Gravel Resources and Placer Gold Development Potential on the Colorado River Indian Reservation, Arizona and California

U.S. Bureau of Mines, Report BIA No. 50-III

By L.G. Nonini, E. K. Peterson, and J.A. Dupree

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This report by the US Bureau of Mines is an in depth analysis of the gravels of the Colorado River Indian Reservation. The study involves terrace deposits as well as fluvial wash deposits. Additional study areas include parts of Gonzales, Seventy and Tyson Washes outside of the Reservation boundaries.

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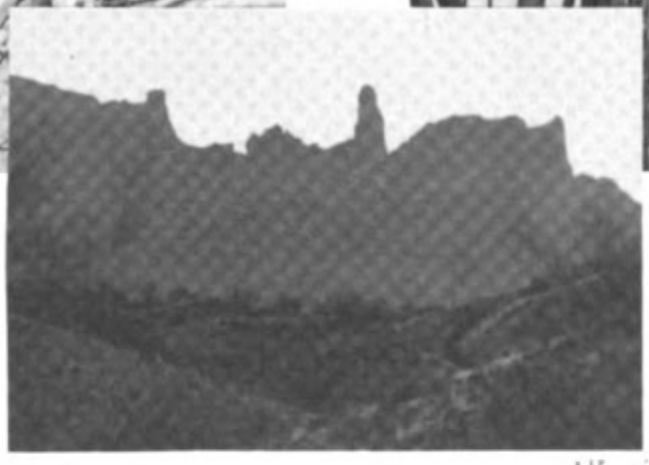

Phase III
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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

cents/yd^3	cents per cubic yard
ft	feet
ft/s	feet per second
in	inch, inches
lb	pound
MMyd^3	million cubic yards
m	meter
m^3/d	cubic meters per day
mg	milligrams
mg/yd^3	milligrams per cubic yard
mg/st	milligrams per short ton
shifts/d	shifts per day
st	short ton
tr oz	troy ounce
yd^3/d	cubic yard per day

GRAVEL RESOURCES AND PLACER GOLD DEVELOPMENT POTENTIAL ON THE COLORADO RIVER INDIAN RESERVATION, ARIZONA AND CALIFORNIA

by

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ABSTRACT

The Bureau of Mines investigated gravel resources and placer gold resources on the Colorado River Indian Reservation. The investigation of gravel resources included mapping and examining Colorado River terrace deposits throughout the reservation and examining some fluvial wash deposits. Extensive gravel resources of variable commercial value were found.

During the placer gold study, 69 channel samples from 12 sample sites were taken from Colorado River terrace deposits. The average value of gold found was 0.199 cents/yd^3. This value does not approach minable grades for placer development. Fluvial wash deposits were studied by means of a geophysical survey followed by a drilling program. A total of 942 samples were collected from 57 drill holes in 3 washes on the reservation: Gonzales, Seventy, and Tyson. Average gold values in Gonzales Wash ranged from 4.51 cents to 26.52 cents/yd^3. Average gold values ranged from 1.69 cents to 15.23 cents/yd^3 in Seventy Wash and from 0.60 cents to 1.95 cents/yd^3 in Tyson Wash. None of the gold values approach placer mining grades.

Anomalous (higher than average) concentrations of copper, lead, molybdenum, and zinc were found in several drill holes. The source of the anomalous copper and zinc found in Gonzales Wash likely lies outside the reservation boundary. The apparent source of anomalous copper, lead, molybdenum, and zinc found in Seventy Wash lies to the southeast, possibly within the reservation. The distribution of anomalous copper, lead, and molybdenum concentrations in Tyson Wash indicates a source to the north, in the Dome Rock Mountains.

INTRODUCTION

The Bureau of Mines prepared this report for the Bureau of Indian Affairs (BIA) under Interagency Agreement Nos. 36 and 42 (extending agreement No.36) and several supplemental agreements (17-S, 19, Tribal Council letter of May 14, 1980, and Tribal Resolution R-29-84). Terms of

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these agreements included investigations of gravel resources and potential placer gold resources on the Colorado River Indian Reservation (fig. 1). This report is a part of the series of Administrative Reports on mineral resources for this reservation.

Previous Investigations

Geologic maps useful in this resource study cover the reservation and adjacent areas. The maps cover the Big Maria Mountains (14),[3] Parker and parts of the Whipple Mountains (10), Vidal and southwest Parker (7), Quartzsite (25), northern Yuma County, now in La Paz County (3, 34), and the Needles and Salton Sea areas (5, 16).

Several unpublished theses contain useful geologic information about parts of the Whipple Mountains (19), the Cienega mining district (36), and the western Buckskin Mountains (6). Recent studies in the Whipple, Riverside, and other mountains, partly within the reservation, relate to the phenomena of detachment faulting and related mineralization (9, 21, 32). U.S. Bureau of Mines reports on the Whipple Mountain Wilderness study area provide geology and mineral resource information (26, 30).

Investigations most closely related to the present study of gravel resources include reports by Metzger (22, 23), Metzger and others (24), and maps by Carr and Dickey (7), and Dickey and others (10).

Previous reports in this series of mineral inventory reports conducted for the BIA include the Phase I study prepared by the U.S. Bureau of Mines and the U.S. Geological Survey (28). That study compiled and summarized known available information on mineral deposits on the reservation. The Phase II report by the Bureau of Mines (27) summarized the status of the gravel and heavy minerals situation and made recommendations upon which the present study was based.

Present Investigation

The present study is the third phase of the mineral inventory program conducted for the BIA and the Colorado River Indian Tribes. This study resulted from the phase II work that recommended, among other things, investigation of gravel resources and potential placer gold resources.

Colorado River terrace gravel deposits (bench deposits) were to be identified by mapping and examining the outcrops (plates 1-6), as recommended in the Phase II study (27), and tested for gold content by sampling selected outcrops.

To test the gold content of the terrace gravel deposits, 12 outcrops were selected where channel samples could be taken across the thickness of the beds. Sixty-nine gravel samples were collected and processed to determine gold content.

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[3]Underlined numbers in parentheses refer to items in the list of references preceding the appendixes at the end of this report.

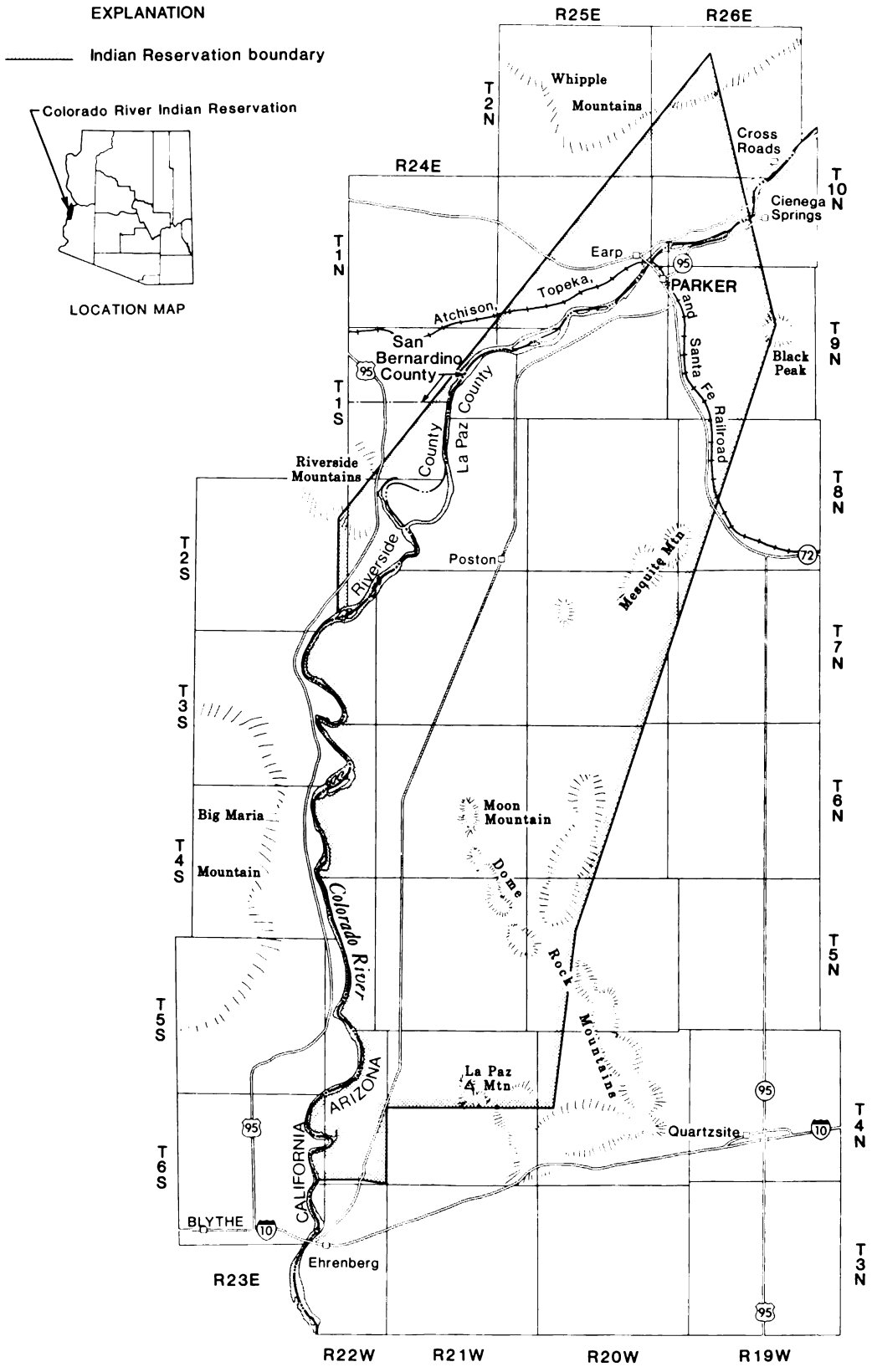


FIGURE 1. - Location map of the Colorado River Indian Reservation. Note: Townships and ranges on the Arizona side of the Colorado River referred to Gila River Meridian; those on the California side referred to San Bernardino Meridian.

Exploration for placer gold in the fluvial washes along the eastern side of the reservation included a geophysical survey and a drilling and sampling program. The geophysical survey provided information about the thickness of wash gravels in Bouse, Gonzales, Seventy, and Tyson Washes and an unnamed wash. The drilling and sampling program was limited to Gonzales, Seventy, and Tyson Washes. Fifty-seven holes were drilled and 943 samples collected and tested for gold content. Additonal testing was done on 312 of the samples to determine base metal content. Anomalous base metal concentrations were found in some drill holes in each of the washes. A preliminary examination of these anomalies and the possible sources of the base metals was conducted.

ACKNOWLEDGMENTS

The authors thank several members of the Colorado River Indian Tribes for providing assistance in the completion of the field work portion of this study: Anthony Drennan, Tribal Council Chairman; Frank McCabe, Tribal Treasurer; Harry Laffoon, member of the Tribal Council and Chairman of the Natural Resources Committee.

The authors gratefully acknowledge the assistance provided by personnel from several BIA offices; Adrienne Swallow, Geologist from the BIA Energy and Minerals Division Office in Golden, Colorado; Jim Crowther, a Mining Engineer from the BIA Phoenix Area Office; Patrick Hayes, Superintendent of the BIA Colorado River Agency Office in Parker, Arizona, and members of his staff including Donna McCurdy, Realty Officer, and Clifford Janson and Vernon Hughes of the engineering office.

The authors also appreciate the assistance of Dick Burdick, an Engineering Technician from the Bureau of Mines Denver Research Center, in planning, supervising, and interpreting the geophysical work performed on the project.

GEOLOGIC SETTING

General

The Colorado River Indian Reservation is in the Sonoran Desert section of the Basin and Range Province (11). According to Metzger and others (24), the last rejuvenation of the mountains occurred after the Colorado River entered the area and after deposition of the Bouse Formation of Pliocene age.

Rocks exposed in the mountain ranges are Precambrian through Tertiary in age (fig. 2). The result is a complex system of intrusive rocks, schists, gneisses, and sediments in varying stages of metamorphism. Recent and on-going studies indicate a recognition of the imprint of Miocene detachment faulting on the area (9, 21, 32). Surrounding the mountain ranges are sedimentary and volcanic rocks of late Tertiary and Quaternary age that are relatively undisturbed and unmetamorphosed. It

is among this latter group of rocks that the gravel deposits of this study are found. For more detailed geology, see Peterson and Nonini (28) and Nonini and Gray (27).

Gravel Deposits

There are three basic types of gravel deposits on the Colorado River Indian Reservation: alluvial fan deposits, Colorado River terrace deposits, and fluvial wash deposits. In addition to the gravels, there are some scattered igneous dikes, plugs, and flow outcrops of basalt-andesite "trap rock" that could be quarried for rubble or crushed rock.

Alluvial Fan Deposits

The alluvial fan deposits consist of material derived from the weathering and erosion of the mountain ranges in and near the reservation. The material ranges in age from the Miocene fanglomerate (24) that overlies the granitic basement rocks but underlies the Bouse and Colorado River Formations, to the Recent, or present day, detritus.

The material consists of angular to sub-angular, unsorted rock fragments mixed with sand, silt, and clay. Rock fragments are extensively weathered; consequently, many are soft, friable, and easily split along bedding or schistosity planes. The size range is commonly from about 1/4 in up to 10 in, although boulders 3 ft in diameter can be found.

Colorado River Terrace Deposits

Terrace gravel deposits are found extensively on both the east and west sides of the reservation. The terrace deposits are units of older alluvium in the Colorado River Formation and were deposited by the Colorado River on top of either the Bouse Formation, the fanglomerates described by Metzger (22), or the granitic basement rocks. The deposits were formed during Pliocene, Pleistocene, and Recent times.

Gravel is in beds or lenses of poorly sorted, well-rounded or subrounded gravel and cobbles. The deposits range from a few feet up to 25 or 30 ft in thickness (averaging 12 ft) and vary from uncemented to firmly cemented with calcium carbonate. Particle sizes range from 1/8-in gravel to 24-in boulders mixed with varying amounts of fine sand and silt.

Terrace gravels are made up of hard, dense rocks that were durable enough to stand the long downstream journey that brought them to their present resting place. The materials include: quartzites, limestones, cherts, and various metamorphic and igneous rocks. Some places the outcrops can be traced for thousands of feet in an unbroken line; in others a clean gravel bed will grade into sand or silt over a distance of a few hundred feet.

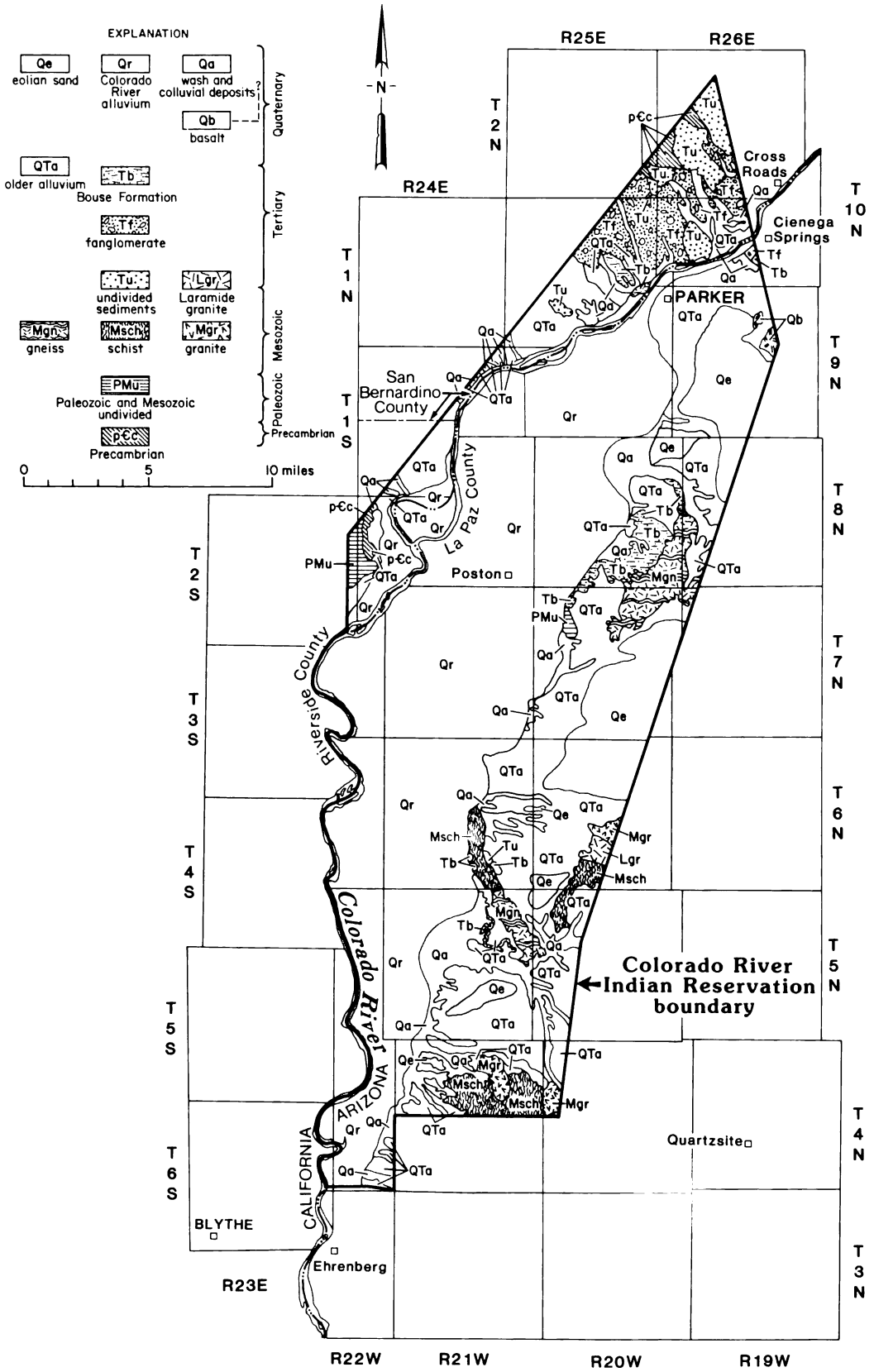


FIGURE 2. - Geologic map of Colorado River Indian Reservation (Modified from (28) for this report).

The Colorado River terrace deposits have long been a favored source of gravel on the reservation as demonstrated by the many old pits west and southwest of Parker. The Poston Materials, Inc., the Eddy Road, and the Peterson Road gravel pits are all in beds or lenses of the Colorado River terrace deposits.

Fluvial Wash Deposits

Fluvial wash deposits are gravels occupying the bottoms or forming embankments within present day tributaries of the Colorado River. Fluvial gravel is primarily unbedded, and frequently exhibits some sorting and partial elimination of weathered and decomposed weaker material. The gravels are composed of medium- to fine-grained igneous rocks, granitic gneisses and schists, other metamorphic rocks, limestones, and quartzites. The deposits reflect the composition of the alluvial fan deposits from which most of the fluvial wash gravels are derived. Abrasion of soft, weathered material and removal of clay and silt by the violent action of flood waters improves the quality of the gravel deposits. Often simple screen sizing, to remove sand and conform to individual specifications, will yield aggregate of good construction grade.

Practically all the washes on the reservation contain deposits of this type, and a large portion of the gravel production on the reservation has been from fluvial wash deposits. Blue Water Concrete and Aggregate, Inc., and Tanner Paving and Materials Co. pits on Osborne Wash, McCabe Road, Tyson Wash, and Gonzales Wash pits all produce gravel from fluvial wash deposits.

Crushed Rock and Rubble

Crushed rock and rubble were not investigated as part of this study; they are mentioned here merely to point out that such resources exist on the reservation. They can be, and have been, mined and utilized. The cost of mining and preparing this material for use is generally higher than that for gravel.

Trap Rock

Extensive occurrences of extrusive volcanic flows and ejecta are to be found in the northwestern part of the reservation. Much of the material is fractured, broken, and easily crushed, and of limited value for construction purposes. Some dikes and plugs of dense, fine-grained material (basalt-andesite), however, can be quarried for use as "trap rock" where the dark color and iron-staining characteristics are of no consequence. The location of some (but not all) of these deposits are shown on plates 2, 4, and 5.

Stone

Mountain ranges within the reservation contain some hard, dense, massive bodies of granite, granitic gneiss, schist, limestone, and marble that could be mined to produce material suitable for crushed rock or

rubble. Quarries producing such material have operated on the west side of Moon Mountain and in the Dome Rock Mountains south of the reservation. Possible quarry sites exist in various parts of the reservation.

GRAVEL RESOURCES

Although about three-fourths of the reservation is covered by alluvium, our investigation revealed that only a relatively small portion is readily suitable for gravel production. Gravel is produced primarily for use as a construction material for roads and highways and secondarily in building construction. Where gravel is used as concrete aggregate for either major use, several properties are important. Deposits must be clean, free of dirt, mica, and organic material. Large quantities of sand or silt are also considered deleterious. Coatings on the gravel of clay or calcium carbonate are undesirable. Deposits should be composed of abrasion resistant rocks such as quartz, quartzite, fresh granitic rocks, or dense limestones and dolomites. Chert is generally unacceptable. Rounded particles are preferred and flat or elongated particles should not compose more than 25% of the material. Ultimately, the end-use of the gravel determines the importance of each of these properties (4, 33). A more detailed explanation of desired gravel properties for specific uses can be found in books by the U.S. Bureau of Reclamation (33) and Bates (4).

Several characteristics that exist in some reservation gravel deposits can create problems in mining and utilizing the gravels. The characteristics include thinness of the beds, variations in composition, presence of deleterious constituents, excessive silt and sand, and the amount and degree of cementation.

During this study, no specific laboratory tests were performed on the gravels to establish their suitability for various purposes. Before new pits are opened, however, sites should always be tested with pits, trenches, or drill holes to make certain that reserves are sufficient and to establish whether the gravels have detrimental characteristics not obvious at the surface.

Gravel deposits included in this study contain dense, solid, well-rounded to subrounded rocks. Diameters ranging between 1/4 in and 4 in are most common; rocks over 12 in are less common. The composition is usually quartzite and other silicified rocks, granite, granitic schists, granitic gneiss, and fine-grained igneous rocks. Some limestone and marble and small amounts of chert, jasper, and epidote are also present. Soft, poorly indurated, or decomposed material has been abraded and removed by stream action. Alluvial fan material is not considered good construction gravel because of the high percentage of soft, weathered material and the large amount of silt and clay. Thus, it is not included in the gravel resource study.

Sections that follow describe the characteristics of gravel deposits on the reservation. Gravel resources are grouped into terrace deposits and fluvial wash deposits.

