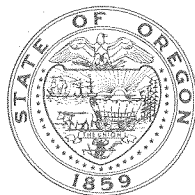


STATE OF OREGON

**RULES AND REGULATIONS
PRESCRIBING
GENERAL STANDARDS FOR THE
CONSTRUCTION AND MAINTENANCE
OF WATER WELLS IN OREGON**



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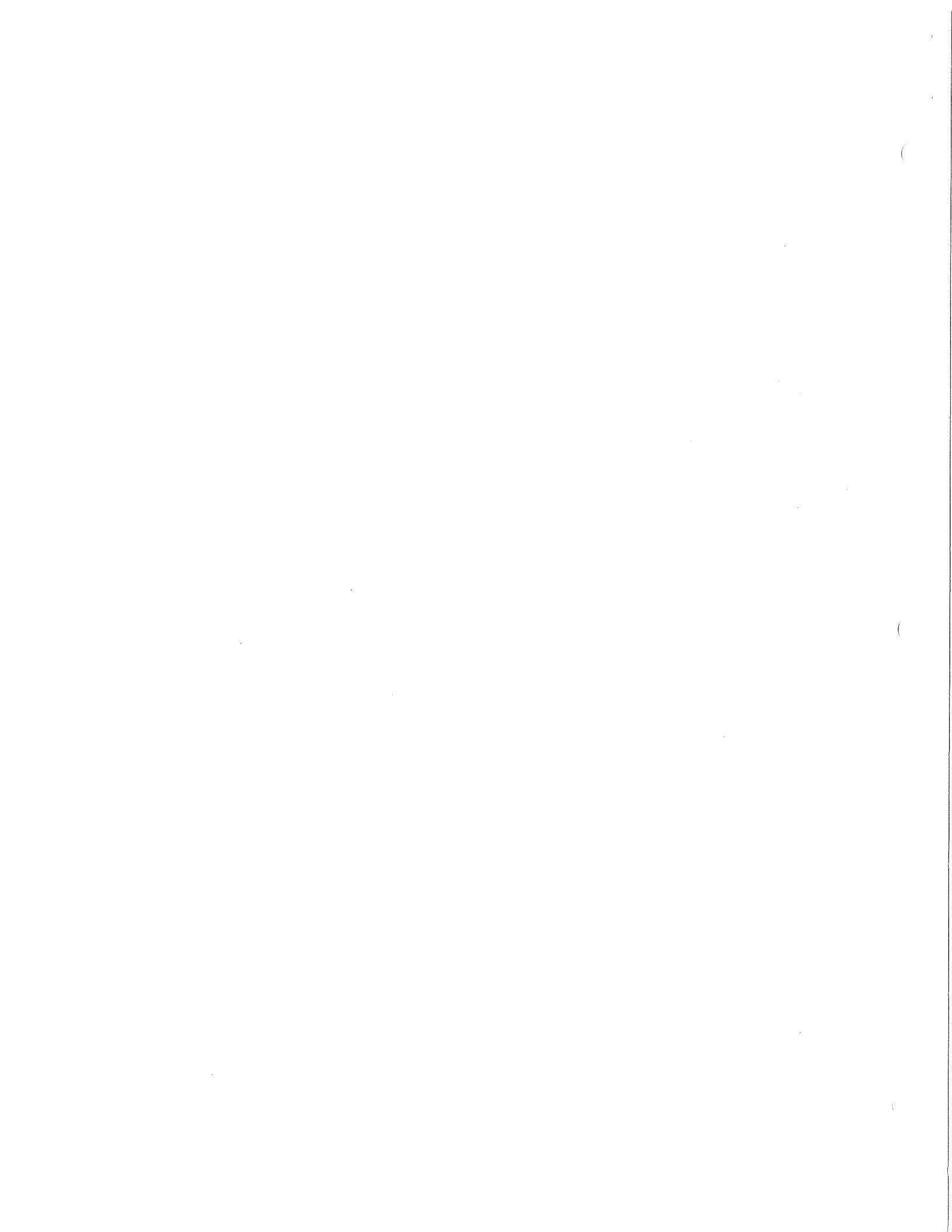
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DIVISION 60

GENERAL STANDARDS FOR THE
CONSTRUCTION AND MAINTENANCE
OF WATER WELLS IN OREGON

60-005 PURPOSE. The right for reasonable control of the ground waters of the State of Oregon has been declared to belong to the public. Through the provisions of the Ground Water Act of 1955, ORS 537.505 to 537.795, the Director of the Water Resources Department has been charged with the administration of the rights of appropriation and use of the ground-water resources of the State and the prevention of waste and contamination of all underground waters.

Under the provisions of ORS 537.780, the Director of the Water Resources Department is authorized to promulgate and adopt such procedural rules and regulations as he deems necessary to facilitate and assist in carrying out his functions in compliance with the Ground Water Law. In fulfillment of these responsibilities and to ensure the preservation of the public welfare, safety, and health, the Water Resources Department has established these rules and regulations as the minimum standards for the construction and maintenance of water wells in Oregon.

The rules and regulations set forth herein shall become effective on January 1, 1979, and were filed with the Secretary of State on December 12, 1978, as Administrative Order WRD 9-1978. All previous rules and regulations prescribing general standards for the construction and maintenance of water wells, or parts of the rules and regulations in conflict therewith, are hereby rescinded.

NOTE: If a well is to be constructed to supply a public or community water system, refer to the Appendix "A" for information regarding regulations pertaining to municipal, public, community, and public utility water supply systems.

60-008 GENERAL STATEMENT. The rules and regulations set forth herein provide the minimum standards for the construction, maintenance, and abandonment of water wells. After the effective date of adoption of these rules and regulations, no water well shall be constructed, altered, or abandoned contrary to the provisions of these rules and regulations. Violation of these standards by a water well contractor and/or drilling machine operator is grounds for suspension or revocation of his license, action against the water well contractor's bond, or may be grounds for legal action against the well owner. Violation of the well construction standards by an individual landowner constructing a well on his own property is grounds for action upon the landowner's water well bond and/or may be grounds for action against the well owner.

Under some circumstances, compliance to the following minimum well standards may not result in a well being free from pollution, or prevent it from being a source of surface or subsurface leakage or contamination for every conceivable well design or geologic setting. Therefore, the water well contractor has the responsibility of providing those safeguards that are needed in addition to the minimum standards to guard against the waste and contamination of ground water. If adherence to these rules and regulations is insufficient to prevent or eliminate ground-water waste and/or contamination, the water well contractor shall request written approval for special standards prior to completion of a well as provided for under Section 60-040.

Every water well shall be designed and constructed to adapt to the existing local geologic and ground-water conditions at the well site and shall fully utilize every natural protection to the ground-water supply.

✓ 60-010 PUBLIC SAFETY. No well shall be constructed, maintained, or abandoned in such a manner as to constitute a public health hazard or a menace to public safety.

60-015 LOCATION OF WELLS. No person, water well contractor, or drilling machine operator shall construct a well within 50 feet of any septic tank, or within 100 feet of any sewage disposal area.

60-025 WELLS CANNOT BE USED FOR DISPOSAL OF POLLUTANTS. No water well, exploration well, or test hole shall be used as a storage place or disposal site for sewage, toxic industrial waste, or other materials that could pollute the ground water.

60-030 INJECTION WELLS. No well shall be used for the injection of surface or ground waters, or chemically or thermally altered waters, unless the injection installation, well design, and receiving formations are approved by the Water Resources Department.

60-035 DRILLING MACHINE IDENTIFICATION. A water well contractor shall conspicuously display in permanent, legible figures his water well contractor's license number on each side of all well drilling machines operated, controlled, or temporarily supervised by him within the State of Oregon. All figures shall not be less than four (4) inches in height, a minimum one-half ($\frac{1}{2}$) inch line, and of a contrasting color to the background upon which the numbers are placed.

In all cases, the license number of the water well contractor shall be removed from the drilling machine immediately upon change of ownership or change of control of the drilling machine. Good quality paint or commercial decal numbers shall be used in placing each identification number on the drilling rig. In no case shall the contractor's license number be inscribed with crayon, chalk, marking keel, pencil, or other temporary markings.

60-040 SPECIAL STANDARDS. If unusual conditions occur at a well site and compliance to the rules and regulations set forth herein will not result in a satisfactory well or protection of the water supply, the water well contractor or landowner constructing the well shall request that special standards be prescribed for the particular well. The request for special standards shall be in writing and shall include:

- (1) the purpose of well construction
- (2) the location of the well
- (3) the name and address of the owner
- (4) the distance to the nearest well and septic drainfield
- (5) the unusual conditions existing at the well site
- (6) the reasons that compliance to the rules and regulations for minimum standards will not result in a satisfactory well
- (7) the proposed standards that the water well contractor or landowner constructing the well believes will be adequate for his particular well, and
- (8) a diagram showing the pertinent features of the proposed well design and construction.

If the Director of the Water Resources Department finds that the proposed construction will result in adequate protection of the public waters, he may approve the proposed construction by prescribing special standards for the particular well under consideration.

60-045 SPECIAL AREA STANDARDS. If in the course of investigating the ground-water resources of the State of Oregon, the Director of the Water Resources Department finds that special standards are required for the development of ground water from any particular ground-water reservoir or area, special standards for the construction and maintenance of wells within such areas may be prescribed.

60-050 DEFINITIONS.

- (1) Abandonment - of a well means to remove a drilling machine from a well site prior to or subsequent to completing or altering the well, or to remove a well from service.
- (2) Access Port - an opening in the upper terminus of a well casing in the form of a tapped hole and plug or a capped pipe welded onto the casing to permit entry of water-level measuring devices into the well.

- (3) Airline - a water level measuring device consisting of a pressure gauge attached to an airtight one-fourth ($\frac{1}{4}$) inch line or pipe extending from land surface within the well bore of a well to below the pumping level so that the water level may be computed by measuring the stable air pressure remaining in the line after completely evacuating water from within the line.
- (4) Altering - a well means the deepening, reaming, casing, re-casing, perforating, re-perforating, installation of liner pipe, packers, seals, and any other material change in the design or construction of a well.
- (5) Annular Space - means the cylindrical space between the drillhole wall and the outer well casing.
- (6) Aquifer - is a geologic formation, group of formations, or part of a formation that contains saturated and permeable material capable of transmitting water in sufficient quantity to supply wells or springs; the terms water-bearing zone or water-bearing stratum or bed are synonymous with the term aquifer.
- (7) Artesian - is synonymous with confined. An artesian well derives its water from an artesian or confined ground-water body. It is ground water under sufficient head to rise above the level at which it was first encountered whether or not the water flows at land surface. If the water level stands above land surface the well is a flowing artesian well.
- (8) Bored Well - means a well constructed with the use of earth augers turned either by hand or by power equipment.
- (9) Buried Slab Type Well - means a dug well in which well casing is used to case the upper drillhole. A slab, sealed with cement grout, is placed between the upper and lower drillhole, and the remainder of the annulus is filled with concrete.
- (10) Casing - means the outer tubing, pipe, or conduit, welded or screw coupled, and installed in the borehole during or after drilling to support the sides of the well and prevent caving, to shut off water, gas, or contaminated fluids from entering the hole, and to prevent waste of ground water. The term "casing" does not include slotted or perforated pipe, well screens, or liner pipe.
- (11) Casing Seal - means the watertight seal established in the well bore between the well casing and the drillhole wall to prevent the inflow and movement of surface water or shallow ground water in the well annulus, or to prevent the outflow or movement of water under artesian or hydrostatic pressures.

- (12) Clay - means a fine-grained, inorganic material having plastic properties and with a predominant grain size of less than 0.005 mm.
- (13) Community Well - means a well, whether publicly or privately owned, which serves, or which is intended to serve, more than three single residences or other users for the purpose of supplying water for drinking, culinary, or household uses.
- (14) Confining Formation - means the "impermeable" stratum immediately overlying an artesian (confined) aquifer.
- (15) Contamination - denotes an impairment of water quality by chemicals, radionuclides, heat, or biologic life to a degree that may or may not affect the potential or intended use of water.
- (16) Consolidated Formation - means materials that have become firm through natural rock-forming processes. It includes such materials as basalt, sandstone, hard claystone, conglomerate, and granite.
- (17) Domestic Well - means a well used to serve three or less residences for the purpose of supplying water for drinking, culinary, or household uses, and which is not used as a public water supply.
- (18) Drawdown - means the difference in vertical distance between the pumping level and the static water level.
- (19) Drive Point Well - means a well constructed by driving into the ground a drive well-point fitted to the end of a pipe section or series of pipe sections.
- (20) Dug Well - means a well in which the excavation is made by the use of picks, shovels, spades or digging equipment such as backhoes, clam shell buckets, or sand buckets.
- (21) Figure - when used herein refers to an illustration and is made a part of the primary article and section by reference.
- (22) Filter Pack Well - means a well in which the area immediately surrounding the well screen or perforated pipe within the water-producing zone is filled with artificially graded coarser material.
- (23) Jetted Well - means a well in which the drillhole excavation is made by the use of a high velocity jet of water.
- (24) Liner Pipe - means the inner tubing, pipe, or conduit installed inside the well casing or lower well bore, and used to protect against caving formations or to seal out polluted or mineralized water zones.
- (25) Lower Drillhole - means that part of the well bore extending below the surface seal interval in a well.

- (26) Mineralized Water - means any naturally occurring ground water containing an undesirable amount of dissolved chemical constituents.
- (27) Municipal Well - means a well owned by a municipality or nonprofit corporation that may be used as a community or public water supply.
- (28) Perched Ground Water - means ground water held above the regional or main water table by a less permeable underlying earth or rock material.
- (29) Permeability - means the ability of a material to transmit fluid, usually described in units of gallons per day per square foot of cross-section area. It is related to the effectiveness with which pore spaces transmit fluids.
- (30) Pitless Adapter - means a commercially manufactured unit or device designed for attachment to one or more openings through a well casing which will permit water service pipes to pass through the wall of a well casing or extension thereof and prevent entrance of contaminants into the well or water supply.
- (31) Pitless Unit - means a commercially manufactured unit extending the upper terminal of the well casing to above land surface, constructed and installed so as to prevent the entrance of contaminants into the well to which units are attached, and to protect the ground water supply, conduct water from the well, and provide full access to the well and water system parts within the well.
- (32) Pollution - a serious impairment of water quality by chemicals, radionuclides, heat, biologic organisms, or other extraneous matter to a degree that creates an actual hazard to the potential or intended use of water or to the public health and safety.
- (33) Porosity - means the ratio of the volume of voids to the overall volume of the material without regard to size, shape, inter-connection, or arrangement of openings.
- (34) Potable Water - means water which is sufficiently free from biological, chemical, physical, or radiological impurities so that users thereof will not be exposed to or threatened with exposure to disease or harmful physiological effects and which has such other physical properties as to be palatable to humans for drinking purposes.
- (35) Potentiometric Surface - is defined by the levels to which water will rise in tightly cased wells.
- (36) Pressure Grouting - a process by which a cement grout is confined within the drillhole or casing by the use of retaining plugs or packers and by which sufficient pressure is applied to drive the grout slurry into and within the annular space or zone to be grouted.

