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REPORT ON THE

HAVILAND PERLITE PROPERTY

near

YUCCA, MOHAVE COUNTY, ARIZONA

By Donn M. Clippinger

April 15, 1965

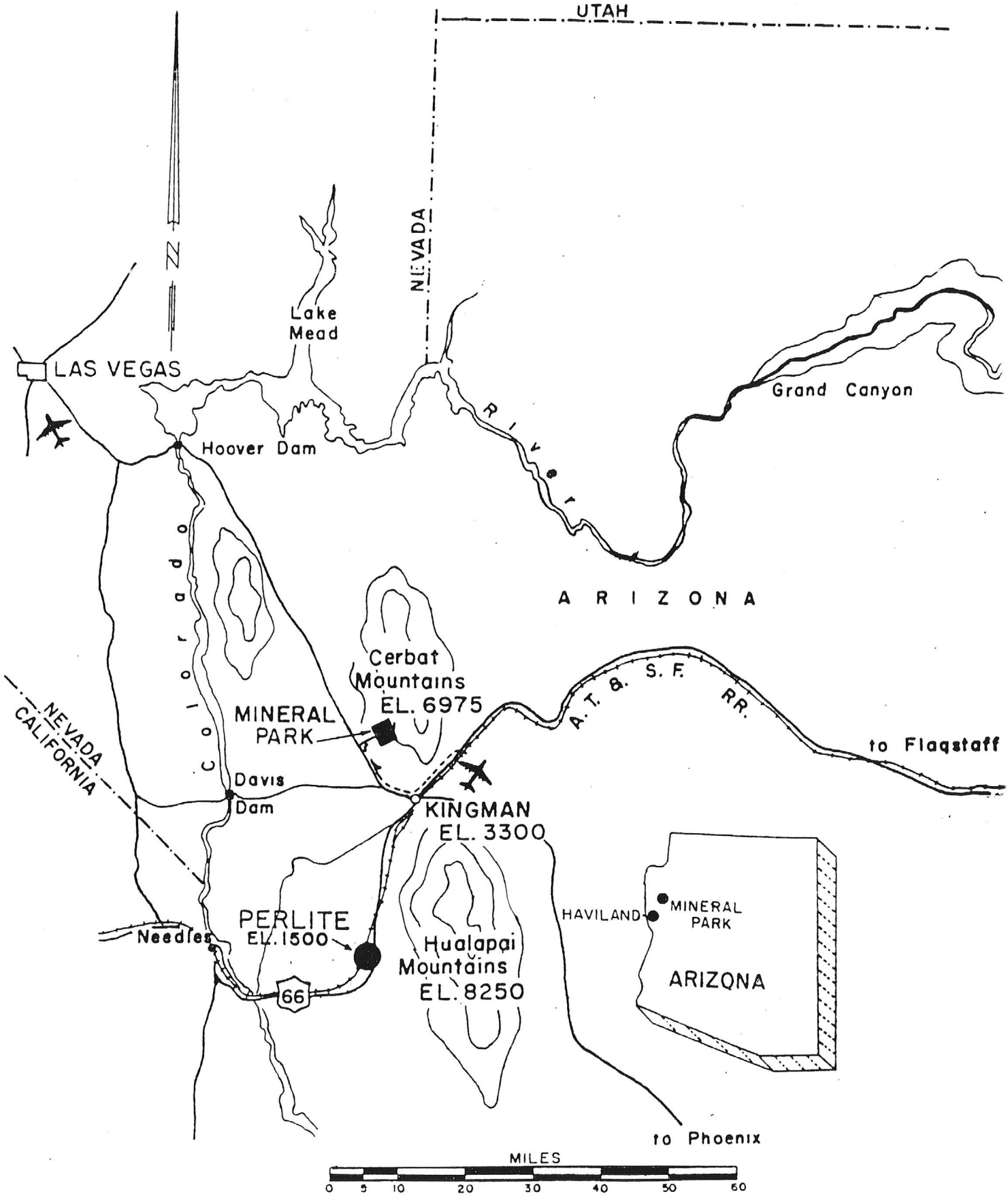


Figure 1. Index map of the Haviland Perlite Deposit, Mohave County, Arizona

HAVILAND PERLITE PROJECT

SUMMARY

Within the nearly 1800 acres of perlite claims now held by Duval Corporation is an estimated, mineable fifty-five million tons of pumiceous perlite and an additional thirteen million tons of perlitic perlite. None of the deposits are more than two and one half miles from the railroad. The best situated of the claims are those in section 20. It is traversed by the railroad, U. S. Highway 66, a power line, and is less than one mile from a gas line. There are estimated to be nearly six million tons of pumiceous perlite in this section which has been found by expansion tests in a commercial furnace to be of suitable quality. The slopes on these claims are relatively gentle, the railroad siding lies about 1000 yards from the proposed pit, at an elevation of 50 feet less than the surface at the outcrop.

There are at least five mineable types of perlite on the property and preliminary tests run both in vertical direct-fired and in horizontal indirect fired furnaces indicate that expanded products equal or better to any on the market can be produced by mining types best suited for the several uses of expanded perlite. These range from three pounds per cubic foot for cryogenics to twenty pounds per cubic foot for concrete aggregates.

The latest investigation of the perlite industry in Southern California and in the United States generally leads to the conclusion that the present Southern California field is in itself not large enough to ordinarily be of interest to Duval. However, at this time there is an opportunity to obtain a conventional established plant, and a new type of furnace operation to produce a material which will exploit an entirely new field in the industry. The plants are nearly side-by-side in the Los Angeles area. The gross sales from these two plants integrated with the Haviland deposits would be on the order of around four hundred thousand dollars per year for the first two years. This could be considered only a pilot operation to prepare for exploitation of eastern markets with perlite from a more strategic source. The "pilot" operation should continue to grow and show a substantial overall profit for the ensuing ten or fifteen year period, especially if the Pozzolan contract for the Road Canyon Dam is obtained.

REPORT ON THE

HAVILAND PERLITE PROPERTY

near

YUCCA, MOHAVE COUNTY, ARIZONA

MARCH 20, 1965

INTRODUCTION

The Haviland Perlite prospects came to the attention of Duval Corporation thru the New Mexico-Arizona Land Company. We were invited by them to acquire an option on a large checker-board block of their land southwest of Kingman, Arizona. The southeast end of the Black Range is included within this area. Other than for a few, small, gold vein prospects east of Oatman and Goldroad, the only apparent commercial possibility was a perlite prospect noted on their map in Section 35, T. 17 N., R. 18 W. In March of 1963, a preliminary reconnaisance of the area disclosed, as we had hoped, that there were overlooked masses of pumiceous perlite that had not been prospected. All previous work had been done in small blocks of "onion skin" type perlite. The quality of some of these was suitable but the mineral tonnages were inadequate where they had been prospected. Samples of the pumiceous block-flow material were submitted to the U. S. Bureau of Mines where it was expanded in a muffle furnace by LaMar Evans. He reported it to be of commercial quality.

Further examination of the area revealed better material on open Federal Land in Section 20, T. 16½ N., R. 18 W., and comparable deposits extending northward from New Mexico-Arizona Land Company property in Section 35 into Section 28. Surface samples of this material from both areas were sent to the Research Laboratories at the Colorado School of Mines. The samples were expanded in a two-inch diameter vertical laboratory furnace by Mr. Parke Yingst. The results of these tests showed the pumiceous perlite to be of commercial quality.

In October, 1963 the area was flown and photographed by Aerial Mapping for further geologic mapping and claim locations.

Since the middle of July, 1964 ninety-seven mining claims have been located, large samples of various flows have been and are presently being tested in commercial furnaces, a contoured geological map has been made for Section 20, and the major part of the remaining claims have been mapped similarly on aerial photographs enlarged to approximately 200 feet to one inch.

LOCATION AND ACCESSIBILITY

The property is located in northern Mohave County, Arizona. Claims are held in Section 20, T. 16½ N., R. 18 W., and in Sections 26, 28, and 34, T. 17 N., R. 18 W. Those in Section 20 are thirty-six miles Southwest of Kingman on U. S.

Highway 66 and twenty miles West of the Colorado River, the Arizona-California boundary. The nearest town, six miles from Haviland, is Yucca, Arizona; population estimated at 150. (See Index Map.) The A.T. & S.F. Railway traverses the northwest corner of Section 20 and it is here that the siding of Haviland is located, about one-thousand yards west of the proposed mining area. Claims in the remaining Sections 26, 28 and 34 are reached from U. S. Highway 66 by established unsurfaced roads, thence by primitive access roads that have been made by Duval Corporation for drilling, sampling and claim locating. It is advisable to travel these tertiary roads in a four-wheel drive behicle.

