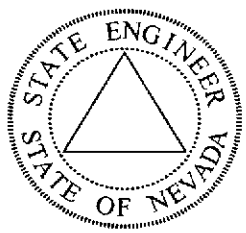
NEVADA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF WATER RESOURCES
Office of the State Engineer

REGULATIONS FOR WATER WELL AND RELATED DRILLING

Revised and adopted June 2006
and
2005 Nevada Revised Statutes Related to Underground Water and Wells



Tracy Taylor, P.E.
State Engineer

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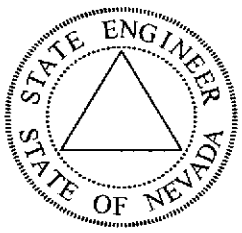

Tracy Taylor, P.E.
State Engineer

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FOREWARD

Protecting ground water from waste and contamination is essential to Nevada's future. In a normal year, ground water is the source of 40 percent of Nevada's water withdrawals. Ground water is used for agricultural, industrial, domestic and public supply purposes. Some surface-water right holders also have supplemental ground water rights that can be used when surface water is not available.

Proper construction of wells and sealing of abandoned boreholes will help to insure the quality and quantity of Nevada's ground water. The State Engineer is authorized and directed by the Legislature to develop the regulations necessary to administer the water law and protect the ground water of the state. The regulations for water well drilling were first promulgated in 1947.

The regulations in this booklet are ***the minimum requirements*** for the construction, alteration and plugging of water wells, monitoring wells, exploratory boreholes and cathodic protection wells in Nevada. These regulations supercede all regulations previously adopted.

These regulations are the result of a cooperative effort between the State Engineer and industry and are the product of substantial comment from the public, industry and other state, federal and local agencies.

Tracy Taylor, P.E.

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State Engineer

REGULATIONS

CHAPTER 534

UNDERGROUND WATER AND WELLS

GENERAL PROVISIONS

LICENSE TO DRILL WELL

DUTIES OF WELL DRILLERS

DRILLING, CONSTRUCTION AND PLUGGING OF WELLS AND BOREHOLES

WAIVERS

ENFORCEMENT

GENERAL PROVISIONS

NAC 534.010 Definitions. (NRS 534.020, 534.110) As used in this chapter, unless the context otherwise requires, the words and terms defined in NAC 534.015 to 534.245, inclusive, have the meanings ascribed to them in those sections.

(Supplied in codification; A by St. Engineer, 1-9-90; 12-30-97)

NAC 534.015 "Abandon" defined. (NRS 534.020, 534.110) "Abandon" means to discontinue the use of a well or borehole or to leave the well or borehole in such a state of disrepair that to use it would be impracticable, may result in contamination of groundwater or may otherwise pose a hazard to the health or safety of the general public.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97)

NAC 534.020 "Annular space" defined. (NRS 534.020, 534.110) "Annular space" means the space between two cylindrical objects, one of which surrounds the other, such as the space between the walls of the well bore and the casing.

[St. Engineer, Drilling Wells Reg. § 1.01, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97)

NAC 534.030 "Aquifer" defined. (NRS 534.020, 534.110) "Aquifer" has the meaning ascribed to it in NRS 534.0105.

[St. Engineer, Drilling Wells Reg. § 1.02, eff. 5-19-81]—(NAC A 1-9-90)

NAC 534.040 "Artesian well" defined. (NRS 534.020, 534.110) "Artesian well" has the meaning ascribed to it in NRS 534.012.

[St. Engineer, Drilling Wells Reg. § 1.03, eff. 5-19-81]—(NAC A 1-9-90)

NAC 534.042 "Bentonite grout" defined. (NRS 534.020, 534.110) "Bentonite grout" means a mixture of a commercially manufactured product and water mixed pursuant to the specifications recommended by the manufacturer which is specifically designed by the manufacturer to seal, grout and plug wells and boreholes and:

1. Consists of not more than 87.9 percent water and not less than 12.1 percent sodium bentonite by weight of water;
2. Has the ability to gel;
3. Does not separate into water and solid materials after it gels;
4. Has hydraulic conductivity or permeability values of 10^{-7} centimeters per second or less; and
5. Has a fluid weight of not less than 9 pounds per gallon.

(Added to NAC by St. Engineer, eff. 12-30-97; A by R009-06, 6-1-2006)

NAC 534.043 "Blast hole" defined. (NRS 534.020, 534.110) "Blast hole" means a borehole that is drilled and, as soon as practicable, is loaded with explosives for mining purposes.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.045 "Board" defined. (NRS 534.020, 534.110) "Board" means the statewide Well Drillers' Advisory Board.

(Added to NAC by St. Engineer, eff. 1-9-90)

NAC 534.047 "Borehole" defined. (NRS 534.020, 534.110) "Borehole" means a penetration in the ground that is deeper than the longest dimension of its opening at the surface and is made to obtain geologic, hydrologic, geophysical or geotechnical information, to obtain information relating to engineering or for any other purpose other than for use as a well.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.048 "Bridge" defined. (NRS 534.020, 534.110) "Bridge" means an obstruction in the well bore or annular space of a borehole or well caused when the walls of the well bore collapse or when materials are jammed or wedged into the well bore or annular space.
(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.050 "Casing" defined. (NRS 534.020, 534.110) "Casing" means the conduit required to prevent waste and contamination of the groundwater and to hold the formation open during the construction or use of the well.
[St. Engineer, Drilling Wells Reg. § 1.04, eff. 5-19-81]—(NAC A 1-9-90)

NAC 534.060 "Cement grout" defined. (NRS 534.020, 534.110) "Cement grout" means a mixture of portland cement, sand and water which contains at least seven bags of cement per cubic yard and not more than 7 gallons of clean water for each bag of cement (1 cubic foot or 94 pounds).
[St. Engineer, Drilling Wells Reg. § 1.14, eff. 5-19-81]—(NAC A 1-9-90)

NAC 534.070 "Concrete grout" defined. (NRS 534.020, 534.110) "Concrete grout" means a mixture of portland cement, sand, 1/4-inch minus aggregate and water which contains at least five bags of cement per cubic yard of concrete and not more than 7 gallons of clean water per bag of cement (1 cubic foot or 94 pounds).
[St. Engineer, Drilling Wells Reg. § 1.13, eff. 5-19-81]—(NAC A 1-9-90)

NAC 534.080 "Conductor casing" defined. (NRS 534.020, 534.110) "Conductor casing" means the temporary or permanent casing used in the upper portion of the well bore to prevent collapse of the formation during the construction of the well or to conduct the gravel pack to the perforated or screened areas in the casing.
[St. Engineer, Drilling Wells Reg. § 1.05, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97)

NAC 534.094 "Contaminant" defined. (NRS 534.020, 534.110) "Contaminant" means any chemical, mineral, live organism, organic material, radioactive material or heated or cooled water that may adversely affect the quality of groundwater.
(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.095 "Contamination" defined. (NRS 534.020, 534.110) "Contamination" means the impairment of water quality by the introduction of contaminants into the groundwater.
(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97)

NAC 534.100 "Division" defined. (NRS 534.020, 534.110) "Division" means the Division of Water Resources of the State Department of Conservation and Natural Resources.
[St. Engineer, Drilling Wells Reg. § 1.07, eff. 5-19-81]

NAC 534.110 "Domestic use" defined. (NRS 534.020, 534.110) "Domestic use" has the meaning ascribed to it NRS 534.013.
[St. Engineer, Drilling Wells Reg. § 1.08, eff. 5-19-81]—(NAC A 1-9-90)

NAC 534.112 "Drill rig" defined. (NRS 534.020, 534.110) "Drill rig" means any power-driven percussion, rotary, boring, coring, digging, jetting or augering machine used in the construction of a well or borehole.
(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.113 "Drive point well" defined. (NRS 534.020, 534.110) "Drive point well" means a temporary monitoring well constructed by driving a drive point attached to the end of a section of pipe into the ground for the purpose of obtaining geotechnical or environmental information. The term is synonymous with a push point well.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97)

NAC 534.120 "Exploratory well" defined. (NRS 534.020, 534.110) "Exploratory well" means a well constructed pursuant to paragraph (a) of subsection 2 of NRS 534.050 to determine the availability of water or whether an aquifer is capable of transmitting water to a well.

[St. Engineer, Drilling Wells Reg. § 1.09, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97)

NAC 534.140 "Groundwater" defined. (NRS 534.020, 534.110) "Groundwater" means water below the surface of the land that is in a zone of saturation.

[St. Engineer, Drilling Wells Reg. § 1.11, eff. 5-19-81]—(NAC A 12-30-97)

NAC 534.148 "Monitoring well" defined. (NRS 534.020, 534.110) "Monitoring well" means any well that is constructed to evaluate, observe or determine the quality, quantity, temperature, pressure or other characteristic of groundwater or an aquifer. The term includes an observation well, piezometer, drive point well or vapor extraction well.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.150 "Neat cement" defined. (NRS 534.020, 534.110) "Neat cement" means a mixture of:

1. Clean water and cement in a ratio of not more than 5.2 gallons of water per bag of portland cement (1 cubic foot or 94 pounds); or
2. Clean water, cement and sodium bentonite in a ratio of not more than 7.8 gallons of water per 3.76 pounds of sodium bentonite by dry weight and one bag of portland cement (1 cubic foot or 94 pounds).

[St. Engineer, Drilling Wells Reg. § 1.12, eff. 5-19-81]—(NAC A 12-30-97)

NAC 534.160 "Nominal size" defined. (NRS 534.020, 534.110) "Nominal size" means the manufactured commercial designation of the diameter of a casing. An example would be casing with an outside diameter of 12 3/4 inches which may be nominally 12-inch casing by manufactured commercial designation.

[St. Engineer, Drilling Wells Reg. § 1.15, eff. 5-19-81]

NAC 534.165 "Observation well" defined. (NRS 534.020, 534.110) "Observation well" means a borehole in which a temporary casing has been set and which is used to observe, test and measure the elevation of the water table, the pressure variations within an aquifer and the movement of contaminants inside or outside a zone of saturation.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.175 "Permit" defined. (NRS 534.020, 534.110) "Permit" means the written permission from the State Engineer to appropriate public waters for a beneficial use from a surface or underground source, at a specific point of diversion, under limited circumstances.

(Added to NAC by St. Engineer, eff. 1-9-90)

NAC 534.179 "Piezometer" defined. (NRS 534.020, 534.110) "Piezometer" means a well that is constructed to measure water pressure or soil moisture tensions at one or more discrete intervals.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.182 "Pitless adapter" defined. (NRS 534.020, 534.110) "Pitless adapter" means a commercially manufactured device designed for attachment to openings through the

casing of a water well that permits water service pipes to pass through the wall or an extension of a casing and prevents the entry of contaminants into the well or water supply.
(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97)

NAC 534.183 "Plug" defined. (NRS 534.020, 534.110) "Plug" means the procedure in which a well or borehole is sealed after it is abandoned.
(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97)

NAC 534.185 "Public land survey" defined. (NRS 534.020, 534.110) "Public land survey" means the description of the location of land using the survey system of the United States Government and includes the 40-acre subdivision within a quarter-quarter section, quarter section, section, township and range.
(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97; R009-06, 6-1-2006)

NAC 534.188 "Reconditioning" defined. (NRS 534.020, 534.110) "Reconditioning" means the deepening, reaming, casing, recasing, perforating, reperforating, installing of liner pipe, packers and seals or any other significant change in the design or construction of a water well.
(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97)

NAC 534.190 "Seal" defined. (NRS 534.020, 534.110) "Seal" means the watertight seal established in a borehole or the annular space between the well casings or a well casing and the well bore to prevent the inflow or vertical movement of surface water or shallow groundwater, or to prevent the outflow or vertical movement of water under artesian pressures. The term includes a sanitary seal.
[St. Engineer, Drilling Wells Reg. § 1.19, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97)

NAC 534.192 "Seismic shot hole" defined. (NRS 534.020, 534.110) "Seismic shot hole" means a borehole in which an explosion is detonated to assist studies of the geology of the earth.
(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.194 "Sodium bentonite" defined. (NRS 534.020, 534.110) "Sodium bentonite" means a colloidal clay that:
1. Consists primarily of the mineral montmorillonite;
2. Has the ability to swell; and
3. May be mixed with water to form bentonite grout.
(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.195 "Static water level" defined. (NRS 534.020, 534.110) "Static water level" means the stabilized level or elevation of the surface of the water in a well or borehole that is not being pumped and is not affected by the pumping of other wells or boreholes.
(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97)

NAC 534.205 "Vapor extraction well" defined. (NRS 534.020, 534.110) "Vapor extraction well" means any well constructed to remove vapors that may contaminate the groundwater.
(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.210 "Waste" defined. (NRS 534.020, 534.110) "Waste" has the meaning ascribed to it in NRS 534.0165.
[St. Engineer, Drilling Wells Reg. § 1.21, eff. 5-19-81]—(NAC A 1-9-90)

NAC 534.220 "Well" defined. (NRS 534.020, 534.110) "Well" means a penetration in the ground made for the purpose of measuring, testing or sampling the underground strata or producing groundwater. The term includes a water well, monitoring well or exploratory well.

[St. Engineer, Drilling Wells Reg. § 1.22, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97)

NAC 534.235 "Well bore" defined. (NRS 534.020, 534.110) "Well bore" means a cylindrical hole made in the construction or drilling of a well.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.240 "Well driller" defined. (NRS 534.020, 534.110) "Well driller" has the meaning ascribed to it in NRS 534.017.

[St. Engineer, Drilling Wells Reg. § 1.24, eff. 5-19-81]—(NAC A 1-9-90)

NAC 534.245 "Well drilling" and "drilling a well" defined. (NRS 534.020, 534.110) "Well drilling" and "drilling a well" have the meaning ascribed to them in NRS 534.0175.

(Added to NAC by St. Engineer by R009-06, eff. 6-1-2006)

LICENSE TO DRILL WELL

NAC 534.280 Application for license. (NRS 534.020, 534.110, 534.140) An application for a well-drilling license must be submitted to the Division. The application:

1. Must be completed and signed by the applicant on a form provided by the Division;
2. Must be accompanied by the fee prescribed in NRS 534.140; and
3. Is valid, for each section of the examination that is required pursuant to NAC 534.282, for the first three dates on which that section of the examination is given which immediately follow the date on which the application is submitted to the Division.

[St. Engineer, Drilling Wells Reg. § 2.01, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97; R009-06, 6-1-2006)

NAC 534.282 Qualifications of applicant; denial of application. (NRS 534.020, 534.110, 534.140)

1. An applicant for a well-drilling license must:

(a) Be at least 18 years of age;

(b) Be a citizen of the United States, or be lawfully entitled to remain and work in the United States;

(c) Submit an application and the fee pursuant to NAC 534.280;

(d) Demonstrate a good working knowledge of:

(1) Standard drilling practice;

(2) The regulations of the State Engineer and applicable laws relating to well drilling; and

(3) The method by which land is described by public land survey;

(e) Have at least 2 years of experience as a well driller determined to be appropriate by the State Engineer for the license for which the applicant applies;

(f) Have at least four references determined to be satisfactory by the State Engineer for the license for which the applicant applies; and

(g) Pass an examination, consisting of the following three sections:

(1) A written examination on which the applicant must obtain a score of at least 70 percent;

(2) A section which requires the applicant to use a map to provide the public land survey description of the location of a well; and

(3) An oral examination conducted by the Board.

2. The State Engineer may deny an applicant a license if the applicant:

(a) Fails to notify the Division that he cannot appear for the examination as instructed by a notice to appear before the State Engineer or the Board; or

(b) Fails to pass all three sections of the examination described in paragraph (g) of subsection 1 within the period for which the application is valid pursuant to NAC 534.280.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97; R009-06, 6-1-2006)

NAC 534.286 Oral examination of applicants. (NRS 534.020, 534.110) Except as otherwise provided in NAC 534.288, the Board shall conduct the oral examination section of the examination for each applicant for a well-drilling license. The oral examination section of the examination must be conducted to determine the sufficiency of the applicant's:

1. Knowledge of the provisions of this chapter and chapter 534 of NRS, including, without limitation, knowledge of the minimum standards established in this chapter for the construction and plugging of wells;
2. Qualifications and experience;
3. Proficiency in the operating procedures and construction methods associated with the various types of drilling rigs used for well drilling; and
4. Ability to resolve problems that may arise during the construction or plugging of a well.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97; R009-06, 6-1-2006)

NAC 534.288 Board not required to conduct oral examination of certain applicants. (NRS 534.020, 534.110) The Board is not required to conduct the oral examination section of the examination for an applicant for a well-drilling license who:

1. Receives a score of less than 70 percent on the written examination section of the examination; or
2. Is unable to demonstrate his ability to locate a well by public land survey on a topographic map.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97; R009-06, 6-1-2006)

NAC 534.290 Revocation or denial of license. (NRS 534.020, 534.110, 534.150, 534.160)

1. The State Engineer may revoke or refuse to reissue a well-drilling license if he determines, after an investigation and a disciplinary hearing, that the well driller has:
   (a) Been found to be incompetent as a well driller by the State Engineer or the Board;
   (b) Supplied false information to an owner of a well or a holder of a permit or his agent; or
   (c) Failed to report information concerning improper construction or improper plugging of a well pursuant to NAC 534.355.
2. The State Engineer will avail himself of the services of the Board pursuant to NRS 534.150 if he determines that to do so is appropriate under the circumstances.

[St. Engineer, Drilling Wells Reg. §§ 8.01 & 8.02, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97; R009-06, 6-1-2006)

NAC 534.292 Notice to renew license; notice of change in mailing address. (NRS 534.020, 534.110)

1. The Division will mail to each licensed well driller a notice to renew his license approximately 30 days before the expiration of the license. Failure to receive the notice does not relieve a well driller of his obligation to pay the fee for renewal in a timely manner.
2. A well driller shall notify the Division of any change in his mailing address within 30 days after the change.

(Added to NAC by St. Engineer, eff. 1-9-90)

NAC 534.2923 Renewal of license: Application for renewal. [Effective through June 30, 2008.] (NRS 534.020, 534.110, 534.140)

1. A well driller may renew his well-drilling license by submitting a renewal application to the Division. The renewal application must:
   (a) Be completed and signed by the well driller on a form provided by the Division;
   (b) Be accompanied by the renewal fee prescribed in NRS 534.140; and

(c) Except as otherwise provided in paragraph (b) of subsection 5 of NAC 534.2927, subsection 6 of NAC 534.2927 and subsection 4 of NAC 534.293, include documentation satisfactory to the Division that the applicant has completed four credit units of continuing education within the previous year beginning July 1 and ending June 30.

2. If the State Engineer has notified a well driller during the previous year that the well driller has violated a provision of this chapter or chapter 534 of NRS related to welding involving work that does not comply with the construction standards for wells, the well driller must obtain a certificate as a certified welder from the American Welding Society or another similar organization approved by the Division and include the certificate with his application for renewal of his license.

(Added to NAC by St. Engineer by R009-06, eff. 6-1-2006)

NAC 534.2923 Renewal of license: Application for renewal. [Effective July 1, 2008.] (NRS 534.020, 534.110, 534.140)

1. A well driller may renew his well-drilling license by submitting a renewal application to the Division. The renewal application must:

(a) Be completed and signed by the well driller on a form provided by the Division;

(b) Be accompanied by the renewal fee prescribed in NRS 534.140; and

(c) Except as otherwise provided in paragraph (b) of subsection 5 of NAC 534.2927, subsection 6 of NAC 534.2927 and subsection 4 of NAC 534.293, include documentation satisfactory to the Division that the applicant has completed eight credit units of continuing education within the previous year beginning July 1 and ending June 30.

2. If the State Engineer has notified a well driller during the previous year that the well driller has violated a provision of this chapter or chapter 534 of NRS related to welding involving work that does not comply with the construction standards for wells, the well driller must obtain a certificate as a certified welder from the American Welding Society or another similar organization approved by the Division and include the certificate with his application for renewal of his license.

(Added to NAC by St. Engineer by R009-06, eff. 6-1-2006; A by R009-06, 6-1-2006, eff. 7-1-2008)

NAC 534.2925 Renewal of license: Processing of and action on application. (NRS 534.020, 534.110, 534.140, 534.160)

1. The Division shall process each application submitted for renewal of a well-drilling license pursuant to NAC 534.2923 in the order in which the applications are received by the Division. A well driller must submit his application for renewal to the Division so that the Division receives the application not later than June 15 to ensure that the license will remain in force and continue without interruption. If the State Engineer determines that an application is complete and the applicant is qualified, the Division shall renew the license for the period ending on June 30 of the year after approval of the renewal.

2. The Division shall not renew a license if the State Engineer determines, upon investigation and after a hearing held upon at least 15 days' notice sent by registered or certified mail to the licensed well driller, that the well driller:

(a) Has not submitted all required notices of intent to the Division as required by NAC 534.320;

(b) Has not furnished a copy of the log and record of work for every well drilled to the State Engineer as required by NRS 534.170;

(c) Has not complied with all orders requiring the repair or plugging of improperly constructed wells;

(d) Is not otherwise in compliance with this chapter or chapter 534 of NRS; or

(e) Has accumulated 100 demerit points or more against his license.

3. If the State Engineer determines, after consultation with the Board, that a well driller has an unacceptable history of noncompliance with this chapter and chapter 534 of NRS, the Division may deny renewal, refuse renewal for a specified time, or renew the license of the well

driller with conditions that the State Engineer considers appropriate. In making this determination, the State Engineer may consider the actions of the well driller within the 5 years immediately preceding the date on which the renewal application is received by the Division with regard to his well-drilling license or other permits issued by the State Engineer pursuant to this chapter or chapter 534 of NRS.

(Added to NAC by St. Engineer by R009-06, eff. 6-1-2006)

NAC 534.2927 Continuing education of well drillers. (NRS 534.020, 534.110, 534.140)

1. A credit unit of continuing education is earned for each hour the holder of a well-drilling license attends a workshop, seminar or course or participates in any other type of educational activity related to well drilling or related subjects approved by the Division. Such educational activities may include, without limitation, the completion of college courses, correspondence courses or videotaped courses, active participation in professional organizations and authoring appropriate publications.

2. A well driller must maintain documentation verifying that he has completed the number of credit units of continuing education required by NAC 534.2923. Documentation of completion of continuing education which is satisfactory to the Division includes, without limitation:

(a) A log, on a form provided by the State Engineer, indicating the type of educational activity claimed, the sponsoring organization, the duration of the course or activity, the name of the instructor and the number of credit units; and

(b) Documents providing evidence of attendance at or participation in an educational activity, including, without limitation, a certificate of completion.

3. A well driller shall maintain the documentation required pursuant to subsection 2 for a period of 3 years after the date of completion of the credit units of continuing education and shall make the documentation available for review by the State Engineer at the request of the Division.

4. Except as otherwise provided in subsection 5 or 6, the Division shall deny the renewal of a license if, at the time of renewal, the well driller is unable to provide documentation of completion of the number of credit units of continuing education required by NAC 534.2923.

5. The Division may:

(a) Withhold action on the application for renewal of the license for a period not to exceed 90 days to allow a well driller to provide documentation of the required credit units of continuing education. The well driller is not authorized to drill until the documentation is provided and the Division has renewed the license.

(b) Exempt a well driller from all or part of the number of credit units of continuing education required by NAC 534.2923 if the well driller:

(1) Served on active duty in the Armed Forces of the United States for 120 consecutive days or more during the licensing period immediately preceding the application for renewal; or

(2) Was prevented from earning the number of credit units of continuing education required by NAC 534.2923 because of a physical disability, serious illness or other extenuating circumstances.

6. A well driller who has allowed his license to expire or otherwise become of no effect is exempt from the requirements of continuing education set forth in NAC 534.2923 unless the well driller files an application for renewal of his license within 3 years after his license expired or otherwise became of no effect.

7. A well driller who is not a resident of this State is subject to the same requirements of continuing education as a well driller who is a resident of this State.

8. The Division shall request that the Nevada Ground Water Association:

(a) Develop a program for continuing education for review and, if appropriate, approval by the Division;

(b) Implement a program that is developed and approved pursuant to paragraph (a);

(c) Provide recommendations to the Division concerning:

(1) The amount and nature of continuing education that is necessary to maintain and improve the competency of a well driller; and

(2) The number of credit units of continuing education that should be assigned to specific educational activities; and

(d) Encourage other associations for well drillers, related professional organizations and educational institutions to make additional educational activities available for well drillers.

9. If the Nevada Ground Water Association does not submit a program for continuing education to the Division pursuant to subsection 8, or if the program submitted pursuant to subsection 8 is not approved by the Division, the Division may request that the Board or another established professional organization approved by the State Engineer:

(a) Develop a program for continuing education for review and, if appropriate, approval by the Division; and

(b) Implement a program that is developed and approved pursuant to paragraph (a).

10. The Division shall review each educational activity submitted to the Division to satisfy the continuing education requirements set forth in NAC 534.2923 to determine the number of credit units of continuing education, if any, to assign to the educational activity.

(Added to NAC by St. Engineer by R009-06, eff. 6-1-2006)

NAC 534.293 Additional requirements for license if prior license has expired or been suspended or revoked. (NRS 534.020, 534.110, 534.140) A well driller whose license has been expired for more than 1 year or whose license has been suspended or revoked must:

1. File a new application with the fee required by NRS 534.140 to obtain a license;
2. Pass the examination required by NAC 534.282;
3. Reduce the number of demerit points he has accumulated against his license to 74 or less; and
4. Provide documentation satisfactory to the Division that he has completed the requirements for continuing education set forth in NAC 534.2923 within the 12 months immediately preceding the date on which he files his new application for a license pursuant to subsection 1.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97; R009-06, 6-1-2006)

NAC 534.294 Scope of authority under license; issuance of restricted licenses. (NRS 534.020, 534.110)

1. A well-drilling license authorizes the licensee to drill, recondition or plug the following types of wells:

(a) Water wells;

(b) Monitoring wells; and

(c) Geothermal wells.

2. The State Engineer may issue restricted well-drilling licenses that limit a well driller to a class of work or type of drilling rig, or both, for which the Board has determined the driller is qualified. The following restricted well-drilling licenses may be issued:

(a) A monitoring well-drilling license;

(b) A geothermal well-drilling license;

(c) A license to drill wells for projects of the Federal Government; and

(d) Any other class of well-drilling license determined to be appropriate by the Board and the State Engineer.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97)

NAC 534.296 Temporary license: Issuance and reissuance; expiration; termination of employment of temporary licensee. (NRS 534.020, 534.110)

1. The State Engineer may issue a temporary well-drilling license to an employee of a drilling contractor if the drilling contractor has insufficient personnel to complete existing contracts.

2. If the employee of a drilling contractor submits an application for a temporary license, the drilling contractor or an employee of the drilling contractor must:

(a) Hold a well-drilling license issued by the State Engineer; and

(b) Sign and submit a letter to the Division containing:

(1) A request that the person named in the application be given a temporary license;

(2) A statement from the contractor or the licensed employee of the contractor stating that the person who is making the statement will take full responsibility for the drilling performed by the prospective temporary licensee; and

(3) A statement that the prospective temporary licensee will comply with all regulations for drilling wells.

3. The State Engineer will evaluate the qualifications of the prospective temporary licensee and, except as otherwise provided in subsection 4, may issue or reissue a temporary license which expires on the date of the next available written examination section of the examination conducted by the Board.

4. The State Engineer will not:

(a) Issue or reissue a temporary license if the applicant has had an application denied by the State Engineer pursuant to subsection 2 of NAC 534.282; or

(b) Reissue a temporary license if the applicant has not obtained a passing score as set forth in NAC 534.282 on the written examination section of the examination.

5. The drilling contractor or the employee of the drilling contractor, whoever signed and submitted the letter described in paragraph (b) of subsection 2, shall inform the Division in writing if the employment of the temporary licensee is terminated before the date of the next available examination. The drilling contractor or the employee of the drilling contractor, whoever signed and submitted the letter described in paragraph (b) of subsection 2, is responsible for any drilling performed by the temporary licensee until the notice of termination is received by the Division. The notice of termination must explain the reasons for terminating the employment of the temporary licensee. The temporary license expires upon receipt of the notice by the Division.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97; R009-06, 6-1-2006)

NAC 534.298 Temporary license: Period of validity; authorized activities; transferability. (NRS 534.020, 534.110) A temporary well-drilling license:

1. Is valid until the next scheduled written examination section of the examination administered by the Board;

2. Authorizes well drilling to be performed only for the contractor who requested the license; and

3. Is not transferable.

(Added to NAC by St. Engineer, eff. 1-9-90; A by R009-06, 6-1-2006)

DUTIES OF WELL DRILLERS

NAC 534.300 Designated basins; replacement wells. (NRS 534.020, 534.050, 534.110, 534.140)

1. Except as otherwise provided in NAC 534.315, a well driller shall not drill a water well within a groundwater basin designated by the State Engineer until the well driller determines that a permit to appropriate the groundwater has been issued pursuant to NRS 534.050.

2. Except as otherwise provided in subsection 3, a water well may be drilled to replace an existing well if a valid permit, waiver or certificate of water right exists for the well to be replaced.

3. If continued use will not be made of the existing well, the existing well must be plugged as required by NAC 534.420 at the time the replacement well is drilled unless the owner of the well first obtains a waiver from the requirement that the well be plugged pursuant to subsection 7 or 8 of NRS 534.060 and NAC 534.449. If continued use will be made of the existing well, a permit must be issued for the replacement well before any drilling is commenced.

4. The replacement well must not be drilled more than 300 feet from the location of the existing point of diversion described in the permit and may not be moved outside of the 40-acre subdivision described in the permit, waiver or certificate.

[St. Engineer, Drilling Wells Reg. §§ 10.01-10.03, 10.05 & 10.06, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97; R009-06, 6-1-2006)

NAC 534.310 Nondesignated basins. (NRS 534.020, 534.050, 534.110, 534.140)

1. Except as otherwise provided in NAC 534.315:

(a) In basins which have not been designated by the State Engineer, a person who drills a well before receiving a permit to appropriate water does so at the risk that a permit to appropriate water cannot be obtained; and

(b) A person shall not use water from a well until a permit or waiver has been obtained pursuant to NRS 534.050.

2. In basins which have not been designated by the State Engineer, the well driller may proceed to drill and perform tests on a well whether or not the owner of the property has a permit to appropriate water. The well driller shall submit to the State Engineer a notice of intent to drill and a log and record of work as prescribed in NAC 534.320 and 534.340.

3. In basins which have not been designated by the State Engineer, a waiver is required for any water well:

(a) That does not comply with the requirements for construction prescribed in this chapter;

(b) The water appropriated from which will be used in constructing a highway or exploring for oil, gas, minerals or geothermal resources; or

(c) That may be used as a monitoring well.

[St. Engineer, Drilling Wells Reg. Part 11, eff. 5-19-81]—(NAC A 12-30-97; R009-06, 6-1-2006)

NAC 534.315 Wells for domestic use. (NRS 534.020, 534.110, 534.140, 534.180)

1. Except as otherwise provided in subsection 10, permits to appropriate groundwater are not required for the drilling of wells for domestic use.

2. A well driller shall take into account the normal annual fluctuations in the demand for water of an area and, if the well is in a developed area, some annual drop in static water level.

3. Water may not be diverted from more than one well for domestic use in one single-family residence.

4. A well drilled for domestic use only must have a casing size not larger than 8.625 inches in diameter.

5. If a well drilled for domestic use cannot be reconditioned, a replacement well may be drilled if the original well is plugged as required by NAC 534.420 before the equipment used for well drilling is moved from the drilling site.

6. Except as otherwise provided in subsection 7, a well may be drilled for domestic use if not more than 1,800 gallons of water per day are diverted from the well for use by a single-family household, including a residence with a lawn, garden and domestic animals.

7. If water service is available from an entity, including, without limitation, a public utility, a water district or a municipality presently engaged in furnishing water to the inhabitants of the area, a well for domestic use may not be drilled, deepened, reconditioned or replaced unless a waiver from the provisions of this section is first obtained from the Division.

8. If the State Engineer has pursuant to subsection 2 of NRS 534.180 designated a groundwater basin or portion thereof as a basin in which the registration of a well drilled for the development and use of underground water for domestic purposes is required, a well drilled for domestic use in that basin or portion thereof must be plugged as required by NAC 534.420 if:

(a) The conditions set forth in subsection 3 of NRS 534.180 are satisfied; and

(b) The State Engineer sends a notice to the owner of the well by certified mail, return receipt requested, indicating that the well must be plugged.

➥ The well must be plugged within 1 year after the owner of the well receives the notice from the State Engineer.

9. If the State Engineer has not pursuant to subsection 2 of NRS 534.180 designated a groundwater basin or portion thereof as a basin in which the registration of a well drilled for the development and use of underground water for domestic purposes is required, a well drilled for domestic use in that basin or portion thereof must be plugged as required by NAC 534.420 if:

(a) The well must be plugged pursuant to subsection 3 of NAC 534.427; and

(b) The State Engineer sends a notice to the owner of the well by certified mail, return receipt requested, indicating that the well must be plugged.

➥ The well must be plugged within 1 year after the owner of the well receives the notice from the State Engineer.

10. A permit must be obtained from the Division if:

(a) More than 1,800 gallons of water per day are diverted from a water well; or

(b) Water is used for purposes other than domestic use.

[St. Engineer, Drilling Wells Reg. § 10.04 + Part 12, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97; R009-06, 6-1-2006)

NAC 534.320 Notice of intent to drill: Submission; contents; correction; forms. (NRS 534.020, 534.110, 534.140)

1. A well driller shall notify the Division before drilling, reconditioning or plugging a well by submitting a notice of intent to drill. The notice must be submitted for work on an exploratory, water or monitoring well. A well driller shall notify the Division before drilling a geothermal well if a permit to appropriate water is required pursuant to NRS 534.050.

2. The notice of intent to drill submitted pursuant to subsection 1 must give the name of the person for whom the work is being performed, the location of the well by public land survey, the lot number, block number and county assessor's parcel number, the purpose of the well, the date on which the work is to be commenced, the type of work to be done and the diameter of casing to be installed. The notice must include:

(a) The signature of the contractor or the well driller responsible for the work; and

(b) The license number of the well driller responsible for the work.

3. The notice of intent to drill submitted pursuant to subsection 1 must be received by the Division at least 3 working days before the well rig is to be set up and the drilling commenced. If a permit or waiver is required for the drilling operation, the number of the permit or waiver issued by the Division must be indicated on the notice of intent to drill in addition to the information required by subsection 2.

4. In addition to the requirements of subsections 2 and 3, the notice of intent to drill must include global positioning system coordinates which:

(a) Are either identified by latitude and longitude using decimal degrees or are identified using coordinates of the Universal Transverse Mercator system; and

(b) Specify for each coordinate whether the North American Datum of 1927, North American Datum of 1983 or the World Geodetic System 1984 was used.

5. If a well driller omits any of the information required by this section from the notice of intent to drill submitted to the Division pursuant to subsection 1, the Division may return the notice of intent to drill to the well driller for correction. Well drilling must not begin until after the Division approves the corrected notice of intent to drill.

6. A well driller may submit the notice of intent to drill required pursuant to subsection 1 to the Division in an electronic format if the Division approves this manner of submission for the well driller before the well driller submits the notice of intent to drill.

7. The forms evidencing notice of intent to drill will be furnished by the Division to the well driller on request and will be stamped and self-addressed.

8. If a well is to be drilled in a township that is located north of the Mount Diablo baseline, the notice of intent to drill must be submitted to the office of the Division located in Carson City. If a well is to be drilled in a township which is located south of the Mount Diablo baseline, the notice of intent to drill must be submitted to the office of the Division located in Las Vegas.

[St. Engineer, Drilling Wells Reg. Part 4, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97; R009-06, 6-1-2006)

NAC 534.325 Notice of intent to drill: Lapse; new notice. (NRS 534.020, 534.110, 534.140)

1. If the well described on a notice of intent to drill is not drilled within 60 days after the Division receives and approves the notice, the notice lapses and a new notice must be submitted before the well is drilled. The new notice must include the number of the lapsed notice.

2. The well driller may set up the drill rig and commence drilling immediately after the Division receives and approves the new notice.

3. The well driller shall indicate on the record of work for the well the number of the notice of intent to drill that the well driller last submitted for that well.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97; R009-06, 6-1-2006)

NAC 534.330 Responsibilities of licensed well driller at drilling site. (NRS 534.020, 534.110, 534.140) A well driller licensed by the State Engineer:

1. Must be present at the well-drilling site when the drill rig is in operation and when any activity involving the construction or plugging of the well is conducted. If the licensed well driller leaves the drilling site, the drilling operation must be shut down until that licensed well driller or another well driller licensed pursuant to this chapter returns to the site.

2. Shall ensure that the drilling of the well complies with:

(a) The provisions of this chapter;

(b) The terms and conditions of any permit, waiver or order issued by the State Engineer; and

(c) The requirements of all other federal, state and local agencies which have jurisdiction over the land on which the well is to be drilled.

3. Shall carry his license card when he is present at the drilling site and produce the card when requested to do so by a representative of the Division.

[St. Engineer, Drilling Wells Reg. § 2.02, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97; R009-06, 6-1-2006)

NAC 534.340 Log and record of work: Form; contents. (NRS 534.020, 534.110, 534.140, 534.170)

1. A log and record of work submitted by a well driller pursuant to NRS 534.170 must be typewritten or legibly handwritten in black ink.

2. In addition to the information required pursuant to NRS 534.170, the following information must be contained in the log and record of work:

(a) The complete name and address of the person for whom the work is being performed.

(b) The location of the well, including:

(1) A description of its location by public land survey and county assessor's parcel number.

(2) Global positioning system coordinates which:

(I) Are either identified by latitude and longitude using decimal degrees or are identified using coordinates of the Universal Transverse Mercator system; and

(II) Specify for each coordinate whether the North American Datum of 1927, North American Datum of 1983 or the World Geodetic System 1984 was used.

(3) In a log and record of work for a well drilled for domestic use, the address of the house to be served by the well, the lot and block description and the name of the subdivision.

(4) If applicable, the waiver number or permit number.

(c) Any pumping test or development data.

(d) An accurate identification of the water-bearing formations.

(e) If the static water level is measured from the top of the casing, the elevation of the top of the casing above the land surface.

3. An accurate description of the perforations in the casing must be set forth in the section of the log and record of work that contains a record of the well casing.

4. If the well driller does not have a thermometer, the temperature of the water may be described in the log and record of work as cold, warm or hot.

5. The flow from a well which flows or is pumped may be determined for the purpose of the log and record of work by measuring the length of time it takes to fill a container of known capacity if the flow is not too large to be measured in that manner.

6. As used in this section, "pumping test" means a test of a well conducted by pumping a specified amount or continuous flow of water from a well to determine the characteristics of the well or an aquifer.

[St. Engineer, Drilling Wells Reg. Part 7, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97; R009-06, 6-1-2006)

NAC 534.345 Log and record of work: Completion; execution; submission; correction. (NRS 534.020, 534.110, 534.140, 534.170)

1. All work performed by the well driller during the drilling operation must be accurately described in the log and record of work submitted by the well driller pursuant to NRS 534.170 and NAC 534.340.

