

STATE OF KANSAS



PLUGGING PACKET

Bureau of Water - Geology Section
1000 S.W. Jackson, Ste. 420
Topeka, Kansas 66612-1367
(785) 296-5524

(PLUGGING PACKET)

Sections from Article 12 (K.S.A. Supp. 82a-1201 et seq.) which pertain to the plugging of abandoned water wells, cased and uncased test holes.

82a-1203. Definitions. As used in this act, unless the context otherwise requires:

- (c) “Water well contractor” or “Contractor” means any individual, firm, partnership, association or corporation who shall construct, reconstruct or treat a water well. The term shall not include.
 - (1) An individual while in the act of constructing a water well on land which is owned by such individual and is used by such individual for domestic purposes at such individual’s place of abode, but only when the well is constructed in compliance with prescribed minimum well standards as provided in this act;

82a-1212. Log of drilling, boring or digging; contents; filed with state geological survey. Any water well contractor licensed under this act who constructs, reconstructs or plugs a water well shall keep a careful and accurate log of the construction, reconstruction or plugging of such well and shall furnish a record of said well log to the secretary within thirty (30) days after completion of such well in such form as the secretary might require. The log shall show:

- (a) The name and address of the landowner and the legal description of the well;
- (b) The character and depth of the formation passed through or encountered;
- (c) The depth at which water is encountered;
- (d) The static water level of the completed well;
- (e) A copy of the record of pumping test, if any; and
- (f) The construction or reconstruction details of the completed water well including lengths and sizes of casing, length and size of perforations or screens, and length and size of gravel packing; [and]
- (g) The amount, type and placement of plug materials used in plugging a water well.

A water sample shall be furnished to the secretary, upon request, within thirty (30) days after completion of such well unless an extension of time is granted by the secretary, in which case, the sample shall be furnished to the secretary within such extended period of time.

The well logs and a copy of the water quality analysis shall be transmitted by the secretary to the state geological survey and kept on file by the survey and be available to the public.

History: L. 1973, ch. 417, § 12; L. 1974, ch. 352, § 180; July 1; L. 1979, ch. 334, § 7. July 1.

82a-1213. Abandoned holes; plugging; failure to properly seal. All holes drilled in search of a water supply and abandoned, shall be properly plugged by the drilling contractor in accordance with rules and regulations established by the secretary in order to assure adequate and proper plugging of abandoned wells to prevent pollution of existing groundwater. Any contractor who fails to properly seal any exploratory wells drilled in search of a water supply and abandoned by him or her shall be subject to the penalties set out in this act. All unplugged abandoned water wells shall be plugged or caused to be plugged by the landowner in accordance with rules and regulations established by the secretary in order to assure adequate and proper plugging of abandoned water wells to prevent pollution to existing groundwater supplies, except that no unplugged abandoned water well existing on the effective date of this act which is not polluting or threatening to pollute a groundwater supply shall be required to be plugged.

History: L. 1973, ch. 417, § 13; L. 1974, ch. 352, § 181; July 1; L. 1979, ch. 334, § 8; July 1.

Sections from **Article 30** (K.A.R. 28-30-1 et seq.) which pertain to the plugging of abandoned water wells, cased and uncased test holes.

28-30-2. Definitions.

- (a) "License" means a document issued by the Kansas Department of Health and Environment to qualified persons making application therefore, authorizing such persons to engage in the business of water well contracting.
- (b) "Department" means the Kansas Department of Health and Environment.
- (c) "Abandoned Water Well" means a water well determined by the department to be a well;
 - (1) whose use has been permanently discontinued;
 - (2) in which pumping equipment has been permanently removed;

- (3) which either is in such a state of disrepair that it cannot be used to supply water, or it has the potential for transmitting surface contaminants into the aquifer or both;
 - (4) which poses potential health and safety hazards; or
 - (5) which is in such a condition it cannot be placed in active or inactive status.
- (d) “Water well contractor” or “contractor” means any individual, firm, partnership, association, or corporation who constructs, reconstructs, or treats a water well. The term shall not include:
- (1) an individual constructing, reconstructing or treating a water well located on land owned by the individual, when the well is used by the individual for farming, ranching, or agricultural purposes or for domestic purposes at the individual’s place of abode; or
 - (2) an individual who performs labor or services for a licensed water well contractor at the contractor’s direction and under the contractor’s supervision.
- (e) “Aquifer” means an underground formation that contains and is capable of transmitting groundwater.
- (f) “Confined aquifer” is an aquifer overlain and underlain by impermeable layers. Groundwater in a confined aquifer is under pressure greater than atmospheric pressure and will rise in a well above the point at which it is first encountered.
- (g) “Unconfined aquifer” is an aquifer containing groundwater at atmospheric pressure. The upper surface of the groundwater in an unconfined aquifer is the water table.
- (h) “Domestic uses” means the use of water by any person or family unit or household for household purposes, or for the watering of livestock, poultry, farm and domestic animals used in operating a farm, or for the irrigation of lands not exceeding a total of two acres in area for the growing of gardens, orchards and lawns.
- (l) “Public water-supply well” means a well that:
- (1) provides groundwater to the public for human consumption; and

- (2) has at least 10 service connections or serves an average of at least 25 individuals daily at least 60 days out of the year.
- (j) “Groundwater” means the part of the subsurface water which is in the zone of saturation.
- (k) “Grout” means cement grout, neat cement grout, bentonite clay grout or other material approved by the department used to create a permanent impervious watertight bond between the casing and the undisturbed formation surrounding the casing or between two or more strings of casing.
 - (1) “Neat cement grout” means a mixture consisting of one 94 pound bag of portland cement to five to six gallons of clean water.
 - (2) “Cement grout” means a mixture consisting of one 94 pound bag of portland cement to an equal volume of sand having a diameter no larger than 0.080 inches (2 millimeters) to five to six gallons of clean water.
 - (3) “Bentonite clay grout” means a mixture consisting of water and commercial grouting or plugging sodium bentonite clay containing high solids such as that manufactured under the trade name of “volclay grout”, or an equivalent as approved by the department.
 - (A) The mixture shall be as per the manufacturer’s recommendations to achieve a weight of not less than 9.4 pounds per gallon of mix. Weighting agents may be added as per the manufacturer’s recommendations.
 - (B) Sodium bentonite pellets, tablets or granular sodium bentonite may also be used provided they meet the specifications listed in paragraph (k)(3) of this regulation.
 - (C) Sodium bentonite products that contain low solids, are designed for drilling purposes, or that contain organic polymers shall not be used.
- (l) “Pitless well adapter or unit” means an assembly of parts installed below the frost line which will permit pumped groundwater to pass through the wall of the casing or extension thereof and prevent entrance of contaminants.

- (m) “Test hole” or “hole” means any excavation constructed for the purpose of determining the geologic, hydrologic and water quality characteristics of underground formations.
- (n) “Static water level” means the highest point below or above ground level which the groundwater in the well reaches naturally.
- (o) “Annular space” means the space between the well casing and the well bore or the space between two or more strings of well casing.
- (p) “Sanitary well seal” is a manufactured seal installed at the top of the well casing which, when installed, creates an airtight and watertight seal to prevent contaminated or polluted water from gaining access to the groundwater supply.
- (q) “Treatment” means the stimulation of production of groundwater from a water well, through the use of hydrochloric acid, muratic acid, sulfamic acid, calcium or sodium hypochlorite, polyphosphates or other chemicals and mechanical means, for the purpose of reducing or removing iron and manganese hydroxide and oxide deposits, calcium and magnesium carbonate deposits and slime deposits associated with iron or manganese bacterial growths which inhibit the movement of groundwater into the well.
- (r) “Reconstructed water well” means an existing well that has been deepened or has had the casing replaced, repaired, added to or modified in any way for the purpose of obtaining groundwater.
- (s) “Pump pit” means a watertight structure which:
 - (1) is constructed at least two feet away from the water well and below ground level to prevent freezing of pumped groundwater; and
 - (2) houses the pump or pressure tank, distribution lines, electrical controls, or other appurtenances.
- (t) “Grout tremie pipe” or “grout pipe” means a steel or galvanized steel pipe or similar pipe having equivalent structural soundness that is used to pump grout to a point of selected emplacement during the grouting of a well casing or plugging of an abandoned well or test hole.
- (u) “Uncased test hole” means any test hole in which casing has been removed or in which casing has not been installed.

- (v) “Drilling rig registration license number” means a number assigned by the department which is affixed to each drilling rig operated by or for a licensed water well contractor.
- (w) “Active well” means a water well which is an operating well used to withdraw water, or to monitor or observe groundwater conditions.
- (x) “Inactive status” means a water well which is not presently operating but is maintained in such a way it can be put back in operation with a minimum of effort.
- (y) “Heat pump hole” means a hole drilled to install piping for an earth coupled water source heat pump system, also known as a vertical closed loop system.

(Authorized by K.S.A. 1992 Supp. 82a-1205 and implementing K.S.A. 82a-1202, K.S.A. 1992 Supp. 82a-1205, 82a-1213; effective E-74-34, July 2, 1974; modified L. 1975, ch. 481, May 1, 1975; amended May 1, 1980; amended May 1, 1987; amended Nov. 22, 1993.)

28-30-3. Licensing.

- (a) Eligibility. To be eligible for a water well contractor’s license and applicant shall:
 - (1) pass an examination conducted by the department; or
 - (2) meet the conditions contained in subsection (c).
- (b) Application and fees.
 - (1) Each application shall be accompanied by an application fee of \$10.00.
 - (2) Before issuance of a water well contractor’s license, each contractor shall pay a license fee of \$100.00 plus \$25.00 for each drill rig operated by or for the contractor. These fees shall accompany the application and shall be by bank draft, check or money order, payable to the Kansas Department of Health and Environment - Water Well Licensure.
- (c) Reciprocity.
 - (1) Upon receipt of an application and payment of the required fees from a nonresident, the secretary may issue a license, providing the nonresident holds a valid license from another

- state and meets the minimum requirements for licensing as prescribed in K.S.A. 82a-1207, and any amendments thereto.
- (2) If the nonresident application is incorporated, evidence shall be submitted to the Department of Health and Environment showing that the applicant meets the registration requirements of the Kansas Secretary of State.
 - (3) Nonresident fees for a license shall be equal to the fee charged a Kansas contractor by the applicant's state of residence but shall not be less than \$100.00. The application fee and drill rig license fee shall be the same as the Kansas resident fees.
- (d) License renewal.
- (1) Each licensee shall make application for renewal of license and rig registrations before July 01 of each year by filing the proper renewal forms provided by the department and fulfilling the following requirements:
 - (A) payment of the annual license fee and a rig registration fee for each drill rig to be operated in the state;
 - (B) filing of all well records for each water well constructed, reconstructed or plugged by the licensee in accordance with K.S.A. 28-30-4 during the previous licensure period;
 - (C) filing a report, on a form provided by the department, of all approved continuing education units earned by the licensee during the previous licensure period;
 - (D) satisfying the continuing education requirements set forth in subsection (g); and
 - (E) providing any remaining outstanding information or records requested that existed prior to the issuance of revocation of a license.
 - (2) Failure to comply with paragraphs (A), (B), (C), (D) and (E) above shall be grounds to revoke the existing license and terminate the license renewal process.
- (e) Water well construction fee. A fee of \$5.00 shall be paid to the Kansas Department of Health and Environment, either by bank draft,

check or money order, for each water well constructed by a licensed water well contractor. The construction fee shall be paid when the contractor requests the water well record form WWC-5 from the department or shall accompany the water well records submitted on form WWC-5 as required under K.A.R. 28-30-4. No fee shall be required for reconstruction or plugged water wells.