Colorado River Terrace Deposits

This inspection of the Colorado River terrace gravel deposits is a reconnaissance of the deposits rather than a definitive determination of their worth. Field studies included: (1) mapping the gravel outcrops; (2) examining the gravel for type, size, and soundness of constituent rocks; (3) estimating sand, silt, and clay content; (4) determining the degree of cementation; and (5) estimating thicknesses of deposits. No systematic drilling, test pitting, or shaft sinking was conducted to obtain samples. Bed thicknesses were estimated from outcrops and may be subject to error owing to float being mistaken for beds or concealment of beds by sand, silt, and debris.

Many of the gravel beds are very thin, only a foot or two thick, and thick minable beds often thin to 2 or 3 ft over a short lateral distance. Thin beds require excessive movement of equipment and large pit areas to produce acceptable tonnages, and also have high stripping ratios if stripping is required. These factors can add up to excessive mining costs and should be avoided.

Some of the terrace gravel beds contain very high percentages of silt and fine sand. The fine fraction can easily be screened out producing a good, clean, coarse gravel fraction. A problem arises concerning what to do with the large quantity of silt and fine sand for which there is little use. If the silt and fine sand are heaped into waste piles or spread about for water and wind to carry into the river or the atmosphere, they will quickly create adverse environmental impacts. The problem appears to be of particular concern for terrace gravels on the west, or California side, of the reservation.

The gravels are sometimes cemented with a calcareous cement and range from uncemented to firmly cemented. Where the cementing is minor, the gravels are loose enough to be readily mined and the interstitial fillings of cement can be easily removed by screens or trommels. Moderately cemented gravels might require a rapid tumbling in a ball mill (perhaps with a light or no ball charge) before screening. Firmly cemented gravels may be hard and dense enough to require drilling and blasting before mining and might defy removal of the cement. In such cases, the production costs may be such as to make its use economically prohibitive. All degrees of cementation exist, especially in the terraces on the eastern side of the reservation.

Table 1 contains a summary of the field data collected during the terrace gravel study. Gravel resource have been divided into six areas which are shown on figure 3 and correspond to plates 1 through 6 in the pocket of the report. Specific details about gravel thickness, particle size range, sand and silt content, cementation, and other pertinent information are in appendix A. For this study resource estimates are based on a 1:1 ratio of overburden thickness to gravel thickness. Tonnage estimates were calculated using an electronic digital planimeter and topographic field maps of the resource areas.

TABLE 1. - Summary of Colorado River terrace deposits gravel

Resource area[1]	Description[2]	Elevation at base, ft	Thickness, ft	Size range, in	Cementing[3]	Dominant rock type[4]	Estimated tonnage, st
NORTHWEST RESERVATION AREA - PLATE 1							
1-A.....	2	400	10	1 to 12	L	B	ND
1-B.....	2,1	400,480	ND	1 to 12	L	B	ND
NORTHERN RESERVATION AREA - PLATE 2							
2-A.....	2,1,3	400	1 to 30	1/4 to 8	L to S	B	4,100,000
2-B.....	2,1	480	3 to 10	1/4 to 8	L to S	B	150,000
2-C.....	2,1,3	460-480	3 to 40	2 to 28	L to S	B	850,000
2-D.....	2,1	400	8 to 30	2 to 18	L to S	B	990,000
2-E.....	2,1,3	440-480	1 to 15	1/2 to 12	L to S	B	2,300,000
2-F.....	2,1	480-640	2 to 30	1/2 to 12	L to S	B	1,000,000
2-G.....	2,1	520,560	3 to 30	1/4 to 12	L to S	B	1,200,000
2-H.....	2,1	560	25	1/8 to 12	L to S	B	ND
2-I.....	2	420	15 to 25	2 to 6	L	B	ND
2-J.....	2	380-460	ND	1/8 to 12	L	B	ND
2-K.....	2	380-400	ND	1/8 to 12	L	B	ND
PARKER BENCH AREA - PLATE 3							
3-A.....	2	500	1 to 10	1 to 6	L	B	1,200,000
3-B.....	1,2	420	1 to 10	1 to 6	L	A	2,700,000
3-C.....	1,3	410	5 to 20	1 to 8	L to S	A	1,700,000
3-D.....	1,3	420	5 to 8	1 to 6	L to S	A	2,100,000
3-E.....	1,2	400-410	5 to 20	1 to 12	L	B	300,000
3-F.....	1,2	410	3 to 5	1 to 6	L	A	1,200,000
3-G.....	1,2	410	5 to 12	1 to 6	L	A	2,900,000
3-H.....	2	400-500	1 to 3	1 to 6	L	B	ND
EAST-CENTRAL RESERVATION AREA - PLATE 4							
4-A.....	3	590	2 to 25	2 to 6	T	A	420,000
4-B.....	1	640	2 to 12	2 to 6	L	A	ND
4-C.....	1,3	620	6 to 24	2 to 6	S	A	1,900,000
4-D.....	2	620	2 to 30	2 to 6	L to S	A	330,000
4-E.....	2	620	15 to 25	2 to 6	L to S	A	440,000
4-F.....	1,3	740	1 to 13	1 to 12	L to M	A	130,000
4-G.....	1,3	600	20 to 40	3 to 6	L to M	A	920,000
4-H.....	3,1	600	20 to 30	1/4 to 6	T	A	610,000
4-I.....	1,3	600	5 to 30	1 to 8	L to S	B	6,500,000
4-J.....	2,3	600	5 to 40	1/2 to 6	S to T	B	3,700,000
4-K.....	1,3	580	5 to 40	1 to 12	S to M	B	1,700,000
4-L.....	3,1	600	15 to 25	1/2 to 6	M to T	B	3,100,000
4-M.....	3,2	600-620	5 to 35	1 to 4	M to T	B	6,900,000
4-N.....	1,3,2	620	10 to 25	1/2 to 6	L to S	B	4,000,000
4-O.....	2,1,3	620	15 to 22	1/2 to 6	L to S	B	1,500,000
4-P.....	1,3,2	580-600	3 to 20	1 to 6	L to S	B	1,000,000

See explanatory notes at end of table.

TABLE 1. - Summary of Colorado River terrace deposits gravel--Continued

Resource area[1]	Description[2]	Elevation at base, ft	Thickness, ft	Size range, in	Cementing[3]	Dominant rock type[4]	Estimated tonnage, st
EAST-CENTRAL RESERVATION AREA - PLATE 5							
5-A.....	1,3,2	580-600	3 to 20	1 to 6	L to S	B	7,800,000
5-B.....	1,3	580	2 to 18	1 to 6	L to S	B	8,400,000
GONZALES WASH AREA - PLATE 6							
6-A.....	2	320-400	ND	1 to 24	L	B	ND
6-B.....	2	320	5 to 7	2 to 24	L to S	B	169,000
6-C.....	2	380	5	4 to 24	L	B	460,000
6-D.....	2	320	3 to 5	2 to 24	L	B	950,000

ND Not determined because of insufficient data.

[1]Refer to resource areas on plates 1 through 6.

[2] 1 = Better quality gravel; 2 = silty or sandy gravel; 3 = cemented gravel.

[3] L = Loose; S = slightly cemented; M = moderately cemented; T = tightly cemented.

[4] A = Quartzite and other silicified rocks; B = type A plus granite, granitic gneiss, and granitic schist.

Fluvial Wash Deposits

The inspection of fluvial wash gravel deposits included examination of washes on the reservation to determine general characteristics of the gravel and discussion with several private lease operators producing gravel from washes on the reservation. Gravel thicknesses were determined only in Gonzales, Sevesnty, and Tyson Washes. Information collected concerning other washes on the reservation is more general.

Practically all washes on the reservation contain deposits of gravel; however, the commercial quality of the gravel is variable. Some washes contain excessive quantities of sand, silt, clay, or deleterious rocks. Washes that have large drainage areas generally have better quality deposits because flood waters have removed some of the deleterious materials. Frequently, the wash gravels are derived from Colorado River terrace gravel deposits through which the washes have cut. Weathering and erosion of the terrace deposits have created in the washes some localiized gravel deposits of good quality.

TABLE 2. - Summary of fluvial wash gravels in Gonzales, Seventy, and Tyson Washes

Resource area[1]	Description[2]	Thickness, ft	Size range, in	Dominant rock type[3]
Gonzales Wash.	2,1	15 to 40	1 to 24	B
Seventy Wash..	2,1	10 to 30	1 to 6	B
Tyson Wash....	2,1	10 to 45	1 to 6	B

[1]On plates 8, 9, and 10 in pocket.
[2] 1 = Better quality gravel; 2 = silty or sandy gravel.
[3] A = Quartzite and other silicified rocks; B = type A plus granite, granitic gneiss, and granitic schist.

Washes on the reservation are dry except during the rainy season and its accompanying flash flood episodes. Because the washes are usually dry, they are accessible to vehicles and equipment for mining and transporting gravel through most of the year. Current gravel production from the washes can be traced back to 1963 when leases were awarded for production in Osborne Wash. Since that time, gravel has been produced continuously with seasonal renewal of resources by flash flooding.

Sand and gravel production from washes on the reservation has occurred for many years. Flood waters have replenished the supply of sand and gravel throughout the period of production, and expectations are that this process of renewal will continue. Because of the variable nature of the seasonal renewal of gravel resources in the washes, no attempt was made to estimate the resource available from this source. The volume of resource available is virtually unlimited.

Gravel Production

Large quantities of sand and gravel occur on the reservation, and many deposits have been mined (fig. 3). Gravel deposits mined in the past include both fluvial wash material and Colorado River terrace gravel deposits.

At present, four commercial gravel mining operations are conducted on the reservation by private operators who have leases from the Tribal Council. Remuneration to the tribe is based upon an annual rental on the acreage held and a royalty on the quantity of gravel extracted.

Six other sites are intermittently operated by the BIA or the Arizona State Highway Department principally to construct and maintain roads, irrigation canals, and buildings. Except as noted, production figures have not been recorded with BIA. The state pays the tribe on a per ton basis for gravel used. Tribal projects conducted by the BIA involve no payments for gravel usage. Neither the State nor the BIA has permanent facilities or sustained requirements, and gravel production areas are chosen for their convenience, availability, and suitability.

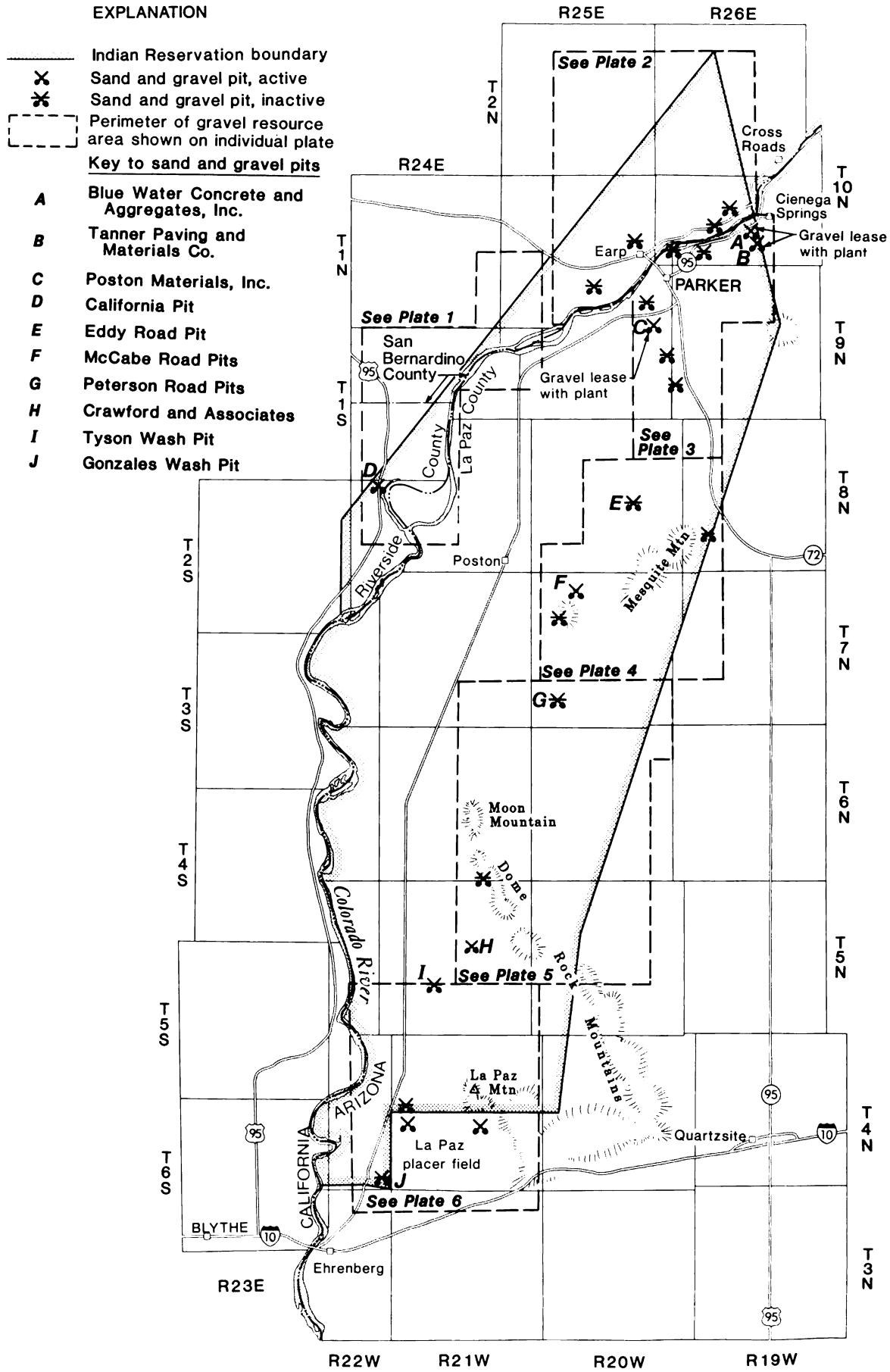


FIGURE 3. - Gravel resource areas and sand and gravel pits.

A summary of recorded gravel production on the reservation is given in table 3. Production is listed by private lease holders, and government operations by pit name. Additonal information about gravel pits and production statistics is provided in appendix B.

TABLE 3. - Gravel production by operator

Operator	Years[1]	Tons produced	Rents and royalties paid[2]
PRIVATE LEASE OPERATIONS			
Blue Water Concrete and Aggregate, Inc.....	1970-1986	340,252	$130,059.27
Tanner Paving and Materials Co.....	1973-1986	590,407	203,515.03
Poston Materials, Inc.....	1969-1986	253,411	57,609.95
Crawford & Associates.....	1983-1986	21,491	12,319.00
GOVERNMENT OPERATIONS			
California Pit.....	1984-1985	44,700	NA
McCabe Pit.....	1980-1986	37,550	NA

NAp Not applicable.
[1]May be less than full year. See appendix B for details.
[2]Rents and royalties vary with term of each lease.
Source: BIA files, Real Estate Services, Parker, AZ.

PLACER DEVELOPMENT POTENTIAL OF GRAVEL DEPOSITS

The first gravel deposits investigated for placer potential in this program were the Colorado River terrace deposits, the second phase of the study was on fluvial wash gravels.

Colorado River Terrace Deposits

Interest in testing the placer development potential of Colorado River terrace deposits was stimulated by the possibility that gold might have accumulated there from sources upstream in the large area drained by the Colorado River or from the surrounding mountain drainages. Records do not indicate whether the placer gold content of terrace gravels on the reservation had been tested. The testing program is described in the following sections.

Sampling

Channel samples were taken from 12 terrace gravel exposures (fig. 4) located in the east-central part of the reservation (plates 4-5). Several samples, each measuring a cubic foot in volume, were taken across the bed thickness at each sample site (69 gravel samples). Each sample was

concentrated using a revolving trommel with water sprays and a vibrating sluice (Humphreys Gold Miser).[4] The sluice concentrate was panned down to a gold-bearing black sand concentrate. After all samples from a channel site had been treated through the device, materials caught in the stationary riffles of the tailings sluice (operated as a scavenger behind the vibrating sluice) were also collected (12 sluice samples) and panned down to black sand concentrates.

Testing

Eighty-one black sand concentrate samples (69 gravel samples plus 12 sluice samples) were submitted to Skyline Labs, Inc., Wheatridge, Colo., for testing. Each concentrate was fused entirely by fire assay techniques to produce a precious metal bead. The bead, inquarted (alloyed) with silver, was weighed, parted with nitric acid to dissolve silver, washed, weighed, and recorded. This procedure determines the total gold in the concentrate rather than only the gold that can be recovered by standard placer recovery operations; it was used here to establish the maximum amount of gold in the gravels.

Gold values obtained from terrace deposits ranged from nil to 1.63 cents/yd^3; average gold value was 0.20 cents/yd^3. Average gold values for each channel site are summarized in table 4; gold values found in each concentrate sample are given in appendix C, table C-1. None of the channel samples contain gold values approaching the minimum value, 361 cents/yd^3, estimated to be necessary for commercial placer dredging operations (see appendix D).

TABLE 4. - Average gold concentrations from Colorado River terrace deposits channel samples

(Gold at $350/tr oz)

Channel samples[1]	Number of concentrate samples	Average gold weight, mg/yd^3	Average gold value, cents/yd^3
A.....	9	0.52	0.58
B.....	8	.24	.27
C.....	9	.10	.11
D.....	7	.17	.20
E.....	7	.36	.40
F.....	5	.02	.02
G.....	5	none	none
H.....	6	.24	.27
I.....	9	.06	.07
J.....	5	.07	.08
K.....	7	.05	.05
L.....	4	.14	.16

[1]Letter reference to sample locations on figure 4 and plates 4-5 in pocket of this report.

[4]References to specific products do not imply endorsement by the Bureau of Mines.

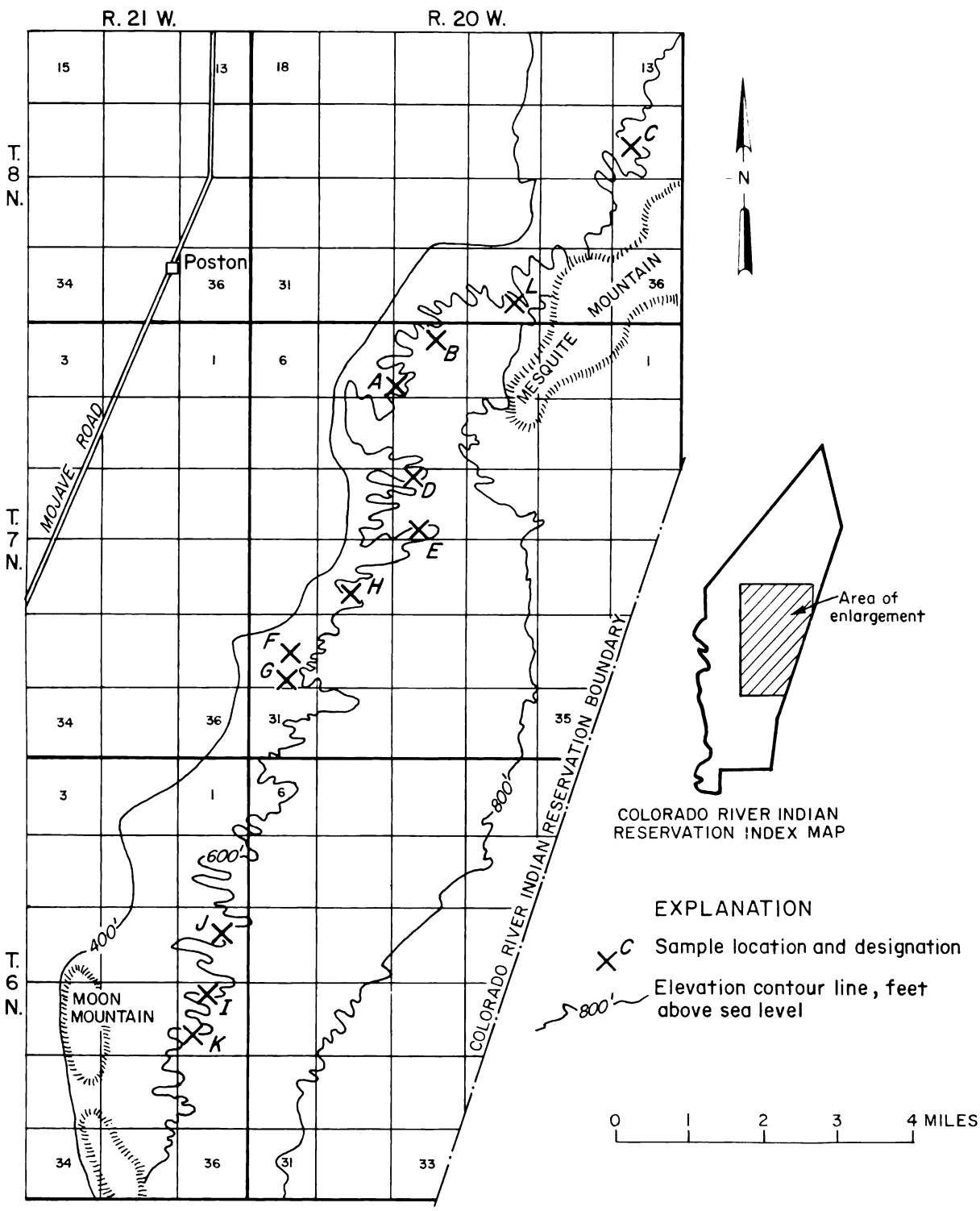


FIGURE 4. - Placer sample locations, terrace gravel deposits.

Fluvial Wash Deposits

Interest in testing the placer development potential of washes on the Colorado River Indian Reservation (fig. 5) was spurred by the presence of important gold placers outside the reservation in the southern Dome Rock Mountains. Both Gonzales and Seventy Washes drain rock formations believed to have been the source of the gold produced from the rich La Paz placer district (27). Tyson Wash drains a large gold-producing area south and east of the Dome Rock Mountains as well as several productive placer districts in the eastern Dome Rock Mountains. Because information regarding the placer fields in the Dome Rock Mountains is detailed in both the Phase I (28) and in the Phase II reports (27), only information pertinent to the drilling program will be noted here.

The La Paz placer district was part of the Colorado Indian Reservation between 1873 and 1910 and also between 1912 and 1915 (1). Placer mining began after Indians showed several gold nuggets to prospectors, and the district flourished between 1862 and 1869 (35). By 1900, most placers were exhausted (17), although a revival of placer mining was attempted during the Depression years.

The La Paz district was characterized by coarse gold and was famous for its plentiful large nuggets, the largest of which weighed about 4-1/2 lb. The coarseness of the gold recovered was partly a result of the relatively inefficient dry washing methods used to recover gold in this arid area during the last century. Because of this, some gold undoubtedly remains in and downstream of the 'exhausted' placers (1). The largest placers occur in La Paz Wash, sec, 26, T. 4 N., R. 21 W., and in Farrar Gulch, sec. 36, T. 4 N., R. 21 W. These washes drain an area in which small gold-quartz lode deposits occur as gash veins in faulted, mylonitized Tertiary age quartz monzonite (8).

