or fissility.

UNDERSTANDING WELL HYDRAULICS

A well is a subsurface hydraulic structure designed and constructed to allow water to be withdrawn from an aquifer. In an efficient well there is relatively little head loss (drawdown). The following terms are important to the understanding of well hydraulics:

STATIC WATER LEVEL	The depth of the water level in a well when it is not being pumped. It is generally given in feet below the land surface.
PUMPING LEVEL	The depth of the water when it is being pumped. It is generally given in feet below the land surface.
DRAWDOWN	The amount the water level is lowered below the static water level when the well is being pumped.
CONE OF DEPRESSION	The surface of the water table around ta pumped well. Its shape is similar to an inverted cone. It produces the gradient or slope necessary to cause water to flow toward the well.
SPECIFIC CAPACITY	The yield of the well in gallons per minute per foot of drawdown.
ENTRANCE VELOCITY	The velocity of water as it moves through the openings in the casing (perforations) or well screen. It is generally given in feet per second.

ENTRANCE VELOCITY

Velocities greater than 0.3 foot per second may result in turbulence and substantial head loss at the well casing. An efficient well is one where there is little head loss and the pumping level is practically the same as the water level outside the casing. The number of square inches of open area that is required to obtain an entrance velocity of 0.3 foot per second can be approximated by multiplying the pumping rate in gallons per minute by two.
For example, a well that is to be pumped at 300 gallons per minute should have approximately 600 square inches of open are in the well casing. It is assumed that one-half of the open area is blocked with rock particles and is not available for the passage of water. A low entrance velocity also tends to prevent the passage of sand into the well.

WELL DIAMETER

In wells developing water from a thick aquifer, the well diameter is not a large factor in determining the yield of the well. In general, the diameter should be approximately two inches greater than the diameter of the pump bowls. In many cases, it is desirable to design a large capacity well so that it could, if necessary, be equipped with a deep well pump. The well diameter and the amount of the well penetrating into a water-bearing formation, determines the surface area of the well casing that is available for perforating or screening.

PERFORMATIONS ON SCREENS

In constructing a well, it is important to keep an accurate report of the formations encountered. Where a well screen is installed, it is important to obtain samples of the water-bearing formation so that a screen with the proper slot size can be selected. Where the water-bearing formation is relatively thick, a sufficient number of perforations may be placed in the casing to obtain an entrance velocity of 0.3 foot per second. Where the water-bearing formation is thin, however, it is not always possible to place a sufficient number of perforations without constructing a very large diameter well. In such instances, the feasibility of installing a well screen should be considered. Well screen have a much larger percentage of open area per foot than may be obtained by perforating. Well screens may also be used in area where sand created problems.

WELL PENETRATING WATER-BEARING FORMATIONS

In most shallow water table aquifers, there is a marked seasonal fluctuation of the water table. A well-constructed and tested during a time of high water levels may have a yield and specific capacity considerably different from a well-tested during periods of low water levels. In order to obtain the maximum yield, the well should penetrate the entire water-bearing formation, permitting the optimum amount of head (drawdown). This is important in obtaining the maximum yield.

WELL DEVELOPMENT

The development of a well consists of removing fine-grained rock particles from the water-bearing formation immediately adjacent to the well screen or perforations. Well development is accomplished by surging or pumping. It may also be accomplished by using air or high velocity water jets. Well development is one of the most important phases of well construction. It results in greater well efficiency and greater specific capacity. It is very important to the economic operation of wells.

INEFFICIENT WELLS

An easy test to determine an inefficient well is to measure the rate the water level recovered after the well had been pumped for one hour. If over 90 percent of the drawdown produced by pumping is recovered within 5 minutes, it can be concluded that the well is inefficient.
For example, let us assume a well has a static water level of 30 feet prior to pumping. The pump is started and operated for one hour. The pumping level is measured at 120 feet below the land surface. The drawdown is found to be 90 feet. Ninety percent of the drawdown then is 81 feet. A water level recovery of 81 feet would bring the water level up to 39. The pump is then shut off and if the well level recovers to or above the 39 foot depth within 5 minutes, the well is inefficient. An appropriate amount of the drawdown can be attributed to well inefficiency. The amount of water that may drain back during recovery will have a negligible effect as a productive aquifer would absorb this quality of water. The water level in the well, five minutes after the pump has stopped, would be representative of the water level in the aquifer.

MEASURING STATIC AND PUMPING WATER LEVELS

An airline provides an easy method of measuring both static and pumping water levels. In wells where the drawdown is large, one airline may not be suitable for making both measurements. Two airlines may be necessary, one to measure pumping levels and one to measure static levels. An airline consists of a quarter-inch pipe that extends down the well between the pump column and the well casing. The amount of air pressure that can be built up inside the airline, before air starts bubbling out of the bottom, will be indicative of the depth of water standing above the bottom of the airline. The exact depth to the bottom of the airline must be known to obtain an accurate measurement of the water level. A pressure of 1 pound per square inch in the airline is equal to 2.31 feet of water. The pressure is generally measured by a gauge attached to the top of the airline and air pressure is supplied by a tire pump.

High Voltage Lines Fact Sheet

Oregon Administrative Rules
Oregon Occupational Safety
and Health Division

GENERAL REQUIREMENTS S

§1910.303 GENERAL REQUIREMENTS.

(a) Approval. The conductors and equipment required or permitted by this subdivision shall be acceptable only if approved.

437-02 - General No employer shall require or permit any employee to enter or to perform any function in proximity to high –voltage lines, unless danger from accidental contact with said high-voltage lines has been effectively guarded against..

Stat. Auth.: ORS 654.025(2) and 656.726(3).
Hist: OR-OSHA Admin.Order 4-1990, . 1123,go,el.1123/90.
OR-OSHAAdmin.Order 2-1991, .214191,el.4/1/91.

437-002-0322 - Clearance or Safegu ards Required.

(1) The operation, erection, or transportation of any tools, equipment, or any part thereof capable of movement; the handling, transportation, or storage of any materials; or the moving of any building, near high-voltage lines, is prohibited, if at any time it is possible to bring such object within 10 feet of high-voltage lines.

(2) For equipment in transit, on smooth surfaces, the clearance shall be a minimum of 4 feet for voltages less than 50 kV., 10 feet for voltages over 50 kV., up to and including 345 kV., and 16 feet for voltages up to and including 750 kV.

(3) A person shall be designated to observe clearance and give timely warning /or all operations where it is difficult for the operator to maintain the desired clearance by visual means.

(4) The 10-feet requirement shall not be reduced by movement due to any strains impressed upon the structures supporting the high-voltage line and upon any equipment, fixtures, or attachments thereon.

Stat Auth.: ORS 654.025(2) and 656.726(3).
Hist: OR-OSHA Admin.Order 4-1990, . 1123,go, ef.1123/90.
OR·OSHA Admin.Order 2-1991,f. 214191,ef. 4/1191.

437-002-0323 - Warning Signs Required.

The employer shall post and maintain in plain view of the operator on each crane, derrick, power shovel, drilling rig, hay loader, hay stacker, pile driver, or similar apparatus, any part of which is capable of vertical, lateral, or swinging motion, adurable warning sign legible at 12 feet reading "Unlawfultooperate thisequipment within 10 feet of high-voltage lines. "

Stat Auth.: ORS654.025(2) and 656.726(3).
Hist: OR-OSHA Admin.Order 4-1990, . 1123,go, ef.1123/90.
. OR-OSHA Admin. Order 2-1991,f. 214191, ef. 4/1191.