- (f) License number. Each drill rig operated by or for a licensed water well contractor shall have prominently displayed thereon the drill rig license number, as assigned by the department, in letters at least two inches in height. Decals, paint, or other permanent marking materials shall be used.
- (g) Continuing education requirements. Licensed water well contractors shall earn at least eight units of approved continuing education per year beginning with the first full year of licensure or the renewal period. One unit of continuing education shall equal 50 minutes of approved instruction except for trade shows and exhibitions which shall be counted as one unit per approved trade show and exhibition attended. (Authorized by K.S.A. 1992 Supp. 82a-1205; implementing K.S.A. 82a-1202, K.S.A. 1992 Supp. 82a-1205, 82a-1206, 82a-1207, 82a-1209; effective, E-74-34, July 2, 1974; effective May 1, 1975; amended May 1, 1980; amended May 1, 1983; amended May 1, 1987; amended Nov. 22, 1993.)

28-30-4. General operating requirements.

- (a) *Water well record.* Within 30 days after construction or reconstruction of a water well, the water well contractor shall submit a report of such work, to the Kansas Department of Health and Environment and the landowner, on the water well record form, form WWC-5, provided by the department. The contractor shall report to the department and to the landowner on the water well record or attachments made thereto any polluted or other noncompliant conditions which the contractor was able to correct and any conditions which the contractor was unable to correct. The contractor shall report to the department and the landowner the plugging of any abandoned water well. The report shall include the location, landowner's name, method, type of material, its placement and amount used to plug the abandoned water well.

A landowner who constructs, reconstructs, or plugs a water well, which will be or was, used by the landowner for farming, ranching or agricultural purposes or is located at the landowner's place of abode, shall submit a water well record, on Form WWC-5, of such work to the department within 30 days after the construction, reconstruction or

plugging of the water well. No fee shall be required from the landowner for the record.

- (b) *Artificial recharge and return.* The construction of artificial recharge wells and freshwater return wells shall comply with all applicable rules and regulations of the department.
- (c) *Well tests.* When a pumping test is run on a well, results of the test shall be reported on the water well record, form WWC-5, or a copy of the contractor's record of the pumping test shall be attached to the water well record.
- (d) *Water samples.* Within 30 days after receipt of the water well record, form WWC-5, the department may request the contractor, or landowner who constructs or reconstructs his or her own water well, to submit a sample of water from the well for chemical analysis. Insofar as is possible, the department will define in advance areas from which well water samples are required. (Authorized by K.S.A. 82a-1205, and implementing K.S.A. 82a-1202, 82a-1205, 82a-1212, 82a-1213; effective, E-74-34, July 2, 1974; modified, L. 1975, ch. 481, May 1, 1975; amended May 1, 1980; amended May 1, 1987.)

28-30-7. Plugging of abandoned wells, cased and uncased test holes.

- (a) All water wells abandoned by the landowner on or after July 01, 1979, and all water wells that were abandoned prior to July 01, 1979 which pose a threat to groundwater supplies, shall be plugged or caused to be plugged by the landowner. In all cases, the landowner shall perform the following as minimum requirements for plugging abandoned wells.
 - (1) The casing shall be cut off three feet below ground surface and removed.
 - (2) All wells shall be plugged from bottom to top using volumes of material equaling at least the inside volume of the well.
 - (3) Plugging top of well:
 - (A) For cased wells a grout plug shall be placed from six to three feet below ground surface.
 - (B) For dug wells, the lining material shall be removed to at least five feet below ground surface, and then sealed at five feet with a minimum of six inches of concrete or other materials approved by the department.

Compacted surface silts and clays shall be placed over the concrete seal to ground surface.

- (4) Any groundwater displaced upward inside the well casing during the plugging operation shall be removed before additional plugging materials are added.
 - (5) From three feet below ground level to ground level, the plugged well shall be covered over with compacted surface silts or clays.
 - (6) Compacted clays or grout shall be used to plug all wells from the static water level to six feet below surface.
 - (7) All sand and gravel used in plugging abandoned domestic or public water supply wells shall be chlorinated prior to placement into a well.
- (b) Abandoned wells formerly producing groundwater from an unconfined aquifer shall be plugged in accordance with the foregoing and in addition shall have washed sand, and gravel or other material approved by the department placed from the bottom of the well to the static water level.
- (c) Abandoned wells, formerly producing groundwater from confined and unconfined aquifers or in confined aquifers only, shall be plugged according to K.A.R. 28-30-7(a) and by using one of the following additional procedures:
- (1) The entire well column shall be filled with grout, or other material approved by the department, by use of a grout tremie pipe.
 - (2) A 10 foot grout plug shall be placed opposite the impervious formation or confining layer above each confined aquifer or aquifers by use of a grout tremie pipe; and
 - A) The space between plugs shall be filled with clays, silts, sand and gravel or grout and shall be placed inside the well so as to prevent bridging.
 - (B) A grout plug at least 20 feet in length shall be placed with a grout pipe so at least 10 feet of the plug extends below the base of the well casing and at least 10 feet of the plug extends upward inside the bottom of the well casing.

- (C) A grout plug at least ten feet in length shall be placed from at least 13 feet below ground level to the top of the cut off casing.
- (3) Wells that have an open bore hole below the well casing, and where the casing was not grouted into the well bore when the well was constructed, shall be plugged by (1) or (2) above, except that the top 20 feet of well casing shall be removed or perforated with the casing ripper or similar device prior to plugging. If the well is plugged according to part (2) of this subsection, the screened or perforated intervals below the well casing shall be grouted the entire length by use of a grout tremie pipe.
- (d) Plugging of abandoned holes. If the hole penetrates an aquifer containing water with more than 1,000 milligrams per liter, mg/l, total dissolved solids or is in an area determined by the department to be contaminated, the entire hole shall be plugged with an approved grouting material from the bottom of the hole, up to within three feet of the ground surface using a grout tremie pipe or similar method. From three feet below ground surface to ground surface the plugged hole shall be covered over with compacted surface silts or clays; otherwise, the hole shall be plugged in accordance with the following paragraphs.
- (1) Plugging of abandoned cased test holes. The casing shall be removed if possible and the abandoned test hole shall be plugged with an approved grouting material from the bottom of the hole, up to within three feet of the ground surface, using a grout tremie pipe or similar method. From three feet below ground surface to ground surface the plugged hole shall be covered over with compacted surface silts or clays.
- If the casing cannot be removed, in addition to plugging the hole with an approved grouting material the annular space shall also be grouted as described in K.A.R. 28-30-6 or as approved by the department.
- (2) Abandoned uncased test holes, exploratory holes or any bore holes except seismic or oil field related exploratory and services holes regulated by the Kansas Corporation Commission under K.A.R. 82-3-115 through 82-3-117. A test

hole or bore hole drilled, bored, cored or angled shall be considered an abandoned hole immediately after the completion of all testing, sampling or other operations for which the hole was originally intended. The agency or contractor in charge of the exploratory or other operations for which the hole was originally intended is responsible for plugging the abandoned hole using the following applicable method, within three calendar days after the termination of testing other operations.

- (A) The entire hole shall be plugged with an approved grouting material from bottom of the hole, up to within three feet of the ground surface, using a grout tremie pipe or similar method.
 - (B) From three feet below ground surface to ground surface the plugged hole shall be covered over with compacted surface silts or clays.
 - (C) For bore holes of 25 feet or less, drill cuttings from the original hole may be used to plug the hole in lieu of grouting material, provided that an aquifer is not penetrated or the bore hole is not drilled in an area determined by the department to be a contaminated area.
- (3) Plugging of heat pump holes drilled for closed loop heat pump systems. The entire hole shall be plugged with an approved grouting material from bottom of the hole, to the bottom of the horizontal trench, using a grout tremie pipe or similar method approved by the department.
- (e) Abandoned oil field water supply wells. A water well drilled at an oil or gas drilling site to supply water for drilling activities shall be considered an abandoned well immediately after the termination of the oil or gas drilling operations. The company in charge of the drilling of the oil or gas well shall be responsible for plugging the abandoned water well, in accordance with K.A.R. 28-30-7(a), (b), and (c), within 30 calendar days after the termination of oil and gas drilling operations.

Responsibility for the water well may be conveyed back to the landowner in lieu of abandoning and plugging the well but the well must conform to the requirements for active or inactive status. The transfer must be made through a legal document, approved by the

department, advising the landowner of the landowner's responsibilities and obligations to properly maintain the well, including the proper plugging of the well when it is abandoned and no longer needed for water production activities. If a transfer is to be made, the oil or gas drilling company shall provide the department with a copy of the transfer document within 30 calendar days after the termination of oil or gas drilling operations. Within 30 calendar days of the effective date of the transfer of the well the landowner shall notify the department of the intended use and whether the well is in active status or inactive status in accordance with K.A.R. 28-30-7(f).

- (f) Inactive status. Landowners may obtain the department's written approval to maintain wells in an inactive status rather than being plugged if the landowner can present evidence to the department as to the condition of the well and as to the landowner's intentions to use the well in the future. As evidence of intentions, the owner shall be responsible for properly maintaining the well in such a way that:
 - (1) The well and the annular space between the hole and the casing shall have no defects that will permit the entrance of surface water or vertical movement of subsurface water into the well;
 - (2) the well is clearly marked and is not a safety hazard;
 - (3) the top of the well is securely capped in a watertight manner and is adequately maintained in such a manner as to prevent easy entry by other than the landowner;
 - (4) the area surrounding the well shall be protected from any potential sources of contamination within a 50 foot radius;
 - (5) if the pump, motor or both, have been removed for repair, replacement, etc., the well shall be maintained to prevent injury to people and to prevent the entrance of any contaminant or other foreign material;
 - (6) the well shall not be used for disposal or injection of trash, garbage, sewage, wastewater or storm runoff; and
 - (7) the well shall be easily accessible to routine maintenance and periodic inspection.

The landowner shall notify the department of any change in the status of the well. All inactive wells found not to be in accordance with the criteria listed in lines one through seven above shall be considered to be abandoned and shall be plugged by the landowner in accordance with K.A.R. 28-30-7(a) through (c). (Authorized by K.S.A. 82a-1205; implementing K.S.A. 82a-1202, 82a-1205, 82a-1212, 82a-1213; effective, E-74-34, July 2, 1974; modified, L. 1975, ch. 481, May 1, 1975; amended May 1, 1980; amended May 1, 1983; amended May 1, 1987.)

28-30-200. Definitions. In addition to the definitions in K.A.R. 28-30-2, the following definitions shall apply to the Equus Beds groundwater management district no. 2:

- (a) “Bedrock” means shale, limestone, sandstone, siltstone, anhydrite, gypsum, salt, or other consolidated rock that can occur at the surface or underlie unconsolidated material.
- (b) “Board” means the board of directors constituting the governing body of the Equus Beds groundwater management district no. 2.
- (c) “Borehole” means any hole that is drilled, cored, bored, washed, driven, dug, or otherwise excavated, in which the casing and screen have been removed or in which the casing has not been installed.
- (d) “Contaminate” means to engage in any act or omission causing the addition or introduction of substances to freshwater in concentrations that alter the physical, chemical, biological, or radiological properties of the freshwater, making the water unfit for beneficial use.
- (e) “District” means the Equus Beds groundwater management district no. 2, which is organized for groundwater management purposes pursuant to K.S.A. 82a-1020 et seq., and amendments thereto.
- (f) “Fluid” means any material or substance that flows or moves in a semisolid, liquid, sludge, gas, or any other form or state.
- (g) “Free-fall” means a method used to place grout in a water well or borehole that meets all of the following conditions:
 - (1) The total grouting depth below ground level does not exceed 75 feet.

- (2) The grouting interval is free of fluids.
 - (3) The diameter of the water well casing or borehole is sufficient to allow the unobstructed flow of grout throughout the entire grouting interval.
 - (4) Grout is poured or discharged into the water well or borehole at a controlled rate.
- (h) “Fresh groundwater” means water containing not more than 1,000 milligrams of total dissolved solids per liter and 500 milligrams of chloride per liter.
- (i) “Grout” has the meaning specified in K.A.R. 28-30-2.
- (j) “Grout seal” means grout that is installed, placed, pumped, or injected to create a permanent, impervious watertight bond in a well casing, annular space, geologic unit, or any other apertures or apparatuses associated with a water well or borehole.
- (k) “Inactive well” means a water well that meets the following conditions:
- (1) Is not operational;
 - (2) is properly constructed as specified in K.A.R. 28-30-5 or K.A.R. 28-30-6;
 - (3) is equipped with a watertight seal; and
 - (4) is maintained in good repair until the water well is returned to service as an active water well.
- (l) “Licensed geologist” means a geologist licensed to practice geology in Kansas by the Kansas board of technical professions.
- (m) “Licensed professional engineer” means a professional engineer licensed to practice engineering in Kansas by the Kansas board of technical professions.
- (n) “Monitoring well” means a water well used to monitor, obtain, or collect hydrologic, geologic, geophysical, chemical, or other technical

Data pertaining to groundwater, surface water, or other hydrologic conditions.