Tyson Wash acts as a catchment drainage for known placer mineralization located in the eastern Dome Rock Mountains. Placer districts there include Middle Camp, Orofino, and La Cholla. Fine-grained gold was proproduced from the districts on a small scale after the discovery of the La Paz placers. The gold-bearing materials differ from those of the La Paz placers in that they consist of both unconsolidated rock debris and an underlying cemented gravel (18).

The Phase II report (27) noted the possibility that gold might not be found in Tyson Wash because it might have settled out far upstream of the reservation, making the section inside the reservation subeconomic. The same type of settling action may also have had some effect on gold concentrations in Gonzales and Seventy Washes.

To determine the placer development potential of fluvial washes, questions to be answered in this study were whether: (1) the fluvial wash gravels were gold-bearing; (2) the gold was concentrated into commercially valuable deposits; and (3) the gold-bearing gravels were too deeply incised into the underlying formations to permit mining using standard commercial placer mining equipment and techniques.

To answer these questions, a determination of the thickness of the wash gravels would be made by geophysical measurements. If the geophysical results indicated attainable placer mining depths in the wash gravels, drilling would be conducted to confirm the geophysical results and obtain samples of the gravels to test for gold content. The following sections describe in more detail the placer evaluation program.

Geophysical Survey

A geophysical prospecting program was conducted during the second quarter of fiscal year 1985 as the preliminary step in evaluating placer gravels in fluvial washes. Within the reservation boundary, Bouse, Gonzales, Seventy, Tyson, and an unnamed wash were selected for geophysical study (fig. 5 and plates 7-10).

Geophysical profiles across each of the washes were prepared to determine the thickness of fluvial wash gravels. Seismic reflection was the geophysical prospecting method used in preparing profiles of the subsurface interface (boundary) between fluvial gravels and underlying materials (plates 7 - 10).

Seismic reflection is a form of echo sounding. A pulse of seismic energy is radiated into the ground (from an explosive source) and reflected or refracted from a subsurface interface back to the surface where the wave impulses are recorded by detectors sensitive to ground movement (fig. 6-A) (31). The detectors used in this study were geophones, with ground spikes, which were connected by sensor cables to a recording device. The arrival times of reflected and refracted energy waves at each geophone location are recorded as a wiggle trace on photographic paper for later interpretation (figs. 6-B and 7).

Individual profile lines were spaced approximately 1 mile apart starting at the mouth of the washes and working toward the reservation boundary (fig. 8). Geophone and shot-point (point of energy pulse initiation) locations were surveyed to obtain accurate location and elevation data for subsequent interpretation by computer.

On the photographic record each geophone location is represented as a separate horizontal line trace (fig. 6-B). When the energy pulse is activated and detected at each successive geophone location, a first wave time break appears on the horizontal line trace. Horizontal distance along the trace represents elapsed time from the energy pulse detonation to arrival of the energy pulse at each geophone. The seismic pulse recorded represents the arrival time of waves traveling from the surface to a subsurface interface and reflected or refracted back to the surface (fig. 6-A).

Interpretation of data collected on the photographic record includes digitizing first arrival times relative to the time of the energy pulse detonation. Wave velocities in the surface and subsurface material can be determined from the length of the geophone line and the time difference in the first-wave arrival times at the nearest and farthest geophones from the shot-point location (velocity = length of geophone spread time

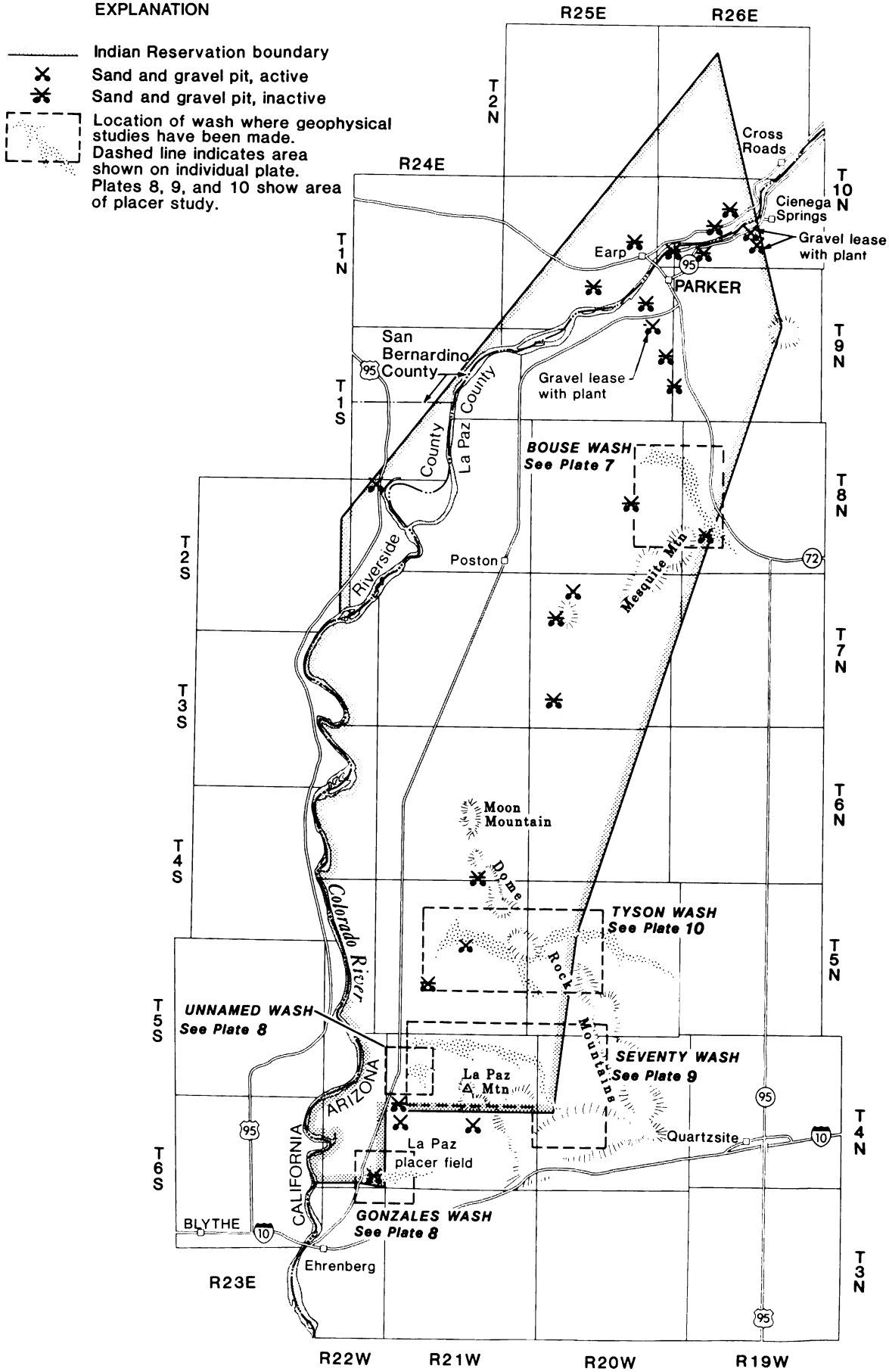
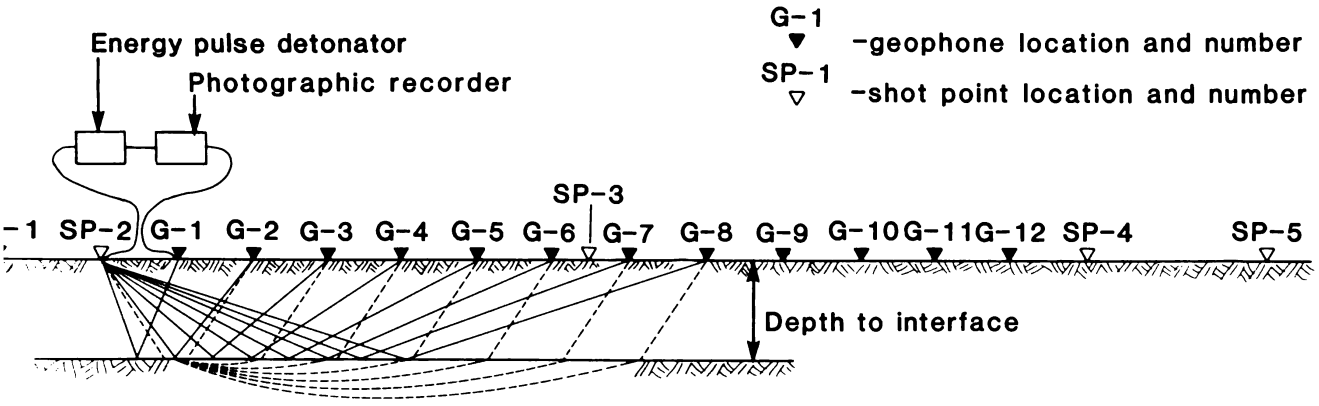
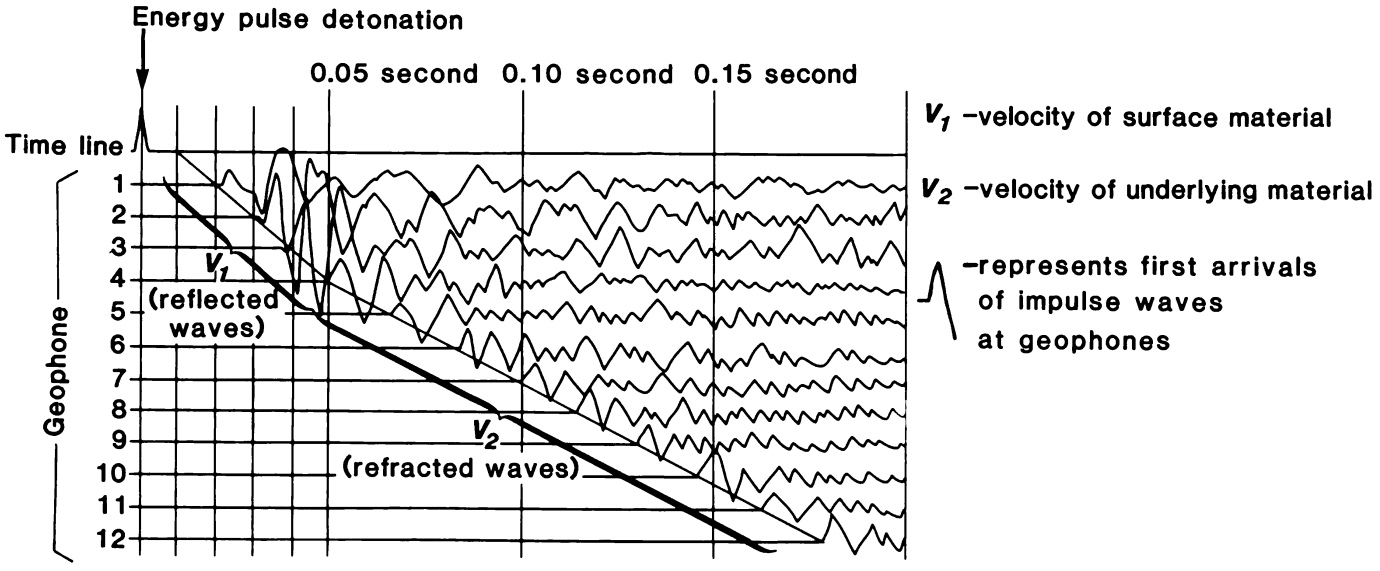


FIGURE 5. - Placer study areas, fluvial wash deposits.



A. Cross-section of seismic array.



B. Seismic photographic record showing first arrivals of impulse waves.

FIGURE 6. - Generalized seismic array. A, cross-section; B, photographic record.

difference). Using the velocities and time of first-wave (reflection) arrivals at each successive geophone location along the spread, depth to the reflecting surface at each geophone location can be determined (reflection time = 2 X depth ▼elocity). Irregularities in the slope of the first arrival time breaks on the photographic record indicate changes in velocities at subsurface interfaces (when waves change from surface or reflected to refracted waves) (31). Such interfaces represent changes from the surface fluvial gravels to underlying unconsolidated sediments, consolidated material, or granitic basement rocks. All field data collected were submitted for computer analysis and printouts were obtained showing expected depths to the interface.

Cross sections of the 19 profiles produced from computer interpretation of the field data show fluvial gravel thicknesses in the washes ranging from 7 to 98 ft (appendix E, plates 7-10). More than 93% of the gravel showed thicknesses between 20 and 60 ft, well within the capability of present day placer mining equipment.

Computer interpretation of field data showed velocities of 1,250 to 1,750 ft/s for the surface fluvial material and 4,150 to 6,670 ft/s for the lower layer (appendix E, table E-1). The lower layer was tentatively identified as granitic basement rock based on a calibration field test of exposed granitic rock which showed similar velocities. Wave velocities in granite typically are within a range of 16,000 to 19,000 ft/s (29). Variations in wave velocities are commonly caused by variations in mineral composition, fluid content, temperature, pressure, grain size, cementation, and amount of weathering (29). Wave velocity errors of more than 10% are not common. The field calibration test result fell outside the range of error expected for granitic rocks.

Drilling

Because the geophysical survey results indicated attainable mining depths in the washes, a reconnaissance drilling program was conducted. To determine whether or not the fluvial wash gravels contained commercial concentrations of gold and to confirm the results of the geophysical survey, a series of widely spaced drill holes were planned in three washes, Gonzales, Seventy, and Tyson. Because of budgetary limitations the drilling program in an unnamed wash and Bouse Wash was delayed and later deleted from the placer evaluation program. Drill holes were located on the same lines used for the geophysical survey. One random hole was completed in mid-wash of the narrowest part of Tyson Wash. The hole spacing was chosen so that subsequent work could be arranged to close gaps in an orderly grid for establishing the grade and volume. The initial work was intended to be scout drilling to establish the presence or absence of gold, or other minerals, and to indicate the likelihood of commercially valuable deposits.

Drilling on the three washes commenced on June 27, 1986, and continued through July 24, 1986 (fig. 9). Seven holes (totaling 706 ft) were drilled in Gonzalez Wash, 15 holes (1,417 ft) were drilled in Seventy Wash, and 35 holes (2,567 ft) were drilled in Tyson Wash, for a total of 57 holes (totaling 4,690 ft). Depths of the holes ranged from a minimum

of 30 ft to a maximum of 122 ft. Locations of the drill holes are shown on figures 10 through 12.

Drilling was done with a truck-mounted rotary drill and compressor. A bulldozer was used to assist the drill truck and pipe truck to move from hole to hole through the deep, loose sand. The drilling media was air, and the drilling system was the Atlas Copco ODEX system wherein a down-the-hole hammer, driving a tungsten carbide button bit and an eccentric, retractable reamer, simultaneously drills and reams a hole while driving the casing. Drill cuttings from 6-in diameter holes were brought to the surface by the exhaust air-stream between the drill rod and the casing. All cuttings were caught in a cyclone and bagged in 5-ft sections (fig. 13). Each sample was weighed and the weight used as a measure of sample loss or gain thus providing a factor for weighting the assay value of each sample in computing average gold values.

As the samples were being bagged, the drill cuttings were logged (appendix F). The surface fluvial wash material collected consisted of sand and drill cuttings of the coarse clastics. Immediately after the drill passed through the fluvial wash material, sediments encountered were either sand (sometimes interspersed with gravel), or clayey silt and sand, or dense clay. Sand ranged from very fine grained to coarse grained. The sands and gravels were interpreted as being sediments of the Colorado River Formation and the clay material as being Bouse Formation sediments. It was not always possible to determine which formation the sediments might represent. Crystalline basement rock in the form of granitic gneiss was found in 3 drill holes in Tyson Wash, T-R-1 at 50 ft, T-E-3 at 90 ft, and T-E-5 at 28 ft.

In planning the project, it was considered that the maximum practicable dredging depth would be less than 120 ft. Consequently it was planned to drill no deeper than 100 ft; the drilling contract and equipment was provided accordingly. Several holes, however, were drilled to 120 ft.

The drilling program in Gonzales, Seventy, and Tyson Washes did not confirm the interface at the bottom of the fluvial gravel to be with granitic basement rock as indicated by the geophysical data (plates 8-10, and appendix E). Granitic basement rock was found in only three drill holes, all in Tyson Wash. A summary of what was found near (within 10 ft) the expected interface depth in each drill hole is given in table 5.

The boundary between recent fluvial sand and gravel and the underlying sand layer was encountered most frequently in Gonzales Wash (3 holes) and Seventy Wash (7 holes). In Tyson Wash, the fluvial gravel and underlying sand boundary was near the expected interface depth in 12 of the drill holes; 14 of the holes had no apparent stratigraphic boundary near the expected interface depth.

Actual thicknesses of the surface gravels in Gonzales Wash ranged from 15 to 40 ft. In Seventy Wash gravels were from 10 to 30 ft thick. Gravels in Tyson Wash were from 10 to 45 ft thick. In 55 of the 57 drill holes, the surface gravels were underlain by a layer of sand, or clayey silt and sand; in 1 drill hole by a clay layer; and in 1 drill hole by granitic rock.

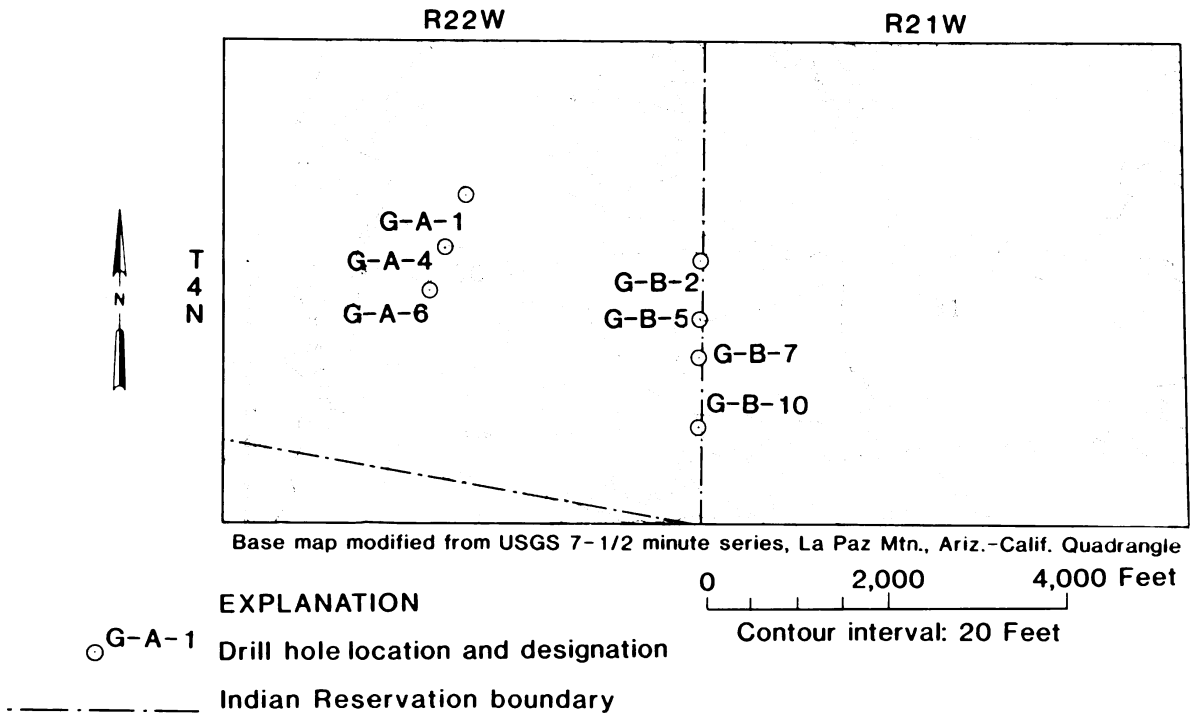


FIGURE 10. - Drill hole locations, Gonzales Wash.

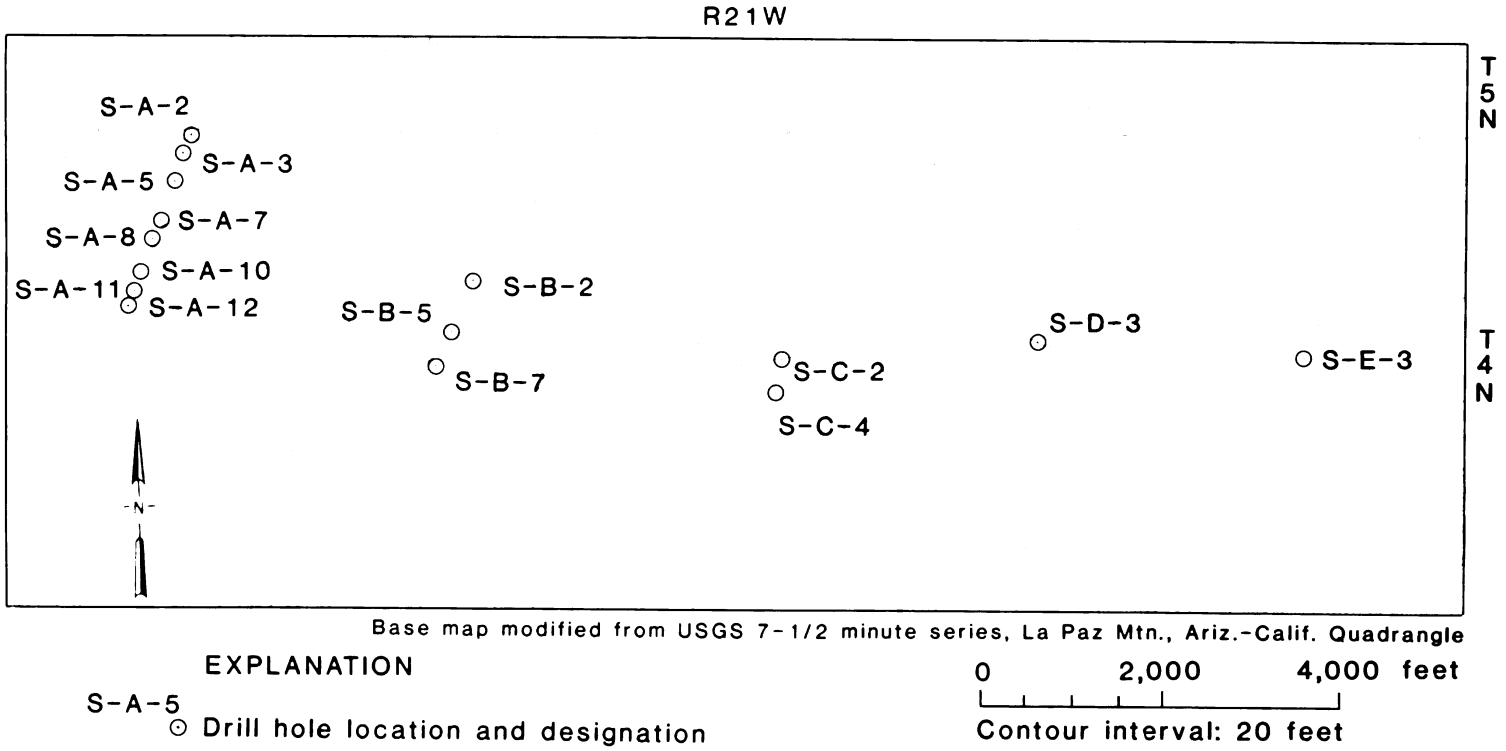


FIGURE 11. - Drill hole locations, Seventy Wash.

