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A PRELIMINARY EVALUATION OF STATIC WATER LEVEL DECLINES IN WELLS IN THE MADDUX PARK SUBDIVISION ANCHORAGE ALASKA

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Introduction

As a result of a public meeting held on July 27, 1989, at which concern was expressed regarding the circumstances surrounding a well failure near the recently constructed Rabbit Creek/DeArmoun Interchange in south Anchorage, the Alaska Division of Geological and Geophysical Surveys was requested to evaluate available data and comment on the likely cause of the well failure and related water level declines. This report contains the results of the analysis. Materials not included in this report because of the limited time available for the analysis, are available for inspection at the Eagle River Office of the Division of Geological and Geophysical Surveys.

Background

The problem under investigation is whether or not any aspect of the DOTPF Rabbit Creek DeArmoun interchange project (hereafter referred to as "the project") caused a well to fail on lot 4 of Maddux Park Subdivision, and water levels to decline in wells on lots 2 and 3 of Maddux Park Subdivision. Table 1 presents pertinent information for these wells. The well failure occurred as a result of the lowering of the static water column in the well below the intake level of the submersible pump.

Table 1

Information about 3 private wells in Maddux Park Subdivision

Lot No.	Reported well depth (ft)	Original reported depth to water* (date)	Measured depth to water**(ft)	Elevation of top of casing (ft)
2	85	55 ft (1977)	59.8	204.45
3	69	56 ft (unknown)	60.4	203.86
4	61	50 ft (unknown)	57	201.33

*assumed from top of casing
**from top of casing, July 10, 1989

Approach

The most likely cause of lowered water levels in the wells listed above that could be attributed to the project is a subdrain constructed at the footing of retaining wall number 3 located a few hundred feet from the Maddux Park Subdivision wells. The focus of the study was to determine the physical position of the subdrain, with respect to the local groundwater flow system, and to interpret the likely effect it would have on local water levels.

Analysis

A cross section was constructed through lots 2, 3 and 4 of Maddux Park Subdivision and the project at station NSH 454.35 along a compass bearing of S81W. The subdrain at this location is about 300 ft from the Maddux Park Subdivision wells. The cross section shows that, at the point where the section crosses the retaining wall, both the preconstruction and post construction ground water levels are 2 to 6 ft higher than comparable levels in the Maddux Park Subdivision wells. An initial interpretation might be that a drain at this location would be unlikely to affect nearby wells because it is physically impossible for groundwater to flow from the wells to the drain. A more detailed examination, however, reveals that the drain has a substantial slope and at a point 85 ft south of station 454.35 the elevation of the drain is about 2 ft lower that the current water levels in Maddux Park Subdivision. These observations indicate that groundwater does not flow along a bearing of S81W, but flows along a more southerly bearing. In order to evaluate the situation more thoroughly, surrounding data were examined.

A comparison of soil borings and drain design document shows that the drain depresses the water table about 6 ft at station NSH 454.35 and 28 to 30 ft at station

R1 12+75, about 500 ft south-southwest of the Maddux Park Subdivision wells. The maximum total depth from original ground surface to the bottom of the footing is about 44 ft and occurs near R1 12+75. This contrasts with earlier estimates (1,2) that the maximum depth of excavation would be less than 35 ft.

A review of water level data from wells within a one mile radius of the project shows that the regional slope of the water table is to the southwest with a gradient of about 0.03 with substantial local variation. The variation is most likely a result of the projects location in a groundwater recharge area (2) and diverse aquifer lithologies. Closely spaced wells of different depths in the area have different water levels.

In contrast to the regional water table slope, the subdrain under retaining wall 3 slopes from 0.02 to 0.09 in a southerly direction near Maddux Park Subdivision. The result is that the drain is entrenched more deeply into the groundwater flow system near the south end of the wall, and tends to re-orient groundwater flow from its southwesterly trend to a more westerly orientation. The drain does not, however, shift the direction of groundwater flow to a direction parallel to the line of cross section described earlier. As a result, the line of section described earlier or any similar east-west cross section line is not appropriate for direct use in determining groundwater flow directions or for determining effects of the subdrain on nearby wells.

Private wells have previously been reported to have failed in a broad area of the lower Hillside area of Anchorage (10-11). A review of documents reveals, however, that none of these failures are known to have occurred within 1 mile of the project. Furthermore, the failures were restricted to wells tapping deep confined aquifers, rather than shallow water table aquifers. Finally, water levels in the confined

aquifers have increased in recent years as a result of a decrease in pumping by municipal wells (12).

Summary and Conclusions

The existing sloping subdrain intersects a sloping water table near the project at an oblique angle to the water table gradient. The water table has been lowered by up to 30 ft in a wedge-shaped area of influence on the east side of the New Seward Highway. The exact extent of the area of influence is unknown, but based on the geology of the area and observations made to date, it includes the wells on lots 2, 3 and 4 of Maddux Park Subdivision.

Based on the following principal factors,the project subdrain under retaining wall No. 3 is concluded to be the primary cause of the well failure on lot 4 of Maddux Park Subdivision and the lowered water levels in wells on lots 2 and 3:

1. all three wells are relatively shallow and tap a water table or semi-confined aquifer;

2. the well on lot 4 is reported to have served to raise a family of four children with no significant problem until this summer;

3. the subdrain has lowered the water table up to 30 ft within about 500 ft of the private wells;

4. the observed lowering of water levels in the private wells are within the range of what would be expected to result from such a de-watering project;

5. water levels in shallow wells in this area are not likely to be related to areawide changes in the potentiometric surfaces of confined aquifers because they are geologically and geographically separated.

Information used for this analysis was all publicly available and consisted of:

1. Engineering geology and soils report, centerline soils, Rabbit Creek and DeArmoun interchanges: Alaska DOTPF, 1987, 13 p., plus appendices.

2. DeArmoun/Rabbit Creek interchanges, environmental assessment and draft section 4(f) statement: AK DOTPF and U.S. Federal Highway Administration, 1983, 84 p., plus appendices.

3. Geotechnical Report, Rabbit Creek interchange, retaining wall no. 3: AK DOTPF, 1987, 7 p.

4. Proposed Highway Project, Rabbit Creek and DeArmoun interchanges I-OA3-1(4), grading, drainage, surfacing, bridges, retaining walls, signing, striping, illumination: AK DOTPF, 1987, unpaginated.

5. Topographic map, original scale 1:2400, 4 ft contour interval topography, from Municipality of Anchorage.

6. Water well data on file at DGGS Office, Eagle River, Alaska.

7. Surveyed well-head elevations and water-level data reportedly collected by DOTPF personnel in Maddux Park Subdivision.

8. Computer plot of water level data from U.S. Geological Survey Ground Water Site Inventory database made by DGGS on 5/14/86.

9. Verbal comments made by local residents during public meeting of 7.27.89 hosted by Representative Jim Zawacki and by telephone contacts.

10. Dearborn, L.L., and Munter, J.A., 1987, Water-level declines in wells tapping lower hillside aquifers, Anchorage, Alaska (1985), Alaska DGGS Report of Investigations 87-12, 9p.

11. Munter, J.A., 1987, Water level declines in wells in south Anchorage, Alaska: A presentation to the Alaska Water Resources Board, September 12, 1985: Alaska DGGS Report of Investigations 87-15, 3p.

12. Prokosch, G.J., 1988, Anchorage lower hillside groundwater management: in Ground Water, Alaska's Hidden Resources, proceedings, American Water Resources Association, Water Research Center, Institute of Northern Engineering, University of Alaska, Fairbanks. Report IWR-112, p. 147-152.