- (o) "Test borehole" means a borehole used to obtain or collect hydrologic, geologic, geophysical, chemical, or other technical data pertaining to groundwater, surface water, or other hydrologic conditions by means of placing sampling, logging, testing, casing, screen, or associated tools or equipment in the borehole for fewer than 30 days. (Authorized by and implementing K.S.A. 2004 Supp. 82a-1028 and K.S.A. 82a-1213; effective P-September 30, 2005)

28-30-201. Plugging operations; notification; report.

- (a) All plugging operations shall be supervised by one of the following:
 - (1) A water well contractor licensed by the department;
 - (2) a licensed professional engineer or licensed geologist; or
 - (3) the water well or borehole owner, or the landowner of the property on which the water well or borehole is located.
- (b) Each water well or borehole owner, or the landowner of the property on which the water well or borehole is located, shall notify the district within 48 hours before any plugging operations occur.
- (c) Within 30 days after the plugging operation is completed, one of the following requirements shall be met:
 - (1) The water well contractor, licensed professional engineer, or licensed geologist that supervised the water well or borehole plugging operations shall submit a completed report of the work on the department's plugging record form WWC-5P or WWC-5 to the department, the district, and the landowner.
 - (2) The water well or borehole owner, or the landowner of the property on which the water well or borehole is located, shall submit a completed report of the work on the department's plugging record form WWC-5P or WWC-5 to the department and the district. (Authorized by and implementing K.S.A. 2004 Supp. 82a-1028 and K.S.A. 82a-1213; effective P-September 30, 2005)

28-30-202. Plugging operations for an abandoned water well or borehole; responsibility.

- (a) Each water well or borehole shall be considered abandoned if at least one of the following conditions exists:
 - (1) The water well or borehole was not completed.
 - (2) The water well or borehole threatens to contaminate fresh groundwater.
 - (3) The water well or borehole poses a safety or health hazard.
 - (4) Uncontrolled fluid flow is encountered or present in the water well or borehole.
 - (5) The use of the water well or borehole has ceased.
 - (6) The borehole testing, sampling, or other operations are completed within 30 days of completion of the borehole drilling.
 - (7) The water well or borehole owner has not demonstrated the intention to use the water well or borehole.
 - (8) The water well can not be maintained in an active or inactive status.
 - (9) The water well or borehole is not operational or functional for the intended use.
- (b) Each water well or borehole owner or the landowner of the property shall plug or cause an abandoned water well or borehole to be plugged as required in subsection (c) of this regulation.
- (c) Except as specified in subsection (e), the minimum plugging operations for an abandoned water well or borehole shall include the following:
 - (1) Before plugging operations begin, the following water well or borehole data shall be recorded as follows:
 - (A) The legal description of the water well or borehole location, to the nearest 10-acre tract and, if available, the geographic coordinates consisting of the latitude,

- longitude, and base datum;
 - (B) the diameter of the water well or borehole;
 - (C) the static water level; and
 - (D) the total depth of the water well or borehole.
- (2) The materials used to plug a water well or borehole shall be clean, free of defects, properly prepared, and installed according to the manufacturer's specifications.
- (3) All plugging material that forms a bridge, entraps air or other fluids, or forms a blockage in the water well or borehole shall be freed or removed before continuing plugging operations.
- (4) All pumping, sampling, logging, and related equipment and any other material or debris in the water well or borehole shall be removed from the water well or borehole.
- (5) The annular space of the water well shall be grouted as specified in K.A.R. 28-30-203.
- (6) Before plugging operations begin and when plugging operations are suspended or interrupted, the opening of the water well or borehole shall be secured to prevent fluids from entering the water well or borehole.
- (7) Before placement of any plugging material, the water well or borehole shall be disinfected as specified in K.A.R. 28-30-205.
- (8) Except as specified in subsection (d) of this regulation, all of the following minimum grouting requirements shall be met:
- (A) The water well or borehole shall be grouted from the bottom to three feet below ground level.
 - (B) Each water well meeting the requirements of subsection (d) shall be grouted from the top of the sand or gravel plugging material to three feet below ground level.
 - (C) Grout shall be placed in the water well or borehole using one of the following:
 - (i) A grout tremie pipe;

- (ii) free-fall; or
 - (iii) a grouting procedure recommended by the grout manufacturer.
 - (D) Grout shall be allowed to cure as recommended by the grout manufacturer.
- (9) Except as required by K.A.R. 28-30-203, the water well casing shall be cut off at a minimum of three feet below land surface and removed.
- (10) From three feet below land surface to land surface, the water well or borehole shall be backfilled with clean, compacted topsoil and sloped so that drainage or runoff is directed away from the plugged water well or borehole.
- (d) Any water well or borehole owner, landowner of the property, water well contractor, licensed geologist, or licensed professional engineer may utilize coarse sand or fine gravel to plug a water well by filling the water well casing to the static water level or six feet below ground level, whichever is the greater distance below ground level, if both of the following water well conditions are present:
 - (1) The water well is cased.
 - (2) The water well is completed in a single unconfined aquifer.
- (e) Drill cuttings from the original borehole may be used to plug a borehole that meets all of the following conditions:
 - (1) The depth of the borehole is less than the highest historical groundwater level.
 - (2) The depth of the borehole is 25 feet or less below ground level.
 - (3) The borehole is not located in a contaminated area. (Authorized by and implementing K.S.A. 2004 Supp. 82a-1028 and K.S.A. 82a-1213; effective P-September 30, 2005)

28-30-203. Annular space grouting procedures.

- (a) Each water well or borehole owner or landowner of the property with an abandoned water well that was constructed on or after May 1,

1983 shall have the water well's annular space grouted as follows:

- (1) From three feet below ground level to a minimum of 20 feet below ground level; or
 - (2) below the point at which a pitless well adapter attaches to the well casing to a minimum of 20 feet below the pitless well adapter.
- (b) The annular space of each abandoned water well in which the water well was constructed before May 1, 1983 shall be grouted as follows:
- (1) If the annular space does not contain grout or gravel pack and is free of debris, the grout shall be placed in the annular space in the following manner:
 - (A) From three feet below ground level to 20 feet below ground level; or
 - (B) below the point at which a pitless well adapter attaches to the well casing to a minimum of 20 feet below the pitless well adapter.
 - (2) If the annular space contains gravel pack or other material, all of the following requirements shall be met:
 - (A) The well casing shall be removed to a depth of four feet below ground level.
 - (B) The annular space shall be freed of gravel pack, any other material, and fluid from the top of the casing to six feet below the top of the well casing.
 - (C) The grout shall be placed in the annular space from six feet below the top of the well casing to one foot above the top of the well casing.
- (c) From three feet below ground level to ground level, the water well or borehole shall be backfilled with clean, compacted topsoil and sloped so that the drainage or runoff is directed away from the plugged water well or borehole.
- (d) If groundwater is encountered at a depth less than the minimum grouting requirement, the annular space grouting requirement may be

modified by requesting a variance from the district as specified in K.A.R. 28-30-208. (Authorized by and implementing K.S.A. 2004 Supp. 82a-1028 and K.S.A. 82a-1213; effective P-September 30, 2005.)

28-30-204. Inactive well; application; construction and extension.

- (a) Each owner of an inactive water well shall meet the following requirements:
- (1) Submit a completed, signed, and notarized inactive water well agreement, on a form provided by the district, to the district manager 30 days before placing the well on inactive status. The form shall include a statement that the water well does not pose a public health or safety hazard and does not threaten to contaminate the groundwater;
 - (2) remove all pumping equipment from the water well;
 - (3) construct the water well and the annular space as specified in K.A.R. 28-30-6;
 - (4) seal and maintain the water well and the annular space to prohibit the entrance of surface fluids and materials and the vertical movement of subsurface water into the well and to prevent damage;
 - (5) post a sign that meets the following conditions within three feet of the water well:
 - (A) Has a minimum height of three feet above land surface;
 - (B) is easily visible;
 - (C) is continually maintained; and
 - (D) is constructed with the words "Inactive Water Well" and a legal description consisting of the 10-acre tract, section, township, and range description printed legibly; and
 - (6) securely install a watertight seal or cap on the water well casing opening a minimum of one foot above land surface that consists of one of the following:

- (A) Steel plating that is a minimum of 1/4 inch thick and is welded to the casing opening;
 - (B) a polyvinylchloride cap glued to the water well casing opening, with a minimum standard dimension ratio (SDR) of 21 or less on well casing less than four inches in diameter and a minimum SDR of 26 or less on well casing four or more inches in diameter. The SDR shall be calculated by dividing the casing's outside diameter (OD) by its minimum wall thickness (MWT); or
 - (C) any other seal or cap that is approved by the district manager.
- (b) Each water well owner shall repair all damage to the water well within 30 days, unless the district manager determines that the water well poses a public health or safety hazard, in which case the district manager shall set the time period for fewer than 30 days.
 - (c) Each water well owner shall notify the district within 30 days after the water well is returned to service as an active water well.
 - (d) The district manager or a staff member of the district may inspect any inactive water well.
 - (e) Each water well owner shall be responsible for properly maintaining the water well in the inactive status.
 - (f) A radius of 50 feet around the inactive well shall be free of contamination.
 - (g) An inactive water well shall not be used for disposal or injection of any fluids or materials.
 - (h) Each inactive water well shall be easily accessible for routine maintenance and inspection.
 - (i) Each water well owner shall notify the district manager of any change in the condition of the water well.
 - (j) Each inactive water well that does not meet the requirements of these regulations shall be deemed abandoned and shall be plugged in accordance with these regulations.

- (k) The expiration date of the inactive water well period may be extended beyond the date authorized in the approved inactive water well agreement or the date of any extension authorized by the district manager, if the water well is in good repair and meets the requirements of these regulations. The extension of time shall not exceed one year beyond the expiration date of the inactive well agreement or the date of any authorized extension.
- (l) Each approved inactive water well request and each approved extension of time shall be reported by the district to the department, in writing, within 30 days of approval on a form provided by the district. (Authorized by and implementing K.S.A. 2004 Supp. 82a-1028 and K.S.A. 82a-1213; effective P-September 30, 2005)

28-30-205. Disinfection of an abandoned water well or borehole.

- (a) Except as specified in subsection (b), the following minimum quantities of sodium hypochlorite with 5.25 percent to 6.0 percent strength, manufactured under trade names including Clorox, Purex, Sno-White, and Topco, and other bleach products with similar properties, shall be used to disinfect each abandoned water well or borehole:

Water well casing or hole diameter (inches)	Sodium hypochlorite (fluid ounces per per foot of water column)
1.25	0.015
1.5	0.023
2	0.041
2.5	0.064
3	0.094
3.5	0.127
4	0.165
5	0.259
6	0.381
8	0.660
10	1.036
12	1.490
14	2.031
16	2.650
18	3.354
24	5.966
30	9.317

- (b) Any concentration of sodium hypochlorite not specified in subsection (a) or any combination of calcium hypochlorite may be used to disinfect an abandoned water well or borehole, if a minimum concentration of 100 milligrams of chlorine solution per liter per foot of water column in the water well or borehole is produced. (Authorized by and implementing K.S.A. 2004 Supp. 82a-1028 and K.S.A. 82a-1213; effective P-September 30, 2005.)

28-30-206. Administrative appeal to the board.