- (37) Public Health Hazard - means a condition whereby there are sufficient types and amounts of biological, chemical, or physical, including radiological, agents relating to water which are likely to cause human illness, disorders, or disability. These include, but are not limited to pathogenic viruses, bacteria, parasites, toxic chemicals, and radioactive isotopes.
- (38) Public Well - means a well, whether publicly or privately owned other than a municipal well, where water is provided for or is available through the single user for public consumption including, but not limited to, a school, a farm labor camp, an industrial establishment, a recreational facility, a restaurant, a motel, or a group care home.
- (39) Pumping Level - means the level or elevation of the water surface in a well while it is being pumped or bailed.
- (40) Pump Test - means the procedure used to determine the yield characteristics of a water well by installing and operating a pump for an extended period of time.
- (41) Rock Aquifer - means any water-producing formation, group of formations, or part of a formation consisting of consolidated rock. The term in these well standards also includes any water-yielding unconsolidated aquifer that might be interbedded between rock strata.
- (42) Sand - means a detrital material having a prevalent grain size ranging from 2 millimeters to 0.06 millimeters.
- (43) Silt - means an unconsolidated clastic sediment composed predominantly of particles between 0.06 and 0.005 mm in diameter.
- (44) Static Water Level - means the stabilized level or elevation of the water surface in a well not being pumped.
- (45) Stratum - means a bed or layer of a formation that consists throughout of approximately the same type of consolidated or unconsolidated material.
- (46) Surface Leakage - means leakage of surface and/or subsurface water around the well casing.
- (47) Thermal Ground Water - means ground water having a temperature greater than 90 degrees Fahrenheit or 32 degrees Celsius. (The statutes of Oregon delegate to the Department of Water Resources the appropriation and supervision of thermal ground water having a temperature of less than 250 degrees Fahrenheit or 121 degrees Celsius, and occurring within 2,000 feet of the land surface.)
- (48) Unconsolidated Formation - means naturally occurring, loosely cemented, or poorly indurated materials including clay, sand, silt, and gravel.

- (49) Upper Drillhole - means that part of the well bore extending from land surface through the vertical zone in the upper reaches of a well which requires a surface casing seal.
- (50) Water Table - means the upper surface of an unconfined water body, the surface of which is at atmospheric pressure and fluctuates seasonally. The water table is defined by the levels at which water stands in wells that penetrate the water body. Water levels in wells of greater depths may stand above or below the water table depending on the gradient of the ground-water flow system.
- (51) Water Well Contractor - means any individual who enters into or offers to enter into an agreement with another person or public agency to construct or alter a water well.
- (52) Well - means any artificial opening or artificially altered natural opening, however made, by which ground water is sought or through which ground water flows under natural pressure, or is artificially withdrawn or injected, provided that this definition shall not include a natural spring, or wells drilled for the purpose of exploration or production of oil or gas.
- (53) Well Drilling Machine - means any power-driven percussion, rotary, boring, digging, or augering machine used in the construction or alteration of water wells.

Subdivision 1

CONSTRUCTION OF WELLS

61-006 WELL CASING. All casing installed, other than plastic casing set forth in Section 61-031, shall be of steel, in new or like new condition, being free of pits or breaks, and shall meet minimum American Society of Testing Materials (ASTM A-120) specifications for line pipe, for the following sizes:

(Minimum specifications for steel well casing)

Nominal Size (inches)	Outside Diameter (inches)	Wall Thickness (inches)	Weight Per Foot (pounds)
2	2.375	.154	3.56
2½	2.875	.203	5.79
3	3.500	.216	7.58
3½	4.000	.226	9.11
4	4.500	.237	10.79
5	5.563	.244	13.70
6	6.625	.250	17.02
8	8.625	.250	22.36
10	10.750	.250	28.04
12	12.750	.312	41.45
14	14.000	.312	45.68
16	16.000	.312	52.27
18	18.000	.375	70.59
20	20.000	.375	78.60

All casing having a diameter larger than twenty (20) inches shall have a wall thickness of at least .375 inch.

Well casing installed in a well greater than a nominal diameter of ten (10) inches, having a wall thickness of .250 inch and meeting ASTM A-120 specifications must not exceed the following depth limitations:

Diameter	Maximum Depth
12 inches	250 feet
14 - 16 inches	150 feet
18 - 20 inches	100 feet

Steel casings of other ASTM specifications may be considered under the provisions of Special Standards (60-040).

61-011 LINER PIPE. Liner pipe installed through caving formations, or for sealing out water of poor quality, and installed without driving, may be of lighter weight than specified by the table under Section 61-006. Such lightweight pipe shall have a wall thickness equal to or greater than a minimum wall thickness of .188 inch. All liner pipe shall be of steel, in new or like new condition, being free of pits or breaks; or shall be of polymerized vinyl chloride (PVC) type 1220 or 1120, SDR 21 (Class 200), or SDR 26 (Class 160). Liner pipe installed in a well shall extend or telescope at least eight (8) feet into the lower end of the well casing. In the event that more than one string of liner pipe is installed, each string shall extend or telescope at least eight (8) feet into the adjacent larger diameter liner pipe. Liner pipe shall not be permanently fixed to a well casing below land surface except by the use of cement grout, packers, or similar sealing materials, placed in the annular space between the liner and well casing.

61-016 CASING JOINTS (STEEL CASING). All casing joints shall be welded or screw coupled and shall be watertight. If welded casing joints are used, the weld shall be a full penetrating weld at least equal in thickness to the wall thickness of the casing. Welded casing joints shall have a tensile strength equal to or greater than that of the casing.

61-021 TEMPORARY CASING. Temporary outer surface casing used in the construction of a well shall be withdrawn as sealing material is placed.

61-026 CASING SHOE. In all drilled wells, permanent well casing that is driven shall be equipped with a standard drive shoe at its lower end, welded or threaded onto the lower end of the string of casing. The shoe shall have a beveled cutting edge of metal forged, cast, or fabricated for this special purpose.

61-031 PLASTIC CASING. All plastic casing shall be installed only in an oversized drillhole without driving. Such casing shall be of polymerized vinyl chloride (PVC), type 1120 or 1220, SDR 21 (Class 200) or SDR 26 (Class 160), meeting the standards of the "National Sanitation Foundation" and ASTM D-2241-73 and ASTM D-1784-69. The well casing must be clearly marked by the manufacturer showing: nominal size, type plastic material, Standard Dimension Ratio (SDR), ASTM designation, and National Sanitation Foundation seal of certified approval. The

maximum depth to which this plastic casing may safely resist collapsing forces is a function of the "Standard Dimension Ratio" (SDR), i.e., the ratio of the outside diameter to the casing wall thickness. The maximum depths have been computed for readily available SDR and are cited as:

SDR	Maximum Depth
21	150 feet
26	100 feet

NOTE: Plastic casing is not acceptable for use in public, community municipal or public water supply wells. See reference to Health Division regulations in Appendix "A".

61-036 CASING JOINTS (PLASTIC CASING). All casing joints shall be watertight. Either "bell" type or coupling hubs are approved. Hub couplings shall be of material meeting the specifications for plastic casings as stipulated in Article 61-031. Joints shall be made by solvent cement in accordance with manufacturer's directions. Newly assembled joints require careful handling until the initial set has taken place, which varies with the temperature and the pipe size. The following recommended initial set times are from manufacturer's recommendations:

Temperature Range During Initial Set Time	Set Time For Various Pipe Sizes In Hours					
	3"	4"	6"	8"	10"	12"
60° F - 100° F	1/2	1/2	1/2	3/4	3/4	1
40° F - 60° F	2	2	4	4	4	4
0° F - 40° F	6	6	8	10	12	12

NOTE: After the initial set, the joints will withstand the stress of a normal installation. However, considerable care should be employed in handling the string.

61-041 TOP TERMINAL HEIGHT. The casing head or pitless unit of any well shall extend not less than twelve (12) inches above the finished ground surface or pumphouse floor, and not less than twelve (12) inches above the local surface runoff level. No casing shall be cut off below land surface except to install a basement offset or a pitless unit, or during permanent abandonment of a well. The ground surface immediately surrounding the top of the well casing or pitless unit should be graded so as to drain surface water away from the well. The watertight casing of any well to be used for public or community use shall extend not less than twelve (12) inches above the finished land surface or pumphouse floor, and not less than twelve (12) inches above the regional flood level of record.

61-046 CASING OPENINGS. There shall be no opening in the casing wall between the top of the casing and the bottom of the required casing seal except for pitless adapters, measurement access ports, and grout nipples installed in conformance with these standards. In no case shall holes be cut in the casing wall for the purpose of lifting or lowering casing into the well bore unless such holes are properly welded closed and watertight prior to placement into the well bore.

61-051 PITLESS WELL ADAPTERS AND UNITS. Surface seal requirements for well casing set forth herein shall also apply when a pitless adapter or unit is installed in a well and shall cover that sealing interval occupied by the pitless case from the point of casing connection to land surface. A cement grout seal shall not be required within the pitless unit sealing interval. The pitless adapter or unit, including the cap or cover, pitless case and other attachments, shall be designed and constructed to be watertight and prevent the entrance of contaminants into the well from surface or near-surface sources. Pitless units shall be vented to the atmosphere.

NOTE: Pitless well adapters or units are not acceptable for use on public, community, municipal or public utility water supply wells. (See references to Health Division regulation in Appendix "A", II)

61-056 MINERALIZED OR POLLUTED GROUND WATER. All formations which yield polluted or highly mineralized water shall be adequately cased or cemented off so as to prevent pollution or contamination of the overlying or underlying water-bearing zones.

61-059 PERCHED GROUND WATER. Wells drawing from perched ground water will incorporate the drilling construction practices and facilities that will prevent the waste of this type of ground water.

61-061 COMMINGLING OF WATERS. In no case shall wells be constructed to allow commingling or leakage of ground water from different ground-water bodies associated with different geological units. However, ground water entering from different depths in the same geological unit may be combined provided the waters are similar as to potentiometric head, temperature and mineral content.

61-066 EXPLOSIVES. Explosives shall not be detonated inside the well casing or liner pipe except that commercially developed perforators may be used. In no case shall an explosive charge be dropped down a well or used to sever installed well casing or liner pipe.

61-071 UNATTENDED WELLS. All wells when unattended during construction shall be securely covered.

61-076 ORGANIC MATERIALS. Organic materials which foster or promote undesired organic growth shall not be employed in the construction of a water well. This includes but is not limited to brans, hulls, grains, starches and proteins.

61-081 WELL TEST. Every well shall be tested for yield and drawdown for a period of not less than one hour either by bailing, pumping or air testing. Any testing method that does not provide for drawdown measurements during testing is not an accurate or reliable test of yield.

61-086 CEMENT GROUT. Only cement grout sealing material which meets the following requirements shall be used to construct the required casing seal in a water well:

1. Cement Grout - Cement grout used to seal a well shall be composed of a uniformly mixed slurry of Portland cement or High Early Strength Type III Portland cement, and potable water, or High-alumina cement, and potable water mixed in the follow proportions:

<u>Type of Cement</u>	<u>Gallons of Water per Sack of Dry Cement</u>
Portland Cement	4½ to 6
High Early Strength Type III Portland Cement . .	5½ to 6½
High-alumina Cement	4½ to 6

Additives to increase fluidity, reduce shrinkage, or control time of set may be used in a cement grout mixture. Expanding agents such as aluminum powder may be used at a rate not exceeding .075 ounce (1 level teaspoonful) per sack of dry cement. The powder shall not contain polishing agents. The addition of bentonite clay to a grout mixture is permissible but shall not in any case exceed five (5) percent by weight of dry cement. Sand shall not be added to grout seal mixtures. Calcium chloride may be added to a Portland cement grout to accelerate the set but shall not exceed two (2) pounds per sack of dry cement. High-alumina cement and Portland cement of any type shall not be mixed together for use in a water well.

Cement types other than those set forth herein shall not be used as a sealing material in a well except upon written approval of the Director of the Water Resources Department.

61-091 CASING CENTRALIZERS. Well casing to be sealed into an oversize drillhole should be equipped with centering guides to ensure the proper centering of a casing. In all events, casings shall be centered in the sealed interval. Guides should be of steel, at least one-fourth (¼) inch in thickness, evenly spaced in groups of three (3) or four (4) in twenty (20) foot intervals or less. (See Figure 1)

61-096 METHODS OF PLACEMENT OF CEMENT GROUT. Cement grout to be used as a sealing material in a well shall be placed or forced upward from the bottom of the space to be grouted and shall be placed in one continuous operation without significant interruption. (For acceptable methods of procedure, see Appendix "B".)

61-101 RESUMPTION OF CONSTRUCTION FOLLOWING PLACEMENT OF CEMENT GROUT. The time of the final set of the cement grout mixture varies greatly in accordance with cement-water ratio and temperature. Cement grout emplaced in a well for sealing purposes should not be disturbed in any way until the final set of the cement grout mixture. Performance of all cement grout seals shall be the responsibility of the water well contractor and drilling machine operator. Recommended periods of time of final set are:

- If Portland Cement is used 72 hours
- If High Early Strength Type III
Portland Cement is used. 48 hours
- If High-alumina Cement is used 6 hours

61-106 MOVEMENT OF CASING AFTER GROUTING. In no case shall the permanent well casing be moved or driven following the placement and initial set of the cement grout.

61-111 DRILL CUTTINGS OR CHIPS. In no case shall drill cuttings and drill chips be used or allowed to fill, partially fill, or fall into the required sealing interval of a well during the construction or the completion of a well.

61-116 DISINFECTION. Every new, altered, or reconditioned water well including pumping equipment, sand, or gravel used in filter pack wells and a well casing standing above the water table, shall be thoroughly hosed or sluiced with water, and shall be disinfected with a solution containing at least fifty (50) parts per million chlorine before being placed in the well. All water introduced into a well during construction shall be clean and potable. The well and its equipment, including the interior of the well casing, shall be thoroughly swabbed and cleaned to remove all oil, grease, and foreign substances upon completion of the well's construction. Following the completion of a well, and again after the pumping equipment has been installed, a well and its equipment shall be disinfected by thoroughly agitating and mixing in the well a solution containing enough chlorine to leave a residual of twenty-five (25) parts per million throughout the well after a period of twenty-four (24) hours. (See chart Recommendations for Disinfection of Water Wells, Appendix "A".)

61-121 COMPLETION OF WELLS. A water well contractor, drilling machine operator, or landowner constructing his own well shall not remove the drilling machine from a well site unless the drilling machine is immediately replaced by another drilling machine in operating condition prior to:

1. Completion of the well in compliance with Sections 61-006 through 61-241 and a watertight seal, threaded or welded cap placed on the well in accordance with Section 63-005; or
2. Completion of the well in compliance with Sections 61-006 through 61-241 and a pump installed; or
3. Abandonment of the well in compliance with Sections 63-005 through 63-045.

DRILLED WELLS

61-126 SEALING OF WELLS IN UNCONSOLIDATED FORMATIONS WITHOUT SIGNIFICANT CLAY BEDS. Wells drilled into unconsolidated water-bearing strata overlain by unconsolidated materials, such as sand, silt, or sand and gravel, without significant clay beds, shall have a watertight, unperforated well casing extending at least five (5) feet below the top of the water table. If the water table is thirteen (13) feet or less below land surface, a watertight, unperforated, permanent well casing shall extend to a minimum depth of eighteen (18) feet. An upper oversize drillhole, four (4) inches greater in diameter than the nominal diameter of the casing, shall be constructed to a minimum depth of eighteen (18) feet. To prevent caving, a temporary surface casing, at least eighteen (18) feet in length, shall be used throughout the construction of the annular seal space.