2. The completed log and record of work must be signed by:

(a) The licensed well driller who is present at the well-drilling site as required pursuant to NAC 534.330; or

(b) The drilling contractor responsible for the work pursuant to NAC 534.296.

3. A well driller may submit the log and record of work required to be submitted to the State Engineer pursuant to NRS 534.170 and NAC 534.340 in an electronic format if the Division approves this manner of submission for the well driller before the well driller submits the log and record of work.

4. If any of the information required to be included by regulation or statute is omitted from the log and record of work, the Division will return the log and record of work to the well driller for correction. Any corrections to the log and record of work must be made and submitted to the State Engineer within 30 days after the date on which the well driller receives the log and record of work from the Division. If corrections are made to the log and record of work and submitted to the State Engineer:

(a) Thirty-one days or more after the date on which the well driller receives the log and record of work but less than 90 days after that date, the log and record of work shall be deemed to be submitted late and the Division shall assess demerit points against the license of the well driller pursuant to NAC 534.500; or

(b) Ninety days or more after the date on which the well driller receives the log and record of work, the log and record of work will be accepted by the State Engineer but the late submittal of the log and record of work shall be deemed to be a failure to file the log and record of work and the Division shall assess demerit points against the license of the well driller pursuant to NAC 534.500.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97; R009-06, 6-1-2006)

NAC 534.350 Identification of well rig. (NRS 534.020, 534.110, 534.140) The name and address of the contractor drilling the well must be conspicuously displayed in legible letters at least 3 inches high on the drill rig operated or owned by that contractor. The identification must be displayed on the rig before the rig is positioned at the drill site.

[St. Engineer, Drilling Wells Reg. Part 9, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97)

NAC 534.355 Reporting of improper construction or plugging of well. (NRS 534.020, 534.110, 534.140) A licensed well driller who becomes aware of specific information relating to improper construction or improper plugging of a well shall report that information to the Division as soon as practicable.

(Added to NAC by St. Engineer, eff. 12-30-97; A by R009-06, 6-1-2006)

NAC 534.360 Construction of well: Casing. (NRS 534.020, 534.060, 534.110, 534.140)

1. Except as otherwise provided in subsection 2, all wells must be cased to the bottom of the well bore and constructed to prevent contamination or waste of the groundwater.

2. If no additional water is developed in the bottom portion of a well, neat cement, cement grout or concrete grout must be placed by tremie pipe in an upward direction from the bottom of the well to the bottom of the casing.

3. The casing must:

(a) Except as otherwise provided in this paragraph and NAC 534.362, be of new steel or clean and sanitary used steel. Materials other than steel may be used if the design of the well or the subsurface conditions prevent the use of steel casing and a professional engineer who holds a certificate of registration issued pursuant to chapter 625 of NRS has approved the casing materials.

(b) Be free of pits and breaks.

(c) Conform to the following minimum specifications, allowing for mill tolerance:

(1) If the conductor casing is 50 feet or less in depth, the thickness of the wall must be:

(I) At least 0.141 or 9/64 of an inch if the wall is made of a material other than galvanized steel pipe that has been corrugated; or

(II) At least 0.109 or 7/64 of an inch if the wall is made of galvanized steel pipe that has been corrugated.

(2) If the depth of the conductor casing exceeds 50 feet, and for all production or intermediate casing, the wall must be sufficiently thick to conform to the casing sizes listed in sub-subparagraphs (I) to (IV), inclusive:

(I) If the casing is smaller than 10 inches nominal size, the wall must be at least 0.188 or 3/16 of an inch thick.

(II) For 10-, 12-, 14- and 16-inch nominal size casing, the wall must be at least 0.250 or 1/4 of an inch thick.

(III) For 18- and 20-inch nominal size casing, the wall must be at least 0.312 or 5/16 of an inch thick.

(IV) For casing larger than 20 inches nominal size, the wall must be at least 0.375 or 3/8 of an inch thick.

4. The top of the casing on all wells must be at least 12 inches above the surface of the ground or the finished grade.

5. All production casing joints must be threaded and coupled or welded and be watertight. If the casing joints are welded, each joint must be welded completely. Spot welds of casing joints are prohibited.

6. The well driller shall ensure that the integrity of any casing to be used in the construction of the well has not been impaired by storage, shipping, handling, perforating or exposure to ultraviolet light.

[St. Engineer, Drilling Wells Reg. § 3.01, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97; R009-06, 6-1-2006)

NAC 534.362 Construction of well: Thermoplastic casing. (NRS 534.020, 534.060, 534.110, 534.140)

1. New thermoplastic water well casing made of polyvinyl chloride may be used as casing in a well if the casing:

(a) Is clearly marked as well casing; and

(b) Complies with the standards adopted by the American Society for Testing and Materials, designated as ASTM F-480-02, which are hereby incorporated by reference. A copy of the standards may be obtained by mail from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, Pennsylvania 19428-2959 or by telephone at (610) 832-9585, at a cost of $48.50, or may be obtained at the Internet address **http://www.astm.org**, at a cost of $45.

2. If polyvinyl chloride well casing is used:

(a) The differential pressures that may occur during the installation of casing, the development of the well and the operation of the well must be considered by the well driller and the person responsible for designing the well.

(b) The wall thickness must:

(1) For nominal diameters that are 6 inches or less, conform to a rating of schedule 40 or heavier. For example, a nominal pipe that is 6 inches in diameter and has a rating of schedule 40 must have a wall thickness of at least 0.280 inch. The ASTM standard dimension ratio that would exceed this standard is an ASTM standard dimension ratio of 21 or heavier. An ASTM standard dimension ratio of 26 would not satisfy the requirements of this subparagraph for nominal diameters that are 6 inches or less.

(2) For nominal diameters that are more than 6 inches, conform to the ASTM standard dimension ratio of 21 or heavier. For example, a nominal pipe that is 8 inches in diameter and has an ASTM standard dimension ratio of 21 must have a wall thickness of at least 0.410 inch. A rating of schedule 40 would not satisfy the requirements of this subparagraph for a nominal pipe that is 8 inches in diameter and has a wall thickness of 0.322 inch.

(c) The joint connections must be:

(1) Flush-threaded;

(2) Threaded and coupled; or

(3) Joined with nonmetallic couplings that are sealed with elastomeric sealing gaskets and which consist of flexible thermoplastic splines that are inserted into precisely machined grooves in the casing.

➥ The joint connections must not be glued or joined by restraining devices that clamp into or otherwise damage the surface of the casing. If the joint connections are flush-threaded or threaded and coupled, the well driller shall ensure that the connections are not overtightened.

3. If polyvinyl chloride well casing is used in a water well or monitoring well, the well driller shall set a protective steel casing which complies with the provisions of NAC 534.360 and extends not less than 5 feet inside the sanitary seal and not less than 1 foot above the finished grade. The top of the protective casing must be fitted with a locking cap or a standard sanitary well cap.

(Added to NAC by St. Engineer, eff. 12-30-97; A by R009-06, 6-1-2006)

NAC 534.370 Construction of well: Prevention of contamination; securing against unauthorized entry; suspension of drilling. (NRS 534.020, 534.110, 534.140)

1. The driller shall take the precautions necessary to:

(a) Seal off any known zones of poor quality water which may affect the zones of good quality water in the well.

(b) Prevent contamination or waste of groundwater.

2. Any additive used in drilling a well must be safe and must not contaminate or induce contamination of the groundwater.

3. If it becomes necessary for the driller to discontinue the drilling operation before completion of the well, the well must be covered securely to prevent a contaminant from entering the casing or borehole and rendered secure against entry by children, domestic animals and wildlife.

4. After drilling is completed, all openings must be closed off to prevent contamination of the well. A sanitary well cap or welded plate must be welded to the well.

5. If drilling is suspended for any reason, the Division must be notified within 24 hours after drilling is suspended or before the drilling equipment is moved from the drilling site, whichever occurs first. The suspension of drilling without completing or plugging the well must be approved by the Division.

[St. Engineer, Drilling Wells Reg. §§ 3.14 & 3.15, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97)

NAC 534.375 Construction of well: Measures required if contaminant or contaminated water is encountered. (NRS 534.020, 534.110, 534.140) If a contaminant or contaminated water is encountered during the construction of a well, the strata which contain the contaminant or contaminated water must be cased or sealed in such a manner that the contaminant or contaminated water does not commingle with or impair other strata or the water contained in other strata. The well driller shall, by grouting or by using special seals or packers, prevent the movement of the contaminant or contaminated water in the well bore.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.378 Construction of well: Measures required if artesian condition is encountered. (NRS 534.020, 534.060, 534.110, 534.140)

1. If an artesian condition is encountered in a well, the well driller shall, in addition to complying with the provisions of subsections 2 and 3 of NRS 534.060, ensure that unperforated casing extends through the confining strata above the artesian zone. The annular space between the casing and the walls of the well bore must be sealed by placing neat cement, cement grout or bentonite grout, that consists of not less than 30 percent bentonite, by tremie pipe in an upward direction from the top of the artesian zone to the level necessary to prevent the leakage of artesian water above or below the surface.

2. Any flow of artesian water must be stopped completely in the manner set forth in subsection 3 of NRS 534.060 before the drill rig is removed from the drill site.

(Added to NAC by St. Engineer, eff. 12-30-97; A by R009-06, 6-1-2006)

NAC 534.380 Construction of well: Seals. (NRS 534.020, 534.060, 534.110, 534.140)

1. Except as otherwise provided in subsection 2, before the drill rig is removed from the drill site of a well, the annular space between the well bore and the casing must be sealed to a minimum depth of 50 feet below ground level by:

(a) Placing neat cement, cement grout, concrete grout or bentonite grout, which consists of not less than 30 percent bentonite, from the sealing depth to 10 feet from the surface; and

(b) Placing neat cement, cement grout or concrete grout from 10 feet below the surface to the surface.

2. Before the drill rig is removed from the drill site of a well, the annular space between the well bore and the casing must be sealed to a depth of greater than 50 feet below ground level if sealing to such a depth is required by subsection 1 of NAC 534.370, NAC 534.375, subsection 1 of NAC 534.378 or paragraph (b) of subsection 1 of NAC 534.390.

3. The casing must be centered as nearly as practicable in the well bore to allow the sanitary seal to surround the casing.

4. If a temporary conductor casing is used, it must be withdrawn during the placement of the grout.

5. If a pitless adapter is used in domestic or small commercial wells:

(a) The sanitary seal must begin not more than 5 feet below ground level;

(b) The sanitary seal must extend at least 50 feet below ground level; and

(c) The portion of the casing above the sanitary seal must be backfilled to ground level with uncontaminated soil which is compacted.

6. A pipe used to feed gravel through the cement seal or to provide access to the interior of the well must be fitted with a watertight cap.

7. A licensed well driller must place the seal or directly supervise the placement of the seal.

8. The seal must be placed:

(a) In the annular space within 3 days after the casing is set and before the drill rig is removed from the drill site.

(b) In one continuous mass from the minimum depth of 50 feet below ground level to the surface.

(c) By tremie pipe in an upward direction to displace the fluid to the surface of the ground, if any fluid is standing in the well bore above the sealing depth.

9. The diameter of the well bore must be at least 4 inches larger than the largest diameter of the outside of the outermost casing to be used, including any joints or collars. If a fill pipe for gravel is installed, the diameter of the well bore must be 4 inches larger than the largest diameter of the casing plus the largest diameter of the fill pipe for gravel. A fill pipe for gravel or any other pipe to provide access to the interior of the well must be completely surrounded by the seal. A conductor casing may be used to convey the gravel pack. If a conductor casing is used:

(a) The diameter of the well bore must be at least 4 inches larger than the largest diameter of the conductor casing; and

(b) The annular space between the conductor casing and the well bore must be sealed.

10. A watertight seal must be installed at the surface level between the conductor casing and the production casing to prevent any contaminants from entering the gravel pack conductor area. A welded plate or a seal consisting of neat cement, cement grout or concrete grout from a minimum depth of 10 feet below ground level to the surface must be used. If a welded plate is used, the entire length of the plate must be welded to the conductor casing and production casing.

[St. Engineer, Drilling Wells Reg. §§ 3.02-3.13 & 3.16, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97; R009-06, 6-1-2006)

NAC 534.390 Construction of well: Location near river, lake, perennial stream, unlined reservoir or unlined canal; compliance with permit or waiver. (NRS 534.020, 534.060, 534.110, 534.140)

1. If a well, other than a monitoring well, is drilled within 1/4 mile of a river, lake, perennial stream, unlined reservoir or unlined canal:

(a) Perforations in the production casing are prohibited from ground level to a depth of 100 feet.

(b) The well must be sealed to a depth of 100 feet.

(c) A permanent conductor casing may be used to convey the gravel pack to the 100-foot level.

2. If a well is being drilled pursuant to a permit or waiver, the well driller is responsible for satisfying the terms and conditions of the permit or waiver concerning the construction of the well.

[St. Engineer, Drilling Wells Reg. Part 5, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97)

NAC 534.420 Plugging of well: General requirements. (NRS 534.020, 534.110)

1. Except as otherwise provided in NAC 534.422, wells must be plugged in the manner prescribed in this section by a well driller licensed by the State Engineer.

2. A well driller shall:

(a) Ensure that a notice of his intent to plug a water well is received by the Division not less than 3 working days before the drill rig is moved to the location where the well will be plugged; and

(b) Notify the Division not less than 24 hours before he begins to plug the well.

3. Before the well driller begins to plug the well, he shall, if possible, obtain the log and record of work for that well from the Division or the owner of the well.

4. On abandonment or order of the State Engineer, a water well must be plugged by:

(a) Removing the pump or debris from the well bore with appropriate equipment; and

(b) If an annular cement seal was not installed, breaking the casing free with appropriate equipment so that the casing may be pulled from the well.

5. If the casing in the well:

(a) Breaks free, the well driller shall plug the borehole in the manner prescribed in NAC 534.4371 as the casing is pulled from the well. The well must be plugged from the total depth of the well to the surface of the well, in stages if necessary, to displace in an upward direction any fluid or debris in the well.

(b) Does not break free, the well driller shall perforate that portion of the casing which extends from the bottom of the well to not less than 50 feet above the top of the uppermost saturated groundwater stratum. That portion of the casing must be perforated not less than four

times per each 2 linear feet to allow the plugging fluid to penetrate the annular space and the geologic formation. The perforations made in each 2 linear feet of the casing must be made along a horizontal plane of the well bore. A well with a diameter of more than 8 inches in nominal size must be perforated a sufficient number of additional times per linear foot to ensure that the plugging fluid penetrates into the annular space and formation. The well driller shall then plug the well from the total depth of the well to 50 feet above the uppermost saturated groundwater stratum or to within 20 feet of the surface of the well, whichever is less, with neat cement or bentonite grout specifically designed to plug abandoned wells. If the neat cement or bentonite grout is not brought to within 20 feet of the surface of the well, the well driller shall:

(1) Measure the depth of the top of the lower plug with the appropriate equipment after he has allowed sufficient time for the lower plug to set up;

(2) Continue to install neat cement or bentonite grout until the top of the lower plug remains at least 50 feet above the top of the uppermost saturated groundwater stratum; and

(3) Install uncontaminated fill material or one of the plugging materials described in subsection 3 of NAC 534.4371 from the top of the lower plug to within 20 feet of the surface of the well.

6. The well driller shall place a surface plug in the well consisting of neat cement, cement grout or concrete grout from a depth of at least 20 feet to the surface of the well.

7. If the well casing does not break free and there is no evidence of a sanitary seal around the well casing, the well driller shall, in addition to the requirements of subsection 5, perforate the upper 50 feet of casing before setting the surface plug. The casing must have at least four perforations per each 2 linear feet of casing, and the surface plug must consist of neat cement and must extend from 50 feet below ground level to the surface of the well.

8. A well driller shall submit a log and record of work to the Division within 30 days after a water well has been plugged. The log and record of work must contain the location of the well by public land survey and county assessor's parcel number, the name of the owner of the well, the condition of the well, the static water level before plugging and a detailed description of the method of plugging, including, but not limited to:

(a) The depth of the well;

(b) The depth to which the materials used to plug the well were placed;

(c) The type, size and location of the perforations which were made in the casing;

(d) The debris encountered in, milled out of or retrieved from the well; and

(e) The materials used to plug the well.

9. If there is any standing liquid in the interval of the well bore that is being plugged, all grout materials used pursuant to this section must be placed by tremie pipe in an upward direction.

[St. Engineer, Drilling Wells Reg. Part 14, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97; R009-06, 6-1-2006)

NAC 534.422 Plugging of well: Use of exceptional method; plugging by person other than licensed well driller. (NRS 534.020, 534.110)

1. A well driller who wishes to plug a well in a manner that does not comply with the provisions set forth in NAC 534.420 must request approval from the Division.

2. If the Division authorizes the well driller to plug the well in a manner other than the manner set forth in NAC 534.420, the well driller shall comply with the instructions he receives from the Division, if any, relating to the manner in which the well must be plugged.

3. A contractor licensed pursuant to chapter 624 of NRS, or any other person, may request and obtain a waiver of the requirement of NAC 534.420 that a well must be plugged by a well driller licensed by the State Engineer if the contractor or other person provides proof satisfactory to the State Engineer that the contractor or other person has the ability to comply with the other requirements of NAC 534.420. A contractor or other person who obtains a waiver pursuant to this subsection must comply with the provisions of NAC 534.420 as if he were a licensed well driller.

(Added to NAC by St. Engineer, eff. 12-30-97; A by R009-06, 6-1-2006)

NAC 534.424 Plugging of well: Responsibility for cost. (NRS 534.020, 534.110)

1. If a well is located on private land, the owner of the land at the time the well is plugged is responsible for the cost of plugging the well.

2. If a well is located on public land, the person who last drilled or used the well is responsible for the cost of plugging the well. If the person who last drilled or used the well does not plug the well after receiving notice from the Division by certified mail, return receipt requested, that the well must be plugged, the Division shall notify the person who owns the land on which the well is located that it is his responsibility to plug the well.

(Added to NAC by St. Engineer, eff. 12-30-97; A by R009-06, 6-1-2006)

NAC 534.427 Mandatory plugging of certain wells. (NRS 534.020, 534.110)

1. If any type of permit, waiver or application to appropriate water from a water well is cancelled, abrogated, forfeited, withdrawn or denied, the well must be plugged in the manner prescribed in NAC 534.420.

2. Except as otherwise provided in subsection 9 of NAC 534.315, a well, other than a water well drilled for a domestic purpose, must be plugged in the manner prescribed in NAC 534.420 if:

(a) The Division has not issued a permit or waiver for the well; or

(b) The well is not located in a designated basin and there is no reasonable expectation of obtaining a valid permit, waiver or certificate of water right from the Division.

3. A well, including a water well drilled for a domestic purpose, must also be plugged in the manner prescribed in NAC 534.420 if the State Engineer sends a notice to the owner of the well pursuant to subsection 9 of NAC 534.315 and either:

(a) The State Engineer has determined that the well is in any manner defective; or

(b) The Division makes a finding that:

(1) The well tends to impair existing rights or the safety and welfare of the residents of this State;

(2) The mechanical integrity of the construction of the well has failed or is unknown;

(3) The well was not drilled in compliance with the provisions of this chapter;

(4) The well was not drilled in compliance with the provisions of chapter 534 of NRS;

(5) The well tends to cause contamination of the groundwater aquifer;

(6) There is no evidence of impending use of the well for any legal purpose or that no legal use of the well is allowed; or

(7) The well tends to cause water to be wasted above or below the surface of the well.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97; R009-06, 6-1-2006)

NAC 534.430 Access port or removable well cap required. (NRS 534.020, 534.110, 534.140)

1. Except as otherwise provided in subsection 3, each well that is drilled, deepened or reconditioned must have:

(a) An access port near the top of the casing that is not less than 1 inch in diameter; or

(b) A commercially manufactured sanitary well cap that may be easily removed to determine the level of water in the well.

2. An access port must have a watertight, screw-type cap seal to prevent contamination and must be kept closed.

3. On wells that are 8 inches in diameter or smaller, the access may be a 1/2-inch hole at the top of the casing or in the casing cover with a removable plug or bolt.

4. As used in this section, "access port" means an opening in the top of a well casing in the form of a tapped hole and plug or a capped pipe welded on the casing to permit entry of a device to measure the water level of the well.

[St. Engineer, Drilling Wells Reg. Part 6, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97)

NAC 534.432 Noncompliance with requirements for well drilling. (NRS 534.020, 534.110, 534.140, 534.160) If a well was:

1. Constructed by a person who, at the time the well was constructed, was not the holder of a well-drilling license issued pursuant to NRS 534.140; or
2. Not constructed or completed in compliance with the provisions of this chapter as determined by the State Engineer,

➥ the well must be abandoned and plugged in the manner prescribed in NAC 534.420 at the expense of the person who constructed the well.

(Added to NAC by St. Engineer, eff. 12-30-97; A by R009-06, 6-1-2006)

NAC 534.4351 Monitoring wells: Restrictions on construction; submission of plat map, map of vicinity, and log and record of work. (NRS 534.020, 534.110, 534.140, 534.170)

1. A monitoring well must be:

(a) Drilled only by a well driller who is licensed by the State Engineer;

(b) Constructed in accordance with the provisions of this chapter, except for any provision that is waived by the State Engineer; and

(c) Drilled only for the purpose of complying with federal, state or local environmental requirements or any other federal, state or local requirements.

2. A plat map showing the actual location of the monitoring well, a map of the vicinity and a log and record of work which contains the information described in NRS 534.170 and NAC 534.340 must be submitted within 30 days after completion of the well by the person who is responsible for the well. The plat map must indicate the distance of the well from permanent reference points, including streets, roads or section lines. The map must be drawn on paper measuring 8 1/2 inches by 11 inches or 11 inches by 17 inches.

(Added to NAC by St. Engineer, eff. 12-30-97; A by R009-06, 6-1-2006)

NAC 534.4353 Monitoring wells: Responsibilities of owner; permits; affidavit of responsibility for plugging. (NRS 534.020, 534.060, 534.110, 534.140)

1. The owner of a monitoring well shall ensure that the well:

(a) Does not cause contamination of groundwater during its use; and

(b) Is plugged upon abandonment.

2. A permit to appropriate water or a waiver from the State Engineer is not required to drill and collect data from a monitoring well unless the well is not constructed in the manner prescribed in this chapter.

3. The well driller shall, when he submits the notice of intent to drill pursuant to NAC 534.320, submit to the Division a notarized affidavit on a form prescribed by the Division which is signed by the person who will be responsible for plugging the well and states that he will be responsible for plugging the well when it is abandoned. The Division shall prescribe the form required pursuant to this subsection and make copies of the form available upon request.

4. The owner of a monitoring well shall notify the Division in writing as soon as practicable after determining that the well will no longer be used.

5. If a monitoring well or any other well is to be used to remove a contaminant from groundwater, a permit to appropriate water for environmental purposes must be obtained from the State Engineer pursuant to the provisions of NRS 533.437 to 533.4377, inclusive.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.4355 Monitoring wells: Casing; prevention of contamination. (NRS 534.020, 534.060, 534.110, 534.140)

1. A well driller shall install casing in a monitoring well. If polyvinyl chloride casing is used, it must comply with the standards adopted by the American Society for Testing and Materials, designated as ASTM F-480.

2. The well driller shall take the precautions necessary to prevent contamination of groundwater. The equipment used to construct a monitoring well must be decontaminated before the construction of the well is commenced.

3. The diameter of the casing must not exceed 4 inches in nominal size.

4. The connections of the casing must comply with the provisions of NAC 534.360 or 534.362. The connections must be made watertight by wrapping them with teflon tape, placing a ring or gasket between them or by any other method which will not introduce contaminants into the well.

5. Both ends of the casing must be capped.

6. The perforations must be of a width and length which will allow the strata to be observed while not permitting the infiltration of the gravel pack through the casing or allowing the contaminants or water from separate strata to commingle.

7. To ensure adequate space for the gravel pack and seals, the well bore of a monitoring well must, for the entire length of the casing placed in the well, be not less than 4 inches larger than the diameter of the casing.

8. Not more than one perforated or screened section of casing may be placed in the well bore of a monitoring well unless the vertical intervals of the well bore in between the screened sections are sealed with neat cement, cement grout, bentonite grout or fully hydrated sodium bentonite tablets or chips.

9. Not more than one casing may be placed in the well bore of a monitoring well unless the vertical intervals of the well bore in between the screened sections of the casings are sealed with neat cement, cement grout, bentonite grout or fully hydrated sodium bentonite tablets or chips.

10. Monitoring wells must be drilled an adequate distance from each other to ensure that there is no commingling of the contaminants or groundwater encountered in the wells.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.4357 Monitoring wells: Placement of gravel and seals in annular space. (NRS 534.020, 534.110, 534.140)

1. If the water or vapors which are being monitored in a monitoring well are not encountered within 5 feet below the surface of the ground, the well driller shall place in the annular space of the well:

(a) From the bottom of the well to 2 feet above the uppermost perforation in the casing, a gravel pack which consists of quartz sand, silica or other materials which will not contaminate the groundwater or the geologic formation;

(b) From the gravel pack placed pursuant to paragraph (a) to 2 feet above that gravel pack, a seal consisting of fully hydrated sodium bentonite pellets or bentonite grout; and

(c) From the seal placed pursuant to paragraph (b) to the surface, a seal consisting of cement grout, neat cement, concrete or bentonite grout.

2. If the water or vapors which are being monitored in a monitoring well are encountered within 5 feet below the surface of the ground, the well driller shall comply with the requirements of subsection 1, except that:

(a) The gravel pack required pursuant to paragraph (a) of subsection 1 must extend only 6 inches above the uppermost perforation in the casing; and

(b) The surface seal required pursuant to paragraph (c) of subsection 1 must be placed from 1 foot below the surface to the surface.

3. The well driller shall ensure that a bridge does not occur in the annular space during the placement of the gravel pack and seals required pursuant to this section.

4. If more than 20 continuous feet of grout are placed in the annular space of the well or if there is standing liquid in the well bore above the sealing depth, the grout must be placed by tremie pipe in an upward direction.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.4359 Monitoring wells: Measures required if contaminant or contaminated water is encountered. (NRS 534.020, 534.110, 534.140) If a contaminant or contaminated water is encountered during the construction of a monitoring well, the strata which contain the contaminant or contaminated water must be cased and sealed in such a manner that the contaminant or contaminated water does not commingle with or impair other strata or the water

contained in other strata. The well driller shall seal the strata by grouting or by using special seals or packers, if necessary, to prevent the movement of the contaminants or contaminated water in the well bore.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.4361 Monitoring wells: Surface pad; prevention of unauthorized use; additional protective measures. (NRS 534.020, 534.110, 534.140)

1. Unless the area surrounding a monitoring well is paved with concrete or asphalt, a surface pad must be installed around the casing at the surface.

2. A threaded or flanged cap or compression seal must be installed to prevent unauthorized use of the well. If the top of the well is flush with the surface and the well protector required pursuant to subsection 3 is of a type which may not be locked, the cap or seal must be of a type which may be locked.

3. The well must also be protected and secured by:

(a) If it is not necessary for the well to be flush with the surface:

(1) Setting a steel surface casing which complies with the requirements set forth in NAC 534.360 and extends not less than 5 feet below the surface pad and not less than 1 foot above the surface pad;

(2) Fitting the top of the steel casing with a locking cap; and

(3) Clearly marking the well as a monitoring well; or

(b) If it is necessary for the well to be flush with the surface:

(1) Placing a well protector capable of supporting vehicular travel which extends one-half inch above the surface pad or concrete or asphalt paving; and

(2) Clearly marking the well as a monitoring well.

4. As used in this section, "surface pad" means a formation of concrete or cement grout with a diameter of not less than 1 foot and a thickness of not less than 3 1/2 inches which is set around a monitoring well at a slope to ensure that water flows away from the well.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.4363 Monitoring wells: Artesian conditions. (NRS 534.020, 534.060, 534.110, 534.140) If an artesian condition is encountered in a monitoring well, the well driller shall ensure that the well is sealed in the manner prescribed in NAC 534.378.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.4365 Monitoring wells: Plugging. (NRS 534.020, 534.110)

1. Except as otherwise provided in this section, a monitoring well must be plugged within 30 days after monitoring is no longer required.

2. Except as otherwise provided in subsections 3 and 4, a monitoring well must be plugged by placing neat cement or a high-solids bentonite grout, which consists of not less than 20 percent bentonite by weight of water, by tremie pipe in an upward direction from the bottom of the well to the surface of the well.

3. If the casing in the monitoring well can be removed from the well bore, the bottom end of the casing in the monitoring well must be removed or perforated and neat cement or high-solids bentonite grout must be placed by tremie pipe in an upward direction from the bottom of the well to the surface of the well as the casing is removed from the well bore.

4. If the integrity of the borehole remains intact as the casing is removed from the well bore, the well may be plugged as provided in NAC 534.4371.

(Added to NAC by St. Engineer, eff. 12-30-97; A by R009-06, 6-1-2006)

NAC 534.4367 Drive point wells. (NRS 534.020, 534.110, 534.140)

1. A well driller may construct a drive point well without placing in the annular space of the well the gravel pack and seals required pursuant to NAC 534.4357.

2. The diameter of the casing used in a drive point well which is not constructed pursuant to the provisions of NAC 534.4357 must not be larger than 2 inches in nominal size.

3. A drive point well which is not constructed pursuant to the provisions of NAC 534.4357 must be abandoned within 60 days after the well is constructed. Upon abandonment, the casing must be removed from the well bore and the well bore must be plugged in the manner provided in NAC 534.4371.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.4369 Boreholes: Generally. (NRS 534.020, 534.110)

1. A borehole may be drilled or plugged by a person who is not a licensed well driller.
2. A person who constructs or plugs a borehole is not required to file with the Division a notice of intent to drill or plug the borehole.
3. A borehole may be drilled without obtaining from the Division a permit to appropriate water or a waiver of the requirement to obtain such a permit.
4. A person who drills or plugs a borehole, the operator of the exploration project or the owner of the land where the borehole is located must maintain a record of the drilling operation which includes:

(a) The dates on which the borehole is constructed and plugged;
(b) The location of the borehole as shown by public land survey;
(c) The depth and diameter of the borehole;
(d) The depth at which groundwater is encountered in the borehole; and
(e) The methods and materials used to plug the borehole.

5. The State Engineer may, at any time, require the person drilling or plugging the borehole, the operator of the exploration project or the owner of the land on which the borehole is located to submit to the State Engineer a copy of the record required pursuant to subsection 4 and any other information relating to the construction, operation or plugging of the borehole that the State Engineer determines is necessary.
6. The owner and the lessor of the land on which a borehole is located, the operator of the exploration project and the drilling or plugging contractor for the project shall ensure that the groundwater is uncontaminated during the drilling, operation or plugging of the borehole.
7. A borehole must not be used to divert water for any purpose.

(Added to NAC by St. Engineer, eff. 12-30-97; A by R009-06, 6-1-2006)

NAC 534.4371 Boreholes: Plugging requirements. (NRS 534.020, 534.110)

1. A borehole must be plugged within 60 days after it is drilled.
2. Except as otherwise provided in subsection 4, a borehole must be plugged:

(a) In the manner prescribed in NAC 534.420; or
(b) If the uppermost saturated groundwater stratum is above the bottom of the borehole:

(1) By placing concrete grout, cement grout, neat cement or bentonite grout by tremie pipe in an upward direction from the bottom of the borehole to within 10 feet of the surface and by placing concrete grout, cement grout or neat cement from 10 feet below the surface to the surface;

(2) By placing sodium bentonite chips or pellets specifically designed to be used to plug boreholes from the bottom of the borehole to within 10 feet of the surface and by placing concrete grout, cement grout or neat cement from 10 feet below the surface to the surface; or

(3) By placing any of the plugging materials described in this subsection from the total depth of the borehole to 50 feet above the uppermost saturated groundwater stratum and by placing concrete grout, cement grout, or neat cement from 10 feet below the surface to the surface.

3. If the concrete grout, cement grout, neat cement, bentonite grout or dry bentonite material is not brought to within 10 feet of the surface pursuant to paragraph (b) of subsection 2, the person responsible for plugging the borehole shall:

(a) Measure the depth of the top of the lower plug with the appropriate equipment after he has allowed sufficient time for the lower plug to set up;

(b) Continue to install concrete grout, cement grout, neat cement, bentonite grout or dry bentonite material until the top of the lower plug remains at least 50 feet above the top of the uppermost saturated groundwater stratum;

(c) Install uncontaminated fill material or one of the plugging materials described in this subsection from the top of the lower plug to within 10 feet of the surface; and

(d) Place concrete grout, cement grout or neat cement from 10 feet below the surface to the surface.

4. If the elevation of the bottom of the borehole is higher than the preexisting natural elevation of the uppermost saturated groundwater stratum, the borehole must be plugged by:

(a) Backfilling the borehole from the bottom of the borehole to within 10 feet of the surface with uncontaminated soil; and

(b) Placing concrete grout, cement grout or neat cement from 10 feet below the surface to the surface.

5. If sodium bentonite chips or pellets or uncontaminated soil are placed in the borehole, they must be placed in such a manner that a bridge does not occur. Sodium bentonite chips or pellets may not be placed in more than 100 feet of standing liquid unless the chips or pellets have been coated by the manufacturer to delay hydration.

6. If casing is set in a borehole, the borehole must be completed as a well pursuant to the provisions of this chapter. The borehole must be plugged pursuant to NAC 534.420, or the casing must be removed from the borehole when it is plugged. The upper portion of the borehole may be permanently cased if the annular space between the casing and the walls of the borehole is completely sealed from the bottom of the casing to the surface pursuant to NAC 534.380.

(Added to NAC by St. Engineer, eff. 12-30-97; A by R009-06, 6-1-2006)

NAC 534.4373 Boreholes: Responsibility for plugging. (NRS 534.020, 534.110) The owner and lessor of the land on which a borehole is located, the operator of the exploration project and the plugging contractor for the project are jointly and severally responsible for plugging the borehole pursuant to this chapter.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.4375 Boreholes, blast holes and seismic shot holes: Artesian conditions. (NRS 534.020, 534.060, 534.110) If an artesian condition is encountered in any borehole, blast hole or seismic shot hole, the artesian water strata must be contained pursuant to NRS 534.060 and NAC 534.378, and the borehole, blast hole or seismic shot hole must be sealed by the method described in subsection 2 of NAC 534.4371. The owner and lessor of the land on which a borehole is located, the operator of the exploration project and the drilling contractor for the project shall take the necessary steps to prevent the loss of water above or below the surface and to prevent the vertical movement of water in the well bore.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.4377 Treatment of certain holes as boreholes. (NRS 534.020, 534.110)

1. For the purposes of this chapter, blast holes are not boreholes.

2. If the construction of a shot hole or a hole used for the installation of electrical conductors as part of a system to prevent corrosion or provide electrical grounding may cause waste or contamination of the groundwater, the hole shall be deemed a borehole for the purposes of NAC 534.4369 and 534.4371.

(Added to NAC by St. Engineer, eff. 12-30-97)

NAC 534.438 Prerequisites to using bentonite grout to seal, grout or plug well or borehole. (NRS 534.020, 534.110) Before using bentonite grout to seal, grout or plug a well or borehole, the person using the bentonite grout must:

1. Consider the geology of the well or borehole, the design of the well and any requirements set forth in this chapter or chapter 534 of NRS in his selection of the bentonite grout; and

2. Mix the bentonite grout and place the bentonite grout in accordance with specifications recommended by the manufacturer.

(Added to NAC by St. Engineer by R009-06, eff. 6-1-2006)

WAIVERS

NAC 534.440 Waiver to drill exploratory well to determine quality or quantity of water in designated basin. (NRS 534.020, 534.050, 534.110)

1. The request for a waiver to drill an exploratory well to determine the quality or quantity of water pursuant to NRS 534.050 in a designated basin must be submitted in writing and contain the following information:

(a) The location by public land survey, county assessor's parcel number, map of the vicinity and plat map of the exploratory well anticipated to be drilled;

(b) The name, address and telephone number of the person who:

(1) Is collecting data from the exploratory well; and

(2) Will be available to answer questions concerning the well;

(c) The reason for requesting a waiver;

(d) The proposed diameter and depth of the exploratory well;

(e) The estimated starting and completion dates of the exploratory well, not to exceed 90 days after authority is given to drill;

(f) The name, address and telephone number of the person who will be responsible for plugging the well, and the name, address and telephone number of the owner of the land where the well will be located if he is not the person responsible for plugging the well; and

(g) A notarized affidavit signed by the person responsible for plugging the well which states that he will be responsible for plugging the well if it is abandoned.

2. Each waiver for an exploratory well will bear a unique number preceded by the letter "W." The notice of intent to drill submitted to the Division pursuant to NAC 534.320 and the record of work submitted to the Division pursuant to NRS 534.170 must bear this number.

3. An application to appropriate water must be on file with the Division or accompany each request for a waiver.

4. A copy of the waiver must be in the possession of the well driller at the drill site.

5. The exploratory well must be:

(a) Plugged by the well driller in the manner prescribed in NAC 534.420 within 3 days after the completion of the aquifer tests for which the well was drilled; or

(b) Completed as a well pursuant to the provisions of this chapter before the drill rig is removed from the drill site.

6. The water from the well may not be used for any purpose other than the purposes set forth in the waiver without the written approval of the State Engineer.

7. A waiver to drill an exploratory well will not be granted pursuant to this section for a well in an area in which the Division determines there is sufficient information existing concerning the aquifer for the area.

[St. Engineer, Drilling Wells Reg. Part 16, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97; R009-06, 6-1-2006)

NAC 534.442 Waiver to use water to explore for minerals. (NRS 534.020, 534.050, 534.110)

1. A request for a waiver to allow a temporary use of water from an existing well to explore for minerals or to drill a well and to use the water from the well to explore for minerals must be submitted to the State Engineer in writing and contain:

(a) The amount of water that will be used each day;

(b) A brief description of the manner in which the water will be put to a beneficial use;

(c) The location of the water well by public land survey, county assessor's parcel number, map of the vicinity and plat map;

(d) The name, address and telephone number of the person who will be responsible for plugging the well, and the name, address and telephone number of the owner of the land where the well will be located if he is not the person responsible for plugging the well;

(e) A notarized affidavit signed by the person responsible for plugging the well which states that he will be responsible for plugging the well if it is abandoned;

(f) The name, address and telephone number of a person who will be available to answer questions concerning the well; and

(g) The date the project is scheduled to be completed.

2. A waiver granted for the temporary use of water from a well for the exploration of minerals will bear a unique number preceded by the letters "MM." The notice of intent to drill submitted to the Division pursuant to NAC 534.320 and the record of work submitted to the Division pursuant to NRS 534.170 must bear this number.