- (a) Any owner of a water well or borehole or any person whose legal rights, duties, privileges, immunities, or other legal interests are affected by an order issued by the district may request an appeal hearing with the board.
- (b) The request for hearing shall be filed with the board within 30 days after service of the order on the owner or owners of the water well or borehole or any person whose legal rights, duties, privileges, immunities, or other legal interests are affected by the order. The request for hearing shall state the basis for requesting a hearing and shall be accompanied by documentation supporting the request.
- (c) During the hearing, the board may take into consideration any relevant information or data, including information and data from any person whose legal rights, duties, privileges, immunities, or other legal interests may be affected by the order.
- (d) After consideration of all information and data presented, the board shall issue one of the following:
 - (1) An order remanding the case to the district manager with instructions for additional investigation; or
 - (2) a final order that contains findings of fact and conclusions of law.
- (e) Within 15 days of the service of a final order, the owner or owners of the water well or borehole or any person whose legal rights, duties, privileges, immunities, or other legal interests are affected may file a written petition for reconsideration to the board. The petition for

reconsideration shall state the basis and contain any facts and conclusions of law that are in dispute.

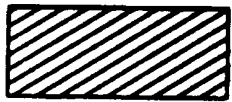
- (f) The board shall render a written order denying the petition for reconsideration, granting the petition for reconsideration and modifying the final order, or granting the petition for reconsideration and setting the matter for further proceedings. After further proceedings, the petition for reconsideration may be denied or granted in whole or in part.
- (g) Unless clear and convincing evidence is presented to the board, the board shall not render a written order if the order would result in any of the following:
 - (1) The impairment of an existing groundwater use;
 - (1) an adverse effect on public health, safety, or the environment;
 - (3) the threat of groundwater contamination;
 - (4) an adverse effect on the public interest; or
 - (5) the impairment of the board's ability to apply and enforce these regulations or the management program specified in K.S.A. 82a-1029, and amendments thereto.
- (h) Any owner or owners or any person whose legal rights, duties, privileges, immunities, or other legal interests are affected by a final order or order rendered upon reconsideration may seek judicial review pursuant to the act for judicial review and civil enforcement of agency actions specified in K.S.A. 77-601 et seq., and amendment thereto.
- (i) Each order issued by the board shall be mailed to the owner or owners; any person whose legal rights, duties, privileges, immunities, or other legal interests are affected by the order; and the department. Service shall be deemed complete upon mailing. (Authorized by and implementing K.S.A. 2004 Supp. 82a-1028; effective P-September 30, 2005)

28-30-207. Variance; extension of time.

- (a) If an individual or party wants a variance from any of the regulations contained in K.A.R. 28-30-200 through K.A.R. 28-30-206 or an extension of time pursuant to K.A.R. 28-30-204, the individual or party shall submit a request, in writing, to the district.

- (1) Each request shall include the following:
 - (A) The name, address, telephone number, and contact person of the individual or party requesting the variance or extension of time;
 - (B) the specific legal description of the site location to which the variance or extension of time would apply;
 - (C) the specific regulation from which the variance is sought or the amount of time requested; and
 - (D) the reason for requesting the variance or extension of time and any supporting data.
 - (2) A variance or extension of time may be granted by the district manager if the variance or extension is in keeping with the purposes of the Kansas groundwater exploration and protection act and the groundwater management district act.
- (c) Each variance or extension of time granted by the district manager shall be reported by the district to the department within 30 days of approval.
 - (d) Each individual or party who wants an extension of time for the inactive water well period shall submit the request at least 30 days before the expiration date on a form provided by the district. (Authorized by and implementing K.S.A. 2004 Supp. 82a-1028; effective P-September 30, 2005.)

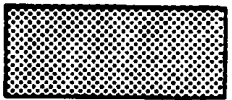
PLUGGING MATERIAL KEY CODE



GROUT



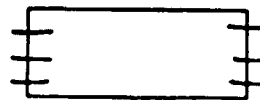
SOIL OR CLAY



SAND & GRAVEL

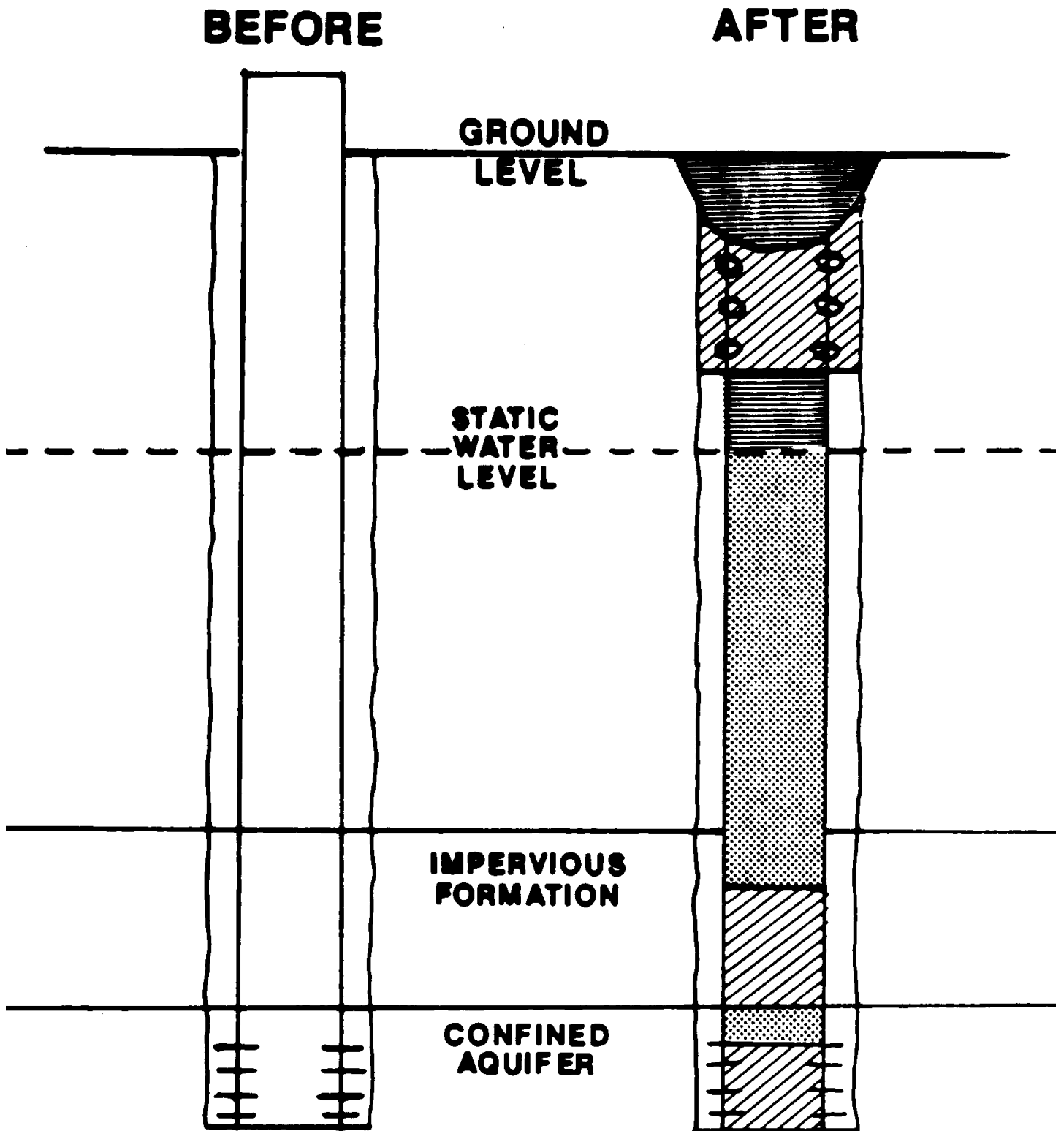


CASING RIPPED



WELL SCREEN

PLUGGING OF AN UNCONFINED WELL (not grouted)



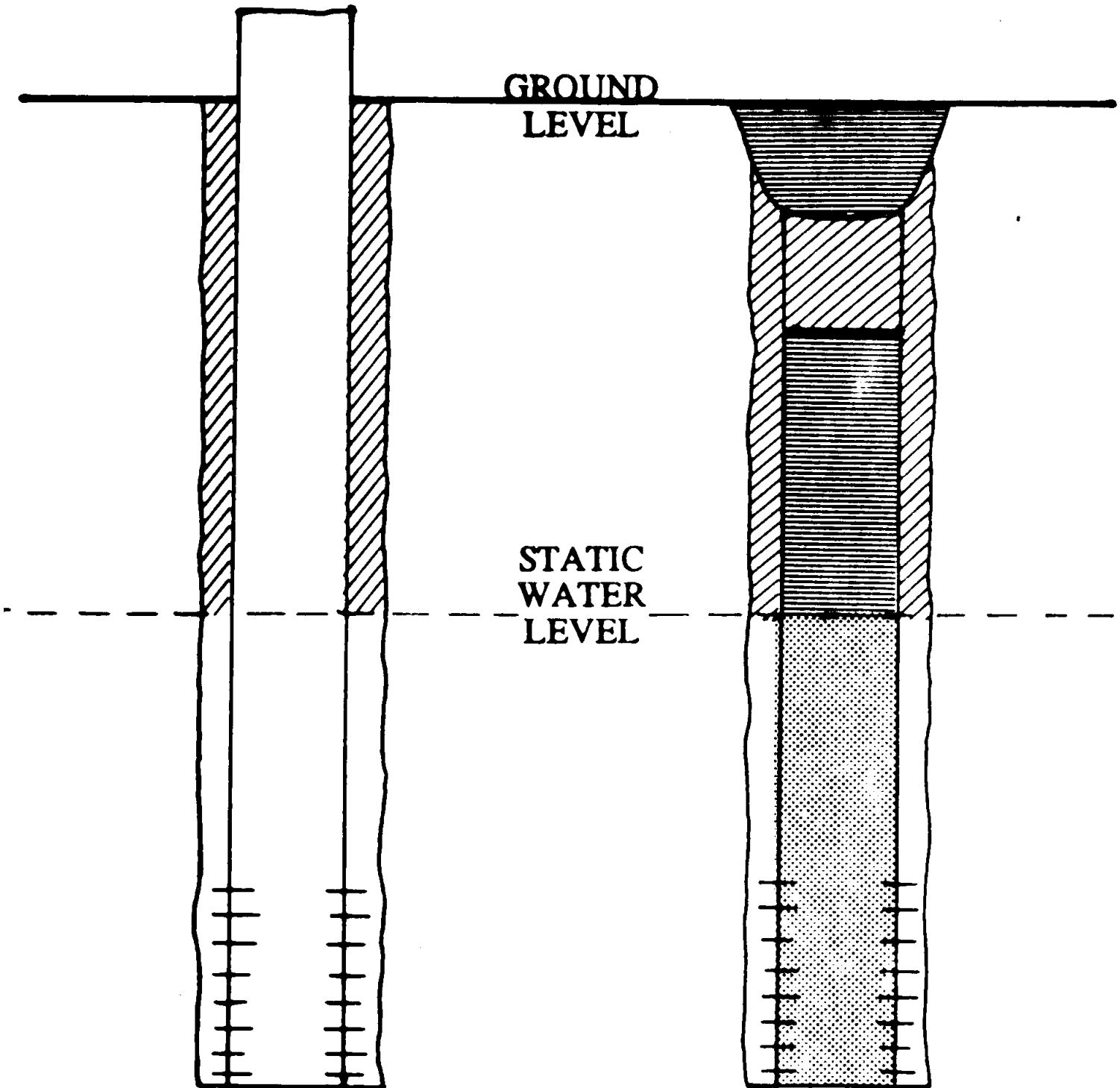
PLUGGING OF AN UNCONFINED WELL (grouted)

