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INVESTIGATORY APPROACH FOR CHARACTERIZATION OF THE HORIZONTAL AND VERTICAL EXTENT OF THE DEEP PLUME AT PNM PERSON GENERATING STATION NMT360010342

PREPARED FOR
PUBLIC SERVICE COMPANY OF NEW MEXICO
ALBUQUERQUE, NEW MEXICO

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INTRODUCTION

During characterization of a shallow groundwater contamination plume at Person Station, it became apparent that two or three deep production wells (PSPW-3,4 and 6 shown on FIGURE 1) at the site are located within the limits of the shallow plume. Since vertical downward gradients had been observed in the Rio Grande aquifer near the site, the decision was made to purge and sample the production wells for volatile organic contaminants present in the shallow plume. EPA Method 601, with a 0.2 ppb detection limit, was used for analysis of samples. The sampling, which was conducted during October 1992, showed elevated levels of volatile organics in PSPW-3 and PSPW-6, as shown in TABLE 1. A trace of volatile organics was found in PSPW-4. PSPW-1, 2 and 5 were all below method detection limits.

During January 1993, extensive geophysical and television logging was performed on production wells PSPW-3, 4 and 6 in an attempt to predict which zones within the aquifer might be receiving volatile organic contaminants from the shallow plume via the production well bores. Analysis of the geophysical and television logs suggested that shallow groundwater is exiting PSPW-6 in the zone from 750 to 805 feet, and shallow groundwater is exiting PSPW-3 in the zone from 480 to 920 feet.

As a result of analysis of the geophysical and television logs, two (2) deep monitoring wells were drilled during February and March of 1993. Deep monitoring well PSMW-22-800 was drilled adjacent to production well PSPW-6, and deep monitoring well PSMW-19-800 was drilled adjacent to production well PSPW-3. The two (2) deep

