Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem Oregon 97301-1266
(503) 986-0900
www.oregon.gov/OWRD

Application for Well Constructor Exam

This application will become part of you well constructor's file. Please complete the application and return to the above address with the $25.00 exam fee prior to the exam date.

Which exam will you be taking? **Water Supply Well Exam** ☐ **Monitoring Well Exam** ☐

Name: _____

Mailing Address: _____

City: _____ State: _____Zip Code: _____

Email: _____Cell Ph. #:_____Date of Birth: _____

If special physical, language, or other accommodations are needed, please advise Buffy Madrigal-Adams at 971-287-8305 or Buffy.M.Madrigal-Adams@water.oregon.gov no later than two (2) business days in advance of the exam.

HISTORY OF WELL DRILLING EXPERIENCE

List all periods of employment in the well construction industry. Additional pages may be added.

PRESENT OR MOST RECENT EMPLOYER

Company Name and Address: _____

Telephone Number: _____

Supervisor's Name and Email: _____

Time Employed: from (month – year) _____to (month – year) _____

Did you operate drilling equipment? Yes ☐ No ☐

Do you have welding experience? Yes ☐ No ☐

Number of wells constructed as an operator: Water Supply#_____Monitoring#_____

Number of wells constructed as a helper: Water Supply#_____Monitoring#_____

If you operated drilling machinery, please indicate **type of drilling machine** operated. Otherwise, please **describe your well drilling experience** in detail.

_____
_____
_____
_____
_____

PREVIOUS EMPLOYER

Company Name and Address: _____

Telephone Number: _____

Supervisor's Name and Email: _____

Time Employed: from (month – year) _____to (month – year) _____

Did you operate drilling equipment? Yes ☐ No ☐

If you operated drilling machinery, please indicate **type of drilling machine** operated. Otherwise, please **describe your well drilling experience** in detail.

_____
_____
_____
_____
_____

I **certify** that all information provided as part of this application is true and correct to the best of my knowledge and contains no misrepresentations or falsifications. I understand that any misstatement of material facts may disqualify me from receiving or be cause for revocation of an already issued Oregon Well Constructor's License.

Signature: _____ Date: _____

Please print your name: _____

Please check the box if your spouse or domestic partner is an active-duty member of the Armed Forces of the United States and is stationed in Oregon: ☐

*Examinations are given the second Monday of **January, April, July, and October**. 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 OR 97301-1266. Exams start promptly at 9:00 am; you are allowed four (4) hours for completion.*

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Water Supply & Monitoring Well Constructor Exam Study Packet

Thank you for your interest in becoming a licensed Oregon Water Well Constructor. This study packet includes the following:

- Examination Schedule and Directions
- Map Reading Fact Sheet
- Oregon Driller's Field Guide
- Classification of Rocks
- Understanding Well Hydraulics
- High Voltage Lines Fact Sheet
- Underground Utility Color code Sheet
- Well report instructions with examples
- Copies of well construction rules and statutes can be found on the Department's *Resources for Well Constructors* webpage.

To take the Well Constructor's (Water Supply or Monitoring Well) exam you must be at least 18 years old, submit a completed application and pay the $25.00 exam fee. It is recommended that you submit the application and exam fee prior to the exam to reserve a seat.

The exam tests the applicant's knowledge of:

- Oregon Revised Statutes (ORS) Chapter 537.505 through 537.795 and 537.992;
- Oregon Administrative Rules (OAR) Chapter 690-200 through 690-230;
- Monitoring Well applicants will be tested on the above listed statutes and Oregon Administrative Rules Chapter 690-240;
- Hydrogeology, the occurrence and movement of groundwater 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 and practices;
- Correctly completing the start card and well log;
- Plotting the location of a well using township, range, section, and ¼ ¼;
- Identification of different rock types (igneous, metamorphic, and sedimentary), including other material types such as sand and gravel.

If special physical, language or other accommodations are needed, please advise Buffy Madrigal-Adams at 971-287-8305 or Buffy.M.Madrigal-Adams@water.oregon.gov. Contact as soon as possible, but no later than two business days in advance of the exam.

Water Supply and Monitoring Well Constructor
Exam Schedule and Directions

The Well Constructor examination is held on the second Monday of January, April, July, and October. All exams are held in **Conference Room 124** at the Salem Office of the Oregon Water Resources Department, located at 725 Summer St., Suite A, Salem OR 97301

The exam begins promptly at 9:00 am and you are allowed four (4) hours for completion. A copy of the rules and statutes will be provided for you to refer to during the exam. The Department will also provide, calculators, pencils and scratch paper. You may NOT use your own notes.

