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October 30, 1950

Manager, United States Atomic Energy Commission
Santa Fe Operations Office
Los Alamos, New Mexico

Subject: Ground Water Observation Wells
Authorization No. 49-119-18

Attention: Mr. R. E. Cole, Director
Office of Engineering and Construction

Dear Sir:

Transmitted herewith is our report covering the construction and completion of six test wells in Pueblo Canyon and Los Alamos Canyon. These wells were drilled during 1949 and the early part of 1950 for the purpose of facilitating a study of the progress of contamination in the ground water zones underlying these two canyons.

On May 11, 1949, Contract No. AT(29-1)-708 was executed with Layne-Western Company, of Kansas City, Missouri, for constructing and equipping four test wells, and two or more sampling wells offsetting each of the test wells. Under this contract, the contractor was required to furnish drilling rigs, tools and crews, well screen, packers, drive shoes and drilling mud required to construct the wells at the locations and to the depths as directed by the Government for all of which payment was to be made to the contractor on the basis of unit prices set out in the Contract. The Government furnished all steel pipe required for casing these wells, and that included in the pump installations. Work under this contract began on June 1, 1949, and was completed on June 12, 1950. The total contract cost of the work was \$87,843.49 and the total cost of Government furnished materials used in the work was \$29,326.64. The total Project cost was \$117,170.13.

Electric motor driven deep well pumps were installed in the six completed wells. These pumps were given an operational test when they were installed, current for operating the motors having been supplied by a portable gasoline-engine-driven generator. At none of the well sites has a permanent power line been installed. These pumps have not been used since they were installed and tested. It is contemplated that water samples for laboratory analysis will be taken from each well on a routine basis at intervals perhaps of one week.

Very truly yours,

Black & Veatch

By *J. F. Brown*
A. E. Brown

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G/M/TR/SO



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REPORT ON GROUND WATER OBSERVATION WELLS

DESCRIPTION OF PROJECT. Surface drainage from the entire area occupied by the Los Alamos Community is discharged into Pueblo and Los Alamos Canyons, both of which head in the Jemez Mountain Range west of the Project, extend in an easterly direction through the Project to a confluence approximately two miles east of the easterly reservation boundary, below which junction Los Alamos Canyon continues eastwardly to the Rio Grande River, a distance of approximately five miles. The effluent from the existing sewage treatment plant serving the community and the TA-1 area, is now discharged into Pueblo Canyon. Effluent from the new sewage treatment plant now under construction to serve the Community and the new waste treatment plant which will receive the plant waste liquids from the TA-1 area, will be discharged into Pueblo Canyon. Sanitary sewage and plant waste liquids from the TA-21 area are discharged into Los Alamos Canyon above its junction with Pueblo Canyon. The effluent from the new sewage treatment plant serving the TA-3 area will be discharged into Sandia Canyon which discharges directly into the RIO GRANDE RIVER. The principal source of water supply for the Project is the group of six wells located in Los Alamos Canyon below the Pueblo Canyon confluence.

To facilitate a long-term study of the movement of contaminated waste liquids from the Project activities into and through the various aquifers underlying the project Site and possibly discharging into the main body of ground water from which the Los Alamos water supply is

taken, a construction project was set up providing for the construction of four groups of test wells, three of which would be located in Pueblo Canyon and one in Los Alamos Canyon. In selecting the general locations for these groups the governing consideration was that one group should be located as near as practicable to the confluence of Pueblo and Los Alamos Canyons; a second group should be located in Pueblo Canyon just below the point of discharge of the effluent from the existing sewage treatment plant; a third group in Los Alamos Canyon just below the TA-21 area, and a fourth group in Pueblo Canyon as near as practicable to the point of discharge of the effluent from the TA-1 acid waste sewer. In the case of the fourth group, difficulty of access to the Canyon floor for moving in the drilling equipment, as well as the presence at the selected site of a lava flow, prompted a decision to locate this group at a point on the south rim of the canyon and on the east rim of the smaller tributary canyon from the south which carries the discharge from the acid waste sewer. Each of the other groups were located on the canyon floor.