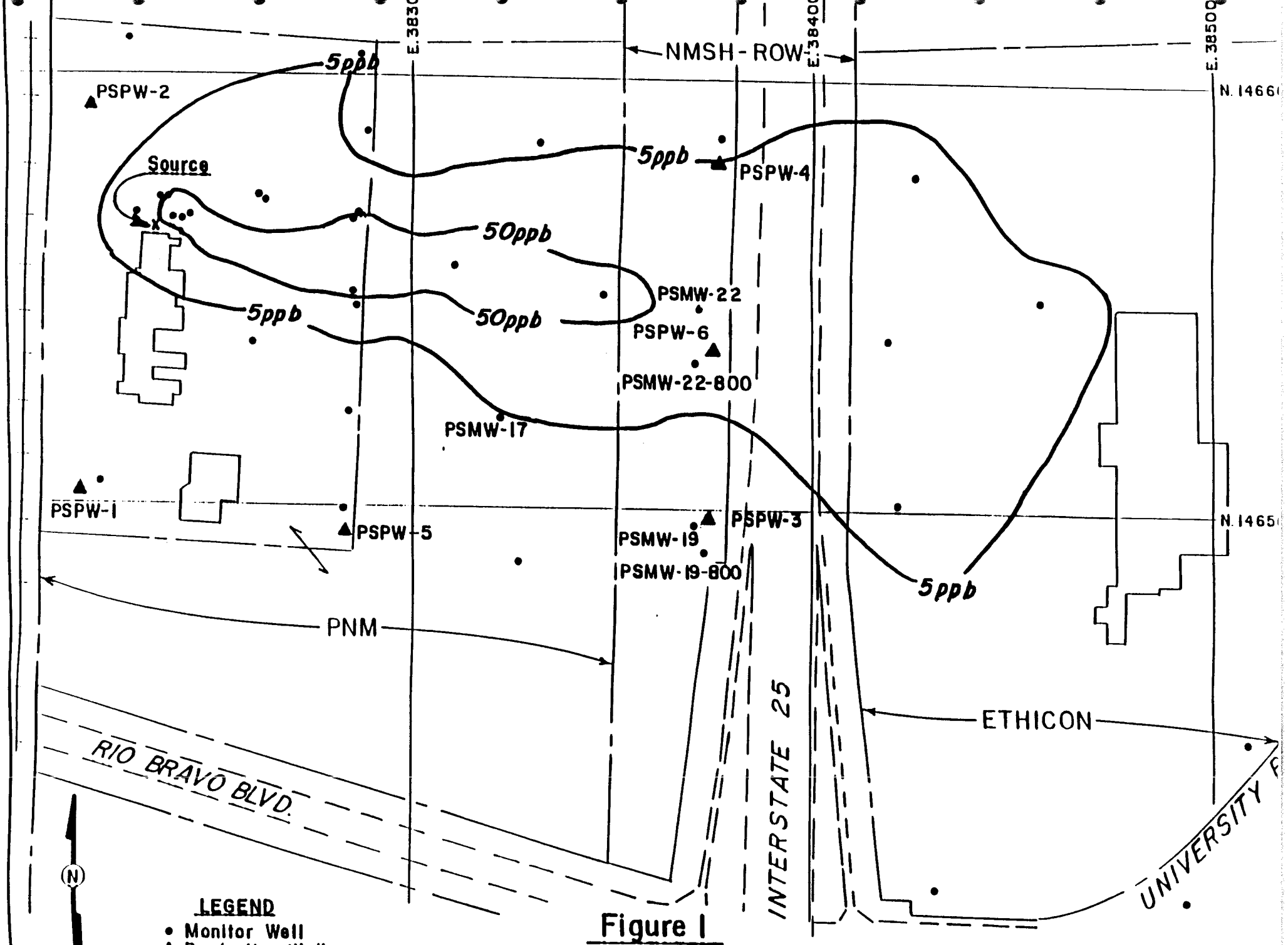


Figure 1

PERSON STATION

PCE CONCENTRATION CONTOUR MAP

TABLE 1

WATER QUALITY SAMPLE RESULTS

WELL	SCREEN INTERVAL (ft-MSL)	WATER LEVEL (ft-MSL)	PCE (ppb)	1,1-DCE (ppb)	1,1,1-TCA (ppb)
PSMW-19	4883-4903	4898.37	0.5	0.5	<0.2
PSMW-19-800	4324-4334	4886.18	2.1	3.7	<0.2
PSPW-3	4186-4801	-	11.0	15.0	0.9
PSMW-22	4884-4904	4899.06	31	28	3.0
PSPW-22-800	4314-4324	4885.22	1.0	1.6	<0.2
PSPW-6	4295-4595	-	0.6	0.8	<0.2
PSPW-4	4300-4760	_	<0.2	<0.2	0.7

monitoring wells are screened from 785 to 795 feet below ground level. The screen intervals of the production wells and the upper flow zone monitoring wells, PSMW-19 and 22, are listed in TABLE 1.

The currently available information, which has been described above, indicates that a deep groundwater contaminant plume exists at the Person Station site, and the source of the plume is vertical downward flow through the well bores of production wells PSPW-3 and 6 from the shallow volatile organic plume (see FIGURE 1).

INVESTIGATORY APPROACH

The objective of this groundwater assessment is to delineate the horizontal and vertical extent of the deep contaminant plume. The investigation will progress through three (3) sequential steps.

The first step will be to determine the groundwater flow direction in the 800 feet deep zone in which monitoring wells PSMW-19-800 and PSMW-22-800 are completed. This will be accomplished by drilling a single deep monitoring well at the PSMW-17 location (see FIGURE 1). The resulting three (3) deep wells will form a triangle with which the groundwater flow direction and gradient can be determined in the deep zone.

The second step will be to determine the vertical extent of the deep plume in the source area, i.e., at the PSPW-3 and PSPW-6 locations. This will be accomplished by installing multiple completion wells at these two locations. Since two (2) monitoring wells already exist at these locations (one screened at the water table, approximately 200 feet, and one screened at approximately 800 feet), the proposed multiple completion wells will be screened at approximately 300', 400', 500', 600', 700', and 900'. The 900 feet level is near the maximum depth of the production wells.

The third step of the investigation will be an iterative process of alternatively evaluating the progress of the investigation and installing additional single or multiple completion wells, while moving out from the source, until the extent of the plume is determined.