3. A copy of the waiver must be in the possession of the well driller at the drill site.

4. The well must be plugged in the manner prescribed in NAC 534.420 within 3 days after the completion of the project.

5. The water from the well may not be used for any purpose other than the purpose set forth in the waiver without the written approval of the State Engineer.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97; R009-06, 6-1-2006)

NAC 534.444 Waiver to use water to explore for oil, gas or geothermal resources. (NRS 534.020, 534.050, 534.110)

1. A request for a waiver to allow the temporary use of water from an existing well to explore for oil, gas or geothermal resources, or to drill a well and use the water from the well to explore for oil, gas or geothermal resources, must be submitted to the State Engineer in writing and contain:

(a) The location of the proposed water well and the oil, gas or geothermal well by public land survey, county assessor's parcel number, map of the vicinity and plat map;

(b) The oil, gas or geothermal state or federal permit and lease number, name of the well and American Petroleum Institute number, if assigned;

(c) The amount of water that will be consumed from the well each day;

(d) The date the project is scheduled to be completed;

(e) The name, address and telephone number of the person responsible for plugging the well, and the name, address and telephone number of the owner of the land if he is not the person who is responsible for plugging the well;

(f) A notarized affidavit signed by the person responsible for plugging the well which states that he will be responsible for plugging the well if it is abandoned; and

(g) The name, address and telephone number of a person who will be available to answer questions concerning the well.

2. A waiver that allows the temporary use of water from a water well to explore for oil, gas or geothermal resources will bear a unique number preceded by the letters "OG." The notice of intent to drill submitted to the Division pursuant to NAC 534.320 and the record of work submitted to the Division pursuant to NRS 534.170 must bear this number.

3. A copy of the waiver must be in the possession of the well driller at the drill site.

4. The well must be plugged in the manner prescribed in NAC 534.420 within 3 days after the completion of the project.

5. The water from the well may not be used for any purpose other than the purpose set forth in the waiver without the written approval of the State Engineer.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97; R009-06, 6-1-2006)

NAC 534.446 Waiver to use water for construction of highway. (NRS 534.020, 534.050, 534.110)

1. A request for a waiver to allow the temporary use of water from an existing well for the construction of a highway, or to drill a well and use the water from the well for the construction of a highway, must be submitted to the State Engineer in writing and contain:

(a) The location of the proposed water well by public land survey, county assessor's parcel number, map of the vicinity and plat map;

(b) The project and contract number, if applicable;

(c) The total amount of water that will be consumed each day;

(d) The name, address and telephone number of the person responsible for plugging the well, and the name, address and telephone number of the owner of the land where the well will be located if he is not the person responsible for plugging the well;

(e) A notarized affidavit signed by the person responsible for plugging the well which states that he will be responsible for plugging the well if it is abandoned;

(f) The name, address and telephone number of a person who will be available to answer questions concerning the project; and

(g) The date the project is scheduled to be completed.

2. A waiver that allows the temporary use of water from a well for the construction of a highway will bear a unique number preceded by the letter "C." The notice of intent to drill submitted to the Division pursuant to NAC 534.320 and the record of work submitted to the Division pursuant to NRS 534.170 must bear this number.

3. A copy of the waiver must be in the possession of the well driller at the drill site.

4. The well must be plugged in the manner prescribed in NAC 534.420 within 3 days after the completion of the project.

5. The water from the well may not be used for any purpose other than the purpose set forth in the waiver without the written approval of the State Engineer.

(Added to NAC by St. Engineer, eff. 1-9-90; A 12-30-97; R009-06, 6-1-2006)

NAC 534.448 Waiver to drill well in shallow groundwater system to alleviate certain potential hazards. (NRS 534.020, 534.050, 534.110)

1. A request for a waiver to drill a well in a shallow groundwater system for removing water for the purpose of alleviating potential hazards to persons and property resulting from the rise of groundwater caused by secondary recharge must be submitted to the State Engineer in writing and contain:

(a) The location of the proposed well by public land survey, county assessor's parcel number, map of the vicinity and plat map;

(b) The project and contract number, if applicable;

(c) The total amount of water that will be consumed each day;

(d) The name, address and telephone number of the person responsible for plugging the well, and the name, address and telephone number of the owner of the land where the well will be located if he is not the person responsible for plugging the well;

(e) A notarized affidavit signed by the person responsible for plugging the well which states that he will be responsible for plugging the well if it is abandoned;

(f) The name, address and telephone number of a person who will be available to answer questions concerning the project; and

(g) The date the project is scheduled to be completed.

2. A waiver to drill a well in a shallow groundwater system for removing water for the purpose of alleviating potential hazards to persons and property resulting from the rise of groundwater caused by secondary recharge will bear a unique number preceded by the letters "DW." The notice of intent to drill submitted to the Division pursuant to NAC 534.320 and the record of work submitted to the Division pursuant to NRS 534.170 must bear this number.

3. A copy of the waiver must be in the possession of the well driller at the drill site.

4. The well must be plugged in the manner prescribed in NAC 534.420 within 3 days after the completion of the project.

5. The water from the well may not be used for any purpose other than the purpose set forth in the waiver without the written approval of the State Engineer.

(Added to NAC by St. Engineer, eff. 12-30-97; A by R009-06, 6-1-2006)

NAC 534.449 Waiver of requirement to plug well. (NRS 534.020, 534.060, 534.110)

1. The owner of a well, other than a well drilled for domestic use, who wishes to obtain a waiver pursuant to subsection 7 or 8 of NRS 534.060 from the requirement that a well be plugged must submit a written request for the waiver to the State Engineer. The State Engineer will grant such a waiver which is valid for 1 year after the date on which the waiver is requested unless the State Engineer finds that the well is dry or abandoned. On or before the date on which the waiver is no longer valid, the owner of the well may submit a request to extend the waiver or to make the waiver permanent, if appropriate, as determined by the State Engineer.

2. A request for a waiver, the extension of a waiver or to make a waiver permanent made pursuant to subsection 1 must:

(a) Be made on a form provided by the State Engineer; and

(b) Include sufficient information and evidence for the State Engineer to determine that the well is not in any manner defective, including, without limitation, that the conditions set forth in subsection 2 of NAC 534.427 do not apply to the well.

(Added to NAC by St. Engineer by R009-06, eff. 6-1-2006)

NAC 534.450 Waiver of requirement of this chapter. (NRS 534.020, 534.110)

1. Except as otherwise provided in subsection 2, the State Engineer may, for good cause shown, waive a requirement of the provisions of this chapter.

2. The State Engineer will not waive the requirements set forth in paragraph (c) of subsection 3 of NAC 534.360.

3. A request for a waiver of a requirement of this chapter must be made in writing and include:

(a) A brief statement of the reason for requesting the waiver and the section of the regulations to be waived;

(b) The location or proposed location of the well by public land survey;

(c) The name and address of the owner of the well;

(d) The street address of the location of the well or, if there is no street address, a description of the location of the proposed well, including, but not limited to, common landmarks and cross-streets near the location of the well;

(e) The county assessor's parcel number for the location of the proposed well;

(f) A description of the proposed design and a sectional drawing of the proposed well that includes the depths to the aquifers, the locations of the screens and seals and the materials that will be used;

(g) A notarized affidavit provided by the Division and signed by the owner of the land where the well will be located or his authorized agent which states that the owner of the land will be responsible for plugging the well if it is abandoned;

(h) Any available data to categorize the hydraulic heads, water quality and permeability characteristics of the aquifer;

(i) A monitoring plan; and

(j) Any other information required pursuant to the provisions of this chapter.

4. After reviewing the request, the State Engineer will issue a written notice of his decision to the owner of the well.

5. Each waiver will bear a unique number preceded by the letter "R." The notice of intent to drill submitted to the Division pursuant to NAC 534.320 and the record of work submitted to the Division pursuant to NRS 534.170 must bear this number.

6. The well driller shall ensure that the well complies with the provisions of the waiver and have a copy of the waiver in his possession when he drills the well.

7. The water from the well may not be used for any purpose other than the purpose set forth in the waiver without the written approval of the State Engineer.

[St. Engineer, Drilling Wells Reg. Part 15, eff. 5-19-81]—(NAC A 1-9-90; 12-30-97; R009-06, 6-1-2006)

ENFORCEMENT

NAC 534.500 Assessment of demerit points against license of well driller; suspension and reinstatement of license; removal of demerit points. (NRS 534.020, 534.110)

1. The Division shall assess demerit points against the license of a licensed well driller who is found by the State Engineer to have violated any provision of this chapter or chapter 534 of NRS pursuant to the following table:

Classification of Violations	Maximum Demerits
Notice of Intent/Approval	
Failing to submit a notice of intent to drill to the Division as required by NAC 534.320	25
Failing to notify the Division or obtain approval from the Division as required by NAC 534.370 if drilling is suspended or drilling equipment is moved from the drilling site before a well is completed or plugged	75
Log or Record of Work of Well Driller	
Failing to furnish a copy of a log or record of work to the State Engineer as required by NRS 534.170, intentionally making a material misstatement of fact in a log or record of work submitted to the State Engineer pursuant to NRS 534.170 or intentionally making a material misstatement of fact in an amendment to a log or record of work submitted to the State Engineer pursuant to NRS 534.170	75
Submitting a log or record of work to the State Engineer pursuant to NRS 534.170 more than 30 days after a well is completed	10
Submitting a log or record of work to the Division pursuant to NAC 534.420 more than 30 days after a water well has been plugged	10
Licenses	
Intentionally making a material misstatement of fact in an application for a well-drilling license	100
A well driller failing to have his license card in his possession at a drilling site or failing to produce his license card when requested to do so by a representative of the Division as required by NAC 534.330	10
Failing to have a licensed well driller at a well-drilling site when a drill rig is in operation or when any activity involving the construction or plugging of the well is conducted as required by NAC 534.330. (Demerit points will be assessed against the license of the principal well driller for the well-drilling company and against the license of the well driller listed on the notice of intent.)	50
Well construction and plugging	
Failing to comply with any provision of this chapter which establishes standards for the construction or plugging of a well, including, without limitation, improperly placing the annular seal, constructing a well with substandard well casing, using improper products or procedures during the construction or plugging of a well and failing to protect against contamination	75
Failing to make a well accessible to measurements of the water level of the well as required by NAC 534.430	30
Failing to prevent, control or stop the flow of water from an artesian well as required by NRS 534.060 and NAC 534.378	30

Classification of Violations	Maximum Demerits
Approvals	
Drilling a replacement well more than 300 feet from the location of the existing point of diversion described in the permit or moving the replacement well outside of the 40-acre subdivision described in the permit, waiver or certificate of water right in violation of NAC 534.300	25
Failing to comply with any term or condition of a permit, waiver or order issued by the State Engineer concerning the drilling of a well as required by NAC 534.330, including, without limitation, the depth of the annular seal, the location of perforations and the minimum or maximum depth of the well	50
Miscellaneous	
Any other violation of any of the provisions of this chapter or chapter 534 of NRS	To be determined by the Division based on the severity of the violation, but not to exceed 10

2. The Division shall assess demerit points against the license of a well driller only:

(a) After the State Engineer makes a finding that the well driller has violated a provision of this chapter or chapter 534 of NRS as provided in subsection 1;

(b) After the Division gives written notice of an alleged violation to the well driller by registered or certified mail to the last known address of the well driller which specifies the provision of this chapter or chapter 534 of NRS that the well driller is alleged to have violated;

(c) If, within 30 days after the date on which the well driller receives a notice of an alleged violation sent pursuant to paragraph (b), the well driller has failed to respond to the notice of an alleged violation or provides a response to the notice of an alleged violation that is unsatisfactory, as determined by the Division; and

(d) After the conditions set forth in paragraphs (a), (b) and (c) are satisfied, regardless of when the violation occurred.

3. If a licensed well driller accumulates 100 or more demerit points, the State Engineer may, after giving notice and holding a hearing pursuant to NRS 534.160 to determine that the violations which resulted in the demerit points occurred, suspend the license of the well driller indefinitely. If the State Engineer suspends the license of a well driller, the Division shall notify the well driller that his license is suspended and the well driller is prohibited from engaging in any activity for which a well-drilling license issued pursuant to NRS 534.140 is required until the license of the well driller is reinstated.

4. A well driller whose license has been suspended pursuant to subsection 3 may have his license reinstated if the well driller:

(a) Satisfies the requirements set forth in NAC 534.293;

(b) Appears before the State Engineer at a hearing and the State Engineer finds that the well driller is competent to engage in the practice of well drilling in the State of Nevada; and

(c) Resolves any outstanding complaints related to his license as a well driller to the satisfaction of the Division.

5. The Division shall reduce the number of demerit points accumulated against the license of a well driller whose license has been suspended pursuant to subsection 3 and reinstated pursuant to subsection 4 to zero.

6. Demerit points assessed against the license of a well driller may be removed by the Division as follows:

(a) Five demerit points may be removed for each credit unit of continuing education approved by the Division and successfully completed by the well driller, as determined by the Division up to a maximum of 50 points per year. The credit units of continuing education that must be completed for the purposes of the removal of demerit points pursuant to this paragraph are in addition to those required by NAC 534.2923.

(b) One-half of the demerit points assessed against the license of a well driller may be removed if the well driller is determined by the State Engineer to not have violated a provision of this chapter or chapter 534 of NRS for the entire year before his license is required to be renewed pursuant to NRS 534.140.

(c) Twenty demerit points may be removed if the well driller takes and passes the written examination section of the examination for a license as a well driller. The Division may remove demerit points pursuant to this paragraph once every other year.

(Added to NAC by St. Engineer by R009-06, eff. 6-1-2006)

STATUTES

CHAPTER 534

UNDERGROUND WATER AND WELLS

WEST PUBLISHING CO.

Waters and Water Courses ⇐ 99-107, 127-152.
WESTLAW Topic No. 405.
C.J.S. Waters §§ 86-98 et seq., 121, 122, 157 et seq., 170-194 et seq.

NEVADA CASES.

Well driller "substantially" licensed under chapter not precluded from recovering on contract; criminal penalty only sanction. Where a well driller sought money judgment on a contract for exploratory drilling for water and where neither experience, financial responsibility nor specific public detriment were at issue, the fact that, while a license from the State Engineer had been issued, no specialty license as a water-well driller from the State Contractors' Board had been issued under NRS 534.140 did not bar suit, pursuant to NRS 624.320, because the driller was licensed under NRS ch. 624 as an oil- and gas-well driller and substantially so under NRS ch. 534, a criminal penalty was the only sanction, NRS 534.190, under latter and nothing in the record suggested water-drilling techniques differed materially from oil- and gas-drilling techniques. Nevada Equities, Inc. v. Willard Pease Drilling Co., 84 Nev. 300, 440 P.2d 122 (1968), cited, Robken v. May, 84 Nev. 433, at 434, 442 P.2d 913 (1968), Martin Bloom Associates, Inc. v. Manzie, 389 F. Supp. 848, at 851 (1975), MGM Grand Hotel, Inc. v. Imperial Glass Co., 533 F.2d 486, at 489, (1976), Day v. West Coast Holdings, Inc., 101 Nev. 260, at 265, 699 P.2d 1067 (1985), Interstate Commercial Bldg. Servs., Inc. v. Bank of Amer., 23 F. Supp. 2d 1166, at 1173 (D. Nev. 1998), see also Kourafas v. Basic Food Flavors, Inc., 120 Nev. 195, at 199, 88 P.3d 822 (2004), distinguished, Loomis v. Lange Fin. Corp., 109 Nev. 1121, at 1129, 865 P.2d 1161 (1993)

FEDERAL AND OTHER CASES.

Water reserved by the United States not subject to appropriation under state law. Where owners of land near a national monument had not acquired water rights by appropriation (see NRS 533.325 and 534.020) and beneficial use (see NRS 533.035 and 534.020) pursuant to NRS chs. 533 and 534 before the time land was withdrawn from the public domain, they had no interest in the water at the time of withdrawal and could acquire none thereafter, because patentees of federal land must acquire water rights pursuant to state law. As the water was reserved by the United States when the monument was created, it was no longer subject to appropriation under state law. Cappaert v. United States, 96 S.Ct. 2062 (1976), cited, Salmon River Canal Co. v. Bell Brand Ranches, Inc., 564 F.2d 1244, at 1247 (1977)

ATTORNEY GENERAL'S OPINIONS.

State engineer authorized to regulate the actual use of water by the holder of a permit. Under NRS chs. 533 and 534, the state engineer has authority to regulate the actual use of water diverted under permission conferred by permit and may make such regulations and orders as are deemed essential for the welfare of the area involved. AGO 223 (3-28-1978)

County commissioners not bound by the determination of the state engineer concerning the availability of water. A board of county commissioners, in adopting a master plan and in approving or disapproving subdivisions pursuant to NRS ch. 278, is not bound by the determinations of the state engineer as to the availability of water and issuance of water permits under NRS chs. 533 and 534. AGO 223 (3-28-1978)

NRS 534.010 Definitions.

1. As used in this chapter, unless the context otherwise requires, the words and terms defined in NRS 534.0105 to 534.0175, inclusive, have the meanings ascribed to them in those sections.

2. As used in this chapter, the terms "underground water" and "groundwater" are synonymous.

[Part 2:178:1939; A 1947, 52; 1949, 128; 1955, 328]—(NRS A 1957, 714; 1971, 867; 1981, 658; 1985, 522, 1302; 1987, 1776)

NRS 534.0105 "Aquifer" defined. "Aquifer" means a geological formation or structure that stores or transmits water, or both.

(Added to NRS by 1987, 1770)

NRS 534.011 "Area of active management" defined. "Area of active management" means an area:

1. In which the State Engineer is conducting particularly close monitoring and regulation of the water supply because of heavy use of that supply; and
2. Which has received that designation by the State Engineer pursuant to NRS 534.030.

(Added to NRS by 1987, 1770; A 1989, 598)

NRS 534.0115 "Area of hydrologic effect" defined. "Area of hydrologic effect" means the surface area of land covering the extent of hydrologic response of water recharged pursuant to a project to recharge.

(Added to NRS by 1987, 1770)

NRS 534.012 "Artesian well" defined. "Artesian well" means a well tapping an aquifer underlying an impervious material in which the static water level in the well stands above where it is first encountered in the aquifer.

(Added to NRS by 1987, 1770)

NRS 534.0125 "Augmentation" defined. "Augmentation" means to increase the volume of stored water in a system of aquifers by artificially introducing water into that system.

(Added to NRS by 1987, 1770)

NRS 534.013 "Domestic use" defined. "Domestic use" or "domestic purposes" extends to culinary and household purposes directly related to a single-family dwelling, including, without limitation, the watering of a family garden and lawn and the watering of livestock and any other domestic animals or household pets, if the amount of water drawn does not exceed the threshold daily maximum amount set in NRS 534.180 for exemption from the application of this chapter.

(Added to NRS by 1987, 1770; A 1999, 1184)

NRS 534.0135 "Percolating waters" defined. "Percolating waters" are underground waters, the course and boundaries of which are incapable of determination.

(Added to NRS by 1987, 1770)

NRS 534.014 "Person" defined. "Person" includes any municipal corporation, power district, political subdivision of this or any state, or an agency of the United States Government.

(Added to NRS by 1987, 1770)

NRS 534.0145 "Project" defined. "Project" means a facility designed and constructed to add water to a system of aquifers, store water underground and recover that water pursuant to a permit issued pursuant to NRS 534.250.

(Added to NRS by 1987, 1770)

NRS 534.015 "Recharged water" defined. "Recharged water" means water that reaches or percolates into an aquifer or system of aquifers:

1. Through natural processes;
2. By secondary recharge as a result of beneficial uses; or
3. Artificially through facilities specifically constructed for that purpose.

(Added to NRS by 1987, 1770)

NRS 534.0155 "Storage account" defined. "Storage account" means an account established pursuant to NRS 534.300 for a project for underground storage and recovery.

(Added to NRS by 1987, 1770)

NRS 534.016 "Stored water" defined. "Stored water" means water which has been stored underground for the purpose of recovery pursuant to a permit issued pursuant to NRS 534.250.

(Added to NRS by 1987, 1770)

NRS 534.0165 "Waste" defined. "Waste" means causing, suffering or permitting any artesian well to discharge water unnecessarily above or below the surface of the ground so that the waters thereof are lost for beneficial use or in any canal or ditch conveying water from a well where the loss of water in transit is more than 20 percent of the amount of the water discharged from the well.

(Added to NRS by 1987, 1770)

NRS 534.017 "Well driller" defined. "Well driller" means any person who drills a well or wells, for compensation or otherwise.

(Added to NRS by 1987, 1770)

NRS 534.0175 "Well drilling" and "drilling a well" defined. "Well drilling" or "drilling a well" are synonymous, and mean drilling or boring new wells, placing casing in wells, cleaning and repairing existing wells, cementing wells and doing all other things normally associated with the construction or rehabilitation of wells.

(Added to NRS by 1987, 1770)

NRS 534.020 Underground waters belong to public and are subject to appropriation for beneficial use; declaration of legislative intent.

1. All underground waters within the boundaries of the State belong to the public, and, subject to all existing rights to the use thereof, are subject to appropriation for beneficial use only under the laws of this State relating to the appropriation and use of water and not otherwise.

2. It is the intention of the Legislature, by this chapter, to prevent the waste of underground waters and pollution and contamination thereof and provide for the administration of the provisions thereof by the State Engineer, who is hereby empowered to make such rules and regulations within the terms of this chapter as may be necessary for the proper execution of the provisions of this chapter.

[1:178:1939; 1931 NCL § 7993.10]

ADMINISTRATIVE REGULATIONS.

Underground water and wells, NAC ch. 534

FEDERAL AND OTHER CASES.

Appropriation by Federal Government on federal reservation not subject to state law. Federal reservations are not public lands, and the Federal Government need not comply with state laws governing appropriation of waters when appropriating waters on federal reservations, regardless of what the law may be concerning public lands. State ex rel. Shamberger v. United States, 165 F. Supp. 600 (D. Nev. 1958)

Immunity of Federal Government from compliance is result of supremacy of Federal Government. The supremacy of the Federal Government within the scope of its delegated powers makes it unnecessary for the Federal Government to comply with state laws governing appropriation on waters insofar as appropriation of waters on federal reservations is concerned. State ex rel. Shamberger v. United States, 165 F. Supp. 600 (D. Nev. 1958)

Immunity follows, under circumstances of case, from power of Federal Government relating to national defense. Provisions of the U.S. Constitution relating to national defense prevent the State of Nevada from requiring the Federal Government to comply with the laws of the state concerning appropriation of waters insofar as appropriation of waters on lands of the U.S. Naval Ammunition Depot in Mineral County is concerned. State ex rel. Shamberger v. United States, 165 F. Supp. 600 (D. Nev. 1958)

Absent consent to suit, action against Federal Government to compel compliance with chapter properly dismissed. An action filed by the State of Nevada in an effort to require the United States to comply with NRS 534.020-534.190 when appropriating water on lands over which jurisdiction had been ceded to the U.S. under NRS 328.260 was properly dismissed because the U.S. has not consented to be sued by a state for a declaration as to which sovereign is vested with control of appropriation of water for beneficial use by the U.S. on public lands withdrawn from entry. Nevada ex rel. Shamberger v. United States, 279 F.2d 699 (9th Cir. 1960)

Effect of federal reservation. Where owners of land near a national monument had not acquired water rights by appropriation (see NRS 533.325 and 534.020) and beneficial use (see NRS 533.035 and 534.020) pursuant to NRS chs. 533 and 534 prior to the time land was withdrawn from the public domain, they had no interest in the water at the time of withdrawal and could acquire none thereafter, because patentees of federal land must acquire water rights pursuant to state law. As water was reserved by the United States when the monument was created, it was no longer subject to appropriation under state law. Cappaert v. United States, 96 S.Ct. 2062 (1976), cited, Salmon River Canal Co. v. Bell Brand Ranches, Inc., 564 F.2d 1244, at 1247 (1977)

Beneficial use must be considered when evaluating petition for reclassification of water rights. In an action appealing the reclassification of water rights on farm land in the Newlands Reclamation Project, the federal court of appeals reversed the district court's finding that a reduction in crop yield justified an increase in water usage. In evaluating the petition for reclassification, the district court erred by failing to apply the beneficial use standard (see also NRS 533.035 and 534.020) which allows consideration of reduction in crop yield but which also requires any such reduction to be reasonably significant in light of the prohibitions against waste and unreasonable applications of water in order to justify a reclassification from "bottom land" to "bench land." United States v. Clifford Matley Family Trust, 354 F.3d 1154 (9th Cir. 2004)

ATTORNEY GENERAL'S OPINIONS.

Developed mining water subject to appropriation. Developed mining water is subject to appropriation as provided under NRS 533.030, because NRS 534.020 provides that all underground water belongs to the public and is subject to appropriation under the law of the state. Prior case law is superseded. AGO 331 (4-25-1966)

NRS 534.025 Removal of underground waters to alleviate hazards caused by secondary recharge is beneficial use. The removal of groundwater from any basin in Nevada, to alleviate potential hazards to persons and property resulting from the rise of groundwater caused by secondary recharge, is hereby declared to be a beneficial use if it is accomplished pursuant to the terms and conditions of a waiver issued pursuant to paragraph (c) of subsection 2 of NRS 534.050.

(Added to NRS by 1987, 1776)

NRS 534.030 Administration by State Engineer: Petition by appropriators in basin; hearing in absence of petition; certain artesian water, underground aquifers and percolating water; advisory services of governing bodies of water districts and water conservation boards.

1. Upon receipt by the State Engineer of a petition requesting him to administer the provisions of this chapter as relating to designated areas, signed by not less than 40 percent of the appropriators of record in the office of the State Engineer, in any particular basin or portion therein, he shall:

(a) Cause to be made the necessary investigations to determine if such administration would be justified.

(b) If his findings are affirmative, designate the area by basin, or portion therein, and make an official order describing the boundaries by legal subdivision as nearly as possible.

(c) Proceed with the administration of this chapter.

2. In the absence of such a petition from the owners of wells in a groundwater basin which the State Engineer considers to be in need of administration, he shall hold a public hearing:

(a) If adequate facilities to hold a hearing are available within the basin; or

(b) If such facilities are unavailable, hold the hearing within the county where the basin lies or within the county, where the major portion of the basin lies,

to take testimony from those owners to determine whether administration of that basin is justified. If the basin is found, after due investigation, to be in need of administration the State Engineer may enter an order in the same manner as if a petition, as described in subsection 1, had been received.

3. The order of the State Engineer may be reviewed by the district court of the county pursuant to NRS 533.450.

4. The State Engineer shall supervise all wells tapping artesian water or water in definable underground aquifers drilled after March 22, 1913, and all wells tapping percolating water drilled subsequent to March 25, 1939, except those wells for domestic purposes for which a permit is not required.

5. Within any groundwater basin which has been designated or which may hereafter be so designated by the State Engineer, except groundwater basins subject to the provisions of NRS 534.035, and wherein a water conservation board has been created and established or wherein a water district has been created and established by law to furnish water to an area or areas within the basin or for groundwater conservation purposes, the State Engineer, in the administration of the groundwater law, shall avail himself of the services of the governing body of the water district or the water conservation board, or both of them, in an advisory capacity. The governing body or water board shall furnish such advice and assistance to the State Engineer as is necessary for the purpose of the conservation of groundwater within the areas affected. The services of the governing body or water conservation board must be without compensation from the State, and the services so rendered must be upon reasonable agreements effected with and by the State Engineer.

[4:178:1939; A 1947, 52; 1949, 128; 1953, 188]—(NRS A 1957, 715; 1961, 489; 1967, 1052; 1981, 916, 1841; 1983, 534)

REVISER'S NOTE.

Ch. 113, Stats. 2003, contains the following provision not included in NRS:

"The State Engineer shall review whether his administrative powers in basins designated pursuant to NRS 534.030 are sufficient for the essential welfare of those basins and on or before February 1, 2005, shall provide to the Director of the Legislative Counsel Bureau for transmission to the 73rd Session of the Nevada Legislature a report identifying any additional administrative powers, including, without limitation, the ability to assess a monetary penalty, that he believes are necessary to enable him to carry out his duties with respect to those basins."

FEDERAL AND OTHER CASES.

Absent consent to suit, action against Federal Government to compel compliance with chapter properly dismissed. An action filed by the State of Nevada in an effort to require the United States to comply with NRS 534.020-534.190 when appropriating water on lands over which jurisdiction had been ceded to the U.S. under NRS 328.260 was properly dismissed because the U.S. has not consented to be sued by a state for a declaration as to which sovereign is vested with control of appropriation of water for beneficial use by the U.S. on public lands withdrawn from entry. Nevada ex rel. Shamberger v. United States, 279 F.2d 699 (9th Cir. 1960)

ATTORNEY GENERAL'S OPINIONS.

State engineer may designate artesian basins under rulemaking power. Ch. 178, Stats. 1939 (cf. NRS 534.010-534.190) providing for administration of underground waters does not contain the full procedure for designating artesian basins, but the state engineer may adopt a procedure for designating the boundaries of the basins under the rulemaking power conferred by sec. 10, ch. 178, Stats. 1939 (cf. NRS 534.110). AGO B-29 (1-6-1941)

Declaration pursuant to section not stayed on review absent filing of bond. Where the state engineer declares an area an artesian basin under NRS 534.030, relating to supervision of groundwater basins by the state engineer, and a petition is filed for judicial review under NRS 533.450, the declaration of the state engineer is not stayed unless a bond is filed in the manner provided by NRS 533.450. AGO 181 (10-11-1960)

NRS 534.035 Groundwater boards: Establishment; number, appointment, terms and expenses of members; officers; meetings and quorum; duties; dissolution.

1. In each area designated as a groundwater basin by the State Engineer pursuant to the provisions of NRS 534.030, the board of county commissioners may recommend to the State Engineer that he establish a groundwater board. The State Engineer shall determine whether or not a groundwater board is to be established and may direct its establishment by order.

2. If a groundwater board is established, the governing bodies of all the cities and towns within the designated area, the board of county commissioners of each county in which the area is located, and the governing body of any water district in which the area is included, or partly included, shall each submit a list of names of residents of the area to the Governor, who shall appoint seven members of the board. At least one member must be appointed from each list.

3. After the initial terms, the term of office of each member of the board is 4 years. The board shall elect one member as chairman and one member as secretary to serve as such at the pleasure of the board.

4. The board shall maintain its headquarters at the county seat of the county in which the designated area is located, or if the area lies in more than one county, in the county seat of one of the counties in which the area is located. The board shall hold meetings at such times and places as it may determine. Special meetings may be called at any time by the secretary at the request of any four members, or by the chairman, upon notice specifying the matters to be acted upon at the meeting. No matters other than those specified in the notice may be acted upon at that meeting unless all members are present and consent thereto.

5. A majority of the board constitutes a quorum, and the board shall act only by a majority of those present.

6. For each day's attendance at each meeting of the groundwater board, or for each day when services are actually performed for the groundwater board, the members are entitled to receive per diem and travel allowances provided by law. Claims for those expenses must be paid as provided in subsection 6 of NRS 534.040.

7. The State Engineer shall not approve any application or issue any permit to drill a well, appropriate groundwater, change the place or manner of use or the point of diversion of water within the designated area, adopt any related regulations or enter any related orders until he has conferred with the board and obtained its written advice and recommendations.

8. It is the intention of the Legislature that the State Engineer and the board be in agreement whenever possible, but, for the purpose of fixing responsibility to the Governor, if there is any disagreement between the State Engineer and the board, the views of the State Engineer prevail. A written report of any such disagreement must be made immediately to the Governor by the State Engineer and the board.

9. Any groundwater board may request from the State Engineer or any other state, county, city or district agency such technical information, data and advice as it may require to perform its functions, and the State Engineer and such other agencies shall, within the resources available to them, furnish such assistance as may be requested.

10. The Governor may dissolve the groundwater board by order if he determines that the future activities of the board are likely to be insubstantial.

(Added to NRS by 1961, 488; A 1967, 1252; 1973, 182; 1977, 1235; 1981, 67, 917)

NRS CROSS REFERENCES.

Board of county commissioners includes Board of Supervisors of Carson City, NRS 0.035
Meetings of public agencies, NRS ch. 241
Vacancies on boards, NRS 232A.020

NRS 534.040 Employment and compensation of well supervisor and assistants; levy, collection and distribution of special assessment.

1. Upon the initiation of the administration of this chapter in any particular basin, and where the investigations of the State Engineer have shown the necessity for the supervision over the waters of that basin, the State Engineer may employ a well supervisor and other necessary

assistants, who shall execute the duties as provided in this chapter under the direction of the State Engineer. The salaries of the well supervisor and his assistants must be fixed by the State Engineer. The well supervisor and his assistants are exempt from the provisions of chapter 284 of NRS.

2. The board of county commissioners shall levy a special assessment annually, or at such time as the assessment is needed, upon all taxable property situated within the confines of the area designated by the State Engineer to come under the provisions of this chapter in an amount as is necessary to pay those salaries, together with necessary expenses, including the compensation and other expenses of the Well Drillers' Advisory Board if the money available from the license fees provided for in NRS 534.140 is not sufficient to pay those costs. In designated areas within which the use of groundwater is predominantly for agricultural purposes the levy must be charged against each water user who has a permit to appropriate water or a perfected water right, and the charge against each water user must be based upon the proportion which his water right bears to the aggregate water rights in the designated area. The minimum charge is $1.

3. The salaries and expenses may be paid by the State Engineer from the Water Distribution Revolving Account pending the levy and collection of the assessment as provided in this section.

4. The proper officers of the county shall levy and collect the special assessment as other special assessments are levied and collected, and the assessment is a lien upon the property.

5. The assessment provided for, when collected, must be deposited with the State Treasurer for credit to the Water District Account to be accounted for in basin well accounts.

6. Upon determination and certification by the State Engineer of the amount to be budgeted for the current or ensuing fiscal year for the purpose of paying the per diem and travel allowances of the groundwater board and employing consultants or other help needed to fulfill its responsibilities, the State Controller shall transfer that amount to a separate operating account for that fiscal year for the groundwater basin. Claims against the account must be approved by the groundwater board and paid as other claims against the State are paid. The State Engineer may use money in a particular basin well account to support an activity outside the basin in which the money is collected if the activity bears a direct relationship to the responsibilities or activities of the State Engineer regarding the particular groundwater basin.

[5:178:1939; A 1943, 139; 1947, 52; 1953, 188]—(NRS A 1957, 716; 1963, 796; 1967, 1253; 1969, 342; 1979, 668; 1985, 694; 1991, 1784; 1993, 2352; 1995, 222)

NRS CROSS REFERENCES.

Board of county commissioners includes Board of Supervisors of Carson City, NRS 0.035

State Personnel System, NRS ch. 284

ATTORNEY GENERAL'S OPINIONS.

Circumstances under which special tax is subject to constitutional limitation on levy of ad valorem taxes. The special tax imposed pursuant to NRS 534.040 for the expenses of groundwater basin administration is an ad valorem tax for public purposes within the five-cent-per-dollar limitation on total tax levy provided in Nev. Art. 10, § 2, when levied against all taxable property in the basin, but is a special assessment outside such constitutional limitation when levied only against water users in the basin where the predominant use of groundwater is agricultural. AGO 125 (4-20-1973)

NRS 534.050 Permit to appropriate water required before sinking well in designated groundwater basin; requirements in undesignated areas; waivers; penalties.

1. Except as otherwise provided in subsection 2 and NRS 534.180, every person desiring to sink or bore a well in any basin or portion therein in the State designated by the State Engineer, as provided for in this chapter, must first make application to and obtain from the State Engineer a permit to appropriate the water, pursuant to the provisions of chapter 533 of NRS relating to the appropriation of the public waters, before performing any work in connection with the boring or sinking of the well.

2. Upon written application and a showing of good cause, the State Engineer may issue a written waiver of the requirements of subsection 1:

(a) For exploratory wells to be drilled to determine the availability of water or the quality of available water;

(b) To allow temporary use of the water in constructing a highway or exploring for oil, gas, minerals or geothermal resources; or

(c) For wells to be drilled in shallow groundwater systems and pumped to alleviate potential hazards to persons and property resulting from the rise of groundwater caused by secondary recharge. If practical, approved by the State Engineer and consistent with this chapter and chapter 533 of NRS, the withdrawn water must be used for some other beneficial use.

3. In other basins or portions of basins which have not been designated by the State Engineer no application or permit to appropriate water is necessary until after the well is sunk or bored and water developed. Before any diversion of water may be made from the well, the appropriator must make application to and obtain from the State Engineer, pursuant to the provisions of chapter 533 of NRS, a permit to appropriate the water.

4. Upon written application and a showing of good cause, the State Engineer may issue a written waiver of the requirements of subsection 3, to allow temporary use of water in constructing a highway or exploring for oil, gas, minerals or geothermal resources.

5. Any person using water after a permit has been withdrawn, denied, cancelled, revoked or forfeited is guilty of a misdemeanor. Each day of violation of this subsection constitutes a separate offense and is separately punishable.

[6:178:1939; A 1943, 139; 1947, 52; 1949, 128; 1953, 190]—(NRS A 1957, 716; 1967, 1053; 1979, 183, 242; 1981, 659; 1983, 2090; 1985, 490; 1987, 1776; 1997, 1621)

ADMINISTRATIVE REGULATIONS.

Underground water and wells, NAC ch. 534

FEDERAL AND OTHER CASES.

Appropriation by Federal Government on federal reservation not subject to state law. Federal reservations are not public lands, and the Federal Government need not comply with state laws governing appropriation of waters when appropriating waters on federal reservations, regardless of what the law may be concerning public lands. State ex rel. Shamberger v. United States, 165 F. Supp. 600 (D. Nev. 1958)

Immunity of Federal Government from compliance is result of supremacy of Federal Government. The supremacy of the Federal Government within the scope of its delegated powers makes it unnecessary for the Federal Government to comply with state laws governing appropriation of waters insofar as appropriation of waters on federal reservations is concerned. State ex rel. Shamberger v. United States, 165 F. Supp. 600 (D. Nev. 1958)

Immunity follows, under circumstances of case, from power of Federal Government relating to national defense. Provisions of the U.S. Constitution relating to national defense prevent the State of Nevada from requiring the Federal Government to comply with the laws of the state concerning appropriation of waters insofar as appropriation of waters on lands of the U.S. Naval Ammunition Depot in Mineral County is concerned. State ex rel. Shamberger v. United States, 165 F. Supp. 600 (D. Nev. 1958)

Absent consent to suit, action against Federal Government to compel compliance with chapter properly dismissed. An action filed by the State of Nevada in an effort to require the United States to comply with NRS 534.020-534.190 when appropriating water on lands over which jurisdiction had been ceded to the U.S. under NRS 328.260 was properly dismissed because the U.S. has not consented to be sued by a state for a declaration as to which sovereign is vested with control of appropriation of water for beneficial use by the U.S. on public lands withdrawn from entry. Nevada ex rel. Shamberger v. United States, 279 F.2d 699 (9th Cir. 1960)

NRS 534.060 Conditions for sinking wells; casings and appliances; repair of defective wells; liens; sealing of wells; use of abandoned wells to monitor groundwater.

1. During the sinking or boring of a well the permittee shall cause to be placed in the well a proper and sufficient casing approved by the State Engineer, so arranged as to prevent the caving in of the well and to prevent the escape of water therefrom through any intervening sand or gravel stratum, which casing must be of sufficient length to reach the deepest aquifer encountered during the sinking or boring of the well.

