Economic Groundwater Problems Encountered in the Development of a Housing Area Near West Lafayette, Indiana

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Introduction

Homewood Addition is a housing development located approximately 3.5 miles northwest of West Lafayette, Tippecanoe County Indiana in the NW ¼ of sec. 35 T 22 N., R 5 W. It lies in a dissected upland about 4 miles west of the Wabash River and 1.5 miles north of U.S. Highway 52 and the town of Klondike.

In 1958 the area was subdivided into individual lots one half acre or more in extent. In most cases the lots were sold directly to prospective home owners who contracted with their builders for home



FIG.I. TOPOGRAPHIC MAP OF THE HOMEWOOD AREA



FIG. 2. GLACIAL THICKNESS MAP OF A PORTION OF

construction. The final plots were sold in 1962 but construction, which was normally initiated some months after the land purchase, continued until 1964.

SCALE: I" = IMIL

ADAPTED FROM W. WAYNE . 1952.

At present the housing development consists of twenty homes of contrasting design which are located on about fourteen acres. The topographic setting of the area is shown in Figure 1.

A water problem was encountered in the development of the Homewood Addition which is becoming increasingly common. The Homewood area is located several miles from the city limits of West Lafayette and is not serviced by its municipal water supply. Housing areas situated beyond available water systems in this manner must rely on groundwater acquifers for their source of water. Therefore, if any groundwater problems exist at the housing location grave difficulties can ensue.

In addition, water supplies for a modern home must be fairly substantial. Present day household appliance put a greater demand on water supplies than were experienced in the past as both an increase in water volume and the rate of water delivery are made necessary by their use. A groundwater supply which would have proved marginal or fairly adequate several decades ago would now be unable to satisfy the demands of modern living.

A disturbing aspect of the problem is that owners who build beyond municipal boundaries are commonly oblivious of groundwater conditions and possible water deficiencies. In many instances, groundwater supplies are either assumed to be available or the subsurface situation is investigated incompletely. It is all too common that the owners become aware of water difficulties only after their first dry well has been drilled and construction of their home is well underway.

Physiographic Setting of Homewood and Vicinity

In section 35 of Tippecanoe County the surface is essentially flat to gently rolling. The maximum elevation in the area is 700+ feet whereas the maximum relief, created by dissection of the glacial drift, is on the order of 40 feet. Homewood Addition is situated on the sloping divide between the upland till plain and the lower outwash which forms a low swampy area elongated in a NE-SW direction. Hadley Lake and Blackbird Lake lie in this trough which may have originated as a sluiceway for glacial melt water. Schneider and others (2) have suggested that this elongated lowland is composed primarily of sand and gravel and that it may be an esker trough. Indian Creek enters this trough south of the Homewood area where it occupies the western margin of the depression and serves as the major drainage system for the till plain. In Figure 1, it can be observed that the creeks which drain the Homewood Addition and adjacent areas flow into this trough and are intercepted by Indian Creek. Although underlain by coarse sand and gravel, the depression is blanketed by bog deposits in many areas thus accounting for its swampy nature.

The till plain, which is less permeable than the lowland area, is being dissected by surface water along the margin of the Hadley trough. Northwest of the Homewood area, beyond the dissected margin, the till plain is essentially flat with little local relief.

Glacial Geology

A portion of Wayne's glacial thickness map of Tippecanoe County (3) is shown as Figure 2. The existing roads transversing the area have been added to facilitate the location of local landmarks. This map, in addition to a glacial thickness map constructed by the authors from well-log and geophysical data, indicates that the maximum glacial cover in Section 35 lies in the southeast corner. This second glacial thickness map is shown as Figure 3. Toward the northwest, glacial deposits become more shallow where they overlie a high in the bedrock surface. The general stratigraphic section indicates till overlying glacial fluvial material. The deposits range in composition from clay to coarse gravel with intermediate mixtures of the two. There is considerable inter-



bedding of outwash making correlation between wells extremely difficult.