Directions:

From I-5, take Exit 256 (Market Street). Heading west on Market, drive approximately two miles to Summer Street; turn left on Summer St. In less than ½ mile, the building will be on your right. The Water Resources Department is located within the North Mall Office Building between the Department of State Lands and the Employment Building.

Parking:

Parking is located along Summer and Winter (west side of building) Streets. Please check parking signage as there is metered parking, car pool parking (with permit), and 90-minute free spaces. The metered parking accepts debit/credit cards and coin.

Parking is also available in the Yellow Lot located two blocks south of the Water Resources Department.

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 Baseline runs east to the Idaho border and west to the Pacific Ocean. The Meridian runs north to Puget Sound and south to the California border. From these surveyed lines, Oregon is divided into townships. A township measures the distance north or south from the baseline which is a designated parallel. Townships measure six miles in size. Range measures east or west from the meridian. Ranges are also six miles in size. Each square, six miles by six miles, is called a township.

Each township is then further divided into 36 sections, each containing one square mile or 640 acres. Sections are identified with a number based on their position. The northeastern- most (upper right corner) is section 1. They are numbered to the west (left) with the northwestern-most (upper left corner) section in the township being section 6. This snake-like pattern of numbering continues so that the southwestern- most (lower left corner) section is section 31 and the southeastern- most (lower right corner) section is section 36.

A section is further subdivided by the use of a quartering system. A section is divided into four equal parts: the Northeast Quarter (NE ¼), the Northwest Quarter (NW ¼), the Southwest Quarter (SW ¼), and the Southeast Quarter (SE ¼). Each quarter is divided again into four equal parts and so on. Be aware that some counties use A, B, C, D designations for the ¼, ¼ rather than NE, NW, SW and SE. The exam will test both methods of well locating. Please see the attachment located in the study guide.

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 quality map will aid in describing the correct township, range, section, and quarter-quarter section. A topographic map also portrays the shape of the land surface by using contour lines, roads, buildings, rides, hills, valleys, and river canyons which could be helpful in identifying the drill site.

As you review topographical 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 is located along the margins of each topographic map.

In locating section lines there are a few items to consider. First, donation land claim boundaries should not be confused with section lines. The Donation Land Act was a statute enacted in the late 1850 by the US Congress. It was intended to promote homestead settlements in the Oregon Territory. In most cases the donation land claim boundaries are irregular lines that often make section boundaries difficult to distinguish. Section numbers can be differentiated from donation land claim numbers by the numerical designation; sections are numbered from 1-36. Any number greater than 36 designates a donation land claim number.

Online Mapping Tools:

There are several online sites that can be useful in determining the well location and township range, section, ¼, ¼ (TRS, QQ/Q):