2. The number, size, type and distribution of perforations is optional with the permittee, except that no perforations may be made in a pipe tapping confined (artesian) water above the confining impervious materials.

3. The permittee shall provide the necessary valves, plugs or other appliances to prevent or control the flow of water from the well and prevent the loss of underground water above or below the ground surface.

4. If in the judgment of the State Engineer a well is in any manner defective he may order the owner to repair the well or, in his discretion, may cause the well to be repaired or sealed. If the State Engineer elects to repair or seal the well, the cost of repairing or sealing the well must be paid from the water distribution account and must not be charged to the owner of the well or be a lien on the land upon which the well is located or on other land of the owner to which water from the well is appurtenant.

5. If the State Engineer orders the owner to repair the well and if upon 15 days' written notice by registered or certified mail, return receipt requested, the owner fails to repair the well, the State Engineer or his assistants or authorized agents may, without further notice, take such steps as may be necessary to effect such repairs. The cost thereof, including the labor and material, may in the first instance be paid by the State Engineer from the Water Distribution Revolving Account, but any such cost in any event is a lien on the land on which the well is located and, also, any other land possessed by the well owner to which the water from the well is appurtenant.

6. The State Engineer, his assistants or authorized agents, as the case may be, shall file an itemized and sworn statement, setting forth the date when the work was done and the nature of the labor so performed, with the board of county commissioners of the county wherein the charge and expense were incurred. The board of county commissioners shall thereupon present a bill for the expense to the person liable therefor under this section, and if that person neglects for 30 days thereafter to pay it, the bill and costs become a lien upon the lands and property of the person so liable for the payment of the bill, and must be collected as delinquent taxes against the lands and property are collected.

7. When a well is abandoned or about to be abandoned, the owner, in lieu of plugging the well, may advise the State Engineer and other interested hydrologic entities that the well is available to monitor the groundwater. If, in the opinion of the State Engineer, the well would be useful as a site for monitoring, the State Engineer may grant the owner a waiver of the requirement that the well be plugged.

8. The State Engineer may grant the owner of a well a waiver of the requirement that the well be plugged under circumstances other than those set forth in subsection 7. The State Engineer shall adopt regulations that provide a procedure by which the State Engineer may approve a waiver from the requirement of plugging an abandoned well pursuant to this subsection.

[7:178:1939; A 1947, 52; 1943 NCL § 7993.16]—(NRS A 1957, 717; 1961, 448; 1967, 192; 1979, 669; 1987, 1777; 2005, 455)

NRS CROSS REFERENCES.
Board of county commissioners includes Board of Supervisors of Carson City, NRS 0.035

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Waters and Water Courses ⇐ 101.
WESTLAW Topic No. 405.
C.J.S. Waters §§ 193, 195-197, 199, 201-206.

NRS 534.070 Waste of water from artesian well unlawful.

1. No person controlling an artesian well in any basin in Nevada shall suffer the waters therefrom to flow to waste, unless, and as far as reasonably necessary in the judgment of the State Engineer, to prevent the obstruction thereof, or to flow or be taken therefrom except for beneficial purposes.

2. The owner of any artesian well from which water is being unnecessarily wasted shall be guilty of a misdemeanor.

[8:178:1939; A 1943, 139; 1947, 52; 1955, 328]—(NRS A 1957, 720)

NRS 534.080 Appropriation of underground water for beneficial use from artesian or definable aquifer: Acquisition of rights under chapter 533 of NRS; orders to desist; dates of priority.

1. A legal right to appropriate underground water for beneficial use from an artesian or definable aquifer subsequent to March 22, 1913, or from percolating water, the course and boundaries of which are incapable of determination, subsequent to March 25, 1939, can only be acquired by complying with the provisions of chapter 533 of NRS pertaining to the appropriation of water.

2. The State Engineer may, upon written notice sent by registered or certified mail, return receipt requested, advise the owner of a well who is using water therefrom without a permit to appropriate such water to cease using such water until he has complied with the laws pertaining to the appropriation of water. If the owner fails to initiate proceedings to secure such permit within 30 days from the date of such notice he shall be guilty of a misdemeanor.

3. The date of priority of all appropriations of water from an underground source, mentioned in this section, is the date when application is made in proper form and filed in the office of the State Engineer pursuant to the provisions of chapter 533 of NRS.

[9:178:1939; A 1947, 52; 1943 NCL § 7993.18]—(NRS A 1957, 718; 1967, 195)

NEVADA CASES.

Cumulative effect of permits. In a proceeding to challenge the state engineer's denial of permits to divert underground water in a designated basin on the ground that existing rights would be impaired and public interest would suffer detriment, the supreme court affirmed the decision of district court that denial was supported by substantial evidence, rejecting the applicants' contention that a finding of impairment was based on the cumulative effect of granting all of the pending permits rather than on the sole granting of their permits. Under NRS 533.370, the state engineer had a duty to deny any permit which would impair existing rights or prove detrimental to public interest. (See also NRS 534.080 and 534.110.) Griffin v. Westergard, 96 Nev. 627, 615 P.2d 235 (1980)

Circumstances justifying denial. In a proceeding to challenge the state engineer's denial of permits to divert underground water in a designated basin, where: (1) the applicants had started drilling a well under valid permits but drilled only to hard rock at 420 feet and did not complete the drilling to the desired depth within the prescribed time limits despite a 1-year extension; (2) the state engineer cancelled the permits for failure to file timely proof of completion and beneficial use; (3) the applicants deepened the well to 500 feet after the permits had been cancelled; (4) the applicants alleged that the state engineer had indicated their applications for new permits would probably be approved if there were no protests, but the state engineer could not recall making any such statement; (5) the state engineer, after a public hearing on all pending applications in the basin, denied the permits on the ground that existing rights would be impaired and public interest would suffer detriment; and (6) the applicants contended that they had relied to their detriment (having expended a total of $16,000) on the alleged assurances that the permits would be granted, the supreme court affirmed district court's refusal to grant the applicants relief on the basis of equitable estoppel. The state engineer was prohibited by NRS 533.370 from granting any permits which would impair existing rights, and the court would not grant such permits on equitable grounds. (See also NRS 534.080 and 534.110.) Griffin v. Westergard, 96 Nev. 627, 615 P.2d 235 (1980)

FEDERAL AND OTHER CASES.

Absent consent to suit, action against Federal Government to compel compliance with chapter properly dismissed. An action filed by the State of Nevada in an effort to require the United States to comply with NRS 534.020-534.190 when appropriating water on lands over which jurisdiction had been ceded to the U.S. under NRS 328.260 was properly dismissed because the U.S. has not consented to be sued by a state for a declaration as to which sovereign is vested with control of appropriation of water for beneficial use by the U.S. on public lands withdrawn from entry. Nevada ex rel. Shamberger v. United States, 279 F.2d 699 (9th Cir. 1960)

NRS 534.090 Forfeiture and abandonment of rights.

1. Except as otherwise provided in this section, failure for 5 successive years after April 15, 1967, on the part of the holder of any right, whether it is an adjudicated right, an unadjudicated right, or a permitted right, and further whether the right is initiated after or before March 25, 1939, to use beneficially all or any part of the underground water for the purpose for which the right is acquired or claimed, works a forfeiture of both undetermined rights and determined rights to the use of that water to the extent of the nonuse. For water rights in basins for which the State Engineer keeps pumping records, if the records of the State Engineer indicate at least 4 consecutive years, but less than 5 consecutive years, of nonuse of all or any part of such a water right which is governed by this chapter, the State Engineer shall notify the owner of the water right, as determined in the records of the Office of the State Engineer, by registered or certified mail that he has 1 year after the date of the notice in which to use the water right beneficially and to provide proof of such use to the State Engineer or apply for relief pursuant to subsection 2 to avoid forfeiting the water right. If, after 1 year after the date of the notice, proof of beneficial use is not sent to the State Engineer, the State Engineer shall, unless he has granted a request to extend the time necessary to work a forfeiture of the water right, declare the right forfeited within 30 days. Upon the forfeiture of a right to the use of groundwater, the water reverts to the public and is available for further appropriation, subject to existing rights. If, upon notice by registered or certified mail to the owner of record whose right has been declared forfeited, the owner of record fails to appeal the ruling in the manner provided for in NRS 533.450, and within the time provided for therein, the forfeiture becomes final. The failure to receive a notice pursuant to this subsection does not nullify the forfeiture or extend the time necessary to work the forfeiture of a water right.

2. The State Engineer may, upon the request of the holder of any right described in subsection 1, extend the time necessary to work a forfeiture under that subsection if the request is made before the expiration of the time necessary to work a forfeiture. The State Engineer may grant, upon request and for good cause shown, any number of extensions, but a single extension must not exceed 1 year. In determining whether to grant or deny a request, the State Engineer shall, among other reasons, consider:

(a) Whether the holder has shown good cause for his failure to use all or any part of the water beneficially for the purpose for which his right is acquired or claimed;

(b) The unavailability of water to put to a beneficial use which is beyond the control of the holder;

(c) Any economic conditions or natural disasters which made the holder unable to put the water to that use;

(d) Any prolonged period in which precipitation in the basin where the water right is located is below the average for that basin or in which indexes that measure soil moisture show that a deficit in soil moisture has occurred in that basin; and

(e) Whether the holder has demonstrated efficient ways of using the water for agricultural purposes, such as center-pivot irrigation.

➥ The State Engineer shall notify, by registered or certified mail, the owner of the water right, as determined in the records of the Office of the State Engineer, of whether he has granted or denied the holder's request for an extension pursuant to this subsection.

3. If the failure to use the water pursuant to subsection 1 is because of the use of center-pivot irrigation before July 1, 1983, and such use could result in a forfeiture of a portion of a right, the State Engineer shall, by registered or certified mail, send to the owner of record a notice of intent to declare a forfeiture. The notice must provide that the owner has at least 1 year from the date of the notice to use the water beneficially or apply for additional relief pursuant to subsection 2 before forfeiture of his right is declared by the State Engineer.

4. A right to use underground water whether it is vested or otherwise may be lost by abandonment. If the State Engineer, in investigating a groundwater source, upon which there has been a prior right, for the purpose of acting upon an application to appropriate water from the same source, is of the belief from his examination that an abandonment has taken place, he shall so state in his ruling approving the application. If, upon notice by registered or certified mail

to the owner of record who had the prior right, the owner of record of the prior right fails to appeal the ruling in the manner provided for in NRS 533.450, and within the time provided for therein, the alleged abandonment declaration as set forth by the State Engineer becomes final.

[9a:178:1939; added 1947, 52; 1943 NCL § 7993.18a]—(NRS A 1967, 193, 1053; 1981, 1842; 1983, 1650; 1995, 1016; 2003, 651)

WEST PUBLISHING CO.

Waters and Water Courses ⇐ 151.
WESTLAW Topic. No. 405.
C.J.S. Waters §§ 102, 332, 404-409.

NEVADA CASES.

Retroactive application of statute is constitutional, but forfeiture may be cured by a substantial use of the water right after the statutory period of nonuse. The amendment of NRS 534.090 in 1981, making the section apply retroactively to water rights present on April 15, 1967, with the effect being that nonuse of the water right for 5 successive years after that date causes forfeiture of that right to the extent of nonuse, was constitutional as a valid exercise of the police power of the State. However, the holder of the water right may cure forfeiture and revitalize the right by substantial use of the right after the statutory period of nonuse, so long as no claim or proceeding of forfeiture has begun. Town of Eureka v. State Engineer, 108 Nev. 163, 826 P.2d 948 (1992), cited, AGO 97-05 (2-11-1997), United States v. Alpine Land & Reservoir Co., 291 F.3d 1062, at 1076 (9th Cir. 2002), distinguished, Preferred Equities Corp. v. State Engineer, 119 Nev. 384, at 389, 75 P.3d 380 (2003)

Forfeiture period was not impliedly tolled. A corporation applied to the State Engineer to change the diversion point and usage of certain water rights. The State Engineer subsequently declared the water rights to be forfeited because the corporation had not used the water rights for a period exceeding 5 years. The corporation did not timely appeal the State Engineer's ruling of forfeiture. The corporation later argued that the provisions of NRS 533.040(2) impliedly tolled the forfeiture period and that it would have been wasteful of the corporation to continue to use the water while waiting for a decision from the State Engineer if the water in question could not be put to beneficial use. On appeal, the Supreme Court rejected the corporation's reading of NRS 533.040(2), holding that if the corporation was unable to make beneficial use of the water, the proper course of action would have been to: (1) request an extension pursuant to NRS 534.090(2); or (2) file a timely appeal after the State Engineer's ruling of forfeiture. Preferred Equities Corp. v. State Engineer, 119 Nev. 384, 75 P.3d 380 (2003)

Beneficial use as prerequisite to equitable relief. In certain instances the Nevada Supreme Court has determined that a holder of water rights is entitled to equitable relief from the termination of those rights, even where the holder has not timely filed an appeal (see NRS 533.450) from the State Engineer's termination decision. However, the preeminent public policy concern in Nevada regarding water rights is beneficial use (see NRS 533.035), and the court has not historically granted equitable relief to a holder of water rights who has not made beneficial use of those rights. (See also NRS ch. 533 and NRS 534.090.) Preferred Equities Corp. v. State Engineer, 119 Nev. 384, 75 P.3d 380 (2003)

Application to change diversion point of water was moot where applicant had already forfeited water rights in question. In a ruling dated December 20, 1996, the State Engineer declared that a corporation had forfeited certain water rights by failing to utilize those rights for a period exceeding 5 years. The forfeiture became final when the corporation failed to appeal the ruling within 30 days. The corporation subsequently sought independent judicial review of its previous application to change the diversion point and usage of the water rights (see NRS 533.345). As determined by the Supreme Court, the district court properly held that the corporation's application was moot because the corporation no longer owned the water rights in question. (See also NRS 534.090.) Preferred Equities Corp. v. State Engineer, 119 Nev. 384, 75 P.3d 380 (2003)

NRS 534.100 Recognition of existing water rights; classification of water in definable aquifer or percolating water by State Engineer; adjudication of vested underground water rights.

1. Existing water rights to the use of underground water are hereby recognized. For the purpose of this chapter a vested right is a water right on underground water acquired from an artesian or definable aquifer prior to March 22, 1913, and an underground water right on percolating water, the course and boundaries of which are incapable of determination, acquired prior to March 25, 1939. The distinction as to whether water is in a definable aquifer or whether

it is percolating water, the course and boundaries of which are incapable of determination, is a matter to be determined by the State Engineer.

2. Any claimant of a vested underground water right may petition the State Engineer to adjudicate such rights. If upon investigation he finds the facts and conditions justify it, he shall enter an order granting the petition and shall make proper arrangements to proceed with such determination. In the order the State Engineer shall designate the area within which such determination is to be made, but the size of such designated area may include other claimed underground vested water rights. Such designated area shall not extend into other drainage basins. Following the designation of such area the State Engineer shall proceed with adjudicating such rights as provided for in chapter 533 of NRS.

[9a:178:1939; added 1947, 52; 1943 NCL § 7993.18b]—(NRS A 1957, 718)

NRS 534.110 Rules and regulations of State Engineer; statements and pumping tests; conditions of appropriation; restrictions.

1. The State Engineer shall administer this chapter and shall prescribe all necessary regulations within the terms of this chapter for its administration.

2. The State Engineer may:

(a) Require periodical statements of water elevations, water used, and acreage on which water was used from all holders of permits and claimants of vested rights.

(b) Upon his own initiation, conduct pumping tests to determine if overpumping is indicated, to determine the specific yield of the aquifers and to determine permeability characteristics.

3. The State Engineer shall determine whether there is unappropriated water in the area affected and may issue permits only if the determination is affirmative. The State Engineer may require each applicant to whom a permit is issued for a well:

(a) For municipal, quasi-municipal or industrial use; and

(b) Whose reasonably expected rate of diversion is one-half cubic foot per second or more,

➥ to report periodically to the State Engineer concerning the effect of that well on other previously existing wells that are located within 2,500 feet of the well.

4. It is a condition of each appropriation of groundwater acquired under this chapter that the right of the appropriator relates to a specific quantity of water and that the right must allow for a reasonable lowering of the static water level at the appropriator's point of diversion. In determining a reasonable lowering of the static water level in a particular area, the State Engineer shall consider the economics of pumping water for the general type of crops growing and may also consider the effect of using water on the economy of the area in general.

5. This section does not prevent the granting of permits to applicants later in time on the ground that the diversions under the proposed later appropriations may cause the water level to be lowered at the point of diversion of a prior appropriator, so long as any protectible interests in existing domestic wells as set forth in NRS 533.024 and the rights of holders of existing appropriations can be satisfied under such express conditions. At the time a permit is granted for a well:

(a) For municipal, quasi-municipal or industrial use; and

(b) Whose reasonably expected rate of diversion is one-half cubic foot per second or more,

➥ the State Engineer shall include as a condition of the permit that pumping water pursuant to the permit may be limited or prohibited to prevent any unreasonable adverse effects on an existing domestic well located within 2,500 feet of the well, unless the holder of the permit and the owner of the domestic well have agreed to alternative measures that mitigate those adverse effects.

6. The State Engineer shall conduct investigations in any basin or portion thereof where it appears that the average annual replenishment to the groundwater supply may not be adequate for the needs of all permittees and all vested-right claimants, and if his findings so indicate the State Engineer may order that withdrawals be restricted to conform to priority rights.

7. In any basin or portion thereof in the State designated by the State Engineer, the State Engineer may restrict drilling of wells in any portion thereof if he determines that additional wells would cause an undue interference with existing wells. Any order or decision of the State Engineer so restricting drilling of such wells may be reviewed by the district court of the county pursuant to NRS 533.450.

[10:178:1939; A 1947, 52; 1949, 128; 1955, 328]—(NRS A 1993, 2641; 2001, 553)

NRS CROSS REFERENCES.
Population defined, NRS 0.050

ADMINISTRATIVE REGULATIONS.
Regulations of State Engineer, NAC 534A.090-534A.160
Underground water and wells, NAC ch. 534

NEVADA CASES.

Cumulative effect of permits. In a proceeding to challenge the state engineer's denial of permits to divert underground water in a designated basin on the ground that existing rights would be impaired and public interest would suffer detriment, the supreme court affirmed the decision of district court that denial was supported by substantial evidence, rejecting the applicants' contention that a finding of impairment was based on the cumulative effect of granting all of the pending permits rather than on the sole granting of their permits. Under NRS 533.370, the state engineer had a duty to deny any permit which would impair existing rights or prove detrimental to public interest. (See also NRS 534.080 and 534.110.) Griffin v. Westergard, 96 Nev. 627, 615 P.2d 235 (1980)

Circumstances justifying denial. In a proceeding to challenge the state engineer's denial of permits to divert underground water in a designated basin, where: (1) the applicants had started drilling a well under valid permits but drilled only to hard rock at 420 feet and did not complete the drilling to the desired depth within the prescribed time limits despite a 1-year extension; (2) the state engineer cancelled the permits for failure to file timely proof of completion and beneficial use; (3) the applicants deepened the well to 500 feet after the permits had been cancelled; (4) the applicants alleged that the state engineer had indicated their applications for new permits would probably be approved if there were no protests, but the state engineer could not recall making any such statement; (5) the state engineer, after a public hearing on all pending applications in the basin, denied the permits on the ground that existing rights would be impaired and public interest would suffer detriment; and (6) the applicants contended that they had relied to their detriment (having expended a total of $16,000) on the alleged assurances that the permits would be granted, the supreme court affirmed district court's refusal to grant the applicants relief on the basis of equitable estoppel. The state engineer was prohibited by NRS 533.370 from granting any permits which would impair existing rights, and the court would not grant such permits on equitable grounds. (See also NRS 534.080 and 534.110.) Griffin v. Westergard, 96 Nev. 627, 615 P.2d 235 (1980)

FEDERAL AND OTHER CASES.

Absent consent to suit, action against Federal Government to compel compliance with chapter properly dismissed. An action filed by the State of Nevada in an effort to require the United States to comply with NRS 534.020-534.190 when appropriating water on lands over which jurisdiction had been ceded to the U.S. under NRS 328.260 was properly dismissed because the U.S. has not consented to be sued by a state for a declaration as to which sovereign is vested with control of appropriation of water for beneficial use by the U.S. on public lands withdrawn from entry. Nevada ex rel. Shamberger v. United States, 279 F.2d 699 (9th Cir. 1960)

ATTORNEY GENERAL'S OPINIONS.

State engineer may designate artesian basins under rulemaking power. Ch. 178, Stats. 1939 (cf. NRS 534.010-534.190) providing for administration of underground waters does not contain the full procedure for designating artesian basins, but the state engineer may adopt a procedure for designating the boundaries of the basins under the rulemaking power conferred by sec. 10, ch. 178, Stats. 1939 (cf. NRS 534.110). AGO B-29 (1-6-1941)

NRS 534.120 State Engineer authorized to make rules, regulations and orders when groundwater is being depleted in designated area; preferred uses of water; temporary permits to appropriate water; revocation of temporary permits; restrictions placed on certain wells.

1. Within an area that has been designated by the State Engineer, as provided for in this chapter, where, in his judgment, the groundwater basin is being depleted, the State Engineer in

his administrative capacity is herewith empowered to make such rules, regulations and orders as are deemed essential for the welfare of the area involved.

2. In the interest of public welfare, the State Engineer is authorized and directed to designate preferred uses of water within the respective areas so designated by him and from which the groundwater is being depleted, and in acting on applications to appropriate groundwater, he may designate such preferred uses in different categories with respect to the particular areas involved within the following limits:

(a) Domestic, municipal, quasi-municipal, industrial, irrigation, mining and stock-watering uses; and

(b) Any uses for which a county, city, town, public water district or public water company furnishes the water.

3. Except as otherwise provided in subsection 5, the State Engineer may:

(a) Issue temporary permits to appropriate groundwater which can be limited as to time and which may, except as limited by subsection 4, be revoked if and when water can be furnished by an entity such as a water district or a municipality presently engaged in furnishing water to the inhabitants thereof.

(b) Deny applications to appropriate groundwater for any use in areas served by such an entity.

(c) Limit the depth of domestic wells.

(d) Prohibit the drilling of wells for domestic use, as defined in NRS 534.013 and 534.0175, in areas where water can be furnished by an entity such as a water district or a municipality presently engaged in furnishing water to the inhabitants thereof.

4. The State Engineer may revoke a temporary permit issued pursuant to subsection 3 for residential use, and require a person to whom groundwater was appropriated pursuant to the permit to obtain water from an entity such as a water district or a municipality engaged in furnishing water to the inhabitants of the designated area, only if:

(a) The distance from the property line of any parcel served by a well pursuant to a temporary permit to the pipes and other appurtenances of the proposed source of water to which the property will be connected is not more than 180 feet; and

(b) The well providing water pursuant to the temporary permit needs to be redrilled or have repairs made which require the use of a well-drilling rig.

5. The State Engineer may, in an area in which he has issued temporary permits pursuant to subsection 3, limit the depth of a domestic well pursuant to paragraph (c) of subsection 3 or prohibit repairs from being made to a well, and may require the person proposing to deepen or repair the well to obtain water from an entity such as a water district or a municipality engaged in furnishing water to the inhabitants of the designated area, only if:

(a) The distance from the property line of any parcel served by the well to the pipes and other appurtenances of the proposed source of water to which the property will be connected is not more than 180 feet; and

(b) The deepening or repair of the well would require the use of a well-drilling rig.

6. For good and sufficient reasons, the State Engineer may exempt the provisions of this section with respect to public housing authorities.

7. Nothing in this section prohibits the State Engineer from revoking a temporary permit issued pursuant to this section if any parcel served by a well pursuant to the temporary permit is currently obtaining water from an entity such as a water district or a municipality engaged in furnishing water to the inhabitants of the area.

[10.5:178:1939; added 1955, 328]—(NRS A 1989, 1401; 1999, 3542; 2001, 555; 2003, 622, 624)

ADMINISTRATIVE REGULATIONS.
Underground water and wells, NAC ch. 534

WEST PUBLISHING CO.
Waters and Water Courses ⇐ 101.
WESTLAW Topic. No. 405.
C.J.S. Waters §§ 193, 195-197, 201-204.

NEVADA CASES.

Revocation of permit reviewable for abuse of discretion; remedy at law precludes equitable relief. Holders of temporary permits to appropriate groundwater were not entitled to equitable relief against an action of the state engineer revoking permits on the ground that completion of a pipeline enabled the water district to serve the affected area. Under the language of NRS 534.120, revocation of the permits was clearly a discretionary act which could be reviewed for abuse of discretion and, there being adequate remedy at law, district court was without authority to grant equitable relief. Las Vegas Valley Water Dist. v. Curtis Park Manor Water Users Ass'n, 98 Nev. 275, 646 P.2d 549 (1982), cited, State Eng'r v. Curtis Park Manor Water Users Ass'n, 101 Nev. 30, at 31, 692 P.2d 495 (1985), United States v. Alpine Land & Reservoir Co., 291 F.3d 1062, at 1077 (9th Cir. 2002), see also United States v. Alpine Land & Reservoir Co., 919 F. Supp. 1470, at 1474 (D. Nev. 1996)

No abuse of discretion in revocation of temporary permit. The state engineer did not abuse his discretion in revoking a temporary permit to appropriate groundwater pursuant to NRS 534.120, which authorizes the state engineer to revoke temporary permits when water can be furnished by an entity such as a water district or municipality, where the record indicated that the decision was based on availability of water from the local water district and its ability to service the affected area, and the permit contained an express provision that it was subject to revocation when water was available from that district. State Eng'r v. Curtis Park Manor Water Users Ass'n, 101 Nev. 30, 692 P.2d 495 (1985)

NRS 534.125 State Engineer to file notice related to temporary permit. If the State Engineer issues a temporary permit pursuant to NRS 534.120 or if a well for domestic use is drilled in an area in which he has issued such a temporary permit, he shall file a notice with the county recorder of the county in which the permit is issued or the well is drilled. The notice must include a statement indicating that, if and when water can be furnished by an entity such as a water district or a municipality engaged in furnishing water to the inhabitants of the designated area:

1. A temporary permit may be revoked;
2. The owner of a domestic well may be prohibited from deepening or repairing the well; and
3. The owner of the property served by the well may be required to connect to this water source at his own expense.

(Added to NRS by 1999, 3541)

WEST PUBLISHING CO.
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WESTLAW Topic No. 405.
C.J.S. Waters § 88.

NRS 534.130 State Engineer, assistants and Artesian Well Supervisor authorized to enter premises to investigate and carry out duties. The State Engineer, his assistants or authorized agents, and the Artesian Well Supervisor, or his assistants, shall have the right to enter the premises of any owner or proprietor where any well mentioned in this chapter is situated at any reasonable hour of the day for the purpose of investigating and carrying out his or their duties in the administration of this chapter.

[11:178:1939; 1931 NCL § 7993.20]

NRS 534.140 Well drillers: Annual licenses; fees; continuing education; regulations for well drilling; licensing by State Contractors' Board.

1. Every well driller, before engaging in the physical drilling of a well in this State for development of water, must annually apply to the State Engineer for a license to drill.
2. The applications for those licenses and all licenses issued for the drilling of wells must be in the form prescribed by the State Engineer.

3. All well-drilling licenses expire on June 30 following their issuance and are not transferable.

4. A fee of $100 must accompany each application for a license and a fee of $50 must be paid each year for renewal of the license.

5. Those license fees must be accounted for in the State Engineer's Water License Account and used to pay costs pertaining to licensing, the adoption and enforcement of regulations for well drilling and the compensation of the members of the Well Drillers' Advisory Board and their expenses.

6. The State Engineer, after consulting with the Well Drillers' Advisory Board, shall adopt regulations relating to continuing education for well drillers.

7. The State Engineer shall prepare and keep on file in his office regulations for well drilling.

8. Before engaging in the physical drilling of a well in this State for the development of water, every well driller who is the owner of a well-drilling rig, or who has a well-drilling rig under lease or rental, or who has a contract to purchase a well-drilling rig, must obtain a license as a well driller from the State Contractors' Board.

[Part 7a:178:1939; added 1947, 52; A 1955, 328]—(NRS A 1957, 719; 1963, 797; 1979, 115 1983, 407; 1991, 63, 1785; 2005, 456)

ADMINISTRATIVE REGULATIONS.

Regulations of State Engineer, NAC 534A.090-534A.160
Underground water and wells, NAC ch. 534

NEVADA CASES.

Recovery on a contract not precluded by lack of license from the State Contractors' Board. Where a well driller sought money judgment on a contract for exploratory drilling for water and where neither experience, financial responsibility nor specific public detriment were at issue, the fact that, while a license from the State Engineer had been issued, no specialty license as a water-well driller from the State Contractors' Board had been issued under NRS 534.140 did not bar suit, pursuant to NRS 624.320, because the driller was licensed under NRS ch. 624 as an oil- and gas-well driller and substantially so under NRS ch. 534, a criminal penalty was the only sanction, NRS 534.190, under latter and nothing in the record suggested water-drilling techniques differed materially from oil- and gas-drilling techniques. Nevada Equities, Inc. v. Willard Pease Drilling Co., 84 Nev. 300, 440 P.2d 122 (1968), cited, Robken v. May, 84 Nev. 433, at 434, 442 P.2d 913 (1968), Martin Bloom Associates, Inc. v. Manzie, 389 F. Supp. 848, at 851 (1975), MGM Grand Hotel, Inc. v. Imperial Glass Co., 533 F.2d 486, at 489 (1976), Day v. West Coast Holdings, Inc., 101 Nev. 260, at 265, 699 P.2d 1067 (1985), Interstate Commercial Bldg. Servs., Inc. v. Bank of Amer., 23 F. Supp. 2d 1166 (D. Nev. 1998), see also Kourafas v. Basic Food Flavors, Inc., 120 Nev. 195, at 199, 88 P.3d 822 (2004), distinguished, Loomis v. Lange Fin. Corp., 109 Nev. 1121, at 1129, 865 P.2d 1161 (1993)

ATTORNEY GENERAL'S OPINIONS.

Board of county commissioners has authority to enact ordinances regulating the placement and testing of domestic wells, but only the state engineer may regulate the construction of such wells. A board of county commissioners, under its general police power (see NRS 244.357), power to regulate building and safety (see NRS 244.3675) and power to regulate planning and zoning (see NRS 278.020), has the power to enact ordinances regulating the placement and testing of domestic wells to promote health and safety. However, a board of county commissioners lacks authority to regulate the construction of domestic wells, as that power has been given to the state engineer through his authority to license and regulate well drillers (see NRS 534.140 and 534.160). AGO 97-19 (6-2-1997), cited, AGO 98-22 (8-7-1998)

NRS 534.142 Payment of child support: Statement by applicant for license to drill; grounds for denial of license; duty of State Engineer. [Expires by limitation on the date of the repeal of the federal law requiring each state to establish procedures for withholding, suspending and restricting the professional, occupational and recreational licenses for child support arrearages and for noncompliance with certain processes relating to paternity or child support proceedings.]

1. An applicant for the issuance or renewal of a license to drill pursuant to NRS 534.140 shall submit to the State Engineer the statement prescribed by the Division of Welfare and

Supportive Services of the Department of Health and Human Services pursuant to NRS 425.520. The statement must be completed and signed by the applicant.

2. The State Engineer shall include the statement required pursuant to subsection 1 in:

(a) The application or any other forms that must be submitted for the issuance or renewal of the license; or

(b) A separate form prescribed by the State Engineer.

3. A license to drill may not be issued or renewed by the State Engineer if the applicant:

(a) Fails to submit the statement required pursuant to subsection 1; or

(b) Indicates on the statement submitted pursuant to subsection 1 that he is subject to a court order for the support of a child and is not in compliance with the order or a plan approved by the district attorney or other public agency enforcing the order for the repayment of the amount owed pursuant to the order.

4. If an applicant indicates on the statement submitted pursuant to subsection 1 that he is subject to a court order for the support of a child and is not in compliance with the order or a plan approved by the district attorney or other public agency enforcing the order for the repayment of the amount owed pursuant to the order, the State Engineer shall advise the applicant to contact the district attorney or other public agency enforcing the order to determine the actions that the applicant may take to satisfy the arrearage.

(Added to NRS by 1997, 2088)

REVISER'S NOTE.

Ch. 483, Stats. 1997, the source of this section, contains the following provision not included in NRS:

"The amendatory provisions of sections 1 to 4, inclusive, and 6 to 516, inclusive, of this act expire by limitation on the date on which the provisions of 42 U.S.C. § 666 requiring each state to establish procedures under which the state has authority to withhold or suspend, or to restrict the use of professional, occupational and recreational licenses of persons who:

1. Have failed to comply with a subpoena or warrant relating to a proceeding to determine the paternity of a child or to establish or enforce an obligation for the support of a child; or

2. Are in arrears in the payment for the support of one or more children,

➥ are repealed by the Congress of the United States."

NRS 534.144 Suspension of license for failure to pay child support or comply with certain subpoenas or warrants; reinstatement of license. [Expires by limitation on the date of the repeal of the federal law requiring each state to establish procedures for withholding, suspending and restricting the professional, occupational and recreational licenses for child support arrearages and for noncompliance with certain processes relating to paternity or child support proceedings.]

1. If the State Engineer receives a copy of a court order issued pursuant to NRS 425.540 that provides for the suspension of all professional, occupational and recreational licenses, certificates and permits issued to a person who is the holder of a license to drill issued pursuant to NRS 534.140, the State Engineer shall deem the license issued to that person to be suspended at the end of the 30th day after the date on which the court order was issued unless the State Engineer receives a letter issued to the holder of the license by the district attorney or other public agency pursuant to NRS 425.550 stating that the holder of the license has complied with the subpoena or warrant or has satisfied the arrearage pursuant to NRS 425.560.

2. The State Engineer shall reinstate a license to drill issued pursuant to NRS 534.140 that has been suspended by a district court pursuant to NRS 425.540 if the State Engineer receives a letter issued by the district attorney or other public agency pursuant to NRS 425.550 to the person whose license was suspended stating that the person whose license was suspended has complied with the subpoena or warrant or has satisfied the arrearage pursuant to NRS 425.560.

(Added to NRS by 1997, 2089)

REVISER'S NOTE.

Ch. 483, Stats. 1997, the source of this section, contains the following provision not included in NRS:

"The amendatory provisions of sections 1 to 4, inclusive, and 6 to 516, inclusive, of this act expire by limitation on the date on which the provisions of 42 U.S.C. § 666 requiring each state to establish procedures under which the state has authority to withhold or suspend, or to restrict the use of professional, occupational and recreational licenses of persons who:

1. Have failed to comply with a subpoena or warrant relating to a proceeding to determine the paternity of a child or to establish or enforce an obligation for the support of a child; or
2. Are in arrears in the payment for the support of one or more children,

➥ are repealed by the Congress of the United States."

NRS 534.146 Application for license to include social security number of applicant. [Expires by limitation on the date of the repeal of the federal law requiring each state to establish procedures for withholding, suspending and restricting the professional, occupational and recreational licenses for child support arrearages and for noncompliance with certain processes relating to paternity or child support proceedings.] An application for the issuance of a license to drill pursuant to NRS 534.140 must include the social security number of the applicant.

(Added to NRS by 1997, 2089)

REVISER'S NOTE.

Ch. 483, Stats. 1997, the source of this section, contains the following provision not included in NRS:

"The amendatory provisions of sections 1 to 4, inclusive, and 6 to 516, inclusive, of this act expire by limitation on the date on which the provisions of 42 U.S.C. § 666 requiring each state to establish procedures under which the state has authority to withhold or suspend, or to restrict the use of professional, occupational and recreational licenses of persons who:

1. Have failed to comply with a subpoena or warrant relating to a proceeding to determine the paternity of a child or to establish or enforce an obligation for the support of a child; or
2. Are in arrears in the payment for the support of one or more children,

➥ are repealed by the Congress of the United States."

NRS 534.150 Well Drillers' Advisory Board: Appointment; terms of members; vacancies; compensation; duties.

1. For the purpose of examining applicants for well drillers' licenses, the State Engineer may appoint a Well Drillers' Advisory Board referred to in this section as the "Board." The Board may be on a regional or statewide basis.
2. In making the initial appointments, the State Engineer shall appoint members to staggered terms of 1, 2 and 3 years. After the initial terms, members shall serve for 3-year terms.
3. The State Engineer may fill vacancies on the Board.
4. Each member of the Board is entitled to receive $60 for each day and $30 for each half day spent doing the work of the Board. Any time spent by members of the Board in work or travel necessary to the discharge of their duties which is less than a full day but more than a half day must be treated for compensation as a full day. Any time less than a half day must be treated as a half day.
5. The purpose of the Board is to determine the qualifications of an applicant as a well driller and to submit its findings to the State Engineer.
6. Regulations of the Board on examining applicants for well drillers' licenses must be developed by the State Engineer in cooperation with the Board upon its creation.
7. If a hearing is held by the State Engineer to determine whether a licensed well driller is complying with the law or the regulations pertaining to well drilling, the State Engineer may avail himself of the services of the Board in an advisory capacity.

[Part 7a:178:1939; added 1947, 52; A 1955, 328]—(NRS A 1963, 798; 1977, 1236; 1979, 793; 1981, 1986; 1985, 434)

NRS 534.160 License required to drill well; revocation of license; order to plug well; penalty for allowing unlicensed person to drill.

1. A person shall not drill a well for water in this State without having first obtained a well-drilling license.

2. Well drillers must comply with the regulations adopted by the State Engineer governing the drilling of water wells.

3. If the State Engineer determines, upon investigation and after hearing held upon at least 15 days' notice sent by registered or certified mail to the licensed well driller, that the well driller has failed to comply with the law or the required regulations, the State Engineer may revoke his license. The State Engineer may refuse to reissue a license to a well driller if he has violated the law or the regulations.

4. The order revoking or refusing to reissue a license is final unless an action for review by the district court is filed pursuant to NRS 533.450.

5. The State Engineer shall order any person who drills a well without a license to plug that well. If the well is not plugged within 30 days after the order, the State Engineer shall plug the well at the expense of the person who owned or drilled the well.

6. If any licensed driller who owns, rents, leases or has a contract to purchase a well-drilling rig allows an unlicensed person to drill or perform any work in connection with well drilling, except under the supervision of the licensed driller, his license must be revoked or not reissued.

[Part 7a:178:1939; added 1947, 52; A 1955, 328]—(NRS A 1957, 719; 1969, 95; 1981, 360)

ADMINISTRATIVE REGULATIONS.

Underground water and wells, NAC ch. 534

FEDERAL AND OTHER CASES.

