State Department of Geology and Mineral Industries

1069 State Office Building
Portland 1, Oregon

MINERAL RESOURCE ACTIVITIES IN BAKER COUNTY DURING 1967

Growing apprehension concerning the continued availability of imports of certain metals in amounts sufficient to meet future industrial needs, and apprehension concerning our ability to recapture significant amounts of the gold and silver bullion lost from our Treasury as a consequence of fiscal policies in force during recent decades, has resulted in a marked upsurge of interest in domestic metal prospects throughout the nation during recent years. Within Baker County this has been manifest by substantial exploratory-appraisal programs in the instance of certain of the counties' better known copper and gold-silver prospects. Specifically, the Cyprus Mining Company and Kennecott's Bear Creek Explorations subsidiary have made extensive investigations of copper-bearing claims extending from the Burkemont area through Balm Creek and in the vicinity of Sparta. Both companies had teams of technical specialists in the area during 1967 and both are currently following up their previous investigations with core drilling projects designed to explore subsurface conditions of mineralization at critical places in their respective holdings areas. Between them, these explorations projects constitute the most comprehensive appraisal ever conducted in terms of the open-pit potential of these prospects. Additionally, the Omega Mines, Vancouver, B. C. continued their appraisal of a group of major gold-silver lode properties at Bourne. Begun three years ago, this consists of re-opening old workings, driving new exploratory headings and diamond drilling. With a summer season force of 12 to 15 employees as against a smaller crew throughout the rest of the year, the company is currently engaged in reopening the old Golconda shaft. On Pine Creek, above Halfway, excavation designed to permit reactivation of the old Steinmitz-Underwood placers was begun by another group during 1967. When completed, this will expose and drain a section of bedrock placer stratum accessible heretofore only by means of shafts and rigorous pumping. Work on the bedrock drain channel has been resumed this year.

During 1967 the U.S. Bureau of Mines inspected and sampled several gold lode properties throughout the country in line with the government's crash Heavy Metals Project designed to hopefully stimulate domestic production of gold, platinum and other so-called heavy minerals. This may lead to eventual test drilling by the Bureau on some properties. Also during 1967, a loan was granted by the U.S. Department of Interior, Minerals Exploration Office, for certain programmed subsurface exploration scheduled to begin this season on the Argonaut Mine in the Cracker Creek district. The development of interesting new silver-lead-zinc occurrences opened up in the Cable Cove area during 1966 was hampered by the closure of smelters throughout the west due to the prolonged copper strike in force during 1967; however with the resumption of activity by the smelters continued development can be anticipated on the Cable Cove properties and other strong silver-bearing lodes throughout the county.

With respect to mineral output by established producers, activities were maintained at near-normal levels at the Oregon Portland Cement Company's operation at Lime and at the Chemical Lime Company's operation at Wingville. The production and shipment to outlying markets of decorative building stone from Dooley Mountain continued during 1967. The business originally opened by Anthony Brandenthaler is now operated by the Blue Mountain Stone and Lime Company of Baker under the management of Ben Ryder.

June 13, 1968
USD-

State Department of Geology and Mineral Industries

1069 State Office Building
Portland 1, Oregon

A BRIEF SUMMARY OF THE GEOLOGY OF BAKER COUNTY

Baker County lies within the Blue Mountains physiographic province, a region characterized by high mountain ranges and steep walled canyons interrupted in places by broad fertile valleys. Elevations range from less than 2000 feet on Snake River to over 9100 feet in the Elkhorn range. The main drainage systems of the county are the Powder River in the northern part and Burnt River in the southern part. Both flow eastward to the Snake River.

The rocks of the county fall into two major groups. The older is a series of marine sediments and volcanics of Paleozoic and Mesozoic Age that have been intricately folded and faulted and invaded by granite and other types of intrusive rocks. The younger is comprised of a wide variety of lavas, tuffs, and loosely consolidated fresh water sediments and gravels of Tertiary and Quaternary Age. Wherever the contact is exposed the Tertiary and younger rocks are generally seen to lie with angular discordance on the pre-Tertiary rocks and due to the markedly higher degree of deformation and alteration suffered by the pre-Tertiary rocks, the distinction between rocks of the older and younger series is usually quite readily apparent.