PHYSICAL FEATURES AND CLIMATE

The claims are situated at the extreme southeast tip of the Black Range. The elevations on the claims range from 1450 ft. in the Sacramento Wash in Section 20 to 2220 feet, the summit of a small peak in Section 28. The extremes of elevation on any of the individual perlite deposits is less than 150 feet. The siding at Haviland, for example, is only fifty feet lower than the proposed pit site on the vulcan claims six-tenths mile to the east.

The area is in the northwest corner of the Sonora Desert, but having a mean elevation of only about 1500 feet, it is within the lower Sonoran temperature zone. Year-round temperatures appear to be comparable to Tucson except for

slightly lower extreme winter temperatures. Average annual precipitation is estimated at around four inches. Most of this falls in July and August. Consequently, vegetation is very sparse and consists principally of small desert shrubs such as creosote bush (Larrea divaricata), mesquite (Propsis juliflora), catclaw (Acacia greggii), palo verde (Cercidium microphyllum), joshua tree (Yucca brevifolia), desert willow (Chilopsis linearis), and ocotillo (Fouquieria splendens), to name a few of the most common ones. Cactuses are not plentiful but a few small varities of prickly pear and cholla (Opuntia) as well as occasional hedge hog (Echinocereus), barrel (Echinocactus), fishook (Mammileria) and Saguaro (Cereus giganteus) have been observed. The latter are found only in one secluded canyon in Section 34. Hence the claims in that section were named for them.

Because the terrain is, generally, not rugged, the vegetation sparse, the temperature mild (except for the summer months), surveying, road building, drilling, constructing, mining and milling are not handicapped by these factors. Costs would compare closely to those at the Esperanza Mine, with the exception of drilling, which is less.

The Sacramento Wash lies between the highway and the major part of the claims and between most of the perlite on Section 20 and the siding at Haviland. This wash heads near Chloride, Arizona, nearly 45 miles to the north, so it carries,

for brief periods, a large run-off a few times a year. A minor amount of maintenance is usually required, on roads that cross the wash, after each run-off.

The "Map of Duval Corporation Perlite Claims" shows that a large arroyo runs south of the proposed pumiceous perlite mine site. This could easily be diverted into another arroyo to the south before the pit perimeter reached a critical elevation.

DEVELOPMENT

There has been no actual production from this district except that a few truckloads of "onion-skin" perlite were shipped from Section 35, T. 17 N., R. 18 W., and from Section 20, T. 16½ N., R. 18 W. These were probably shipped in the late '40's or early '50's for test purposes. The earliest claims located for perlite were those of Messrs. Prophet and Fuller of Oatman, Arizona in 1941. The latest claim notices found were dated 1957. Mr. Earl Tate, Postmaster at Yucca, Arizona, located most of the open ground in the area in 1955 but he stated that he dropped all of it several years ago when Greatlakes Carbon Company expressed no interest in it. All location and test pits had previously explored only the "onion-skin" perlite. No one had apparently tested any of the pumice block-flow perlites. The former work was done either on very small blocks of suitable material or on inferior vitrophyres containing too abundant feldspar phenocrysts to be of commercial value. The district

does not seem to have been very carefully studied by any of the major perlite companies in the past.

GEOLOGY

No attempt will be made at this time to hypothesize on the source of the eruptions that produced the pumice flows resulting in the perlite deposits. It will be assumed only that they are part of a chain of volcanoes that were active along the east flank of the Black Range northerly for more than fifty miles. The "Cottonwood rhyolite" mentioned by Ransome probably occured about the same time; late (?) Tertiary.

In the vicinity of Haviland the perlite is exposed within a northwesterly trending faulted zone more than two miles wide and several miles long. The entire area is composed of relatively small fault blocks of varying displacements measuring only a few hundreds of feet in any horizontal dimension. Vertical displacement between adjacent blocks may be more than 300 (?) feet in some instances. To the north these rhyolite glasses and tuffs are covered by younger, basic volcanics. To the south and east they are erroded and buried by alluvium.

Nowhere within the area mapped is an entire section of the acid volcanic flows to be seen nor are there any exposures of the underlying rocks. From a study of the zoning within the flows, I assume that there were at least two major eruptions, possibly three, each one covering the area with two to five-

hundred feet of pumice flows. Intervals before and after the major eruptions are marked by ash fall tuffs up to 100 feet thick. Errosion channels seen on the tops of the tuffs indicate that there was a significant time lapse between, at least one of the stages of vulcanism.

A single pumice eruptive stage appears to produce the following typical zoned cross section:

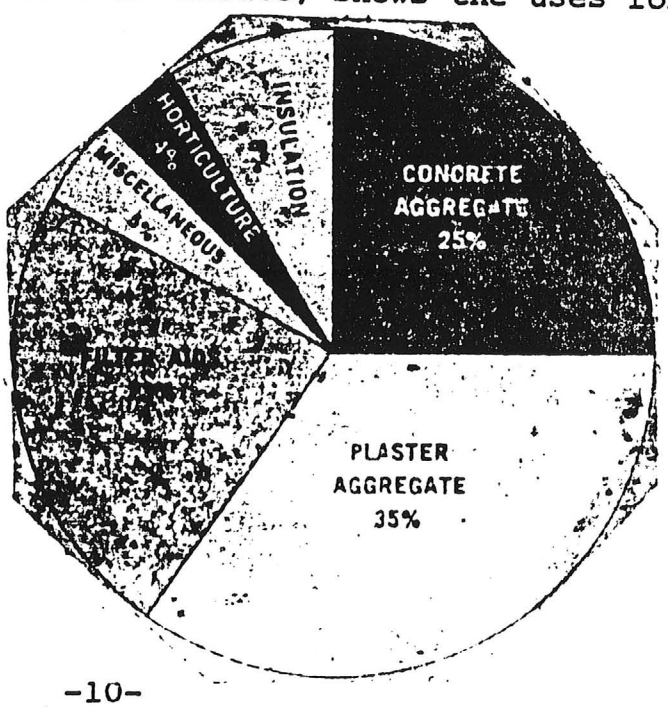
Ashfall tuffs	20' - 100'
Block-flow Pumice	50' - 100'
Perlite	30' - 130'
Spherulitic Perlite	10' - 30'
Lithophysal Rhyolite	10' - 50'
Spherulitic Rhyolite	30' - 100'
Spherilitic Perlite	10' - 30'
Perlite	30' - 80'
Block-flow Pumice	100' - 200'

Fortunately, for mining purposes, the fault boundaries of the blocks are generally steeply dipping. The flatest measured was forty-five degrees, the majority of faults dip sixty degrees or steeper. The "flows" are quite flat, dipping on an average of about twenty degrees. One of the steepest dipping series of pumice block-flows is that of the proposed pit-site in section twenty. Here the pumiceous perlite dips from thirty to thirty-seven degrees, but due to the topography in

this area and the thickness of the beds they can be mined easily to depth, maintaining a negligible stripping ratio.

Due to the unusual nature of perlite marketing which ties in with the geology and mining, it is necessary at this point to diverge from the usual format of a report and interject an explanatory note about perlite "ores".

Perlite marketing either raw or expanded presents many problems. One of the most important of these was brought out in the study of the Haviland deposits and of the market in Southern California. This is the fact that one type of raw material will not fill the requirements for all needs of the market. As an example, Marxus A. McClure, and others in the Los Angeles area, buy raw perlite from both Combined Metals Company and American Perlite Co. One company supplies a perlitic glass, the other a pumiceous aggregate. The following pie-graph, taken from a brochure of the Perlite Institute, shows the uses for perlite in 1962:



Plaster aggregate (including gypsum wall-board) has the largest use at 35%. This is classed as a "soft" perlite and is expanded in vertical, direct fired furnaces to produce a fine aggregate weighing 7½ to 10 pounds per cubic foot. A white color is desirable, and varying crushing and friability properties are required by individual users. A.S.T.M. specifications have also been established, as well as building code requirements for fire resistance of the plaster made from the expanded product.

Tests made on the pumiceous perlite block-flows in section 20 have shown that this type of perlite is very satisfactory for plaster aggregate, but firewall tests have not been made.

Concrete Aggregate represented 25% of the 1962 market. This is for "conventional" aggregate expanded in direct fired furnaces. The product weighs from six to twelve pounds per cubic foot and is used in making twenty-seven to thirty-six pound per cubic-foot concretes having compressive strengths with required minimums ranging from 160 p.s.i. to 400 p.s.i.

