ALASKAN GEOLOGY BRANCH
TECHNICAL DATA FILE

OF 235

Superseded by:
HA-187

U. S. Geological Survey

Anchorage, Alaska

PRELIMINARY REPORT ON GROUND-WATER CONDITIONS AT HOMER, ALASKA

By

Roger M. Waller

Open-file report

1962

PRELIMINARY REPORT ON GROUND-WATER CONDITIONS AT HOMER, ALASKA

By

Roger M. Waller

INTRODUCTION

A ground-water study of the Homer area is being made during 1961-62 as a part of an investigation of ground-water resources of Alaska begun by the U. S. Geological Survey in 1947. The purpose of the studies are to map the water-bearing formations and determine the occurrence, availability, and quality of ground water in the state. The Homer area has a water problem in regard to poor quality water and to rather limited yield of wells (Cederstrom, Wahrhaftig, and Barnes, 1950, p. 4, and Cederstrom, 1952, p. 18-19). Many homes rely on springs or shallow wells which furnish a meager supply of poor quality water. This preliminary report was compiled at the urgent request of the Homer Public Utilities for planning a water utility. A final report on the investigation of the ground water and geology of the greater Homer area is scheduled for completion in 1962.

Work to date consists of a drilled-well inventory, water-level observations, partial spring inventory and geologic field observations, and field determinations of the iron content of well and stream water. Data representing over 100 wells have been tabulated as to location, depth, yield, reported quality, and topographic situation. This report summarizes the tentative conclusions on the occurrence and availability of ground water. Office compilations of a well-location map, well logs, and chemical analyses of water in the area are available at Anchorage for consultation by interested parties for planning water improvements.

GEOLOGY

The Homer area is underlain by sedimentary rocks of the Kenai Formation of Tertiary age, which is considered to be of fresh-water origin (Smith, 1939, p. 61). A recent investigation of the coal resources present in the Kenai Formation (Barnes and Cobb, 1959) shows that "The Kenai formation consists of moderately indurated sand, silt, and clay in generally thin and intergrading beds and lenses, interbedded with a few thin lenses of fine conglomerate and many beds of subbituminous and lignitic coal ranging from a few inches to 7 feet in thickness.***Ferruginous masses in thick sandstone beds, and ironstone

concretions, in distinct bands and as scattered nodules, are common throughout the formation***" The thickness of the formation at Homer is unknown, but it is probably on the order of several thousand feet.

The structure of the Kenai Formation at Homer is summarized by Barnes and Cobb (1959, p. 227) as "***being characterized by broad, gentle folds in which the dips are generally less than 10°, and by high-angle faults with vertical displacements ranging from a few inches to nearly 80 feet.*** The general trend of the fold axes appear to be to the northeast, and the faults, with a few exceptions, strike northwestward."

Most of the Homer area is mantled with unconsolidated silt, sand, or gravel to depths ranging from a few inches to at least one hundred feet. The material represents glacial, alluvial, colluvial, and wind-blown silt deposits. Several feet of peat covers much of the land at the base of the Homer escarpment.

The surficial deposits are related to glaciation. Glaciers moved westward, from the Kenai Mountains, down Kachemak Bay and probably coalesced with glaciers moving south down Cook Inlet and across the Kenai Peninsula lowland. The glaciers and associated melt-water streams left thin, predominately silty clay deposits overlying the Tertiary bedrock. Below about the 150-foot elevation contour (approximates the main road through Homer), the surficial material becomes thicker as noted in beach bluffs (50 feet or more) and recorded in well logs (about 100 feet). Unverified information from seismic crews drilling on the Homer Spit indicates that unconsolidated sediments over 300 feet thick occur there. Drillers' interpretation of the "moderately indurated" Kenai Formation versus glaciofluvial deposits are questionable, however. The spit is tentatively considered to represent a reworked terminal moraine deposit athwart the bay, with a maximum thickness (based on Kachemak Bay soundings) of about 500 feet at the end of the spit.

GROUND WATER

Occurrence

Ground water is derived by infiltration into the earth from rain, from the melting of snow, and from surface bodies of water. The water moves downward through the soil and permeable rock until it reaches the water table. It then migrates laterally to lower parts of the saturated zone until it is discharges naturally through seeps and springs into streams or lakes, or by evaporation, or by transpiration of plants. Artificial discharge may take place from wells constructed into the water-bearing zone.

Fine-grained material inhibits downward and lateral migration of the ground water. Dense material, such as clay, restricts ground-water movement and causes the water to build up behind or above it and create a perched water table. Many springs, lakes, and swamps may be formed in this manner.

Bedrock aquifers

Most of the wells in the Homer area obtain water from permeable zones in the Kenai Formation at depths of 50 to 200 feet. The water-bearing zones occur in fine- to medium-grained sandstones and in fractured coal beds. Studies to date do not indicate that any particular aquifer exists over a large area. On the basis of the study by Barnes and Cobb (1959) the formations should be fairly uniform in any one area and hence, the aquifers would be consistent also. However, local variations in the permeability of the sandstone and coal beds are thought to create the apparent lack of areal extent of the aquifers.

In general, water-bearing sandstone or coal beds are encountered almost anywhere in the area. The ground water moves laterally through the permeable sandstones and the fractured coal beds overlying siltstone or "underclay" (beneath coal beds) which inhibits downward movement. Hence, the water-bearing zones probably are numerous and not necessarily interconnected. The strike of the Kenai Formation along the Homer escarpment, generally mantled by the thin unconsolidated material, creates many springs as the ground water emerges from its "perched" condition over each impermeable layer. These springs are prominent in the numerous gulleys or canyons cut into the escarpment, where they flow over or out of the coal beds. Farther down the slope, where the surficial material mantles the bedrock, probably the same type of ground-water movement occurs, but the water is dissipated through the thin mantle creating a very wet condition. Many homes are tapping water from this source, either as an improved "spring" or as a dug well.