Several million dollars worth of gold and silver and some copper have been produced from sources within the county and occurrences of other metallic minerals carrying molybdenum, antimony, manganese, iron and tungsten are known. Excepting for gold placers in Tertiary to recent alluvium these prospects all occur in the older group of rocks. Production of limestone for cement manufacture, sugar refining, paper processing and carbide rates as the principal mineral industry active today because the fixed price of gold in relation to current operating costs no longer affords a favorable economic climate for gold mining. The limestones are one of the pre-Tertiary sediments but deposits of another important non-metal, diatomite, are present at places in association with the Tertiary sediments. Occurrences of the volcanic glass, perlite, are also known in the Tertiary rocks. Both the diatomite and perlite have a growing number of industrial uses and hence constitute reserves for eventual industrial development.

Report by: Brooks & Wagner
February 8, 1963

State Department of Geology and Mineral Industries

1069 State Office Building
Portland 1, Oregon

GROUNDWATER RESOURCES IN BAKER COUNTY

Foreword: The objective in the following paragraphs is to review the ways in which groundwater occurs in Baker County and the extent to which the planning committee is justified in regarding it as a reserve source of supply for the County's water needs in the future.

By way of introduction to the subject, there is given first a thumbnail sketch of both surface and subsurface requirements pertinent to the formation of groundwater in general. This is followed in somewhat greater detail by a description of geologic conditions present in the county. These topics are of necessity reviewed in a highly summarized form, except that where it is appropriate to elaborate for the purpose of explaining the significance of certain conditions with respect to groundwater occurrence in the county, greater explanation is given.

Basic groundwater requirements: The soils and loose sediments covering the earth's surface and the bedrocks underlying this mantle constitute the environment in which groundwater occurs. Whether this environment does, or does not, favor the existence of a groundwater potential in any particular geographical area depends on (1) the conditions under which the loose surface materials and their underlying bedrocks occur, (2) the availability of surface waters for charging and recharging subsurface aquifers and (3) the existence of watershed situations capable of entrapping precipitation water and diverting it underground.

All three of these factors must be present and in balance, one against the other for optimum groundwater potential to exist. For example, ideal conditions for the capture and subterranean storage and transfer of groundwater are to no avail if there is no surface water available to be captured and stored. Neither is an abundance of precipitation water of any avail in places where the surface and subsurface rocks are as tight and impervious as a paved street. In short, for balanced conditions to exist it is essential that within certain limits all required factors occur in the same place at the same time. Thus, precipitation must not only be available in consistently good supply, it must fall on terrain conditions that will enable it to be soaked up with a minimum of loss by evaporation and run-off. At the same time, subsurface reservoir capacity must exist in conjunction with the watershed if water is to be transferred from the saturated soils to a state of subterranean storage. The subsurface storage may be afforded by unconsolidated or semi-consolidated alluvial material or by a bedrock having physical characteristics such as a network of interconnecting fractures, porous textures, or solution cavities that will permit the intake of water and its incorporation in the rock mass. Either way, the existence of suitable subsurface storage conditions is fully as necessary as is the availability of water for storage. Without either, there would be no groundwater.

Subsurface water contained in alluvial material is known as unconfined water. This is the water that soaks into the ground and accumulates on top of some impervious subsurface horizon which may be either an alluvial clay layer or some type of equally impervious bedrock. Although on occasion such water may be deep, it is normally the water encountered in shallow dug wells. It is also the water, the top level of which constitutes the water table. The type of groundwater that is taken up in hosting bedrock and channeled away from the intake area under circumstances where it is carried beneath an impervious overlying strata is known as confined water. This is the water which provides large flowing artesian wells when the proper structural conditions prevail.