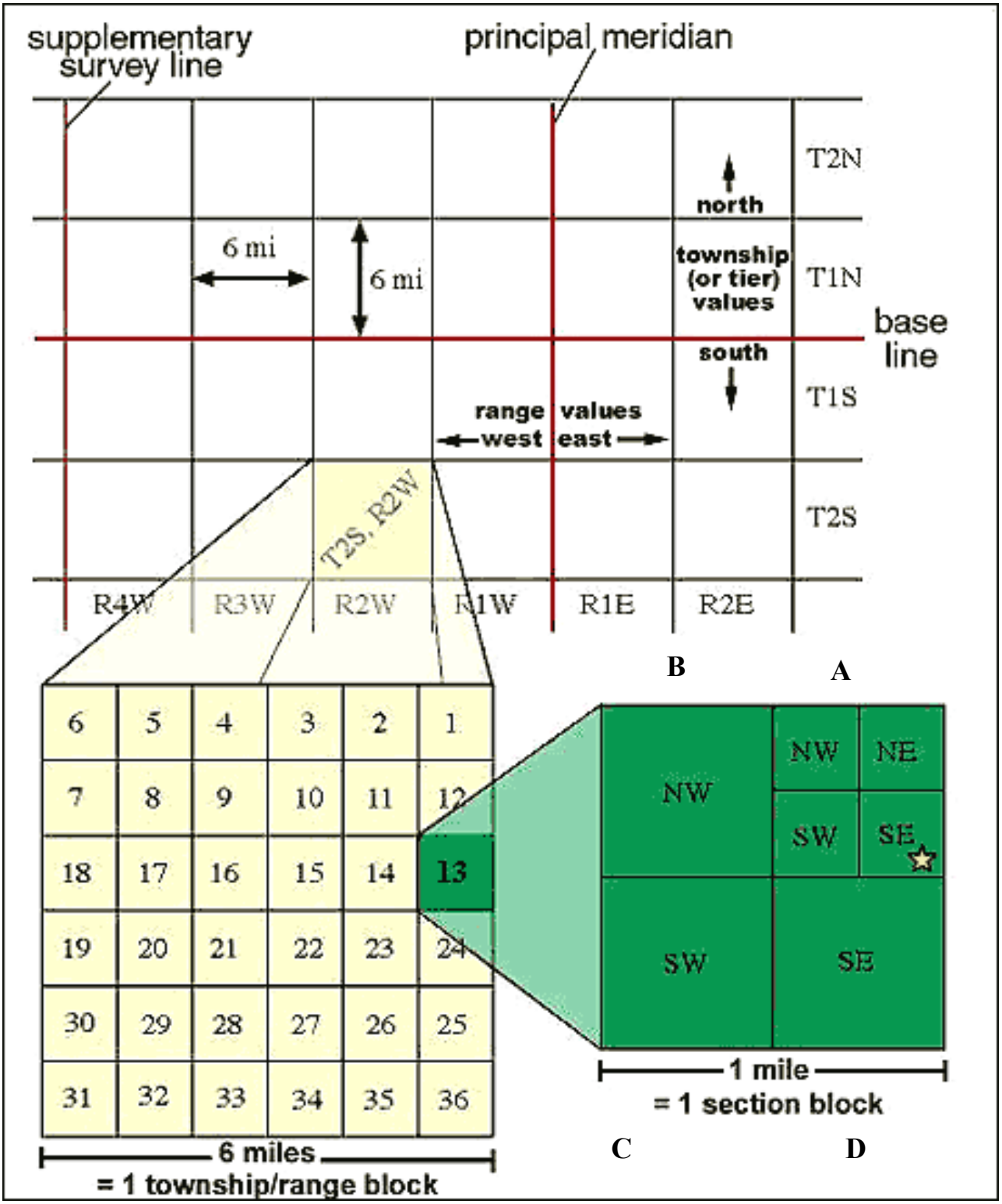
Resources	Web Address	Use
OWRD Water Right Mapping Tool	https://apps.wrd.state.or.us/apps/gis/wr/Default.aspx	To find TRS, QQ/Q
OWRD Location Information Lookup	http://apps.wrd.state.or.us/apps/misc/lkp_trsqq_features/default.aspx	To find TRS QQ/Q with GPS coordinates
OR Map	http://www.ormap.net/	To find Oregon tax lot info
Earth Point	http://www.earthpoint.us/	To find TRS, QQ/Q
Portland Maps	https://www.portlandmaps.com/	To find property info in Portland Metro Area
Marion Co Assessor's Office	https://mcasr.co.marion.or.us/	To find TRS QQ/Q & tax lots in Marion Co

Many county websites have map functions that will give the location information. For example:

Deschutes County: http://dial.deschutes.org/Real/InteractiveMap

Klamath Falls County:
https://kcgis.maps.arcgis.com/apps/webappviewer/index.html?id=664411956da94614a80be24849b74c1b

THE PUBLIC LAND SURVEY SYSTEM POSTER
TOWNSHIP AND RANGE



The above example would be written as follows:

Township 2 South, Range 2 West, Section 13, SE/NE or
2S, 2W, 13, SE/NE

OREGON DRILLER'S FIELD GUIDE FOR SOIL & ROCK FORMATIONS

1/16TH

CHECKLIST:

1. Color
2. Grain Size & Soil or Rock Type
3. Moisture Content
4. Marker Beds
5. Drilling Action
6. % Fines
7. Hardness or Density
8. Structures and Definitions

1. Color

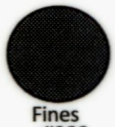
lavender | light brown | reddish brown | yellowish brown | blue-gray | greenish gray | olive gray | light gray | dark gray

2. Sand Grain Size

Coarse Sand

Medium Sand

Fine Sand



Fines <#200

2. Grain Size & Soil Type (According to Unified Soil Classification System)

COARSE-GRAINED SOILS

More than 50% of the soil particles are visible to the naked eye

Gravel

	Inches (USCS)		Inches (USCS)
Boulders	>12 in	Coarse	3/4 - 3 in
Cobbles	3 - 12 in	Fine	>1/4 - 3/4 in

Sand

	Inches (USCS)	Screen Slot Size
Coarse	1/8 - 1/4	100-slot +
Medium	1/32 - 1/8	20 - 100 slot
Fine	Visible - 1/32	<20 slot

FINE-GRAINED SOILS

More than 50% of the soil particles are not visible to the naked eye

Silt

Can't roll into 1/8" rod
Doesn't stick to fingerprints
Easy to break when dry

Clay

Can roll into a 1/8" rod
Sticky or sticks to fingerprints
Hard when dry

Particles not visible to the naked eye

Peat or Organic Soil

2. Rock Type

Sedimentary rock: composed of detrital grains, such as siltstone, shale or sandstone; usually rounded