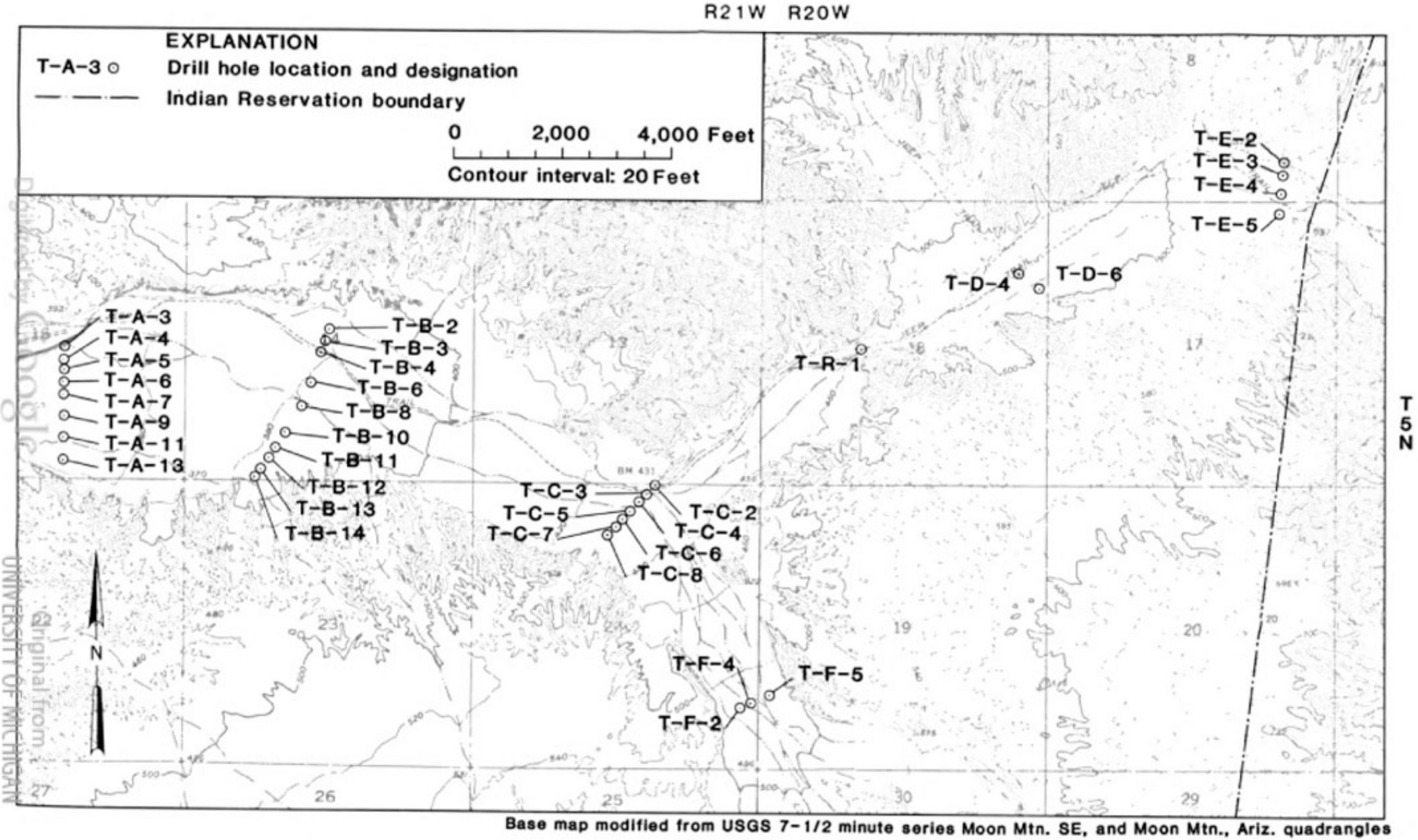


FIGURE 12. - Drill hole locations, Tyson Wash.

TABLE 5. - Summary of drill hole cuttings at expected interface depth

(drill holes where expected interface is near a stratigraphic interface)

Wash	Total holes drilled	Stratigraphic boundary				
		Lower fluvial boundary	Damp sand or gravel	Clay	Granitic rock	No apparent stratigraphic boundary
Gonzales.....	7	3	0	2	0	2
Seventy.....	15	7	5	0	0	3
Tyson.....	35	12	3	3	3	14

Sampling

At the sample treatment plant, each sample was run through a spiral concentrator (Reichert Spiral) until all heavy sands were obtained as a concentrate (fig. 14). The heavy sand concentrate was then amalgamated in an amalgamation barrel, and the mercury and amalgam separated from the sands by means of a panning machine (Gold Genie). The amalgam was then parted with dilute nitric acid and the gold dried and weighed. This method of treatment extracts only the free gold in the sample and obtains a recovery comparable to what can be expected from commercial treatment and recovery. Gold enclosed in magnetite, ilmenite, sulfides, or other minerals is not recovered and is lost to waste, as it would be in commercial placer mining. Sample results obtained are shown in appendix C, table C-2. A summary of gold recovery results is given in table 6.

The drilling and sampling demonstrated that:

1. The thickness of the recent fluvial gravels is less than indicated by the geophysical measurements. Thicknesses ranged from 10 to 40 ft rather than the expected 20 to 60 ft (plates 7-10).

2. The fluvial gravels are incised and bedded principally in the sediments of the Colorado River Formation and the Bouse Formation. To a lesser extent, the granitic crystalline gneisses and schists of the basement complex underlie the fluvial gravels.

3. None of the test holes revealed concentrations of gold values at or near the contact between the recent fluvial wash gravels and the underlying formations. Values were distributed throughout the gravels and extend into the underlying formations. The two highest values were found in the top 5 ft of gravel, not an unusual feature of desert placers.

4. Gold values in Gonzales Wash gravels would run about 5 to 25 cents/yd^3. Seventy Wash gravels would run about 3 to 6 cents and Tyson Wash gravels would run about 1 cent/yd^3. At today's operating costs, none of these values approach the estimated minimum value needed, 361 cents/yd^3 (see appendix D), for a commercial placer dredging operation.

TABLE 6. - Average gold concentrations in drill holes, fluvial wash deposits

(Gold valued at $350/tr oz)

Drill hole	Average gold weight, mg/yd^3	Average gold value, cents/yd^3	Drill hole	Average gold weight, mg/yd^3	Average gold value, cents/yd^3
G-A-1.....	8.15	9.17	T-A-13...	1.17	1.31
G-A-4.....	23.56	26.52	T-B-2....	0.85	0.95
G-A-6.....	20.10	22.62	T-B-3....	0.89	1.00
G-B-2.....	9.50	10.69	T-B-4....	1.19	1.34
G-B-5.....	4.87	5.48	T-B-6....	0.98	1.10
G-B-7.....	7.96	8.96	T-B-8....	0.53	0.60
G-B-10....	4.01	4.51	T-B-10...	0.76	0.86
S-A-2.....	4.55	5.12	T-B-11...	0.87	0.98
S-A-3.....	5.11	5.76	T-B-12...	0.89	1.00
S-A-5.....	3.77	4.86	T-B-13...	1.15	1.29
S-A-7.....	3.70	4.16	T-B-14...	0.73	0.82
S-A-8.....	13.54	15.23	T-C-2....	1.35	1.43
S-A-10....	12.40	13.96	T-C-3....	1.74	1.95
S-A-11....	5.25	5.92	T-C-4....	1.46	1.65
S-A-12....	5.71	5.91	T-C-5....	1.43	1.61
S-B-2.....	6.21	6.98	T-C-6....	1.20	1.35
S-B-5.....	8.58	9.66	T-C-7....	1.12	1.26
S-B-7.....	5.54	6.22	T-C-8....	1.15	1.29
S-C-2.....	4.75	5.34	T-D-4....	1.06	1.19
S-C-4.....	1.67	1.88	T-D-6....	1.30	1.46
S-D-3.....	1.50	1.69	T-E-2....	0.88	1.00
S-E-3.....	1.73	1.94	T-E-3....	0.91	1.02
T-A-3.....	0.79	0.89	T-E-4....	1.21	1.36
T-A-4.....	1.09	1.23	T-E-5....	0.94	1.06
T-A-5.....	1.04	1.73	T-F-2....	0.83	0.93
T-A-6.....	1.26	1.42	T-F-4....	1.08	1.21
T-A-7.....	0.99	1.12	T-F-5....	0.77	0.87
T-A-9.....	1.01	1.12	T-R-1....	0.99	1.12
T-A-11....	0.90	1.02			

G Gonzales Wash; S Seventy Wash; T Tyson Wash; A-F, R drill hole line designation.

ADDITIONAL STUDY OF FLUVIAL WASH PLACER SAMPLES

Because the gold sample data were available and statistics can be calculated easily, the opportunity was taken to perform additional studies on the data, including geochemical analyses. Black sand concentrates from one drill hole per line were sent to a laboratory for standard 31 element semi-quantitative emission spectrographic analyses. The emission spectrographic data were examined for anomalous (higher than average) concentrations for the elements, and several base metal elements were found in anomalous amounts. The geochemical study included a precise determination of what concentrations are anomalous, an examination of the anomalous distribution patterns, and discernment of source areas for the gold and base metals.

To determine if anamolous metallic concentrations occurred in the drill hole samples, statistical information was calculated for each element using only the drill hole geochemical analyses. The comparison was limited to samples consisting of unconsolidated sediments; five samples from three holes that bottomed in granitic basement were omitted from the calculations. An anomalous concentration is usually defined statistically as any sample amount equal to or greater than the sum of the mean (M) and twice the standard deviation (S). The sum (M + 2S) is called the threshold concentration (20).

It should be noted that several lithologic units, each with its own set of threshold concentrations, are drained by the washes and are represented in different proportions in the unconsolidated sediments. Because the washes drain known mineralized areas, the threshold concentrations are probably high and resulted in a conservative number of anomalous samples.

Four numbers were tabulated for each anomalous element: (1) the total number of samples containing anomalous concentrations; (2) the maximum anomalous concentration; (3) the average anomalous concentration; and (4) the total number of samples analyzed.

Gold

Areal Distribution Pattern

The mean, standard deviation, and threshold concentration for the gold data are tabulated in table 7.

TABLE 7. - Gold statistical data, all values in milligrams per ton (total analyses considered, 942 drill hole samples)

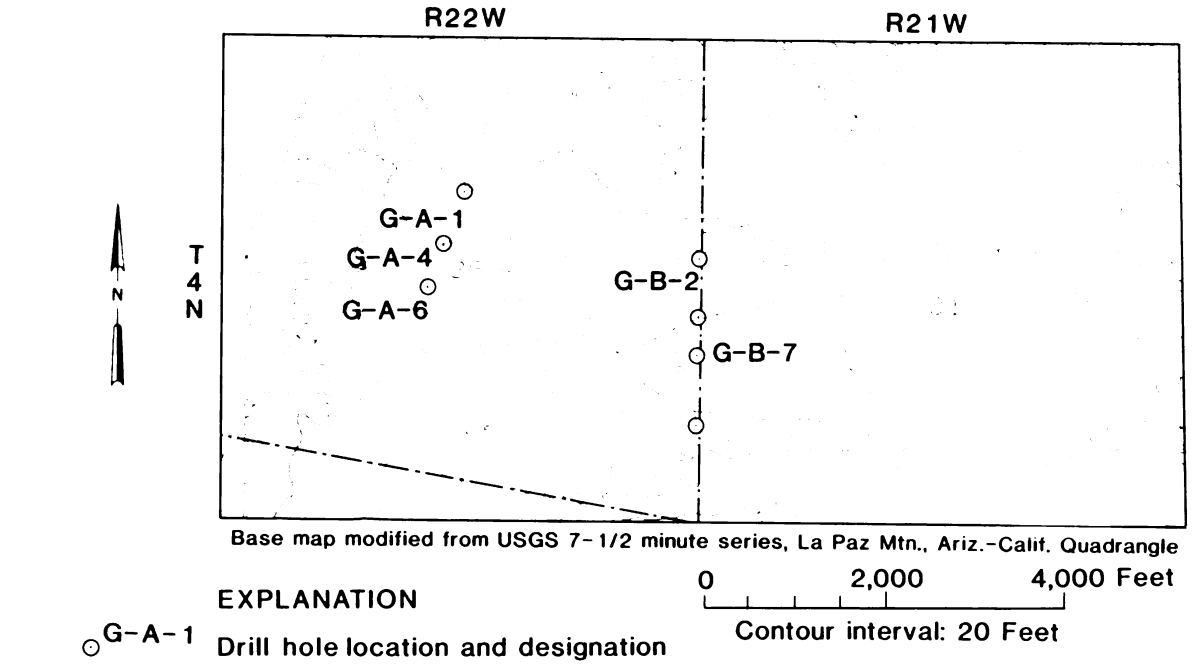
Element	Mean (M)	Standard Deviation (S)	Threshold (M + 2S)
Gold	2.57	6.50	15.58

Only Gonzales and Seventy Washes carried gold anomalies, and in each case the anomalies occurred in the holes farthest downstream. In Gonzales Wash, for example, hole G-A-4 (fig. 15) contained six anomalous intervals, the most of any hole in the drainage. All other holes drilled on line G-A had at least one anomalous gold interval, and two out of the three holes drilled upstream on line G-B contained anomalous gold intervals. In Seventy Wash (fig. 16), only lines S-A and S-B showed anomalous gold concentrations: two out of eight holes drilled on line S-A and one out of three holes on line S-B contained anomalous gold amounts.

Generally, gold seems to have been flushed out of the washes by flash floods and concentrated near the mouths of the washes. Flash flood waters exiting the wash channels spread out and lose velocity, and in the process lose their ability to carry gold. The gold is most closely associated with sediments resembling wadi (desert wash) channel and wadi fan sediments. A minor gold concentration, however, may have occurred in dune sands as a result of local reworking of wadi sediments (appendix G). Both the gold and the associated sediments came from the mountains drained by Gonzales and Seventy Washes.

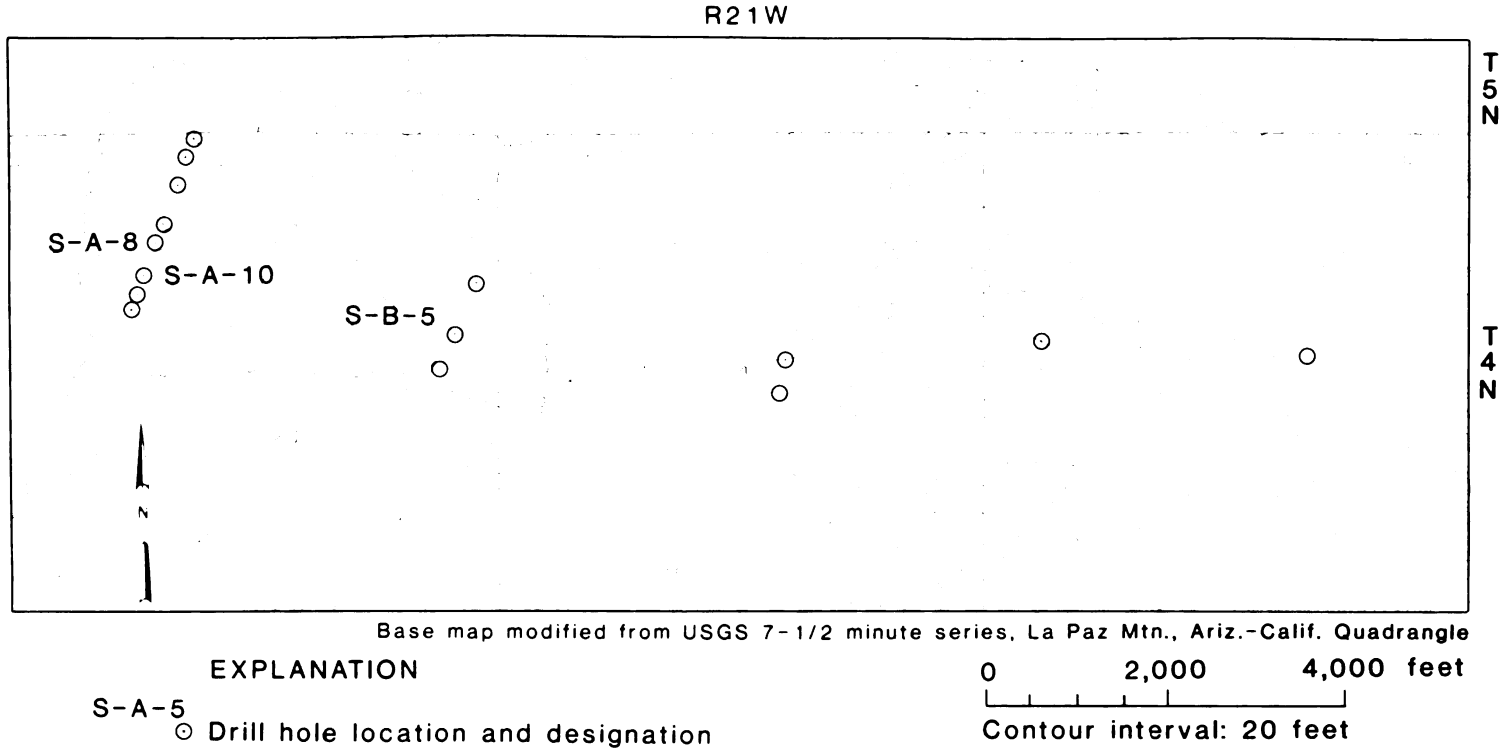
Down-hole Distribution Patterns

Three general patterns of down-hole gold distribution are suggested by the drill-hole data. Most salient of these is the tendency of gold anomalies to cluster within 15 ft of the surface (holes G-A-4, G-A-6, G-B-7, S-A-8, S-A-10). Such surface concentrations are common in arid areas and are caused by reconcentration of heavy minerals by sheetwash or by winds. Other patterns are less obvious. An example of this is the slight tendency for anomalous gold concentrations to occur just above a clay horizon (holes G-B-2, S-A-8, S-A-10). Overall, however, the clay layers did not act especially well as hardpan surfaces over which gold migrated and concentrated. In addition, a few gold anomalies occurred between 40 and 55 ft deep in both Gonzales Wash (holes G-A-4, G-A-6) and Seventy Wash (holes S-A-8, S-A-10). The reason for this pattern is unclear. It is not related to any discernable change in sedimentation and may be fortuitous. Descriptions of sediments encountered in every drill hole are given in appendix F.



Drill hole			G-A-1	G-A-4	G-A-6	G-B-2	G-B-7
No. of samples			21	24	17	22	20
Element			Au				
Anomaly		Total	1	6	2	1	1
	mg/t	Max.	20	109	116	16	49
		Avg.	20	40	76	16	49

FIGURE 15. - Gold anomalies, Gonzales Wash.



Drill hole			S-A-8	S-A-10	S-B-5
No. of samples			11	12	25
Element			Au		
Anomaly	Total		2	2	1
	mg/t	Max.	22	21	25
		Avg.	20	20	25

FIGURE 16. - Gold anomalies, Seventy Wash.

Base Metals

Black sand samples from one drill hole per line were submitted to Skyline Laboratory in Wheatridge, Colorado, for standard 31 element semi-quantitative emission spectrographic analysis. A total of 312 samples from 14 holes were analyzed. Several holes contained anomalous concentrations of the base metal elements: copper (Cu), lead (Pb), zinc (Zn), and molybdenum (Mo). Because the last sample from hole T-R-1 in Tyson Wash contained granitic basement material, analyses for this sample were omitted from calculations, and only 311 samples were used to obtain statistical data.

As noted in the introduction to the geochemistry section, it is customary to define as anomalous any concentration equal or greater than the sum of the sample mean plus two times the standard deviation: (M + 2S). In this case, a slightly different sum than (M + 2S) was chosen for the threshold concentration, the lowest concentration that would be considered anomalous for a given base metal element. One must use a threshold concentration distinct from the sum (M + 2S) because emission spectrographic data are recorded incrementally. Each concentration in parts per million was estimated by a Skyline geochemist to the nearest increment in the series 1, 1.5, 3, 5, 7, 10 within each power of ten. To match the amount the geochemist would have recorded for a concentration equal to (M + 25), it was necessary to round each calculated (M + 2S) sum to the nearest emission spectrographic increment. This increment was then used as a threshold. The (M + 2S) sum and the threshold increment for each base metal are shown in table 8.

TABLE 8. - Base-metal statistical data from emission spectrographic analyses, all concentrations in parts per million (311 analyses considered)

Element	M	S	2S	M + 2S	Threshold
Cu.....	65	33	66	131	150
Pb.....	129	206	412	541	500
Zn.....	187	113	226	412	500
Mo.....	24	16	33	57	50

M Mean; S standard deviation; M + 2S threshold; Cu copper Pb lead; Zn zinc; Mo molybdenum.

Unlike gold, the base metal content of stream sediments is primarily introduced in solution via ground water and runoff. Eventually, the base metals precipitate onto clays, iron oxides, and manganese oxides. In desert areas, where mechanical weathering is important, some metals also travel as discrete mineral grains. Where metal amounts in stream sediments in an upstream direction are examined, a point of peak concentrations usually occurs. This point, called a cutoff, is where the

metal-rich ground waters enter the drainage, where the metallic minerals enter the stream mixed with the other clastic sediments, or, rarely, where the stream crosses a mineralized vein. Ideally, the metal amounts decrease quickly upstream of the cutoff, whereas the metal concentrations downstream of the cutoff decrease gradually because of dilution.

Gonzales Wash

Both lines drilled in Gonzales Wash (fig. 17) contained several strongly anomalous copper and zinc concentrations. Of the two lines, however, hole G-B-2 contained proportionally more anomalous sample intervals, the highest anomalous concentrations for copper and zinc, and the highest average anomalous amount for each element. Because anomalous concentrations increase in intensity upstream, the mineralized source area must lie upstream and off the reservation.