County Groundwater potential: Within the county the requirements prerequisite to the occurrence of groundwater are present in a great many combinations. For instance, areas of maximum precipitation tend to be localized in the higher elevations. So also are the areas in which lower temperatures prevail and in which natural vegetation and absorbant soils are best developed. Elsewhere, with progressive decrease in elevation, there is less precipitation on the average and what there is falls on terrain in which protective vegetative and soil conditions are less favorable and hot, windy weather is seasonally more prevalent.

This variability in watershed conditions is enough in itself to account for differences in groundwater potential even if subsurface storage capabilities were uniformly good everywhere. Actually, however, subsurface conditions in the county are far from uniform. Instead, great variations exist with respect to the physical characteristics of the native bedrocks. Furthermore, the areas in which favorable subsurface conditions exist do not coincide in all instances with the area in which the best watershed conditions occur. Accordingly areas with a potential for developing large amounts of groundwater are by no means commonplace while in some parts of the county even small quantities of water are hard to come by.

By and large, the least well-known of the factors influencing groundwater occurrence in the county are those that identify with geologic conditions. This subject is therefore summarized in the succeeding paragraphs. Bedrock geology is reviewed first, that pertaining to recent alluviums last.

The bedrocks are divided into two categories. The first, and oldest, of these constitutes the basement complex underlying the whole of the county. This is made up of a wide variety of sedimentary, volcanic and magmatic rock types. A more detailed description is that the sediments consist of shales, sandstones, conglomerates and limestones, all of which were deposited in marine seas. The volcanic components include lavas, related breccias and tuffs emplaced, in part, in both terrestrial and submarine environments. The crystalline intrusives are represented mainly by granodiorite, quartz diorite, tonalite, gabbro and albite granite. However, serpentine and a few other lithic oddities occur also, to a much lesser extent.

All of these rocks were emplaced between the middle of the Permian period of geologic time and the end of the Cretaceous. This represents a time span of approximately 180 million years, beginning approximately 250 million years ago and ending approximately 70 million years ago.

As originally deposited, and in the way they existed for many millions of years following their initial consolidation into a solid rock state, many of the sediments and most of their volcanic interbeds undoubtedly possessed the physical characteristics needed to enable them to function admirably as aquifers for the storage and subterranean transfer of groundwaters. Unfortunately, however, the history of events that have transpired since these rocks originated is not one characterized by a simple warping of the earth's crust. Instead, the diastrophic history these sediments and volcanics have experienced has been severe to the point that porous textures and permeability characteristics have been virtually eliminated and physical continuity has been materially disrupted. All member strata exhibit this deformation, some much more so than others. In fact, evidence exists to show that some of the older strata exhibit mineralogical and textural alterations induced by a succession of deformational events.

Introduction of the crystalline rocks took place concurrent with various of the afore mentioned episodes of diastrophism and culminated during the late Cretaceous with the massive emplacements of the granitics constituting the cores of the Wallowa and Elkhorn mountains. Under the circumstances, some of the crystalline rocks, notably the gabbros and albite granites, pre-date some of the sedimentary strata, while others, notably the granodiorites and tonalites, are considerably younger than the youngest sediment.

Also, as in the instance of the sediments, the older crystalline rocks exhibit far more post-emplacement alteration than do the younger ones. Mineralogic changes of this sort are especially prominent in the instance of certain of the gabbros while, conversely, the type of intrusives represented by the Wallowa-Elkhorn granitics remain in a fresh, substantially unaltered condition except for a tendency to disintegrate in the instance of a few select exposures.

Whether fresh or altered, crystalline intrusive rocks host groundwater only to the extent they are laced with a network of inter-connecting fractures. Such fractures may account for many mountain springs but practically never do they constitute a situation which can be developed into a dependable source of large volumes of water. The reason is that the body material of crystalline rock is non-porous, hence not able to absorb and store water in amounts over and beyond the capacity of the fracture system itself. Futhermore, larege-sized networks of inter-connecting, open fractures occur but rarely in crystalline igneous rock.