The yields of wells in the Kenai Formation aquifers are poorly known. Very few of the drilled wells have been tested for sustained yield. One well which supplies several homes, businesses, and the school system has a reported capacity of 50 gallons per minute (gpm) at 120 feet of drawdown. The well casing is perforated from 30 to 37 feet and 98 to 165 feet below the land surface. Two deep (500-600 feet) wells of comparable yield have been drilled at the top of the 1,000-foot escarpment, outside the area of this preliminary report. One of these wells has supplied over 10,000 gallons per day for several years. Neither of these wells tap the aquifers encountered in Homer wells. Elsewhere in the vicinity of Homer, the 6-inch, cased, open-end wells have an average reported yield of about 9 gpm as based on the driller's bailer tests.

Unconsolidated sand and gravel aquifers

Several wells have been drilled into the several tens of feet of glaciofluvial deposits in the lower part of the Homer area and have encountered water in sand or gravel. Based on the drillers' logs, the water-bearing formations were inadequate for well completion. These wells generally encountered a water-bearing zone, yielding enough water for domestic or commercial use, at what appears to be the base of the surficial deposits or the top of the underlying Kenai Formation.

It appears that no extensive aquifer in the surficial deposits has been encountered to date. About 8 wells on the low bench south of Beluga Lake obtain water in limited quantities from this material, however.

Quality of water

Water in the Homer area is distinguished by the relatively high content of iron, up to 25 parts per million (ppm). Dissolved solids content of ground water is moderate with a range of 100-350 ppm, although one well showed 979 ppm. Generally, silica, calcium, and bicarbonate are the largest constituents.

As part of the current investigation, field determinations of the iron content of water from most of the small streams flowing off the escarpment were made. In addition, two stream systems were checked in detail for iron content. It was thought that such determinations might delineate sources of iron-bearing water from seeps or springs. The study was made in May at a time when most of the streamflow was considered derived from springs and ground-water seepage.

Tentative conclusions based on stream-water analyses, point toward the East Hill Road area as an area of better quality (less than 2 ppm iron) ground water. Sampling of waters to determine iron content is planned to confirm this possibility. The few well-water analyses on hand before the investigation indicate that less iron is present in wells above Homer than those on the lower and far east slopes.

WATER UTILIZATION

Current use

Two wells at Homer are considered as semipublic supply wells. The Homer Water Company well is estimated to supply about 3,000 gallons per day (gpd) during the school term. The Scroggs well probably supplies about 4,000 gpd. Approximately 90 other drilled wells in the area are principally domestic wells and probably are pumped less than 200 gpd. Total ground-water utilization, including springs, at Homer is roughly estimated to be about 50,000 gpd.

Ground water for future development

Preliminary results of the investigation indicate that ground water is available from the Kenai Formation in small to moderate quantities and of generally good quality except for a high-iron content in most areas. Potable domestic supplies are apparently difficult to obtain because of the high-iron content which precludes a simple inexpensive treatment. Obtaining public supplies appears feasible by the construction of two or more large diameter wells screened or perforated opposite water-bearing zones, properly developed, and spaced more than a few hundred feet apart to prevent drawdown interference while pumping. Water treatment, especially for iron content, will be necessary. Test drilling in specific areas prior to developing a public supply should be undertaken. Careful records should be kept of each well drilled, accurate sampling of water from each horizon is imperative to delineate water of inferior quality (particularly iron), and a properly conducted pumping test should be made to determine the yield. For the sake of economy, a properly constructed successful test well may be converted to a production well.

The geologic and hydrologic conditions of the area point out an alternate means of obtaining public-water supplies which is successful in some areas. The successive water-bearing zones of the northward-dipping Kenai Formation make it feasible for the construction of a tunnel into the escarpment to intercept the water.

Some advantages of this type of supply are:

1. Greater amount of water available than from a single well source.

2. Construction at an elevation above 300(?) feet would create a gravity supply.

3. A tunnel source would provide air to the water which should remove much of the iron by oxidation.

4. The tunnel could act as a reservoir by installing a bulkhead at the tunnel entrance.

5. The supply could easily be increased by extension of the tunnel or constructing drifts along water-bearing zones.

6. Construction by local means is feasible. Experience and feasibility may be gained from former coal-mine operations in the area.

Some disadvantages of the tunnel method are:

1. Initial costs may be high for excavation and lining (perforated) the tunnel to prevent cave-ins.

2. Site of tunnel should be cored or drilled (extra cost) to make sure an impermeable "dry" section is not present.

3. Periodic cleaning of the tunnel probably would be necessary.

References cited

Barnes, F. F., and Cobb, E. H., 1959, Geology and coal resources of the Homer District Kenai coal field, Alaska: U. S. Geol. Survey Bull. 1058-F, p. 217-260.

Cederstrom, D. J., 1952, Summary of ground-water development in Alaska, 1950: U. S. Geol. Survey Circ. 169, 37 p.

Cederstrom, D. J., Wahrhaftig, C., and Barnes, F. F., 1950, Ground water in the vicinities of Healy and Homer, Alaska: U. S. Geol. Survey open-file report, 4 p.