Each group of test wells was planned to include a main test hole, drilled with a cable-tool rig, of the depth required to penetrate the main ground water body, and one or more offset sampling holes, each drilled into an aquifer lying above the main ground water body if such an aquifer were **found** in the drilling of the main test hole. Thus if only one aquifer were found above the main ground water

body in the drilling of a main test hole, only one sampling well offsetting the main hole would be required in that group.

During the drilling of the main test hole in each group samples of the drill cuttings were taken by a representative of the U. S. Geological Survey at 5-foot depth intervals, and the location of each aquifer was determined. The samples of drill cuttings were classified and the results recorded in the form of geologists logs, copies of which are attached to this report.

Under Contract No. AT(29-1)-708, the Layne-Western Company, well construction contractor of Kansas City, Missouri, began the work of constructing and equipping the test wells and sampling wells on June 1, 1949, and the entire work, including the installation of the pumping equipment, was completed on June 12, 1950. The Contractor, or his sub-contractor, furnished all drilling equipment, tools, drilling crews, well screens, casing packers, fuel, lubricants and drilling mud, as well as the pumps and motors installed in the completed wells. The Government furnished all steel pipe required for casing the wells and for installation of the pumping equipment. Upon completion of the drilling, each test well and each sampling well was cased throughout its length to prevent caving and to seal off the flow from any aquifers located above that which the well was designed to tap. A 10-foot length of bronze wire-wrapped well screen was installed at the bottom of the casing string in each well. A sketch showing the physical dimensions, details of the casing and screen installation, and the classifications of the principal formations penetrated, for each well, is attached hereto.

DETAILS OF WELL CONSTRUCTION. Test Well No. 1 and sampling

Well No. O.S. 1-A are located on the floor of Pueblo Canyon at a site approximately 100 feet north of the Bayo Canyon Road, and 2500 feet northwest of the junction of State Route No. 4 and the Los Alamos main access road. At this site, the Layno-Western No. 24-L drilling rig was moved onto location designated as TA No. 1-A on June 1, 1949, and drilling began on June 8. On July 14 the hole was abandoned at a depth of 108 feet, since the lower 32 feet was crooked and could not be straightened with the available tools. The drilling rig was then shifted to a new location six feet west of the abandoned hole, the new location being designated as TH No. 1-B, where drilling began on July 19. On August 23, the drilling of this hole was stopped at a depth of 140 feet, since repeated attempts, including the firing of three dynamite charges, had failed to straighten it.

On November 27 the Jenkins Drilling Company No. 36-L drilling rig was moved onto a location, designated as TH No. 1-C, approximately 20 feet south of TH No. 1-B, where drilling began on November 29. A flow of water was encountered at depth 210 feet, estimated at 18 gallons per minute, which rose in the hole to depth 188 feet. Drilling continued in open hole to depth 350 feet, and 12-inch casing was set to that depth in an unsuccessful attempt to seal off the water produced from the formation at 210-240 feet. The casing was then pulled back to depth 241 feet, and the hole below that depth was filled with sand, preparatory to cementing the casing. The cementing operation was performed by the Halliburton Oil Well

Cementing Company, on December 17, and was successful in scaling off the flow of water into the well. One hundred bags of portland cement were used in this operation. Drilling then continued through the 12 inch casing to depth 642 feet. A flow of water was encountered at depth 623 feet, the water rising in the hole to depth 584.9 feet. On January 3, 1950, this test well was completed, with 627 feet of 8-inch casing, 10 feet of 6-inch casing and 10 feet of 6-inch well screen, bottomed at 642 feet, in the hole. The lead packer between the 6-inch and 8-inch casing is at depth 622 feet. The geologist's log headed "Test Well No. 1" and the sketch titled "Log-Well No. 1", Figure 2, both attached to this report, pertain to this location TH No. 1-C.

The sampling well, offsetting Test Well No. 1, is on the location referred to above as TH No. 1-B. On January 4, 1950, the Jenkins No. 36-L drilling rig was set up over the TH No. 1-B hole, which had previously been drilled to depth 140 feet. Drilling began on January 5, and continued to depth 225 feet. A flow of water was encountered at depth 212 feet, the water rising in the hole to depth 188 feet. Apparently this is the same water bearing formation as that encountered in TH No. 1 at depth 210 feet. On January 10 and 11, 214 feet of 6-inch casing, with a 10 feet length of 6-inch well screen coupled to its lower end was set in this well and bottomed at depth 225 feet. This sampling well is designated on the sketch (Figure 3) attached hereto as Well No. O.S. 1-A.