BEFORE

AFTER

GROUND
LEVEL

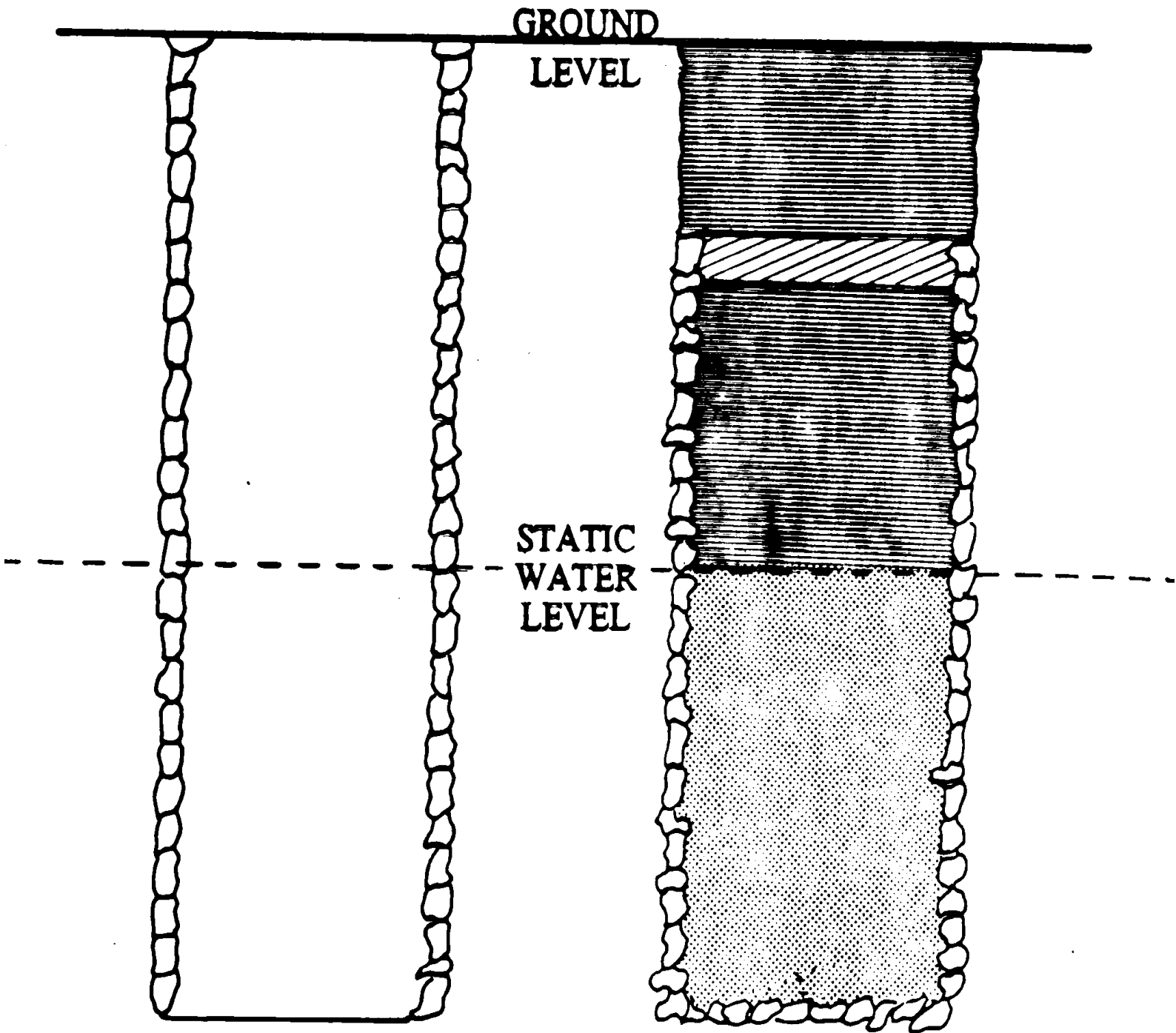
STATIC
WATER
LEVEL



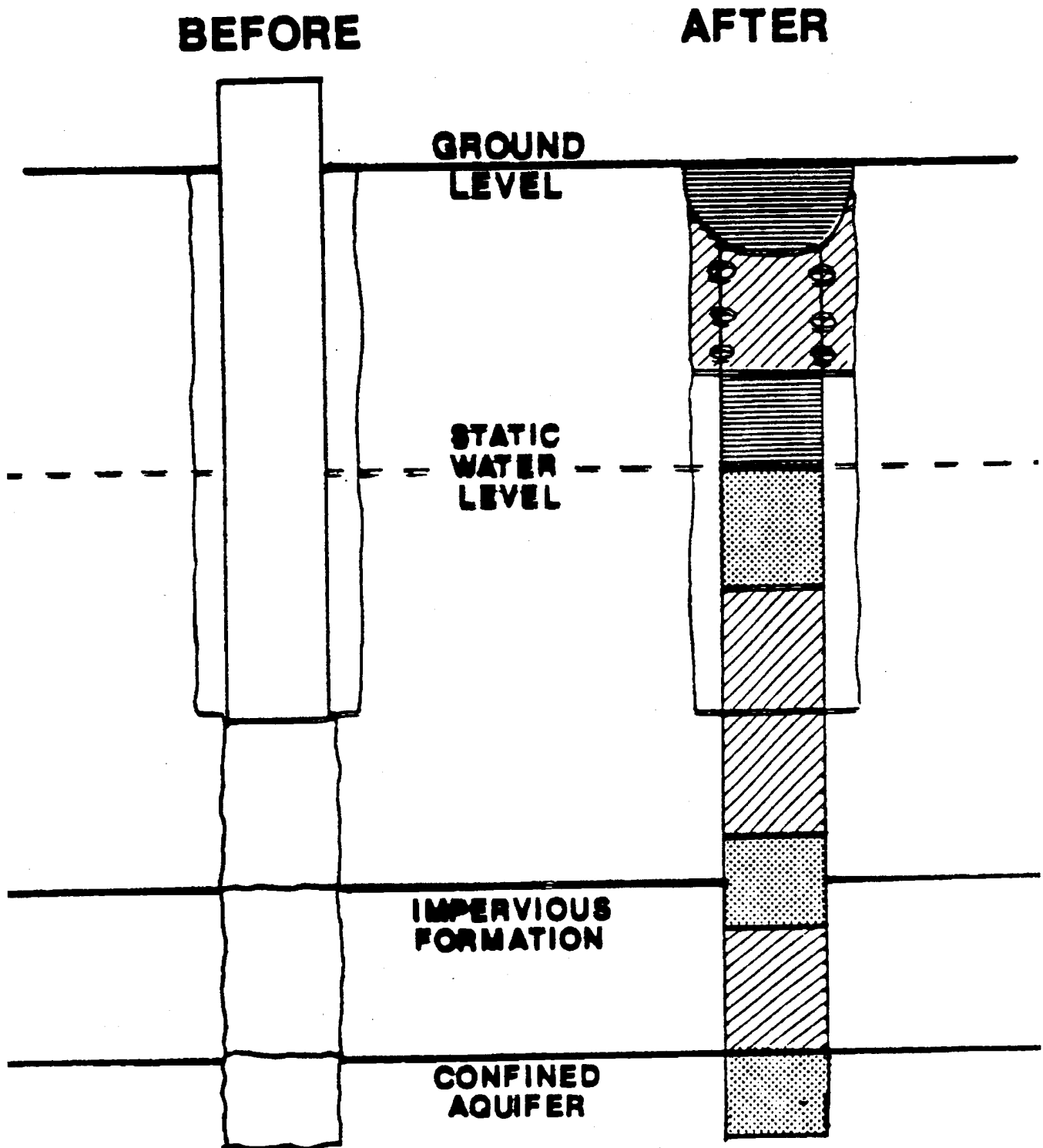
PLUGGING OF A DUG WELL

BEFORE

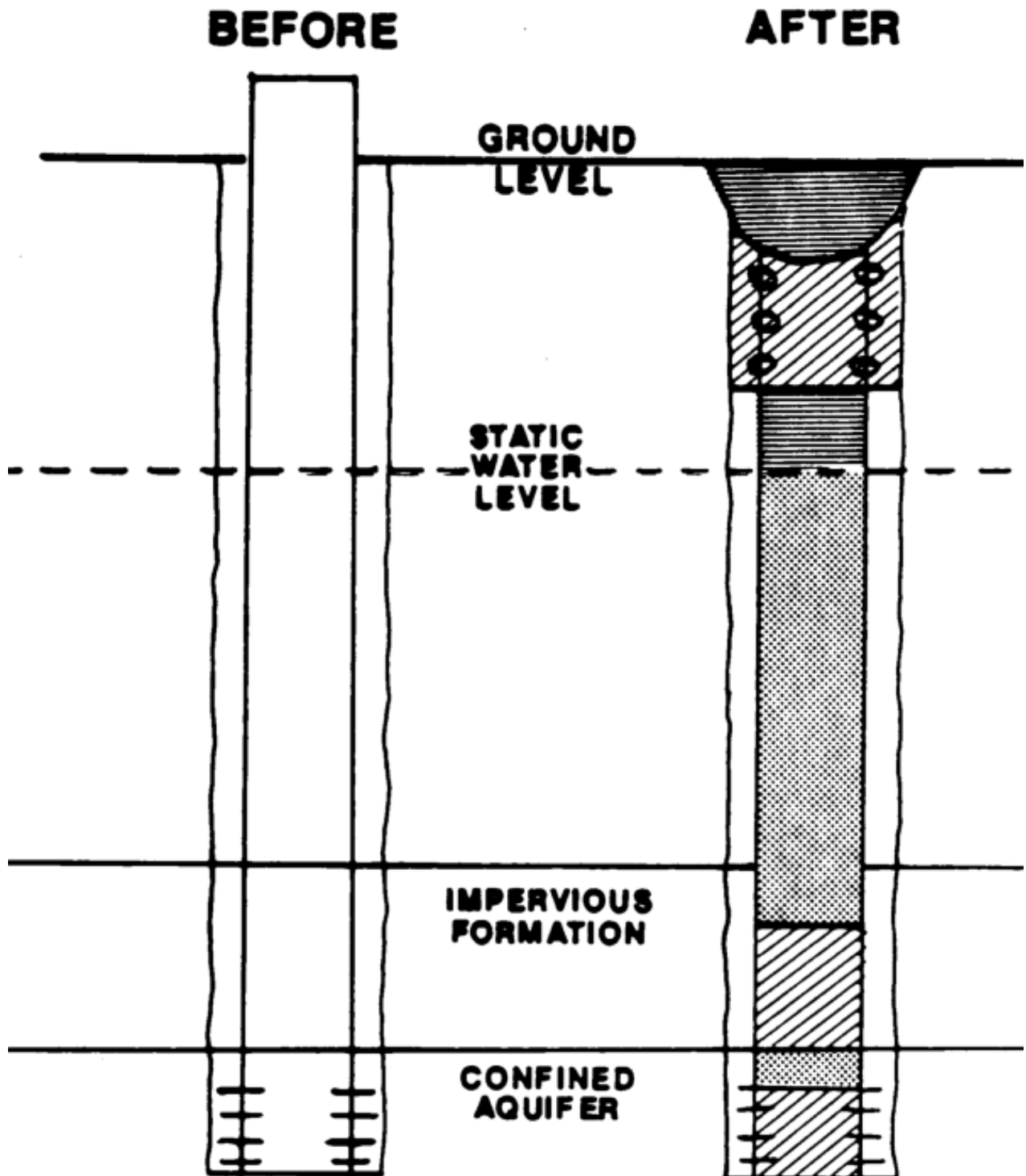
AFTER



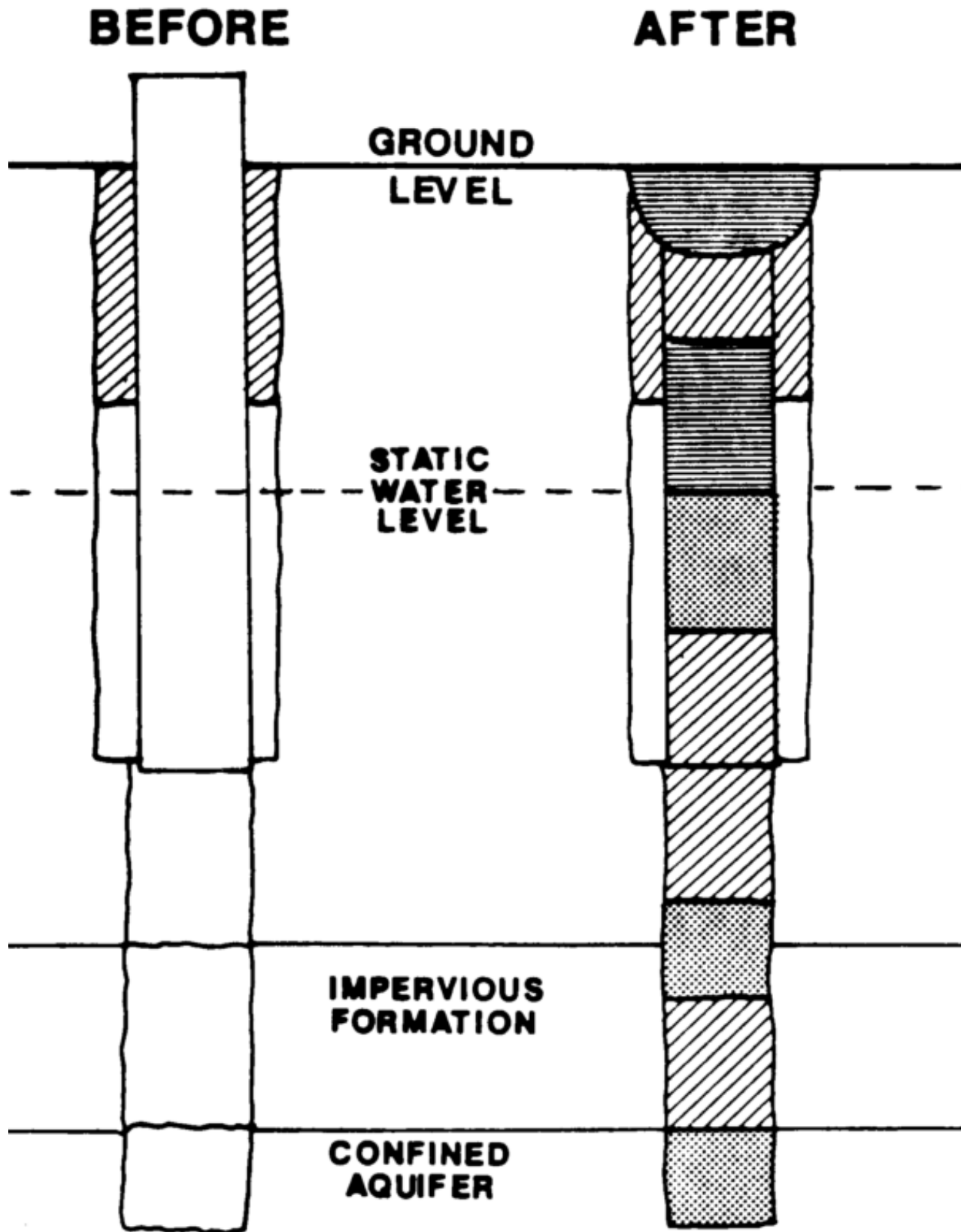