The annular space between the permanent well casing and the temporary surface casing or drillhole wall shall be completely filled and sealed from a depth of at least eighteen (18) feet to land surface with cement grout in accordance with Sections 61-086 through 61-111 after the permanent well casing is set into its final position. The temporary surface casing shall be removed as the annular space is filled with cement grout. (See Figure 3)

61-131 SEALING OF WELLS IN UNCONSOLIDATED FORMATIONS WITH SIGNIFICANT CLAY BEDS. Wells drilled into water-bearing strata overlain by unconsolidated deposits of clay, or sand and gravel in which significant interbeds of clay are present, shall have a watertight, unperforated, permanent well casing extending at least five (5) feet into a clay or other impermeable stratum overlying the water-bearing zone. In all cases, an upper oversize drillhole, at least four (4) inches greater in diameter than the nominal diameter of the permanent well casing shall be constructed to this same depth. In the event that the subsurface materials penetrated by the upper drillhole cave, or tend to cave, an outer, temporary surface casing shall be used to case out caving materials throughout the construction of the oversize drillhole. If the clay or other impermeable stratum is thirteen (13) feet or less below land surface, the watertight, unperforated well casing and the upper, oversize drillhole shall extend to a minimum depth of eighteen (18) feet below land surface. If necessary to complete the well, the single, permanent well casing may be extended below the required sealing depth prior to sealing the well with cement grout. If preferred, a smaller diameter casing, perforated liner, or well screen may be installed. The annular space between the permanent well casing and the upper, oversize drillhole shall be completely filled with cement grout in accordance with Sections 61-086 through 61-111 after the permanent well casing is set into final position. The temporary surface casing shall be removed from the well as the annular space is filled. (See Figure 4)

61-136 SEALING OF WELLS IN CONSOLIDATED FORMATIONS. Wells drilled into a water-bearing rock formation overlain by clay, sand, or gravel, or similar materials, shall be constructed in accordance with one of the following methods:

Method 1 - An upper drillhole, four (4) inches greater in diameter than the nominal diameter of the permanent well casing to be installed, shall extend from land surface to at least five (5) feet into sound, uncreviced, consolidated rock below a depth of thirteen (13) feet. Unperforated permanent well casing shall extend to this same depth. The annular space between the casing and the drillhole wall within the rock formation shall be filled with cement grout. The upper annular space between the casing and the drillhole wall shall be filled from land surface to at least five (5) feet into an impermeable clay stratum below a depth of thirteen (13) feet. The annular space between the upper and lower required cement grout sealing intervals shall be filled with an impermeable sealing material or cement grout. (See Figure 5) If necessary to complete the well, a smaller diameter well casing, liner pipe, or well screen may be installed. If cement grout is placed by a suitable pump from the bottom of the casing (Methods A, B, D, Appendix "B"), the upper drillhole diameter may be only two (2) inches larger than the nominal diameter of the casing. (See Figure 5)

Method 2 - An upper drillhole, four (4) inches greater in diameter than the permanent well casing to be installed, shall extend from land surface to at least five (5) feet into an impermeable clay stratum below a depth of thirteen (13) feet. Unperforated, permanent well casing shall extend to and shall be driven into sound, uncreviced, consolidated rock overlying the water-bearing rock formation. A lower drillhole, equal in diameter to the inside diameter of the upper permanent well casing, shall be constructed at least five (5) feet into sound uncreviced rock overlying the water-bearing formation. A smaller diameter casing or liner pipe, at least two (2) inches smaller in diameter than the diameter of the upper permanent well casing, shall extend at least five (5) feet into the lower drillhole and at least eight (8) feet into the overlying permanent well casing. The annular space between the upper oversize drillhole and the permanent well casing, and the annular space between the smaller diameter lower casing or liner pipe and the lower drillhole, shall be completely filled with cement grout in accordance with Sections 61-086 through 61-111 after the permanent well casing and the lower casing or liner pipe are set into final position. (See Figure 6)

Method 3 - An upper drillhole, four (4) inches greater in diameter than the permanent well casing to be installed, shall extend from land surface to at least five (5) feet into an impermeable clay stratum below a depth of thirteen (13) feet. Unperforated, permanent well casing shall extend to and shall be driven into sound, uncreviced, consolidated rock overlying the water-bearing formation. A lower drillhole, at least two (2) inches greater in diameter than the diameter of the upper permanent well casing, shall be constructed at least five (5) feet into sound, uncreviced, consolidated rock by under-reaming methods. The upper permanent well casing shall be lowered to the full depth of the lower oversize drillhole. The annular space between the upper oversize drillhole and the upper permanent well casing, and the annular space between the lower under-reamed drillhole and the permanent well casing, shall be completely filled with cement grout applied under pressure in accordance with the appropriate Methods A, B, C, or D, in Appendix "B". (See Figure 2 and 7)

In all cases, (Methods 1, 2, or 3 above), should materials penetrated by the upper oversize drillhole cave, or tend to cave, an outer temporary surface casing shall be used to case out all caving material throughout construction of the oversize drillhole. The temporary surface casing shall be withdrawn as the annular space is filled with cement grout.

FILTER PACK WELLS

61-141 SEALING OF FILTER PACK WELLS WITH SURFACE CASING. If a permanent surface or outer casing is installed in the construction of a filter pack well, a well bore having a nominal diameter of at least four (4) inches greater than the nominal diameter of the permanent surface casing shall extend from land surface to at least five (5) feet into a clay or other impermeable formation overlying the water-bearing zone. Unperforated watertight casing shall extend to this same depth and the annular space between the well bore and the surface casing shall be filled with cement

grout. If the clay or other impermeable formation is at or near land surface, a minimum of eighteen (18) feet of unperforated casing shall be installed. A watertight, welded, steel plate at least three-sixteenths (3/16) of an inch in thickness shall be installed between the inner production casing and the outer surface casing at the well head. A watertight fill pipe with threaded cap may be installed for the purpose of placing additional filter pack material in the well. (See Figure 8)

61-146 SEALING OF FILTER PACK WELLS WITHOUT SURFACE CASING. If a permanent surface or outer casing is not installed in the construction of a filter pack well, a well bore having a nominal diameter of at least eight (8) inches greater than the nominal diameter of the permanent well casing shall extend from land surface to at least five (5) feet into a clay or other impermeable formation overlying the water-bearing zone. Unperforated watertight casing shall extend to this same depth and the annular space between the well bore and the permanent casing shall be completely filled with cement grout. If the clay or other impermeable formation is at or near land surface, the upper oversize drillhole and unperforated, permanent well casing shall extend to a minimum depth of eighteen (18) feet below land surface. A suitable packer shall be installed in the annular space between the filter pack material and the cement grout seal. A watertight fill pipe with threaded cap may be installed for the purpose of placing additional filter pack material in the well. The outside diameter of the fill pipe shall not exceed one-half the thickness of the cement grout seal surrounding the permanent well casing. (See Figure 9)

SPECIAL ADDITIONAL STANDARDS FOR ARTESIAN WELLS

61-151 ELIMINATION OF LEAKAGE. All artesian wells shall be completed with the seals, packers, and casings that are necessary to eliminate subsurface and/or surface leakage.

61-156 COMMINGLING OF WATER. In no case shall the casing in an artesian well be perforated or the well constructed in a manner that will allow the commingling of water from an artesian zone with other water-bearing zones representing different groundwater bodies. All artesian wells shall be adequately cased and sealed into the confining stratum. Surface or subsurface leakage leading to a water loss or decay of artesian pressures will not be allowed.

61-161 CONTROL VALVES. If a well flows at land surface, the well shall be equipped with a watertight mechanical cap, threaded or welded, and a control valve, so that all flow of water from the well can be completely stopped.

61-166 PRESSURE GAUGE. All flowing artesian wells shall be equipped with a pressure gauge and a petcock valve between the gauge and well casing so that the artesian head can be determined at any time. (See Figure 17)

61-171 WELL TEST. All flowing artesian wells shall be tested for artesian shut-in pressure in pounds per square inch and rate of flow in cubic feet per second, or gallons per minute, under free discharge conditions. This data shall be reported on the well log.

61-176 CONSTRUCTION OF ARTESIAN WELLS. Wells penetrating into an artesian aquifer shall have an upper drillhole four (4) inches greater in diameter than the nominal diameter of the permanent well casing extending at least five (5) feet into the confining formation immediately overlying the artesian water-bearing zone. Unperforated, watertight casing shall extend to this same depth. If the confining formation is at or near land surface, the upper oversize drillhole and watertight casing shall extend to a minimum depth of eighteen (18) feet. The unperforated, permanent well casing shall be grouted into the confining stratum with cement grout. If cement grout is placed by a suitable pump from the bottom of the casing (Methods A, B, and D, in Appendix "B", See Figure 2), the diameter of the upper drillhole may be only two (2) inches larger than the nominal diameter of the casing. If necessary to complete the well, a smaller diameter casing, a perforated liner, or a well screen may be installed. (See Figure 10) In all cases, a sufficient amount of cement grout shall be placed in the well to rise a minimum of thirty (30) feet above the lower end of the well casing or to land surface. The upper annular space shall be completely filled with cement grout from land surface to a depth at least five (5) feet into a clay or other impermeable formation below a depth of thirteen (13) feet. The remainder of the annular space between the upper annular seal and the lower cement grout seal above the artesian zone shall be filled with either an impermeable sealing material or cement grout.

In wells which encounter artesian pressures in the absence of a confining formation, the foregoing requirements of Section 61-176 are not applicable and may be altered by receiving written approval by the Director in accordance with Special Standards Section 60-040.

THERMAL WELL STANDARDS

61-181 CONSTRUCTION OF THERMAL OR HOT WATER WELLS. All thermal or hot water wells having a maximum water temperature of less than 250 degrees Fahrenheit (121 degrees Celsius) and constructed to depths of less than 2,000 feet shall be constructed in conformance with Sections 61-006 through 61-176. The bottom-hole temperature shall be measured and recorded on the water well report.

DRIVEN OR JETTED WELLS

61-186 DRIVE PIPE. All drive point wells or jetted wells shall be constructed with drive pipe meeting the following minimum specifications:

Nominal Size (inches)	Outside Diameter (inches)	Wall Thickness (inches)	Weight Per Foot (pounds)
1½	1.900	0.145	2.72
2	2.375	0.154	3.65
2½	2.875	0.203	5.79
3	3.500	0.216	7.58
3½	4.000	0.226	9.11

Drive pipe greater than three and one-half (3½) inches shall comply with the minimum specifications given in Section 61-006.

61-191 CONSTRUCTION OF DRIVEN OR JETTED WELLS. All drive point wells or jetted wells shall have unperforated, watertight pipe extending a minimum distance of eighteen (18) feet below land surface. An upper drillhole at least four (4) inches greater in nominal diameter than the permanent production pipe shall extend at least eighteen (18) feet below land surface. The annular space shall be filled with cement grout after the pipe is set into final position. (See Figure 11)

NOTE: Wells constructed by the above driving or jetting methods may not produce water of suitable quality for use as public, community, municipal or public utility supplies. (See Appendix "A", II)

DUG WELLS

61-196 CONSTRUCTION OF DUG WELLS. All dug wells greater than twelve (12) feet in depth shall be constructed with a watertight surface curbing extending from a minimum of twelve (12) inches above land surface to a depth of eighteen (18) feet below land surface, or to within three (3) feet of the bottom of the well in the case of wells ranging from twelve (12) to twenty-one (21) feet in depth. Open wells, sometimes called sumps, which exceed ten (10) feet in average diameter are exempt from these construction requirements, but are subject to all the requirements covering the use of the ground water and protection of the quality of the ground water.

NOTE: Wells constructed by the above methods may not produce water of suitable quality for use as public, community, municipal or public utility supplies. (See Appendix "A", II)

61-201 SURFACE CURBING. The surface curbing required in Section 61-196 shall be of concrete, concrete tile, or steel. If concrete is used, the concrete wall thickness shall not be less than six (6) inches. In the case of buried slab type well, well casing meeting the minimum specifications given in Section 61-006 through Section 61-031 shall be used. (See Figure 12)

If precast concrete tile or steel casing are used for the surface curbing, the well diameter to the bottom of the surface curbing shall be eight (8) inches greater than the outside diameter of the tile or steel, and the annular space shall be completely filled with concrete. (See Figure 12)

61-206 BURIED SLAB CONSTRUCTION. In a buried slab type well, the slab shall be at least eighteen (18) feet below land surface and shall be at least three (3) inches in thickness. The slab shall be reinforced to withstand all stresses. The slab shall be sealed with cement grout at least one (1) foot thick, and the well bore backfilled with cement grout or concrete. (See Figure 12)

61-211 CONCRETE. Concrete for use in the construction of a dug well, or for filling the annular space or well bore of a well, shall consist of clean, hard, and durable aggregate, and not less than five (5) sacks of Portland cement per cubic yard of concrete. The maximum diameter of aggregate particles shall not exceed one and one-half (1½) inches, but, in any case, shall not exceed one-fifth (1/5) or twenty (20) percent of the minimum width of the space to be filled. The ratio of coarse aggregate to fine aggregate (Passing No. 4, U. S. Standard Sieve) shall be approximately one and one-half (1½) to one (1) by volume, but, in any case, shall not exceed two (2) to one (1) nor be less than one (1) to two (2).

BORED WELLS

61-216 RULES FOR DRILLED WELLS, FILTER PACK WELLS, OR DUG WELLS APPLY TO BORED WELLS. Sections 61-006 through 61-136; 61-141 through 61-146; and 61-196 through 61-211 apply to all bored wells.

NOTE: Wells constructed by the above boring methods may not produce water of suitable quality for use as public, community, municipal or public utility supplies. (See Appendix "A", II)

DEEPENING OR REPAIR OF WELLS

61-221 CASING. All casing or liner pipe used in the repair or deepening of wells shall meet the minimum standards in Sections 61-006 through 61-046.

61-226 SEALING OF CASING. If in the repair of a drilled well the old casing is withdrawn, the well shall be recased in accordance with the rules set forth in Sections 61-006 through 61-146.

61-231 INNER CASING. If an inner casing is installed to prevent leakage of undesirable water into a well, the space between the two well casings shall be pressure grouted with cement grout so as to prevent the movement of water between the two casings.

61-236 ARTESIAN WELL. If upon deepening of an existing well, an artesian zone is encountered, the well shall be cased and completed as set forth in Sections 61-151 through 61-176.

61-241 DRILLING IN A DUG WELL. In no case shall a dug well be deepened by drilling methods.

Subdivision 2

MAINTENANCE OF WELLS

62-005 PREVENTION OF CONTAMINATION. All wells shall be maintained in a condition whereby they are not a hazard to life or property nor a source of contamination to the ground-water supply.

62-010 VALVES AND CASING ON ARTESIAN WELLS. Valves and casing on all artesian wells shall be maintained in a condition so that the flow of water can be completely stopped when the water is not being put to beneficial use. All casing, liner pipe, and casing seals shall be maintained in a condition that will prevent surface or subsurface leakage of ground water. Valves shall be closed when water is not being put to beneficial use.