Igneous rock: composed of crystalline groundmass; may have crystal inclusions; grains may be angular

Metamorphic rock: altered sedimentary or igneous rock; typically with warped banding or shiny, scaly texture, light and dark wavy banding

3. Moisture Content

Dry • Moist
Wet or Saturated

4. Marker Beds

Ash or Pumice
Peat • White or Tan layers
Wood • Red or Black Sand

5. Drilling Action

Hard • Heaving • Boulders • Refusal
Chattery • Choppy • Void • Easy

7. Hardness or Density—Rated by Ease of Drilling (Easy, Moderate Effort needed, Hard or Very Difficult)

Density (if silt, sand, gravel): Loose (Easy); Dense (Moderate); Very Dense (Hard)

Hardness (if clayey silt & clay): Soft (Easy); Stiff (Moderate); Hard (Hard)

Strength (if rock): Weak (Moderate to Easy); Moderate (Difficult); Strong (Very Difficult)

8. Structures and Definitions

Bedded: Has layers • **Cemented:** Grains held together by mineral deposits • **Fractured:** Breaks easily along planar surfaces • **Interbedded:** Alternating light and dark layers or alternating grain sizes

Silt or Clay Bound: Grains held together by silt or clay • **Slickenside:** Has polished fracture planes

Till: Hardpan, gravels held in suspension by fines, non-sorted • **Weathered:** Grains decayed into smaller pieces • **Well Sorted:** Particles are similar in size

6. % Fines

Coarse (dark) grains versus fine (white background) grains

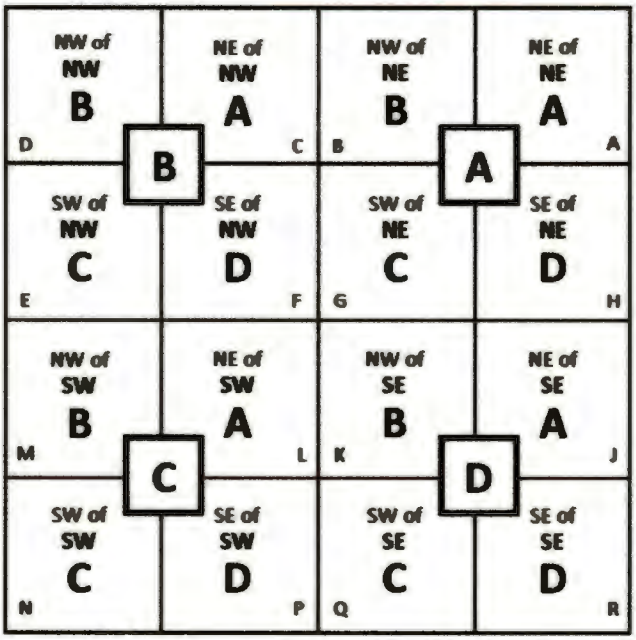
OREGON WATER RESOURCES DEPARTMENT - CONTACT INFORMATION

Main Office: 725 Summer Street NE, Suite A
Salem, OR 97301-1266
Phone: 503-986-0900
Fax: 503-986-0902

Well Construction: 503-986-0852
Well Log searches: 503-986-0854
Well Identification Numbers: 503-986-0854
Groundwater Use Registration: 503-986-0861

District Watermasters:

Dist. 1 Tillamook 503-815-1967 Fax: 503-815-1968
Dist. 2 Springfield 541-682-3620 Fax: None
Dist. 3 The Dalles 541-506-2652 Fax: 541-506-2651
Dist. 4 Canyon City 541-575-0119 Fax: 541-575-0641
Dist. 5 Pendleton 541-278-5456 Fax: 541-278-0287
Dist. 6 La Grande 541-963-1031 Fax: 866-214-3493
Dist. 7 Enterprise 541-426-4464 Fax: 888-572-7936
Dist. 8 Baker City 541-523-8224 x 231 Fax: 866-214-3493
Dist. 9 Vale 541-473-5130 Fax: 541-473-5522
Dist. 10 Burns 541-573-2764 Fax: 541-573-8387
Dist. 11 Bend 541-306-6885 Fax: 541-388-5101
Dist. 12 Lakeview 541-947-6038 Fax: 541-947-6063
Dist. 13 Medford 541-774-6880 Fax: 541-774-6187
Dist. 14 Grants Pass 541-479-2401 Fax: 541-479-2404
Dist. 15 Roseburg 541-440-4255 Fax: 541-440-6264
Dist. 16 Salem 503-986-0889 Fax: 503-986-0903
Dist. 17 Klamath Falls 541-883-4182 Fax: None
Dist. 18 Hillsboro 503-846-7780 Fax: 503-846-7785
Dist. 19 Coquille 541-396-1905 Fax: 541-396-1906
Dist. 20 Oregon City 503-722-1410 Fax: 503-722-5926
Dist. 21 Condon 541-384-4207 Fax: 541-384-2167