PLUGGING OF A CONFINED WELL (open hole, ungrouted)



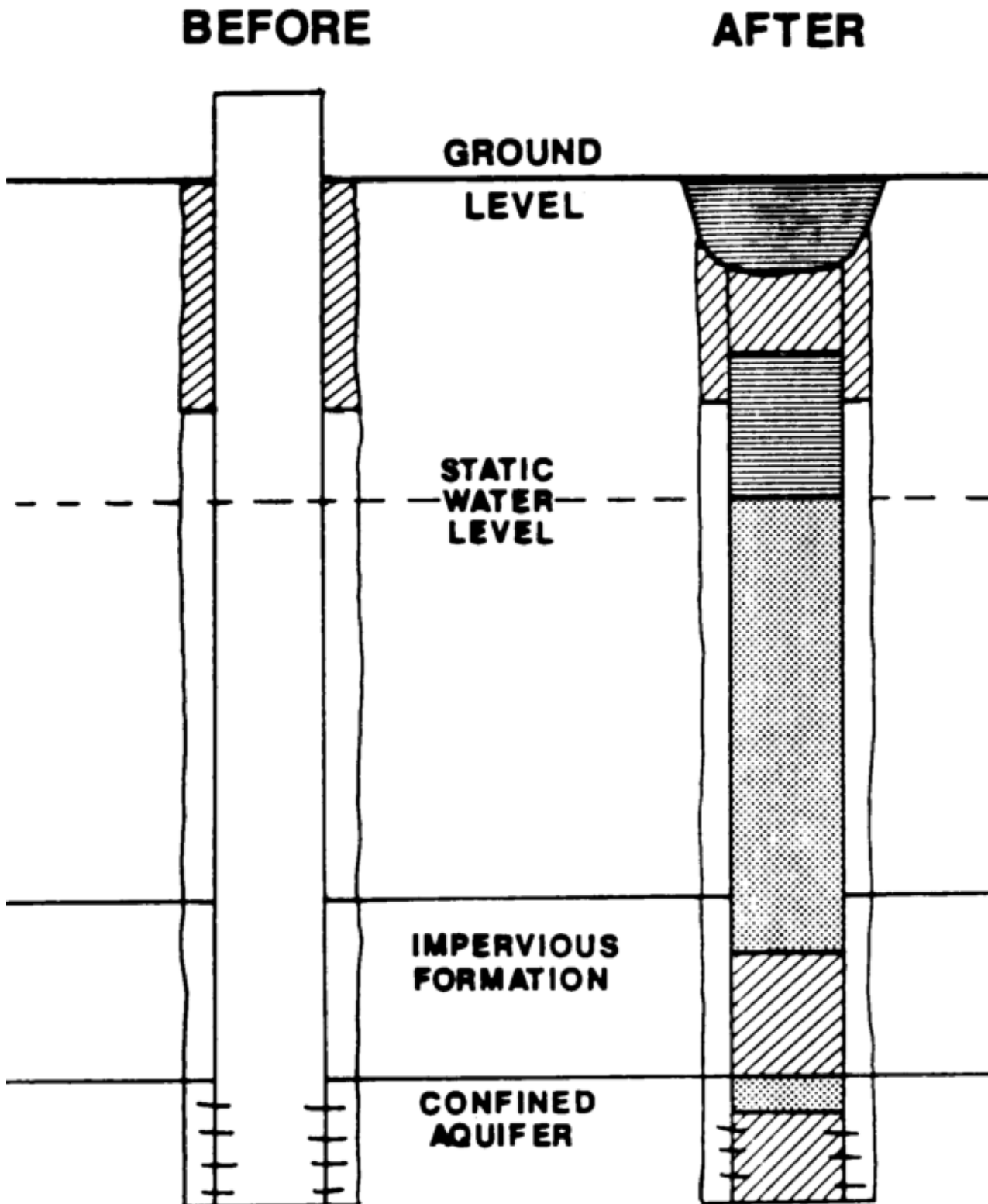
PLUGGING OF A CONFINED WELL (not grouted)



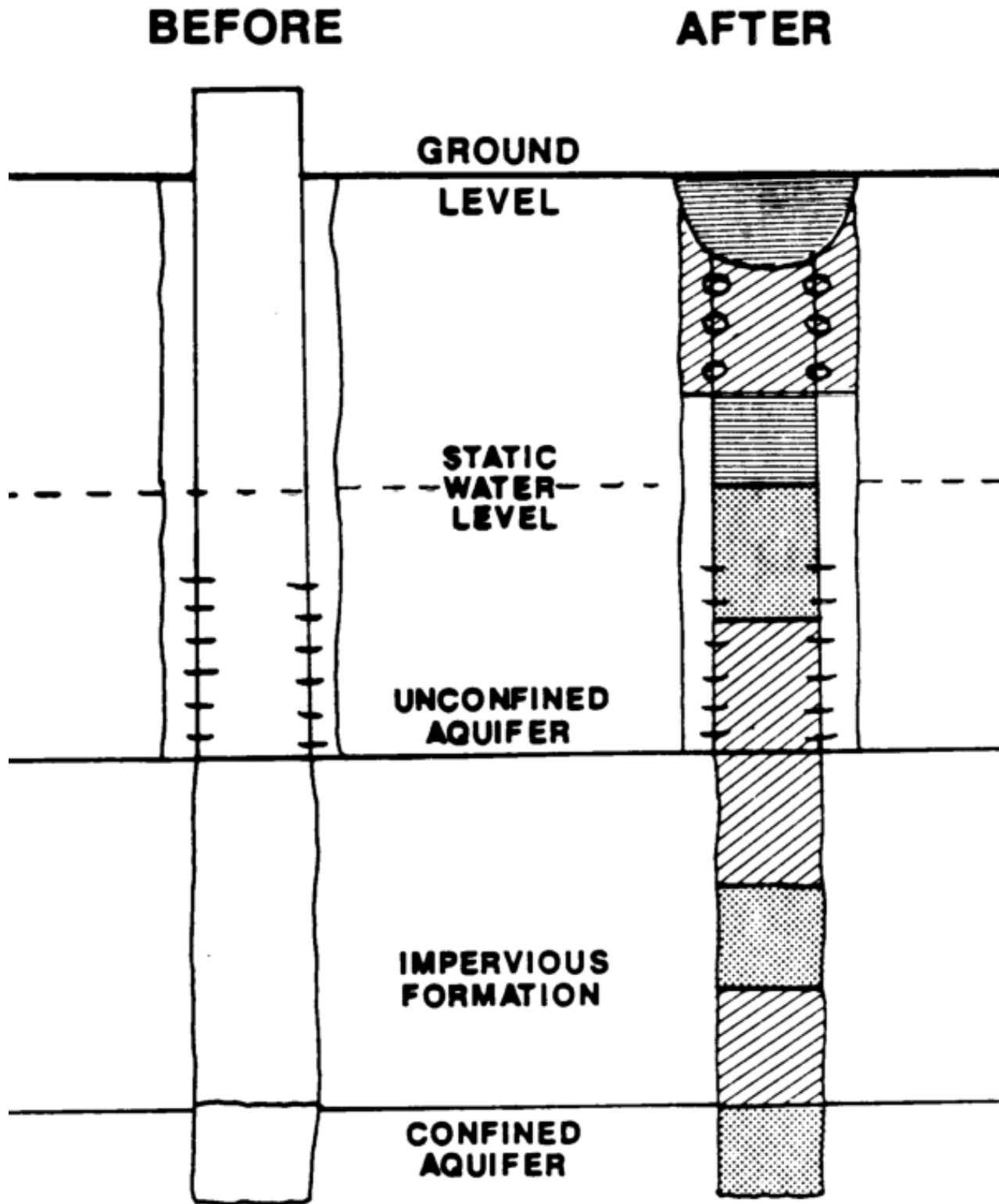
PLUGGING OF A CONFINED WELL (open hole, grouted)