A new furnace has been developed by Precision Lightweight Aggregate Company of Los Angeles, California, that can produce perlite concrete aggregates weighing from twelve to twenty-five pounds per cubic foot. With these products concretes can be made with air-dry weights from 50 to 60 pounds per cubic foot, having compressive strengths from 1200 to 2000 p.s.i. By using the perlite as sand sizes and expanded shale as gravel, 77 lb/ft^3

concrete with 28-day strengths in excess of 4000 p.s.i. has been made.

It seems inevitable that this type of perlite will increase the volume of the perlite market several fold within the next few years. The expansion of perlite by the above method opens an entirely new field of applications such as structural concrete, floor fill, diaphram roof decks, concrete block, roofing tile, satisfactory mortar, and many more. Much of this market is in large commercial and high-rise buildings where great quantities of such concrete are used.

Mr. John Adkins who is responsible for the development of the furance to produce this unique type of aggregate, delivered a paper on his furnace and its capabilities at the 1965 Perlite Institute meeting. (Descriptive sheets on the furnace, aggregates, and concretes are included in the appendix of this report.) The announcement of this innovation created a great deal of interest among the perlite producers.

We were familiar with Adkins operation several months before the meeting and had approached him on the subject of joining him in this field. Presently we are in good position to obtain a portion of his company and become a leader in this new market.

It should also be noted that the use of light weight concrete products in the eastern States is growing appreciably.

This market can be penetrated deeply with fifteen to twenty-pound perlite, not from Haviland, of course, but from material more strategically located. By the time processing and marketing in southern California is piloted, we would be ready to enter the large eastern markets with full-sized expanding plants supplied by New Mexico, Texas, or foreign perlite. The eastern markets are well into the multi-million dollar per year volume.

Two perlitic types from Haviland were found to be satisfactory for use in the Plagco furnace to make concrete aggregate. Thru a misconception of the requirements, the pumiceous material which may prove, juding from its reaction in the direct fired horizontal furnace, to be an exceptionally good aggregate, was not tested. More samples have been taken and it is hoped that we will have an opportunity to have them tested.

Filter aid accounted for 23% of the market in 1962. In Southern California, at least, perlite is replacing diatomaceous earth to some extent, in spite of the fact that it is being marketed by small companies with no sales organization or advertising. Great Lakes Carbon who should logically push the product prefer to sell their "Dicalite" .

The aggregate used for making filter aid should be a low temperature, high expansion type of perlite; the raw material is ground to minus 30 mesh, plus 100 mesh. The blue-gray glass from the Pota Claims which failed to make as hard a concrete

aggregate as is desirable, will probably when treated in a vertical furnace, produce an ideal filter aid product at low cost.

Insulation grade perlite is being used in increasing quantities to insulate containers and trucks for storage and hauling of liquified gasses. The raw aggregate required is minus - 40 + 100 mesh size, with expanding properties similar to filter aid. Either blue-gray or pumiceous perlite will fill the requirements in this field. Loose fill insulation for building requires a similar raw material in coarser sizes. Perlite has long been recognized for its outstanding sound-insulation qualities. With the increasing use and number of ultrasonic planes, sound insulation is becoming more important. The need for better insulated homes and industrial buildings is resulting in an ever greater demand for perlite accoustical materials. Pumiceous perlite from Haviland expanded in vertical direct-fired furnaces is ideal for this product.

Horticulture consumes 4% of the market. The major producer in Southern California is the Paramount Perlite Co. of Paramount, California. This company mines its own perlite near Agua Caliente, Nevada. From Haviland we can supply it more cheaply than it can be mined and shipped from Nevada. Pumiceous or Pota will meet the requirements for this product. Ashcraft and Wilkinson Company, as experts in the marketing of fertilizers,

have a great advantage in increasing the market in that direction. This is a field that requires sales promotion and has a much larger potential than the present market indicates.

POZZOLAN - A BY-PRODUCT

Preliminary crushing and screening tests run by George Roseveare on the block-flow pumiceous perlite from section 20 showed that approximately 20% of minus 100 mesh rejects can be expected in processing this material for plaster and insulation aggregates. This was far below the estimates that had been made by visual inspection of the "agglomerate" and from the results of the inefficient crushing and grinding done by Lincoln Machinery Company on the first batch of samples.

It is possible that the minus 100 mesh material from the pumiceous perlite need not be wasted, and can be ground further to produce pozzolan. Combined Metals Company is supplying the Southern California market with a material that they mine from ash-fall beds in the Pioche district. The potential market has not been investigated. However, the proposed Road Canyon Dam on the Colorado River will require probably about 500,000 tons for its construction. Tae Chang, who worked at the mill that furnished most of the pozzolan for the Glen Canyon Dam, states that between 300,000 and 400,000 tons were used in that structure. The Bureau of Reclamation specifications for concrete for large dams of that type call for about 800 lbs. of

pozzolan to every ton of Portland cement used. A grinding plant at Haviland could capture both the Southern California market and the Road Canyon Dam contract. The latter would yield a very handsome profit inasmuch as the mill feed would cost nothing and Duval already has an experienced "pozzolan engineer" in the person of Tae Chang, already in its employ.

The zoning of the Haviland volcanics followed by the faulting and errosion to expose the various zones has resulted in a unique and versatile area wherein "custom" quality perlites can be mined to satisfy the entire market requirements. Because of the proximity of the various types of perlite, mining three blocks simultaneously to feed one crushing and screening plant poses no problem. The mill can be designed with storage facilities to accommodate the various products. This is common practice as Great Lakes Carbon Co., for example, produces eight different sized aggregates. However, it is all the same perlite which, as pointed out above, may be ideal for some uses but may be a compromise for others. Duval could produce an ideal product for every use.

ORE RESERVES

Estimates of ore reserves are only inferred tonnages as they are based on rather meager information. Only three very shallow diamond-drill holes have been drilled solely as exploration holes. The fifteen holes done for location work

were placed, whenever practicable, to obtain the greatest amount of geologic information of economic value. Due to the arrangement of the claims and the necessity of minimizing road costs, it was not always possible to spot the holes advantageously. Only one section of the four that include Duval's mining claims has been mapped topographically. Most of the remaining claims have been mapped geologically on aerial photographic bases which inherently contain an appreciable amount of distortion.

From field observations and the data available from the drill-holes it is felt that the estimates are generally on the conservative side. Further exploratory drilling must certainly be done before mining and milling plans are begun.

TONNAGES ESTIMATED

By Blocks

(See Haviland Perlite Claims & Deposits Map)

Block No.	Sq.In.	tons/sq.in.	Estimated av. thickness	M tons/bloc Pumiceous	M tons/bloc Perlitic
1-V (Vulcan)	0.41	13,888	55	314	(1)
2-V	2.56	"	158	5,640	(2)
3-V	3.27	"	100	4,540	(3)
4-V	1.65	"	100	2,285	
5-V	0.50	15,625	50		392 (4)
6-V	1.70	13,888	100	2,363	
7-St'y	0.48	15,625	50		333
1-P (Pota)	0.30	13,888	75	312	
2-P	0.65	"	100	925	
3-P	1.46	"	100	2,030	
4-P	0.48	"	50	334	
5-P	0.30	15,625	50		234
6-P	0.30	"	50		234
7-P	3.00	13,888	120	5,000	
8-P	0.67	15,625	50		522 (5)
9-P	0.69	13,888	75	720	
10-P	1.14	15,625	30		534
11-P	1.41	13,888	70	1,370	
12-P	0.56	"	50	389	
S-1 (Saguaro)	3.00	13,888	150	6,250	
S-2	1.60	"	50	1,100	
S-3	0.10	15,625	50		73
S-4	1.83	"	100		2,860 (6)
S-5	0.15	13,888	50	106	
S-6	0.16	15,625	50		125
S-7	0.07	13,888	50	48	
S-8	1.95	15,625	100		3,250
S-9	0.48	13,888	50	333	
S-10	0.18	"	50	125	
S-11	0.20	13,888	50	139	
S-12	1.00	15,625	40	625	625
S-13	1.64	"		2,280	2,280 (7)
S-14	0.048	13,888		12	

Block No.	Sq.In.	tons/sq.in.	Estimated av. thickness	M tons/bloc Pumiceous	Perlitic
1-D (DMC)	1.13	13,888	70	1,090	
2-D	1.55	"	70	1,507	
3-D	0.17	"	50	107	
4-D	0.40	"	50	277	
5-D	2.31	"	100	3,210	(8)
6-D	1.26	"	50	872	
7-D	0.55	"	50	382	
8-D	6.40	"	150	13,320	
9-D	0.23	15,625	50		159
10-D	0.55	13,888	50	430	
Total Pumiceous Perlite				58,435	
Total Perlitic Perlite					11,621
Total Combined Tonnage					70,056

(1) Prepared to - 16, + 40 mesh by U. of A. and run in M. A. McClure Co. vertical furnace for plaster aggregate. Required 1740° F. temperature, feed rate about 200 cubic feet per hour. Produced a good "hard" plaster aggregate weighing 9 pounds per cubic foot. Apparently there was very little decrepitation. Temperature, feed rate and bulk density could probably be improved by including finer sized feed but still meeting A.S T.M. sieve analysis requirements, due to the low decrepitation during expansion. This material should be tested in the Plagco furnace, as it may make excellent concrete aggregate with coarse material.