62-015 ACCESS PORT OR AIRLINE. The access port or airline on all wells shall be maintained in a condition that will prevent contamination of the water body. Access ports and airlines shall be maintained so that the position of the water table can be determined at any time.

62-020 PRESSURE GAUGE. The pressure gauge and petcock valve required by Section 61-166 shall be maintained so that the artesian pressure can be accurately determined at any time.

Subdivision 3

ABANDONMENT OF WELLS

63-005 TEMPORARY ABANDONMENT. Any well to be temporarily removed from service, temporarily abandoned due to a recess in construction, or any well to be temporarily abandoned before commencing service, shall be capped with a watertight seal, watertight welded steel cap, or threaded cap. In the event that temporary abandonment is to be of a short duration, or less than ninety (90) days from the date of removal of the drilling machine from the well site, a temporary steel cap may be welded to the well casing with at least four (4) separate welds, evenly spaced, each at least one-half ($\frac{1}{2}$) of an inch in length. In all cases, caps shall be of steel or cast iron of at least three-sixteenths ($\frac{3}{16}$) of an inch in thickness.

63-008 CASING, SEALING, AND CAPPING OF TEMPORARILY ABANDONED WELLS. Any well to be temporarily abandoned for any reason shall be capped in conformance with Section 63-005 and shall be cased and sealed in conformance with Sections 61-006 through 61-216.

63-010 PERMANENT ABANDONMENT. Any well that is to be permanently abandoned shall be completely filled in such a manner that vertical movement of water within the well bore, including vertical movement of water within the annular space surrounding the well casing, is effectively and permanently prohibited. All fluids within a well are to be permanently confined to the specific strata in which they were originally encountered.

63-011 ABANDONMENT OF UNCASSED WELLS IN UNCONSOLIDATED FORMATIONS. Uncased wells to be abandoned that extend only into unconsolidated materials shall be completely filled with cement grout or concrete. (See Figure 13)

63-012 ABANDONMENT OF UNCASSED WELLS IN CONSOLIDATED FORMATIONS. Uncased wells to be abandoned that penetrate a water-bearing rock formation shall be filled with concrete or cement grout, or alternating layers of cement grout or concrete and clean gravel throughout the water-producing horizon. A concrete or cement grout plug shall be constructed from the top of the rock formation to a depth of at least twenty (20) feet below the top of the rock formation. The remainder of the well above the rock formation shall be filled to land surface with cement grout or concrete. Plugs of cement grout or concrete, at least three (3) feet in length, shall be placed in non-producing zones between all water-bearing zones. In all cases, a cement grout or concrete plug, at least three (3) feet in length, shall be constructed in a non-producing stratum immediately above the uppermost water-bearing zone. (See Figure 14)

63-013 ABANDONMENT OF CASED WELLS. If the well casing or the liner pipe is not removed during the abandonment of a well, the casing or liner shall be thoroughly ripped or perforated throughout the water-producing zones and throughout all non-producing zones between the aquifers. The annular space between the casing or liner and the drillhole wall shall be effectively and completely filled with cement grout applied under pressure. The remainder of the well shall be filled with cement grout or concrete. Uncased horizons in a cased well to be abandoned shall be filled in accordance with Sections 63-010 through 63-012. The casing of wells to be abandoned may be severed below land surface and removed. (See Figure 15)

63-015 ABANDONMENT OF ARTESIAN WELLS. The flow of artesian wells to be abandoned shall be confined or restricted by cement grout applied under pressure, or by the use of a suitable well packer, or a wooden or cast lead plug placed at the bottom of the confining formation immediately above the artesian water-bearing zone. Cement grout or concrete shall be used to effectively fill the well to land surface. (See Figure 16)

63-016 ABANDONMENT OF FILTER PACK WELLS. Appropriate methods of abandonment of filter pack or gravel enveloped wells, or other wells in which coarse material has been added around the inner casing should be determined individually by the responsible water well contractor. Variance and approval should be obtained from the Director of the Water Resources Department prior to abandonment.

63-021 REMOVAL OF WELL CASING DURING ABANDONMENT. If the casing of a well is removed during abandonment, the well shall be plugged and sealed in accordance with Sections 63-010 through 63-012 and shall be filled with sealing materials as the casing is removed.

63-026 OBSTRUCTIONS. All obstructions or debris which may interfere with effective sealing operations shall be removed from the well to be abandoned.

63-031 CEMENT GROUT. Cement grout for use in abandonment operations shall conform to the requirements of Section 61-086.

63-035 CONCRETE. Concrete for use in abandonment operations shall conform to the requirements of Section 61-211.

63-040 METHOD OF PLACEMENT OF CONCRETE OR CEMENT GROUT. Concrete or cement grout used as a sealing material in abandonment operations shall be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. All such sealing materials shall be placed by the use of a grout pipe, tremie, or by dump bailer in order to avoid segregation or dilution of the sealing materials.

63-045 WATER WELL REPORT. A water well report, fully describing all abandonment procedures, shall be submitted to the Water Resources Department in accordance with ORS 537.765.

APPENDIX A

I. Recommendations For Disinfection of Water Wells

Every newly constructed well or modified well should be assumed to be contaminated by micro-organisms. Before the initiation of use, each well must be thoroughly and carefully cleaned and treated to ensure that all disease carrying organisms are eliminated. Care should be exercised to make certain that all areas of a well come into intimate contact with a solution containing enough available chlorine to completely destroy all harmful bacteria. An initial chlorine concentration of 50 parts per million (ppm) with a residual chlorine requirement of 25 ppm after 24 hours is considered adequate for this purpose. Either domestic laundry bleaches containing sodium hypochlorite, such as Clorox or Purex, or calcium hypochlorite in powder or tablet form (Olin HTH) may be used.

Hypochlorite solutions should be thoroughly mixed throughout the well either by the use of drilling tools, a pump, or by placing a calculated number of HTH tablets at regular intervals on a nylon string and dissolving them in places throughout the well. In all cases, the well casing and pump column standing above the water table should be thoroughly cleaned of all grease and oil and should be carefully washed down with the hypochlorite solution.

The well should be allowed to remain undisturbed after the treatment for a period of 24 hours and then tested for residual chlorine (at least 25 ppm must remain). After successful treatment, all water remaining in the well and supply system should be run to waste and a sample of fresh water from the well tested by the local county sanitarian for bacteriological purity.

SOLUTIONS CONTAINING HYPOCHLORITES

Laundry Bleach

Common domestic laundry bleaches contain from 5.25 percent to 6.00 percent sodium hypochlorite. These amounts are equivalent to approximately 2.5 percent available chlorine or about 25,000 ppm as originally purchased. A one gallon container of liquid bleach mixed with 500 gallons of water will dilute the original solution to approximately 50 ppm available chlorine.

High-Test Hypochlorite Compounds

Calcium hypochlorite (Olin HTH) in powder or tablet form contains about 50 percent active chlorine. One ounce of dry HTH powder mixed with 75 gallons of water will result in a solution containing approximately 50 ppm available chlorine. Eight tablets (1/8 oz.) of HTH are equivalent to one ounce of dry powder or granules.

QUANTITY OF HYPOCHLORITE NEEDED TO PROVIDE
50 PPM ACTIVE CHLORINE IN WELL WATER

1. If using liquid bleaches, the following formula is applicable:

$$\frac{\text{Feet of water in well} \times \text{Gallons per foot}}{62} = \text{Pints of bleach needed}$$

Feet of water = Total depth of well minus static water level multiplied by gallons per foot (See Table I).

2. If using HTH compounds, the following formula is applicable:

$$\frac{\text{Feet of water} \times \text{Gallons per foot}}{75} = \text{Ounces HTH needed}$$

3. If HTH tablets are used:

$$\frac{\text{Feet of water} \times \text{Gallons per foot}}{9} = \frac{1}{8} \text{ Number of oz. tablets needed}$$

TABLE I

CAPACITY OF DRILLHOLE OR CASING

<u>Nominal size (inches)</u>	<u>Gallons per linear foot</u>
2	0.163
4	0.653
5	1.020
6	1.469
7	1.999
8	2.611
9	3.305
10	4.080
11	4.937
12	5.875
14	7.997
16	10.445
18	13.219
20	16.320
24	23.501

II. Additional Requirements by Other State Agencies of Oregon

In the administration of ORS 537.505 to 537.795, the Director of the Water Resources Department has statutory authority under the provisions of ORS 537.780 "to prescribe and enforce general standards for the construction and maintenance of wells and their casings, fittings, valves, and pumps ..." Other agencies of the state have statutory responsibilities that relate either directly or indirectly to the construction and operation of public water supply systems and their source of water supply. These agencies and their responsibilities are listed as follows:

OREGON HEALTH DIVISION 1400 SW 5th Avenue Portland, OR 97201	ORS Chapter 448	Municipal water supply systems. Public water supply systems. Community water supply systems (serving more than three single residents)
OREGON DEPARTMENT OF COMMERCE Labor and Industries Building Salem, OR 97310	ORS Chapter 446	Mobile home park water supply systems.
OREGON PUBLIC UTILITY COMMISSIONER Labor and Industries Building Salem, OR 97310	ORS Chapter 757	Private owners (water supply systems, 200 homes or more).

All wells constructed in Oregon, including those to serve as a source of ground water to municipal, community, public, or public utility water supply systems, must be constructed in accordance with the rules and regulations prescribing general standards for the construction and maintenance of water wells in Oregon (OAR 690-60-005 through OAR 690-63-045). Additional construction standards for water supply systems are required by the above listed agencies. Such rules and regulations generally include the source of water supply to the systems and may affect well construction requirements. Copies of the various agency rules may be obtained by contacting the responsible agency. Water well contractors planning to construct a well as a source of water supply for any of the above systems are requested to contact the responsible agency prior to the beginning of well construction.

Appendix B

I. Recommended Methods of Placement of Cement Grout

Method A - The well bore shall be plugged with a drillable plug or bridge at the lowest point to be sealed. A well casing with a float shoe at its lower end shall be placed in the well and suspended slightly above the point of bearing. A grout pipe shall be run inside the casing to the check valve. The grout pipe shall be connected to a suitable pump and water or drilling fluid shall first be circulated to clear the annular space. Grout shall be pumped through the grout pipe until clean grout completely fills the interval to be sealed. The grout pipe shall then be removed and the cement allowed to set. (See Figure 2)

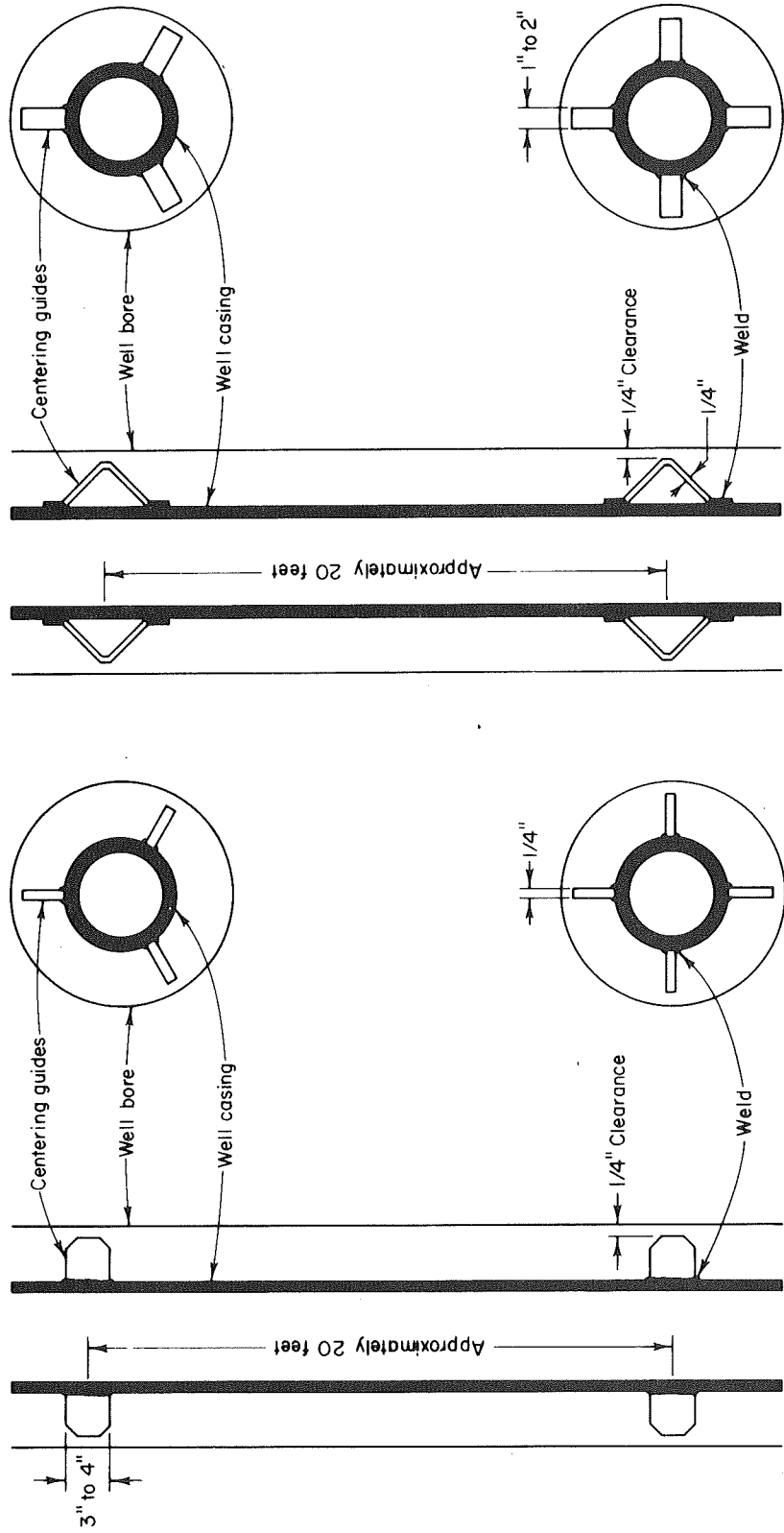
Method B - Grout shall be placed by pumping or air pressure injection through a grout pipe installed inside the casing from the casing head to a point five (5) feet above the bottom of the casing. The grout pipe shall extend through an airtight sealed cap on the head of the well casing. The casing head shall be equipped with a relief valve and the grout pipe shall be equipped at the top with a valve permitting injection. The lower end of the grout pipe and the casing shall be open. Clean water shall be injected down the grout pipe until it returns through the casing head's relief valve. The relief valve is then closed and injection of water is continued to clean the hole until it flows from the bore hole outside the casing to be grouted in place. Without significant interruption grout shall be substituted for water and, in a continuous manner, injected down the grout pipe until it returns to the surface outside of the casing. A small amount of water may be used to flush the grout pipe, but the pressure should remain constant on the inside of the grout pipe and the inside of the casing until the grout has set. Pressure shall be maintained for at least twenty-four (24) hours, or until such time as a sample of the grout indicates a satisfactory set. Neat cement grout shall be used for this procedure with a minimum annular space of one (1) inch completely surrounding the casing. (See Figure 2)

Method C - The wellbore shall be plugged with a drillable packer or bridge at the lowest point to be sealed. The well casing shall be firmly seated at the bottom of the drillhole. A grout pipe shall be run to the bottom of the hole through the annular space between the casing and the well bore. After water or any other drilling fluid has been circulated in the annular space sufficiently to clear obstructions, the grout pipe shall be connected to a suitable pump and grout shall be pumped through the grout pipe until clean grout is circulated to land surface, or until grout completely fills the interval to be sealed. The lower end of the grout pipe shall remain submerged in grout at all times during the period that grout is being placed. The grout pipe shall be withdrawn before the initial set of the grout. (See Figure 2)

Method D - The well bore shall be plugged with a drillable packer or bridge at the lowest point to be sealed. After the casing is run and landed, a casing plug, having a length greater than the diameter of the casing, shall be placed in the casing. If the drillhole is free of mud or water, this lower separation plug may be eliminated. A measured amount of cement grout necessary to completely fill the annular space of the interval to be grouted is pumped or placed by bailer in the casing. A second casing plug, having a length greater than the diameter of the casing, shall be placed in the casing above the grout, and the casing shall be capped with a pressure cap and shut-off valve, and shall be connected to a suitable pump. The casing shall then be raised far enough above the point of bearing to clear the first separation plug. Water or drilling mud shall then be pumped under pressure into the casing forcing the grout and upper casing plug down the casing. A measuring line should be run behind the upper plug so that the position of the plug may be known at all times. A small amount of the grout shall be allowed to remain in the lower end of the casing. When the plug reaches the point desired above the bottom of the casing, the pump shall be stopped and the casing seated. (See Figure 2)

Method E - The well bore shall be plugged with a drillable packer or bridge at the lowest point to be sealed. A sufficient amount of cement grout to completely fill the interval of the well to be sealed shall be placed at the bottom of the drillhole by dump bailer, grout pipe, or tremie pipe. The bottom of the well casing shall be fitted with a tight drillable plug and shall be lowered into the drillhole forcing the grout upward into the annular space. Gravity installation without the aid of a tremie or grout pipe shall not be used. In no instance shall this method be used beyond a depth of thirty (30) feet and in no case for a municipal, community, or public water supply well. (See Figure 2)

CENTERING GUIDES



NOTE: Well casing, to be sealed into an oversize drillhole, should be equipped with a series of centering guides to insure proper centering of casing. Guides should be constructed of steel, at least 1/4" in thickness, evenly spaced in groups of 3 or 4, and welded to the casing.