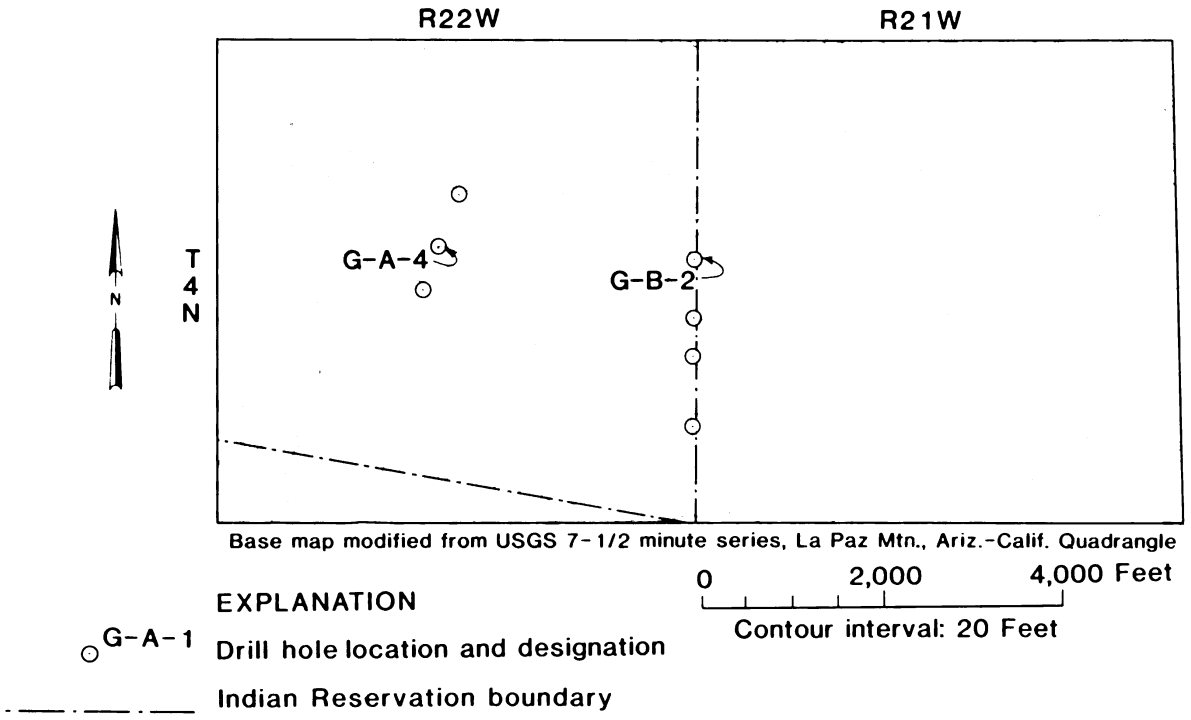
Seventy Wash

Seventy Wash contained five drill-hole lines (fig. 18). There were no anomalies in the downstream-most line S-A. Holes S-B-7 and S-C-4 on the next two lines upstream included several strong base-metal anomalies. Each of the holes on the last two lines in the drainage (S-D and S-E) showed either a single zinc or a single lead anomaly. Because the anomalous data increase upstream to a cutoff near hole S-C-4 and then fade, the source of the metals probably lies southeast of Seventy Wash in the mountains drained by the wash just upstream of hole S-C-4. No mineralization has been reported in this area, although it lies just north of the La Paz placer district and just inside the reservation boundary. It is possible that this area was never thoroughly prospected merely because it was too far inside the former reservation boundary. Like the rest of the reservation, this area occurs within a large region stretching from Nevada to Sonora, Mexico that is deformed by mid-Miocene age detachment faults and related faults and fractures. Current hypotheses regarding the geology of this region connect the localization of mineralization in this region with the fracture zones created during the detachment faulting event (12, 15).

Tyson Wash

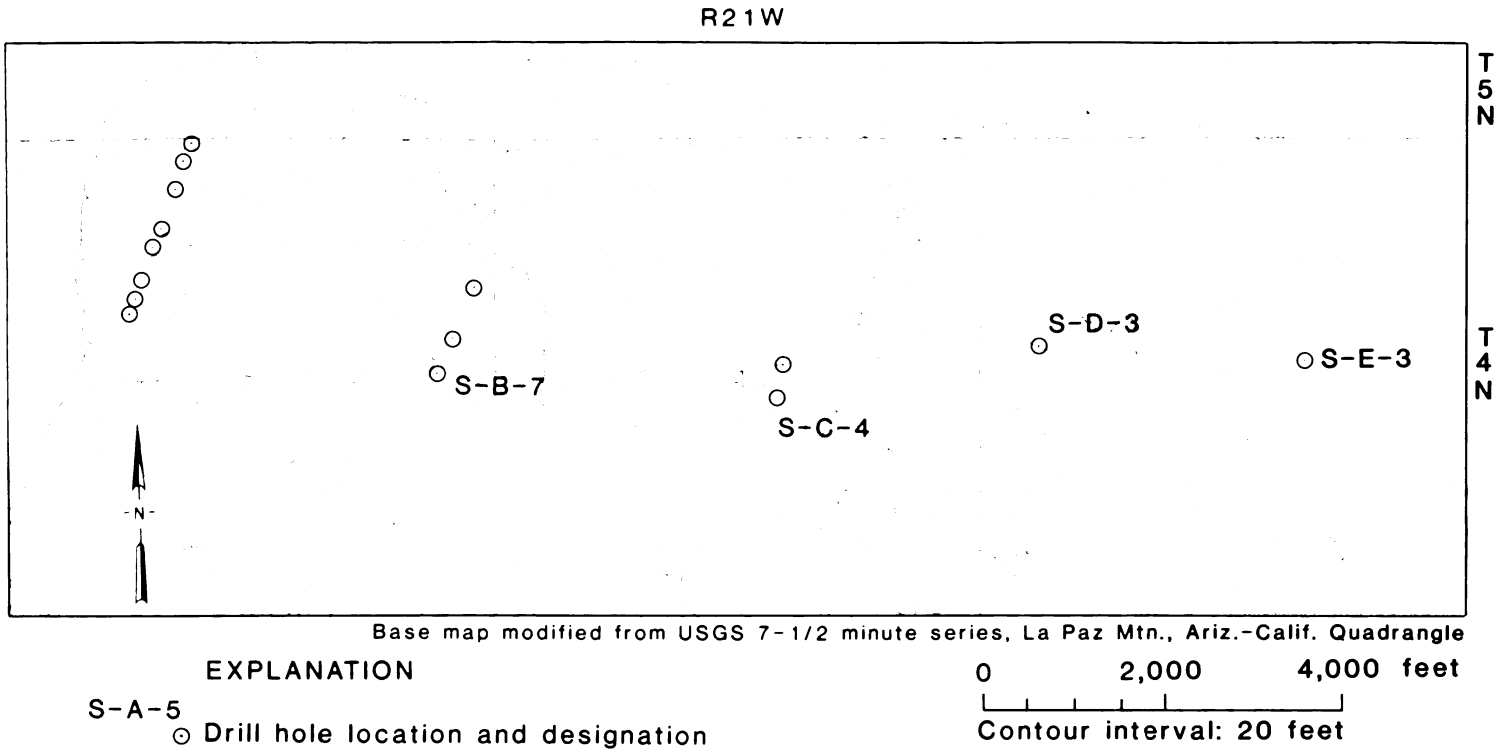
Seven lines were drilled in Tyson Wash (fig. 19). The anomalous concentrations increase upstream in the main Tyson Wash drainage to line T-D. Of the three washes drilled, the data from Tyson Wash most clearly discriminate between areas favorable for base-metal mineralization and those that would be considered unfavorable. For example, because the small wash tested by hole T-F-4 contained only 1 anomalous copper interval in 24 intervals, the stream probably does not drain significant base-metal mineralization.

The base-metal anomalies in Tyson Wash are strongest and most numerous in the holes drilled on lines T-R and T-D. Nine samples out of 10 were anomalous in hole T-R-1; 10 samples out of 24 were found to be anomalous in hole T-D-4 (with a higher lead anomaly in hole T-D-4 than in hole T-R-1). Both holes were located immediately downstream of washes



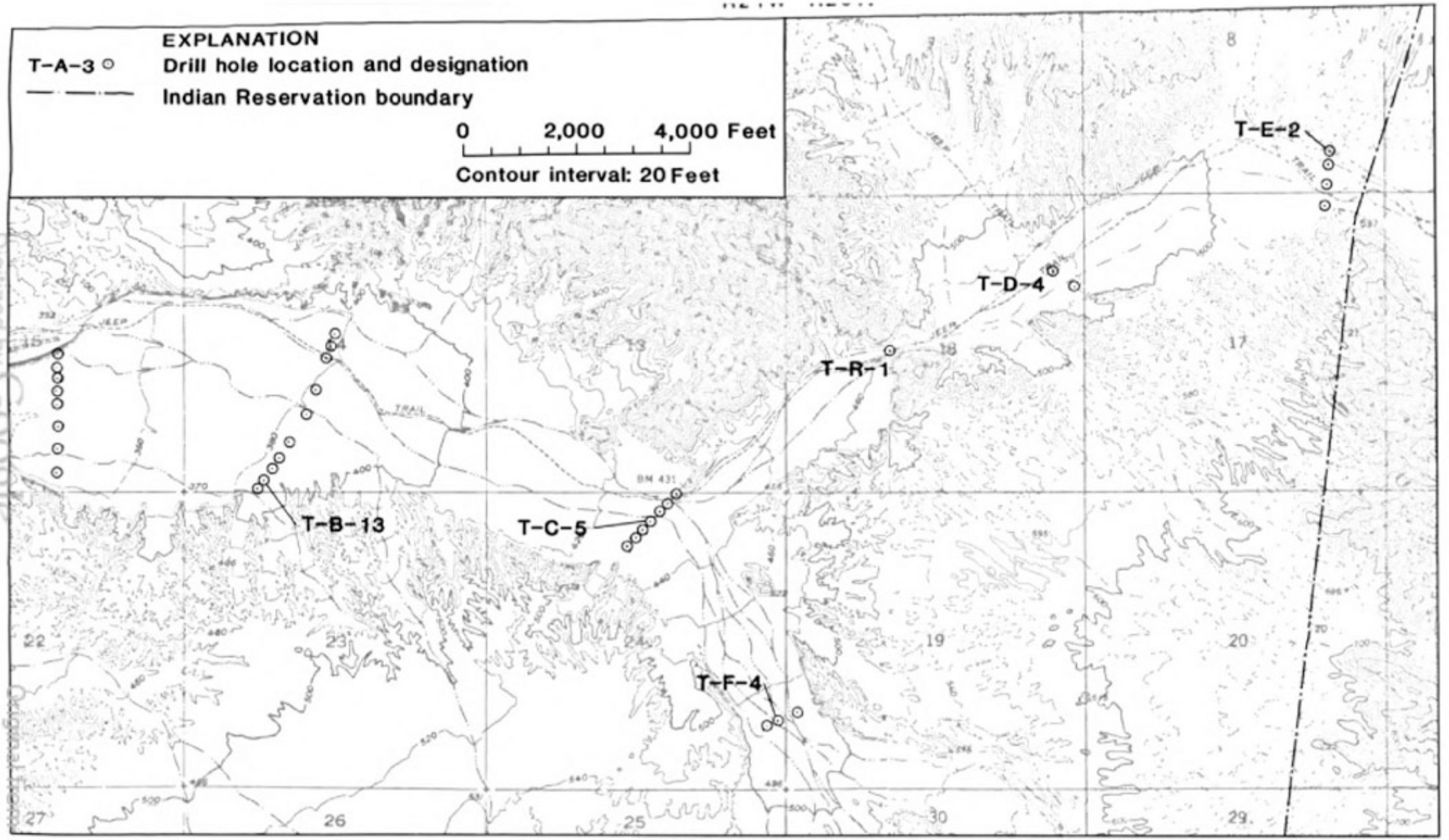
Drill hole			G-A-4		G-B-2	
No. of samples			24		22	
Element			Cu	Zn	Cu	Zn
Anomaly		Total	4	5	3	5
	ppm	Max.	200	500	300	1,000
		Avg.	175	500	217	700

FIGURE 17. - Base metal anomalies, Gonzales Wash.



Drill hole			S-B-7		S-C-4				S-D-3	S-E-3
No. of samples			24		24				24	24
Element			Pb	Mo	Cu	Pb	Zn	Mo	Zn	Pb
Anomaly		Total	7	10	1	4	4	6	1	2
	ppm	Max.	1,000	100	200	1,500	500	100	500	500
		Avg.	586	63	200	1,125	500	58	500	500

FIGURE 18. - Base metal anomalies, Seventy Wash.



Base map modified from USGS 7-1/2 minute series Moon Mtn. SE, and Moon Mtn., Ariz. quadrangles

Drill hole		T-B-13	T-C-5		T-R-1			T-D-4			T-E-2		T-F-4
No. of samples		24	19		10			24			24		24
Element		Mo	Pb	Mo	Cu	Pb	Mo	Cu	Pb	Mo	Pb	Mo	Cu
Anomaly	Total	3	1	5	1	1	8	1	3	6	3	2	1
ppm	Max.	70	700	50	150	500	70	150	1,500	70	1,000	50	100
	Avg.	57	700	50	150	500	58	150	967	53	733	50	100

FIGURE 19. - Base metal anomalies, Tyson Wash.

draining the Moon Mountains and the lower plate of the Moon Mountain detachment fault. Known base-metal mineralization occurs north of Tyson Wash in the Moon Mountains at the Mammoth, Apache, and Valenzuella Mines. Baker (2) mapped a detachment fault near the Mammoth and Apache Mines. As noted in the discussion regarding Seventy Wash, mineralization is probably related to the regional Miocene detachment fault event or at least to the rock fracturing, faulting, and crushing associated with that event.

Drill hole T-E-2 also contained several strong lead anomalies and two weak molybdenum anomalies. In contrast to the holes on lines T-R and T-D, hole T-E-2 lacked anomalous copper and had proportionally fewer anomalies.

The source for the strong anomalous concentrations in T-E-2 is not as obvious as it is for the holes on lines T-R and T-D. Mountains and rock exposures do occur upstream of hole T-E-2, but are several miles away and probably are not the source for the high base metal concentrations. Streams from the westernmost Moon Mountains and Cyprus Minerals Company's Copperstone discovery do drain into Tyson Wash upstream of hole T-E-2, this nearby mineralized mountain range is the probable source area.

SUMMARY AND RECOMMENDATIONS

1. The Colorado River Indian Reservation contains gravel resources both as Colorado River terrace deposits and fluvial wash deposits. The deposits contain millions of tons but must be qualified by virtue of varying physical factors. For more detailed data refer to appendix A and plates 1 through 6. When new gravel pits are needed, possible sites should be selected using the maps and tables in this report. Then trenches, cuts, or test pits should be dug at the desired site to confirm the quantity and quality of material prior to commitment for pit development. Analytical testing of gravel samples would be needed to determine the quality of the gravel for any specific use.

2. Gold was found in all the gravel deposits tested but not in economically minable quantities. The terrace gravels carry less than 1/2 cent/yd^3 and the fluvial wash gravels in Gonzales, Seventy, and Tyson Washes carry from 1 cent to 25 cents/yd^3. Unnamed wash and Bouse Wash were not tested and their development potential remains unknown.

3. Semi-quantitative emission spectrographic analyses on the concentrates from 312 of the samples obtained while drilling in Gonzales, Seventy, and Tyson Washes showed anomalous concentrations for copper, lead, molybdenum, and zinc. The anomalous base metal amounts indicate possible mineralization in some of the areas drained by the washes. Further geochemical investigation is suggested. Additional sampling would be required to determine the source of the base metal anomalies obtained in Seventy Wash. Follow-up work should focus on obtaining stream sediment samples from a wash located in sec. 10, T. 4 N., R. 21 W., that probably drains an area containing base-metal mineralization. No mineralization has been reported in the area drained by this wash, and additional sampling would be necessary to determine whether the base-metal mineralization lies within the reservation boundary. It is anticipated that base-metal mineralization exists as small lode occurrences similar to those on the reservation in the Moon Mountains (Apache, Valenzuella, and Mammoth Mines) and to others outside the reservation in the northern Dome Rock Mountains. As at these known occurrences, it is possible that spotty precious metal mineralization may also occur associated with base-metal mineralization.

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APPENDIX A.--GRAVEL RESOURCES

Tables in this appendix contain site specific information about gravel deposits on the reservation. Tables A-1 through A-6 contain a summary of Colorado River terrace gravel deposits and table A-7 is a summary of fluvial wash gravel in Gonzales, Seventy, and Tyson Washes.

TABLE A-1. - Summary of northwest reservation area gravels, Colorado River Indian Reservation, Arizona and California

Plate No. and area[1]	Location	Estimated tonnage[2]	Remarks
	CALIFORNIA		
1-A....	T. 1 S., R. 24 E. secs. 1,2,11, 12,14,15,21,22, 23,27,28,29,32, 33 T. 2 S., R. 24 E. secs. 5,6,8	ND	Entire area is covered by recent alluvial deposits of loose, unsorted sand, silt, and gravel. General thickness is less than 10 ft. Drainages at 400 ft elev contain concentrations of sand and gravel material. Sizes of rocks range from 1 to 12 in. Rocks are quartzite, other silicified rocks, and igneous rocks.
1-B....	T. 2 S., R. 24 E. sec. 5 NW1/4NW1/4 sec. 6 NE1/4NE1/4 sec. 17 NW1/4NW1/4	ND	Localized concentration of subrounded, loose gravel. Primarily siliceous rocks. Size range, 1 to 12 in.

ND Not determined because of insufficient data.
Elev elevation; R. Range; sec. section; T. Township.
[1]Refer to plates in pocket.
[2]Tonnage estimates based on 1:1 overburden to gravel thickness.

TABLE A-2. - Summary of northern reservation area gravels, Colorado River Indian Reservation, Arizona and California

Plate No. and area[1]	Location	Estimated tonnage[2]	Remarks
	CALIFORNIA		
2-A....	T. 1 N., R. 25 E. sec.33 N1/2NE1/4 sec. 28 SE1/4SE1/4 sec. 27 NE1/4,SE1/4, SW1/4 sec. 26 NW1/4 sec. 23 SE1/4,SW1/4	4,100,000	Gravel bed in sec. 33 is very thin and silty. Sec. 28, same quality, bed about 4 ft thick. In SW1/4SW1/4 sec. 27, the gravel bed is 5 to 25 ft thick, average 20 ft thick, good siliceous material, sizes 1/4 to 8 in. Sand and silt content approximately 50%. In NW1/4SW1/4 sec. 27, bed splits into two thin, silty beds. In the center of S1/2 sec. 27, is a large mound with a 5- to 10-ft-thick bed of gravel. Size of rock 1/4 to 8 in, silt content about 50%. SE1/4 sec. 27 has an area where gravel is 20 to 30 ft thick, with minor sand. Rock is dense, sizes 2 to 8 in. Area well bedded but outcrops are erratic. In NE1/4 sec. 27, the gravel is much thinner and becomes increasingly cemented toward the north. In E1/2NE1/4 sec. 27, silt content increases to 20 to 25% and bed disappears under wash material. Throughout area bed is at 400 to 410 ft elev. In NW1/4 sec. 26, gravel varies from 2 to 28 ft thick, all 20 to 25% silt. In washes gravel is visible for 1,200 to 1,500 ft from mouth of washes to northwest. In NE1/4NW1/4 sec. 26, an old gravel pit operated in a bed of silty gravel 20 to 25 ft thick. Bed thins to the north, 10 to 15 ft thick. Bed is visible for 2,300 ft in the wash before disappearing under wash material. In SW1/4 sec. 23, there is a bed of silty gravel 10 to 15 ft thick. Bed extends for 2,300 ft up wash before being covered. In SE1/4, sec 23, the gravel is too silty to determine a bed thickness.
2-B....	T. 1 N., R. 25 E. sec. 22 SE1/4NE14 sec. 23 SW1/4NW1/4	150,000	In sec. 22 there is a 3 ft bed of good, siliceous gravel, sizes from 1 to 6 in, silt content up to 50%. No lateral extent. In SW1/4NW1/4 sec. 23, is a 10-ft-thick bed of small gravel, 1/4 to 2 in., lateral extent only 100 ft.

See explanatory notes at end of table.

TABLE A-2. - Summary of northern reservation area gravels, Colorado River Indian Reservation, Arizona and California--Continued

Plate No. and area[1]	Location	Estimated tonnage[2]	Remarks
			Also in SW1/4NW1/4 sec. 23. is an area of washed gravel, sizes 3 to 24 in. Near point of bench gravel bed is 3 ft thick, sizes range from 2 to 24 in. Bed continues to the north and disappears in wash material. Throughout this area, gravel at 480 elev. Silicified and granitic rocks
2-C....	T. 1 N., R. 25 E. sec. 23 E1/2NW1/4, NE1/4 sec. 14 SW1/4 SE1/4	850,000	Gravel in drainage, sizes to 12 in. In In NE1/4 sec. 23, gravel bed is seen intermittently at 460 to 480 ft elev. Bed thickness varies from 3 to 40 ft. Sizes range from 2 to 18 in. Sand and silt in some areas, other areas fairly clean. Silicified and granitic rocks.
2-D....	T. 1 N., R. 25 E. sec. 24 S1/2N1/2	990,000	In SW1/4NW1/4 sec. 24, gravel appears to be 30 ft thick. In SE1/4NW1/4 gravel on ridge is about 25 ft thick. Along ridge south of railroad tracks gravel is 8 to 12 ft thick, silt and sand with gravel. Sizes from 2 to 18 in. Material loose to slightly cemented. Rocks silicified and minor igneous material.
2-E....	T. 1 N., R. 25 E. sec. 24 N1/2 sec. 13 S1/2	2,300,000	Throughout N1/2 sec. 24, gravel bed appears intermittently. Thickness is variable, 1 to 3 ft. Elev varies from 440 to 480 ft. Silt content up to 50%. In S1/2 sec. 13 thickness varies from 1 to 15 ft. Gravel is not continuous, perhaps covered by overlying silty gravel. Sizes from 1/2 to 12 in. Gravel appears to be in lenses, very erratic. Loose to slightly cemented. Silicified and granitic rocks.
2-F....	T. 1 N., R. 25 E. sec. 13 N1/2 sec. 12 S1/2	1,000,000	Rounded gravel bed continues to appear intermittently at 480 to 640 ft elev. Bed thickness from 2 to 30 ft. Sizes 1/2 to 12 in. Loose to slightly cemented, silicified and granitic rocks. Exposures of gravel vary from a few feet to several hundred feet in length.

See explanatory notes at end of table.