(2) Prepared to a poorly sized aggregate of - 16 + 100 mesh by Lincoln Machinery Company. Expanded in M. A. McClure Co. vertical furnace for plaster aggregate it required 1640° F. temperature (same as American Perlite used by M. A. McClure Co.) Feed rate was not ascertained because of excess fines. Produced a "soft" aggregate similar to American Perlite. The product weighted 7½ to 8 pounds per cubic foot.

Two more samples were taken April 9, 1965 for possible testing in Plagco furnace.

(3) Prepared to - 16 + 40 mesh by U. of A. and run in M. A. McClure Co. vertical furnace for plaster aggregate. Results were similar to number (1) above, but there was slightly more decrepitation; also the aggregate was somewhat softer than #1. The sample contained some welded tuff fragments but there was practically no drop-out of it in the furnace, so the percentage of this lithic material is too small to be objectionable.

(4) A pale tan perlitic material which was crushed to - 4 mesh, + 40 mesh at the U. of A. and tested in Plagco furnace as sample Number V-9-P. This produced a pale cream colored, strong, fine aggregate that had a bulk weight of 20 pounds per cubic foot. Furnace temperature was 1875° F.* This type perlite would produce an excellent aggregate for lightweight concrete products such as building-blocks, roofing tile, etc.

(5) Dark blue-gray, perlitic glass mapped as "Tpb". This was crushed and screened at U. of A. to minus 4, plus 40 mesh and tested in the Plagco furnace. At 2000° F.* the product weighed 15 pounds per cubic foot with noticeable decrepitation during furnacing. At 1750° F.* the product weighed 22 pounds per cubic foot but did not decrepitate but slightly. Neither product appeared to be as hard as Combined Metals perlite from Pioche, Nevada. Considering the reaction of this type of perlite in the Plagco furnace, it should be tested in a vertical, direct fired type as it will probably make a good filter aid and horticultural product.

(6) Pale gray biotitic perlite mapped as "Tpc". This was crushed and screened at U. of A. to minus 4 mesh, plus 40 mesh and tested in the Plagco furnace. At 1900° F.* the product weighed 17.5 pounds per cubic foot, did not decrepitate and was an off-white colored, hard-type aggregate suitable for concrete.

Footnote: *Temperatures in the Plagco furnace taken in fire chamber between inner and outer shells. Temperatures in expansion tube are somewhat less.

(7) Similar to above but contained a small amount of lithic material. The results were comparable to (6).

(8) Pale gray, dense, pumiceous perlite having an appearance similar to some of Great Lakes Carbon Company's No Agua perlite. In physical appearance this ore looks as good as any obtainable anywhere. A sample was sent to Zonalite Company's laboratory but no results have been reported on this material.

CONCLUSIONS

In Mr. C. T. Nixon's report on perlite he suggests that "it would be difficult for a new crude perlite producer to effectively market more than 50,000 tons annually." This is probably including some shipment to the eastern markets. It was a foregone conclusion that the only market available for the Haviland deposits is Southern California. The recent investigations at the Perlite Institute Convention and of the producers in the Los Angeles area with Mr. Frank Lamb of Duval's research and development division disclosed many interesting facets of the perlite industry:

(1) The present market in Southern California is on the order of only 15,000 tons annually.

(2) The Marcus A. McClure Plant of Los Angeles, owned by Mr. O. D. Sisson, produces about 4,000 tons of expanded perlite a year, approximately one-fourth of the total.

(3) The McClure plant sells a little of each type of the products now used: plaster aggregate, wall-board aggregate, loose-fill insulation, low-strength concrete aggregate, filter

aid, cryogenic tank insulation, and horticultural soil conditioner.

(4) Plago (Precision Lightweight Aggregate Company), owned and managed by Mr. John Atkins of Los Angeles, has developed an expanding furnace that will produce a perlite aggregate much superior for many uses to that presently expanded in directly fired furnaces. In addition, the perlite produced in this furnace is acceptable for use in structural concretes with strengths heretofore out of the perlite market.

(5) The introduction of the "Plago-type" hard perlite should within a short time double the market for perlite in Southern California, as well as open up an entirely new market in the rest of the United States.

(6) The growth of the perlite industry as a whole is stunted. The cause of this stems from the fact that there are two major types of producers within the industry, each with its own disadvantages in furthering progress.

(a) The small producer with inadequate capital and initiative for sales promotion, research and development.

(b) The very large company with diversified products, some of which conflict with perlite. Although they are perlite producers, they are interested mainly in their own captive markets. The wallboard producers use a maximum of gypsum and a minimum of perlite but

their strong sales organizations have taken over the plaster field. The insulation companies compete against perlite with other, apparently more profitable, products such as rock wool and expanded micas. One large perlite company, in addition to manufacturing wallboard, sells diatomite for filter aid which in many instances could be substituted by perlite at a lower cost to the consumer.

(7) The value of sales promotion as well as research and development is best illustrated by the latest Mineral Yearbook figures (1963) which show the value of expanded vermiculite and of expanded perlite sold in the United States to be nearly equal for that year: $14,000,000.00. Perlite, while superior in nearly every field of application, enjoys practically no more popularity than the well advertized and promoted inferior expanded micas.

Let it be assumed that the present Southern California market by itself is too small to be considered by a company such as Duval Corporation. Certainly the overall national market is large enough to be of interest as a diversified field.

If Duval Corporation was to buy Marcus A. McClure Company and an interest in Plagco, these could be supplied with Haviland perlite and run at a profit while considered

only as a pilot operation to gradually break into the entire perlite industry. In the meantime, a source of supply to the East from New Mexico, Texas, Wyoming, Islands in the Gulf of Mexico, Carribean Ocean, Iceland, Italy, or elsewhere, could be developed. The experience in operation and marketing gained in California would then be utilized in distributing Duval-Plago furnaces and supplying these and others across the nation with Duval perlite.

Within the next two or three years the pozzolan contract for the Road Canyon Dam on the Colorado River should come up for bid. This would be a profitable $5,000,000.00 contract and its possibility should not be overlooked in the evaluation of the Haviland project.

With the freight and mining advantages at Haviland, it is likely that we can supply some of the smaller producers who now mine their own material in Nevada and Central Arizona.

PRECISION Lightweight AGGREGATE CO. 4530 EAST PACIFIC WAY, LOS ANGELES, CALIFORNIA 90022

STRUCTURAL LIGHTWEIGHT CONCRETE

PHONE
AN 1-0264

AGGREGATE INTEGRITY TESTS

AGGREGATE	AGGREGATE WT/CF	MIX YIELD, % OF CONTROL AFTER MIXING			% YIELD LOSS 5 MIN. TO 30 MIN.	
		5 MIN.	15 MIN.	30 MIN.		
CONTROL	67.90	103.0	100.0	100.0	3.0	
P-2	27.24	88.5	83.2	78.5	11.3	***
P-3	26.50	92.7	90.9	89.0	4.0	***
P-4	25.38	81.2	78.5	77.0	5.2	***
P-5	24.00	92.2	88.1	86.0	6.7	***
P-6	20.40	88.4	84.9	84.0	4.9	
P-7	19.85	92.4	89.0	85.4	8.0	
P-8	19.60	98.3	97.2	94.3	4.1	*
P-9	18.90	102.0	94.8	92.6	9.2	
P-10	17.80	92.4	91.5	88.6	4.0	
P-11	17.64	90.5	86.5	84.4	6.8	
P-12	17.44	84.4	78.3	77.9	7.7	
P-13	16.76	89.0	84.3	80.0	10.1	
P-14	14.00	86.4	81.0	77.8	9.9	
P-15	11.50	74.3	69.6	58.6	21.1	
P-16	9.00	78.5	70.5	58.7	25.2	
A	9.00	62.6	60.0	58.8	6.1	**
B	8.20	69.8	65.5	63.8	8.5	**
C	7.50	72.3	64.8	63.8	11.7	**
D	7.20	66.8	64.5	62.4	6.6	**
E	4.88	67.3	63.2	61.4	8.7	**

* USED IN ALL PRESENT STRUCTURAL CONCRETE MIX DESIGNS

** CONVENTIONAL EXPANDED PERLITE CONCRETE AGGREGATE

*** EXPERIMENTAL ORES FROM NON-PRODUCTION MINES

NOTES: CONTROL AGGREGATE USED WAS EXPANDED SHALE SAND

ALL TESTS USED ½ CUBIC FOOT OF AGGREGATE, 10 POUNDS OF CEMENT, AND 10 POUNDS OF WATER. MIXER USED WAS A PAN TYPE WITH NO AGITATION OTHER THAN THE PAN ROTATION, AND DIVERTERS.