FIGURE 1

WRC '76

CEMENT GROUT PLACEMENT

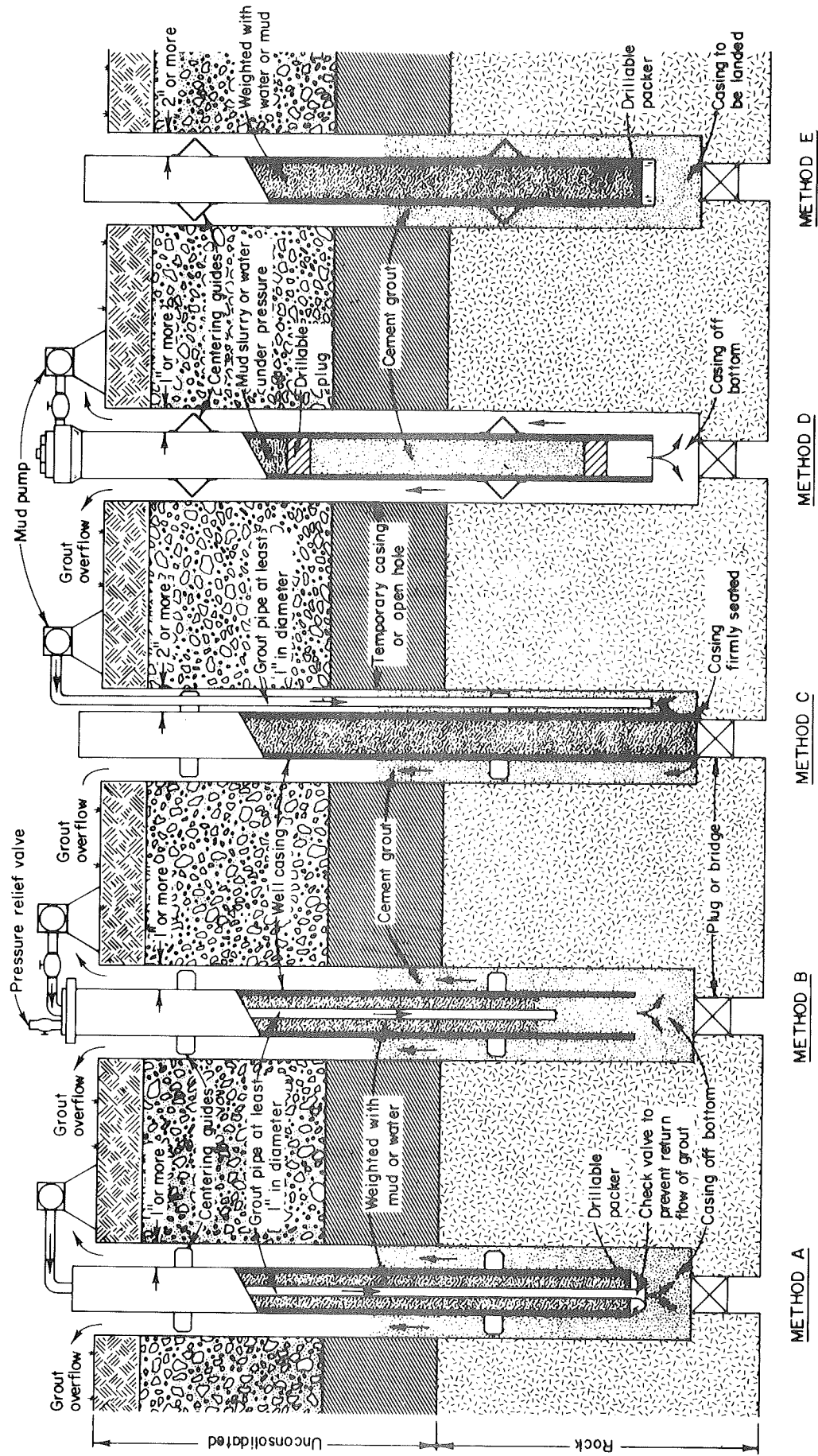
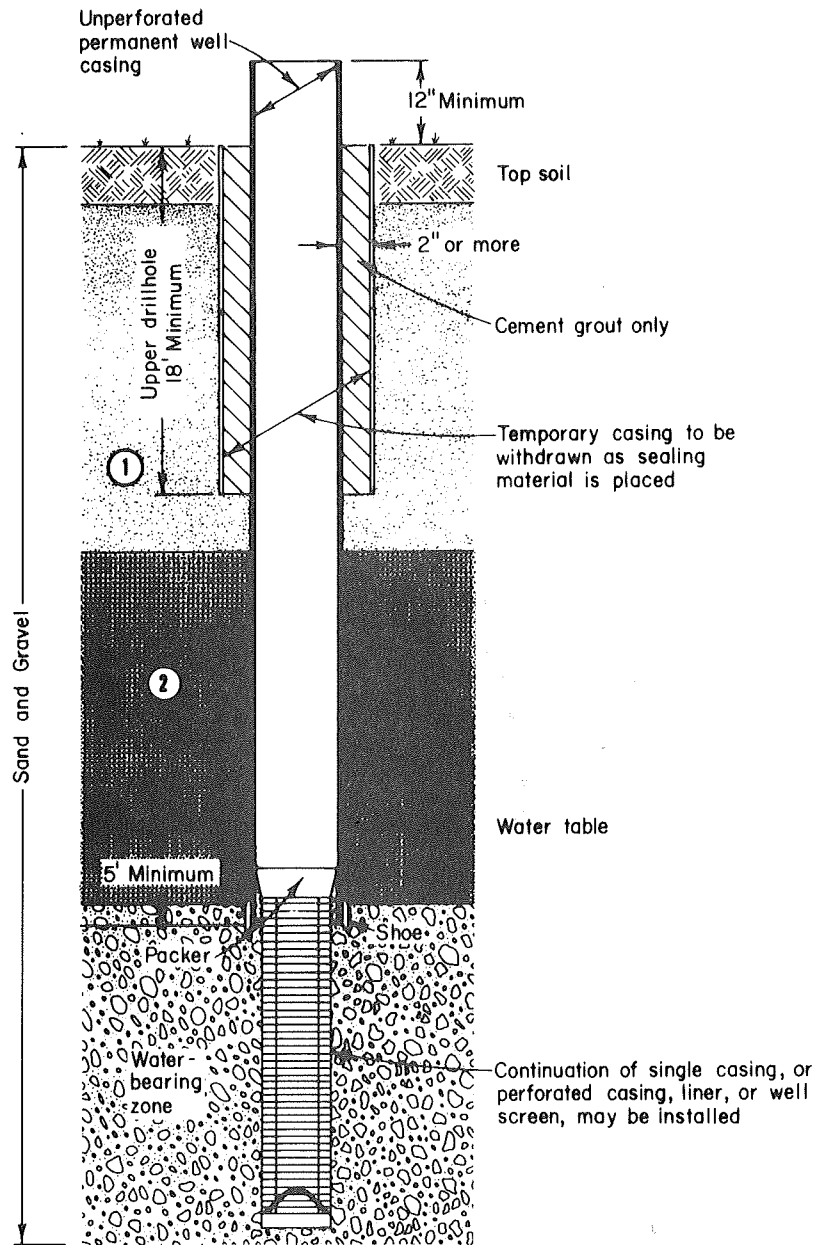


FIGURE 2
WRD 76

SEALING OF DRILLED WELL IN UNCONSOLIDATED FORMATION WITHOUT SIGNIFICANT CLAY BEDS

Overlying Material - Sand and Gravel without Clay
Water-bearing Formation - Sand and Gravel or Similar

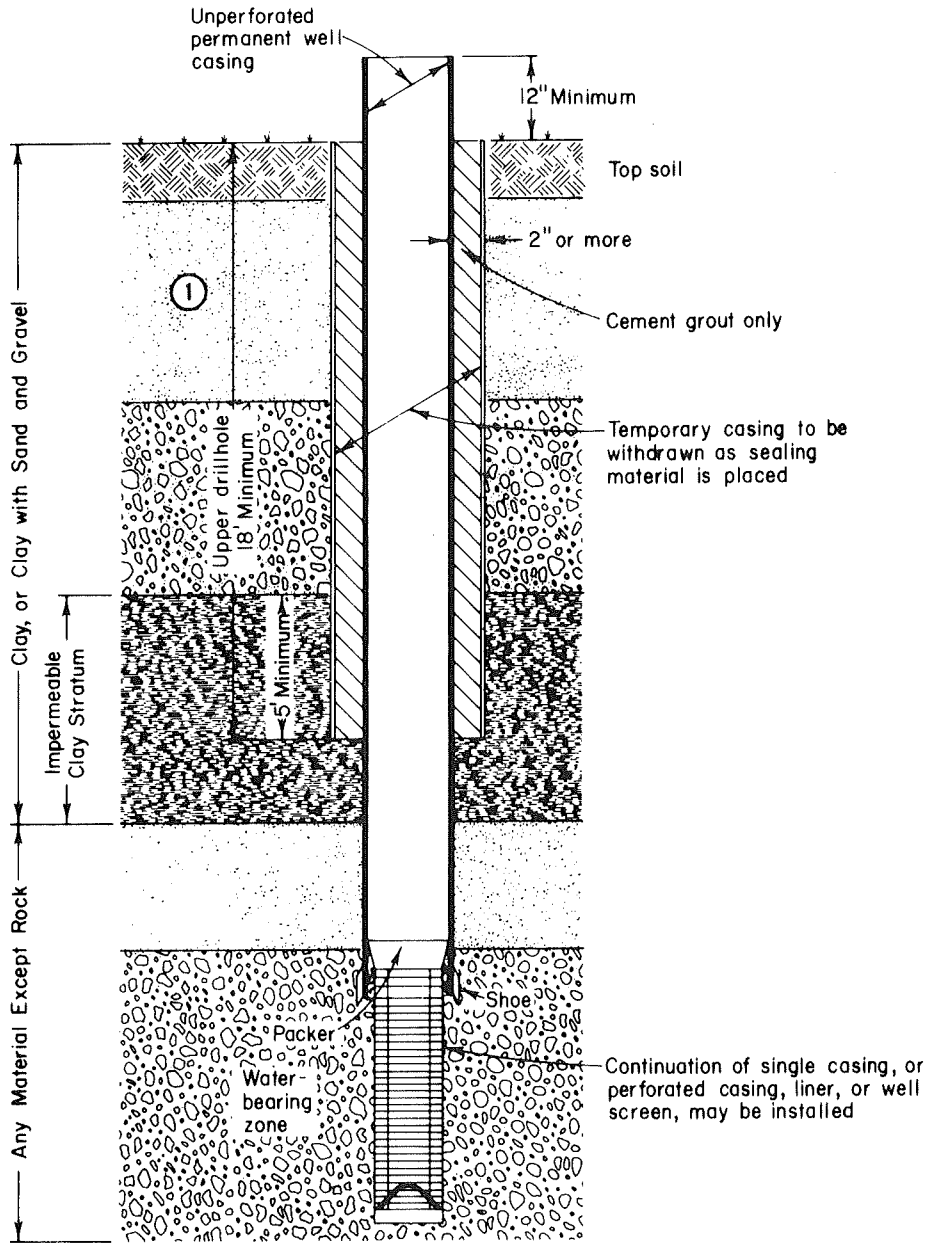


- ① Upper oversize drillhole and annular seal must extend to a depth of at least 18 feet.
- ② Unperforated watertight well casing must extend at least 5 feet below the water table and to a minimum depth of 18 feet.