Individual lenses of blue, gray and yellow till are interbedded with outwash material along the margin of the Hadley trough, where Homewood Addition is located. There appears to be some continuity of the glacio-fluvial material, but the composition varies from fine sand to coarse gravel. This composition indicates considerable deposition under periodic slack water conditions.

The glacial cover is observed to increase eastward from the Homewood area toward the Hadley Lake depression where the drift thickness reaches about 200 feet. An increase in the percentage of sand and gravel in this eastern section is also indicated which, coupled with the increased drift thickness, tends to yield more suitable water supply.

Bedrock Geology

The bedrock underlying Homewood and vicinity is Mississippian age rock of the Borden group. The material observed at one well location in Homewood was a light gray, slightly calcareous, siltstone. Rosenshein (1) has described similar material as blue to gray, fissile shale which may be fossiliferous and pyrite bearing at some locations.

A bedrock map was constructed utilizing available well log data. This map is shown as Figure 4. Maximum relief on the bedrock surface is approximately 97 feet and the surface slopes from the northwest toward the southeast. The maximum elevation observed is 652 feet whereas the lowest is 455 feet.

Two valley systems are indicated on this bedrock map. One slopes eastward from an area about ½ mile south of Homewood whereas the second slopes southeast from the central portion of the Homewood area itself.



CONTOUR INTERVAL = 20' SEC 35,T 24N, R 5 W.

The Groundwater Problem

A shortage of available groundwater in the Homewood area became apparent in 1960 when the first dry hole was drilled. Since that time six other attempts to obtain water in the subdivision have ended with the same result. The water shortage is also exemplified by the fact that several existing wells in the area are limited to a production of from 2 to 5 gallons of water per minute.

A map of the Homewood Addition is shown as Figure 5. The location of water producing wells and dry holes are indicated on this map. Homes have not been constructed to date on lots 7 through 10 so no well records are available in that region. A producing well is located on a neighboring farm just north of the intersection of Hebron Court and Union Road which indicates a suitable water supply in that general area.

Groundwater supply is notablypoorsouth of Homewood Drive. Five dry holes have been drilled to date in this region and the single producing well on lot 25 was obtained only after lengthly operations which may have included gravel packing of the well.

The area just north of Homewood Drive is somewhat better in that dry holes are not normally encountered in this vicinity. Water supply, however, is not as abundant here as in other parts of the housing area.

The largest producing wells in the subdivision lie near the circumference of Hebron Court. The well designated No. 12' was test pumped at 150+ gallons per minute and has the greatest production in the area. This well currently supplies six houses and provisions are available for a seventh house on lot 15 when it is constructed at a later date. The location of the connecting waterline is shown by a dashed line which leads from the well location at 12' to the problem area south of Homewood Drive.





Well log data for the area are shown in Figure 6. Much of this information was obtained directly from the homeowners as well logs have not been recorded for all wells in the area. It can be observed that the depth to bedrock is of the order of 100 to 110 feet.

A contributing factor to the scarcity of available groundwater in the area of Homewood is the fairly thin veneer of glacial material at this location. The glacial thickness increases from approximately 100 feet at Homewood to an excess of 200 feet near Hadley Lake. This added thickness greatly improves the probability of finding a water-bearing, permeable zone in the drift which will yield an adequate water supply.

Groundwater and Subsurface Evaluation

Water supplies in the Homewood area are obtained primarily from glacial drift. Much of this water is pumped from coarse gravel, but coarse sands serve as acquifers for several of the wells. There is a definite lack of suitable acquifers in the drift owing to the presence of fine sands in many of the water bearing coarse sands and gravels. Filter costs prohibit the economic extraction of the water.