PRECISION
Lightweight AGGREGATE CO. 4530 EAST PACIFIC WAY, LOS ANGELES, CALIFORNIA 90022

STRUCTURAL LIGHTWEIGHT CONCRETE

PHONE
AN 1-0264

STRUCTURAL CONCRETE SPECIFICATIONS

APPLICATION	SPECIFICATION REQUIREMENTS	SACK CONTENT PER CU. YD.	AIR DRY WT. LBS. / CU.FT.
PRECAST YARDS	SMOOTH SURFACE WEATHER RESISTANCE 2000 PSI	8	75
FLOOR FILL	PENETRATION RESISTANCE 1200 PSI	6	55
STRUCTURAL	2000 PSI	8	60
STRUCTURAL	2000 PSI	6	72
STRUCTURAL	3000 PSI	6½	74
STRUCTURAL	3750 PSI	7	77

NOTE: MIX DESIGNS FOR ALL OF THE ABOVE HAVE BEEN DEVELOPED.

TESTS BY A CERTIFIED LABORATORY ON 6" x 12" CYLINDERS OF THE 3750 PSI MIX SHOWED AN AVERAGE 28 DAY COMPRESSIVE STRENGTH OF 4250 PSI.

REPORT
TO
City of Los Angeles
Board of Building and Safety Commissioners

SUBJECT:

GENERAL APPROVAL - Modification

R.R.: 22742
No.:
BOARD FILE: 65.401.1
RECEIPT: 61305/63

PETITIONER:

Precision Lightweight Aggregate Co.
4530 Pacific Way
Los Angeles 90022

REA

DEPARTMENT RECOMMENDATION

Approval until March 1, 1967 of the following

1 Plagco-Lite lightweight concrete as a non-structural floor covering for 1-hour construction subject to the following:
   a) The structural subfloor and 15# felt is installed as required by Section 91.4306(e) of the Code.
   b) The concrete shall have a minimum thickness of 1 5/8" and a maximum thickness of 3".
   c) Design calculations for supporting floor joists will be required
   d) The minimum density shall be 80 lbs. per cubic foot.

2 Plagco-Perlite aggregate as a lightweight aggregate in Grade "A" concrete with the following exceptions:
   a) Prestressed concrete
   b) Reinforced concrete columns
   c) Bearing walls exceeding 2 stories in height

The Modulus of Elasticity shall be determined by test for each mix. This value shall be used in the structural design.

FINDINGS

Tests have been performed on the Plagco-Lite lightweight concrete as t indentations, density and strength. The 28 day strength exceeds 2000 psi and the indentation is less than that obtained on A-C plywood. Th Plagco-Perlite aggregate has been tested and found to conform to the requirements of ASTM 330.

The approval is modified to add the Plagco-Perlite lightweight aggrega

J. C. MONNING
Superintendent of Building

RECOMMENDED BY

WALTER A. BRUGGER, Chief
Engineering Research and
Development Bureau

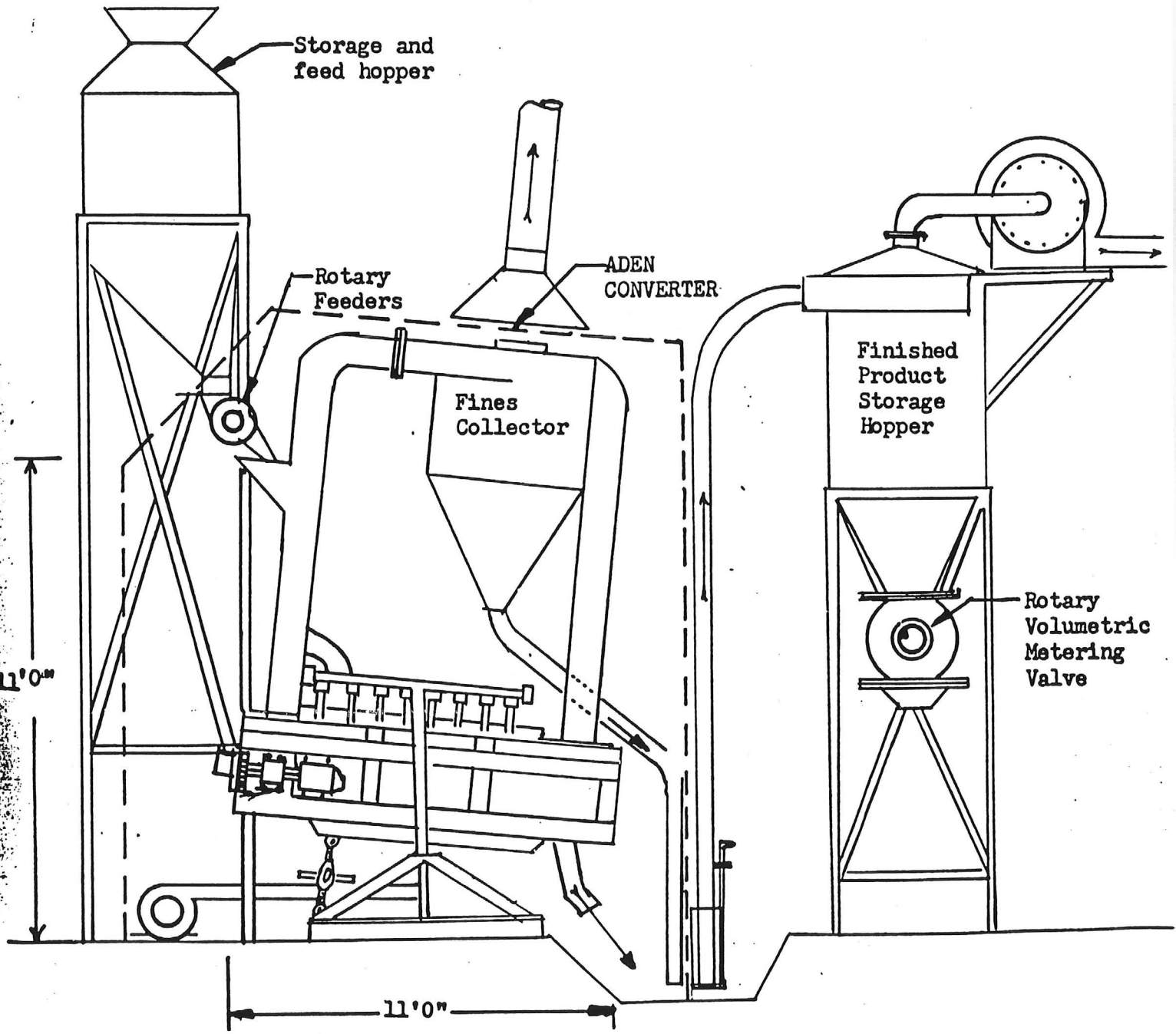
Report and recommendations adopted by the BOARD OF BUILDING AND SAFETY COMMISSIONERS on FEB 8 1965

PRECISION
Lightweight AGGREGATE CO. 4530 EAST PACIFIC WAY, LOS ANGELES, CALIFORNIA 90022

PHONE
AN 1-0264

213

TYPICAL ADEN CONVERTER INSTALLATION



MELVIN H. JONES
Mining Geologist
Box 1, Montello, Nevada 89830

July 19, 1974.

RECONNAISSANCE GEOLOGICAL INVESTIGATION OF PERLITE DEPOSITS IN MIDDLE AREA OF THE BLACK MOUNTAINS, MOHAVE COUNTY, ARIZONA.

In accordance with instructions of Mr. Howard S. Gable, Box 946, Kansas City, Mo., the undersigned, on the 17th of July, 1974 was conducted over the "Pearl" mining claim area by Mr. and Mrs Clellan L. Daily of Winslow, Arizona. Mr. Jack Day, agent of Mr. Gable was also present and assisted in the study of the perlite outcrops. With only one day spent in the area, and with intermittant rain storms, only a limited portion of the perlite outcrops, including that on the mining claims, was covered. Only the observed outcrops are outlined on the attached map (Incl.#1), and many outcrops in the area could be missed.