TABLE A-2. - Summary of northern reservation area gravels, Colorado River Indian Reservation, Arizona and California--Continued

Plate No. and area[1]	Location	Estimated tonnage[2]	Remarks
			It is impossible to determine exact extent of gravel.
2-G....	T. 1 N., R. 26 E. sec. 18 sec. 7 S1/2	1,200,000	In W1/2W1/2 sec. 18 a good clean bed of gravel, apparently 3 to 6 ft thick, can be traced for several thousand feet. In NE1/4NW1/4 sec. 18 good, clean gravel, 15 to 25 ft thick appears at 520 ft elev. Rock sizes are 1/4 to 12 in. Good beds quickly grade into silty gravels in some exposures. In sec. 7 gravel appears at 560 ft elev, exposures vary from 5 to 30 ft thick. Some good clean silicified rocks, some areas contain poor quality granitic rocks Beds loose to slightly cemented.
2-H....	T. 1 N., R. 26 E. sec. 8 N1/2SW1/4	ND	Isolated patches of good, clean gravel visible on both sides of wash. Thickness appears to be 25 ft. Rock sizes 1/8 to 12 in. No apparent lateral extent. Rocks are silicified, and granitic, loose to slightly cemented. Elev 560 ft.
2-I....	T. 1 N., R. 26 E. sec.9 SW1/4	ND	Rounded gravel bed, 15 to 25 ft thick. Rock sizes from 2 to 6 in. Silt and fine-grained sand make up 50% of bed. No cementing and no apparent lateral extent. Rocks are silicified and granitic. Elev 420 ft.
2-J....	T. 1 N., R. 26 E. sec. 3 C1/2	ND	Very silty (50%) mounds of gravel. Mixture of dense rounded gravels and soft, friable, angular gravels. Might make good fill material. Rocks are silicified and granitic. Sizes from 1/8 to 12 in. Elev 380 to 460 ft.
2-K....	T. 1 N., R. 26 E. sec. 10 Center	ND	Same as previous entry.

ND Not determined because of insufficient data.
Elev elevation; R. Range; sec. section; T. Township.
[1]Refer to plates in pocket.
[2]Tonnage estimates based on 1:1 overburden to gravel thickness.

TABLE A-3. - Summary of Parker bench area gravels, Colorado River Indian Reservation, Arizona and California

Plate No. and area[1]	Location	Estimated tonnage[2]	Remarks
	ARIZONA		
3-A....	T. 10 N., R. 19 W. sec. 27 SW1/4 sec. 28 SW1/4SW1/4 sec. 34 NW1/4	1,200,000	No cementing. Bed 1 to 10 ft thick. Elev 500 ft. Variable sand and silt content. Some fractured rocks. Mostly silicified rock, minor granitic and schistose rocks, sizes 1 to 6 in.
3-B....	T. 10 N., R. 19 W. sec. 33 NW1/4NW1/4 sec.32 E1/2	2,700,000	Loose gravel bed at 420 ft elev. At east end of area the bed is very thin but is 10 ft thick in NE1/4 of sec. 32. In SE1/4 sec. 32, there is an old borrow pit. Screened material at the site is primarily less than 6 in., all less than 12 in. Bed is about 3 ft thick in this area. In W1/2NE1/4 sec. 32 bed is about 5 ft thick with some sand, primarily silicified rocks.
3-C....	T. 10 N., R. 19 W. sec. 32 NW1/4	1,700,000	Gravel is loose, 5 to 20 ft thick. Near center of area there are three gravel beds, total thickness 23 to 30 ft. In an old borrow pit near west section line gravel is very loosely cemented, sizes primarily less than 8 in., few up to 12 in. Gravel up to 20 ft thick, mixed with sand. Rocks are primarily silicified. Overlying gravel is a silty gravel bed at the surface. Elev 410 ft.
3-D....	T. 10 N., R. 19 W. sec. 31 S1/2	2,100,000	Loose gravel 5 to 8 ft thick, generally in two beds with silty-sandy gravel between. There is a fairly persistent bed of siliceous gravel about 5 ft thick throughout the area at the 420 ft elev. Bed appears to thin to the south. Sizes range from 1 to 6 in. A bed of silty gravel overlies the clean gravel.
3-E....	T. 9 N., R. 20 W. sec. 2 E1/2	300,000	Three beds of gravel exposed. Total thickness 5 to 20 ft. Upper bed very sandy, disappears near center of

See explanatory notes at end of table.

TABLE A-3. - Summary of Parker bench area gravels, Colorado River Indian Reservation, Arizona and California--Continued

Plate No. and area[1]	Location	Estimated tonnage[2]	Remarks
			section. Lower two beds continue to south at 400 to 410 ft elev. Lower bed disappears near section line between secs. 2 and 11. Middle bed is 5 to 10 ft thick. Silicified and igneous rocks.
3-F....	T. 9 N., R. 20 W. sec. 11 E1/4 sec. 12 SW1/4	1,200,000	Throughout this area is a persistent bed of gravel 3 to 5 ft thick at 410 ft elev. There are areas where sand makes up 50% of the bed. There is some surface silt, apparently from the overlying beds. Rocks are primarily siliceous, sizes 1 to 6 in.
3-G....	T. 9 N., R. 20 W. sec. 13 C1/2 sec. 24 NE1/4	2,900,000	Loose gravel bed at 410 ft elev. Active gravel pit in N1/2NW1/4 sec. 13 is producing gravel from this bed. South from this pit the bed varies from 5 to 12 ft thick. Sizes 1 to 6 in. Below gravel is a bed of fine-grained sand. Gravel is primarily siliceous.
3-H....	T. 9 N., R. 19 W. sec. 19 SW1/4 sec. 30 W1/2 sec. 31 W1/2 T. 9 N., R. 20 W. sec. 36 E1/2 T. 8 N., R. 20 W. sec. 1 sec. 12 N1/2	ND	Throughout this area the gravel is seen only in hummocks of gravelly sand at 400 to 500 ft elev. Gravel content 20% or less. Gravels appear to be very thin. No good deposits were seen. Gravels are siliceous, granitic and schistose. Dune sands are present in this area. Gravels from 1 to 3 ft thick, sizes from 1 to 6 in.

ND Not determined because of insufficient data.
Elev elevation; R. Range; sec. section; T. Township.
[1]Refer to plates in pocket.
[2]Tonnage estimates based on 1:1 overburden to gravel thickness.

TABLE A-4. - Summary of east-central reservation area gravels, north half, Colorado River Indian Reservation, Arizona and California

Plate No. and area[1]	Location	Estimated tonnage[2]	Remarks
	ARIZONA		
4-A....	T. 8 N., R. 20 W. sec. 13 SE1/4 sec. 24 NE1/4NE1/4	420,000	Bed tightly cemented (caliche), extends no more than 200 ft from outcrop. One to three beds depending on presence of silt lenses. Beds average 4 to 5 ft thick, total thickness 2 to 25 ft. Rocks are primarily silicified, sizes range from 2 to 6 in. Elev 590 ft.
4-B....	T. 8 N., R. 20 W. sec. 24 NE1/4	ND	Area of loose hummocks of gravel. Thickness variable, 2 to 12 ft. Rock sizes 2 to 6 in, primarily silicified. Elev 640 ft.
4-C....	T. 8 N., R. 20 W. sec. 24 W1/2 sec.23 SE1/4NE1/4	1,900,000	Gravel slightly cemented, 24 ft thick, occasionally two beds are present, 6 to 12 ft thick, separated by silt bed 10 to 12 ft thick. Sample C taken from this area: 70% gravel, and 30% sand. Rock size 2 to 6 in, primarily siliceous. Elev 620 ft.
4-D....	T. 8 N., R. 20 W. sec. 23 SE1/4SE1/4 sec. 26 NE1/4NE1/4	330,000	Ridge capped with loose to slightly cemented silty gravel 2 to 30 ft thick, average 15 ft thick. Thins to a few inches to the southeast. Siliceous rock, sizes 2 to 6 in. Elev 620 ft.
4-E....	T. 8 N., R. 20 W. sec. 23 SW1/4SE1/4 sec. 26 NW1/4NE1/4	440,000	Ridge capped with loose to slightly cemented silty gravel 15 to 25 ft thick. Gravel thins to a few inches to southeast. Siliceous rocks, size 2 to 6 in. Elev 620 ft.
4-F....	T. 8 N., R. 20 W. sec. 34 S1/2NE1/4 N1/2SE1/4	130,000	Several gravel beds, loose to moderate cementing, 1 to 13 ft thick. Some silty lenses. Sample L taken from this area: 70% gravel, 30% sand and silt. Rocks are primarily siliceous, size 1 to 12 in. Elev 740 ft, about 100 ft higher than gravel to the southwest (plate 4).
4-G....	T. 8 N., R. 20 W. sec. 34 SW1/4	920,000	Gravel bed 20 to 40 ft thick, loose to moderate cementing, some silt lenses. Siliceous rocks, 3 to 6 in. Elev 600 ft.

See explanatory notes at end of table.

TABLE A-4. - Summary of east-central reservation area gravels, north half, Colorado River Indian Reservation, Arizona and California--Continued

Plate No. and area[1]	Location	Estimated tonnage[2]	Remarks
4-H....	T. 8 N., R. 20 W. sec. 33 SE1/4SE1/4 sec. 34 SW1/4SW1/4	610,000	Area of tightly cemented gravel 20 to 30 ft thick. Siliceous rocks, sizes 1/4 to 6 in. Elev 600 ft.
4-I....	T. 8 N., R. 20 W. sec. 33 W1/2SE1/4 T. 7 N., R. 20 W. sec. 4 N1/2NW1/4 N1/2NE1/4	6,500,000	Loose to slightly cemented gravel, 5 to 30 ft thick. Silt lenses toward southwest. Sample B taken in this area: 50% gravel, 50% sand. Rocks siliceous, granitic, and schistose, sizes from 1/2 to 6 in. Elev 600 ft.
4-J....	T. 7 N., R. 20 W. sec. 4 S1/2NW1/4 N1/2SW1/4 sec. 5 N1/2SE1/4	3,700,000	Slightly to tightly cemented gravel, 5 to 40 ft thick, high silt content. Rock types siliceous, granitic, and schistose, sizes 1/2 to 6 in. Elev 600 ft.
4-K....	T. 7 N., R. 20 W. sec.4 SW1/4SW1/4 sec. 5 SE1/4SE1/4 sec. 8 NE1/4NE1/4 sec. 9 NW1/4NW1/4	1,700,000	Several gravel beds, total thickness 5 to 40 ft, slight to moderate cement. Sample A taken in this area: 70 to 80% gravel, 20 to 30% sand. Siliceous, granitic, and schistose rocks, sizes 1 to 12 in. Elev 580 ft.
4-L....	T. 7 N., R. 20 W. sec. 8 NE1/4	3,100,000	Moderate to tight cementing, gravel 15 to 25 ft thick. Few silt lenses. Siliceous, granitic, and schistose rocks, sizes 1/2 to 6 in. Elev 600 ft.
4-M....	T. 7 N., R. 20 W. sec. 8 S1/2SW1/4 sec. 16 W1/2 sec. 17 E1/2 sec. 20 N1/2NE1/4	6,900,000	Moderate to tight cementing, 5 to 35 ft thick. Numerous silty areas. Sample E taken from this area: 50% gravel, 50% sand. Rocks siliceous, granitic, and schistose, sizes 1 to 4 in, few larger. Elev 600 to 620 ft.

See explanatory notes at end of table.

TABLE A-4. - Summary of east-central reservation area gravels, north half, Colorado River Indian Reservation, Arizona and California--Continued

Plate No. and area[1]	Location	Estimated tonnage[2]	Remarks
4-N....	T. 7 N., R. 20 W. sec. 16 SE1/4SW1/4 sec. 20 SE1/4NE1/4 sec. 21 NW1/4	4,000,000	Loose to slightly cemented, 10 to 25 ft thick, few silty areas. Sample E taken from this area: 70% gravel, 30% sand. Rock material siliceous, granitic, and schistose, sizes from 1/2 to 6 in. Elev 620 ft.
4-O....	T. 7 N., R. 20 W. sec. 20 N1/2SE1/4	1,500,000	Loose to slightly cemented, 15 to 22 ft thick, high silt content. Rocks siliceous, granitic, schistose, 1/2 to 6 in. Elev 620 ft.
4-P....	T. 7 N., R. 20 W. sec. 20 S1/2	1,000,000	Several gravel beds 3 to 6 ft thick, total thickness 3 to 20 ft, occur in this area; most are loose to slightly cemented. Sample H taken from this area, 70% gravel, 30% sand (sand also occurs in distinct beds). Rocks are siliceous, granitic and schistose. Sizes from 1 to 6 in. Elev 580 to 600 ft.

ND Not determined because of insufficient data.
Elev elevation; R. Range; sec. section; T. Township.
[1]Refer to plates in pocket.
[2]Tonnage estimates based on 1:1 overburden to gravel thickness.

TABLE A-5. - Summary of east-central reservation area gravels, south half, Colorado River Indian Reservation, Arizona and California

Plate No. and area[1]	Location	Estimated tonnage[2]	Remarks
	ARIZONA		
5-A....	T. 7 N., R. 20 W. sec. 29 W1/2 sec. 30 E1/2 sec. 31 E1/2 sec. 32 W1/2 T. 6 N., R. 20 W. sec. 6 N1/2	7,800,000	Several gravel beds 3 to 6 ft thick, total thickness 3 to 20 ft, occur in this area. Most are loose to slightly cemented. Samples taken from this area: Sample F, 50% gravel, 50% sand and clay in matrix and; Sample G, gravel with sand, clay, and silt but no cementing. Cementing in this area is stronger near surface and at west ends of benches. Upper reaches of washes have less cementing and generally are filled with blown sand. Generally there is up to 20 ft of sandy gravel underlying cleaner gravel bed, average thickness 5 ft. Rock materials siliceous, granitic, and schistose. Sizes from 1 to 6 in. Elev 580 to 600 ft.
5-B....	T. 6 N., R. 20 W. sec. 6 S1/2SE1/4 sec. 7 NW1/4 T. 6 N., R. 21 W. sec. 1 SE1/4SE1/4 sec. 12 E1/2 sec. 24 sec. 25 W1/2 sec. 26 E1/2E1/2 sec. 35 NE1/4NE1/4 sec. 36 NW1/4	8,400,000	Loose to slight cementing, 2 to 18 ft thick. Occasionally cemented sand layers a few inches thick. Three samples were taken from this area. Each sample interval had two gravel beds. Sample J: upper bed 8 ft thick, 20% gravel, 80% sand; lower bed 4 ft thick, 70% gravel, 30% sand. Sample I: upper bed 9 ft thick, 6 ft of clean sand in middle of gravel; lower bed 6 ft thick, 80% gravel, 20% sand. Sample K: upper bed 8 ft thick, 70% gravel, 30% sand; lower bed 4 ft thick, 40% gravel, 60% sand. Gravel siliceous, granitic, and schistose. Throughout this area the cleanest gravel bed varies from 2 to 8 ft thick. Rock sizes 1 to 6 in. Elev 580 ft. Below is a persistent layer of sandy gravel up to 10 ft thick. Gravels disappear where the 600 ft elev contour approaches Dome Rock Mountains and the gravel beds are covered by blown sand and an angular gravel capping.

ND Not determined because of insufficient data.
Elev elevation; R. Range; sec. section; T. Township.
[1]Refer to plates in pocket.
[2]Tonnage estimates based on 1:1 overburden to gravel thickness.

TABLE A-6. - Summary of Gonzales Wash area gravels, Colorado River Indian Reservation, Arizona and California

Plate No. and area[1]	Location	Estimated tonnage[2]	Remarks
	ARIZONA		
6-A....	T. 4 N., R. 22 W sec. 36 SW1/4 S1/2SE1/4	ND	Small hills in this area are covered with an angular gravel of gray schist with much white quartz. Concentrations of this material are seen in washes. Tops of some hills are covered with a thin layer of siliceous, rounded gravel. No discernible thickness of either gravel in this area. Rock sizes from 1 to 24 in. Elev 320 to 340 ft.
6-B....	T. 4 N., R. 22 W. sec. 36 NW1/4SE1/4	170,000	Hill on south side of Gonzales Wash has a bed of rounded siliceous gravel 3 ft thick, 10 to 15% silt, all rocks less than 6 in. Bed can be traced only a few feet. Above is a bed of angular gravel 5 to 7 ft thick at elev 320 ft. Sizes range from 2 to 24 in, silt content 20 to 40%. All gravel is loose to slightly cemented.
6-C....	T. 4 N., R. 22 W. sec. 36 NE1/4	460,000	North side of Gonzales Wash, elev 380 ft, a 5-ft-thick bed of angular gravel sizes 4 to 24 in. Above and below are beds of silty angular gravels, sizes 6 in and less. Rocks in all three beds are primarily igneous, some siliceous material.
6-D....	T. 4 N., R. 22 W. sec. 36 NW1/4 sec. 25 E1/2 sec 24 SE1/4SE1/4	950,000	Throughout this area the angular gravel bed is seen in the washes and main drainages. The bed is 5 ft thick at southern end of area and thins to 3 ft near the northern end of the area. Rocks are igneous and siliceous. Bed is loose, rock sizes from 2 to 24 in. Some areas covered by silty material, possibly from overlying silty gravel bed. Elev 320 ft.

ND Not determined because of insufficient data.
Elev elevation; R. Range; sec. section; T. Township.
[1]Refer to plates in pocket.
[2]Tonnage estimates based on 1:1 overburden to gravel thickness.

TABLE A-7. - Summary of fluvial wash gravel resources in Gonzales, Seventy and Tyson Washes

Wash	Location	Remarks
Gonzales..	ARIZONA T. 4 N., R. 22 W. secs. 24,25,26	Gravel thickness at mouth of wash ranges from 35 to 40 ft. At the eastern reservation boundary thicknesses are from 15 to 25 ft. Rock sizes are from 1 in up to 24 in, 50% is in the range of 1/4 to 4 in. Gravel contains granite, schist, basalt, quartz, quartzite, sandstone, and small amounts of chert, jasper, and epidote. Sand, silt, and clay are present, up to 25% of the deposit. Gravel is rounded or subrounded, unsorted, and only slightly stratified.
Seventy...	T. 4 N., R. 21 W. secs. 3,4,5	Gravel thickness at mouth of wash ranges from 10 to 30 ft. In secs. 3 and 4 gravel is 15 to 20 ft thick. Rock sizes are less than 6 in, larger rocks are rare. Gravel contains granite, schist, basalt, quartz, quartzite, and sandstone. Sand and silt content is over 50%. Gravel is subrounded to angular and unsorted.
Tyson.....	T. 5 N., R. 20 W. secs. 8,17,18,19 T. 5 N., R. 21 W. secs. 13,14,15,24	Gravel thickness at mouth of wash range from 10 to 45 ft. In sec. 14 gravel is from 10 to 35 ft thick. In secs. 13 and 24 gravel is 10 to 30 ft thick. In secs. 8 and 17 the gravel is 20 to 25 ft thick. Rock sizes are generally less than 6 in. Gravel contains granite, schist, basalt, quartz, quartzite, and sandstone. Gravel is rounded to angular. Sand, silt, and clay content is variable.

R Range; sec. section; T Township.

APPENDIX B.--GRAVEL PRODUCTION

This appendix contains information about gravel pits and production statistics. Both private lease operations and government operations are included in this appendix.

GRAVEL PRODUCTION

The gravel operations on the reservation are described in the sections that follow. Deposits are grouped by private lease operations and government operations and described within each category from north to south (fig. B-1).

Private Lease Operations

Blue Water Concrete and Aggregate, Inc.

The Blue Water Concrete and Aggregate, Inc., lease and gravel plant are on the north side of Osborne Wash, secs. 28, 33, and 34, T. 10 N., R. 19 W.,[1] about 1/2 mile southeast of State Highway 95 and 3-1/2 miles east-northeast of Parker (fig. B-1).

The lease originally was awarded in November 1966 for 3 years on 7.9 acres of land; with extensions and modifications, the lease now applies to 23.88 acres and has been extended to March 31, 1994. Lease terms call for a rental fee of $3,959/yr and a royalty of 43 cents/yd^3 of gravel produced.

Gravel is mined from various lenses along the edges and in the bed of the wash. The lenses vary greatly in character, extent, and thickness. Reportedly, by judicious selection of the lenses, material can be produced that approximates any desired combination. Little treatment is required to meet any given specification. Production records on file with the BIA are shown in table B-1.

No reserves have been estimated for the lease, and the great variation in the characteristics of the lenses would make estimation very difficult. The operators, however, do not appear apprehensive about reserves, which are relatively constant owing to replenishment from flood wash.

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[1] Gila River Meridian unless otherwise noted.

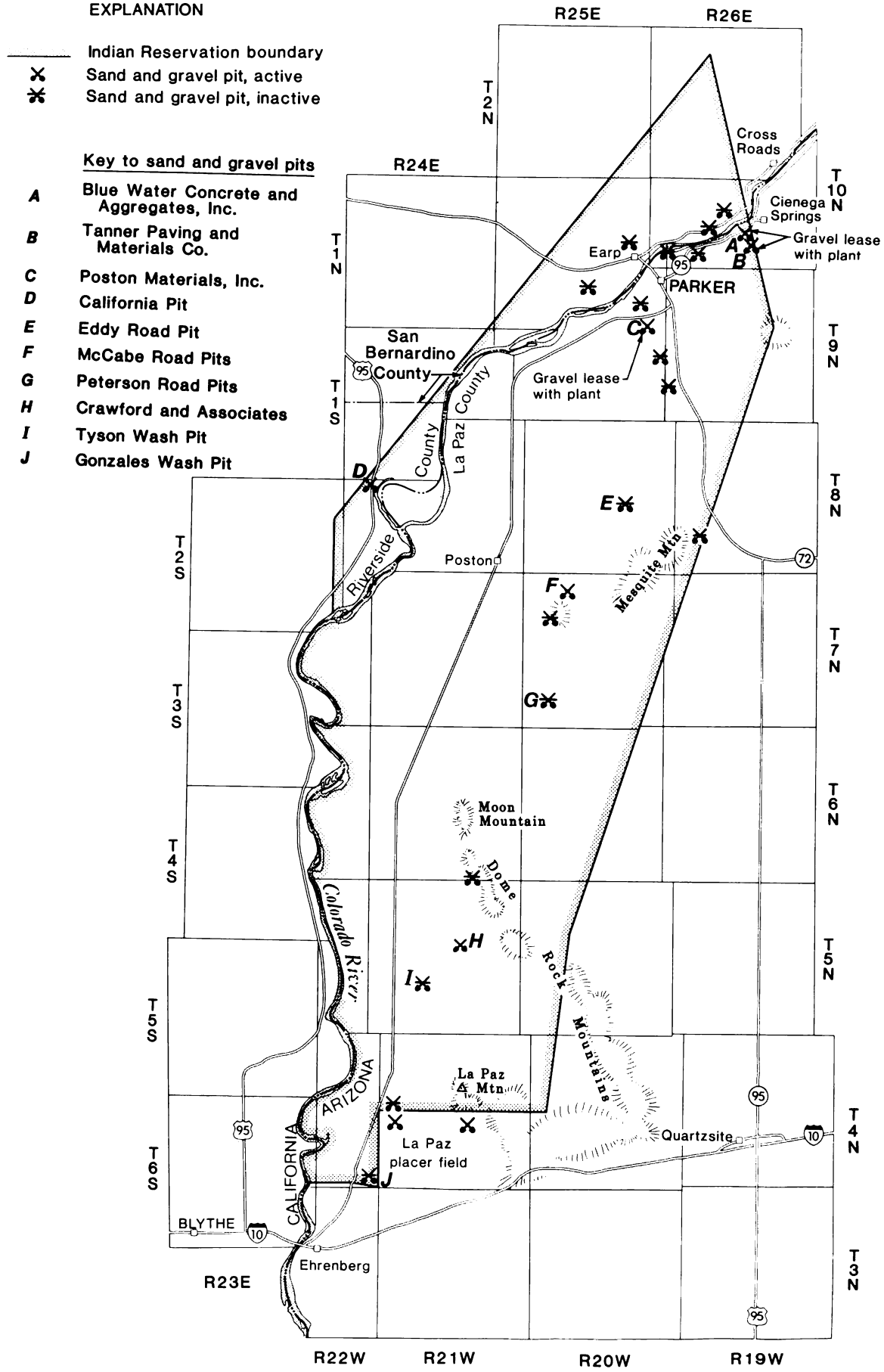

FIGURE B-1. - Location map, gravel pits.