Appropriation by the Federal Government on a federal reservation not subject to state law. Federal reservations are not public lands, and the Federal Government need not comply with state laws governing the appropriation of waters when appropriating waters on federal reservations, regardless of what the law may be concerning public lands. State ex rel. Shamberger v. United States, 165 F. Supp. 600 (D. Nev. 1958)

Immunity of the Federal Government from compliance is the result of the supremacy of the Federal Government. The supremacy of the Federal Government within the scope of its delegated powers makes it unnecessary for the Federal Government to comply with state laws governing the appropriation of waters insofar as the appropriation of waters on federal reservations is concerned. State ex rel. Shamberger v. United States, 165 F. Supp. 600 (D. Nev. 1958)

Immunity follows, under circumstances of case, from the power of the Federal Government relating to national defense. Provisions of the U.S. Constitution relating to national defense prevent the State of Nevada from requiring the Federal Government to comply with laws of the state concerning the appropriation of waters insofar as the appropriation of waters on lands of the U.S. Naval Ammunition Depot in Mineral County is concerned. State ex rel. Shamberger v. United States, 165 F. Supp. 600 (D. Nev. 1958)

ATTORNEY GENERAL'S OPINIONS.

Board of county commissioners has authority to enact ordinances regulating the placement and testing of domestic wells, but only the state engineer may regulate the construction of such wells. A board of county commissioners, under its general police power (see NRS 244.357), power to regulate building and safety (see NRS 244.3675) and power to regulate planning and zoning (see NRS 278.020), has the power to enact ordinances regulating the placement and testing of domestic wells to promote health and safety. However, a board of county commissioners lacks authority to regulate the construction of domestic wells, as that power has been given to the state engineer through his authority to license and regulate well drillers (see NRS 534.140 and 534.160). AGO 97-19 (6-2-1997), cited, AGO 98-22 (8-7-1998)

NRS 534.170 Well driller to keep log and records; contents; information to be furnished to State Engineer; report of test.

1. The well driller shall keep:

(a) A log of the depth, thickness and character of the different strata penetrated and the location of water-bearing strata; and

(b) An accurate record of the work, including:

(1) A statement of the date of beginning work;

(2) The date of completion;

(3) The length, size and weight of the casing and how it is placed;

(4) The size of the drilled hole;

(5) Where sealed off and the type of seal;

(6) The name of the well driller and the type of drilling machine used;

(7) The number of cubic feet per second or gallons per minute of flow from such well when completed; and

(8) The pressure in pounds per square inch if it is a flowing well, and, if nonflowing, the static water level, and the water temperature.

2. The well driller shall furnish a copy of the log and the record of work for every well drilled to the State Engineer within 30 days after the well is completed.

3. If the well is to be tested by pumping by the holder of the permit, the report of the test must include the drawdown with respect to the amount of water pumped and any additional information requested by the State Engineer. This information must be reported and verified on forms prescribed by the State Engineer. The report must be returned:

(a) Immediately following the completion of the test; or

(b) Within 30 days following the completion of the well,

➥ whichever occurs later.

4. The log, record of the work and report of the test are a permanent record in the State Engineer's office.

[Part 7a:178:1939; added 1947, 52; A 1955, 328]—(NRS A 1981, 1842)

ADMINISTRATIVE REGULATIONS.

Regulations of State Engineer, NAC 534A.090-534A.160

Underground water and wells, NAC ch. 534

NRS 534.180 Applicability of chapter to wells used for domestic purposes; registration and plugging of wells used for domestic purposes.

1. Except as otherwise provided in subsection 2 and as to the furnishing of any information required by the State Engineer, this chapter does not apply in the matter of obtaining permits for the development and use of underground water from a well for domestic purposes where the draught does not exceed a daily maximum of 1,800 gallons.

2. The State Engineer may designate any groundwater basin or portion thereof as a basin in which the registration of a well is required if the well is drilled for the development and use of underground water for domestic purposes. A driller who drills such a well shall register the information required by the State Engineer within 10 days after the completion of the well. The State Engineer shall make available forms for the registration of such wells and shall maintain a register of those wells.

3. The State Engineer may require the plugging of such a well which is drilled on or after July 1, 1981, at any time not sooner than 1 year after water can be furnished to the site by:

(a) A political subdivision of this State; or

(b) A public utility whose rates and service are regulated by the Public Utilities Commission of Nevada,

➥ but only if the charge for making the connection to the service is less than $200.

[3:178:1939; A 1947, 52; 1949, 128; 1955, 328]—(NRS A 1971, 868; 1977, 383; 1981, 1843; 1983, 2090; 1985, 1302; 1997, 2010)

NRS 534.185 Waiver of certain requirements for domestic wells by State Engineer; exceptions.

1. The State Engineer shall, upon written request and receipt of a written agreement between the affected property owners, waive the requirements of this chapter regarding permits for the use and development of underground water from a well if:

(a) The well existed on July 1, 1983;

(b) It is used solely for domestic purposes by not more than three single-family dwellings; and

(c) Each of those dwellings does not draw more than 1,800 gallons of water in a day.

2. The State Engineer may require an owner who has been granted such a waiver to apply for a permit if one or more of the dwellings is drawing more than 1,800 gallons of water in a day.

3. This section does not apply to any groundwater basin for which the State Engineer has in effect on July 1, 1983, a procedure of issuing revocable permits.

(Added to NRS by 1983, 1674)

NRS 534.190 Penalties. Any person violating any of the provisions of NRS 534.010 to 534.180, inclusive, shall be guilty of a misdemeanor.

[12:178:1939; A 1947, 52; 1943 NCL § 7993.21]—(NRS A 1967, 610)

NEVADA CASES.

Well driller "substantially" licensed under chapter not precluded from recovering on contract; criminal penalty only sanction. Where a well driller sought money judgment on a contract for exploratory drilling for water and where neither experience, financial responsibility nor specific public detriment were at issue, the fact that, while a license from the State Engineer had been issued, no specialty license as a water-well driller from the State Contractors' Board had been issued under NRS 534.140 did not bar suit, pursuant to NRS 624.320, because the driller was licensed under NRS ch. 624 as an oil- and gas-well driller and substantially so under NRS ch. 534, a criminal penalty was the only sanction, NRS 534.190, under latter and nothing in the record suggested water-drilling techniques differed materially from oil- and gas-drilling techniques. Nevada Equities, Inc. v. Willard Pease Drilling Co., 84 Nev. 300, 440 P.2d 122 (1968), cited, Robken v. May, 84 Nev. 433, at 434, 442 P.2d 913 (1968), Martin Bloom Associates, Inc. v. Manzie, 389 F. Supp. 848, at 851 (1975), MGM Grand Hotel, Inc. v. Imperial Glass Co., 533 F.2d 486, at 489 (1976), Day v. West Coast Holdings, Inc., 101 Nev. 260, at 265, 699 P.2d 1067 (1985), Interstate Commercial Bldg. Servs., Inc. v. Bank of Amer., 23 F. Supp. 2d 1166, at 1173 (D. Nev. 1998), see also Kourafas v. Basic Food Flavors, Inc., 120 Nev. 195, at 199, 88 P.3d 822 (2004), distinguished, Loomis v. Lange Fin. Corp., 109 Nev. 1121, at 1129, 865 P.2d 1161 (1993)

NRS 534.250 Project for recharge, storage and recovery of water: Permit required; issuance, contents, modification and assignment of permit; monitoring requirements.

1. Any person desiring to operate a project must first make an application to, and obtain from, the State Engineer a permit to operate such a project.

2. The State Engineer shall, upon application, issue a permit to operate a project if he determines that:

(a) The applicant has the technical and financial capability to construct and operate a project.

(b) The applicant has a right to use the proposed source of water for recharge pursuant to an approved appropriation consistent with this chapter and chapter 533 of NRS. Any determination made by the State Engineer for purposes of this paragraph is not binding in any other proceeding.

(c) The project is hydrologically feasible.

(d) If the project is in an area of active management, the project is consistent with the program of augmentation for that area.

(e) The project will not cause harm to users of land or other water within the area of hydrologic effect of the project.

3. The holder of a permit may apply to the State Engineer for approval to assign the permit to another person. The State Engineer must approve the assignment if the person to whom the permit is to be assigned will meet the requirements of paragraphs (a) and (b) of subsection 2 when the assignment is completed.

4. A permit for a project must include:

(a) The name and mailing address of the person to whom the permit is issued.

(b) The name of the area of active management, groundwater basin or groundwater sub-basin, as applicable, in which the project will be located.

(c) The capacity and plan of operation of the project.

(d) Any monitoring program required pursuant to subsection 5.

(e) Any conditions which are imposed pursuant to this chapter or any regulation adopted pursuant thereto.

(f) Any other information which the State Engineer deems necessary to include.

5. The State Engineer shall require the holder of a permit to monitor the operation of the project and the effect of the project on users of land and other water within the area of hydrologic effect of the project. In determining any monitoring requirements, the State Engineer shall cooperate with all government entities which regulate or monitor, or both, the quality of water.

6. The State Engineer, on his initiative or at the request of the holder of the permit, may modify the conditions of the permit if monitoring demonstrates that modifications are necessary. In determining whether modifications are necessary, the State Engineer shall consider uses of land or water which were not in existence when the permit was issued.

(Added to NRS by 1987, 1771)

NRS 534.260 Project for recharge, storage and recovery of water: Contents of application for permit. The State Engineer shall prescribe and furnish guidelines for an application for a permit for a project. The application must include:

1. A fee for application of $2,500;

2. The name and mailing address of the applicant;

3. The name of the area of active management, groundwater basin or groundwater sub-basin, as applicable, in which the applicant proposes to operate the project;

4. The name and mailing address of the owner of the land on which the applicant proposes to operate the project;

5. The legal description of the location of the proposed project;

6. Such evidence of financial and technical capability as the State Engineer requires;

7. The source, quality and annual quantity of water proposed to be recharged, and the quality of the receiving water;

8. The legal basis for acquiring and using the water proposed to be recharged;

9. A description of the proposed project including its capacity and plan of operation;

10. A copy of a study that demonstrates:

(a) The area of hydrologic effect of the project;

(b) That the project is hydrologically feasible;

(c) That the project will not cause harm to users of land and water within the area of hydrologic effect; and

(d) The percentage of recoverable water;

11. The proposed duration of the permit; and

12. Any other information which the State Engineer requires.

(Added to NRS by 1987, 1771)

NRS 534.270 Project for recharge, storage and recovery of water: Review of application for permit; notice of application; protests; hearing; determination; judicial review.

1. Upon receipt of an application for a permit to operate a project, the State Engineer shall endorse on the application the date it was received and keep a record of the application. He shall conduct an initial review of the application within 45 days after receipt of the application. If the State Engineer determines in the initial review that the application is incomplete, he shall notify the applicant. The application is incomplete until the applicant files all the information requested in the application. The State Engineer shall determine whether the application is correct within 180 days after receipt of a complete application. The State Engineer may request additional information from the applicant. The State Engineer may conduct such independent investigations as are necessary to determine whether the application should be approved or rejected.

2. If the application is determined to be complete and correct, the State Engineer, within 30 days after such a determination or a longer period if requested by the applicant, shall cause

notice of the application to be given once each week for 2 consecutive weeks in a newspaper of general circulation in the county or counties in which persons reside who could reasonably be expected to be affected by the project. The notice must state:

(a) The legal description of the location of the proposed project;

(b) A brief description of the proposed project including its capacity;

(c) That any person who may be adversely affected by the project may file a written protest with the State Engineer within 30 days after the last publication of the notice;

(d) The date of the last publication;

(e) That the grounds for protesting the project are limited to whether the project would be in compliance with subsection 2 of NRS 534.250;

(f) The name of the applicant; and

(g) That a protest must:

(1) State the name and mailing address of the protester;

(2) Clearly set forth the reason why the permit should not be issued; and

(3) Be signed by the protester or the protester's agent or attorney.

3. A protest to a proposed project:

(a) May be made by any person who may be adversely affected by the project;

(b) Must be in writing;

(c) Must be filed with the State Engineer within 30 days after the last publication of the notice;

(d) Must be upon a ground listed in subsection 2 of NRS 534.250;

(e) Must state the name and mailing address of the protester;

(f) Must clearly set forth the reason why the permit should not be issued; and

(g) Must be signed by the protester or the protester's agent or attorney.

4. Upon receipt of a protest, the State Engineer shall advise the applicant by certified mail that a protest has been filed.

5. Upon receipt of a protest, or upon his own motion, the State Engineer may hold a hearing. Not less than 30 days before the hearing, the State Engineer shall send by certified mail notice of the hearing to the applicant and any person who filed a protest.

6. The State Engineer shall either approve or deny each application within 1 year after the final date for filing a protest, unless he has received a written request from the applicant to postpone his decision or, in the case of a protested application, from both the protester and the applicant. The State Engineer may delay action on the application pursuant to paragraph (c) of subsection 2 of NRS 533.370.

7. Any person aggrieved by any decision of the State Engineer made pursuant to subsection 6, may appeal that decision to the district court pursuant to NRS 533.450.

(Added to NRS by 1987, 1772; A 2003, 2983)

NRS 534.280 Project for recharge, storage and recovery of water: Annual report to State Engineer.

1. Any person who holds a permit for a project must compile and file with the State Engineer annual reports which define the operation of the project and provide such information as the State Engineer requires.

2. Each report must contain either a sworn statement or a certification, under penalty of perjury, that the information contained in the report is true and correct according to the best belief and knowledge of the person filing the report.

3. The annual report must be maintained on a calendar-year basis for the preceding calendar year. If a person who is required to file an annual report under this section fails to file a report when due, the State Engineer may assess and collect a penalty of $500 for each month or portion of a month that the annual report is delinquent. The total penalty assessed under this subsection must not exceed $5,000.

4. The records and reports required to be kept and filed pursuant to this section must be in such form as the State Engineer prescribes.

(Added to NRS by 1987, 1773)

NRS 534.290 Project for recharge, storage and recovery of water: Permit for recovery well; recovery limited to designated wells; designation of person entitled to recover water; use or exchange of recovered water.

1. A permit for a recovery well must comply with the requirements of this chapter and chapter 533 of NRS.

2. The holder of a permit for a project may recover water stored pursuant to the permit only from wells designated by the holder and approved by the State Engineer, located within the area of hydrologic effect of the project as determined by the State Engineer.

3. The person entitled to recover the water must be designated by the holder of the permit and approved by the State Engineer.

4. The holder of a permit for a project and a permit for a recovery well may use or exchange water recovered pursuant to those permits only in the manner in which it was permissible for him to use that water before it was stored.

(Added to NRS by 1987, 1774)

NRS 534.300 Project for recharge, storage and recovery of water: Storage account to be established; limit on amount of water recovered.

1. The State Engineer shall establish a storage account for each project for which he has issued a permit. If the project stores water from more than one source, he shall establish subaccounts for each source of water.

2. The holder of a permit for a project may recover only the recoverable amount of water that is stored by the project.

3. For the purposes of this section, "recoverable amount" means the amount of water, as determined by the State Engineer, that has reached the aquifer and remains within the area of active management.

(Added to NRS by 1987, 1774)

NRS 534.310 Project for recharge, storage and recovery of water: Annual fee for permit; disposition of money received by State Engineer; employment of consultants by State Engineer.

1. The State Engineer shall levy and collect an annual fee from each person who holds a permit for a project. The State Engineer shall establish the amount of the fee for the following year not later than October 1 of each year.

2. Within 30 days after the State Engineer sets the fee, he shall mail written notice of the fee to all holders of permits.

3. The fee must be paid to the State Engineer at the time the person holding a permit files an annual report. If a person who is required to pay a fee fails to pay the fee when due, the State Engineer may assess and collect a penalty of 10 percent of the unpaid fee, without compounding, for each month or portion of a month that the fee is delinquent. The total penalty assessed must not exceed 60 percent of the unpaid fee.

4. Money received by the State Engineer pursuant to this section, subsection 1 of NRS 534.260 and subsection 3 of NRS 534.280 must be deposited with the State Treasurer for credit to the Account for Projects for Recharge, Underground Storage and Recovery of Water in the State General Fund. The interest and income earned on the money in the Account, after deducting any applicable charges, must be credited to the Account. Money in the Account must only be used for the administration of this chapter.

5. The State Engineer may employ special consultants to assist him in fulfilling his responsibilities pursuant to this chapter.

(Added to NRS by 1987, 1774; A 1989, 288)

NRS 534.320 Project for recharge, storage and recovery of water: Revocation or suspension of permit; orders to cease and desist; injunction.

1. The State Engineer may periodically review a project to determine if the holder of the permit is complying with the terms and conditions of the permit and the public interest is

properly guarded. The State Engineer may permanently revoke or temporarily suspend the permit for good cause after an investigation and a hearing. Notice must be sent to the holder of the permit at least 15 days before the hearing, by registered or certified mail, that the holder has failed to comply with this chapter. In determining whether to revoke or suspend a permit, the State Engineer shall consider uses of land and water which were not in existence when the permit was issued.

2. Except as otherwise provided in subsection 3, if the State Engineer has reason to believe that a person is violating or has violated a provision of this chapter or a permit issued or regulation adopted pursuant to this chapter, the State Engineer may issue a written notice that the person must appear and show cause, at a hearing before the State Engineer not less than 15 days after the receipt of the notice, why the person should not be ordered to cease and desist from the violation. The notice must inform the person of the date, time and place of the hearing and the consequences of failure to appear.

3. If the State Engineer finds that a person is constructing or operating a project in violation of this chapter, the State Engineer may issue a temporary order for the person to cease and desist the construction pending final action by the State Engineer pursuant to subsection 4. The order must include written notice to the person of the date, time and place where the person must appear at a hearing before the State Engineer to show cause why the temporary order should be vacated. The hearing must be held not less than 15 days after the date of the order.

4. After a hearing pursuant to subsection 2 or 3, or after the expiration of the time to appear, the State Engineer shall issue a decision and order. The decision and order may take such form as the State Engineer determines to be reasonable and appropriate and may include a determination of violation, an order to cease and desist, the recommendation of a civil penalty and an order directing that positive steps be taken to abate or ameliorate any harm or damage arising from the violation. The person affected may appeal the decision to the district court pursuant to NRS 533.450.

5. If the person continues the violation after the State Engineer has issued a final decision and order pursuant to subsection 4 or a temporary order pursuant to subsection 3, the State Engineer may apply for a temporary restraining order or a preliminary or permanent injunction from the district court. A decision to seek injunctive relief does not preclude other forms of relief or enforcement against the violator.

(Added to NRS by 1987, 1774)

NRS 534.330 Project for recharge, storage and recovery of water: Penalties.

1. A person who is determined pursuant to NRS 534.320 to be in violation of this chapter or a permit issued or regulation adopted pursuant to this chapter may be assessed a civil penalty in an amount not exceeding:

(a) One hundred dollars per day of violation not directly related to illegal recovery or use of stored water; or

(b) Ten thousand dollars per day of violation directly related to illegal recovery or use of stored water.

2. An action to recover penalties pursuant to this section must be brought by the State Engineer in the district court in the county in which the violation occurred.

(Added to NRS by 1987, 1775)

NRS 534.340 Project for recharge, storage and recovery of water: Designation of areas of active management. The State Engineer shall designate areas of active management pursuant to NRS 534.030.

(Added to NRS by 1987, 1776)

NRS 534.350 State Engineer to establish program that allows public water system to receive credits for addition of new customers to system.

1. The State Engineer shall adopt regulations establishing a program that allows a public water system to receive credits, as provided in this section, for the addition of new customers to the system. The program must be limited to public water systems in areas:

(a) Designated as groundwater basins by the State Engineer pursuant to the provisions of NRS 534.030; and

(b) In which the State Engineer has denied one or more applications for any municipal uses of groundwater.

2. Before the State Engineer adopts any regulations pursuant to this section regarding any particular groundwater basin, he shall hold a public hearing:

(a) Within the basin to which the regulations will apply if adequate facilities to hold a hearing are available within that basin; or

(b) In all other cases, within the county where the major portion of that basin lies,

↳ to take testimony from any interested persons regarding the proposed regulations.

3. Upon adoption of the regulations required by this section regarding a particular groundwater basin, a public water system which provides service in that basin is entitled to receive a credit for each customer who is added to the system after the adoption of those regulations and:

(a) Voluntarily ceases to draw water from a domestic well located within that basin; or

(b) Is the owner of a lot or other parcel of land, other than land used or intended solely for use as a location for a water well, which:

(1) Is located within that basin;

(2) Was established as a separate lot or parcel before July 1, 1993;

(3) Was approved by a local governing body or planning commission for service by an individual domestic well before July 1, 1993; and

(4) Is subject to a written agreement which was voluntarily entered into by the owner with the public water system pursuant to which the owner agrees not to drill a domestic well on the land and the public water system agrees that it will provide water service to the land. Any such agreement must be acknowledged and recorded in the same manner as conveyances affecting real property are required to be acknowledged and recorded pursuant to chapter 111 of NRS.

4. The State Engineer may require a new customer, who voluntarily ceases to draw water from a domestic well as provided in paragraph (a) of subsection 3, to plug that well.

5. A credit granted pursuant to this section:

(a) Must be sufficient to enable the public water system to add one service connection for a single-family dwelling to the system, except that the credit may not exceed the increase in water consumption attributable to the additional service connection or 1,800 gallons per day, whichever is less.

(b) May not be converted to an appropriative water right.

6. This section does not:

(a) Require a public water system to extend its service area.

(b) Authorize any increase in the total amount of groundwater pumped in a groundwater basin.

(c) Affect any rights of an owner of a domestic well who does not voluntarily bring himself within the provisions of this section.

7. As used in this section:

(a) "Domestic well" means a well used for culinary and household purposes in a single-family dwelling, including the watering of a garden, lawn and domestic animals and where the draught does not exceed 1,800 gallons per day.

(b) "Public water system" has the meaning ascribed to it in NRS 445A.840.

(Added to NRS by 1993, 1154)

WEST PUBLISHING CO.
Waters and Water Courses ⇐ 101, 180.
WESTLAW Topic No. 405.
C.J.S. Waters §§ 88 et seq., 230.

NRS 534.360 Water Rights Technical Support Fund: Creation; administration; uses.

1. There is hereby created in the State Treasury a fund to be designated as the Water Rights Technical Support Fund to be administered by the Board for Financing Water Projects.

2. The Water Rights Technical Support Fund is a continuing fund without reversion. Money in the Fund must be invested as the money in other funds is invested. The interest and income earned on the money in the Fund, after deducting any applicable charges, must be credited to the Fund. Claims against the Fund must be paid as other claims against the State are paid.

3. The Board for Financing Water Projects may accept gifts, grants and donations from any source for deposit in the Water Rights Technical Support Fund.

4. Except as otherwise provided in subsection 5, money in the Water Rights Technical Support Fund must be used by the Board for Financing Water Projects only to make grants to a local government to:

(a) Obtain and provide expert and technical assistance to gather data to protect its existing water rights; or

(b) Fund projects to enhance or protect its existing water rights.

5. Any grant of money from the Water Rights Technical Support Fund must not be used by a local government to pay for any assistance or projects as set forth in subsection 4 if the only purpose of the assistance or project is to obtain evidence, including, without limitation, technical evidence and oral testimony or to pay for expert witnesses or attorney's fees for or in anticipation of any administrative or judicial proceeding, including, without limitation, hearings before the State Engineer or in any state or federal court.

(Added to NRS by 2005, 2565)

WEST PUBLISHING CO.
States ⇐ 127.
WESTLAW Topic No. 360.
C.J.S. States §§ 386-387.

CHAPTER 534A

GEOTHERMAL RESOURCES

NRS 534A.010 "Geothermal resource" defined. As used in this chapter, unless the context otherwise requires, "geothermal resource" means the natural heat of the earth and the energy associated with that natural heat, pressure and all dissolved or entrained minerals that may be obtained from the medium used to transfer that heat, but excluding hydrocarbons and helium.

(Added to NRS by 1975, 611; A 1977, 1172; 1981, 659)

NRS 534A.031 Exploration and subsurface information: Filing with Division of Minerals of Commission on Mineral Resources; confidentiality; release to State Engineer or other agency. Any exploration and subsurface information obtained as a result of a geothermal project must be filed with the Division of Minerals of the Commission on Mineral Resources within 30 days after it is accumulated. The information is confidential for 5 years after the date of filing and may not be disclosed during that time without the express written consent of the operator of the project, except that it must be made available by the Division to the State Engineer or any other agency of the State upon request. The State Engineer or other agency shall keep the information confidential.

(Added to NRS by 1977, 383; A 1985, 1303; 1993, 1701; 1999, 3633)

NRS 534A.040 Applicability of procedures for appropriation. A consumptive use of water brought to the surface outside of a geothermal well is subject to the appropriation procedures of chapters 533 and 534 of NRS, except for:

1. Water that is removed from an aquifer or geothermal reservoir to develop and obtain geothermal resources if the water is returned to or reinjected into the same aquifer or reservoir; or

2. The reasonable loss of water:

(a) During a test of a geothermal well; or

(b) From the temporary failure of all or part of a system that removes water from an aquifer or geothermal reservoir, transfers the heat from that water and reinjects that water into the same aquifer or reservoir.

(Added to NRS by 1975, 611; A 1983, 2091; 1985, 1303; 1997, 284)

NRS 534A.050 Ownership of geothermal resources. The owner of real property owns the rights to the underlying geothermal resources unless they have been reserved by or conveyed to another person.

(Added to NRS by 1983, 2091)

NRS 534A.060 Permit required to drill or operate geothermal well or drill exploratory well; application.

1. A person may not drill or operate a geothermal well or drill an exploratory well without obtaining a permit from the Administrator of the Division of Minerals of the Commission on Mineral Resources and complying with the conditions of the permit.

2. An application must set forth such information as the Administrator requires by regulation.

(Added to NRS by 1983, 2091; A 1985, 1303; 1993, 1701; 1999, 3633)

ADMINISTRATIVE REGULATIONS.

Permits, fees and other requirements for drilling, NAC 534A.190-534A.360

NRS 534A.070 Approval or rejection of application for permit to drill exploratory well; review of application for permit to drill or operate geothermal well; hearing; conditions.

1. The Administrator of the Division of Minerals of the Commission on Mineral Resources shall approve or reject an application for a permit to drill an exploratory well within 10 days after he receives the application in proper form. The permit must not be effective for more than 2 years, but may be extended by the Administrator.

2. Upon receipt of an application for a permit to drill or operate a geothermal well, the Administrator of the Division of Minerals shall transmit copies of the application to the State Engineer, the Administrator of the Division of Environmental Protection of the State Department of Conservation and Natural Resources, and the Director of the Department of Wildlife. After consultation with the State Engineer, the Administrator of the Division of Environmental Protection, and the Director of the Department of Wildlife, the Administrator of the Division of Minerals may issue a permit to drill or operate a geothermal well if it is determined that issuance of a permit is consistent with:

(a) The policies specified in NRS 445A.305 and 445B.100;

(b) The purposes of chapters 533 and 534 of NRS; and

(c) The purposes specified in chapter 501 of NRS.

3. The Administrator of the Division of Minerals shall approve or reject the application to drill or operate a geothermal well within 90 days after he receives it in proper form, unless it is determined that a conflict exists pursuant to subsection 2 or a public hearing is necessary pursuant to subsection 4. Notice of the conflict or need for a public hearing must be provided to the applicant within the 90-day period.

4. The State Engineer and the Administrator of the Division of Minerals may hold public hearings jointly or separately to gather such evidence or information as they deem necessary for a full understanding of all the rights involved and to guard properly the public interest.

5. A permit issued pursuant to this section must include any conditions:

(a) Deemed necessary by the Administrator of the Division of Minerals to carry out the purposes of this section; and

(b) Imposed by the State Engineer consistent with the provisions of chapters 533 and 534 of NRS.

(Added to NRS by 1983, 2091; A 1985, 1304; 1987, 778; 1993, 1701; 1997, 509; 1999, 3633; 2003, 1581)

NRS CROSS REFERENCES.
Water and air pollution control, NRS 445A.305, 445B.100
Wildlife, NRS ch. 501

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Mines and Minerals ⇐ 92.15, 92.23(1).
WESTLAW Topic No. 260.
C.J.S. Mines and Minerals §§ 338, 349.

NRS 534A.080 Fees; use of money.

1. The Commission on Mineral Resources shall impose and collect a fee for examining and filing an application for a permit to drill or operate a geothermal well or to drill an exploratory well. The fee must be deposited with the State Treasurer, for credit to the Account for the Division of Minerals created in the State General Fund pursuant to NRS 513.103.

2. The fee may be based in part on the number of acres of land being used by the person who holds the permit.

3. The Commission and the Division of Minerals may use the money deposited in the Account for the Division of Minerals pursuant to this section to administer the provisions of this chapter.

(Added to NRS by 1983, 2091; A 1985, 1304; 1993, 111, 1702; 1995, 579)

ADMINISTRATIVE REGULATIONS.
Fees, NAC 534A.210-534A.216

NRS 534A.090 Regulations of Commission on Mineral Resources. The Commission on Mineral Resources may adopt regulations necessary for carrying out the provisions of this chapter.

(Added to NRS by 1983, 2091)

ADMINISTRATIVE REGULATIONS.
General provisions, NAC 534A.010-534A.085
Regulations of Commission on Mineral Resources, NAC 534A.170-534A.690

ANSWERS TO COMMONLY ASKED QUESTIONS

ANSWERS TO COMMONLY ASKED QUESTIONS

- Do I have to have a well driller's license to drill my own well?

  Yes. Every well drilled in the State of Nevada must be drilled by a licensed well driller pursuant to Nevada Revised Statutes (NRS) 534.160.

- Is a permit required to drill a domestic well within the State of Nevada?

  No. Domestic wells are the only type of water well exempt from the State Engineer's permitting process (NRS 534.080 and 534.180). Domestic use is defined as water used for culinary and household purposes, in a single-family dwelling, the watering of a family garden, lawn and the watering of domestic animals. No more than 1,800 gallons per day can be pumped from a domestic well. Because domestic wells aren't subject to the permitting process, there is not a water right associated with a domestic well.

- When is a domestic well not allowed to be drilled?

  When the subject parcel of land can be physically and legally supplied water from a public water supply.

- Can I have two or more homes on a single domestic well?

  No. Domestic use as defined under NRS 534.013 is very specific in that the use is limited to one single-family dwelling. Multiple dwellings are considered a quasi-municipal use and thus, require a permit. A quasi-municipal well is often times refered to as a community well.

- Can I have more than one home on one parcel of land?

  That is a local government decision. There are counties within Nevada that allow more than one livable structure on the same parcel. You should check with the local governing body. However, if more than one structure is allowed on the same parcel, a domestic well can still only serve one dwelling and thus the number of domestic wells needed must match the number of dwellings being served. Septic tank concentration and well separation must be considered and must comply with local or state health laws.

- When is a sanitary seal deeper than 50' required on a well?

  Pursuant to Nevada Administrative Code (NAC these regulations), no perforations are allowed in the first 100 feet of the well and the well must have a minimum 100 foot sanitary seal where the well is within ¼ of a mile from a river, lake, perennial stream, unlined reservoir or unlined canal. Also, there may be other seal requirements as described in the water right's permit terms or even by another agency such as public health or where poor water quality is encountered.

ANSWERS TO COMMONLY ASKED QUESTIONS (continued)

- When is an environmental permit required?

  Pursuant to NRS 533.437, an environmental permit is required when, under order from the Division of Environmental Protection, it is required to appropriate water for treatment/clean-up and then discharge the clean water to a different source.

- When drilling a replacement well, do I have to plug the old Well?

  Yes. Permission to drill a replacement well is contingent upon the plugging of the old well. In advance of drilling a replacement well, it is important that the owner understand that the old well needs to be plugged and abandoned at the same time the new well is drilled.

- When is a waiver required to drill a monitoring well?

  A waiver is not required unless:
  (1) the construction of the monitoring well deviates from the standard as described in NAC 534.4351 through 534.4365.
  (2) a monitoring well is to be installed for a reason <u>other than</u> to comply with an environmental order or other permit requirements.

  In all cases, there must be an Affidavit of Abandonment on file with the State Engineer's office prior to drilling any monitoring well and, it is still the licensed well driller's responsibility to file a notice of intent card and a well log.

- What is the format for the well driller's licensing exam?

  The well driller's exam consist of three parts:

  Part 1: Is a written examination to determine the applicants' knowledge of the rules and regulations for drilling wells in the State of Nevada.

  Part 2: Requires the applicant to identify a well location on a topographic map by full legal description (see Appendix F).

  Part 3: Is an oral interview by the Statewide Well Driller's Advisory Board regarding the applicants experience and knowledge of general drilling practices.

- Do I need to hire a licensed well driller to install cathodic protection borings?

  No. However, if the construction of the boring may cause waste or contamination of the ground water, it must be treated as a borehole pursuant to NAC 534.4369 and 534.4371. (see cross section of typical cathodic protection well in illustration portion of these reg.)

ANSWERS TO COMMONLY ASKED QUESTIONS (continued)

- Do I need to hire a licensed well driller to install closed loop geothermal borings used in conjunction with heat exchangers to heat homes?

  No. However, if the construction of the boring may cause waste or contamination of the ground water, it must be treated as a borehole pursuant to NAC 534.4369 and 534.4371. Also, as long as there is no consumptive use, a water right does not need to be obtained from the State Engineer. The Division of Minerals should be contacted prior to these installations however.

- What if I can't complete a well pursuant to the regulations?

  The State Engineer's approval of a written request is required to waive any of the regulations.

- Can I access and download the regulations over the internet?

  Yes. The regulations can be seen at www.leg.state.nv.us/NAC/NAC-534.html or a complete copy of this publication in pdf format can be downloaded or printed from our website at water.nv.gov.

Q: What are the differences in polyvinyl chloride (PVC) "well casing"?

A: I am often asked by drillers, "If the words 'Well Casing' are stamped in the PVC casing, it must be acceptable to use in a well, right?" The answer to this question depends on what state the driller is planning on drilling in. In some states, any type of PVC casing is unacceptable. In others, if 'Well Casing" is stamped on the casing, it is acceptable to use. However, in most states that allow PVC casing, the casing itself must conform to ASTM standards for well casing and be a specific wall thickness (as defined by either an SDR or Schedule rating). Some states even have a placement depth limitation.

Most states rely on the ASTM Standard F480 (Standard Specifications for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Rations (SDR), SCH 40 and SCH 80). PVC pipe is generally rated as either Standard Dimension Ratio (SDR) (e.g., SDR 26, SDR 21, SDR 17, SDR 13.5) or Schedule pipe (e.g., Schedule 40 and Schedule 80).

The minimum wall thickness of standard plastic well casings as per ASTM F480 is determined by the well casing SDR. SDR is the ratio of average outside pipe diameter to minimum wall thickness, and the ratio in a given SDR series is a set and constant value regardless of actual pipe diameter. The typical SDR series established by ASTM F480 are 13.5, 17, 21, 26, 32.5, and 41. The casing well thickness is inversely proportional to the SDR rating. That is, the smaller the SDR rating, the thicker the casing wall.

SDR 21 and 17 pipe are the most commonly used in for well casing. The minimum standard well thickness can be determined from the markings on the well casing. The minimum wall thickness can be determined by dividing the average outside diameter into the SDR rating (4.5"/21 = 0.214"). The advantage of establishing wall thickness categories according to a constant ratio of diameter to wall thickness is that for any given SDR, the pipe stiffness and collapse pressure are independent of pipe size. For example, theoretically, SDR 17 pipe exhibits a constant hydraulic collapse strength regardless of its actual diameter.

Schedule 40 and 80 PVC pipe are also commonly used for monitor and water wells. The minimum wall thickness of this pipe is set by a Schedule, and the ratios of outside diameter to wall thickness of Schedule dimensioned casing vary from one size to the next, tending to increase with increasing diameter. Because of this, the hydraulic collapse pressure and pipe stiffness are not consistent for all sizes within a schedule, tending to decrease in value as the casing diameter increases. In summary, the wall thickness of SDR pipe increases with increasing diameter in order to maintain constant stiffness, pressure rating, and collapse strength standards. On the other hand, the wall thickness of Schedule pipe does not increase proportional to the diameter and thus the stiffness and collapse pressure decreases with increasing pipe diameter. For example, the wall thickness of 4-inch SDR 21 and SCH 40 PVC casing is 0.214" and 0.237", respectively. At this diameter, the strength and stiffness of the two casings are comparable with the SCH40 casing being a little stronger. However, the wall thickness of 12-inch SDR 21 and SCH 40 PVC casing is 0.606" and 0.406", respectively. At this diameter, the wall thickness and strength of the SDR 21 pipe is much greater than the SCH40 casing.

GLOSSARY OF RELATED TERMS

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A

Acid — (1) Chemicals that release hydrogen ions (H^+) in solution and produce hydronium ions (H_3O^+). Such solutions have a sour taste, neutralize bases, and conduct electricity. (2) Term applied to water with a pH of less than 7.0 on a pH scale of 0 to 14.

Activated Carbon — A material produced by heating coal or wood in such a manner as to yield a porous structure, creating a very large internal surface area. Activated carbon is available in both powdered and granular forms, and is widely used to adsorb organic compounds from water and wastewater. It provides a means of removing tastes and odors from drinking water. Also referred to as *Activated Charcoal.*

Adsorption — (1) The adherence of ions or molecules in solution to the surface of solids. (2) The adherence of a gas, liquid, or dissolved material on the surface of a solid. (3) The attraction and adhesion of a layer of ions from an aqueous solution to the solid mineral surfaces with which it is in contact. An example is the adsorption of organic materials by activated carbon. Not to be confused with *Absorption.*

Advection — The process by which solutes are transported by the bulk of flowing fluid such as the flowing ground water.

Aeration — (1) Any active or passive process by which intimate contact between air and liquid is assured, generally by spraying liquid in the air, bubbling air through water, or mechanical agitation of the liquid to promote surface absorption of air. (2) The process of loosening or puncturing the soil by mechanical means in order to increase water and air permeability.

Aggregation — Formation of aggregate. In drilling fluids, aggregation results in the stacking of the clay platelets face to face; as a result, viscosity and gel strength decrease.

Air Stripping — (Water Quality) A process for the removal of organic contaminants from groundwater. The groundwater flows downward inside a tower filled with materials (the packing) over a large surface area. Air is introduced at the bottom of the tower and is forced upward past the falling water. Individual organic contaminants are transferred from the water to the air, according to the gas and water equilibrium concentration values of each contaminant. Also referred to as *Packed Tower Aeration.*

Alkaline — Sometimes water or soils contain an amount of *Alkali* substances sufficient to raise the pH value above 7.0 and be harmful to the growth of crops. Generally, the term alkaline is applied to water with a pH greater than 7.4.

Alluvial — (1) Pertaining to processes or materials associated with transportation or deposition by running water. (2) Pertaining to or composed of *alluvium*, or deposited by a stream or running water. (3) An adjective referring to soil or earth material which has been deposited by running water, as in a riverbed, flood plain, or delta.

Alluvium — (1) A general term for deposits of clay, silt, sand, gravel, or other particulate material that has been deposited by a stream or other body of running water in a streambed, on a flood plain, on a delta, or at the base of a mountain. (2) A general term for such unconsolidated detrital material deposited during comparatively recent geologic time by a stream or other body of running water as a sorted or semi-sorted sediment in the bed of the stream or its flood plain or delta, or as a cone or fan at the base of a mountain slope; especially such a deposit of fine-grained texture (silt or silty clay) deposited during time of flood.

Anion — In an electrolyzed solution, the negatively charged particle, or ion, which travels to the anode and is therefore discharged, evolved, or deposited. Also, by extension, any negative ion.