As stated above, the major part of the area visited is covered by lode mining claims owned by Mr. Gable. These claims will be surveyed in the near future and re-alligned. A map of the claims is not made part of this report for this reason.

GEOLOGY. The general area is composed of Tertiary Rhyolites, with some of the higher ridges and hills covered with Quaternary basaltic lava flows. The valley area where the perlite outcrops are found, is called "Detrital Valley", which is well named. The perlite crops out intermittently along the ridges and sporatically in the lower regions in the form of ancient flows, but parallels rhyolite flows and in some places there are alternating bands of perlite and tuffs, as well as some breccas with fragments of perlite. Some latites were also observed. In places, the perlite becomes of poorer quality and grades into rhyolite.

It is to be pointed out that this is a rhyolite type of perlite. Some of the outcrops show what appears to be the highest grade of perlite, and this is in color from grey, bluish grey to white. A small amount of black perlite was found. This perlite has the typical volcanic glass appearance with concentric cracks. At this point, it might be well to go into some definetions used in the perlite industry. "Perlitic" means resembling perlite, concentrically lamellar; applied to microscopic structure in glassy rocks resembling that of an onion. "Pumiceous" refers to the foamy structure of pumice. A devitrified perlite is also known and this is usually considered not suitable for perlite industrial use. Some of the outcrops in the area have this appearance.

In the perlite industry, it appears that any rock that has 2 to 5% water, and will expand from 4 to 20 times its original volume, sets it apart from other volcanic glasses, and this is the distinguishing feature.

One perlite exposure on the side of a ridge had a thickness in excess of 30 feet. Perhaps some flows will have a much greater thickness, but this can only be determined by drilling.

CONCLUSIONS:

While hearsay evidence indicates the perlite in the Black Mountains is of good commercial grade, and I see no reason to disagree with this viewpoint, based on observed deposits and perusal of literature having a bearing on the subject. However, in considering the various industrial uses of perlite, with different specifications, laboratory testing should be accomplished. Using for these tests, the several types of perlitic rocks found in the area. The results should show the cut off points, when mining is undertaken. This information will be most important when tonnage of reserves is estimated.

Several grab samples of the perlitic rocks were taken and Mr. Day has this petrographic material. This includes volcanic rocks that appear to grade into perlite. As the testing of perlite requires a specialty laboratory, and the costs will be high, the writer is not undertaking this task as part of this report.

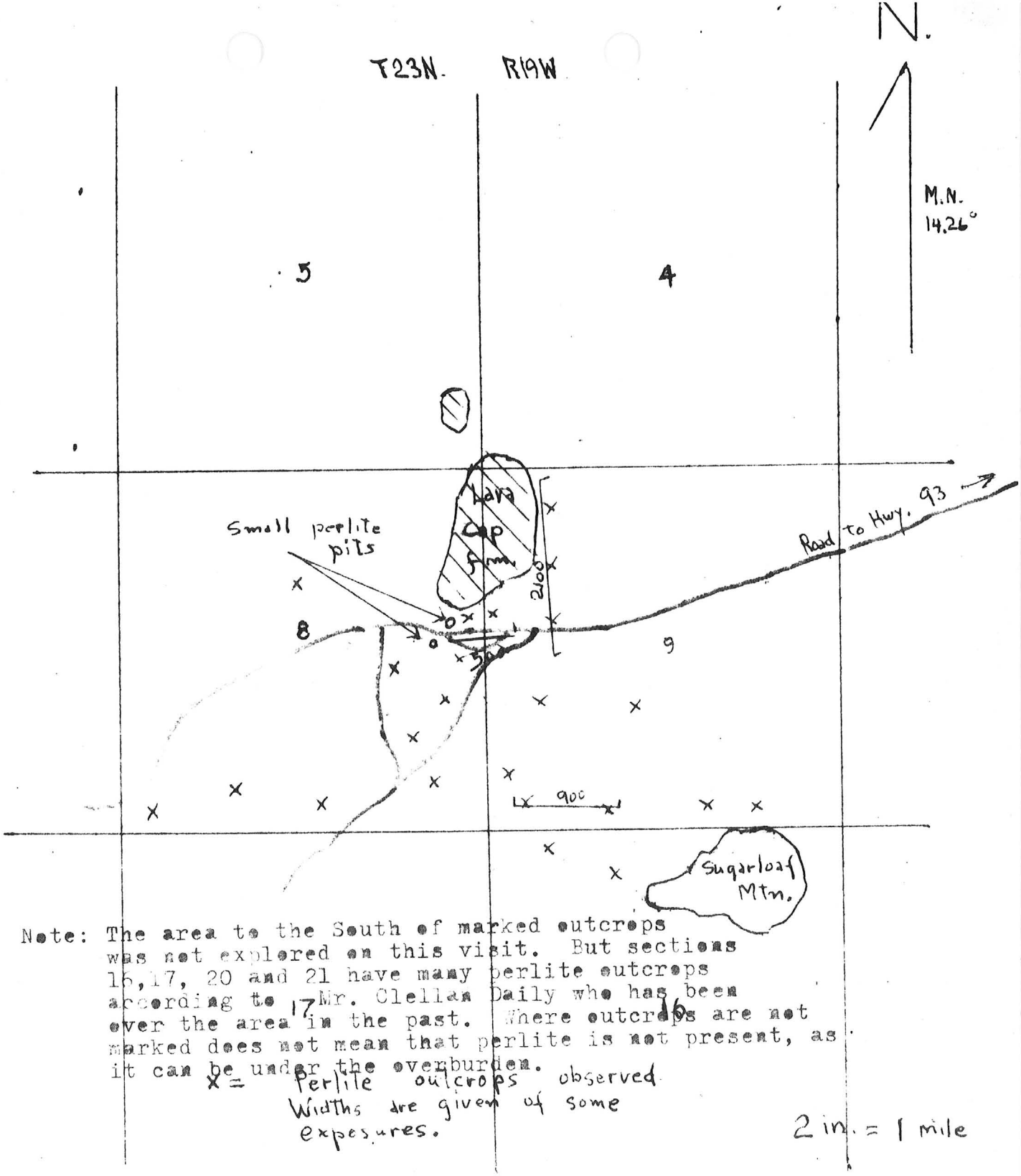
After laboratory testing has been accomplished, a drilling program should be initiated to determine reserves of commercial grade perlite.

It is the opinion of the undersigned, that the perlite claims in the area covered by this report, have great value. Efforts should be continued to survey and re-allign present claims, and to develope the property so it can be put into production.

MINING GEOLOGIST.

P.O. box 406,
Wickenburg, Arizona, 85358.

cc To Mr. Jack Day.