1. Investigatory Methods

Four (4) different well completion methods have been considered for this investigation. These methods include:

- Single Completion Wells
- Westbay Wells
- Barcad Wells
- Cluster Wells

Construction diagrams for each of the methods are shown in FIGURES 2, 3, 4 and 5. The completion methods were compared in eight different categories concerning their applicability to this assessment as shown in EXHIBIT 1.

The single completion method provides a proven technique for preventing cross contamination by the drilling mud, because a cemented surface casing can be installed down to the top of the screened interval. Following installation of the surface casing, the drilling mud can be changed, and fresh mud can be used to drill the screened interval. The other methods only allow the use of a surface casing above the upper screened interval. Our recent experience of testing the mud during installation of PSMW-22-800 indicates that cross contamination by the drilling mud is probably not a major concern for the other methods.

Single Completion Wells and Westbay Wells are the most easily developed of the four methods. They have four inch (4")

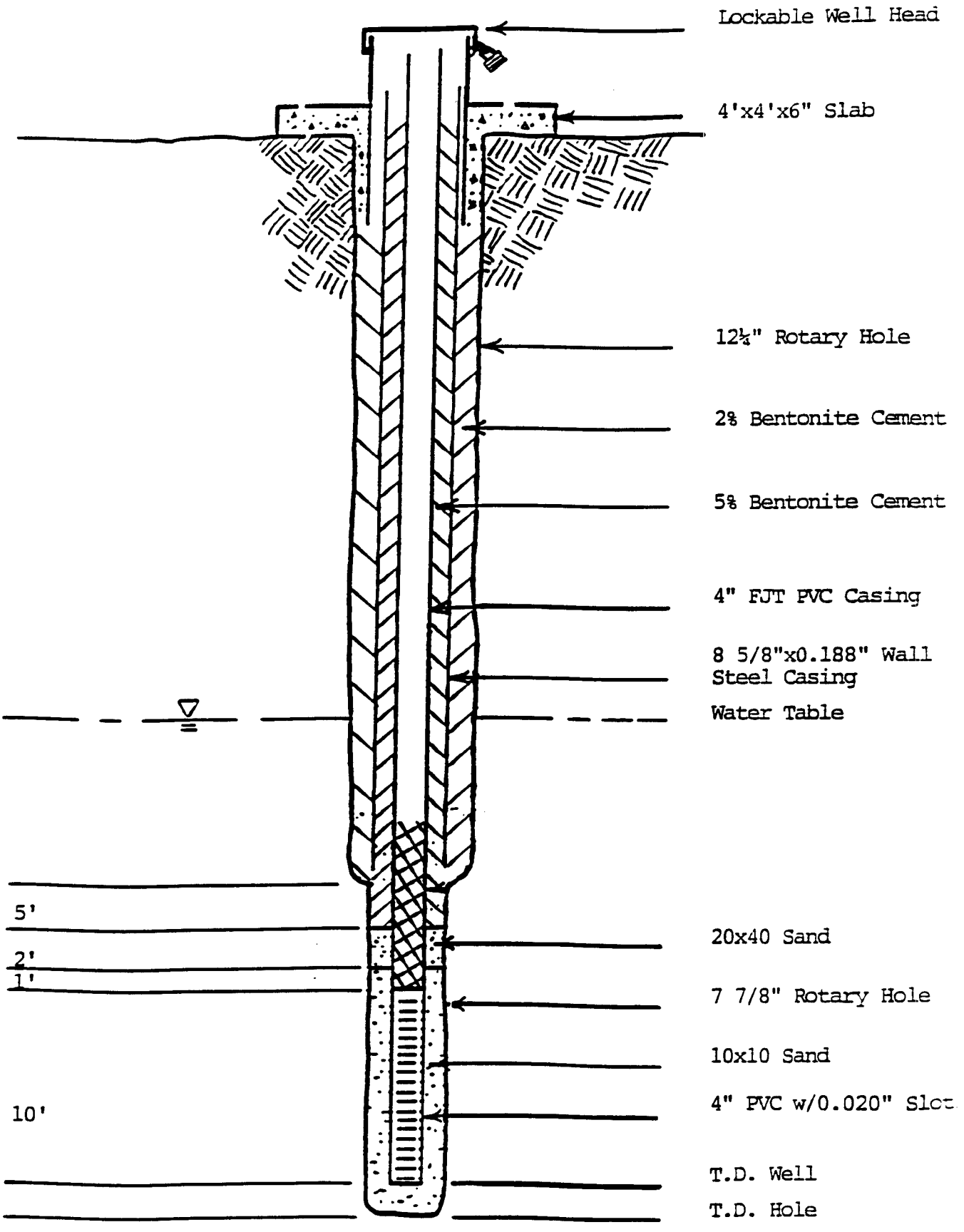


FIGURE 2

SINGLE COMPLETION

WELL CONSTRUCTION

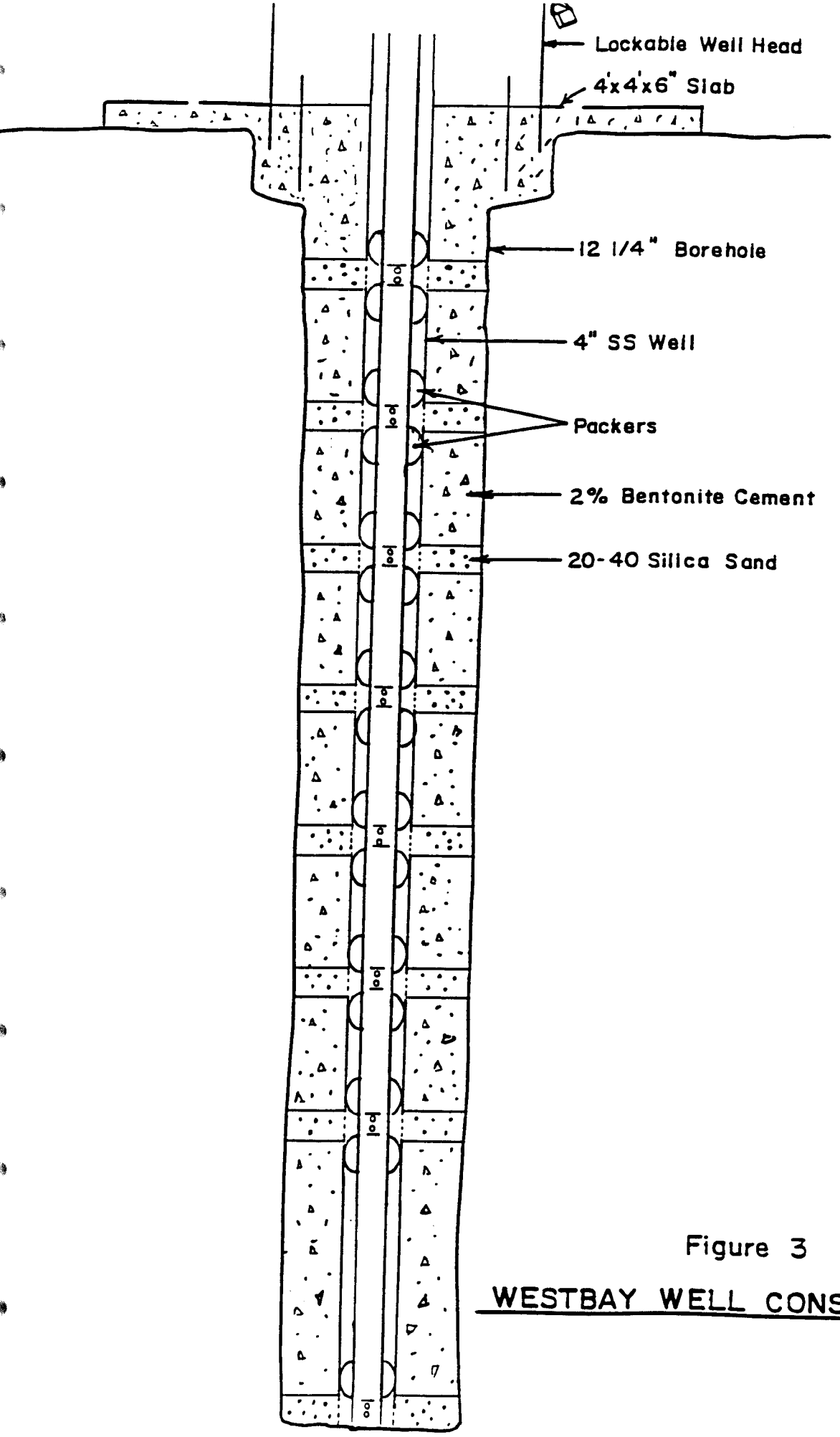


Figure 3

WESTBAY WELL CONSTUCTION