Anion Exchange — Iron exchange process in which anions in solution are exchanged from other anions from an ion exchange.

Anisotropic — Having some physical property that varies with direction.

Annular Space — The space between two cylindrical objects, one of which surrounds the other, such as the space between the wall of the drilled hole and the casing, or between a permanent casing and the borehole.

Annulus — For a well, the space between the pipe and the outer wall (casing) of the borehole, which may be a pipe also (the well casing).

Annulus Pressure — The positive pressure maintained by a fluid introduced between the well piping and the outer wall (casing) of the borehole of an underground *Injection Well* providing an indication of the integrity of the well.

Anode — Any positively charged electrode as in an electrolytic cell, storage battery or electron tube.

Aquiclude (Confining Bed) — A formation which, although porous and capable of absorbing water slowly, will not transmit water fast enough to furnish an appreciable supply for a well or spring. Aquicludes are characterized by very low values of "leakage" (the ratio of vertical *Hydraulic Conductivity* to thickness), so that they transmit only minor inter-aquifer flow and also have very low rates of yield from compressible storage. Therefore, they constitute boundaries of aquifer flow systems.

Aquifer — (1) A geologic formation, a group of formations, or a part of a formation that is water bearing. (2) A geological formation or structure that stores or transmits water, or both, such as to wells and springs. (3) An underground layer of porous rock, sand, or gravel containing large amounts of water. Use of the term is usually restricted to those water-bearing structures capable of yielding water in sufficient quantity to constitute a usable supply. (4) A sand, gravel, or rock formation capable of storing or conveying water below the surface of the land. (5) A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Aquifer stimulation — A type of development that is done in semi-consolidated and completely consolidated formations to alter the formation physically to improve the hydraulic properties.

Aquifer Test — A test to determine hydrologic properties of an aquifer, involving the withdrawal of measured quantities of water from, or the addition of water to, a well and the measurement of resulting changes in head in the aquifer both during and after the period of discharge or addition (recharge).

C

Clast (Clastic) — (1) Pertaining to a rock or sediment composed principally of broken fragments that are derived from pre-existing rocks or minerals and that have been transported some distance from their places of origin. (2) An individual constituent, grain, or fragment of a sediment or rock, produced by the mechanical weathering (disintegration) of a larger rock mass.

Coefficient of Storage — The volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.

Coefficient of Permeability — Obsolete term. See Hydraulic conductivity.

Coefficient of Transmissivity (*t*) — The rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of the aquifer under a unit *Hydraulic Gradient*. It is equal to an integration

of the hydraulic conductivities across the saturated part of the aquifer perpendicular to the flow paths. Also, the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient. Transmissivity values are given in gallons per minute through a vertical section of an aquifer 1 foot wide and extending the full saturated height of an aquifer under a hydraulic gradient of one in the *English Engineering System*; in the *Standard International System*, transmissivity is given in cubic meters per day through a vertical section of an aquifer 1 meter wide and extending the full saturated height of an aquifer under hydraulic gradient of one. It is a function of properties of the liquid, the porous media, and the thickness of the porous media. Also see *Transmissivity*.

Colloids — (1) Any substance with particles in such a fine state of subdivision dispersed in a medium (for example, water) that they do not settle out, but not in so fine a state of subdivision that they can be said to be truly dissolved. (2) Quantities of extremely small particles, typically 0.0001 to 1 micron in size, and small enough to remain suspended in a fluid medium without settling to the bottom. Substances that, when apparently dissolved in water or other liquid, diffuse not at all or very slowly through a membrane and show other special properties, as lack of pronounced effect on the freezing point or vapor pressure of the solvent. Colloids represent intermediate substances between a true dissolved particle and a suspended solid, which will settle out of solution.

Cone of Depression (COD)/Cone of Influence (COI) — A cone-like depression of the water table or other piezometric surface that has the shape of an inverted cone and is formed in the vicinity of a well by withdrawal of water. The surface area included in the cone is known as the area of influence of the well. Also referred to as the *Pumping Cone* and the *Cone of Drawdown*.

Confined Aquifer — (1) An aquifer containing water between two relatively impermeable boundaries. The water level in a well tapping a confined aquifer stands above the top of the confined aquifer and can be higher or lower than the water table that may be present in the material above it. In some cases the water level can rise above the ground surface, yielding a flowing well. (2) An aquifer or water-bearing subsurface stratum which is bounded above and below by formations of impermeable or relatively impermeable material; a water-bearing formation whose upper boundary is a layer which does not transmit water readily. (3) An aquifer in which ground water is under pressure significantly greater than atmospheric and its upper limit is the bottom of a bed of distinctly lower hydraulic conductivity than that of the aquifer itself.

Contamination (Water) — Impairment of the quality of water sources by sewage, industrial waste, or other matters to a degree which creates a hazard to public health. Also, the degradation of the natural quality of water as a result of man's activities. There is no implication of any specific limits, since the degree of permissible contamination depends upon the intended end use, or uses, of the water.

Corrosion — The act or process of dissolving or wearing away metal.

Corrosive — A substance that deteriorates material, such as pipe, through electrochemical processes.

D

Darcy's Law — An empirically derived equation for the flow of fluids through porous media. It is based on the assumption that flow is laminar and inertia can be neglected, and states that velocity of flow is directly proportional to *Hydraulic Gradient*. For groundwater, this is equivalent to the velocity being equal to the product of the hydraulic gradient and the effective subsoil conductivity or permeability.

Deflocculate — To cause the particles of the disperse phase of a colloidal system to become suspended in the dispersion medium.

Deflocculating Agent — A material added to a suspension to prevent settling.

Density — (1) Matter measured as mass per unit volume expressed in pounds per gallon (lb/gal), pounds per cubic foot (lb/ft_3), and kilograms per cubic meter (kg/m_3). The mass of quantity of a substance per unit volume

Desalination, or Desalinization — (1) To remove salts and other chemicals, as from sea water or soil, for example. Usually used with respect to the salt contained in water. (2) Specific treatment processes to demineralize sea water or brackish (saline) water for reuse. Also referred to as *Desalting*.

Development — The act of repairing damage to the formation caused by drilling procedures and increasing the porosity and permeability of the materials surrounding the intake portion of the well.

Diatomaceous Earth — A yellow, white or light-gray material composed of the siliceous shells of *Diatoms* (fossilized diatoms) and used in water filtration to filter out solid waste in wastewater treatment plants; also used as an active ingredient in some powdered pesticides. Also referred to as *Diatomite*.

Dispersion — The spreading and mixing of chemical constituents in both surface and ground waters caused by diffusion and mixing due to microscopic variations in densities and velocities.

Dissociation — A chemical process that causes a molecule to split into simpler groups of atoms, single atoms or ions. For example, the water molecule (H_2O) breaks down spontaneously into H^+ and OH^- ions.

Drainage Basin — (1) The land area drained by a river. (2) Part of the Earth's surface that is occupied by a drainage system with a common outlet for its surface runoff. (3) Part of the surface of the earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water. The term is used synonymously with *Watershed*, *River Basin*, or *Catchment*.

Drawdown — (1) The act, process, or result of depleting, as a liquid or body of water as in the lowering of the water surface level due to release of water from a reservoir. (2) The magnitude of lowering of the surface of a body of water or of its piezometric surface as a result of withdrawal of the release of water therefrom. (3) The decline of water below the static level during pumping. (4) (Water Table) The lowering of the elevation of the *Groundwater Table*, usually from pumping wells, but can occur naturally during periods of prolonged drought. At the well, it is the vertical distance between the static and the pumping level.

Drill Collar — A length of extremely heavy steel tube. It is placed in the drill string immediately above the drill bit to minimize bending caused by the weight of the drill pipe. (Helps maintain a straight hole)

Drill Pipe — Special pipe used to transmit rotation from the rotating mechanism to the bit. The pipe also transmits weight to the bit and conveys air or fluid, which removes cuttings from the hole and cools the bit.

Drilling Fluid — A water or air-based-fluid, used in the water well drilling operation to remove cuttings from the hole, to clean and cool the bit, to reduce friction between the drill string and the sides of the hole and to seal the borehole.

Drilling Mud — A mixture of clay, water, and other materials, often bentonite clay and barite, commonly used in drilling with a rotary drill rig. The mud is pumped down the drill pipe and through a drill bit and back up to the surface between the drill pipe and the walls of the hole. The mud helps lubricate and cool the drill bit as well as carry the cuttings to the surface. The mud also stabilizes the hole. Also referred to as *Drilling Fluid*.

Drive Point — See Well Point

E

Effective Size — The 90 percent retained size of a sediment as determined from the grain-size analysis; therefore, 10 percent of the sediment is finer and 90 percent is coarser.

Effluent — (1) Something that flows out or forth, especially a stream flowing out of a body of water. (2) (Water Quality) Discharged wastewater such as the treated wastes from municipal sewage plants, brine wastewater from desalting operations, and coolant waters from a nuclear power plant.

Electrical Conductance — The measure of the ease with which a conducting current can be caused to flow through a material under the influence of an applied electric field. It is the reciprocal of resistivity and is measured in 'mhos' per foot (meter).

Electrical Conductivity — Alternate term to Electrical Conductance. Generally used as a measure of the salt content of water.

Electrical Resistivity — The property of a material, which resists the flow of electrical current per unit length through a unit cross sectional area. (Unit of measure-'ohms')

Electrical Log — A record of electrical-resistivity tests made at various depths in a well.

Electrolyte — (1) (Chemistry) Any compound that dissociates into ions when dissolved in water. The solution that results will conduct an electric current. For example, table salt (NaCl) is an electrolyte. (2) (Physiology) Any of various ions, such as sodium, potassium, or chloride, required by cells to regulate the electric charge and flow of water molecules across the cell membrane.

Equipotential Line — A line in a field of flow such that the total head is the same for all points on the line; therefore, the direction of flow is perpendicular to the line at all points.

Erosion — (1) Detachment of soil particles under the influence of water and/or wind. (2) The wearing away and removal of materials of the earth's crust by natural means. (3) The process by which flood waters lower the ground surface in an area by removing upper layers of soil. As usually employed, the term includes weathering, solution, corrosion, and transportation. The agents that accomplish the transportation and cause most of the wear are running water, waves, moving ice, and wind currents.

Evaporation — (1) The physical process by which a liquid (or a solid) is transformed to the gaseous state. (2) The process by which water is changed from a liquid to a vapor. In *Hydrology*, evaporation is vaporization that takes place at a temperature below the boiling point. Also see *Evapotranspiration*.

Evapotranspiration (ET) — (1) The process by which plants take in water through their roots and then give it off through the leaves as a by-product of respiration; the loss of water to the atmosphere from the earth's surface by evaporation and by transpiration through plants. (2) The quantity of water transpired (given off), retained in plant tissues, and evaporated from plant tissues and surrounding soil surfaces. (3) The sum of *Evaporation* and *Transpiration* from a unit land area. (4) The combined processes by which water is transferred from the earth surface to the atmosphere; evaporation of liquid or solid water plus transpiration from plants. (5) The combined evaporative-type processes, including evaporation, interception, and transpiration, usually applied to biological systems. Evapotranspiration occurs through evaporation of water from the surface, evaporation from the capillary fringe of the groundwater table, and the transpiration of groundwater by plants (*Phreatophytes*) whose roots tap the capillary fringe of the groundwater table. The sum of evaporation plus transpiration.

Extrusive Bedrock — (Geology) Those *Igneous Rocks* derived from volcanic lavas that cooled on the surface of the earth. This lava cools rapidly and forms fine-textured rocks such as basalt and andesite.

F

Fault — (Geology) A fracture in rock along which movement can be demonstrated. A fracture in the earth's crust forming a boundary between rock masses that have shifted. Faults may be classified as follows:

Filter Cake — (1) The solids or semisolids deposited on a filter as a fluid is moved through it. (2) The remaining solids or semisolids on a filter after the fluid in a material is extracted by a negative pressure.

Filter Pack — Sand or gravel that is smooth, uniform, clean, well rounded and siliceous. It is placed in the annulus of the well between the borehole wall and well screen to prevent formation material from entering the screen.

Filtration — (1) The process in which suspended matter is removed from a liquid through a medium which is permeable to the liquid but not to the suspended material. (2) (Water Quality) A treatment process, under the control of qualified operators, for removing solid (particulate) matter from water by means of porous media such as sand or a man-made filter; often used to remove particles that contain *Pathogens*.

Fish — Any object lost in the borehole.

Flocculation — (Water Quality) In water and wastewater treatment, the agglomeration or clustering of colloidal and finely divided suspended matter after coagulation by gentle stirring by either mechanical or hydraulic means such that they can be separated from water or sewage.

Flood Plain, also Floodplain — (1) (FEMA) Any normally dry land area that is susceptible to being inundated by water from any natural source. This area is usually low land adjacent to a river, stream, watercourse, ocean or lake. (2) A strip of relatively smooth land bordering a stream, built of sediment carried by the stream and dropped in the slack water beyond the influence of the swiftest current. It is called a *Living Flood Plain* if it is overflowed in times of high water but a *Fossil Flood Plain* if it is beyond the reach of the highest flood. (3) The lowland that borders a stream or river, usually dry but subject to flooding. (4) The transversely level floor of the axial-stream drainageway of a semi-bolson or of a major desert stream valley that is occasionally or regularly alluviated by the stream overflowing its channel during flood. (5) The land adjacent to a channel at the elevation of the bankfull discharge, which is inundated on the average of about 2 out of 3 years. The floor of stream valleys, which can be inundated by small to very large floods. The one-in-100-year floodplain has a probability of 0.01 chance per year of being covered with water. (6) That land outside of a stream channel described by the perimeter of the *Maximum Probable Flood*. Also referred to as a *Flood-Prone Area*.

Flowline (Streamline) — The line indicating the direction followed by ground water toward points of discharge. Flow lines are perpendicular to *Equipotential Lines*.

Foaming Agent — See Surfactant

Formation Stabilizer — A sand or gravel placed in the annulus of the well between the borehole wall and the well screen to provide temporary or long-term support for the borehole.

Fouling — The process in which undesirable foreign matter accumulates in a bed of filter media or ion exchanger, clogging pores and coating surfaces and thus inhibiting or retarding the proper operation of the bed.

G

Gel — (Water Quality) A jellylike material formed by the coagulation of a colloidal suspension or sol.

Gel Strength — The minimum shearing stresses that will produce permanent deformation of colloidal suspension.

Glacial Drift — All earth material transported and deposited by the ice and/or by water flowing from a glacier. It consists of rock flour, sand, pebbles, cobbles, and boulders, and may occur in a heterogeneous mass or be reasonably well sorted, depending on the manner of deposition.

Glaciofluvial Deposits — Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers, and kame terraces. Also see *Glacial Action*, *Glacial Drift* and *Glacial Till*.

Graded — An engineering term pertaining to a soil and or an unconsolidated sediment consisting of particles of several or many sizes or having a uniform or equable distribution of particles from coarse to fine.

Grain per gallon (gpg) — A common basis for reporting water analyses in the water treatment industry in the United States and Canada. One grain per U.S. gallon equals 17.17 milligram per liter.

Ground Water Table — (1) The depth below the surface of the ground where the soil is saturated (the open spaces between the individual soil particles are filled with water). (2) The upper surface of the *Zone of Saturation* for underground water. It is an irregular surface with a slope or shape determined by the quantity of ground water and the permeability of the earth materials. In general, it is highest beneath hills and lowest beneath valleys. Also referred to as the *Water Table*.

Grout — A fluid mixture of cement and water (neat cement) of a consistency that can be forced through a pipe and placed as required. Various additives, such as sand, bentonite and hydrated lime may be included in the mixture to meet certain requirements. Bentonite and water are sometimes used for grout.

Grouting — The operation by which grout is placed between the casing and the side of the well bore to a predetermined height above the bottom of the well. This secures the casing in place and excludes water and other fluids from the well bore.

H

Hardness — (1) A characteristic of water which describes the presence of dissolved minerals. Carbonate hardness is caused by calcium and magnesium bicarbonate; noncarbonate hardness is caused by calcium sulfate, calcium chloride, magnesium sulfate, and magnesium chloride. (2) A property of water which causes an increase in the amount of soap that is needed to produce foam or lather and that also produces scale in hot water pipes, heaters, boilers and other units in which the temperature of water is increased materially. Hardness is produced almost completely by the presence of calcium and magnesium salts in solution. The following scale may assist in appraising water hardness, measured by weight of dissolved salts (in milligrams) per unit (in liters) of water:
[1] ***Soft*** — 0–60 milligrams/liter (mg/l);
[2] ***Moderately Hard*** — 61–120 mg/l;
[3] ***Hard*** — 121–180 mg/l; and
[4] ***Very Hard*** — over 180 mg/l.

Head — Difference in elevation between intake and discharge points for a liquid. In geology, most commonly of interest in connection with the movement of underground water.

Head Loss — (1) The decrease in total head caused by friction. (2) The effect of obstructions, such as narrow bridge openings or buildings, that limit the area through which water must flow, raising the surface of the water upstream from the obstruction.

Heterogeneity — Characteristic of a medium in which material properties vary from point to point. Contrast with *Homogeneity*.

Homogeneity — Characteristic of a medium in which material properties are identical throughout. A material is homogeneous if its hydrologic properties are everywhere identical. Although no known aquifer is homogeneous in detail, models based on the assumption of homogeneity have proven to be valuable tools for predicting the approximate relationship in aquifers between discharge and potential. Contrast with *Heterogeneity*

Hydration — The chemical combination of water with another substance.

Hydraulic Conductivity (Ê) — Simply, a coefficient of proportionality describing the rate at which water can move through an aquifer or other permeable medium. The density and kinematic viscosity of the water must be considered in determining hydraulic conductivity. More specifically, the volume of water at the existing kinematic viscosity that will move, in unit time, under a unit *Hydraulic Gradient* through a unit area measured at right angles to the direction of flow, assuming the medium is isotropic and the fluid is homogeneous. In the Standard International System, the units are cubic meters per day per square meter of medium (m_3/day/m_2) or m/day (for unit measures).

Hydraulic Gradient (*I*) — (1) The slope of the water surface. (2) The gradient or slope of a water table or *Piezometric Surface* in the direction of the greatest slope, generally expressed in feet per mile or feet per feet. Specifically, the change in static head per unit of distance in a given direction, generally the direction of the maximum rate of decrease in head. The difference in hydraulic heads ($h_1 - h_2$), divided by the distance (L) along the flowpath, or, expressed in percentage terms:
$I = (h_1 - h_2) / L \times 100$
A hydraulic gradient of 100 percent means a one foot drop in head in one foot of flow distance.

Hydrogeologic — Those factors that deal with subsurface waters and related geologic aspects of surface waters.

Hydrosphere — (1) The water on or surrounding the surface of the globe, as distinguished from those of the *Lithosphere* and the *Atmosphere*. (2) The region that includes all the earth's liquid water, frozen water, floating ice, frozen upper layer of soil, and the small amounts of water vapor in the earth's atmosphere. Together, the waters of the *Hydrosphere*, *Atmosphere*, *Lithosphere*, and *Biosphere*, constitutes the earth's *Ecosphere*.

I

Igneous Rock — (Geology) A rock formed by the solidification of molten materials (magma). The rock is extrusive (or volcanic) if it solidifies on the surface and intrusive (or plutonic) if it solidifies beneath the surface.

Incrustation — The process by which a crust or coating is formed.

Interference (Wells) — A change in the water level of one well caused by the pumping at another well. The condition occurring when the area of influence of a water well comes into contact with or overlaps that of a neighboring well, as when two wells are pumping from the same aquifer or are located near each other.

Intrusive Bedrock — (Geology) Denoting igneous rocks in a molten state which have evaded other, older rock formations and cooled below the surface of the earth. These magmas are slow-cooling and form coarse-textured rocks, such as granite.

Ion — (1) An atom or molecule that carries a net charge (either positive or negative) because of an imbalance between the number of protons and the number of electrons present. If the ion has more electrons than protons, it has a negative charge and is called an anion; if it has more protons than electrons it has a positive charge and is called a cation. (2) (Water Quality) An electrically charged atom that can be drawn from waste water during electrodialysis.

Isotropy — That condition in which a medium has the same properties in all directions.

K

Karst, also Karstic Region — Limestone and dolomite areas with a topography peculiar to and dependent on underground solution and the diversion of surface waters to underground routes. Characteristic of an area of irregular limestone in which erosion has produced fissures, sinkholes, underground streams, and caverns. Also referred to as *Karst Topography*.

Kelly — Hollow steel bar that is the main section of drill string to which the power is directly transmitted from the rotary table to rotate the drill pipe and bit.

L

Laminar Flow — A flow in which fluid moves smoothly in streamlines in parallel layers or sheets. The stream lines remain distinct and the flow directions at every point remain unchanged with time. It is characteristic of the movement of ground water. Contrasts with turbulent flow. Synonymous with *Streamline Flow* and *Viscous Flow*.

Landfill — (Water Quality) A disposal site which disposes of solid wastes on land. Wastes are deposited and compacted. At specific intervals, a layer of soil covers the waste and the process of deposit and compaction is repeated. The purpose is to confine the wastes to the smallest practical area and volume without creating nuisances or hazards to public health and safety, for example through leaching into the groundwater below the waste site.

Leachate — Liquid which has percolated through the ground, such as water seeping through a sanitary landfill, wastes, pesticides, or fertilizers. Leaching may occur in farming areas, feedlots, and landfills, and may result in hazardous substances entering surface water, ground water, or soil.

Limestone — (Geology) A sedimentary rock composed of calcite, or calcium carbonate ($CaCO_3$), and sometimes containing shells and other hard parts of prehistoric water animals and plants. When chemical conditions are right, some calcite crystallizes in sea water and settles to the bottom to form limestone.

Lithosphere — That part of the earth which is composed predominantly of rocks (either coherent or incoherent, and including the disintegrated rock materials known as soils and subsoils), together with everything contained in this rocky crust.

Lost Circulation — The result of drilling fluid escaping from the borehole into the formation by way of crevices or porous media.

M

Marsh Funnel Viscosity — Commonly called the funnel viscosity. The Marsh funnel viscosity is reported as the number of seconds required for one qt. (946 ml) of a given fluid to flow through the funnel.

Metamorphic Rock — (Geology) A sedimentary or igneous rock that has been changed by pressure, heat, or chemical action. For example, limestone, a sedimentary rock, is converted to marble, a metamorphic rock.

Moho — The boundary surface or sharp seismic-velocity discontinuity that separates the Earth's crust from the underlying mantle.

Molecular Diffusion — The process in which solutes are transported at the microscopic level due to variations in the solute concentrations within the fluid phases. Also see the *Coefficient of Molecular Diffusion*.

Molecule — A group of atoms held together by chemical bonds. They may be either atoms of a single element (O_2) or atoms of different elements that form a compound (H_2O). The smallest amount of a compound which has all the properties of the compound.

Moraine — An accumulation of boulders, stones, or other debris carried and deposited by a glacier. Moraines, which can be subdivided into many different types, are deposits of *Glacial Till. Lateral Moraines* are the ridges of till that mark the sides of the glacier's path. *Terminal Moraines* are the material left behind by the farthest advance of the glacier's toe. Each different period of glaciation leaves behind its own moraines.

N

Naturally Developed Well — A well in which the screen is placed in direct contact with the aquifer materials; no filter pack is used.

Nominal — Used to describe standard sizes for pipe from 1/8 inch to 12 inches (3.2 mm to 305 mm). The nominal size is specified on the basis of inside diameter. Depending on the wall thickness, the inside diameter may be less than or greater than th number indicated.

Nongraded — An engineering term pertaining to a soil or an unconsolidated sediment consisting of particles of essentially the same size.

O

Observation Well — A well used to monitor changes in water levels of an aquifer and to obtain samples for water quality analyses.

Outwash — A deposit of sand and gravel formed by streams of meltwater flowing from a glacier and laid down in stratified deposits.

Outwash Plain — A broad gently sloping sheet of outwash.

Overburden — The earth, rock, and other materials that lie above a desired ore or mineral deposit.

Oxidation (Oxidizing) — (1) A chemical reaction that involves combination with oxygen or the loss of electrons. (2) The process of increasing the positive valence or of decreasing the negative valence of an element or ion. (3) The process by which electrons are removed from atoms or ions, also, reduction. (4) (Water Quality) The addition of oxygen that breaks down organic waste or chemicals such as cyanides, phenols, and organic sulfur compounds in sewage by bacterial and chemical means.

P

Partial Penetration — A well constructed in such a way that it draws water directly from a fractional part of the total thickness of the aquifer. The fractional part may be located at the top, the bottom, or anywhere else in the aquifer.

Pathogen — A disease-producing agent; usually applied to a living organism (i.e., biological). Generally, any viruses, bacteria, or fungi that cause disease.

Perched Ground Water — Ground water in a saturated zone of material underlain by a relatively impervious stratum which acts as a barrier to downward flow and which is separated from the main ground water body by a zone of unsaturated material above the main ground water body.

Perched Water Table — The top of a *Zone of Saturation* that bottoms on an impermeable horizon above the level of the general water table in the area. Is generally near the surface, and frequently supplies a hillside spring.

Percolating Waters — Underground waters whose course and boundaries are incapable of determination. Waters which pass through the ground beneath the earth's surface without a definite channel. May be rainwater slowly infiltrating through the soil or water seeping through the banks or the bed of a stream, but these waters have left the flow of the stream so that they no longer may be characterized as a part of the stream flow. It is presumed that ground waters percolate.
Percolation — (1) The movement, under hydrostatic pressure, of water through the interstices of a rock or soil. Also, the movement of water within a porous medium such as soil toward the water table without a definite channel. (2) The entrance of a portion of the streamflow into the channel materials to contribute to ground water replenishment. (3) Slow seepage of water through a filter.

Permeability — (1) The capacity of soil, sediment, or porous rock to transmit water; the property of soil or rock that allows passage of water through it. (2) For a rock or an earth material, the ability to transmit fluids; the rate at which liquids pass through soil or other materials in a specified direction. It is measured by the rate at which a fluid of standard viscosity can move through a material in a given interval of time under a given *Hydraulic Gradient*. Permeability for underground water is sometimes expressed numerically as the number of gallons per day that will flow through a cross section of 1 square foot, at 60EF, under a hydraulic gradient of 100 percent. Permeability is equal to velocity of flow divided by hydraulic gradient. The following permeability terms apply:
[1] ***Very Slow*** – less than 0.05 inch per hour;
[2] ***Slow*** – 0.05 to 0.20 inch per hour;
[3] ***Moderately Slow*** – 0.20 to 0.80 inch per hour;
[4] ***Moderate*** – 0.80 to 2.50 inches per hour;
[5] ***Moderately Rapid*** – 2.50 to 5.0 inches per hour;
[6] ***Rapid*** – 5.0 to 10.0 inches per hour; and
[7] ***Very Rapid*** – More than 10.0 inches per hour.

pH (Hydrogen Ion Concentration, or Potential of Hydrogen) — (1) A convenient method of expressing the acidity or basicity of a solution in terms of the logarithm of the reciprocal (or negative logarithm) of the hydrogen ion concentration. The pH scale runs from 0 to 14; a pH value of 7.0 indicates a neutral solution. Values above 7.0 pH indicate basicity (basic or alkaline solutions); those below 7.0 pH indicate acidity (acidic solutions). Natural waters usually have a pH between 6.5 and 8.5. Because the units are derived from common logarithms, a difference of one pH unit indicates a tenfold (10_1) difference in acidity; similarly, a difference of two units indicates a hundredfold (10_2) difference in acidity. The term originally derived from "potential of hydrogen," or hydrogen power. (2) A term indicating the hydrogen ion concentration of a solution, i.e., a measure of the solution's acidity. The term (from French, pouvoir hydrogène, or literally, "hydrogen power") is defined as the negative logarithm of the concentration of H+ ions (protons): $pH = -\log 10\ [H+]$, where [H+] is the concentration of H+ ions in moles per liter (see *Mole*).

Because H^+ ions associate with water molecules to form hydronium (H_3O^+) ions (see *Acid* and *Base*), pH also is often expressed in terms of the concentration of hydronium ions. In pure water at 22° C (72°F),H_3O^+ and hydroxyl (OH^-) ions exist in equal quantities; the concentration of each is 0.107 moles/liter. Consequently, the pH of pure water is –log (0.107), which equals log 107, or 7. If an acid is added to water, however, an excess of H_3O^+ ions is formed; their concentration can range between 0.106 and 0.10 moles/liter, depending on the strength and amount of the acid. Therefore, acid solutions have a pH ranging from 6 (for a weak acid) to 1 (for a strong acid). Inversely, a basic solution has a low concentration of H_3O^+ ions and an excess of OH^- ions, and the pH ranges from 8 (for a weak base) to 14 (for a strong base). The presence and concentration of many dissolved chemical constituents found in water are, in part, influenced by the hydrogen-ion activity of water. Biological processes including growth, distribution of organisms, and toxicity of the water to organisms are also influenced, in part, by the hydrogen-ion activity of water.

Plate Tectonics — (Geology) The concept that both continents and ocean basis are only the emergent parts of large pieces or plates of the earth's surface. It is generally agreed that the global surface can be divided into at least twenty discrete plates (seven major and many minor) with each plate moving in a different direction from that of its neighbor. It is this motion that creates the variety of features of the earth as well as leads to instability along the plate edges. The motion of the plates is believed to be caused by tremendous heat and pressure built up beneath the relatively thin veneer of the overlying plates. The motion of the plates is characterized by spreading centers whereby molten rock is forced to the surface to form new crustal rocks, and collision zones where plates meet and the older, heavier plate is forced beneath the newer, lighter plate to be turned into a molten state once again deep beneath the earth's surface. This subduction process builds up the mountains along the collision line and results in considerable seismic activity. The seven major plates are named for the continents or oceans and include Pacific, Eurasian, African, Australian, North American, South American, and Antarctic. Also see *Plate Boundaries.*

Pollution — (1) Any alteration in the character or quality of the environment which renders it unfit or less suited for certain uses. With respect to water, the alteration of the physical, chemical, or biological properties by the introduction of any substance that adversely affects any beneficial use. (2) Adverse and unreasonable impairment of the beneficial uses of water even though no actual health hazard is involved. Under the Clean Water Act (CWA), for example, the term is defined as the manmade or man-induced alteration of the physical, biological, chemical, and radiological integrity of water.

Polymer — A substance formed by the union of two or more molecules of the same kind of linked end to end into another compound having the same elements in the same proportion but a higher molecular weight and different physical properties..

Porosity — Most generally, porosity is the property of containing openings or interstices. In rock or soil, it is the ratio (usually expressed as a percentage) of the volume of openings in the material to the bulk volume of the material. With respect to water, porosity is a measure of the water-bearing capacity of a formation. However, with respect to water extraction and movement, it is not just the total magnitude of porosity that is important, but the size of the voids and the extent to which they are interconnected, as the pores in a formation may be open, or interconnected, or closed and isolated. For example, clay may have a very high porosity with respect to potential water content, but it constitutes a poor medium as an aquifer. More important in this respect are a formation's *Effective Porosity* (defined below) and its *Specific Retention.*

Porosity, Effective — The amount of interconnected pore space in a material available for fluid transmission; expressed as a percentage of the total volume occupied by the interconnecting interstices. Porosity may be primary, formed during deposition or cementation of the material, or secondary, formed after deposition or cementation, such as fractures.

Potentiometric Surface — A surface which represents the static head of ground water in tightly cased wells that tap a water-bearing rock unit (i.e., aquifer). In relation to an aquifer, the potentiometric surface is defined by the levels to which water will rise in tightly cased wells. If the head varies significantly with depth in the aquifer, then there may be more than one potentiometric surface. The *Water Table* is a particular potentiometric surface for an *Unconfined Aquifer.* This term has generally replaced the term *Piezometric Surface.*

Pumping Test — A test that is conducted to determine aquifer or well characteristics. More specifically, a test made by pumping a well for a period of time and observing the change in *Hydraulic Head* in the aquifer. A pump test may be used to determine the capacity of the well and the hydraulic characteristics of the aquifer. Also referred to as *Aquifer Test.*

Q

Quick Condition — A condition of soil in which an increase in pore-ware pressure decreases particle-to-particle attraction and reduces significantly the soil's bearing capacity.

R

Radius of Influence — The radial distance from the center of a well bore to the point where there is no lowering of the water table or *Potentiometric Surface* (the edge of its *Cone of Depression*).

Recharge (Hydrologic) — (1) The downward movement of water through soil to groundwater. (2) The process by which water is added to the *Zone of Saturation.* (3) The introduction of surface or ground water to groundwater storage such as an aquifer. Recharge or replenishment of groundwater supplies consists of three (3) types:
[1] ***Natural Recharge*** which consists of precipitation or other natural surface flows making their way into groundwater supplies;
[2] ***Artificial or Induced Recharge*** which includes actions by man specifically designed to increase supplies in a groundwater reservoirs through various methods such as water spreading (flooding), ditches, and pumping techniques; and
[3] ***Incidental Recharge*** which consists of actions, such as irrigation and water diversion, which add to groundwater supplies but are intended for other purposes. Recharge may also refer to the amount of water so added.

Recharge Area (Groundwater) — (1) The land area over which precipitation infiltrates into soil and percolates downward to replenish an aquifer. (2) The area in which water reaches the *Zone of Saturation* by surface infiltration. Infiltration moves downward into the deeper parts of an aquifer in a recharge area. Also referred to as a *Recharge Zone.*

Recharge, Artificial — The designed (as opposed to the natural or incidental) replenishment of ground water storage from surface water supplies. There exist five (5) common techniques to effect artificial recharge of a groundwater basin:
[1] ***Water Spreading*** consisting of the basin method, stream-channel method, ditch method, and flooding method, all of which tend to divert surface water supplies to effect underground infiltration;
[2] ***Recharge Pits*** designed to take advantage of permeable soil or rock formations;
[3] ***Recharge Wells*** which work directly opposite of pumping wells although have limited scope and are better used for deep, confined aquifers;
[4] ***Induced Recharge*** which results from pumping wells near surface supplies thereby inducing higher discharge towards the well; and
[5] ***Wastewater Disposal*** which includes the use of secondary treatment wastewater in combination with spreading techniques, recharge pits, and recharge wells to reintroduce the water to deep aquifers thereby both increasing the available groundwater supply and also further improving the quality of the wastewater. Also referred to as *Induced Recharge.* Also see *Natural Recharge*, *Incidental Recharge*, *Injection*, and *Perennial Yield.*
Recharge Basin — A surface facility, often a large pond, used to increase the infiltration of surface water into a ground water basin.

Recharge Boundary — An aquifer system boundary that adds water to the aquifer. Streams and lakes are typical recharge boundaries.

Recharge, Incidental — Ground water recharge (infiltration) that occurs as a result of human activities unrelated to a recharge project, for example, irrigation and water diversion (unlined canals). Also see *Artificial* (or *Induced*) *Recharge*, *Natural Recharge*, and *Perennial Yield.*

Recharge, Induced — See *Artificial Recharge*, above. Also see *Injection.*

Recharge, Natural — The replenishment of groundwater storage from naturally-occurring surface water supplies such as precipitation and stream flows. Also see *Artificial* (or *Induced*) *Recharge*, *Incidental Recharge*, and *Perennial Yield.*

Recharge Rate — The quantity of water per unit of time that replenishes or refills an aquifer.

Recharge Well — Used in conjunction with artificial or induced ground water recharge techniques, the recharge well works directly opposite of pumping wells to induce surface water into the ground water system. Based on the nature of the soil and rock being recharged, the use of recharge wells typically have limited scope and are better employed for recharging deep, confined aquifers. Also see *Injection.*

Recharge Zone — A land area into which water can infiltrate into an *Aquifer* relatively easily. The infiltration replenishes the aquifer. The location is also referred to as a *Recharge Area.*

Redox — A chemical reaction in which an atom or molecule losses electrons to another atom or molecule. Also called oxidation-reduction. Oxidation is the loss of electrons; reduction is the gain of electrons.

Regolith — A general term for the layer of fragmental and unconsolidated rock material that nearly everywhere forms the surface of the land and overlies or covers the bedrock.

Residual Drawdown — The difference between the original static water level and the depth to water at a given instant during the recovery period.

Runoff — (1) That portion of precipitation that moves from the land to surface water bodies. (2) That portion of precipitation which is not intercepted by vegetation, absorbed by the land surface or evaporated, and thus flows overland into a depression, stream lake or ocean (runoff called "immediate subsurface runoff" also takes place in the upper layers of the soil). (3) That part of the precipitation, snow melt, or irrigation water that appears in uncontrolled surface streams, rivers, drains or sewers. It is the same as streamflow unaffected by artificial diversions, imports, storage, or other works of man in or on the stream channels. Runoff may be classified according to speed of appearance after rainfall or melting snow as direct runoff or base runoff, and according to source as surface runoff, storm interflow, or ground-water runoff. (4) The total discharge described in (1), above, during a specified period of time. (5) Also defined as the depth to which a drainage area would be covered if all of the runoff for a given period of time were uniformly distributed over it.

Meteorological Factors Affecting Runoff:

[1] Type of precipitation (rain, snow, sleet, etc.);
[2] Rainfall intensity;
[3] Rainfall amount;
[4] Rainfall duration;
[5] Distribution of rainfall over the drainage basin;
[6] Direction of storm movement;
[7] Antecedent precipitation and resulting soil moisture; and
[8] Other meteorological and climatic conditions which affect evapotranspiration such as temperature, wind, relative humidity, and season.

Physical Basic Characteristics Affecting Runoff:

[1] Land use;
[2] Vegetation;

[3] Soil type;
[4] Drainage area;
[5] Basin shape;
[6] Elevation;
[7] Slope;
[8] Topography;
[9] Direction of orientation;
[10] Drainage network patterns; and
[11] Ponds, lakes, reservoirs, sinks, etc. in the basin which prevent or alter runoff from continuing downstream.

S

Sandstone — A sedimentary rock composed of abundant rounded or angular fragments of sand set in a fine-grained matrix (silt or clay) and more or less firmly united by cementing material.

Sandstone Aquifer — The type of aquifer supplying groundwater to large parts of the United States upper Middle West, Appalachia, and Texas. The water-bearing formation is often contained by shale strata, and the water has high levels of iron and magnesium.

Sedimentary Rock — (Geology) Rock formed of sediment, especially from mechanical, chemical, or organic processes, and specifically: (1) clastic rock, such as conglomerate, sandstone, and shale, formed of fragments of other rock transported from their sources and deposited in water; and (2) rocks formed by precipitation from solution, as rock salt and gypsum, or from secretions of organisms, such as most limestone. Many sedimentary rocks show distinct layering, which is the result of different types of sediment being deposited in succession. Also see *Igneous Rock* and *Metamorphic Rock*.

Shale — A fine-grained sedimentary rock, formed by the consolidation of clay, silt or mud. It is characterized by finely laminated structures and is sufficiently indurated so that it will not fall apart upon wetting.

Shear — A force parallel to a surface as opposed to directly on the surface. An example of shear would be the tractive force that removes particles from a stream bank as flow moves over the surface of the slope; a floating log that directly strikes the bank would not be a shear force.