Section = 1 square mile (640 acres) **Q** = 160 acres **QQ** = 40 acres

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

Region Offices:

Northwest Region
725 Summer Street NE, Suite A
Salem, OR 97301-1266
Phone: 503-986-0893
Fax: 503-986-0903

Southwest Region
10 S Oakdale, Room 309A
Medford, OR 97501
Phone: 541-774-6880
Fax: 541-774-6187

North Central Region
116 SE Dorion Ave
Pendleton, OR 97801
Phone: 541-278-5456
Fax: 541-278-0287

South Central Region
231 SW Scalehouse Loop, Suite 103
Bend, OR 97702
Phone: 541-306-6885
Fax: 541-388-5101

Eastern Region
Baker County Courthouse
1995 3rd Street, Suite 180
Baker City, OR 97814
Phone: 541-523-8224
Fax: 866-214-3493

Classification of Rocks

The three main classes of rock are igneous, metamorphic, and sedimentary. The differences among them relate to how they are formed.

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 that results in a dark-grey to black appearance. Individual flows may exhibit gas bubbles near the top and rubbly textures near the bottom. Contacts are generally marked by cinder beds, thin deposits of sediments, and reddish bake zones.

CINDERS: Glassy, vesicular (a texture characterized by a rock being pitted with many cavities known as vesicles), volcanic fragments ranging from 4 to 32 mm in diameter that fall to the ground in a solid condition. In reporting cinders, describe the color (generally red or black) and degree of coarseness, e.g. coarse red cinders, fine black cinders (can also be interbedded with sediments).

OBSIDIAN: A black or dark-colored volcanic glass that forms when molten rock material cools so rapidly that the atoms are unable to arrange themselves into a crystalline structure. Also characterized by conchoidal fractures.

PUMICE: A light-colored porous rock that forms during explosive volcanic eruptions. Many specimens have a high enough porosity that they can float on water until they slowly become waterlogged.

RYOLITE: Usually pink or gray in color, rhyolite is made up of primarily quartz and plagioclase. Trapped gases can produce cavities in the rock that can contain crystals, opal, or glassy material. Often associated with obsidian flows.

SCORIA: A vesicular, cindery crust on the surface of lava flows, typically having a frothy texture. It is heavier, darker and more crystalline than pumice. Unlike cinders, scoria is typically partially molten when deposited resulting in a cohesion of particles.

II. Metamorphic: Rocks that started out as some other rock type but have been substantially

changed from their original igneous, sedimentary or earlier metamorphic form. Metamorphic rocks form when rocks are subjected to high heat, high pressure, hot mineral-rich fluids or a combination of these factors.

Examples of Metamorphic Rock:

GNEISS: Very hard. Formed by the metamorphosis of granite or sedimentary rock. While gneiss is not defined by its composition, most specimens have bands of feldspar and quartz grains in an interlocking texture.

QUARTZITE: A light-colored, extremely hard sandstone consisting almost entirely of quartz. It forms when quartz-rich sandstone is altered by the heat, pressure, and chemical activity of metamorphism.

SLATE: A compact, fine-grained metamorphic rock that is formed by the alteration of shale or mudstone by low-grade regional metamorphism. Slate is composed mainly of clay minerals or micas. Slate will 'ring' when struck, unlike mudstone or shale which makes a dull 'thud'.

III. Sedimentary: Rocks that are formed from sediment grains deposited by water, wind or ice. They are always formed in layers, called "beds" or "strata". They may also preserve signs of life and surface activity, such as fossils, tracks, and ripple marks.

CLAY: The term "clay" is applied both to materials having a particle size of than 2 micrometers and to the family of minerals that has similar chemical compositions and common crystal characteristics. Clay minerals all have a high affinity for water.

COBBLE: A clast (composed of fragments of pre-existing minerals and rock) of rock defined as having a particle size of 64-256 millimeters. Cobbles are larger than pebbles (4-64 mm) in diameter and smaller than boulders (256-4096 mm).

CLAYSTONE: A hardened clay that is composed primarily of clay-sized particles (< 1/256 mm in diameter) which have become cemented into a hard rock.