TABLE B-1. - Recorded production of Blue Water Concrete and Aggregate, Inc.

Year	Tons	Rents and royalties paid[1]
1970.....	9,826	$5,232.25
1971.....	7,886	4,885.14
1972.....	12,502	5,987.37
1973.....	NA	NA
1974.....	NA	NA
1975.....	25,399	10,605.49
1976.....	16,154	6,386.98
1977.....	30,390	8,975.31
1978.....	38,746	10,494.64
1979.....	36,945	10,167.32
1980.....	20,981	7,264.81
1981.....	22,113	7,470.63
1982.....	26,370	8,244.56
1983.....	27,121	8,381.00
1984.....	24,214	11,653.67
1985.....	21,482	12,570.10
1986[2].....	20,125	11,740.00
Total.....	340,252	130,059.27

NA Not available.
[1]Rents and royalties vary with term of the leases.
[2]January through October.
NOTE.--Unrecorded production might increase total figure by about 48,000 st. Data may not add to total shown because of independent rounding.
Source: BIA files, Real Estate Services, Parker, AZ.

Tanner Paving and Materials Co.

The Tanner Paving and Materials Co. lease and gravel plant are in Osborne Wash in secs. 33 and 34, T. 10 N., R. 19 W., southeast of and adjacent to the Blue Water Concrete and Aggregate, Inc., lease (fig. B-1). The current lease was awarded in January 1982 and is up for renewal.

The lease covers 80 acres and specifies an annual rental of $4,810 and a royalty of 40 cents/st produced.

Production comes from various gravel lenses on the sides of and in the bed of the wash. Production as recorded in BIA files is listed in table B-2.

No reserve estimates have been made, occasional floods replenish the gravel mined and no shortage of reserves is foreseen. Because the Tanner and Blue Water leases are only about 1,000 ft inside the eastern boundary of the reservation, eventual exhaustion of the gravel source within the reservation on Osborne Wash can be expected. Both companies, however, claim that the flood-borne gravel carried down the wash exceeds the amount being mined.

TABLE B-2. - Recorded production of Tanner Paving and Materials Co.

Year	Tons	Rents and royalties paid[1]
1973.....	18,284	$5,903.25
1974.....	17,805	6,920.75
1975.....	32,092	9,063.80
1976.....	25,280	8,042.00
1977.....	27,980	8,447.00
1978.....	41,024	10,403.59
1979.....	61,617	13,492.53
1980.....	80,173	16,275.90
1981.....	66,208	14,181.25
1982.....	64,347	26,771.54
1983.....	48,519	23,057.99
1984.....	38,429	19,168.17
1985.....	38,854	20,983.52
1986[2].....	29,795	17,776.74
Total.....	590,407	203,515.03

[1]Rents and royalties vary with term of the leases.
[2]January through September.
NOTE.--Data may not add to total shown because of independent rounding.
Source: BIA files, Real Estate Services, Parker, AZ.

Poston Materials, Inc.

The Poston Material, Inc., (David Shephardson) lease and gravel plant are in the NW1/4 sec. 13, T. 9 N., R. 20 W., just south of the Mojave Road (fig. B-1), and about 3/4 mile east of the tribal headquarters. In 1969 when the original lease was awarded, it included only 11.5 acres. With modifications and renewals, it now covers 13 acres and will be in effect until 1994. Lease terms call for a rental payment of $3,500/yr and a royalty payment of 43 cents/st on the gravel produced.

Gravel is mined from a flat or gently dipping lens, 8 to 16 ft thick, exposed in the bench bordering the eastern edge of the Colorado River flood plain. This bed can be traced northward from the Poston Materials, Inc., lease past the sewage disposal plant, and beyond the BIA Colorado River Indian Agency Headquarters.

Although the gravel contains some sand, overall it is well-sorted, rounded material ranging in diameter from about 1/4 in to 4 in, with the majority being between 1/2 in and 1-1/2 in. Table B-3 shows production as recorded in BIA files.

A limited amount of earlier production by unknown producers occurred north of the lease, but encroachment of cultural features and expansion of the town of Parker probably will inhibit further mining in that direction.

TABLE B-3. - Recorded production of Poston Materials, Inc.

Year	Tons	Rents and royalties paid[1]
1969.....	NA	$ 100.00
1970.....	11,466	2,219.95
1971.....	13,073	2,461.00
1972.....	18,025	2,573.84
1973.....	NA	500.00
1974.....	NA	500.00
1975.....	21,195	3,679.25
1976.....	29,430	4,823.83
1977.....	22,011	3,801.65
1978.....	20,717	3,607.65
1979.....	26,451	4,468.85
1980.....	15,265	2,789.75
1981.....	14,490	3,310.40
1982.....	7,908	1,791.35
1983.....	7,006	2,440.90
1984.....	29,812	8,945.55
1985.....	14,284	5,239.14
1986[2].....	2,278	4,456.84
Total.....	253,411	57,609.95

NA Not available.

[1]Rents and royalties vary with term of the leases.

[2]January through October.

NOTE.--Unrecorded production might increase total figure by about 30,000 st. Data may not add to total shown because of independent rounding.

Source: BIA files, Real Estate Services, Parker, AZ.

Crawford & Associates

The Crawford & Associates lease and gravel plant are in sec. 15, T. 5 N., R. 21 W., near the mouth of Tyson Wash (fig. B-1). Gravel is mined from the bottom of the wash then screened and crushed in a mobile plant in a yard on the north bank of the wash. Stockpiles of sized material are maintained in the yard.

The lease was assigned December 1983 and is renewable annually. The area of the lease is 3 acres, which is leased for an annual rental of $450 and a royalty of 40 cents/st produced. Production figures are given in table B-4.

No reserve estimates have been made, however; flood wash intermittently replenishes the reserves.

TABLE B-4. - Recorded production of Crawford & Associates

	Tons	Rents and royalties paid
Sept. 1983 through Jan. 1984	2,611	$1,494
Feb. 1984 through Dec. 1984	5,551	4,487
Jan. 1985 through Dec. 1985	9,569	4,379
Jan. 1986 through Sept. 1986	3,670	1,954
Total.....	21,491	12,314

NOTE.--Data may not add to total shown because of independent rounding.
Source: BIA files, Real Estate Services, Parker, AZ.

Government Operations

California Pit

The California pit is in the extreme northwest corner of sec. 5, T. 2 S., R. 24 E. (San Bernardino Base and Meridian), near the base of the Riverside Mountains in California (fig. B-1). BIA production appears to be from a bedded deposit of gravel, which is screened and crushed before use as road metal. Production as recorded by BIA is listed in table B-5.

TABLE B-5. - Recorded production from California Pit

Year	Tons
1984.....	20,800 to 22,700
1985.....	22,000

Source: BIA files, Real Estate Services, Parker, AZ.

Eddy Road Pit

Eddy Road gravel pit is in sec. 22, T. 8 N., R. 20 W., about 4-1/2 miles east of Mojave Road (fig. B-1). The deposit consists of several 1to 3-ft-thick lenses of gravel, intercalated with sand and silt, and one 8-ft-thick lens of silty, clayey gravel. The gravel is mostly well-rounded quartzite, sandstone, and granite, with small quantites of igneous rocks and schist. Sizes are primarily less than 4 in. At the pit site, most of the material has been mined out; only a few thousand cubic yards remain. About 1/4 mile to the east, there is another gravel deposit of similar quality. No production figures are available for this gravel pit.

McCabe Road Pits

The McCabe Road (Poston Pit) sand and gravel pits are in sec. 5, T. 7 N., R. 20 W., about 2-1/2 miles east of Mojave Road and the settlement of Poston (fig. B-1).

The pits are excavated over an area of about 300 ft by 1,320 ft in fluvial material near the mouth of a wash that drains westward from Mesquite Mountain. Unsorted and poorly bedded material, consisting of about 30% fine gravel in sand and silt characterize the deposit. No attempt was made to estimate reserves, but the deposit is far from being exhausted. Production recorded in BIA files is listed in table B-6.

TABLE B-6. - Recorded production from McCabe Road Pits

Year	Tons
1980	2,550
1981	2,000
1982	22,000
1983	2,000
1984	2,500
1985	3,000
1986[1]	3,500
Total	37,550

[1]January through September.

Source: BIA files, Real Estate Services, Parker, AZ.

Peterson Road Pits

The Peterson Road gravel pits are in sec. 30, T. 7 N., R. 20 W., 3 to 4 miles east of Mojave Road (fig. B-1). The gravel pits are near the top of the terrace that forms the eastern edge of the Colorado River flood plain. Excavations occur on both sides of the access road and cover an area of nearly 1 square mile. The deposit is a flat or gently dipping bed of gravel, 1 to 16 ft thick. Gravel consists of well-rounded, unsorted material rarely more than 4 in. in diameter, including sandstone, quartzite, basalt, quartz, chert, jasper, and chalcedony.

About 75% of the gravel resource in the pit area has been exhausted. Several hundred thousand cubic yards of gravel are visible in the vicinity, and it seems probable that prospecting could extend reserves to the north, south, and east.

Tyson Wash Pits

The Tyson Wash pits are in sec. 21, T. 5 N., R. 21 W., on the southeast side of Tyson Wash and about 1-1/2 miles downstream from the Crawford & Associates pit (fig. B-1).

The deposit consists of small, scattered lenses of about 40% minus 2-in gravel, and 60% interbedded fine-grained sand and silt. Although the gravel is of good quality production would result in large quantities of waste material. No reserve estimates were attempted owing to the variable and scattered nature of the deposits.

Gonzales Wash Pit

Gonzales Wash pit is in sec. 36, T. 4 N., R. 22 W., about 1/2 mile north of the southern boundary of the reservation (fig. B-1). Approximately 200 ft east of Mojave Road is an excavation about 250 by 100 ft and 25 ft deep from which gravel has been mined. Some screened products

were still stockpiled on site in July 1986. There appears to be 3 MMyd^3 or more of minable gravel in the deposit within the reservation boundary.

The deposit is fluvial wash material, about 600 ft in width and possibly 40 ft deep, extending upstream nearly 1 mile between Mojave Road and the eastern reservation boundary. The gravel contains granite, schist, basalt, quartz, quartzite, and sandstone, plus small amounts of chert, jasper, and epidote. The material is rounded, unsorted, and only slightly stratified. About 50% of the material is between 1/4 in and 4 in. in diameter, 25% is larger than 4 in., and the balance is mostly sand, silt, and clay. Boulders larger than 1 ft in diameter are rare.

APPENDIX C.--GOLD VALUES IN SAMPLE CONCENTRATES

Table C-1 contains gold concentrate values found in Colorado River terrace gravel samples. Table C-2 contains gold concentrate values found in each drill hole sample. Gold values were calculated on gold valued at $350/tr oz.

TABLE C-1. - Gold values in terrace gravel sample concentrates

(Gold values at $350/tr oz)

Sample	Total gold weight, mg	Gold, mg/yd^3	Gold value, cents/yd^3	Remarks
		SAMPLE SITE A		
A-1....	0.0012	0.0324	0.0365	
A-2....	0.0027	0.0729	0.0820	[1]Sum of weights = 0.1528
A-3....	0.0424	1.1448	1.2884	[2]Avg mg/yd^3 = 0.5157
A-4....	0.0082	0.2214	0.2492	[3]Avg cents/yd^3 = 0.5804
A-5....	0.0045	0.1215	0.1367	
A-6....	0.0537	1.4499	1.6317	
A-7....	0.0054	0.1458	0.1641	
A-8....	0.0072	0.1944	0.2188	
Sluice.	0.0275	0.0115	0.0129	
		SAMPLE SITE B		
B-1....	0.0045	0.1215	0.1367	
B-2....	0.0010	0.0270	0.0304	[1]Sum of weights = 0.0628
B-3....	0.0025	0.0675	0.0760	[2]Avg mg/yd^3 = 0.2422
B-4....	0.0132	0.3564	0.4011	[3]Avg cents/yd^3 = 0.2725
B-5....	0.0398	1.0746	1.2094	
B-6....	none	none	none	
B-7....	0.0018	0.0486	0.0547	
Sluice.	none	none	none	
		SAMPLE SITE C		
C-1....	0.0024	0.0648	0.0729	
C-2....	0.0055	0.1485	0.1671	[1]Sum of weights = 0.0297
C-3....	0.0050	0.1350	0.1519	[2]Avg mg/yd^3 = 0.1002
C-4....	0.0016	0.0432	0.0486	[3]Avg cents/yd^3 = 0.1128
C-5....	0.1038	0.1026	0.1155	
C-6....	0.0045	0.1215	0.1367	
C-7....	0.0029	0.0783	0.0881	
C-8....	0.0010	0.0270	0.0304	
Sluice.	0.0030	0.0108	0.0122	
		SAMPLE SITE D		
D-1....	0.0075	0.2025	0.2279	
D-2....	0.0078	0.2106	0.2370	[1]Sum of weights = 0.0386
D-3....	0.0075	0.2025	0.2279	[2]Avg mg/yd^3 = 0.1737
D-4....	0.0036	0.0972	0.1094	[3]Avg cents/yd^3 = 0.1955
D-5....	0.0038	0.1026	0.1155	
D-6....	none	none	none	
Sluice.	0.0084	0.0378	0.0425	

See explanatory notes at end of table.

TABLE C-1. - Gold values in terrace gravel sample concentrates--Con.

(Gold values at $350/tr oz)

Sample	Total gold weight, mg	Gold, mg/yd^3	Gold value, cents/yd^3	Remarks
		SAMPLE SITE E		
E-1....	0.0019	0.0513	0.0577	
E-2....	0.0020	0.0540	0.0608	[1]Sum of weights = 0.0791
E-3....	0.0377	1.0179	1.1456	[2]Avg mg/yd^3 = 0.3560
E-4....	0.0107	0.2889	0.3251	[3]Avg cents/yd^3 = 0.4006
E-5....	0.0014	0.0378	0.0425	
E-6....	0.0010	0.0270	0.0304	
Sluice.	0.0244	0.1107	0.1246	
		SAMPLE SITE F		
F-1....	none	none	none	
F-2....	none	none	none	[1]Sum of weights = 0.0025
F-3....	none	none	none	[2]Avg mg/yd^3 = 0.0169
F-4....	none	none	none	[3]Avg cents/yd^3 = 0.0190
Sluice.	0.0025	0.0169	0.0190	
		SAMPLE SITE G		
G-1....	none	none	none	
G-2....	none	none	none	[1]Sum of weights = .0
G-3....	none	none	none	[2]Avg mg/yd^3 = .0
G-4....	none	none	none	[3]Avg cents/yd^3 = .0
Sluice.	none	none	none	
		SAMPLE SITE H		
H-1....	0.0452	1.2204	1.3734	
H-2....	none	none	none	[1]Sum of weights = 0.0452
H-3....	none	none	none	[2]Avg mg/yd^3 = 0.2441
H-4....	none	none	none	[3]Avg cents/yd^3 = 0.2747
H-5....	none	none	none	
Sluice.	none	none	none	
		SAMPLE SITE I		
I-1....	0.0055	0.1485	0.1671	
I-2....	none	none	none	[1]Sum of weights = 0.0190
I-3....	0.0021	0.0567	0.0638	[2]Avg mg/yd^3 = 0.0641
I-4....	0.0030	0.0810	0.0911	[3]Avg cents/yd^3 = 0.0722
I-5....	none	none	none	
I-6....	0.0029	0.0783	0.0881	
I-7....	0.0021	0.0567	0.0638	
I-8....	0.0034	0.0918	0.1033	
Sluice.	none	none	none	

See explanatory notes at end of table.

TABLE C-1. - Gold values in terrace gravel sample concentrates--Con.

(Gold values at $350/tr oz)

Sample	Total gold weight, mg	Gold, mg/yd^3	Gold value, cents/yd^3	Remarks
		SAMPLE SITE J		
J-1....	0.0063	0.1701	0.1914	
J-2....	0.0011	0.0297	0.0334	[1]Sum of weights = 0.0105
J-3....	0.0012	0.0324	0.0365	[2]Avg mg/yd^3 = 0.0709
J-4....	none	none	none	[3]Avg cents/yd^3 = 0.0798
Sluice.	0.0019	0.0135	0.0152	
		SAMPLE SITE K		
K-1....	none	none	none	
K-2....	none	none	none	[1]Sum of weights = 0.0105
K-3....	0.0053	0.1431	0.1611	[2]Avg mg/yd^3 = 0.0486
K-4....	0.0011	0.0297	0.0334	[3]Avg cents/yd^3 = 0.0547
K-5....	none	none	none	
K-6....	none	none	none	
Sluice.	0.0041	0.0162	0.0182	
		SAMPLE SITE L		
L-1....	none	none	none	
L-2....	0.0075	0.2025	0.2279	[1]Sum of weights = 0.0156
L-3....	0.0039	0.1053	0.1185	[2]Avg mg/yd^3 = 0.1404
Sluice.	0.0042	0.0378	0.0425	[3]Avg cents/yd^3 = 0.1580

A-L sample locations; avg average.

[1]Sum in milligrams of all sample weights including sluice sample weight.

[2]Sum of weights number above divided by number of cubic feet collected at each channel site (each sample is one cubic foot, except sluice sample) multiplied by 27 ft^3/yd^3.

[3]Avg mg/yd^3 number above multiplied by conversion factor of 1.1254 cents/mg = [(10^{-3} g/mg) x (0.0311 tr oz/g) x (350 dollar/tr oz) x (10^2cents/dollar)].

TABLE C-2. - Gold values in drill hole samples

(Gold values in cents per cubic yard, gold valued at $350/tr oz)

Depth, interval, ft	DRILL HOLE											
	G-A-1		G-A-4		G-A-6		G-B-2		G-B-5		G-B-7	
	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3
0-5.....	.0	.0	164.16	184.73	174.72	196.62	20.60	23.18	14.35	16.02	73.34	82.53
5-10.....	8.90	10.01	12.05	13.55	5.46	6.14	.0	.0	1.20	1.35	.0	.0
10-15.....	8.90	0.01	20.90	23.51	4.95	5.57	2.91	3.27	.0	.0	1.85	2.08
15-20.....	5.51	6.19	23.78	26.75	2.91	3.27	1.32	1.49	.0	.0	.0	.0
20-25.....	8.52	9.59	21.45	24.14	18.54	20.86	5.40	6.08	7.07	7.95	4.25	4.78
25-30.....	.0	.0	41.46	46.66	4.38	4.93	4.10	4.61	.0	.0	4.01	4.51
30-35.....	14.22	16.00	49.86	56.11	6.00	6.70	1.91	2.14	.0	.0	5.55	6.24
35-40.....	14.39	16.19	19.86	22.35	4.23	4.76	.0	.0	4.80	5.40	.0	.0
40-45.....	5.12	5.76	9.74	10.96	52.38	58.94	8.00	9.00	4.22	4.74	6.99	7.87
45-50.....	8.12	9.13	48.71	54.80	3.68	4.14	7.16	8.05	8.05	9.06	6.11	6.87
50-55.....	30.42	34.23	13.70	15.41	10.22	11.50	7.14	8.03	8.57	9.64	10.34	11.63
55-60.....	8.85	9.96	.0	.0	7.26	8.19	11.25	12.66	6.32	7.11	1.89	2.12
60-65.....	15.65	17.61	22.86	25.73	10.80	12.15	18.65	20.98	8.63	9.71	5.57	6.26
65-70.....	3.60	4.05	3.32	3.73	22.50	25.32	18.44	20.75	2.54	2.85	.0	.0
70-75.....	2.94	3.31	13.07	14.70	7.22	8.11	10.88	12.24	5.70	6.41	4.70	5.28
75-80.....	6.47	7.28	15.00	16.88	6.51	7.32	0.81	0.91	2.61	2.94	.0	.0
80-85.....	7.56	8.51	9.50	10.69	.0	.0	14.31	16.10	7.22	8.12	8.28	9.31
85-90.....	4.52	5.08	33.65	37.86			15.86	17.54	9.06	10.20	6.63	7.46
90-95.....	7.86	8.85	8.78	9.87			14.07	15.83	4.79	5.38	18.50	20.81
95-100....	4.40	4.95	15.89	17.88			12.92	14.53	2.34	2.63	[1]2.64	2.97
100-105...	5.28	5.94	.0	.0			24.59	27.67				
105-110...			7.04	7.92			9.08	10.21				
110-115...			6.75	7.60								
115-120...			4.07	4.57								
120-125...												
Average.	8.15	9.17	23.56	26.52	20.10	22.62	9.50	10.69	4.87	5.48	7.96	8.96

[1]This sample covered only 2-1/2 ft in drill hole.
See explanatory notes at end of table.