Test Well No. 2 is located on the floor of Pueblo Canyon approximately three miles upstream from Test Well No. 1, one mile upstream from the easterly Project boundary, and one mile downstream from the point at which the effluent from the Community sewage treatment plant is discharged into this canyon. On August 25, 1949, the Layno-Western No. 24L drilling rig was set up on this location. Drilling began on August 29 and continued to a depth of 789 feet which was reached on November 3. A small flow of water, estimated at four gallons per minute, was encountered at depth 115 feet, the water rising in the hole to depth 93 feet. The geologists log for this well indicates that a second water zone was encountered at depth 165-170 feet, from which water rose in the hole to depth 108 feet. No mention of a water zone at this depth is made in the driller's log. Two holes subsequently drilled as offsets to TH No.2 encountered no water bearing zone at or near the 165-170 foot depth. The main ground water zone was encountered at depth 767 feet, the water rising in the hole to depth 758.9 feet. The main casing string in this test well consists of 778 feet of 8-inch steel pipe, with approximately five feet of 6-inch steel pipe and a 10-foot length of 6-inch well screen at its lower end. The well screen is bottomed at depth 789 feet, and the lead packer between the 6-inch and 8-inch casing is at depth 774.5 feet. (Figure 4)

Sampling Well A, offsetting Test Well No. 2, and designated on the attached sketch (Figure 5) as Well O.S. 2-A, is located 50 feet west of Test Well No. 2. The purpose of this well was to

penetrate the water bearing zone encountered at depth 165 feet in Test Well No. 2. On January 30, 1950, Jenkins No. 36-L drilling rig was moved onto the location. Drilling began on February 2, and continued until February 5, when a depth of 155 feet was reached. The upper water bearing zone was encountered at depth 112 feet, and a string of 8-inch casing was set to a depth of 152 feet in an unsuccessful attempt to seal off the flow of water. It was then decided to complete the well in the upper water bearing zone. The casing string was lifted to depth 118 feet, the hole filled to depth 133 feet, and a 10-foot length of 6-inch well screen made on a 10-foot length of 6-inch steel pipe was set through the 8-inch casing, with the screen bottomed at depth 132.75 feet. The lead packer between the 6-inch and 8-inch casing is at depth 113 feet. This well was completed on February 7.

In a second attempt to complete a sampling well penetrating the water bearing zone encountered at depth 165 feet in Test Well No. 2, the Jenkins drilling rig was moved onto a location 50 feet southeast of Test Well No. 2. Drilling began at this location on February 9 and continued until February 14 when a depth of 225 feet was reached. The upper water bearing zone was encountered at depth 104 feet. A string of 8-inch casing was set to depth 123.5 feet, which shut off the flow from the upper zone. The drilling continued through the 8-inch casing to depth 225 feet, but no water was found below the upper zone. The hole was ordered abandoned, the casing was pulled out and the hole filled with sand.

In the third attempt to complete a sampling well penetrating the water bearing zone encountered at depth 165 feet in Test Well No. 2, the Jenkins drilling rig was moved to a location 36 feet northwest of Test Well No. 2. Drilling began at this location on February 17, and continued until February 23, when a depth of 225 feet was reached. The upper water bearing zone was encountered at depth 103 feet, and 126.5 feet of 8-inch casing was set in the hole which shut off the flow from this zone. Drilling continued through the 8-inch casing string to depth 225 feet, but, again, no water was found below the upper zone. The hole was ordered abandoned. An attempt was made to pull and salvage the 8-inch casing, without success. The casing was capped one foot above ground line, and left in the hole.