CONGLOMERATE: A clastic rock that contains large (> 2mm in diameter) rounded clasts. The space between the clasts is typically filled with smaller particles and/or a calcite or quartz cement that binds the rock together.

DIATOMITE: A chalk-like, soft, earthy, very fine-grained rock, usually light in color, composed of the tiny shells of diatoms. It's very finely porous and very low in density. It is 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. Gravel is the unconsolidated equivalent of conglomerate.

LIMESTONE: Composed primarily of calcium carbonate in the form of the mineral calcite. It most commonly forms in clear, warm, shallow marine waters.

LOESS: A clastic rock with predominately silt-sized sediment that is formed by the accumulation of wind-blown silt. Loess can be found in Northeastern Oregon.

SAND: A granular material that is defined by having a diameter of 1/16 mm to 2 mm. Sand can be composed of mineral material such as quartz, orthoclase or gypsum; organic material such as mollusk shells, or coral fragments; or rock fragments such as basalt, pumice or chert.

SANDSTONE: Is composed of sand-size grains of mineral, rock, or organic material. It also contains a cementing material (commonly silica, iron oxide or calcium carbonate) that binds the sand grains together.

Understanding Well Hydraulics

A well is a subsurface hydraulic structure designed and constructed to allow water to be withdrawn from an aquifer. 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 land surface.

Pumping Water Level: The depth of water level in a well when it is being pumped. It is generally given in feet below land surface and is recorded along with the elapsed time of pumping as it will increase with the amount of time the well is pumped.

Drawdown: The difference between the static water level and the pumping water level. It is generally given in feet and is recorded along with the elapsed time of pumping as it will increase with the amount of time the well is pumped.

Cone of Depression: The change in shape of the surface of the water table around a 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: A measure of the yield of the well normalized to draw-down. Typically measured in gallons per minute per foot of drawdown. It is recorded along with the elapsed time of pumping as it will decrease with the amount of time the well is pumped. Changes in specific capacity over time (that is, the results of specific capacity measurements made several years apart) can show changes in efficiency over time.

Well Efficiency: The difference between the pumping water level measured inside the well and the water level in the aquifer just outside the well, as a proportion of total drawdown. Can be measured during pumping tests with 2 or more observation wells, but can be inferred from Reductions in measured specific capacity over time.

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. 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 between the aquifer and the well and the pumping water level is practically the same as the water level just 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 2. For example, a well that is to be pumped at 300 gallons per minute should have approximately 600 square inches of open area in the perforated portion of the well casing or the screen. 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 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.

Perforations/Screens:

In constructing a well it is important to keep an accurate report of the formations encountered. Where a well screen is installed or perforations made in the casing, it is important to obtain samples of the water-bearing formation so that 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 less than 0.3 foot per second or less. 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 screens have a much larger of percentage of open area per foot than may be obtained by perforating. Well screens may also be used in areas where sand creates problems.

Well Penetrating Water Bearing Formations:

In most shallow water table aquifers, there is a marked seasonal fluctuation of the water table. A well that is 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 maximum amount of available 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 over-pumping. It may also be accomplished by air-lifting 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 especially important to the economic operation of the well.

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 or compressed air cylinder with regulating gage.

The precision of airline measurements is relatively poor, and dependent on the accuracy and graduations of the gage and the accuracy to which the bottom of the airline is known, all of which should be reported with airline measurements. Analog gage accuracy is rarely better than 1 psi (2.3 feet of water) and can be 5 psi (11.5 feet of water) or more, while modern digital gages may have an accuracy of 0.1 psi (0.2 feet of water) or less. Further, the integrity of an airline can degrade over time and any blockages or breaches will affect the accuracy of the measurement. Airline integrity is not easily observed without removing it from the well, which often entails removing the pump column. Airlines should be routinely replaced and total depth carefully measured and recorded with the date of installation whenever a pump column is pulled for pump maintenance.

Water level measurements using an electrical water level sounder (e-tape) are generally more accurate and precise than airline measurements. E-tapes are generally graduated to allow water level measurement to the nearest $1/100^{th}$ of a foot, the integrity of the tape can be monitored with each measurement, and e-tape measurements are not reliant on knowing total depth of equipment semi permanently installed in the well (as is necessary with airline length). E-tape readings are generally recorded as depth to water below ground surface. Note that all wells are required to have access ports to allow for e-tape measurements. Refer to OAR 690-210-0280. OAR 690-215-0060and OAR 690-507-0640 and -0780. Some wells are additionally required to have dedicated measuring tubes (for example, in the Mosier Area, refer to OAR 690-200-0028).