Several well logs on Figure 6 indicate limestone beds within the shale bedrock, usually at a depth of about 140 feet. Several of the owners of the wells in question have stated that their drillers claimed that this limestone bed was the water producing zone of the well. In other deep wells in the area, for one example 21a, this limestone was not intercepted. Owing to the fact that the Borden siltstone is calcareous in the area and its gray color may be confused with that of many limestones, the existence of this limestone layer is in some doubt and the possibility of it being an acquifer is questioned. The Borden group at this location is extremely tight and water production from lenses within it are doubtful. However, more than one well driller has reported this rock member so that its existence should not be dismissed entirely.

The well driller who developed several of the bedrock-seated wells is known to have used perforated casing for these wells. This allows water to seep in from marginal water bearing zones and to accumulate in the bottom of the well. An exceptionally deep well into the bedrock would set up a collection reservoir from which the water could be pumped.

Many of the water supplies in the area are obtained close to the bedrock surface. Water appears to collect in the basal sands and gravels. In one case, difficulty in clearing the shale particles from the water was observed and the well was finally abandoned. Some fairly thick lenses of coarse, dry gravel are found in Homewood area. This indicates that these deposits are local in extent and probably are not connected with the main acquifer system.

Artesian wells are associated with all the acquifers in the area. These artesian conditions as well as the complex lensing of sands and gravels seem to indicate movement of groundwater between stratified layers. The lack of sand or gravel outcrops indicates that artesian acquifiers are recharged outside the vicinity of Homewood Addition and perhaps beyond the confines of section 35.

Coarse, clean, water bearing gravels are found at depth in the area around Hebron Court. In well 12' the acquifer is located at a depth of 88 feet in this gravel. The fact that only a 20 foot drawdown occurred when this well was test pumped at 150 + gpm is evidence of abundant water. Well 12 only 40 feet away also has a generous flow of water.

The occurrence of this tremendous water production in the midst of the considerably more modest water supplies of the area is an interesting phenomenon. Examination of the glacial thickness map presented as Figure 3 shows a V-shaped finger parallel to the creek in the Homewood area and indicates an increased glacial thickness at this point. In addition, the bedrock contour map shown as Figure 4 indicates a valley in the bedrock surface in the vicinity of well 12'.

As previously stated the area east of Homewood has a thicker glacial cover which contains greater percentages of water-producing sands and gravels. It is suggested on the basis of current evidence that a protrusion of this deposit extends into the Homewood area and is intercepted by the large production well.

The water problem in the remainder of the subdivision is brought about by a two fold situation, the thin veener of glacial cover and the low percentage of water producing zones in this limited thickness. An impermeable bedrock material completes the bleak subsurface situation in regard to groundwater supply.

Recommendations

The groundwater problem described in this report is one which could occur in many glaciated areas of the United States. The heterogeneous nature of ice contact glacial deposits is such that problems of this nature may be fairly common.

An object lesson can be derived from this example problem. A thorough investigation concerning groundwater supply would not have alleviated the problem but would have lessened the concern of the prospective home owner who inadvertently began house construction only to learn of water supply problems at a later time.

The development of the Homewood Addition was such that a single water system for the entire area was not possible. Since the lots were sold on an individual basis with no overall construction firm involved, water supplies were developed individually as well. Under different circumstances a community well would have best served the purpose.

A limited community well was established in Homewood out of desperation after the surprisingly high production well, 12', was obtained by an individual owner. Other land owners located in possible problem areas were invited to join the venture. This proved to be an excellent solution to the problem but a great deal of luck was involved for all parties involved in this water find.

As a suggestion to those who are confronted with the problem of building a home beyond municipal water mains the following suggestions may be applied.

- 1. Investigate the water situation in the area by inquiring with existing home owners and by checking available literature. Universities and the State Geological Survey can be consulted for advice.
- 2. Do not initiate construction until a producing well has been obtained on the land.
- 3. If possible, obtain an option on the land until a producing well is gotten, then purchase the property and initiate construction.

Acknowledgments

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