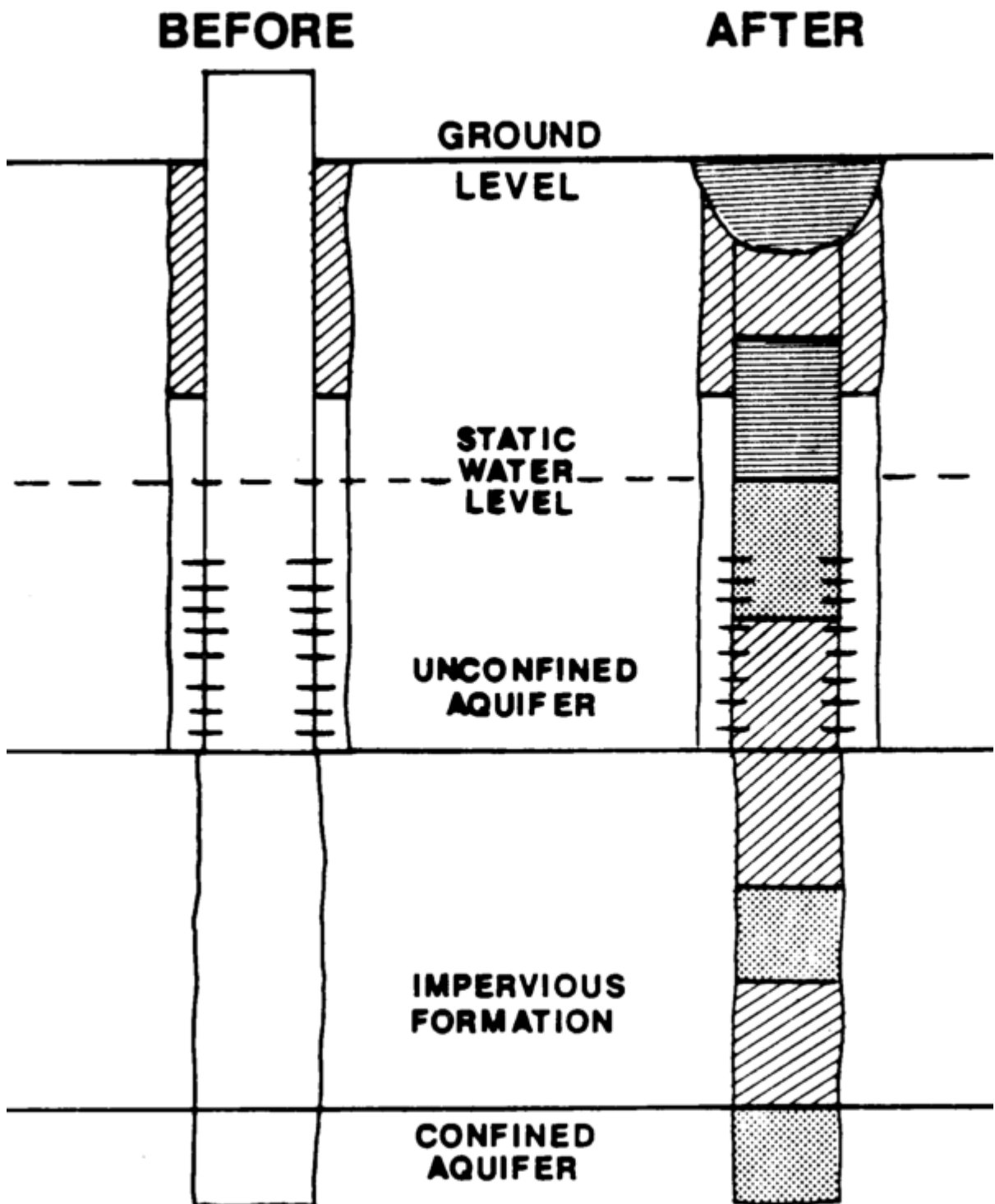
PLUGGING OF A CONFINED WELL (grouted)



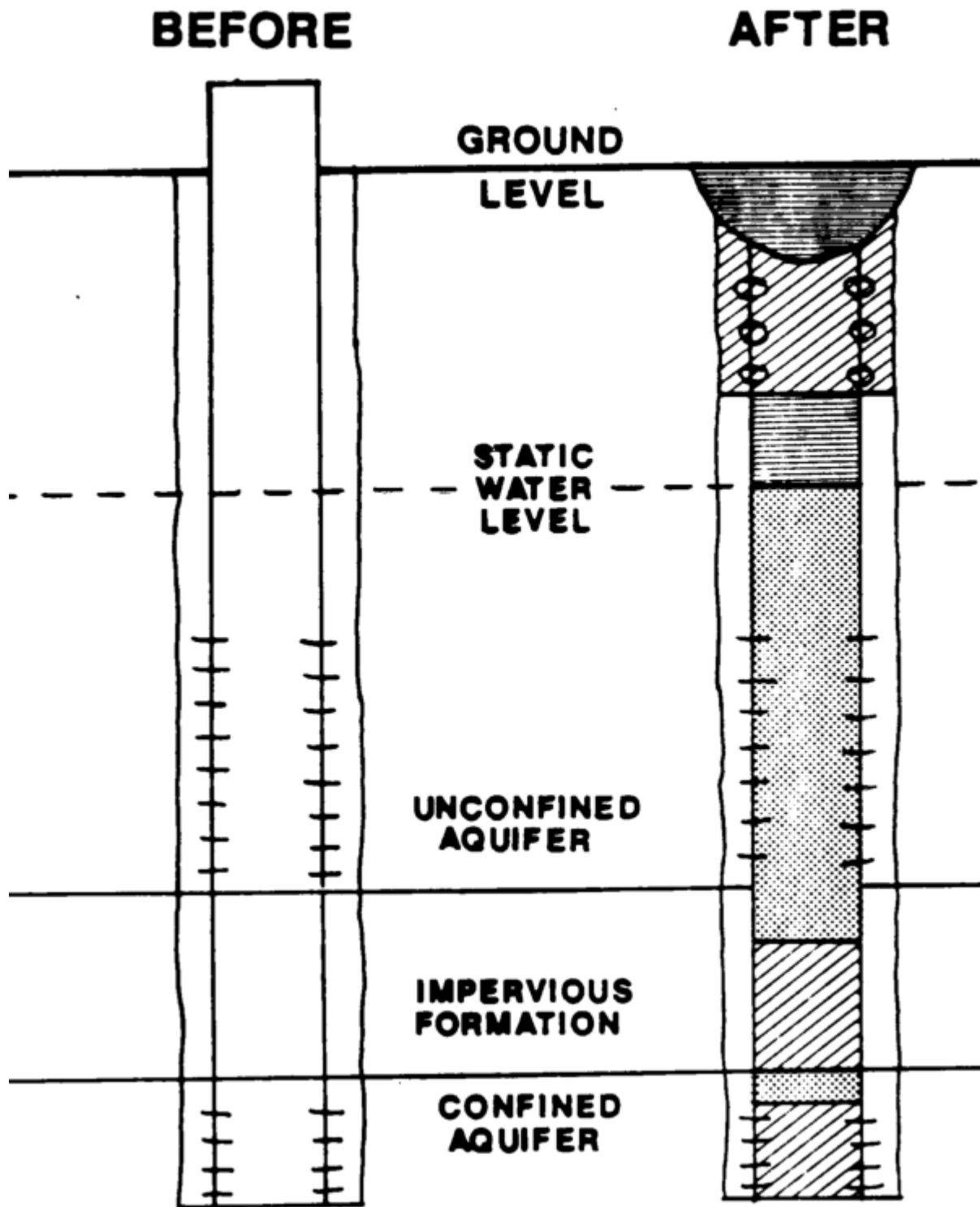
PLUGGING OF AN UNCONFINED, CONFINED WELL (open hole, ungrouted)



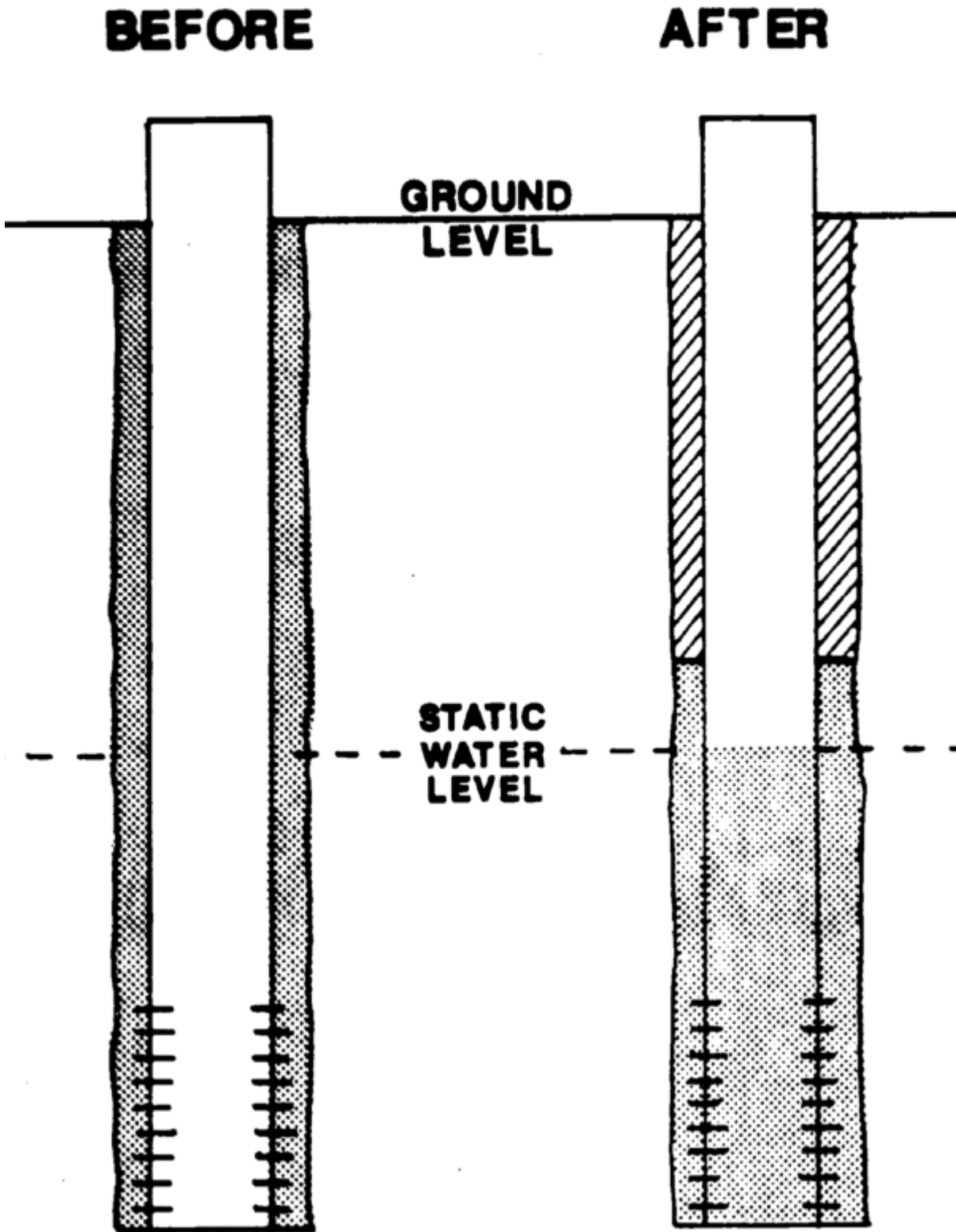
PLUGGING OF AN UNCONFINED, CONFINED WELL (open hole, grouted)



PLUGGING OF AN UNCONFINED, CONFINED WELL (not grouted)