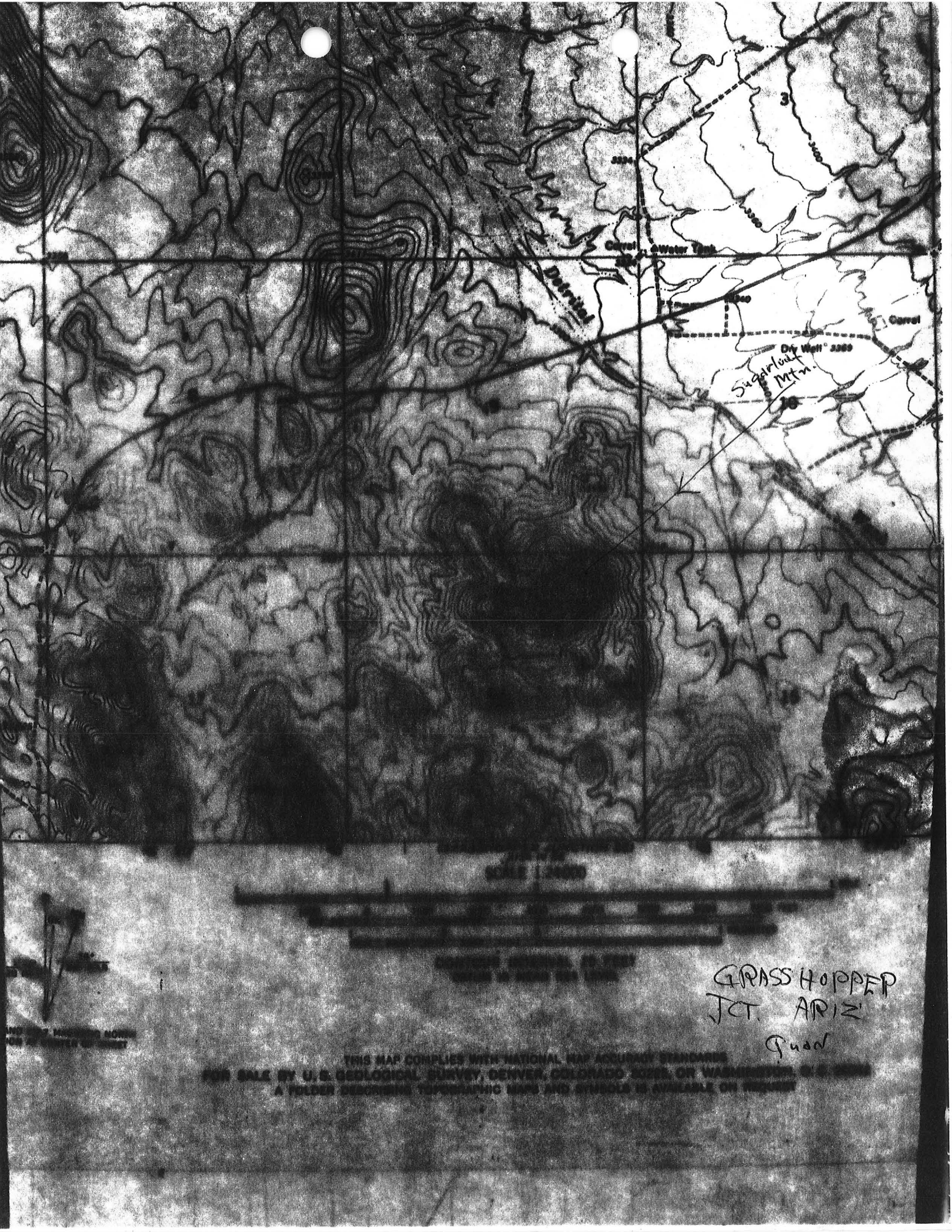


Note: The area to the South of marked outcrops was not explored on this visit. But sections 16, 17, 20 and 21 have many perlite outcrops according to Mr. Clellan Daily who has been over the area in the past. Where outcrops are not marked does not mean that perlite is not present, as it can be under the overburden.

X = Perlite outcrops observed. Widths are given of some exposures.

2 in. = 1 mile

INCL. #1


Detrital
Dry Wash
Sugarloaf Mtn.
GRASSHOPPER JCT. ARIZ
Quad

MELVIN H. JONES
Mining Geologist
~~Box F, Mohello, Nevada 89830~~ Box 406
Wickenburg, Ariz.85358.

MEMORANDUM FOR THE RECORD.

SUBJECT: Perlite - Kingman, Arizona area.

April 15, 1974. At Kingman, Arizona with Howard S. Gable. Together with Actor Patten*, Pearl Craig, Van Daily, Jack Day, Al Hack* and Gable, proceeded to the Haviland Perlite claims out of Yucca, Arizona accompanyied by Boris Ivakowsky** and John W Rains (California Portland Cement Company). The latter individuals were interested in acquiring, leasing or purchasing perlite from the property. The group went over the claims, generally. The writer accompanied John Rains (mining engineer) in looking over formations and sampling. Samples were taken from : #1 Grab sample over large area on Claim No. 14 (West side); #2 Grab sample from perlite exposure in gulch on Claim No. 77; Grab sample from pit on claim No.80.

April 16, 1974. Part of above group (Patten,Craig,Daily, Day, Hack, Gable and writer made trip to upper area of the Black mountain - 20 miles NW of Kingman on Hwy No.93 and then 3 miles E. on dirt road, to another perlite deposit. Perlite extends across road in places and goes to hill. Mr. Gable made decision to have Mrs. Craig (and crew) to stake out a minimum of 6 lode mining claims in the vicinity. At a small pit near road, the material is the typical perlitic (onion skin) perlite, other exposures grade into pumaceous or tufaceous perlite.

April 18, 1974. MELVIN H JONES

* Marketing expert (from New Jersey)
** Ore processing expert(from Denver, Colo.)
*** Part of Management, California Portland Cement Co.

Box 406
Wickenburg, Arizona, 85358
12 April 1974

MEMORANDUM FOR THE RECORD

Subject: Visit to the Haviland Perlite claims, Yucca, Ariz.

The writer spent April 10-11, April 1974 on the Haviland Perlite claims located SW of Yucca, Arizona. Mrs. Pearl Craig, Kingman, Arizona, who has been doing most of the claim location work, was also present. Time was spent going over the claims (90 lode claims), examining posting of location notices, roads, and perlite exposures. The property is known to have pumaceous perlite and perlitic perlite (estimated to be 55 and 13 million tons, respectively). These claims were initially taken out by Duval (copper) about 10 years ago under the claim names of Saguara, Chapo, Vulcan, Sliver, Dec.21, DMC, Peta, Shorty, and subsequently abandoned (the property was drilled in 1964, however) Considerable time was spent by Mrs. Craig, and the writer locating the old drill holes (a total of 15). These will be mapped.

On April 11, Mr. Don Rodriguez, General Manager of the Metler Bros. Drilling Corporation, accompanyied us in going over the mining claims. Mr. Rodriguez will submitt an estimate of the cost to re-drill the property to cover location work requirements. Metler Bros. initially drilled the property in 1964 for Duval. He said the drilling at the time took 55 days. Mr. Rodriguez had some of the earlier drilling data with him and gave us the depths of overburden on the drill sites (length of casing used). See inclosure.

Upon arriving at Kingman on April 10th, I made a fast trip to the Duval plant(Northwest of Kingman). There I met and talked with Ronald F. Teissere, Duval geologist. I asked him the question, Why did Duval abandon the Yucca perlite claims ? His answer was, that"there is nothing wrong with the perlite ore, but the economic situtiom years ago, would not permit the mining and shipping of perlite at profit, then. Perhaps there is more demand for perlite, now".

Melvin H Jones
geologist

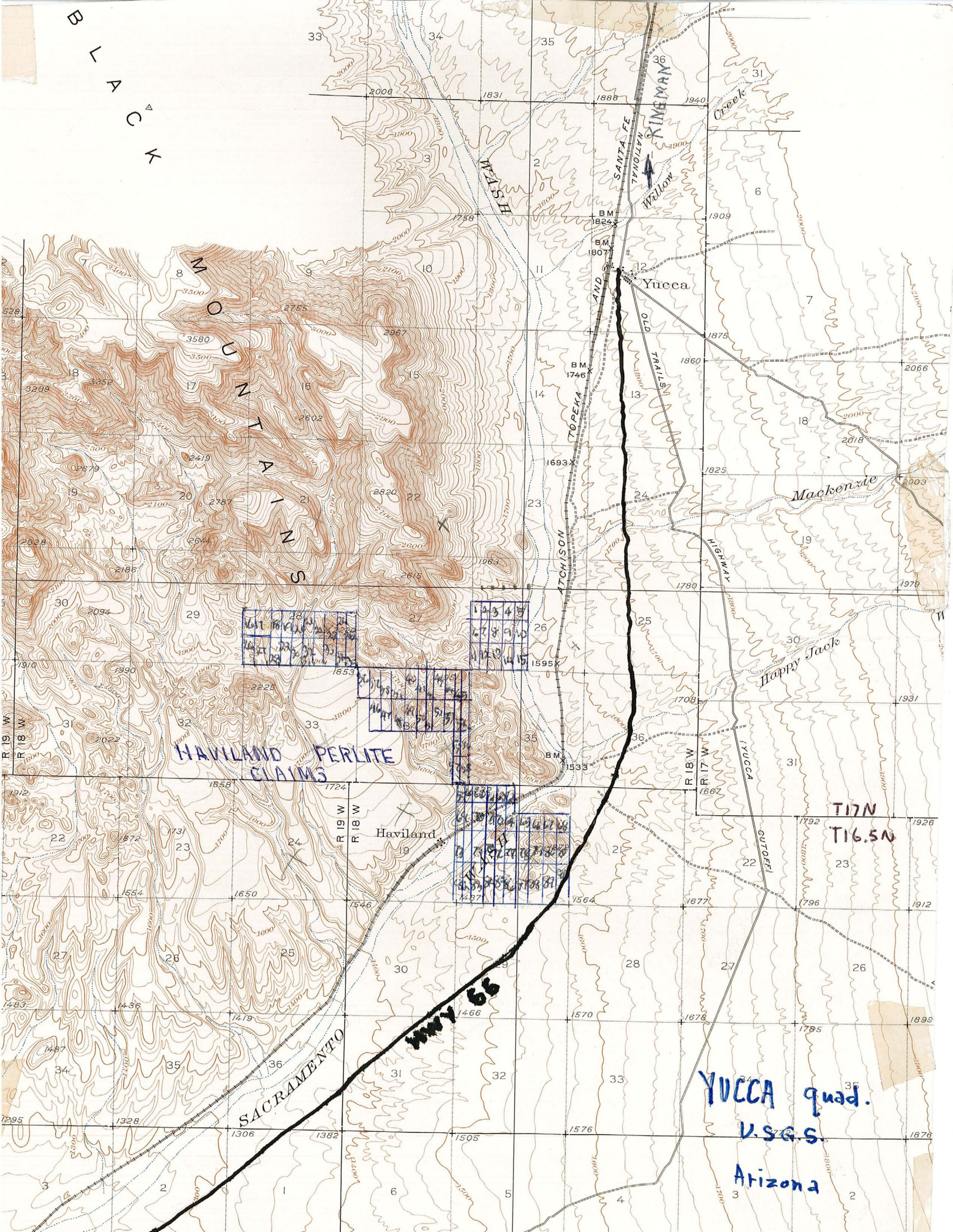
From the desk of ... Haviland Claims

DON RODRIGUEZ

Overburden in feet.