FIGURE 3

SEALING OF DRILLED WELL IN UNCONSOLIDATED FORMATION WITH SIGNIFICANT CLAY BEDS

Overlying Material - Clay, or Sand and Gravel with Interbedded Clay
 Water-bearing Formation - Any Material Except Rock



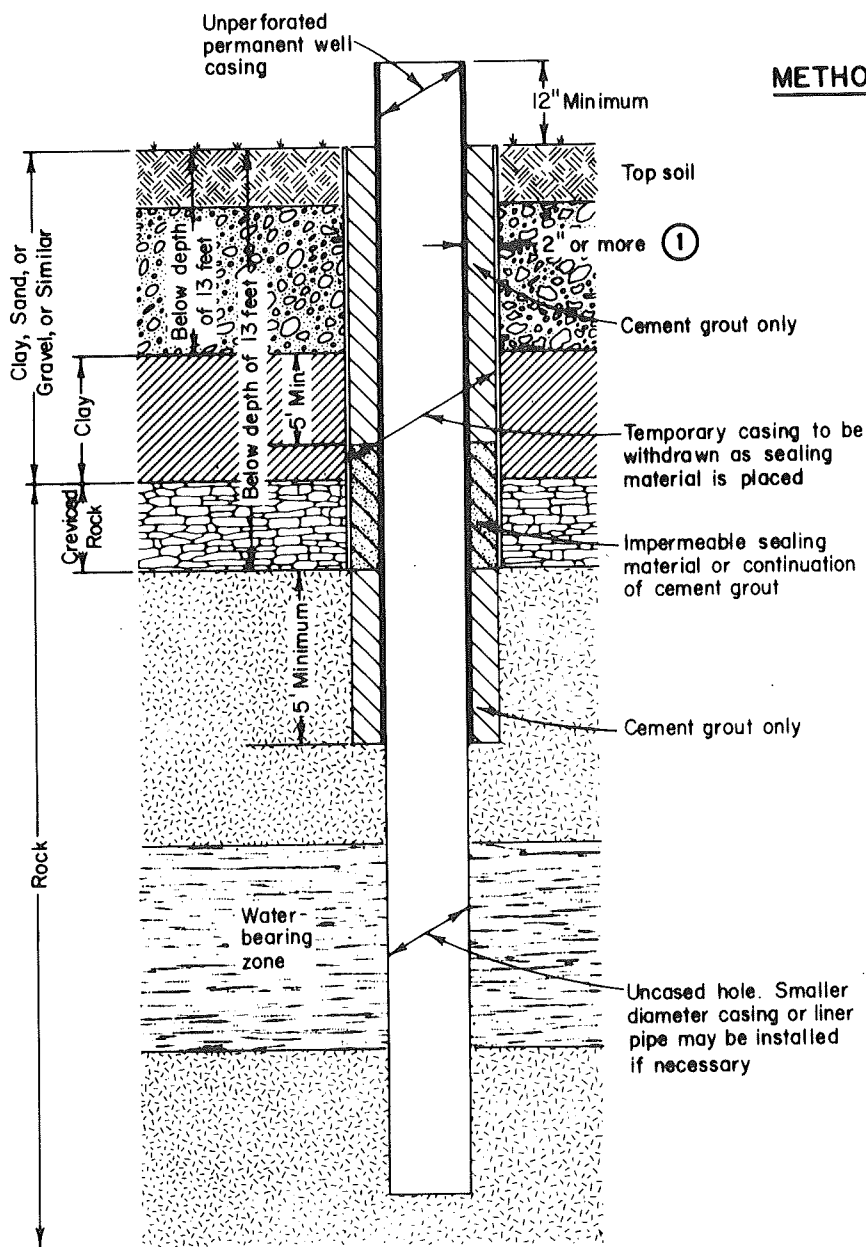
① Unperforated well casing and annular seal must extend at least 5 feet into impermeable stratum, and must extend at least 18 feet below land surface.

FIGURE 4

SEALING OF A DRILLED WELL IN CONSOLIDATED FORMATION

Overlying Material - Clay, Sand, or Gravel

Water-bearing Formation - Rock

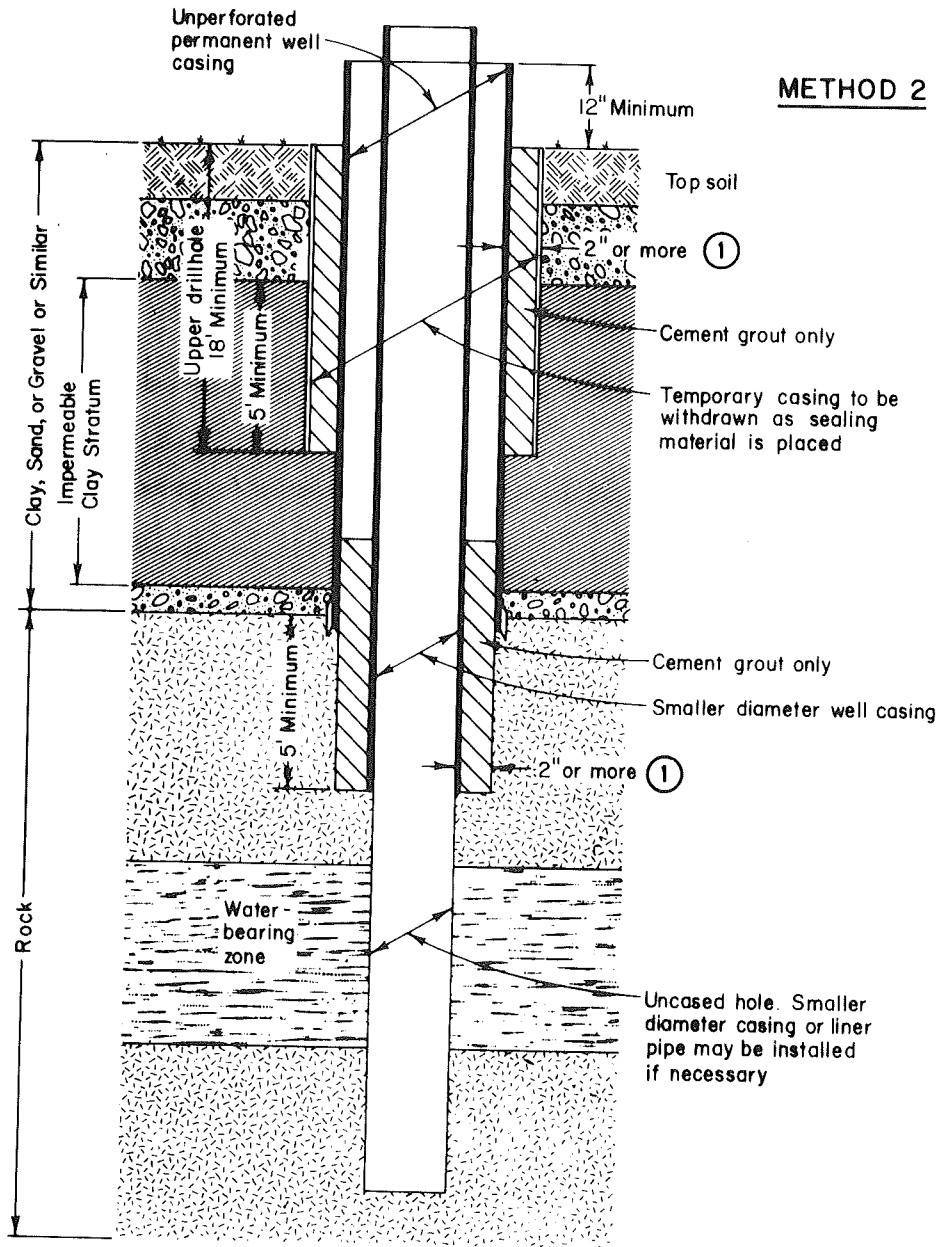


① 1" or more if cement grout is placed by grouting method A, B, or D.

FIGURE 5

SEALING OF A DRILLED WELL IN CONSOLIDATED FORMATION

Overlying Material - Clay, Sand, or Gravel, or Similar
 Water-bearing Formation - Rock



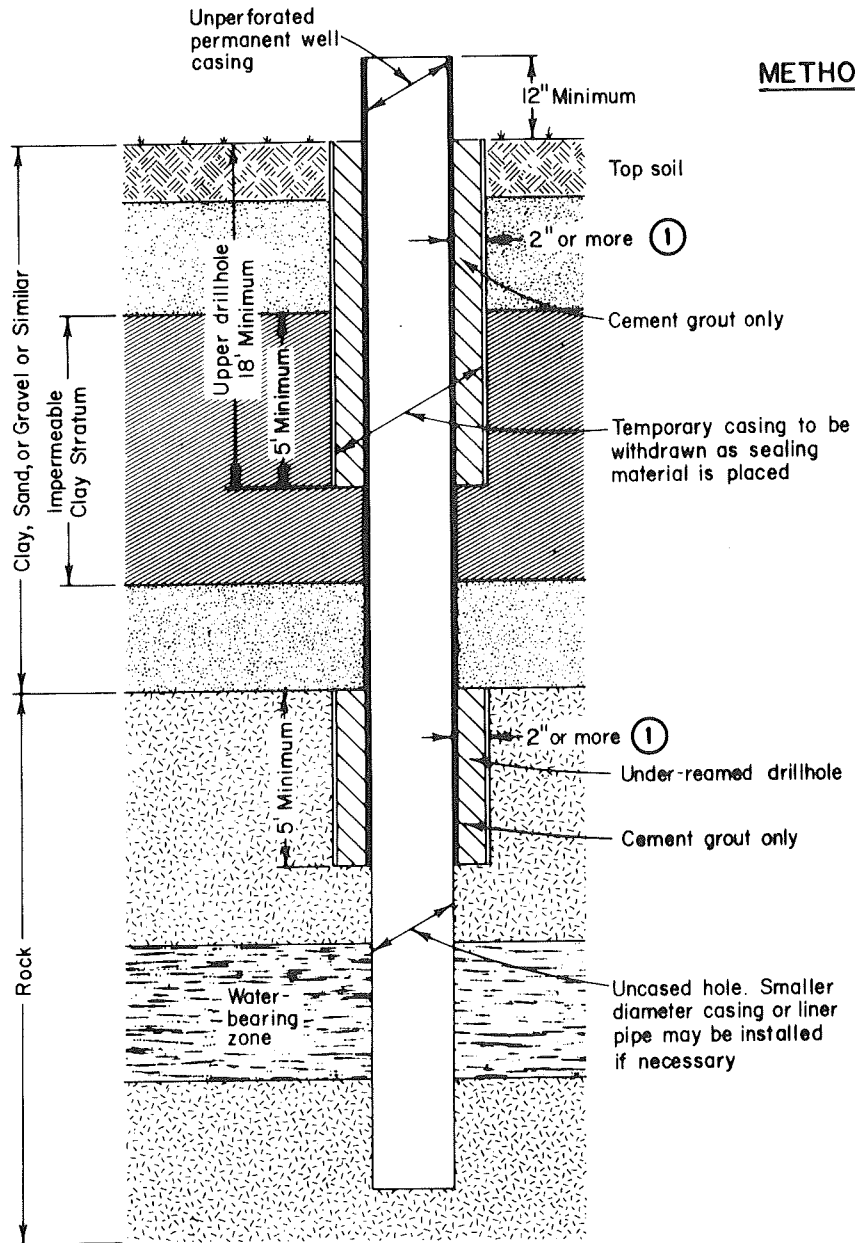
① 1" or more if cement grout is placed by grouting method A, B, or D.

FIGURE 6

SEALING OF A DRILLED WELL IN CONSOLIDATED FORMATION

Overlying Material - Clay, Sand, or Gravel or Similar

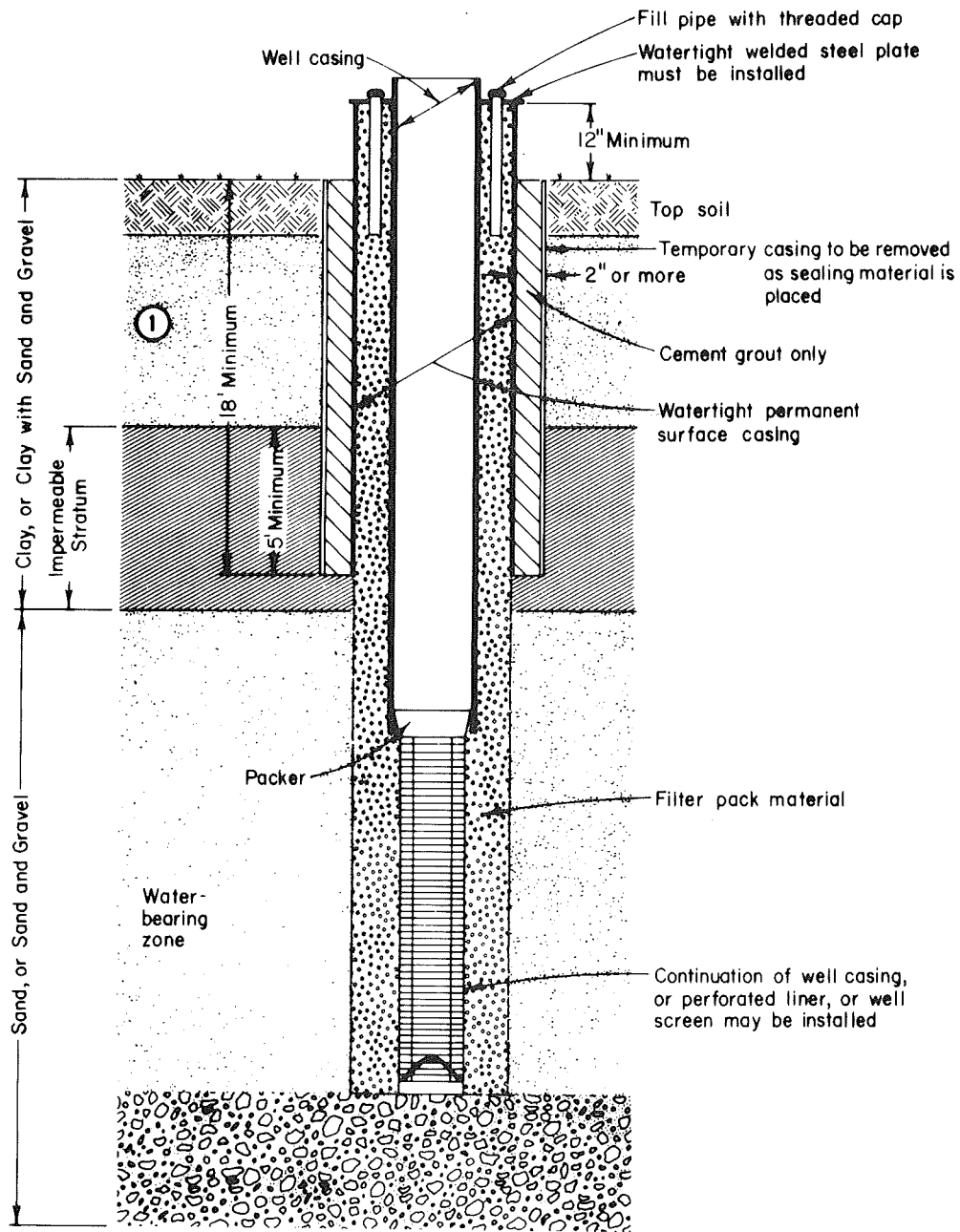
Water-bearing Formation - Rock



① 1" or more if cement grout is placed by grouting method A, B, or D.

