Research Technical Termination Report

Project A-031-Ida.

Groundwater Pressure Wave in Confined Porous Media

Project Investigator

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RESEARCH TECHNICAL TERMINATION REPORT

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GROUNDWATER PRESSURE WAVES IN CONFINED POROUS MEDIA

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INTRODUCTION

This project as originally proposed involved a 3-year theoretical and experimental study to determine what factors effect the rate of travel of pressure waves in confined porous media. The relationships developed were then to be applied to a field situation such as in the Snake River Plain aquifer.

As finally funded the project involved about 1/2 man month of effort directed toward a literature review and a well defined statement of the problem which occurs in the Snake River aquifer.

LITERATURE REVIEW

Two types of literature were required. One dealing with reports on the groundwater hydrology of the Snake River Plain and the other with the theoretical aspects of pressure wave movement in aquifers.

Hydrology of Snake River Plain Aquifer.

The first report of a "pressure wave phenomenon" appears in the 1965 annual report by Barraclough et. al. (1). The phenomenon was brought about by extremely high flows in the Big Lost River during the summer of 1965. By December of 1965 the water table had risen more than 2 ft. over a 400 sq. mi. area of the NRTS and over part of this area had risen as much as 6 feet. The fact that the water table rose was not unexpected, but the rate at which it rose in areas considerably removed from the recharge area was unexpected. There were also many inconsistencies at various wells. For example, one well 235 ft. from the river shows an almost immediate response and rose 80 ft. during 1965 while another well about the same distance from the river responded approximately one month later. Another

well only 1100 feet from the river responded five months later. By December of 1965, approximately 6 months after the major recharge occurred, some increase in water level was shown as far as 30 miles from the point of recharge. This rate of movement is much faster than would be expected under true water table condition, and according to Barraclough is not due to mass movement of water. True pressure wave movement in confined aquifers, however, would be more rapid than this. It seems likely that the reason the movement is not a true pressure wave nor ordinary groundwater movement is because the aquifer is very non-homogeneous with some areas being confined while other areas are not confined. Thus, through some areas there would be mass movement of water while in others there would be an actual pressure wave. However, there is another possible explanation and that is that there is rapid movement of water through extremely permeable regions and through lava tubes which could allow the rapid migration of pollutants from one area to another. There is certainly not enough information as yet to explain the phenomenon, and several statements have been made in (1), (2), (10), emphasizing the need for additional research.

Pressure waves in aquifers.

There are few articles in the literature considering pressure wave movement in either confined or unconfined aquifers. One of the more useful is that by Werner and Noren (18) in which they develop an equation for the rate at which a fluctuation due to a river rising or falling will move through an aquifer. Using their equation and assumed values of aquifer properties that are possible, it appears that the rate experienced on the Snake River Plain is possibly due to a true water table condition.

Other articles considering pressure waves are by Bredehoeft (4), Knox, et.al. (8) and Cooper, et.al. (5). None of these articles give anything that is of use for this particular problem. There is a paper by Z. A. Saleem given at a recent national meeting that appears from the title to be significant, but it is not available as yet. Two thesis studies have been completed recently that have limited application in this area of research (9) and (13).

SUMMARY

There is no doubt that a great deal of research will have to be done to assure the correct explanation of the "pressure wave" movement. There are two possible methods of attack:

1. Conduct a field study of the movement of water in the aquifer. This would involve drilling more wells in order to more completely define the geologic conditions of the aquifer and would be quite costly. It is doubtful that it is economically feasible.
2. A model of various aquifer conditions, such as confined, unconfined and layered conditions could perhaps be developed. This could possibly be a physical analogy or mathematical model. It would not be a model of any particular aquifer; rather it would be a model of various non-homogeneous conditions that commonly exist in basalt aquifers. If the results were satisfactory, they could perhaps be applied in a general way to aquifers occurring in nature. This would be considerably less costly than drilling many wells, although the usefulness of the results is unknown.

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PUBLICATIONS ARISING FROM THIS WORK

None