The appraisal of groundwater potential just given for the igneous rocks applies equally well to the sedimentary and volcanic rock types included in this category. It does so because in the condition which they exist today the sedimants and volcanics rate, for all practical intents and purposes, no better than their igneous associates. In short, the tectonic involvements they have experienced over the ages has virtually eliminated whatever native water-storing capacity they may have had originally so that today the reduced potential afforded by fractures and faults is all they have to offer. That this represents penny-ante potential is illustrated amply by the deep mine shafts with extensive lateral workings which exist in many parts of the county. Many are bone dry. Some generate only a trickle. None have encountered water in sufficient volume to constitute a pumping problem from a mining standpoint.

The second, or youngest category of bedrocks in Baker County date from approximately 70 million years ago to approximately one million years ago. This is recognized as the Tertiary period of geologic time. Considered as a unit, all rock formations of Tertiary age are super-imposed unconformably on one or another of the rocks described heretofore. Furthermore, most of them were deposited on an old land surface under what classes as terrestial conditions, and never since their formation have they been deeply buried in the earth's crust or subjected to structural deformations comparable in severity to those experienced by the older formations. Instead, gentle folding and minor faulting constitutes the measure of post depositional disturbance they have experienced.

Considered individually, the Tertiary rocks consist mainly of basalts, andesites, rhyolite breccias and their related cinders and pumiceous tuffs all of which are materials of volcanic derivation. However, fresh water lakes did exist from time to time in various parts of the county during the Tertiary. These were filled with the normal water-borne products of erosion and the air-borne clastic materials of volcanic origin. Some also supported an abundance of diatoms, an algae-like class of plant life capable of growing so prolifically that their skeletal remains accumulated in thick layers on the lake bottoms. As they exist today, therefore, these lakebeds are represented by strata of clays and gravels interbedded with water-laid tuffaceous sand and ash, and, in some instances, with interbeds of diatomaceous earth.

When they exist under the proper conditions, some of the Tertiary volcanics have excellent capabilities for soaking up surface water and transforming it to groundwater. It is the lavas in particular, and especially the basalts, that have this capability the most, and they do because of the abundance of fracturing and cross-fracturing they acquired while cooling, plus whatever extra fracturing they may have acquired since as a consequence of structural warping and faulting. The largest producing wells in the county pump from basalts or the gravel interbeds which sometimes separate them when several flows occur one on top of the other. Morrissey's irrigation well at the head of Keating Valley and the old California Pacific well and the recently completed Ellingson wells at the head of the Baker Valley are examples. On the other hand, most of the tuffs and the tuffaceous rhyolite breccias have but little capacity to host groundwater in that they are not characterized by either natural prosity nor an abundance of close-interval fracturing. And, except for their gravel interbeds which can and sometimes do, contain groundwater, the lakebeds as a whole have a negliable potential because they are comprised largely of impervious clays and water-laid tuff which is often broken down, at least partially, into a clayish condition.

What is important with respect to the water-bearing members of the Tertiary is the nature of their occurrence. A thin basalt flow covering only a few acres on the bare rangeland hills, for instance, can never be expected to hold or deliver water in any appreciable quantity compared with an occurrence comprised of a thick sequence of flows, one on top of the other, extending thoughout the best part of a couple townships in an area where surface water is available in good supply. In this connection, the unfortunate circumstance is that while Tertiary lavas are widely distributed in the county, a large percent of the individual occurrences are of the erosional remnant type----small in areal extent and all too frequently poorly located with reference to advantageous watershed conditions. Conversely, thick sequences covering large areas are comparitively infrequent. Accordingly, therefore, while it is to be anticipated that more large-yeild wells will eventually be developed in the county from such sources, their number is limited by the comparative scarcity of occurrence situations capable of supporting large-yield wells.

The third category of materials, namely soils, the natural products of rock decay, and transported sediments of recent to near recent origin, occur throughout the entire county. These are superimposed, in one place and another, and to varying extents, on all the previously mentioned bed-rocks, Tertiary and pre Tertiary alike.