FIGURE 7

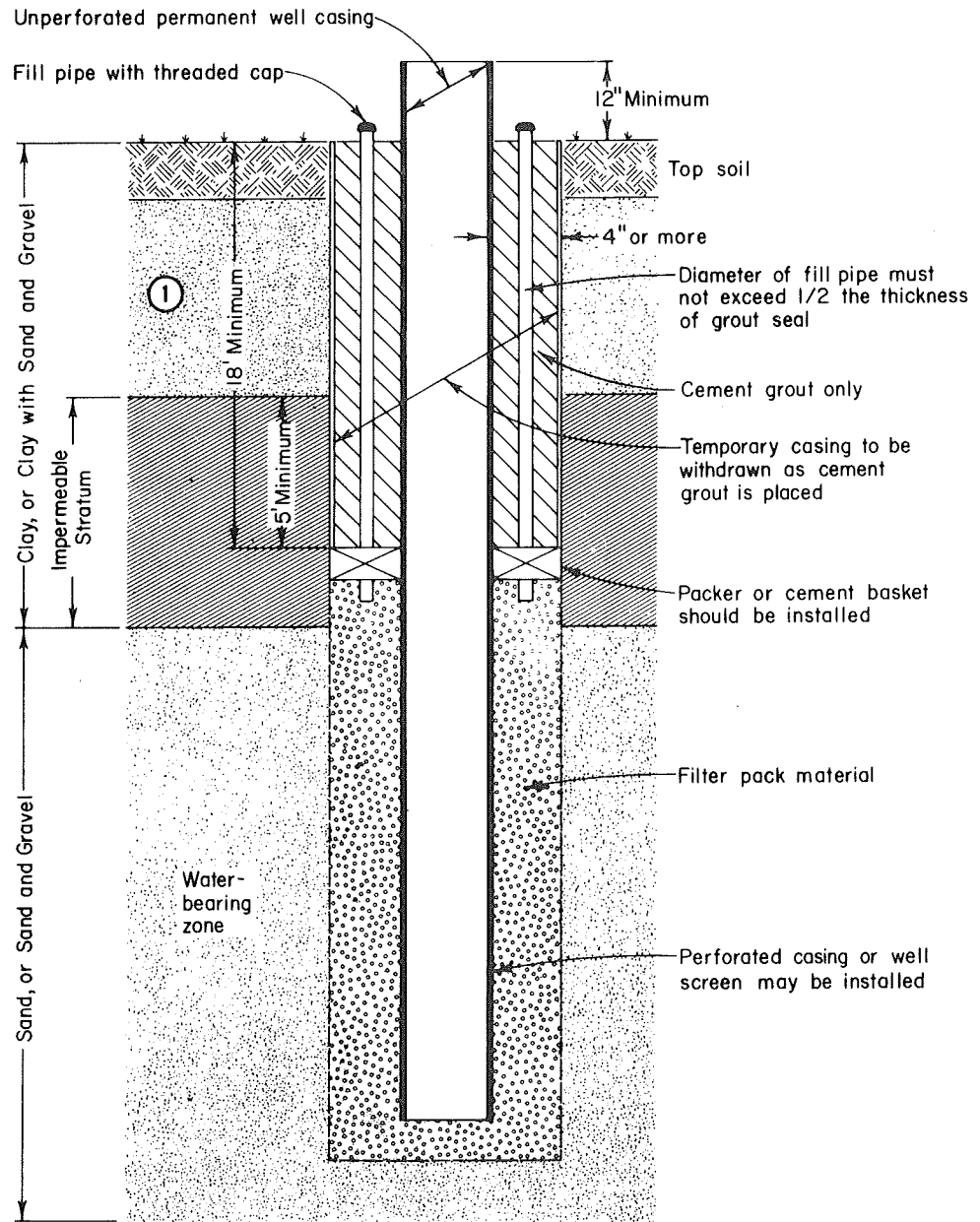
SEALING OF A FILTER PACKED WELL WITH SURFACE CASING



① Minimum of 18 feet provided that the impermeable stratum is at or near land surface.

FIGURE 8

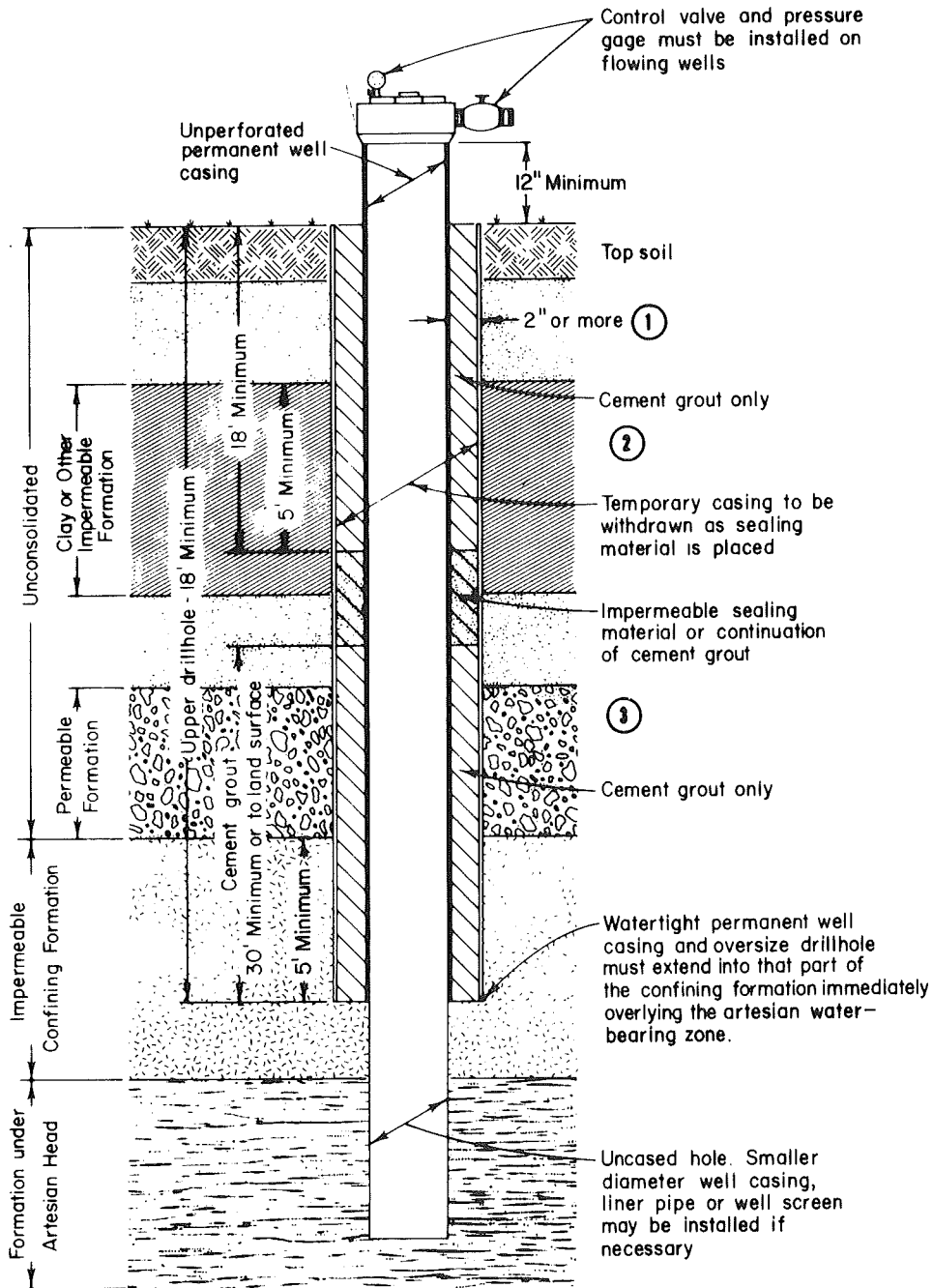
SEALING OF A FILTER-PACKED WELL WITHOUT SURFACE CASING



① Minimum of 18 feet provided that the impermeable stratum is at or near land surface.

FIGURE 9

SEALING OF AN ARTESIAN WELL



- ① 1" or more if cement grout is placed by grouting method A, B, or D.
- ② Well must not be constructed in a manner that will allow water from an artesian zone to commingle with other confined or unconfined water-bearing zones having different potentiometric heads.
- ③ Must be completed with the seals, packers, or casing necessary to eliminate all subsurface or surface leakage.

FIGURE 10

SEALING OF A DRIVEN OR JETTED WELL

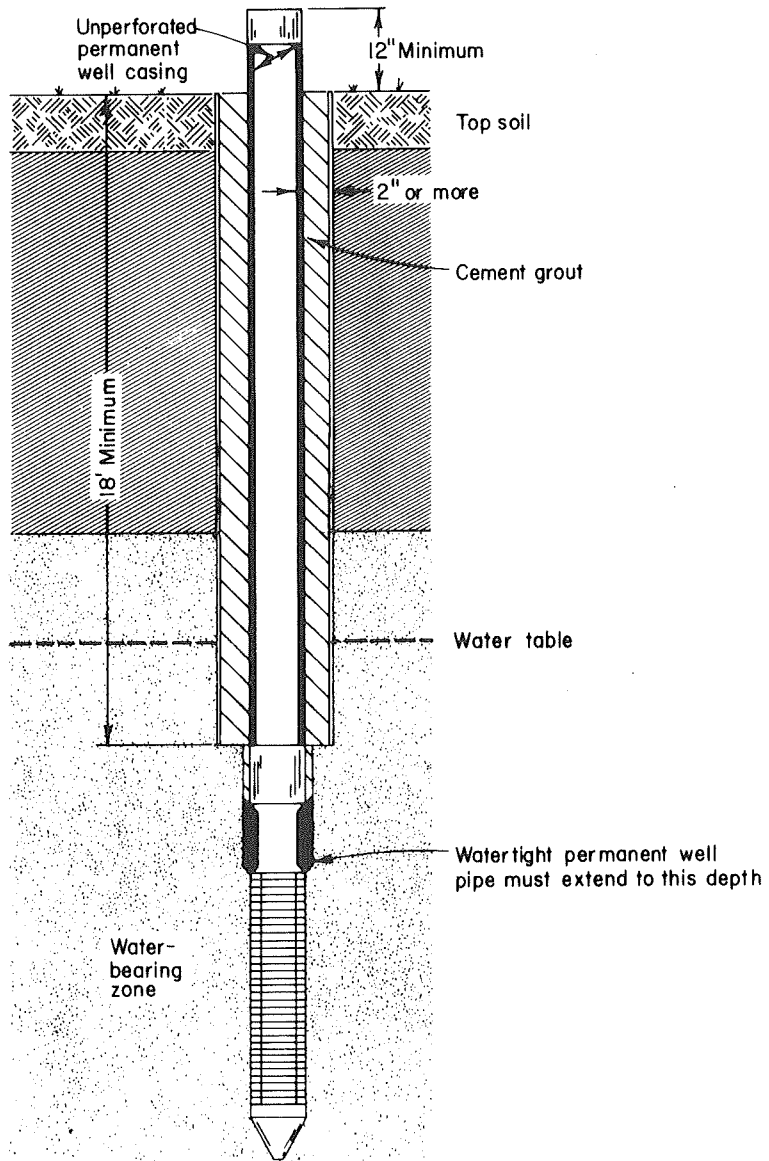


FIGURE 11

SEALING OF DUG WELLS

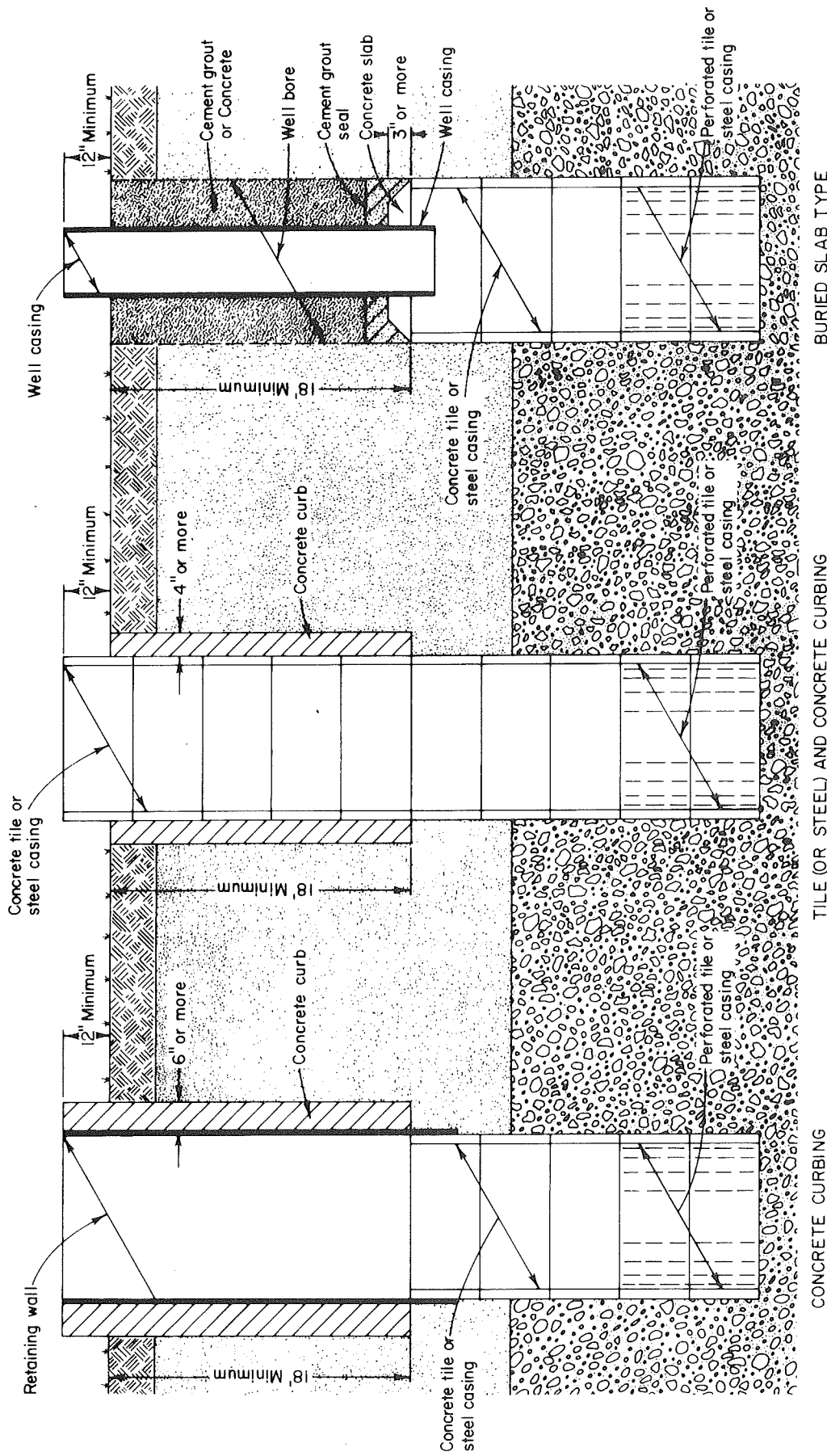
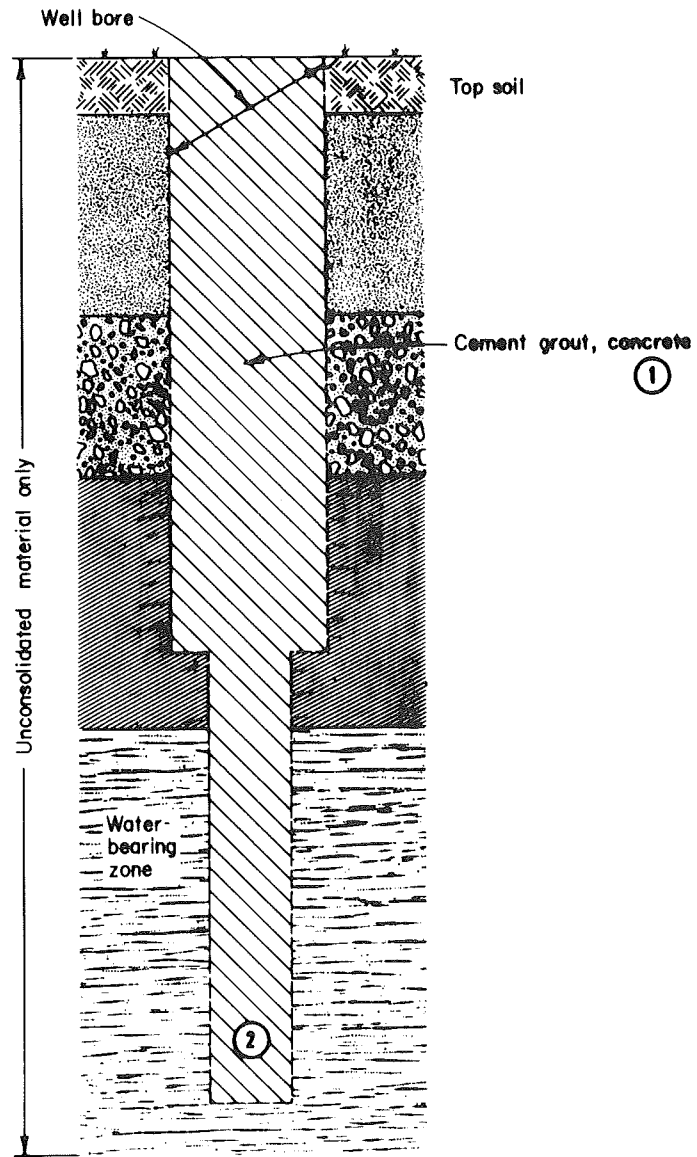