Oregon OSHA

FACT SHEET Plus

Power line safety – evaluating the work zone

1926.1408
Division 3/CC

Power line safety – evaluating the work zone

If a crane is going to operate within 20 feet of an overhead power line up to 350 kV, do the following:

NOTE: ***Not applicable to utility owner/operators.***

Determine the power line's voltage.
Ask the utility owner or utility operator for the information. Allow two working days for a response.

— 1926.1408 (c)

Use Table A to determine the crane's Minimum Approach Distance (**MAD**) to the power line.

— 1926.1408 (a)(2)(iii)

Table A

Power line voltage – nominal kV, alternating current	Minimum Approach Distance (feet)
Up to 50	10
More than 50 to 200	15
More than 200 to 350	20
More than 350 to 500	25
More than 500 to 750	35
More than 750 to 1,000	45
More than 1,000	See 1926.1408

Once you know the MAD, identify your work zone by either:

A

Mark boundaries at or outside your MAD with items such as flags or range limit/range control warning devices. The operator must not operate the crane beyond those boundaries.

— 1926.1408 (a)(1)(i)

- or -

B

Define the work zone as an area 360 degrees around the crane, up to the crane's maximum working radius, for the actual crane work.

— 1926.1408 (a)(1)(ii)

Can any part of the equipment, load line, or load get closer than 20 feet?

— 1926.1408 (a)(2)

No – nothing else needs to be done.

Yes: **— 1926.1408 (a)(2)**

Employer must follow requirements in one of the options:

Option 1: De-energize and ground – confirm with utility owner/operator. **(i)**
Option 2: Maintain the **20-foot clearance**. **(ii)**
Option 3: Maintain the MAD identified in **Table A**. **(iii)**

If operating up to the equipment's maximum working radius in the work zone, can any part of the equipment, load line, or load get closer than the MAD permitted under Table A?

No – nothing else needs to be done.

Yes:
Follow 1926.1408(b) Preventing encroachment/ electrocution requirements for Options 2 and 3 *(listed on page 2).*

— 1926.1408 (b)

Website:
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Requirements for preventing encroachment.

(1) Conduct a planning meeting.
Meet with the operator and the other workers who will be in the area to review the location of the power line(s), and steps that will be implemented to prevent encroachment.

(2) Non-conductive tag lines
If tag lines are used, they must be non-conductive.

(3) Erect an elevated warning line, barricade, or line of signs, in view of the operator.
The warning line must have flags or similar high-visibility markings at 20 feet from the powerline if using Option (2) or at the minimum approach distance under Table A if using Option (3). If the operator is unable to see the warning line, a dedicated spotter must be used who is in continuous contact with the operator.

(4) Do at least one of the following:

- Use a proximity alarm set to give sufficient warning to prevent encroachment.
- Use a dedicated spotter who is in continuous contact with the operator.
  Dedicated spotter must:
  - Be equipped with a visual aid to assist in identifying the minimum clearance distance, such as clearly visible lines painted on the ground, a clearly visible line of stanchions, or a set of clearly visible line-of-sight landmarks.
  - Be positioned to effectively gauge the clearance distance.
  - Use equipment that enables the dedicated spotter to communicate directly with the operator.
  - Give timely information to the operator so that the required clearance distance can be maintained.
- Use a device that automatically warns the operator when to stop movement, such as a range-control warning device that is set to give the operator sufficient warning to prevent encroachment.
- Use a device that automatically limits range of movement.
- Use an insulating link/device that is installed at a point between the end of the load line (or below) and the load.

Resources:

- Oregon OSHA construction crane rule
  http://osha.oregon.gov/OSHARules/div3/div3CC.pdf
- Oregon OSHA crane publication
  http://osha.oregon.gov/OSHAPubs/4927.pdf
- Cranes and Derricks Federal Register
  https://www.osha.gov/FedReg_osha_pdf/FED20100809.pdf
- Crane Fact Sheet
  http://osha.oregon.gov/OSHAPubs/factsheets/fs37.pdf

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WCC

Water Supply Well Report Instructions

Well Label #L: Enter the well identification label number.
Start Card #: Enter assigned Start Card number.
Original Log #: Enter the original well report number if work is *other than* new construction.
Water Right #: Enter file character & permit number (if applicable).

(1) LANDOWNER: Enter landowner's name and mailing address.

(2) TYPE OF WORK: Check all that apply.

(2a) PRE-ALTERATION: (depth, type of seal, casing, etc.).

(3) DRILL METHOD: Check the appropriate box.

(4) PROPOSED USE: Check all that apply. Community wells serve more than three households.