Test Well No. 3 is located on the floor of Los Alamos Canyon approximately, 3000 feet west (upstream) from the easterly Project boundary. On October 6, 1949, the Jenkins No. 36-L drilling rig was moved onto this location where drilling began on October 7. On October 23, at depth 362 feet the drill stem broke in the wrench square. Fishing for the tools in the hole began at 12 30 on that date and continued without success until 2400 on October 30, at which time it was decided to abandon the hole. The drilling rig was shifted to a new location 8 feet west of the abandoned hole, where drilling began on November 1, and continued until November 20, when a depth of 815 feet had been reached. No water was encountered above depth 790, where the main ground water

zone was reached; the water rising in the hole to depth 743.3. The main casing string in this well is of 10-inch steel pipe extending to depth 811 feet. A 10-foot length of well screen with a 10-foot length of 6-inch steel pipe made on its upper end was set at depth 815 feet with the lead seal between the 6-inch pipe and the 10-inch casing at depth 795 feet. No sampling well was drilled offsetting this Test Well, since no water bearing zone above the main ground water body was penetrated in the drilling of Test Well No. 3. (See Figure 6)

Test Well No. 4 is located in Los Alamos at a point 221 feet north of Canyon Road and 293 feet northeast of the sewage lift station at 2610 Canyon Road. This site is on the easterly rim of the branch canyon into which the effluent from the new waste treatment plant is discharged, and approximately 1100 feet south of the southerly rim of Pueblo Canyon. On November 5, 1949, the Layne-Western No. 24L drilling rig was moved onto this location. Drilling began on November 10, and continued until March 8, 1950, when a depth of 1205 feet was reached. Water was encountered in the hole at depth 1184 feet, the water rising to depth 1170.8 feet. The main casing string is 6-inch steel pipe, which was set at depth 1195 feet. A 10-foot length of 4-inch well screen, with an 11-foot length of 4-inch steel pipe made on its upper end, was set with its lower end at depth 1205 feet. The lead seal between the 4-inch pipe and the 6-inch casing is at depth 1183 feet. Since no water bearing zone was penetrated above the 1184 foot depth, no sampling well offsetting the main hole was drilled. (See Figure 7)

PUMPING EQUIPMENT. The four Test Wells and the two sampling wells constructed under this project were equipped with electric motor driven Roca submergible deep well type centrifugal pumps. These pumps and motors were manufactured by the Roca Pump Company of Bartlesville, Oklahoma. In this type of pumping unit the motor and pump, bolted together to form a single unit, are lowered into the cased well to the desired depth on the end of a 1-1/2 inch steel pipe column, which after the installation serves as the pump discharge column. The power cable, entering the motor through a water-tight sealed gland, extends to the motor control box at the well head, and is anchored to the discharge column by means of stainless steel bands spaced at 5-foot intervals. The motor is completely enclosed in a water tight steel housing; is of the capacitor type, 220-volt, single phase, 2-pole, 3450 RPM at full load. The motor is of squirrel cage construction. The starter is mechanically bonded to the housing. The motor operating switch is a centrifugal switch located at the bottom of the motor shaft, which disconnects the starting winding when the motor reaches operating speed. The motor is filled with transformer oil at the factory, and needs no further addition of oil. A conical check valve in the head of the pump closes when the pump stops and prevents draining of the pump discharge column. In each installation, a small snifter hole was drilled in the discharge column five feet below the ground line to permit the column above this point to drain to prevent freezing. The arrangement of discharge column at the well head is indicated on the attached sketch, (Fig. 8).

The following tabulation indicates, as to each well, the pump model number, size of motor, depth of setting from ground level to center of water inlet, the pump and motor serial numbers and the approximate pumping rate for the pumping equipment installed therein:

Well No.	Pump Mod.No.	Motor H.P.	Depth of Setting	Pump Serial No.	Motor Serial No.	Discharge Rate GPM
1	60A-11	3	637	6528	5-1050	8
O.S.-1A	19A-5	5/8	218	4504715	4506244	4
2	90A-5	3	784	6526	5-1047	8
O.S.-2A	19A-5	5/8	128	4506282	4504634	9
3	90A-5	3	810	6524	5-1048	8
4	90A-5	3	1179	6525	5-1049	3

Upon completion of installation each pump was operated for a sufficient length of time to ascertain that it had been properly installed and connected, both electrically and mechanically, and that it would deliver water at the well head.