Sieve Analysis — Determination of the particle size distribution of a soil, sediment or rock by measuring the percentage of the particles that will pass through standard sieves of various sizes.

Slurry — (1) A thin, watery muck, or any substance resembling it, such as a lime slurry. The mixture is pourable and can be transported by pipe. (2) A very wet, highly mobile, semiviscous mixture or suspension of finely divided, insoluble matter, especially a muddy lake-bottom deposit having the consistency of a thick soup. (3) The form in which some raw material is added to an industrial process. Compare with *Liquor*.

Specific Capacity (of a Well) — In ground water hydrology, the ratio of the discharge or yield of a well, usually measured in gallons per minute per foot, to drawdown after a period of sustained pumping.

Specific Gravity (SG or SP GR) — (1) The ratio of the density of a substance to the density of some substance (as pure water) taken as a standard when both densities are obtained by weighing in air. (2) The ratio of the mass of a solid or liquid to the mass of an equal volume of distilled water at 4EC (39EF) or of a gas to an equal volume of air or hydrogen under prescribed conditions of temperature and pressure. Relative to water, the specific gravity (SG) is given by:
$SG = \tilde{n}/\tilde{n}_w$ where $\tilde{n}$ is the density (weight per unit volume) of the unknown substance and $\tilde{n}_w$ is the density of water. The parameter has no units and is frequently used to determine the concentration of a *Solution*.

Specific Retention (of a Water-Table Aquifer) — Generally, a measure of the water-retaining capacity of a porous medium. The amount of water held in saturated rock or soil after the excess gravitational water has drained away as compared to the total volume of the rock or soil. Specific retention is dependent on both pore characteristics as well as factors affecting the surface tension, such as temperature, viscosity, mineral composition of the water, etc. Also referred to as *Field Capacity* or *Water-Holding Capacity*. Also see *Porosity*.

Specific Yield (Ground Water) — The ratio of the volume of water that a rock will yield by gravity, after being saturated, to its own volume, expressed as a percentage.

Static Water Level — (1) The elevation or level of the water table in a well when the pump is not operating. (2) The level or elevation to which water would rise in a tube connected to an *Artesian Aquifer* or basin in a conduit under pressure.

Storage Coefficient — (1) For surface water, the relation of storage capacity in a reservoir to the mean annual flow of a stream above the dam forming the reservoir. (2) For ground water, primarily in a *Confined Aquifer*, it is a measure of the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head. This definition is similar to that of the *Specific Yield* for a water-table aquifer. However, confined aquifers remain saturated at all times and therefore water release in not met by drainage of the void spaces as is the case of an *Unconfined Aquifer*, but due to the change in pore pressure. Also referred to as the *Storativity*.

Storativity — The volume of water that a permeable unit, i.e., aquifer, will absorb or expel from storage per unit surface area per unit change in head. In an unconfined aquifer, the storativity value is equal to the *Specific Yield*. The specific yield of the aquifer can be used to estimate the time between when pumping begins and equilibrium groundwater conditions are reached.

Stratigraphy — (1) The branch of geology which treats the formation, composition, sequence and correlation of the layered rocks as parts of the earth's crust. (2) The branch of geology that deals with the definition and description of major and minor natural divisions of rocks (mainly sedimentary, but not excluding igneous and metamorphic) available for study in outcrop or from subsurface, and with the interpretation of their significance in geologic history. It involves interpretation of features of rock strata in terms of their origin, occurrence, environment, thickness, lithology, composition, fossil content, age, history, paleogeographic conditions, relation to organic evolution, and relation to other geologic concepts. (3) The arrangement of strata, especially as to geographic position and chronological order of sequence.

Surfactant — An agent that is used to decrease the surface tension of water, useful for removing or dispersing oils or oily residues. Most detergents are surfactants. The term is derived from *surface active agent*.

T

Tensile Strength — The resistance of a material to a force tending to tear it apart.

Till (Glacial) — Till is the mixture of rocks, boulders, and soil picked up by a moving *Glacier* and carried along the path of the ice advance. The glacier deposits this till along its path — on the sides of the ice sheet, at the toe of the glacier when it recedes, and across valley floors when the ice sheet melts. These till deposits are akin to the footprint of a glacier and are used to track the movement of glaciers. These till deposits can be good sources of ground water, if they do not contain significant amounts of impermeable clays.

Tortuosity — Sinuosity of the actual flow path in porous medium; it is the ratio of the length of the flow path divided by the length of the sample.

Total Dissolved Solids (TDS) — (Water Quality) A measure of the amount of material dissolved in water (mostly inorganic salts). Typically aggregates of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, etc. of calcium, magnesium, manganese, sodium, potassium, and other cations which form salts. The inorganic salts are measured by filtering a water sample to remove any suspended particulate material, evaporating the water, and weighing the solids that remain. An important use of the measure involves the examination of the quality of drinking water. Water that has a high content of inorganic material frequently has taste problems and/or water hardness problems. As an example, water that contains an excessive amount of dissolved salt (sodium chloride) is not suitable for drinking. High TDS solutions have the capability of changing the chemical nature of water. High TDS concentrations exert varying degrees of osmotic pressures and often become lethal to the biological inhabitants of an aquatic environment. The common and synonymously used term for TDS is "salt". Usually expressed in milligrams per liter. Also see *Hard Water* and *Salinity*.

Transmissibility (Ground Water) — The capacity of a rock to transmit water under pressure. The coefficient of transmissibility is the rate of flow of water, at the prevailing water temperature, in gallons per day, through a vertical strip of the aquifer one foot wide, extending the full saturated height of the aquifer under a hydraulic gradient of 100 percent. A *Hydraulic Gradient* of 100 percent means a one foot drop in head in one foot of flow distance.

Transmissivity, also Coefficient of Transmissivity (ô) — The ability of an aquifer to transmit water. The rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of the aquifer under a unit *Hydraulic Gradient*. It is equal to an integration of the hydraulic conductivities across the saturated part of the aquifer perpendicular to the flow paths. Also, the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient. Transmissivity values are given in gallons per minute through a vertical section of an aquifer 1 foot wide and extending the full saturated height of an aquifer under a hydraulic gradient of one in the *English Engineering System*; in the *Standard International System*, transmissivity is given in cubic meters per day through a vertical section of an aquifer 1 meter wide and extending the full saturated height of an aquifer under hydraulic gradient of one. It is a function of properties of the liquid, the porous media, and the thickness of the porous media.

Transpiration — (1) The movement of water from the soil or ground water reservoir via the stomata in plant cells to the atmosphere. (2) The quantity of water absorbed, transpired, and used directly in the building of plant tissue during a specified time period. It does not include soil evaporation. (3) The process by which water vapor escapes from a living plant, principally through the leaves, and enters the atmosphere. Transpiration, combined with *Evaporation* from the soil, is referred to as *Evapotranspiration*.

Turbulent Flow — (1) (Physics) The motion of a fluid having local velocities and pressures that fluctuate randomly. (2) The mechanism by which a fluid such as water moves near a rough surface. Fluid not in contact with the irregular boundary outruns that which is slowed by friction or deflected by the uneven surface. Fluid particles move in a series of eddies or whirls. Most stream flow is turbulent, and turbulent flow is important in both erosion and transportation. Contrast with *Laminar Flow*.

U

Unconfined Aquifer — An aquifer containing water that is not under pressure; the water level in a well is the same as the water table outside the well. An unconfined aquifer made up of loose material, such as sand or gravel, that has not undergone lithification (settling). In an unconfined aquifer the upper boundary is the top of the *Zone of Saturation* (water table).

Uniformity Coefficient — A numerical expression of the variety in particle sizes in mixed natural soils, defined as the ratio of the sieve size on which 40 percent (by weight) of the material is retained to the sieve size on which 90 percent of the material is retained.

V

Vadose Zone — The subsurface zone between the water table (*Zone of Saturation*) and the land surface where some of the spaces between the soil particles are filled with air. Also referred to as the *Unsaturated Zone* or, less frequently, the *Zone of Aeration*.

Viscosity (ç) — A measure of the resistance of a fluid to flow. For liquids, viscosity increases with decreasing temperature. For gases, viscosity increases with increasing temperature. Expressed as mass per length-time (e.g., kilograms per meter-second). A common viscosity unit is the *Poise*. One poise equals 1.0 gram per centimetersecond. Also referred to as *Dynamic Viscosity*.

W

Water Table — (1) The surface of a groundwater body at which the water is at atmospheric pressure; the upper surface of the ground water reservoir. (2) The upper surface of the *Saturated Zone* that determines the water level in a well in an *Unconfined Aquifer*. (3) The level of groundwater; the upper surface of the *Zone of Saturation* for underground water. It is an irregular surface with a slope or shape determined by the quantity of ground water and the permeability of the earth material. In general, it is highest beneath hills and mountains and lowest beneath valleys. Also referred to as *Ground Water Table*.

Weathering — (1) The physical disintegration or chemical decomposition of rock due to wind, rain, heat, freezing, thawing, etc. (2) The response of materials that were once in equilibrium within the earth's crust to new conditions at or near contact with water, air, or living matter. The breakdown of rock through a combination of chemical, physical, geological, and biological processes. The ultimate outcome is the generation of soil.

Well Point — A screening device, equipped with a point on one end, that is meant to be driven into the ground.

Well Screen — A filtering device used to keep sediment from entering a water well.

Well Yield — The volume of water discharged from a well in gallons per minute or cubic meters per day.

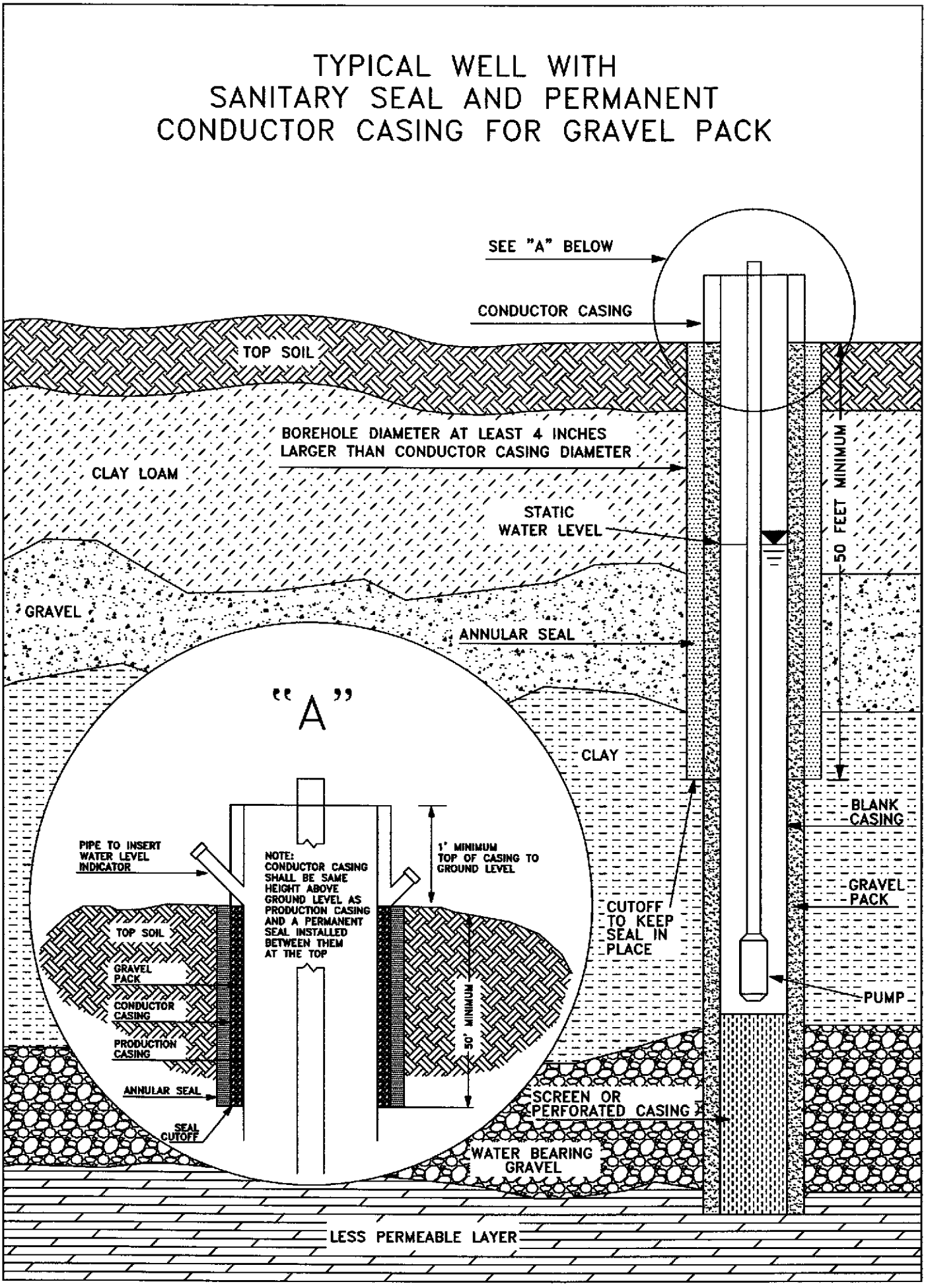
Y

Yield — (1) The quantity of water expressed either as a continuous rate of flow (e.g., cubic feet per second – cfs) or as a volume per unit of time (e.g., acre-feet per year – AFY) which can be collected for a given use or uses from surface- or ground-water sources on a watershed. The yield may vary with the use proposed, with the plan of development, and also with economic considerations. (2) Total runoff. (3) The streamflow in a given interval of time derived from a unit area of watershed. It is determined by dividing the observed streamflow at a given location by the drainage area above that location and is usually expressed in cubic feet per second per square mile.

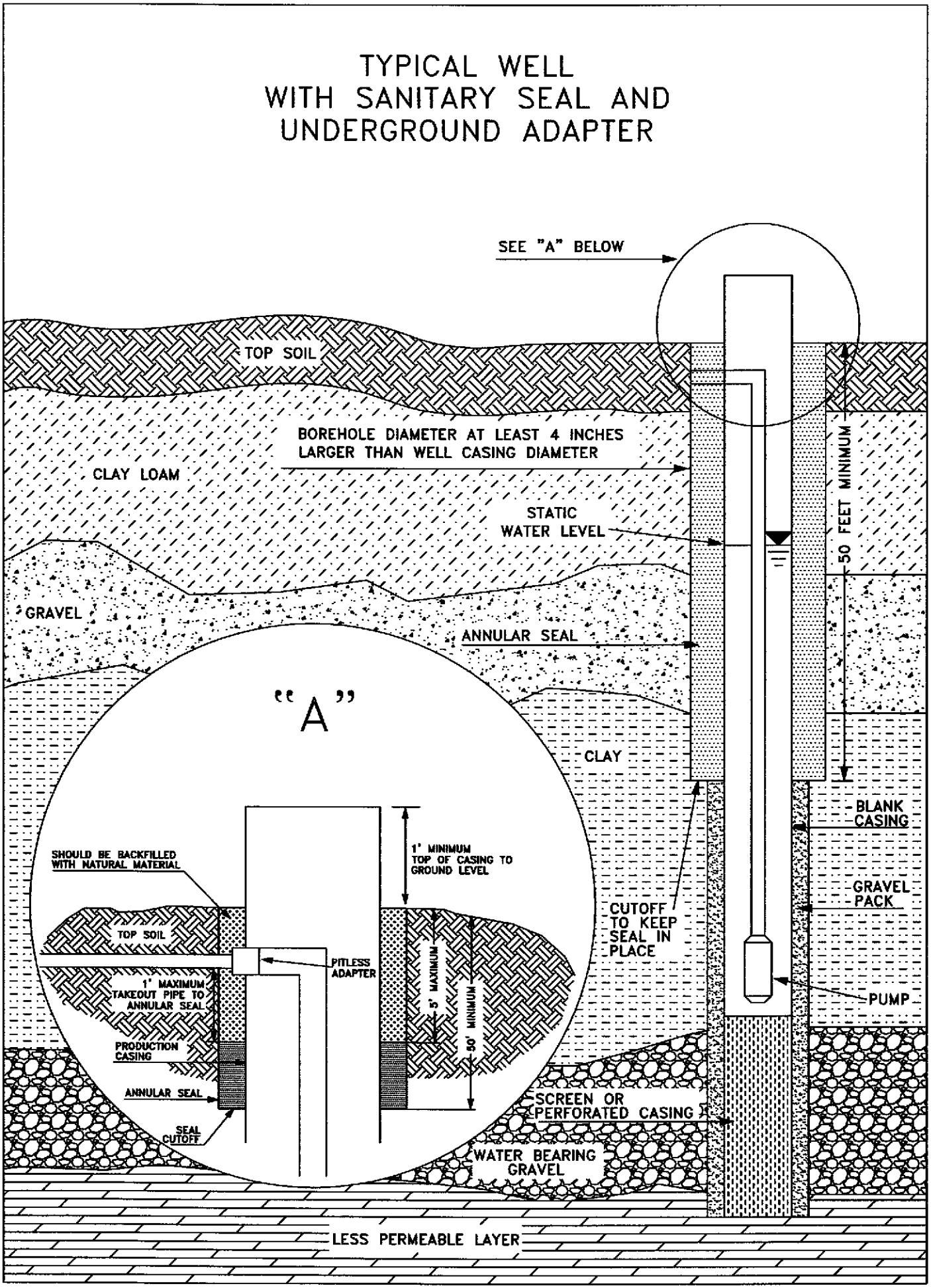
Yield Strength — The tensile stress required to produce a total elongation of 0.5 percent of the original length as determined by an extensiometer. Expressed in psi.

ILLUSTRATIONS

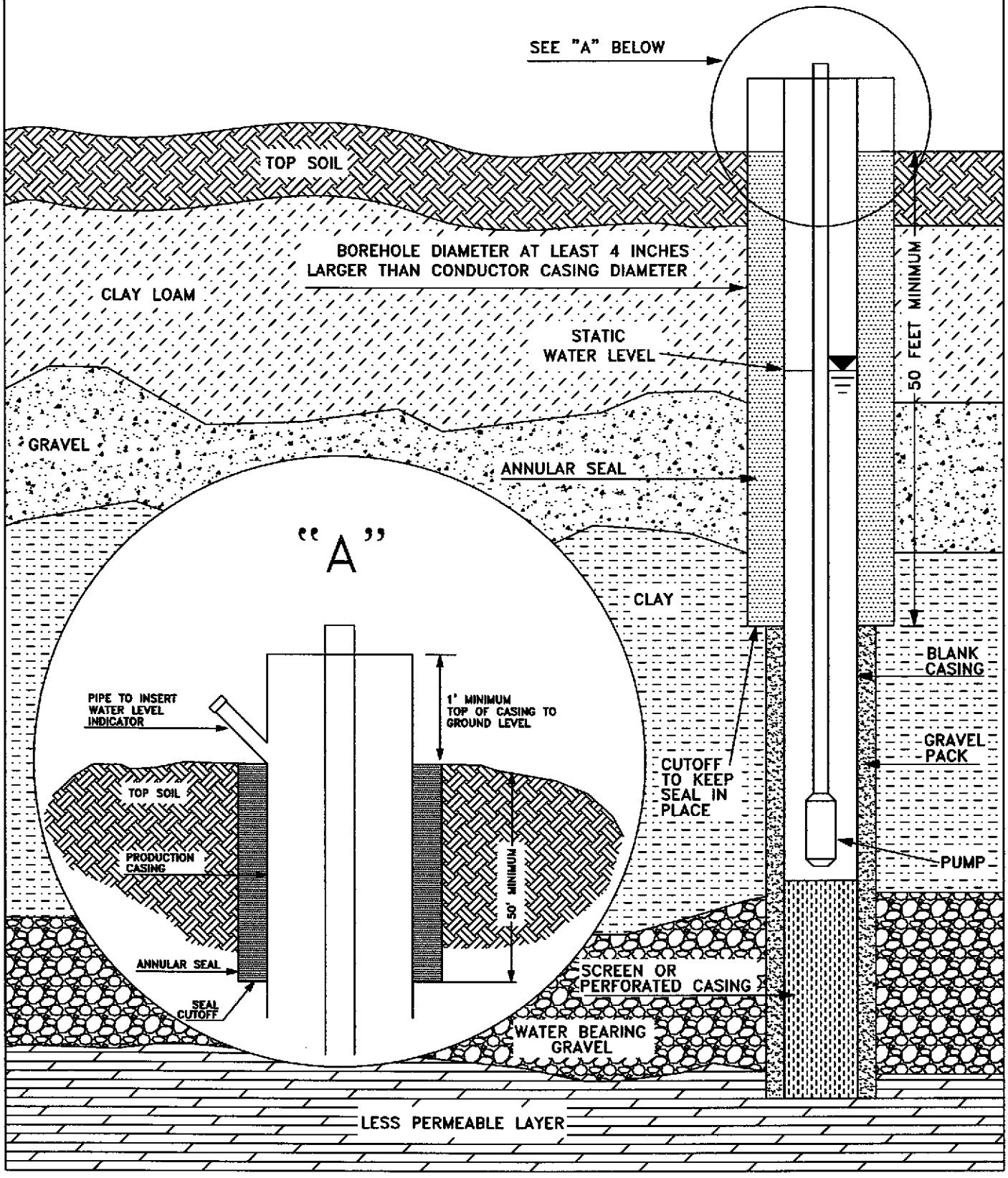
TYPICAL WELL WITH SANITARY SEAL AND PERMANENT CONDUCTOR CASING FOR GRAVEL PACK



TYPICAL WELL WITH SANITARY SEAL AND UNDERGROUND ADAPTER



TYPICAL WELL
WITH SANITARY SEAL AND WITHOUT
UNDERGROUND ADAPTER OR CONDUCTOR CASING



CROSS SECTION OF A TYPICAL CATHODIC PROTECTION WELL

(NOTE: SCHEMATIC NOT TO SCALE)

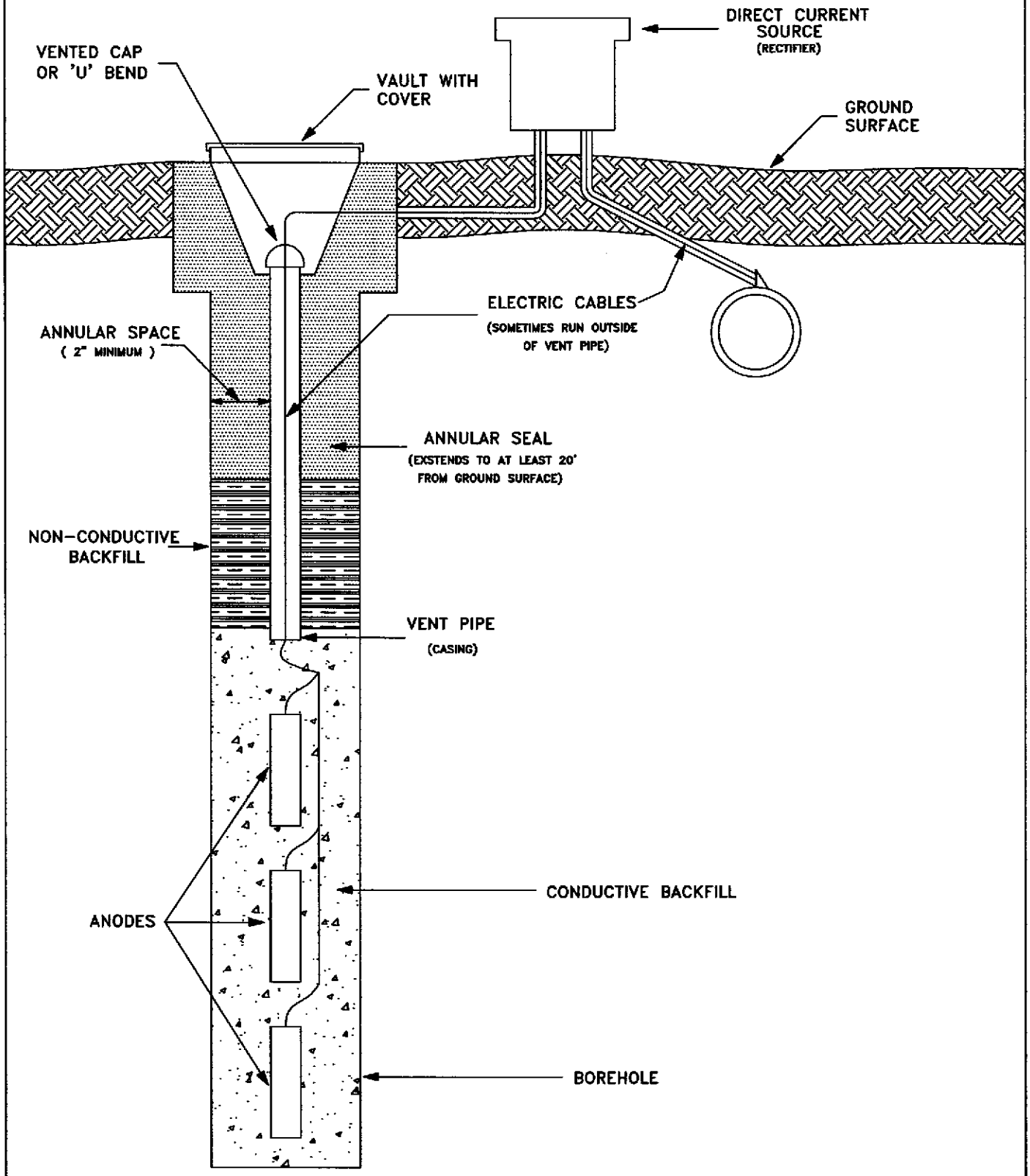
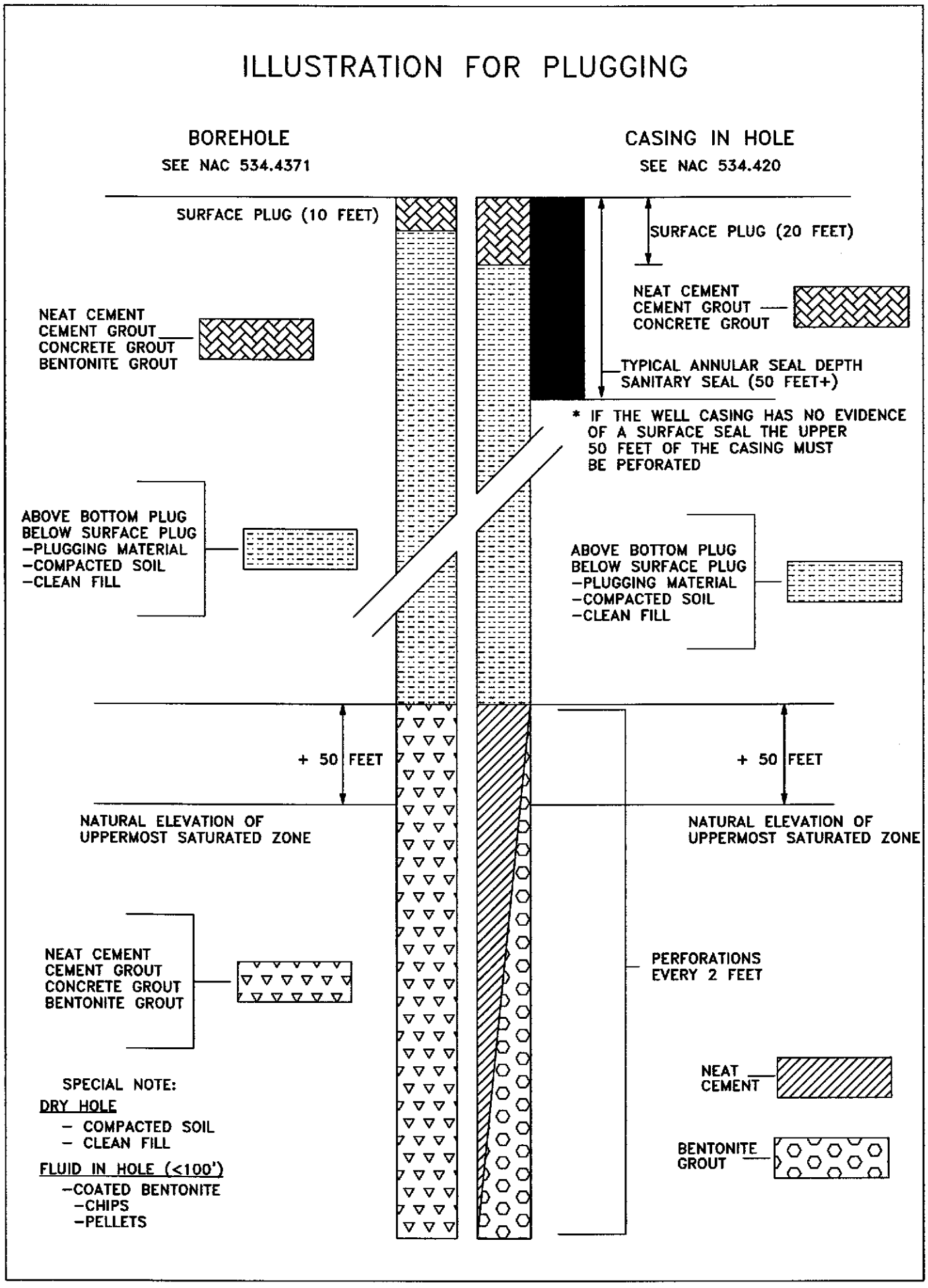


ILLUSTRATION FOR PLUGGING



APPENDIX A

DUPLICATE
RETAIN THIS COPY

NOTICE OF INTENT

No. 59580

DIVISION OF WATER RESOURCES: ....., 20.....

On or about....., 20....., I plan to commence drilling ☐, deepening ☐, reconditioning ☐, plugging ☐ of a ..... inch well, for.....purposes.
(Proposed use of well)

This well is ☐ is not ☐ a replacement well.

The work will be done for.....
(Name of client and address)

location of well is.....¼.....¼ Sec.....T.....N/S R.....E.....

PARCEL NO.....SUBDIVISION NAME.....

ADDRESS (at well location).....

PERMIT/WAIVER NO....., in.....County.

Contractor's Lic. No.....Driller's Lic. No.....

Company Name and Address.....

.....
Driller's Signature

Need log forms ☐ Need notice cards ☐ Date log mailed....., 20.....

ORIGINAL
FILE WITH DIVISION OF
WATER RESOURCES

NOTICE OF INTENT

No. 59580

DIVISION OF WATER RESOURCES: ....., 20.....

On or about....., 20....., I plan to commence drilling ☐, deepening ☐, reconditioning ☐, plugging ☐ of a ..... inch well, for.....purposes.
(Proposed use of well)

This well is ☐ is not ☐ a replacement well.

The work will be done for.....
(Name of client and address)

location of well is.....¼.....¼ Sec.....T.....N/S R.....E.....

PARCEL NO.....SUBDIVISION NAME.....

ADDRESS (at well location).....

PERMIT/WAIVER NO....., in.....County.

Contractor's Lic. No.....Driller's Lic. No.....

Company Name and Address.....

.....
Driller's Signature

Need log forms ☐ Need notice cards ☐

(O)5256 (Rev. 12-00)

STATE OF NEVADA
DIVISION OF WATER RESOURCES
WELL DRILLER'S REPORT

OFFICE USE ONLY
Log No. ....
Permit No. ....
Basin

PRINT OR TYPE ONLY
DO NOT WRITE ON BACK

Please complete this form in its entirety in accordance with NRS 534.170 and NAC 534.340

NOTICE OF INTENT NO. ....

1. OWNER ....
MAILING ADDRESS ....

ADDRESS AT WELL LOCATION ....
Subdivision Name: County:

2. LOCATION ..... ¼ ..... ¼ Sec ..... T ..... N/S R ..... E
PERMIT/WAIVER No. ....
Issued by Water Resources
Parcel No.

Latitude ....
Longitude ....
UTM E .... ☐ NAD 27
N .... ☐ NAD 83/WGS 84

3. WORKED PERFORMED
☐ New Well ☐ Replace ☐ Recondition
☐ Deepen ☐ Other

4. PROPOSED USE
☐ Domestic ☐ Irrigation ☐ Test
☐ Municipal/Industrial ☐ Monitor ☐ Stock

5. WELL TYPE
☐ Cable ☐ Rotary ☐ RVC
☐ Air ☐ Other

6. LITHOLOGIC LOG

Material	*Water Strata*	From	To	Thick-ness

Date started: .... , 20 .....
Date completed: .... , 20 .....

9. *WELL CONSTRUCTION*
Depth Drilled Feet Depth Cased Feet

HOLE DIAMETER (BIT SIZE)

	From	To
.... Inches	.... Feet	.... Feet
.... Inches	.... Feet	.... Feet
Inches	Feet	Feet

CASING SCHEDULE

Size O.D. (Inches)	Weight/Ft. (Pounds)	Wall Thickness (Inches)	From (Feet)	To (Feet)

Perforations:
Type of perforation ....
Size of perforation ....
From .... feet to .... feet
From .... feet to .... feet
From .... feet to .... feet
From .... feet to .... feet
From feet to feet

Annular Seal: ☐ Yes ☐ No
☐ Neat Cement ..... to ..... ☐ Pumped ☐ Poured
☐ Cement Grout ..... to ..... ☐ Pumped ☐ Poured
☐ Concrete Grout ..... to ..... ☐ Pumped ☐ Poured
☐ ≥30% Bentonite Grout to ☐ Pumped ☐ Poured
Gravel Pack: ☐ Yes ☐ No ..... to ..... ☐ Pumped ☐ Poured
Type: ....
Bentonite Chips: ☐ Yes ☐ No ..... to ..... ☐ Pumped ☐ Poured
Type: ....

7. *Water Level*
Static water level: .... feet below land surface
Artesian Flow: .... G.P.M. .... P.S.I.
Water Temperature: .... °F
Quality:

8. WELL TEST DATA
TEST METHOD: ☐ Bailer ☐ Pump ☐ Air Lift

G.P.M.	Draw Down (Feet Below Static)	Time (Hours)

10. DRILLER'S CERTIFICATION
This well was drilled under my supervision and the report is true to the best of my knowledge.
Name ....
Contractor
Address ....
Contractor
....
Nevada contractor's license number issued by the *State Contractor's Board* ....
Nevada driller's license number issued by the Division of Water Resources, the *on-site driller* ....
Signed ....
By driller performing actual drilling on site or contractor
Date

(Rev. 06-06)

USE ADDITIONAL SHEETS IF NECESSARY

STATE OF NEVADA
DIVISION OF WATER RESOURCES

WELL DRILLER'S PLUGGING REPORT

OFFICE USE ONLY
Log No. .....
Permit No. .....
Basin

PRINT OR TYPE ONLY
DO NOT WRITE ON BACK

Please complete this form in its entirety in accordance with NRS 534.170 and NAC 534.340

NOTICE OF INTENT NO. .....

1 OWNER .....
MAILING ADDRESS .....

ADDRESS AT WELL LOCATION .....
Subdivision Name: *County:*

2 LOCATION ¼ ¼ Sec T N/S R E
PERMIT/WAIVER No. .....
Issued by Water Resources *Parcel No.*

Latitude ..... UTM E ..... ☐ NAD 27
Longitude ..... N ..... ☐ NAD 83/WGS 84

3 TYPE OF WELL
☐ Domestic ☐ Irrigation ☐ Test
☐ Municipal/Industrial ☐ Monitor ☐ Stock

Is this well being plugged because a replacement well was drilled? .....
If yes, what is replacement well NOI?

Is there an existing well log? .....
If yes, what is NDWR well log #?

4 *EXISTING WELL CONSTRUCTION*
Depth Drilled ..... Feet Depth Cased ..... Feet

EXISTING CASING SCHEDULE

Size O.D. (Inches)	Weight/Ft. (Pounds)	Wall Thickness (Inches)	From (Feet)	To (Feet)

Existing Perforations:
Type of perforation .....
Size of perforation .....

From ..... feet to ..... feet
From ..... feet to ..... feet
From ..... feet to ..... feet
From ..... feet to ..... feet
From ..... feet to ..... feet

5 *WATER LEVEL*
Static water level ..... feet below land surface
Artesian flow ..... G.P.M. ..... P.S.I
Water temperature ..... ° F Quality .....

6 Additional Notes or Comments

7 WELL PLUGGING PROCEDURE
Was well cleaned out to total depth? ☐ yes ☐ no
If well was not cleaned out to total depth, please explain why: .....

Was the well contaminated? ☐ yes ☐ no
Was the casing pulled? ☐ yes ☐ no
Was the casing over drilled? ☐ yes ☐ no
If casing was left in place, please show where additional perforations were made:

Additional Perforations:
Type of perforater used: .....

From ..... feet to ..... feet Number of perfs per linear foot .....
From ..... feet to ..... feet Number of perfs per linear foot .....
From ..... feet to ..... feet Number of perfs per linear foot .....
From ..... feet to ..... feet Number of perfs per linear foot .....
From ..... feet to ..... feet Number of perfs per linear foot .....
From ..... feet to ..... feet Number of perfs per linear foot

8 WELL PLUGGING MATERIALS
Material Used

From ..... feet to ..... feet ..... ☐ Pumped ☐ Poured
From ..... feet to ..... feet ..... ☐ Pumped ☐ Poured
From ..... feet to ..... feet ..... ☐ Pumped ☐ Poured
From ..... feet to ..... feet ..... ☐ Pumped ☐ Poured
From ..... feet to ..... feet ..... ☐ Pumped ☐ Poured
From ..... feet to ..... feet ..... ☐ Pumped ☐ Poured

Neat Cement Fluid Weight lbs/gal
Bentonite Grout % bentonite

Date Started .....
Date Completed

9 DRILLER'S CERTIFICATION
This well was plugged and abandoned under my supervision and the report is true to the best of my knowledge.

Name ..... Contractor

Address ..... Contractor

Nevada contractor's license number issued by the *State Contractor's Board* .....
Nevada driller's license number issued by the Division of Water Resources, the *on-site driller* .....

Signed ..... By driller performing actual drilling on site or contractor

Date

(Rev. 05-06)

USE ADDITIONAL SHEETS IF NECESSARY

IN THE OFFICE OF THE STATE ENGINEER OF NEVADA

AFFIDAVIT OF INTENT TO ABANDON A WELL

I, _____ *Notice of Intent #*_____

_____

_____ Address where owner / agent can be reached

_____

TELEPHONE NO. (____)_____

The owner / owner's agent (circle one) of the real property located at:

Address _____

County Assessor Parcel Number (APN)_____

Situated within the _____¼ _____¼ Section _____, T_____N., R. _____E., M.D.B.&M.,

Latitude and Longitude_____

Or

Easting and Northing_____

and whereupon an existing well or wells are located, fully understand that I shall be responsible for, and shall cause the existing well to be plugged and abandoned in accordance with the provisions contained in Nevada Administrative Code (NAC) 534.420 and all other applicable rules and regulations for drilling/plugging wells in the State of Nevada, **not later than thirty days after completion of the replacement well or not later than_____(date).** I shall further make any purchaser of this parcel aware of these conditions.