(5) BOREHOLE CONSTRUCTION:

- ✓ Were Special Standards requested and approved?
- ✓ Indicate depth of the completed well.
- ✓ Describe each change in borehole size or construction
- ✓ Describe seal material, where placed, amount used (sacks/pounds), & method of placement (see OAR 690-210, Appendix 210-3 for seal method descriptions).
- ✓ **If applicable:**
  - Note location and material if backfill was used.
  - Note location and material if filter pack was used.
  - Describe type and amount if explosives were used.

Seal Material Volume: Report both the *calculated* volume of seal material & the actual volume used.
Seal Placement Begin Date & Time: Report date and time seal placement began

(6) Casing/Liner: Describe type of casing and/or liner and location of each. Include information regarding drive shoe or temporary casing if applicable

(7) Perforations/Screens: Describe location, method, and size of perforations. Indicate if perforations are in the casing and/or liner. Describe screen type, material, diameter, location, slot size & if diameter is tele or pipe size.

(8) Well Tests: Include type of well test, yield & duration. Note water temperature and total dissolved solids (TDS).

(9) Location of Well: Indicate the legal description of the well, including township, range, section, ¼, ¼, tax lot number, latitude & longitude, and the street address of well (or nearest address)

(10) Static Water Level (SWL): If this is an existing well, note SWL prior to beginning work in addition to the SWL following work performed.
Water Bearing Zone: Indicate the depth water was first found, date SWL taken, location of all water bearing zones, estimated flow (in psi if flowing).

(11) Well Log: Describe each change in location, including color, texture, grain size & structure of material. Complete one entry for each change of formation, indicating the thickness of each stratum encountered. Note start & end date of construction.
Construction Begin Date & Time and Construction End Date: Accurately complete these fields.
Dates/Signature: Sign and date as appropriate on the well report form.
Exempt Use Well Recording Fee & Map: a map showing the exact location of the well on the tax lot and a one-time recording fee of $300 (check or money order if sending by mail) must accompany all new exempt use well reports (within 30 days after the well is completed).
Paper filed Exempt Use Map Requirements:
Tax Lot Map showing the location of the completed well, including:

- ✓ map reference number (Township, Range & Section).
- ✓ location of the completed well with GPS coordinates or distances (north/south/ and east/west) from an identified property boundary property corner or survey corner. (Multiple wells may be shown on one tax lot map.)
- ✓ the direction of north marked on the map.
- ✓ Well Identification Number for each completed well.
- ✓ street address of completed well (or nearest address).

MONITORING WELL REPORT FORM INSTRUCTIONS

Well Label #L: Enter the well identification label number (well ID tag).
Start Card #: Enter the assigned start card number.
Original Log#: Enter the original well report number if work is *other than* new construction.

1) **Landowner**: Enter Owner Well ID # (assign an identifier for each well in the project). Enter the landowner's name and mailing address.
2) **Type of Work**: Check one. Describe alteration or abandonment procedures in the comment section (page 2 of the monitoring well report).
3) **Drill Method**: Check one.
4) **Construction** (of the borehole): Indicate the depth of the completed well. If Special Standards were used, please check the Special Standard box and attach a copy. If the hole is a Piezometer Well, please check the box. For full descriptions of seal methods, see OAR 690-240-0475 Well Seals.
    - indicate location of the monument/vault
    - indicate diameter of the borehole and depth
    - provide casing information
    - provide liner information (if applicable)
    - indicate type and amount of sealant used and measured weight of the grout slurry as required in OAR 690-240-0475(2)(g)
    - provide screen information
    - report date and time seal placement began

    Complete all blanks as appropriate. If information requested in not applicable, indicate with a line through or N/A.

5) **Well Tests**: Please note the temperature of the water. The amount of Total Dissolved Solids (TDS) with units of measure (ppm, ppb, mg/L) is required on the well report.
6) **Location of Well** (Legal Description): Indicate the location of the well as accurately as possible so that it can be located by other parties in the future. Include township, range, section, QQ/Q and tax lot number. If a tax lot number has yet to be assigned, please use "NONE". If this is a public right-of-way, please use "ROW". Latitude and longitude must be reported on the monitoring well report.

    Attach a site map to the monitoring well report. Map shall include an approximate scale and north arrow.

7) **Static Water Level**: Show the static water level of the completed well. Indicate artesian pressure if applicable. Complete information for the water bearing zones (date, thickness of aquifer, measured SWL).
8) **Well Log**: Describe the color, texture, grain size, and structure of materials. Show the thickness of each stratum and aquifer drilled. There should be at least one entry for each change of formation. Provide construction begin date & time and construction end date.
9) **Sign and date** the well report as appropriate.
10) **Submit** all well reports to the Oregon Water Resources Department within 30 days of completion of work.