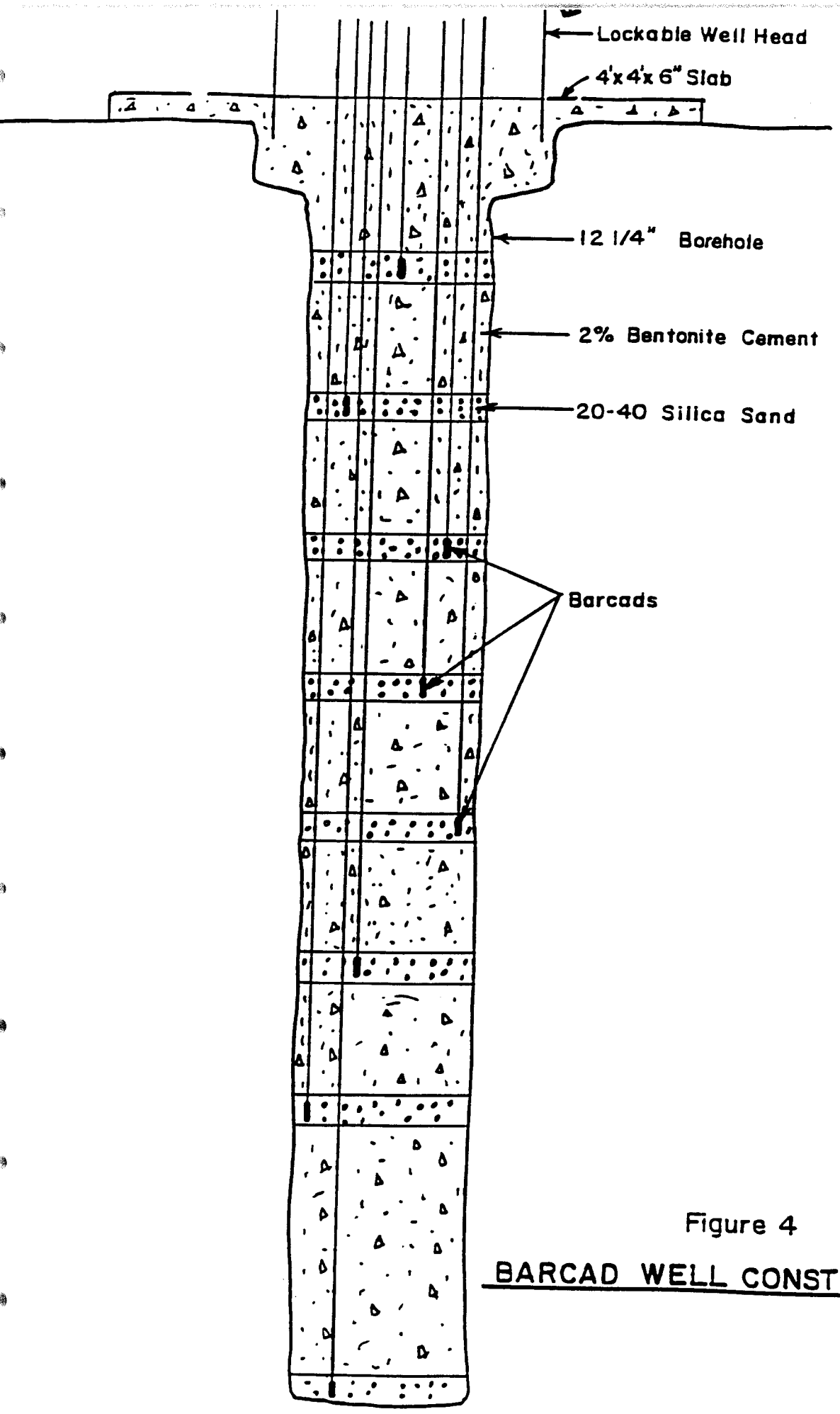


Figure 4

BARCAD WELL CONSTRUCTION

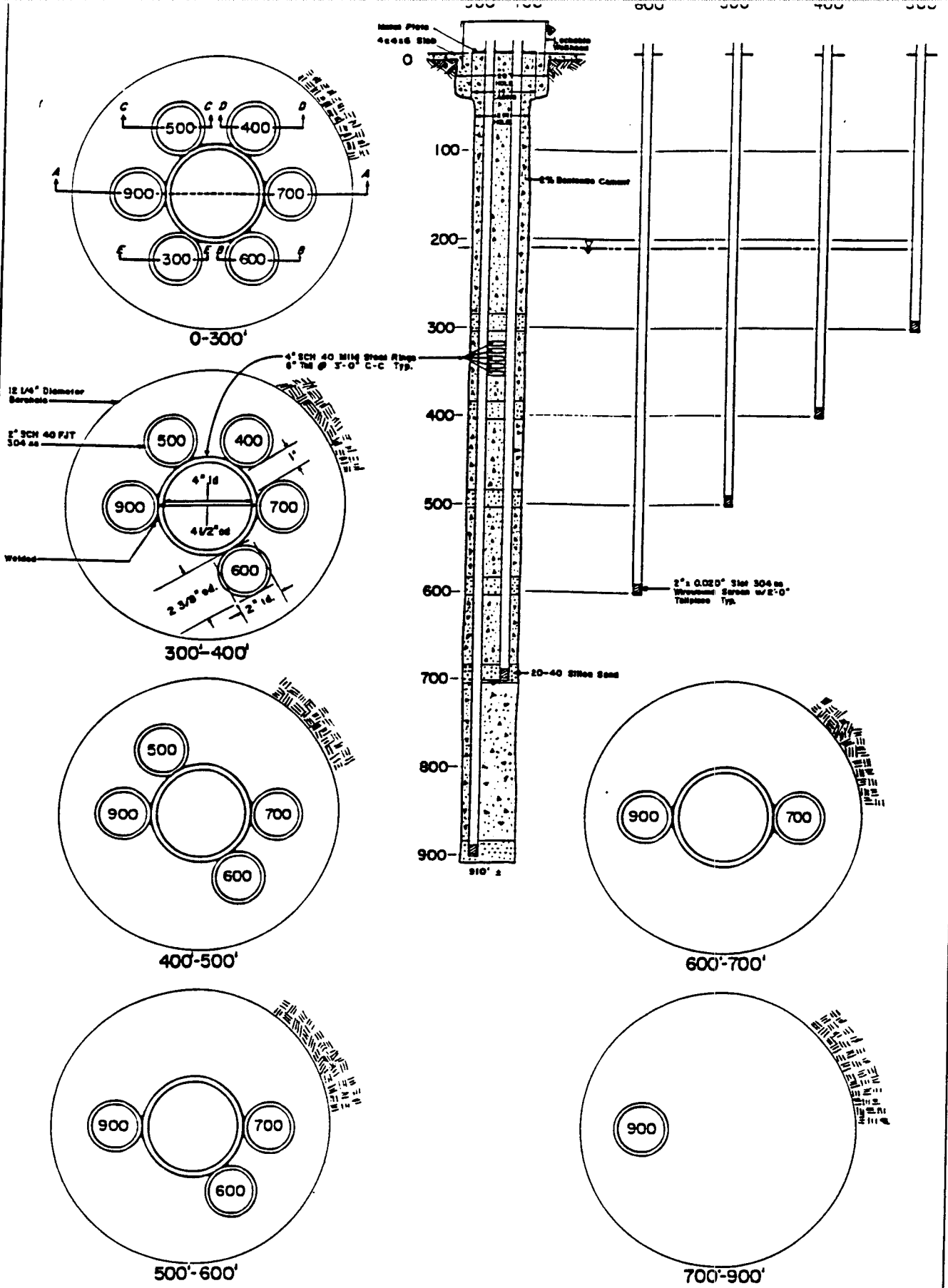


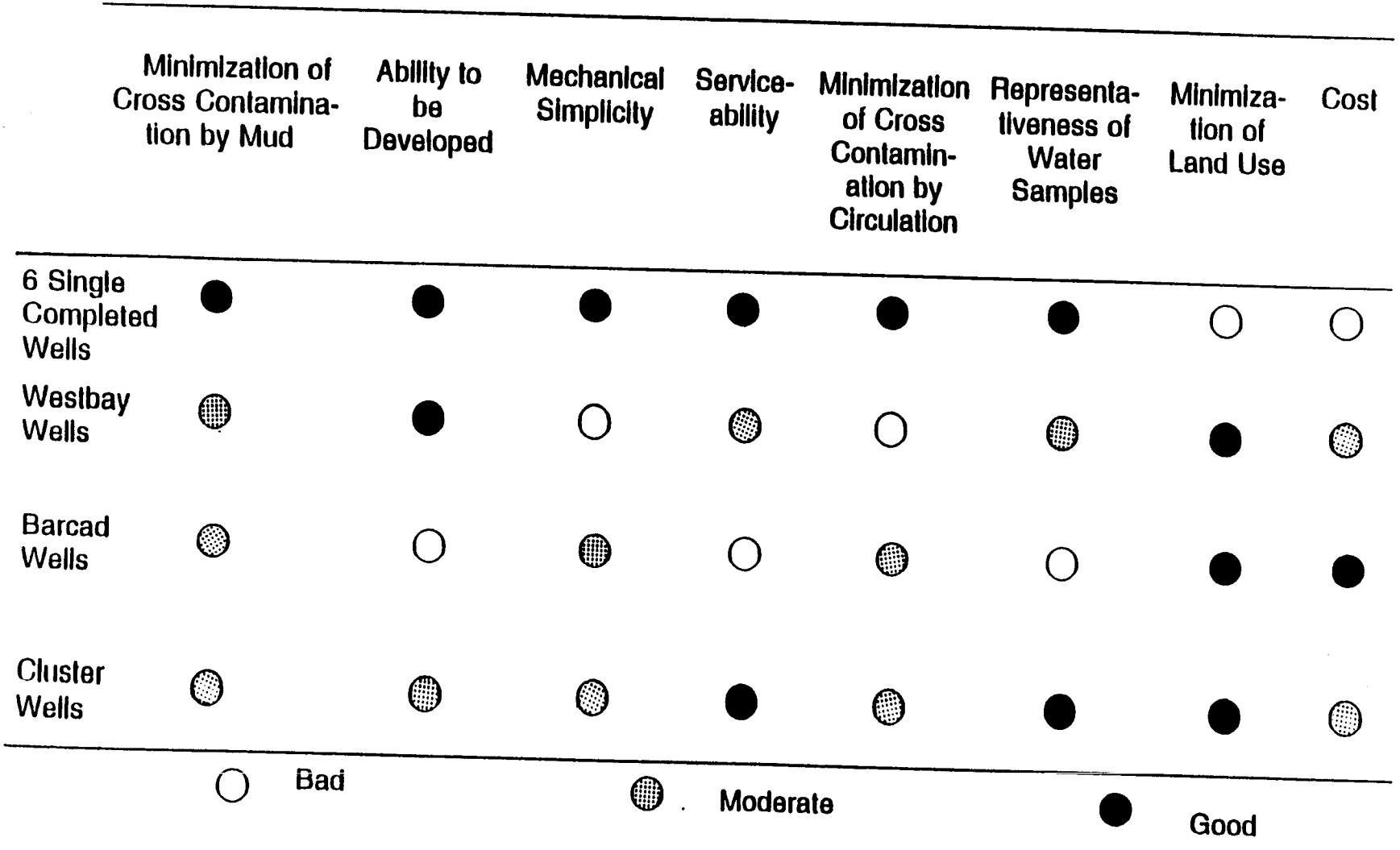
FIGURE 5

CLUSTER WELL CONSTRUCTION

METRIC	CLUSTER WELL CONSTRUCTION
	Public Service Company of New Mexico Person Station Deep Plume Delinlation
Date: 8/93	