Whereas the soils are of great importance in terms of groundwater, and particularly so with respect to the watershed phase of the subject, it is the transported sediments that constitute the aquifers. In the county, these sediments consist, principally of (1) glacial erosian products in some of the higher mountains, (2) bench and terrace gravels related historically to the present-day and near-recent drainage systems, (3) fan-like accumulations of alluvial gravels located along the borders of some valleys at points entered by creeks with capacities enough to carry coarse sediments in substantial quantities during flood stages, and (4) sheets of sedimentary materials spread by meandering streams accross the floors of valleys in which erosional down-cutting has been arrested.

The sand and gravel components of such sediments are capable of carrying water and are, in fact, the source of countless springs and domestic wells and stock resevoirs. Of the various kinds of occurrences, the alluvial fans and the sheets of sediments that veneer the surface of the larger valleys are the most important. However, because these sources have been utilized so extensively they are probably already over-developed in some areas, though certainly not in others. In any event, future development from such sources will be spotty because suitable occurrences themselves are localized and because many of the remaining underdeveloped ones are located where there is little or no immediate user need for additional water. At best, circumstances under which recent alluvial deposits can be expected to yield water in sufficient volume at any one place to support a large irrigation project or to meet heavy industrial requirements are rare, if not non-existent.

Summary and conclusions: From what has been explained in the preceding paragraphs, it should be evident that geologic conditions favorable to the intake, storage and transfer of groundwater are not commonplace. Instead, they are localized in their occurrence and quite frequently relatively small in both areal extent and potential. Furthermore, they are not always situated advantageously with reference to optimum watershed environments or to user needs. For these reasons, and even though several notably satisfactory wells attest to the fact that favorable conditions do exist for the development of groundwater in some parts of the county, the overall picture is that groundwater can not safely be regarded as a source of reserves capable of contributing materially to the county's future needs, except locally, in certain select places. Under the circumstances, therefore, and for purposes of planning on a long range, county-wide basis, groundwater had best be regarded as a supplemental source of supply strictly secondary in importance to surface run-off water which still exists, seasonally, in amounts greater than existent resevoirs have the capacity to hold. Accordingly, studies dealing with increased efficiency in the management of surface water should be given priority in any present day appraisal involving eventual development of large water reserves.

Report by: N. S. Wagner
November 25, 1965

NSW/lc

State Department of Geology and Mineral Industries

1069 State Office Building
Portland 1, Oregon

GROUNDWATER

My function on this committee has been to evaluate the County's groundwater potential. This constitutes the subject of the comments I will now offer.

The report I have prepared is, in itself, a highly condensed account of the prevailing groundwater situation. Even so, it is too long and too involved to warrant outlining at this time. Under the circumstances, I will deal off the bottom of the deck and simply review my conclusion.

This is that even though several large-yield wells already exist in the county, and even though there is good reason to believe that other large-yield wells can be developed in certain other places, the chance for recovering large amounts of groundwater throughout the County as a whole— is negative.

The reason for this conclusion is that geologic conditions favorable to the intake, storage and subterrainian transfer of large volumes of groundwater are simply not universal —— or even commonplace. Instead, favorable bedrock situations are comparitively scarce, strictly localized in their occurrence, and not always situated advantageously with respect to favorable watershed conditions which in themselves vary appreciably in potential from place to place throughout the County.

The net result of this state of affairs is that groundwater cannot properly be regarded as an important source of reserve water capable of contributing materially to the County's future needs —— in the sense of being an ace-in-the-hole available for tapping at a moments notice.

This is not to say that our groundwater is not important, or that it should not be tapped where ever possible —— because it is indeed important and can, with luck and careful development, be recovered in useful amounts in many places.

Instead, the conclusion that is intended —— and the one that is indicated by the prevailing geologic conditions —— is that surface water still rates as the County's prime reserve. Therefore, since surface water is still generally available, seasonally, in amounts greater than existent reservoirs have the capacity to store, groundwater had best be regarded as a strictly secondary source of supply.

In other words, for committee purposes —— and for any planning involving the appraisal of our water reserves on a long-range, County-wide basis,—— priority had best be given to surface water and to studies dealing with increased efficiency in the management thereof.

Report by N. S. Wagner
Presented for the Upper Columbia River Basin
Projects Committee at the State Water Resource
Board hearing in Baker, January 19, 1966.