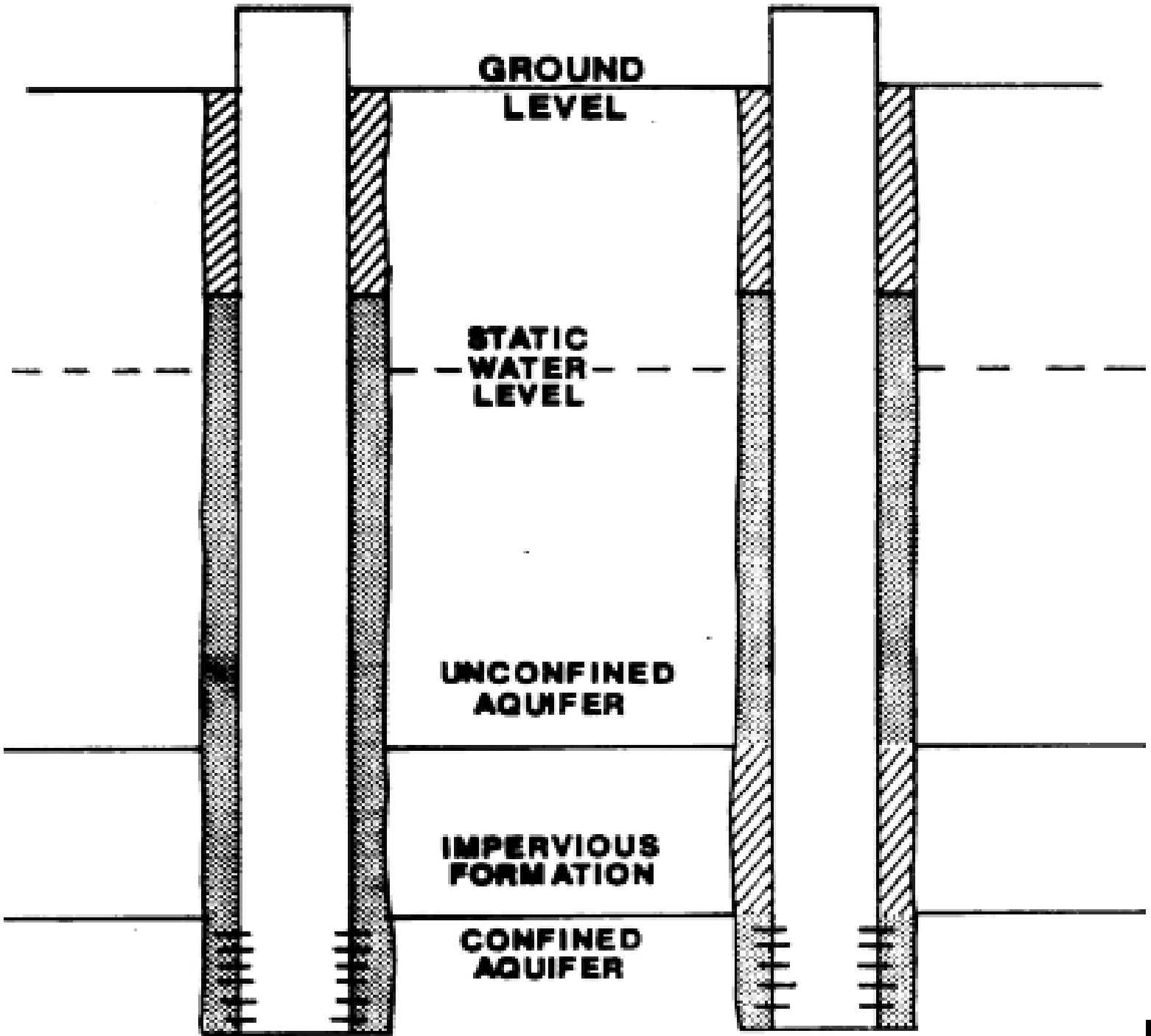
GROUTING AN UNCONFINED WELL



GROUTING A CONFINED WELL

BEFORE

AFTER



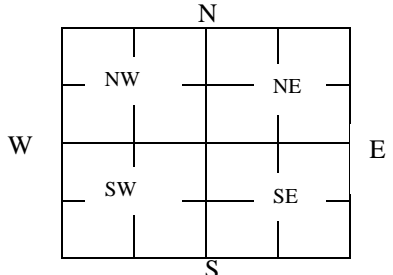
WATER WELL PLUGGING RECORD Form WWC-5P

KSA 82a-1212

ID NO.

1 LOCATION OF WATER WELL: County:	Fraction 1/4 1/4 1/4 1/4	Section Number	Township Number T S	Range Number E W <input type="checkbox"/> E <input type="checkbox"/>
---	--------------------------------------	----------------	-----------------------------------	--

Street/Rural Address of Well Location; if unknown, distance & direction from nearest town or intersection: If at owner's address, check here <input type="checkbox"/>	Global Positioning Systems (GPS) information: Latitude: _____ (in decimal degrees) Longitude: _____ (in decimal degrees) Elevation: _____ Datum: <input type="checkbox"/> WGS84, <input type="checkbox"/> NAD83, <input type="checkbox"/> NAD27 Collection Method: <input type="checkbox"/> GPS unit (Make/Model: _____) <input type="checkbox"/> Digital Map/Photo, <input type="checkbox"/> Topographic Map, <input type="checkbox"/> Land Survey Est. Accuracy: <input type="checkbox"/> < 3 m, <input type="checkbox"/> 3-5 m, <input type="checkbox"/> 5-15 m, <input type="checkbox"/> > 15 m
2 WATER WELL OWNER: RR#, St. Address, Box #: City, State ZIP Code:	

3 MARK WELL'S LOCATION WITH AN "X" IN SECTION BOX: 	4 DEPTH OF WELL _____ ft. WELL'S STATIC WATER LEVE _____ ft. WELL WAS USED AS: <table style="width: 100%;"> <tr> <td><input type="checkbox"/> Domestic</td> <td><input type="checkbox"/> Public Water Supply</td> <td><input type="checkbox"/> Dewatering</td> </tr> <tr> <td><input type="checkbox"/> Irrigation</td> <td><input type="checkbox"/> Oil Field Water Supply</td> <td><input type="checkbox"/> Monitoring</td> </tr> <tr> <td><input type="checkbox"/> Feedlot</td> <td><input type="checkbox"/> Domestic (Lawn & Garden)</td> <td><input type="checkbox"/> Injection Well</td> </tr> <tr> <td><input type="checkbox"/> Industrial</td> <td><input type="checkbox"/> Air Conditioning</td> <td><input type="checkbox"/> Other _____</td> </tr> </table> Was a chemical/bacteriological sample submitted to Department? Yes <input type="checkbox"/> No <input type="checkbox"/>	<input type="checkbox"/> Domestic	<input type="checkbox"/> Public Water Supply	<input type="checkbox"/> Dewatering	<input type="checkbox"/> Irrigation	<input type="checkbox"/> Oil Field Water Supply	<input type="checkbox"/> Monitoring	<input type="checkbox"/> Feedlot	<input type="checkbox"/> Domestic (Lawn & Garden)	<input type="checkbox"/> Injection Well	<input type="checkbox"/> Industrial	<input type="checkbox"/> Air Conditioning	<input type="checkbox"/> Other _____
<input type="checkbox"/> Domestic	<input type="checkbox"/> Public Water Supply	<input type="checkbox"/> Dewatering											
<input type="checkbox"/> Irrigation	<input type="checkbox"/> Oil Field Water Supply	<input type="checkbox"/> Monitoring											
<input type="checkbox"/> Feedlot	<input type="checkbox"/> Domestic (Lawn & Garden)	<input type="checkbox"/> Injection Well											
<input type="checkbox"/> Industrial	<input type="checkbox"/> Air Conditioning	<input type="checkbox"/> Other _____											

5 TYPE OF BLANK CASING USED:

Steel RMP (SR) Wrought Fiberglass Other (Specify below) _____
 PVC ABS Asbestos-Cement Concrete Tile

Blank casing diameter _____ in. Was casing pulled? Yes No If yes, how much _____

Casing height above or below land surface _____ in.

6 GROUT PLUG MATERIAL: Neat cement Cement grout Bentonite Other _____

Grout Plug Intervals: From _____ ft. to _____ ft., From _____ ft. to _____ ft., From _____ to _____ ft.

What is the nearest source of possible contamination:

<input type="checkbox"/> Septic tank	<input type="checkbox"/> Seepage pit	<input type="checkbox"/> Fuel Storage	<input type="checkbox"/> Other (specify below) _____
<input type="checkbox"/> Sewer lines	<input type="checkbox"/> Pit privy	<input type="checkbox"/> Fertilizer storage	
<input type="checkbox"/> Watertight sewer lines	<input type="checkbox"/> Sewage lagoon	<input type="checkbox"/> Insecticide storage	
<input type="checkbox"/> Lateral lines	<input type="checkbox"/> Feedyard	<input type="checkbox"/> Abandoned water well	Direction from well? _____
<input type="checkbox"/> Cess pool	<input type="checkbox"/> Livestock pens	<input type="checkbox"/> Oil well/Gas well	How many feet? _____

FROM	TO	PLUGGING MATERIALS	FROM	TO	PLUGGING MATERIALS

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was plugged under my jurisdiction and was completed on (mo/day/year) _____ and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. _____. This Water Well Record was completed on (mo/day/year) _____ under the business name of _____ by (signature) _____

INSTRUCTIONS: Use typewriter or ballpoint pen. Please press firmly and print clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Geology Section, 1000 SW Jackson St., Ste. 420, Topeka, Kansas 66612-1367. Telephone: 785/296-5524. Send one to Water Well Owner and retain one for your records. Visit us at <http://www.kdheks.gov/waterwell/index.html>.

SIGNIFICANCE OF WATER MINERALIZATION

(THESE ARE ONLY SUGGESTED FOR PRIVATE WELLS)

- **Total Dissolved Solids:** The total dissolved solids is a measure in weight (mg/l) of the mineral matter dissolved in the water. This figure multiplied by 8.34 gives pounds of mineral matter per million gallons of water. The U.S. Public Health Service Drinking Water Standards recommend less than 500 mg/l total solids for drinking or culinary uses. If such water is not available 1000 mg/l will be considered satisfactory. The specific conductance (micromhos per centimeter) is a measure of the water's ability to conduct an electric current and is therefore an indication of the ionic strength, or mineralization of the water.
- **Total Hardness:** The calcium ion and the magnesium ion cause the hardness of water and the sum of the two, both expressed as CaCO_3 , is termed the total hardness. Hardness is undesirable in water in that it produces an insoluble sticky curd with soap and produces scaling in teakettles and hot water tanks. A total hardness above 400 mg/l as CaCO_3 is considered excessive for public water supplies in Kansas. Hardness can be removed readily by the softening process.
- **Sodium:** Sodium is not particularly significant physiologically except to those persons having an abnormal sodium metabolism and who are thus on a restricted sodium diet. It is important in irrigation waters because a high sodium to calcium-magnesium ratio tends to decrease the permeability of the soil and thus will have a harmful effect on soil structure. The base exchange or zeolite process of softening increases the sodium content of the water being softened. Limit 100 mg/l.
- **Iron and Manganese:** Iron and manganese have little significance physiologically but they are undesirable in a public water supply because both will produce staining of laundered fabrics and porcelain plumbing fixtures and create consumer complaint. If present in an appreciable amount, iron gives the water a rusty turbid appearance and an unpleasant taste. Both substances create problems in the chlorination of water. The U.S.P.H.S. Drinking Water Standards recommend that iron be less than 0.3 mg/l and manganese less than 0.05 mg/l. Iron and manganese can be readily removed by treatment, particularly if lime-soda softening is also being practiced.
- **Sulfate:** Sulfate is one of the principal mineralizing substances present in water in Kansas and if present in large amounts it will impart a bitter taste to the water and it may act as a laxative to people who are not accustomed to drinking the water. The drinking water standards recommend that sulfate be less than 250 mg/l. Sulfate cannot be removed economically.
- **Chloride:** Chloride is one of the principal mineralizing substances present in water in Kansas. When present in sufficient amount, chloride imparts a salty taste to the water but otherwise has little or no physiological significance when present in concentrations not offensive to taste. The drinking water standards recommend that chloride be less than 250 mg/l. Chloride cannot be removed economically.
- **Nitrate:** Nitrate is important in drinking water because high concentrations may produce cyanosis or methemoglobinemia in infants. The recommended limit for public water supplies in Kansas is 10 mg/l nitrate (as N) when used for infants under one year of age. Older children and adults are not affected. Nitrate is also important in water to be used for livestock watering because excessive amounts may be harmful, particularly to young animals. Nitrate cannot be removed economically.

- **Fluoride:** Fluoride is important in drinking water because in high concentration it may produce a mottling or discoloration of the tooth enamel of children and in low concentration it does not afford sufficient protection for the prevention of dental decay in children. A concentration of 10 mg/l fluoride is considered optimum for public water supplies in Kansas and a concentration of 1.5 mg/l fluoride is the recommended limit. It is recommended that fluoride be added to public water supplies when the concentration is substantially less than the optimum.
- **Phosphate:** Total phosphate represents all forms of phosphate in water including polyphosphates used in the treatment of water. Phosphate in water has little physiological significance but it does stimulate the growth of algae and thus may cause water treatment problems. If a poly-phosphate is being fed to stabilize iron, it is recommended that the feed rate be limited to 3 mg/l phosphate per 1 mg/l iron.

- * mg/l = milligrams per liter
- * One gallon weighs 8.34 pounds
- * 1 mg/l = 8.34 lbs. per million gallons
- * 17.1 mg/l = 1 grain per gallon
- * To obtain results in grains per gallon, divide results in milligrams per liter by 17.1
- * Reacting values are in terms of milligram equivalents per liter