EXHIBIT 1

COMPARISON OF WELL INSTALLATION METHODS



casings which allow installation of four inch (4") submersible pumps for jetting and development pumping to remove drilling mud from the borehole wall. The Barcad Wells would be virtually impossible to develop since they cannot be jetted or pumped at a rate exceeding the capacity of the sampling pump. The Cluster Wells could be jetted with fresh water, and they could be pumped at a high rate by airlift techniques for development purposes. Some concern may exist for airlift development. These concerns can be minimized by using filtered compressed air and maintaining the bottom of the blow pipe well above the top of the screened interval.

Mechanical simplicity (as used in EXHIBIT 1) relates to simplicity of construction and operation of the system. The single completion method has the least potential for problems while the Westbay system has the highest potential for problems due to the complex packers, sampling ports and sampling tools. The Barcad and Cluster Wells are intermediate in potential for problems.

Single Completion and Cluster Wells are readily serviceable since there is a removable sample pump in each well. Servicing Westbay Wells would be difficult and time consuming due to the complexity of the system. Barcad Wells are unserviceable because the pumps are grouted into the well and cannot be removed.

Single Completion Wells exhibit a very low potential for cross contamination due to circulation of groundwater from a contaminated zone to an uncontaminated zone since the entire annular space is grouted. Westbay Wells exhibit a high potential for cross contamination due to circulation caused by vertical gradients during the development process. After the well has been developed and before the Westbay system is in place and inflated, substantial cross contamination can occur. Additionally, substantial circulation can occur should any of the packers deflate during the life of the well. Barcad and Cluster Wells exhibit a potential for circulation during the life of the well if the pump tubes (Barcad Wells) or the casings (Cluster Wells) become bunched

together during construction and prevent the grout from surrounding each one individually, and thereby providing a vertical flow path. The cluster well has been designed to hold the two inch (2") diameter well casings apart so that the grout can surround each one individually (see PLATE 1), and prevent circulation.

Single Completion and Cluster Wells are both capable of producing very representative water samples with dedicated bladder pumps, which allow recommended purging and sample pumping. Samples from Westbay Wells may not be as representative since the well cannot be purged. Samples collected with the Barcad System for organic analysis would be very questionable because the nitrogen or compressed air used to operate the pump comes in contact with the water sample. The Barcad pump is essentially an air ejector pump.

Due to high relief, improvements (including freeways, powerlines, streets and buildings) and varied land ownership in the plume area, sufficient land may not be available to allow the exclusive use of single completion wells. The other three alternative completion methods would use substantially less land.

The above outlined comparison of well installation methods led to the conclusion that both Single Completion and Cluster Wells are technically acceptable, while the Cluster Wells would utilize substantially less land at a somewhat more modest cost. As a result, Cluster Wells were selected for this project. The construction details of the Cluster Wells are presented on PLATE 1. The number of wells in a particular cluster would be varied upward or downward depending on the data requirements at a particular well site.

WORK PLAN

Drilling of a third well to the 800 feet level will begin immediately, for the purpose of determining the groundwater flow direction and gradient at that level. This well will be drilled at the PSMW-17 location (see FIGURE

1).

The second step will be to install 6-well Cluster Wells at PSMW-19 and PSMW-22 locations, for the purpose of determining the vertical extent of the deep plume in the source area.

The third step will be initiated by drilling a cluster well on the down gradient side of the plume. The location and number of screened intervals of this Cluster Well will be based on the results from the first two steps. The third step will continue by alternating evaluating progress and installing additional cluster or single completion wells until the extent of the deep plume is defined. Again, the location and number of screened intervals will be based on the results from preceding wells.

PLATE 1 is the same as FIGURE 5

TO VIEW THE MAP AND/OR MAPS WITH THIS DOCUMENT, PLEASE CALL THE HAZARDOUS WASTE BUREAU AT 505-476-6000 TO MAKE AN APPOINTMENT