Dit.

#1	27	A-1	10
2	30	A-2	25
3	25	A-3	10
4	25		
5	25		
6	10	Didn't see	
7	10		
8	10		
9	5		
10	10	pieces of ore	
11	10		
12	10		
13	10		
14	10		
15	10		


BLACK
MOUNTAINS
WASH
Willow Creek
SANTA FE NATIONAL
KINGMAN
Yucca
OLD TRAILS
AND
TOPEKA
ATCHISON
HIGHWAY
Mackenzie
Happy Jack
YUCCA CUTOFF
Haviland
HAVILAND PERLITE CLAIMS
SACRAMENTO
HWY 66
R 19 W
R 18 W
R 17 W
T17N
T16.5N
BM 1824
BM 1807
BM 1746
BM 1693
BM 1595
BM 1533
YUCCA quad.
U.S.G.S.
Arizona

OLIVIA DE GROUP

DMC . . GROUP

N.M.-A. L. CO.

N.M.-A. L. CO.

N.M.-A. L. CO.

POTA GROUP

SAGUARO GROUP

SACRAMENTO WASH

A.T. & S. F. R.R.

T. 16½ N., R. 19 W.

T. 17 N., R. 18 W.

T. 16½ N., R. 18 W.

EXPLANATION

PERLITE (PUMICEOUS)

PERLITE (PERLITIC)

TONS IN MILLIONS (INFERRED) 8.27

"ROADS" PICK-UPS ONLY

DIAMOND DRILL HOLE, DISCOV.

" " " , EXPLOR.

SHORTY GROUP

FEE LAND (A.T. & S.F.RY.)

ATCHISON TOPEKA & SANTA FE RAIL ROAD

HAVILAND

SACRAMENTO WASH

SLIVER

CHAPO GROUP

VULCAN GROUP

Gem Acres Realty Co.

Gas Pumping Station - Two miles

POWER LINE

GAS LINE

SECTION 30
FEDERAL LAND

SECTION 29
PRIVATE LAND

28

27

26

33

35

34

20

Haviland

19

24

16 17 18 19 20 21 22 23 24 25

26 27 28 29 30 31 32 33 34 35

1 2 3 4 5

6 7 8 9 10

11 12 13 14 15

36 37 38 39 40 41 42 43 44 45

46 47 48 49 50 51 52 53 54

55 56

57 58

59 60 61 62 63

64 65 66 67 68

69 70 71 72 73

74 75 76 77 78 79 80 81

82 83 84 85 86 87 88 89 90

D.H.
No. unknown

HAVILAND CLAIMS

= Drill Hole
approx. locations

AT&SF RR

Wash

Sacramento Wash

HWY 66

GEM ACRES
Overpass
Approx. Location

N

WH 74


1 2 3 4 5
6 7 8 9 10
11 12 13 14 15
19 20 21 22 23 24 25
29 30 31 32 33 34 35
28 27
33 34
21 26
34 35
36 37 38 39 40 41 42 43 44 45
46 47 48 49 50 51 52 53 54
55 56
57 58
59
60 61 62 63
69 70 71 72 64 65 66 67 68
73 74 75 76 77 78 79 80 81
82 83 84 85 86 87 88 89 90
N
FEE LAND
HAVILAND
WELL
AR
US Hwy
PERLITE
PERLITIC
PUMICEOUS

28

27

26

35

34

20

19

N

Perlite Pumiceous

Perlite Perlitic

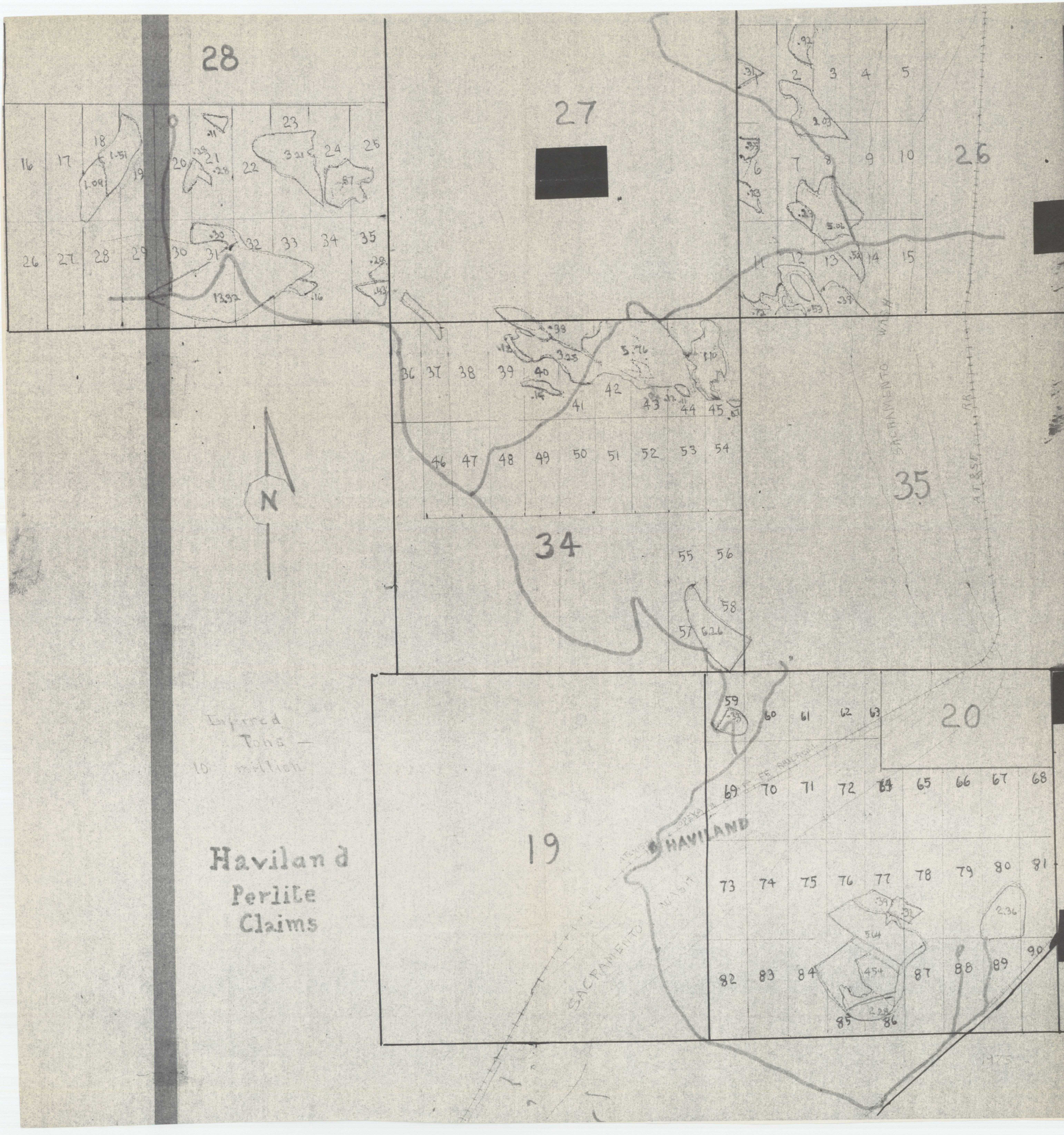
Inferred
Tons -
10 million

Haviland
Perlite
Claims

SACRAMENTO WASH

A.T. & S.F. RR.

HAVILAND


28
27
26
34
35
19
20
N
SACRAMENTO WASH
A.T.&S.F. RR
HAVILAND
Inferred Tons — 10 million
Haviland
Perlite
Claims
1975