Signature Owner/Agent: _____

Subscribed and sworn before me this _____ day of _____, 20__

Notary Public in and for the County of _____,

State of _____.

My Commission expires _____.

_____

Notary Signature Notary Seal

Revised January 2004

IN THE OFFICE OF THE STATE ENGINEER OF NEVADA

AFFIDAVIT OF INTENT TO ABANDON MONITORING WELLS

Notice of Intent #_____; Number of wells _____; NDEP Order #_____

I, _____

_____

_____ Address where owner / agent can be reached

_____

TELEPHONE NO. (____)_____

The owner / owner's agent (circle one) of the real property located at:

Street Address (if any)_____

County Assessor Parcel Number (APN)_____

Situated within the _____¼ _____¼ Section _____, T_____N., R. _____E., M.D.B.&M.,

Latitude and Longitude_____

Or

Easting and Northing_____

and whereupon one or more monitoring wells are located or to be located, fully understand that I shall be responsible for, and shall cause the wells to be plugged and abandoned in accordance with the provisions contained in Nevada Administrative Code (NAC) 534.4365 and all other applicable rules and regulations for drilling/plugging wells in the State of Nevada, **not later than thirty days after the date when monitoring is no longer required.**

I shall further make any purchaser of this parcel aware of these conditions.

Signature Owner/Agent: _____

Subscribed and sworn before me this _____ day of _____, 20___

Notary Public in and for the County of _____,

State of _____.

My Commission expires _____.

_____

Notary Signature Notary Seal

APPENDIX B

SUGGESTIONS FOR LITHLOGOLY DESCRIPTION

When completing the lithologic log on the well driller's report, please try to keep in mind the following important items:

- **Where is water encountered and how much**
- **Drilling or penetration rate**
- **Color of cuttings or rock chips**
- **Texture of materials or rock type**

APPENDIX C

JIM GIBBONS
Governor

STATE OF NEVADA

ALLEN BIAGGI
Director

TRACY TAYLOR, P.E.
State Engineer

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF WATER RESOURCES
901 S. Stewart Street, Suite 2002
Carson City, Nevada 89701
(775) 684-2800 • Fax (775) 684-2811
http://water.nv.gov

MEMORANDUM

To: Applicants for Well Driller's License and License Renewal

From: State Engineer, Division of Water Resources
Carson City, Nevada

Subject: Child Support Information

Federal Welfare Reform as implemented by Senate Bill 356 passed by the 1997 Session of the Nevada Legislature requires that professional and occupational licensing agencies add certain requirements regarding child support to all applications for new licensing and for renewals. As a result of Senate Bill 356, Nevada Revised Statutes (NRS) Chapter 534 was amended to include NRS § 534.142, professional and occupational licenses, certificates, or permits may be denied or restricted if back child support is owed by the licensee. The Well Drilling License issued by the Division of Water Resources is subject to this requirement made mandatory by NRS § 534.142.

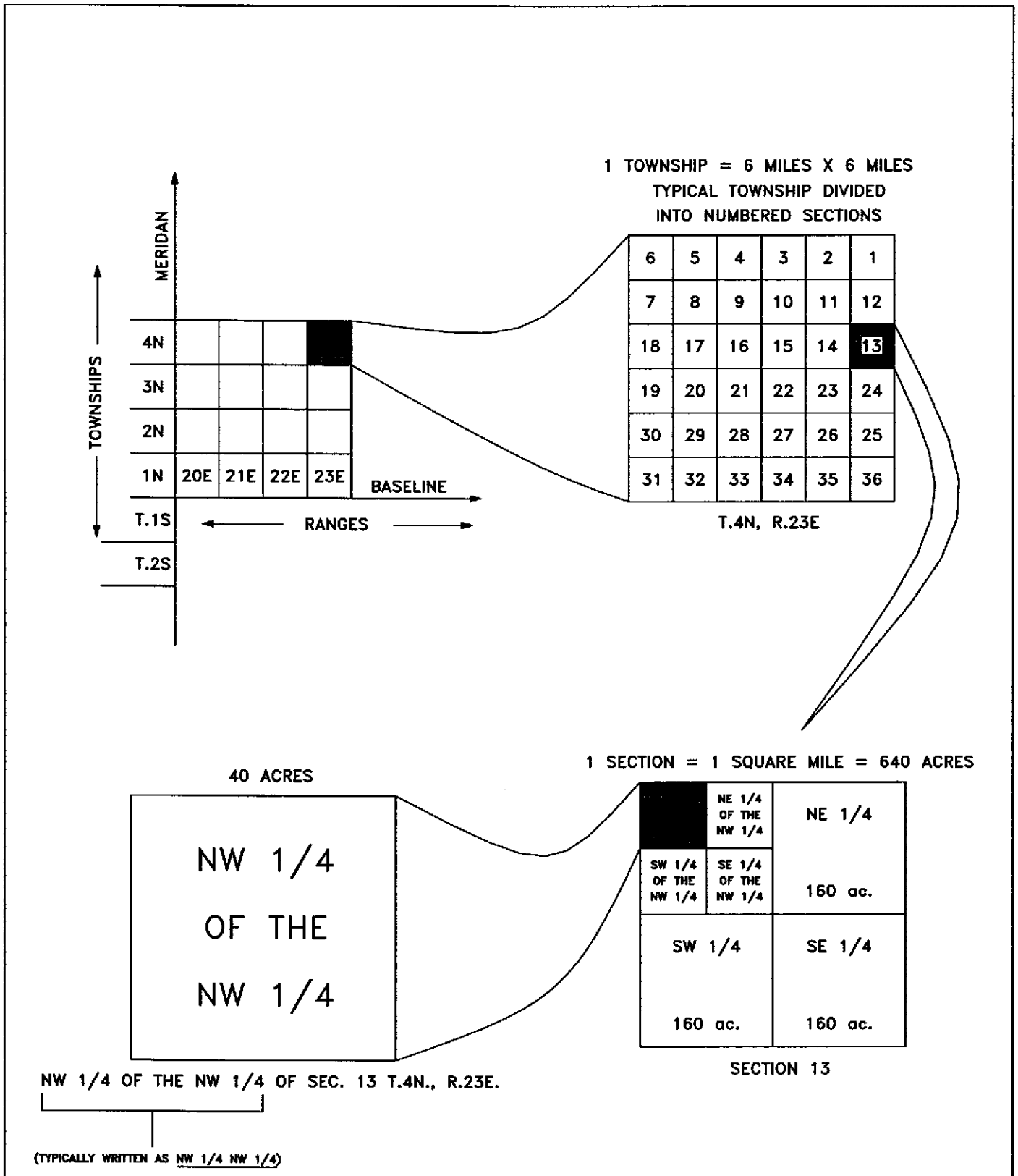
Every application for an occupational license must include a statement regarding the applicant's child support payment status, and failure to give a response or to sign the statement will cause the denial of the application for licensing. If the applicant reports that he or she is not in compliance with a child support order or an approved repayment plan, then the applicant must contact a local district attorney or the Welfare Division to arrange for payment of child support. NRS § 534.142 requires the attached **CHILD SUPPORT INFORMATION** form to be completed and returned with the Application for Well Driller's License.

APPENDIX D

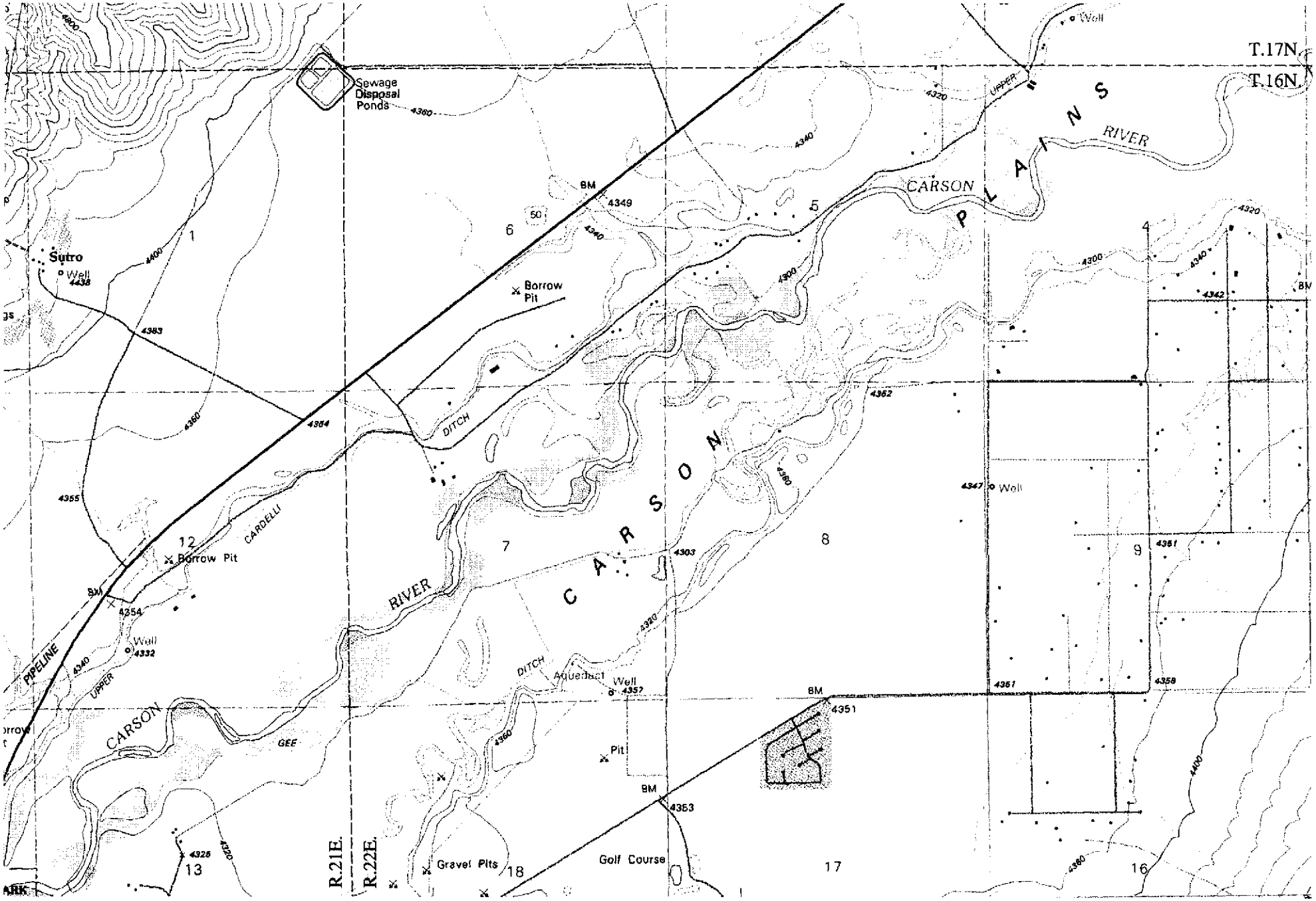
PUBLIC LAND SURVEY

A township is a square parcel of land six miles on each side. Its location is established as being so many six-mile units east of a north-south line (called the "meridian") and so many six-mile units north or south of an east-west line (called the "baseline"). The township is described by "township" and "range", e.g. T.4N., R.23E. (see illustration on following page). Each township is further divided in 36 parts called "sections" one (1) mile square. A typical section containing 640 acres may be further subdivided into quarters. The quarter (¼) of a section is equal to 160 acres and described as the NE¼ or the NW¼ or the SE¼ or the SW¼ of that Section. The quarter section may be further subdivided into four quarters, each being 1/16 of a section or 40 acres. Each sixteenth (1/16) is described as the NE¼ or the NW¼ or the SE¼ or the SW¼ of the particular quarter section. A person must determine which is north on the map (which is generally the top). In this case the easterly direction would be to the right, south to the bottom and west to the left. The written location of a specific 40 acre parcel of land would be NW¼ of the NW¼ of Section 13, T.4N., R.23E. Some sections may contain more or less acreage than 640.

- A Section measures 5,280 feet on each side.
- A one quarter (¼) Section measures 2,640 feet on each side.
- A one sixteenth Section of land (¼ of ¼) measures 1,320 feet on each side.


1 TOWNSHIP = 6 MILES X 6 MILES
TYPICAL TOWNSHIP DIVIDED
INTO NUMBERED SECTIONS
MERIDAN
TOWNSHIPS
4N
3N
2N
1N
T.1S
T.2S
20E
21E
22E
23E
BASELINE
RANGES
6 5 4 3 2 1
7 8 9 10 11 12
18 17 16 15 14 13
19 20 21 22 23 24
30 29 28 27 26 25
31 32 33 34 35 36
T.4N, R.23E
1 SECTION = 1 SQUARE MILE = 640 ACRES
40 ACRES
NW 1/4
OF THE
NW 1/4
NE 1/4 OF THE NW 1/4
NE 1/4
160 ac.
SW 1/4 OF THE NW 1/4
SE 1/4 OF THE NW 1/4
SW 1/4
160 ac.
SE 1/4
160 ac.
SECTION 13
NW 1/4 OF THE NW 1/4 OF SEC. 13 T.4N., R.23E.
(TYPICALLY WRITTEN AS NW 1/4 NW 1/4)

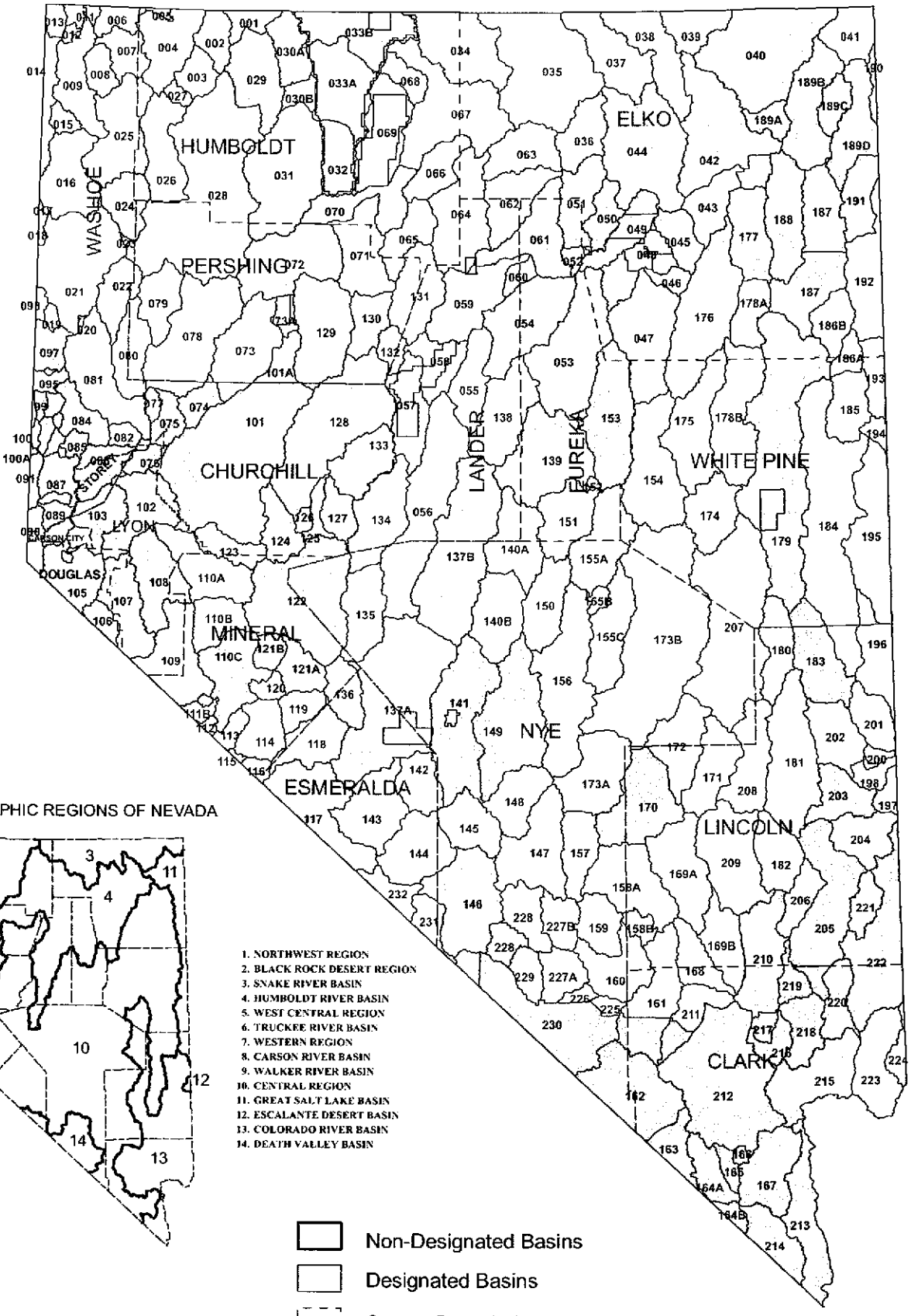
APPENDIX E



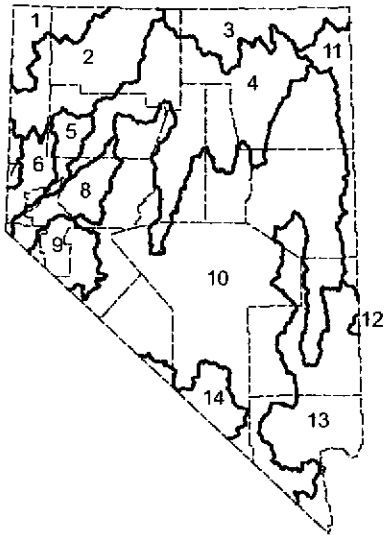
WELL LOCATED WITHIN THE - SW 1/4 NW 1/4 Section 9, Township 16 North, Range 22 East
WELL LOCATED WITHIN THE - SE 1/4 SE 1/4 Section 7, Township 16 North, Range 22 East
WELL LOCATED WITHIN THE - NW 1/4 SW 1/4 Section, 1, Township 16 North, Range 21 East

APPENDIX F

GROUNDWATER BASINS OF NEVADA



HYDROGRAPHIC REGIONS OF NEVADA



1. NORTHWEST REGION
2. BLACK ROCK DESERT REGION
3. SNAKE RIVER BASIN
4. HUMBOLDT RIVER BASIN
5. WEST CENTRAL REGION
6. TRUCKEE RIVER BASIN
7. WESTERN REGION
8. CARSON RIVER BASIN
9. WALKER RIVER BASIN
10. CENTRAL REGION
11. GREAT SALT LAKE BASIN
12. ESCALANTE DESERT BASIN
13. COLORADO RIVER BASIN
14. DEATH VALLEY BASIN

Non-Designated Basins

Designated Basins

County Boundaries

A detailed map is available at the Division's website \\water.nv.gov

January 2007

1. NORTHWEST REGION

1. PUEBLO V.
2. CONTINENTAL LAKE V.
3. GRIDLEY LAKE V.
4. VIRGIN V.
5. SAGE HEN V.
6. GUANO V.
7. SWAN LAKE V.
8. MASSACRE LAKE V.
9. LONG V.
10. MAZY FLAT
11. COLEMAN V.
12. MOSQUITO V.
13. WARNER V.
14. SURPRISE V.
15. BOULDER V.
16. DUCK LAKE V.

2. BLACK ROCK DESERT REGION

17. PILGRIM FLAT
18. PAINTERS FLAT
19. DRY V.
20. SAND V.
21. SMOKE CREEK DESERT
22. SAN EMIDIO DESERT
23. GRANITE BASIN
24. HUALAPAI FLAT
25. HIGH ROCK LAKE VALLEY
26. MUD MEADOW
27. SUMMIT LAKE V.
28. BLACK ROCK DESERT
29. PINE FOREST V.
30. KINGS RIVER V.
    (A) RIO KING SUBAREA
    (B) SOD HOUSE SUBAREA
31. DESERT V.
32. SILVER STATE V.
33. QUINN RIVER V.
    (A) OROVADA SUBAREA
    (B) McDERMITT SUBAREA

3. SNAKE RIVER BASIN

34. LITTLE OWYHEE RIVER AREA
35. SOUTH FORK OWYHEE RIVER AREA
36. INDEPENDENCE V.
37. OWYHEE RIVER AREA
38. BRUNEAU RIVER AREA
39. JARBIDGE RIVER AREA
40. SALMON FALLS CREEK AREA
41. GOOSE CREEK AREA

4. HUMBOLDT RIVER BASIN

42. MARYS RIVER AREA
43. STARR VALLEY AREA
44. NORTH FORK AREA
45. LAMOILLE V.
46. SOUTH FORK AREA
47. HUNTINGTON V.
48. DIXIE CREEK - TENMILE CREEK AREA
49. ELKO SEGMENT
50. SUSIE CREEK AREA
51. MAGGIE CREEK AREA
52. MARYS CREEK AREA
53. PINE V.
54. CRESCENT V.
55. CARICO LAKE V.
56. UPPER REESE RIVER V.
57. ANTELOPE V.
58. MIDDLE REESE RIVER V.
59. LOWER REESE RIVER V.
60. WHIRLWIND V.
61. BOULDER FLAT
62. ROCK CREEK V.
63. WILLOW CREEK V.
64. CLOVERS AREA
65. PUMPERNICKEL V.
66. KELLY CREEK AREA
67. LITTLE HUMBOLDT V.
68. HARDSCRABBLE AREA
69. PARADISE V.
70. WINNEMUCCA SEGMENT
71. GRASS V.
72. IMLAY AREA
73. LOVELOCK V.
    (A) OREANA SUBAREA
74. WHITE PLAINS

5. WEST CENTRAL REGION

75. BRADYS HOT SPRINGS AREA
76. FERNLEY AREA
77. FIREBALL V.
78. GRANITE SPRINGS V.
79. KUMIVA V.

6. TRUCKEE RIVER BASIN

80. WINNEMUCCA LAKE V.
81. PYRAMID LAKE V.
82. DODGE FLAT
83. TRACY SEGMENT
84. WARM SPRINGS V.
85. SPANISH SPRINGS V.
86. SUN V.
87. TRUCKEE MEADOWS
88. PLEASANT V.
89. WASHOE V.
90. LAKE TAHOE BASIN
91. TRUCKEE CANYON SEGMENT

7. WESTERN REGION

92. LEMMON V.
    (A) WESTERN PART
    (B) EASTERN PART
93. ANTELOPE V.
94. BEDELL FLAT
95. DRY V.
96. NEWCOMB LAKE V.
97. HONEY LAKE V.
98. SKEDADDLE CREEK V.
99. RED ROCK V.
100. COLD SPRING V.
    (A) LONG V.

8. CARSON RIVER BASIN

101. CARSON DESERT
    (A) PACKARD V.
102. CHURCHILL V.
103. DAYTON V.
104. EAGLE V.
105. CARSON V.

9. WALKER RIVER BASIN

106. ANTELOPE V.
107. SMITH V.
108. MASON V.
109. EAST WALKER AREA
110. WALKER LAKE V.
    (A) SCHURZ SUBAREA
    (B) LAKE SUBAREA
    (C) WHISKEY FLAT-
    HAWTHORNE SUBAREA

10. CENTRAL REGION

111. ALKALAI V. (MINERAL)
    (A) NORTHERN PART
    (B) SOUTHERN PART
112. MONO V.
113. HUNTOON V.
114. TEELS MARSH V.
115. ADOBE V.
116. QUEEN V.
117. FISH LAKE V.
118. COLUMBUS SALT MARSH V.
119. RHODES SALT MARSH V.
120. GARFIELD FLAT
121. SODA SPRING V.
    (A) EASTERN PART
    (B) WESTERN PART
122. GABBS V.
123. RAWHIDE FLATS
124. FAIRVIEW V.
125. STINGAREE V.
126. COWKICK V.
127. EASTGATE VALLEY AREA
128. DIXIE V.
129. BUENA VISTA V.
130. PLEASANT V.
131. BUFFALO V.
132. JERSEY V.
133. EDWARDS CREEK V.
134. SMITH CREEK V.
135. IONE V.
136. MONTE CRISTO V.
137. BIG SMOKY V.
    (A) TONOPAH FLAT
    (B) NORTHERN PART
138. GRASS V.
139. KOBEH V.
140. MONITOR V.
    (A) NORTHERN PART
    (B) SOUTHERN PART
141. RALSTON V.
142. ALKALAI SPRING V. (ESMERALDA)
143. CLAYTON V.
144. LIDA V.
145. STONEWALL V.
146. SARCOBATUS FLAT
147. GOLD FLAT
148. CACTUS FLAT
149. STONE CABIN V.
150. LITTLE FISH LAKE V.
151. ANTELOPE V. (EUREKA & NYE)
152. STEVENS BASIN
153. DIAMOND V.
154. NEWARK V.
155. LITTLE SMOKY V.
    (A) NORTHERN PART
    (B) CENTRAL PART
    (C) SOUTHERN PART
156. HOT CREEK V.
157. KAWICH V.
158. EMIGRANT V.
    (A) GROOM LAKE V.
    (B) PAPOOSE LAKE V.
159. YUCCA FLAT
160. FRENCHMAN FLAT
161. INDIAN SPRINGS V.
162. PAHRUMP V.
163. MESQUITE V. (SANDY V.)
164. IVANPAH V.
    (A) NORTHERN PART
    (B) SOUTHERN PART
165. JEAN LAKE V.
166. HIDDEN V. (SOUTH)
167. ELDORADO V.
168. THREE LAKES V.
    (NORTHERN PART)
169. TIKAPOO V. (TIKABOO V.)
    (A) NORTHERN PART
    (B) SOUTHERN PART
170. PENOYER V. (SAND SPRING V.)
171. COAL V.
172. GARDEN V.
173. RAILROAD V.
    (A) SOUTHERN PART
    (B) NORTHERN PART
174. JAKES V.
175. LONG V.
176. RUBY V.
177. CLOVER V.
178. BUTTE V.
    (A) NORTHERN PART (ROUND V.)
    (B) SOUTHERN PART
179. STEPTOE V.
180. CAVE V.
181. DRY LAKE V.
182. DELAMAR V.
183. LAKE V.
184. SPRING V.
185. TIPPETT V.
186. ANTELOPE V.
    (WHITE PINE & ELKO)
    (A) SOUTHERN PART
    (B) NORTHERN PART
187. GOSHUTE V.
188. INDEPENDENCE V.

11. GREAT SALT LAKE BASIN

189. THOUSAND SPRINGS V.
    (A) HERRILL SIDING-
    BRUSH CREEK AREA
    (B) TOANO-ROCK SPRING
    AREA
    (C) ROCKY BUTTE AREA
    (D) MONTELLO-
    CRITTENDEN CREEK AREA
    (MONTELLO V.)
190. GROUSE CREEK V.
191. PILOT CREEK V.
192. GREAT SALT LAKE DESERT
193. DEEP CREEK V.
194. PLEASANT V.
195. SNAKE V.
196. HAMLIN V.

12. ESCALANTE DESERT BASIN

197. ESCALANTE DESERT

13. COLORADO RIVER BASIN

198. DRY V.
199. ROSE V.
200. EAGLE V.
201. SPRING V.
202. PATTERSON V.
203. PANACA V.
204. CLOVER V.
205. LOWER MEADOW VALLEY WASH
206. KANE SPRINGS V.
207. WHITE RIVER V.
208. PAHROC V.
209. PAHRANAGAT V.
210. COYOTE SPRING V.
211. THREE LAKES V.
    (SOUTHERN PART)*
212. LAS VEGAS V.
213. COLORADO RIVER V.
214. PIUTE V.
215. BLACK MOUNTAINS AREA
216. GARNET V. (DRY LAKE V.)*
217. HIDDEN V. (NORTH)*
218. CALIFORNIA WASH
219. MUDDY RIVER SPRINGS AREA
    (UPPER MOAPA V.)
220. LOWER MOAPA V.
221. TULE DESERT
222. VIRGIN RIVER V.
223. GOLD BUTTE AREA
224. GREASE WOOD BASIN
    * NON CONTRIBUTING PART OF
    THE COLORADO RIVER BASIN

14. DEATH VALLEY BASIN

225. MERCURY V.
226. ROCK V.
227. FORTYMILE CANYON
    (A) JACKASS FLATS
    (B) BUCKBOARD MESA
228. OASIS V.
229. CRATER FLAT
230. AMARGOSA V.
231. GRAPEVINE CANYON
232. ORIENTAL WASH

Reference: Water for Nevada. Report No. 3, October 1971

APPENDIX G

VOLUME OF ANNULUS IN GALLONS PER FOOT OF DEPTH

Diameter of Hole (inches)	Outside Diameter of Casing or Screen (inches)																			
	0.000	1.550	1.900	2.375	2.875	3.500	4.000	4.500	5.000	5.563	6.625	8.625	10.750	12.750	14.000	16.000	18.000	20.000	24.000	26.000
4.500	0.83	0.73	0.68	0.60	0.49	0.33	0.17	0.00												
5.000	1.02	0.92	0.87	0.79	0.68	0.52	0.37	0.19	0.00											
5.625	1.29	1.19	1.14	1.06	0.95	0.79	0.64	0.46	0.27	0.03										
6.000	1.47	1.37	1.32	1.24	1.13	0.97	0.82	0.64	0.45	0.21										
6.500	1.72	1.63	1.58	1.49	1.39	1.22	1.07	0.90	0.70	0.46										
7.000	2.00	1.90	1.85	1.77	1.66	1.50	1.35	1.17	0.98	0.74	0.21									
7.625	2.37	2.27	2.22	2.14	2.03	1.87	1.72	1.55	1.35	1.11	0.58									
7.875	2.53	2.43	2.38	2.30	2.19	2.03	1.88	1.70	1.51	1.27	0.74									
8.500	2.95	2.85	2.80	2.72	2.61	2.45	2.29	2.12	1.93	1.69	1.16									
9.000	3.30	3.21	3.16	3.07	2.97	2.80	2.65	2.48	2.28	2.04	1.51	0.27								
9.625	3.78	3.68	3.63	3.55	3.44	3.28	3.13	2.95	2.76	2.52	1.99	0.74								
10.630	4.61	4.51	4.46	4.38	4.27	4.11	3.96	3.78	3.59	3.35	2.82	1.58								
11.000	4.94	4.84	4.79	4.71	4.60	4.44	4.28	4.11	3.92	3.67	3.15	1.90	0.22							
12.250	6.12	6.02	5.98	5.89	5.79	5.62	5.47	5.30	5.10	4.86	4.33	3.09	1.41							
13.000	6.83	6.73	6.68	6.60	6.49	6.33	6.18	6.01	5.82	5.58	5.06	3.82	2.16	0.26						
14.500	8.58	8.48	8.43	8.35	8.24	8.08	7.93	7.75	7.56	7.32	6.79	5.54	3.86	1.95	0.58					
17.000	11.79	11.69	11.64	11.56	11.45	11.29	11.14	10.96	10.77	10.53	10.00	8.76	7.08	5.16	3.79	1.35				
20.000	16.32	16.22	16.17	16.09	15.98	15.82	15.67	15.49	15.30	15.06	14.53	13.28	11.60	9.69	8.32	5.88	3.10	0.00		
22.000	19.75	19.65	19.60	19.52	19.41	19.25	19.09	18.92	18.73	18.48	17.96	16.71	15.03	13.11	11.75	9.30	6.53	3.43		
24.000	23.50	23.40	23.35	23.27	23.16	23.00	22.85	22.67	22.48	22.24	21.71	20.47	18.79	16.87	15.50	13.06	10.28	7.18	0.00	
26.000	27.58	27.48	27.43	27.35	27.24	27.08	26.93	26.75	26.56	26.32	25.79	24.54	22.87	20.95	19.58	17.14	14.36	11.26	4.08	0.00
28.000	31.99	31.89	31.84	31.76	31.65	31.49	31.33	31.16	30.97	30.72	30.20	28.95	27.27	25.35	23.99	21.54	18.77	15.67	8.49	4.41
30.000	36.72	36.62	36.57	36.49	36.38	36.22	36.07	35.89	35.70	35.46	34.93	33.68	32.00	30.09	28.72	26.27	23.50	20.40	13.22	9.14
32.000	41.78	41.68	41.63	41.55	41.44	41.28	41.13	40.95	40.76	40.52	39.99	38.74	37.06	35.15	33.78	31.33	28.56	25.46	18.28	14.20
34.000	47.16	47.07	47.02	46.93	46.83	46.66	46.51	46.34	46.14	45.90	45.37	44.13	42.45	40.53	39.17	36.72	33.94	30.84	23.66	19.58
36.000	52.88	52.78	52.73	52.65	52.54	52.38	52.22	52.05	51.86	51.61	51.08	49.84	48.16	46.24	44.88	42.43	39.66	36.56	29.38	25.30
42.000	71.97	71.87	71.82	71.74	71.63	71.47	71.32	71.14	70.95	70.71	70.18	68.93	67.25	65.34	63.97	61.52	58.75	55.65	48.47	44.39
48.000	94.00	93.90	93.85	93.77	93.66	93.50	93.35	93.17	92.98	92.74	92.21	90.97	89.29	87.37	86.00	83.56	80.78	77.68	70.50	66.42

CALCULATION: Volume = (hole diameter squared - casing diameter squared) / 24.511

- 27 cubic feet equals one cubic yard
- One cubic foot equals 7.48 U.S. gallons
- Chart does not assume any waver or variation in bore hole diameter

VOLUME OF ANNULUS IN CUBIC FEET PER FOOT OF DEPTH

Diameter of Hole (inches)	Outside Diameter of Casing or Screen (inches)																			
	0.000	1.550	1.900	2.375	2.875	3.500	4.000	4.500	5.000	5.563	6.625	8.625	10.750	12.750	14.000	16.000	18.000	20.000	24.000	26.000
4.500	0.11	0.10	0.09	0.08	0.07	0.04	0.02	0.00												
5.000	0.14	0.12	0.12	0.11	0.09	0.07	0.05	0.03	0.00											
5.625	0.17	0.16	0.15	0.14	0.13	0.11	0.09	0.06	0.04	0.00										
6.000	0.20	0.18	0.18	0.17	0.15	0.13	0.11	0.09	0.06	0.03										
6.500	0.23	0.22	0.21	0.20	0.19	0.16	0.14	0.12	0.09	0.06										
7.000	0.27	0.25	0.25	0.24	0.22	0.20	0.18	0.16	0.13	0.10	0.03									
7.625	0.32	0.30	0.30	0.29	0.27	0.25	0.23	0.21	0.18	0.15	0.08									
7.875	0.34	0.33	0.32	0.31	0.29	0.27	0.25	0.23	0.20	0.17	0.10									
8.500	0.39	0.38	0.37	0.36	0.35	0.33	0.31	0.28	0.26	0.23	0.15									
9.000	0.44	0.43	0.42	0.41	0.40	0.37	0.35	0.33	0.31	0.27	0.20	0.04								
9.625	0.51	0.49	0.49	0.47	0.46	0.44	0.42	0.39	0.37	0.34	0.27	0.10								
10.630	0.62	0.60	0.60	0.59	0.57	0.55	0.53	0.51	0.48	0.45	0.38	0.21								
11.000	0.66	0.65	0.64	0.63	0.61	0.59	0.57	0.55	0.52	0.49	0.42	0.25	0.03							
12.250	0.82	0.81	0.80	0.79	0.77	0.75	0.73	0.71	0.68	0.65	0.58	0.41	0.19							
13.000	0.92	0.91	0.90	0.89	0.88	0.85	0.83	0.81	0.79	0.75	0.68	0.52	0.29	0.04						
14.500	1.15	1.13	1.13	1.12	1.10	1.08	1.06	1.04	1.01	0.98	0.91	0.74	0.52	0.26	0.08					
17.000	1.58	1.56	1.56	1.55	1.53	1.51	1.49	1.47	1.44	1.41	1.34	1.17	0.95	0.69	0.51	0.18				
20.000	2.18	2.17	2.16	2.15	2.14	2.11	2.09	2.07	2.05	2.01	1.94	1.78	1.55	1.30	1.11	0.79	0.41	0.00		
22.000	2.64	2.63	2.62	2.61	2.59	2.57	2.55	2.53	2.50	2.47	2.40	2.23	2.01	1.75	1.57	1.24	0.87	0.46		
24.000	3.14	3.13	3.12	3.11	3.10	3.07	3.05	3.03	3.01	2.97	2.90	2.74	2.51	2.25	2.07	1.75	1.37	0.96	0.00	
26.000	3.69	3.67	3.67	3.66	3.64	3.62	3.60	3.58	3.55	3.52	3.45	3.28	3.06	2.80	2.62	2.29	1.92	1.51	0.55	0.00
28.000	4.28	4.26	4.26	4.25	4.23	4.21	4.19	4.17	4.14	4.11	4.04	3.87	3.65	3.39	3.21	2.88	2.51	2.09	1.13	0.59
30.000	4.91	4.90	4.89	4.88	4.86	4.84	4.82	4.80	4.77	4.74	4.67	4.50	4.28	4.02	3.84	3.51	3.14	2.73	1.77	1.22
32.000	5.59	5.57	5.57	5.55	5.54	5.52	5.50	5.47	5.45	5.42	5.35	5.18	4.95	4.70	4.52	4.19	3.82	3.40	2.44	1.90
34.000	6.31	6.29	6.29	6.27	6.26	6.24	6.22	6.19	6.17	6.14	6.07	5.90	5.67	5.42	5.24	4.91	4.54	4.12	3.16	2.62
36.000	7.07	7.06	7.05	7.04	7.02	7.00	6.98	6.96	6.93	6.90	6.83	6.66	6.44	6.18	6.00	5.67	5.30	4.89	3.93	3.38
42.000	9.62	9.61	9.60	9.59	9.58	9.55	9.53	9.51	9.48	9.45	9.38	9.22	8.99	8.73	8.55	8.22	7.85	7.44	6.48	5.93
48.000	12.57	12.55	12.55	12.54	12.52	12.50	12.48	12.46	12.43	12.40	12.33	12.16	11.94	11.68	11.50	11.17	10.80	10.38	9.42	8.88

- CALCULATION: Volume = (hole diameter squared - casing diameter squared) / 183.346
- 27 cubic feet equals one cubic yard
- One cubic foot equals 7.48 U.S. gallons
- This chart does not assume any waver or variation in hole diameter

APPENDIX H

Calculating fluid weight

The weight or density of an abandonment fluid must only reflect the active sodium bentonite solids content in the slurry, not inactive filler material such as sand or drill cuttings. The following formula can be used to determine the fluid weight (W) of the mix in pounds per gallon:

$$W = \frac{1}{.120 - .074x}$$

where x = the weight fraction of bentonite in the compound. For example, if the fluid has a bentonite weight fraction or solids content of 0.121 (or 12.1%) then:

$$W = \frac{1}{.120 - .074(.121)} = 9.005ppg$$

Remember too, that this is not a mix of high-yield bentonite drilling mud but a grout specifically designed for abandonment.

The new regulation allows for the ***minimum*** bentonite solids content in the plugging fluid. If you can pump a higher solids content, so much the better.

This minimum mix of 12.1% solids can be obtained by mixing a ***maximum of 40 gallons of water per 50 pound bag of bentonite grout, but follow the grout manufacturer's instructions in all cases.***