FIGURE 12 WRC 75

ABANDONMENT OF UNCASED WELL IN UNCONSOLIDATED FORMATION

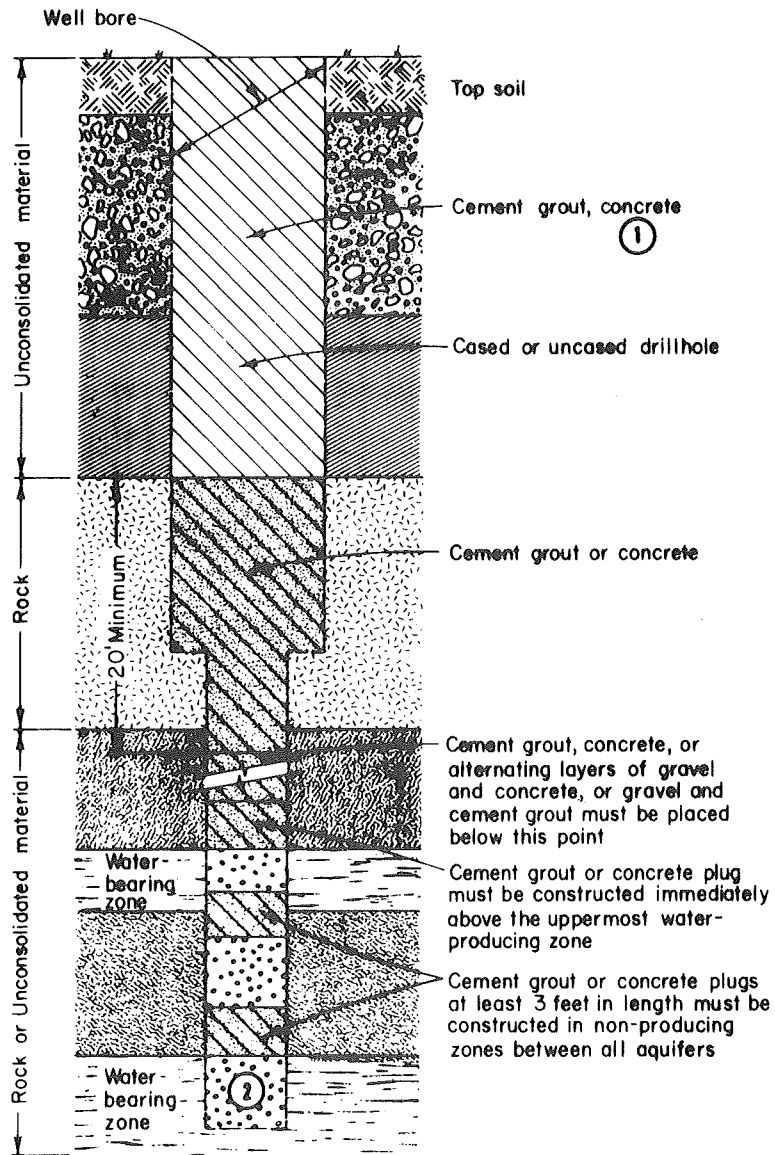


① In all wells to be abandoned, cement grout and concrete must be placed by grout pipe, tremie, or dump bailer.

② In all wells to be abandoned, sealing material must be introduced at the bottom of the well and placed progressively upward.

FIGURE 13

ABANDONMENT OF UNCASED WELL IN CONSOLIDATED FORMATION

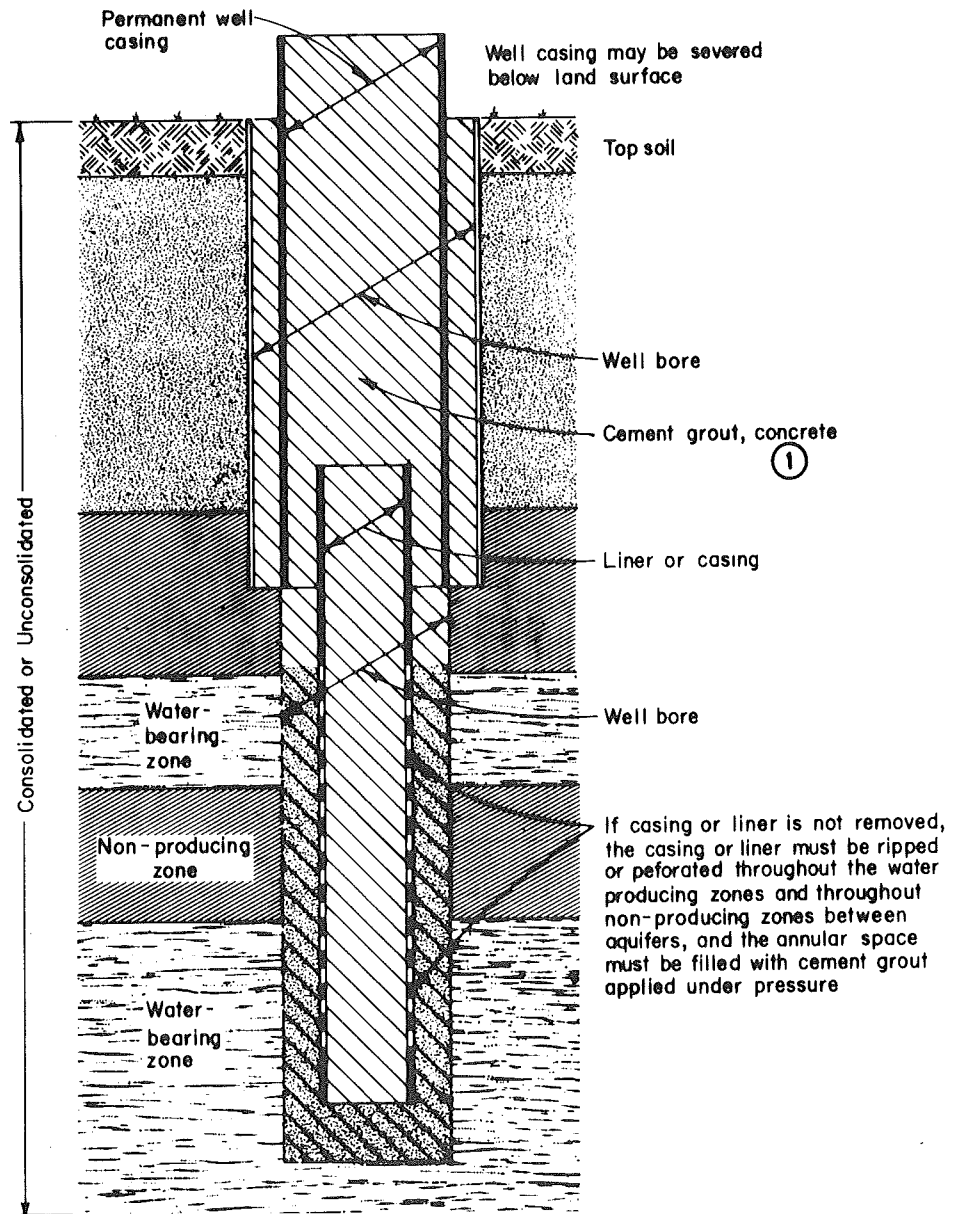


① In all wells to be abandoned, cement grout and concrete must be placed by grout pipe, tremie, or dump bailer.

② In all wells to be abandoned, sealing material must be introduced at the bottom of the well and placed progressively upward.

FIGURE 14

ABANDONMENT OF CASED WELL

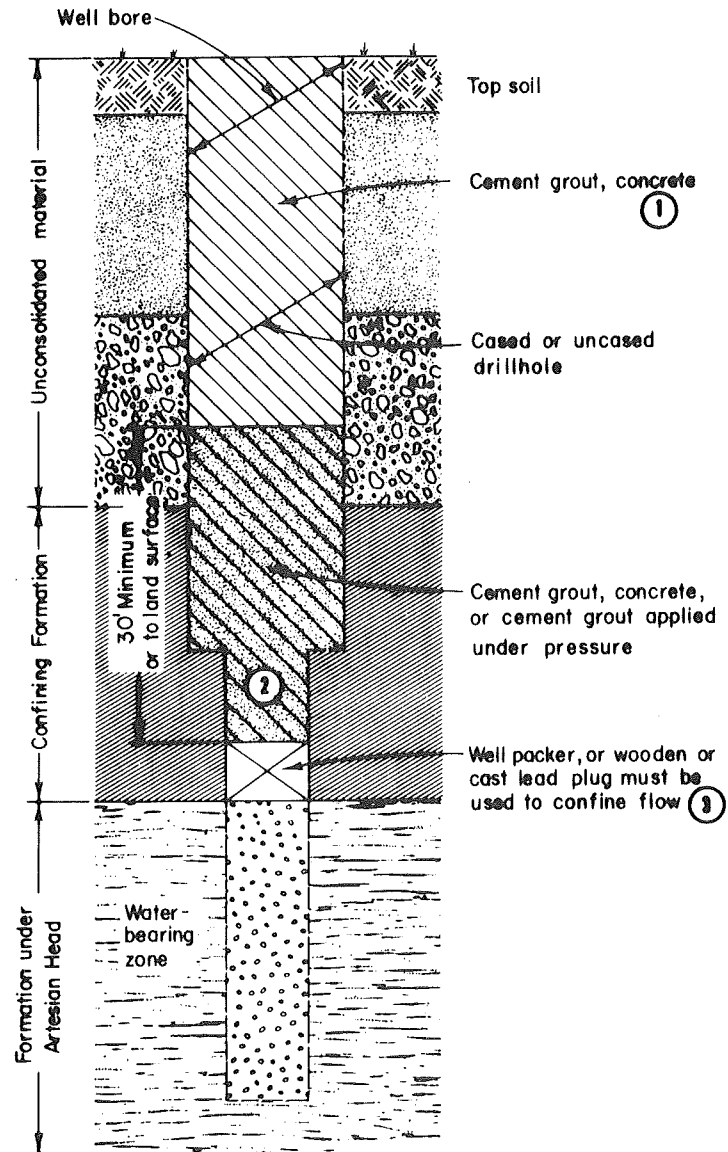


① In all wells to be abandoned, cement grout and concrete must be placed by grout pipe, tremie or dump bailer.

② In all wells to be abandoned, sealing material must be introduced at the bottom of the well and placed progressively upward.

FIGURE 15

ABANDONMENT OF ARTESIAN WELL

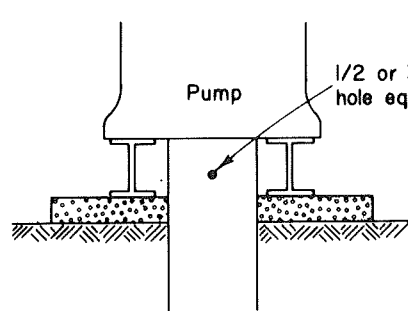


- ① In all wells to be abandoned, cement grout and concrete must be placed by grout pipe, tremie or dump bailer.
- ② In all wells to be abandoned, sealing material must be introduced at the bottom of the well and placed progressively upward.
- ③ Preshaped or precast plugs should be several times longer than the diameter of the well to prevent filling.

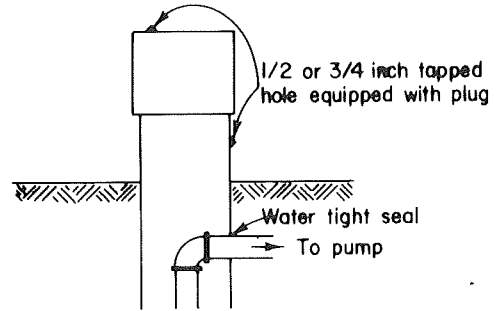
FIGURE 16

WRD 76

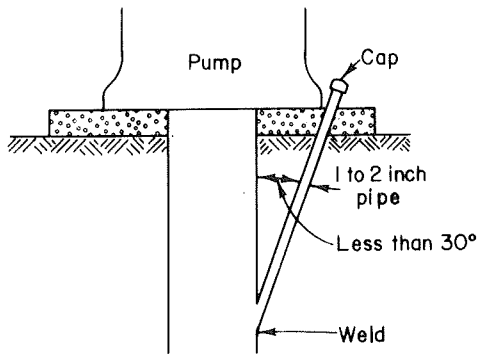
SUGGESTED METHODS OF INSTALLING ACCESS PORTS, PRESSURE GAUGES, AND AIR LINES FOR MEASURING WATER LEVELS IN WELLS



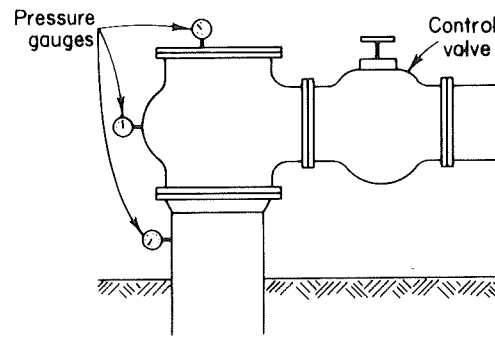
ACCESS PORT FOR MEASURING DEVICE



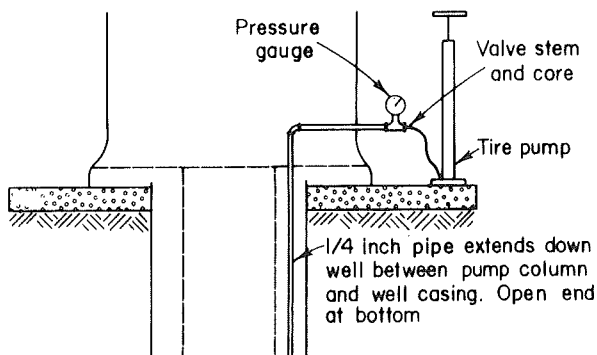
ACCESS PORT FOR MEASURING DEVICE



ACCESS PORT FOR MEASURING DEVICE



POSSIBLE LOCATION FOR PRESSURE
GAUGES ON AN ARTESIAN WELL



AIR LINE INSTALLATION

An air line installation is recommended where the water level lies at a considerable depth below land surface. The amount of air pressure that can be built up inside the air line will be equal to the depth of water standing above the bottom of the air line. The exact depth to the bottom of the air line is required to obtain an accurate measurement of the water level in the well. One pound per square inch pressure equals 2.31 feet of water.

FIGURE 17