TABLE C-2. - Gold values in drill hole samples--Continued

(Gold values in cents per cubic yard, gold valued at $350/tr oz)

Depth, interval, ft	DRILL HOLE											
	G-B-10		S-A-2		S-A-3		S-A-5		S-A-7		S-A-8	
	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3
0-5.....	1.58	1.77	17.15	19.29	3.75	4.22	2.18	2.45	15.50	17.44	27.00	30.33
5-10.....	2.07	2.33	3.93	4.42	5.12	5.76	.0	.0	4.89	5.50	21.00	23.63
10-15.....	2.58	2.90	3.20	3.60	2.00	2.25	10.85	12.20	6.30	7.09	7.89	8.88
15-20.....	0.50	0.55	0.86	0.96	5.52	6.21	3.47	3.90	3.93	4.42	10.91	12.27
20-25.....	2.94	3.31	1.07	1.20	8.99	10.11	2.34	2.63	5.46	6.14	7.61	8.56
25-30.....	4.25	4.78	6.53	7.34	5.13	5.77	2.00	2.25	1.61	1.81	1.02	1.15
30-35.....	5.94	6.68	7.05	7.93	11.51	12.95	1.10	1.23	8.13	9.15	16.02	18.03
35-40.....	13.17	14.82	4.25	4.78	.0	.0	5.90	16.63	9.80	11.02	8.30	9.33
40-45.....	2.85	3.20	5.15	5.79	4.25	4.78	8.45	9.50	1.44	1.62	0.32	0.35
45-50.....	6.54	7.36	3.17	3.56	10.88	12.24	1.11	1.25	2.40	2.70	33.00	37.14
50-55.....	2.57	2.89	2.73	3.07	1.92	2.16	6.59	7.41	1.95	2.19	15.92	17.91
55-60.....	7.94	8.93	2.81	3.16	2.36	2.65	4.02	4.52	5.16	5.81		
60-65.....	7.25	8.15	1.32	1.49	5.15	5.79	2.64	2.97	5.60	6.30		
65-70.....	1.32	1.49			5.07	5.71	5.52	6.21	1.25	1.40		
70-75.....	1.37	1.53					2.33	2.62	1.22	1.37		
75-80.....	.0	0.					1.73	1.94	1.70	1.91		
80-85.....	3.95	4.44							0.42	0.47		
85-90.....	[1]10.83	12.19							1.97	2.21		
90-95.....									3.92	4.41		
95-100....									0.75	0.84		
100-105...									1.25	1.40		
105-110...									0.99	1.11		
110-115...									2.10	2.36		
115-120...									1.07	1.20		
120-125...												
Average.	4.01	4.51	4.55	5.12	5.11	5.76	3.77	4.86	3.70	4.16	13.54	15.23

[1]This sample covered only 2-1/2 ft in drill hole.
See explanatory notes at end of table.

TABLE C-2. - Gold values in drill hole samples--Continued

(Gold values in cents per cubic yard, gold valued at $350/tr oz)

Depth, interval, ft	DRILL HOLE											
	S-A-10		S-A-11		S-A-12		S-B-2		S-B-5		S-B-7	
	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3
0-5.....	31.82	35.80	4.67	5.25	2.40	2.70	2.57	2.89	13.23	14.89	11.51	12.95
5-10.....	14.55	16.37	3.41	3.83	4.38	4.93	0.86	0.96	4.05	4.56	1.67	1.87
10-15.....	.0	.0	2.58	2.90	11.87	13.35	8.81	9.91	4.59	5.17	7.58	8.52
15-20.....	1.01	1.13	0.30	0.34	11.78	13.25	1.59	1.79	7.62	8.58	1.97	2.21
20-25.....	7.94	8.93	2.52	2.84	0.26	0.29	11.69	13.15	2.40	2.70	5.79	6.52
25-30.....	14.00	15.75	2.04	2.30	1.11	1.25	9.90	11.14	10.01	11.26	3.86	4.34
30-35.....	16.29	18.33	1.67	1.87	2.51	2.82	10.01	11.26	3.95	4.44	6.18	6.95
35-40.....	17.22	19.38	2.73	3.07	8.88	9.99	8.66	9.74	9.20	10.35	4.50	5.06
40-45.....	29.16	32.81	13.13	14.77	1.70	1.91	5.36	6.03	37.00	41.63	1.25	1.40
45-50.....	.0	.0	10.35	11.65	10.01	11.26	1.95	2.19	11.73	13.20	2.57	2.89
50-55.....	8.85	9.96	9.66	10.87	14.36	16.15	7.83	8.81	6.14	6.90	17.94	20.19
55-60.....	8.03	9.03	[1]20.00	22.50	1.10	1.23	4.80	5.40	13.01	14.63	5.18	5.82
60-65.....					7.67	8.61	5.49	6.18	2.97	3.34	5.63	6.33
65-70.....					[2]1.97	2.21	10.58	11.90	0.98	1.10	8.76	9.86
70-75.....							9.48	10.67	1.14	1.28	6.00	6.75
75-80.....							1.28	1.43	2.39	2.68	4.65	5.23
80-85.....							4.22	4.74	7.22	8.12	4.91	5.52
85-90.....							1.35	1.52	10.53	11.85	8.93	10.04
90-95.....							16.52	18.58	5.15	5.79	3.57	4.02
95-100....							6.14	6.90	6.32	7.11	3.17	3.56
100-105...							4.91	5.52	9.38	10.55	.0	.0
105-110...							.0	.0	9.71	10.92	2.70	3.04
110-115...							6.42	7.22	12.98	14.60	5.31	5.98
115-120...							8.57	9.64	8.94	10.06	9.29	10.45
120-125...									14.15	15.92		
Average.	12.40	13.96	5.25	5.92	5.71	5.91	6.21	6.98	8.58	9.66	5.54	6.22

[1]This sample covered only 2-1/2 ft in drill hole.
[2]This sample covered only 2 ft in drill hole.
See explanatory notes at end of table.

TABLE C-2. - Gold values in drill hole samples--Continued

(Gold values in cents per cubic yard, gold valued at $350/tr oz)

Depth, interval, ft	DRILL HOLE											
	S-C-2		S-C-4		S-D-3		S-E-3		T-A-3		T-A-4	
	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3
0-5.....	15.65	17.61	8.00	9.00	0.0	0.0	0.42	0.47	0.0	0.0	1.56	1.30
5-10.....	7.22	8.12	3.84	4.32	1.49	1.67	0.60	0.68	0.99	1.11	0.80	0.89
10-15.....	1.02	1.15	6.06	6.82	.0	.0	1.05	1.18	1.44	1.62	0.84	0.95
15-20.....	3.14	3.52	6.18	6.95	0.63	0.71	0.65	0.73	0.89	1.00	1.26	1.42
20-25.....	3.20	3.60	0.77	0.86	12.53	14.09	1.31	1.47	0.83	0.93	1.10	1.23
25-30.....	7.76	8.73	.0	.0	1.71	1.92	5.94	6.68	0.59	0.66	1.65	1.86
30-35.....	1.47	1.65	0.95	1.06	0.74	0.83	7.07	7.95	0.71	0.79	1.73	1.94
35-40.....	1.59	1.79	0.71	0.79	0.68	0.76	8.18	9.20	0.60	0.68	1.44	1.62
40-45.....	6.60	7.43	0.68	0.76	1.59	1.79	1.35	1.52	1.08	1.22	0.84	0.95
45-50.....	5.70	6.41	0.63	0.70	1.23	0.38	0.90	1.01	0.86	0.96	0.53	0.59
50-55.....	4.25	4.78	1.23	1.38	1.38	1.55	1.32	1.49			0.57	0.64
55-60.....	10.20	11.48	0.99	1.11	3.50	3.93	1.88	2.11			1.17	1.32
60-65.....	2.64	2.97	0.74	0.82	0.65	0.73	.0	.0				
65-70.....	.0	.0	0.66	0.74	0.33	0.37	1.56	1.76				
70-75.....	1.32	1.49	3.48	0.54	0.32	0.35	1.89	2.13				
75-80.....	14.78	16.62	0.65	0.73	0.89	1.00	1.53	1.72				
80-85.....	4.82	5.42	0.29	0.32	0.62	0.69	0.72	0.81				
85-90.....	5.73	6.45	0.30	0.34	trace	trace	1.02	1.15				
90-95.....	2.51	2.82	0.32	0.35	1.01	1.13	1.17	1.31				
95-100....	2.30	2.58	0.87	0.98	1.05	1.18	.0	.0				
100-105...	1.55	1.74	1.28	1.43	0.62	0.69	1.02	1.15				
105-110...	2.33	2.62	0.33	0.37	1.10	1.23	0.53	0.59				
110-115...	2.19	2.46	0.29	0.32	1.22	1.37	0.56	0.62				
115-120...	6.11	6.87	0.81	0.91	2.79	3.14	0.80	0.89				
120-125...												
Average.	4.75	5.34	1.67	1.88	1.50	1.69	1.73	1.94	0.79	0.89	1.09	1.23

See explanatory notes at end of table.

TABLE C-2. - Gold values in drill hole samples--Continued

(Gold values in cents per cubic yard, gold valued at $350/tr oz)

Depth, interval, ft	DRILL HOLE											
	T-A-5		T-A-6		T-A-7		T-A-9		T-A-11		T-A-13	
	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3
0-5.....	1.77	1.99	3.66	4.12	0.64	1.84	1.61	1.81	1.70	1.91	2.34	2.63
5-10.....	0.96	1.08	0.99	1.11	0.95	1.06	1.26	1.42	1.05	1.18	1.10	1.23
10-15.....	0.99	1.11	1.40	1.57	0.86	0.96	0.60	0.68	1.07	1.20	0.87	0.98
15-20.....	1.26	1.27	1.07	1.20	1.43	1.60	1.47	1.65	0.30	0.34	1.41	1.59
20-25.....	0.65	0.73	1.56	1.76	0.87	0.98	0.75	0.84	0.50	0.56	0.53	0.59
25-30.....	0.65	0.73	0.96	1.08	0.89	1.00	1.64	1.84	0.50	0.56	0.98	1.10
30-35.....	0.66	0.74	0.86	0.96	1.56	1.76	1.10	1.23	0.75	0.84	2.07	2.33
35-40.....	0.68	0.76	0.96	1.08	1.05	1.18	0.62	0.69	0.50	0.56	0.50	0.56
40-45.....	0.87	0.98	1.58	1.77	1.13	1.27	1.02	1.15	0.60	0.68	0.93	1.05
45-50.....	0.57	0.64	1.08	1.22	0.56	0.62	1.04	1.16	0.74	0.83	.0	.0
50-55.....	1.22	1.36	1.17	1.32	0.80	0.89	0.56	0.62	0.80	0.89	0.98	1.10
55-60.....	2.45	2.75	1.23	1.38	0.93	1.05	0.86	0.96	1.86	2.09	1.89	2.13
60-65.....	.0	.0	0.84	0.95	0.62	0.69	0.87	0.98	1.28	1.43	1.50	1.69
65-70.....	2.03	2.28	1.02	1.15	0.66	0.74	1.16	1.30	0.83	0.93	1.25	1.40
70-75.....			0.87	0.98			0.77	0.86	1.10	1.23		
75-80.....			0.90	1.01			0.09	0.10				
80-85.....							0.72	0.81				
85-90.....							2.73	3.07				
90-95.....							0.84	0.95				
95-100....							0.60	0.68				
100-105...												
105-110...												
110-115...												
115-120...												
Average.	1.04	1.73	1.26	1.42	0.90	1.12	1.01	1.12	0.90	1.02	1.17	1.31

See explanatory notes at end of table.

TABLE C-2. - Gold values in drill hole samples--Continued

(Gold values in cents per cubic yard, gold valued at $350/tr oz)

Depth, interval, ft	DRILL HOLE											
	T-B-2		T-B-3		T-B-4		T-B-6		T-B-8		T-B-10	
	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3
0-5.....	0.95	1.06	0.80	0.89	3.56	4.00	0.90	1.01	2.15	2.41	trace	trace
5-10.....	1.13	1.27	0.78	0.89	1.47	1.65	0.59	0.66	0.54	0.61	0.87	0.98
10-15.....	0.27	0.30	.0	.0	0.26	0.29	0.83	0.93	0.51	0.57	0.93	1.05
15-20.....	1.10	1.23	0.81	0.91	1.19	1.33	1.40	1.57	0.80	0.89	0.89	1.00
20-25.....	0.57	0.64	.0	.0	2.00	2.25	1.16	1.30	.0	.0	1.05	1.18
25-30.....	0.48	0.54	1.25	1.40	1.29	1.45	0.92	1.03	0.57	0.64	0.87	0.98
30-35.....	1.19	1.33	0.50	0.56	0.74	0.83	0.90	1.01	trace	trace	0.29	0.32
35-40.....	.0	.0	3.30	3.71	trace	trace	0.95	1.06	0.87	0.98	0.86	0.96
40-45.....	0.93	1.05	0.51	0.57	0.26	0.29	1.38	1.55	.0	.0	trace	trace
45-50.....	0.60	0.68	0.95	1.06	1.56	1.30	0.72	0.81	trace	trace	0.60	0.68
50-55.....	2.10	2.36					1.07	1.20	0.32	0.35	0.57	0.64
55-60.....							1.43	1.60	0.65	0.73	0.66	0.74
60-65.....							1.05	1.18			1.17	1.32
65-70.....							0.74	0.83			0.32	0.35
70-75.....							0.84	0.95			1.31	1.47
75-80.....							0.66	0.74			0.71	0.79
80-85.....							1.19	1.33			0.81	0.91
85-90.....							0.65	0.73			1.07	1.20
90-95.....							1.17	1.32			1.10	1.23
95-100....							0.68	0.76			1.65	1.86
100-105...							1.41	1.59			0.27	0.30
105-110...												
110-115...												
115-120...												
120-125...												
Average.	0.85	0.95	0.89	1.00	1.19	1.34	0.98	1.10	0.53	0.60	0.76	0.86

See explanatory notes at end of table.

TABLE C-2. - Gold values in drill hole samples--Continued

(Gold values in cents per cubic yard, gold valued at $350/tr oz)

Depth, interval, ft	DRILL HOLE											
	T-B-11		T-B-12		T-B-13		T-B-14		T-C-2		T-C-3	
	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3
0-5.....	0.53	0.59	1.73	1.94	1.61	1.81	0.0	0.0	1.79	2.01	3.00	3.38
5-10.....	0.74	0.83	0.48	0.32	1.10	1.23	0.80	0.89	1.13	1.27	trace	trace
10-15.....	0.50	0.56	1.13	0.75	0.24	0.27	0.62	0.69	0.87	0.98	1.58	1.77
15-20.....	1.11	1.25	0.80	0.53	0.78	0.88	0.51	0.57	1.04	1.16	3.14	3.53
20-25.....	0.81	0.91	0.86	0.57	0.75	0.84	.0	.0	1.44	1.62	1.55	1.74
25-30.....	1.32	1.49	0.57	0.38	1.49	1.67	1.04	1.16	1.28	1.43	1.61	1.81
30-35.....	0.66	0.74	0.29	0.19	1.23	1.38	0.77	0.86	0.93	1.05	0.87	0.98
35-40.....	.0	.0	.0	.0	1.05	1.18	1.46	1.64	1.38	1.55	1.14	1.28
40-45.....	1.07	1.20	0.81	0.54	0.78	0.88	0.86	0.96	1.56	1.76	1.17	1.32
45-50.....	1.17	1.32	0.87	0.58	0.92	1.03	1.37	1.54			3.33	3.75
50-55.....	.0	.0	2.70	1.80	0.92	1.03	1.10	1.23				
55-60.....	0.87	0.98	2.37	1.58	1.28	1.43	0.68	0.76				
60-65.....	0.65	0.73	0.30	0.20	0.98	1.10	0.33	0.37				
65-70.....	0.90	1.01	.0	.0	1.38	1.55	0.57	0.64				
70-75.....	2.73	3.07	1.31	0.87	1.50	1.69	0.93	1.05				
75-80.....			0.09	0.06	0.92	1.03	0.59	0.66				
80-85.....					0.71	0.79	0.62	0.69				
85-90.....					2.12	2.38	0.92	1.03				
90-95.....					1.29	1.45						
95-100....					1.01	1.13						
100-105...					2.18	2.45						
105-110...					1.23	1.38						
110-115...					1.16	1.30						
115-120...					1.01	1.13						
120-125...												
Average.	0.87	0.98	0.89	1.00	1.15	1.29	0.73	0.82	1.35	1.43	1.74	1.95

See explanatory notes at end of table.

TABLE C-2. - Gold values in drill hole samples--Continued

(Gold values in cents per cubic yard, gold valued at $350/tr oz)

Depth, interval, ft	DRILL HOLE											
	T-C-4		T-C-5		T-C-6		T-C-7		T-C-8		T-D-4	
	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3
0-5.....	2.31	2.60	2.21	2.48	0.84	0.95	2.85	3.21	1.41	1.59	1.94	2.18
5-10.....	0.84	0.95	1.37	1.54	2.25	2.53	1.05	1.18	1.23	1.38	1.08	1.22
10-15.....	1.02	1.15	1.23	1.38	0.87	0.98	0.81	0.91	1.23	1.38	1.38	1.55
15-20.....	1.52	1.70	1.73	1.94	0.87	0.98	0.86	0.96	1.26	1.42	0.74	0.82
20-25.....	0.72	0.81	1.01	1.13	0.95	1.06	0.72	0.81	0.71	0.79	1.07	1.20
25-30.....	0.75	0.84	1.28	1.43	0.84	0.95	0.50	0.56	0.80	0.89	1.25	1.40
30-35.....	1.28	1.43	1.34	1.50	1.22	1.37	0.84	0.95	0.98	1.10	.0	.0
35-40.....	1.82	2.04	1.64	1.84	2.36	2.65	0.81	0.91	1.58	1.77	.0	.0
40-45.....	0.84	0.95	1.20	1.35	0.84	0.95	0.75	0.84			1.26	1.42
45-50.....	3.72	4.19	2.46	2.77	1.23	1.38	2.06	2.31			1.01	1.13
50-55.....	1.50	1.69	0.83	0.93	0.98	1.10	1.29	1.45			1.37	1.54
55-60.....	1.26	1.42	0.66	0.74			0.96	1.08			0.83	0.93
60-65.....			0.65	0.73							.0	.0
65-70.....			1.11	4.22							.0	.0
70-75.....			0.75	0.73							.0	.0
75-80.....			0.56	1.25							1.44	1.62
80-85.....			2.84	0.84							1.44	1.62
85-90.....				0.62							1.28	1.43
90-95.....				3.19							1.38	1.55
95-100....											0.66	0.74
100-105...											2.39	2.68
105-110...											1.65	1.86
110-115...											1.68	1.89
115-120...											1.61	1.81
120-125...												
Average.	1.46	1.65	1.43	1.61	1.20	1.35	1.12	1.26	1.15	1.29	1.06	1.19

See explanatory notes at end of table.

TABLE C-2. - Gold values in drill hole samples--Continued

(Gold values in cents per cubic yard, gold valued at $350/tr oz)

Depth, interval, ft	DRILL HOLE											
	T-D-6		T-E-2		T-E-3		T-E-4		T-E-5		T-F-2	
	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3
0-5.....	1.01	1.13	0.57	0.64	1.16	1.30	1.32	1.49	1.55	1.74	0.77	0.86
5-10.....	1.23	1.38	2.16	2.43	0.80	0.89	2.16	2.43	0.86	0.96	0.47	0.52
10-15.....	1.25	1.40	1.01	1.13	1.62	1.82	0.77	0.86	0.89	1.00	0.47	0.52
15-20.....	1.17	1.31	0.60	0.68	0.63	0.71	0.75	0.84	0.74	0.83	0.66	0.74
20-25.....	1.94	2.18	0.71	0.79	1.82	2.04	0.83	0.93	1.17	1.32	3.00	3.38
25-30.....	3.00	3.38	1.41	1.59	1.07	1.20	0.86	0.96	0.47	0.52	.0	.0
30-35.....	0.75	0.84	0.72	0.81	1.01	1.13	0.93	1.05			0.60	0.68
35-40.....	0.72	0.81	0.66	0.74	1.17	1.31	2.04	2.30			0.57	0.64
40-45.....	1.20	1.35	0.33	0.37	1.07	1.20					0.95	1.06
45-50.....	0.89	1.00	0.80	0.89	1.44	1.62						
50-55.....	0.89	1.00	0.62	0.69	1.23	1.38						
55-60.....	0.98	1.10	0.60	0.68	0.71	0.79						
60-65.....	0.60	0.68	0.93	1.05	0.98	1.10						
65-70.....	1.50	1.69	0.93	1.05	0.30	0.34						
70-75.....	1.32	1.49	0.89	1.00	0.71	0.79						
75-80.....	1.17	1.32	0.86	0.96	0.30	0.34						
80-85.....	2.15	2.41	0.93	1.05	0.44	0.49						
85-90.....	1.41	1.59	1.13	1.27	0.62	0.69						
90-95.....	0.54	0.61	1.49	1.67	0.84	0.95						
95-100....	0.68	0.76	0.83	0.93	1.25	1.40						
100-105...	0.99	1.11	0.93	1.05	.0	.0						
105-110...	1.58	1.77	0.77	0.86								
110-115...	1.43	1.60	0.62	0.69								
115-120...	2.76	3.11	0.78	0.88								
120-125...												
Average.	1.30	1.46	0.88	1.00	0.91	1.02	1.21	1.36	0.94	1.06	0.83	0.93

See explanatory notes at end of table.

TABLE C-2. - Gold values in drill hole samples--Continued

(Gold values in cents per cubic yard, gold valued at $350/tr oz)

Depth, interval, ft	DRILL HOLE					
	T-F-4		T-F-5		T-R-1	
	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3	Weight, mg/yd^3	Value, cents/yd^3
0-5.....	2.00	2.25	0.93	1.05	0.81	0.91
5-10.....	1.01	1.13	1.01	1.13	1.37	1.54
10-15.....	1.34	1.50	2.97	3.34	1.38	1.55
15-20.....	0.78	0.88	0.45	0.51	0.35	0.39
20-25.....	0.86	0.96	0.57	0.64	1.20	1.35
25-30.....	0.89	1.00	0.60	0.68	.0	.0
30-35.....	1.22	1.37	0.63	0.71	0.66	0.74
35-40.....	1.11	1.25	trace	trace	0.36	0.41
40-45.....	1.38	1.55	0.30	0.34	1.37	1.54
45-50.....	0.98	1.10	0.27	0.30	1.13	1.27
50-55.....	1.01	1.13	0.77	0.86	2.31	2.60
55-60.....	2.01	2.26				
60-65.....	1.10	1.23				
65-70.....	0.29	0.32				
70-75.....	0.98	1.10				
75-80.....	0.60	0.68				
80-85.....	1.17	1.32				
85-90.....	1.47	1.65				
90-95.....	0.90	1.01				
95-100....	0.50	0.56				
100-105...	1.02	1.15				
105-110...	1.04	1.16				
110-115...	0.78	0.88				
115-120...	1.46	1.64				
120-125...						
Average.	1.08	1.21	0.77	0.87	0.99	1.12

G Gonzales Wash; S Seventy Wash; T Tyson Wash; A-F, R drill hole line designation.

APPENDIX D.--PLACER DREDGE OPERATING COSTS ESTIMATE

Calculations in this appendix are based on formulas developed by Bureau of Mines Minerals Availability Field Offices in Denver and Spokane. The formulas are from the Cost Estimating Systems Handbook, v. 2, Surface Mining, now in draft revision.

Bucket line dredge operating costs

Operating 3 shifts/d, clean up and repair on 1 or 2 shifts/d. Dredge capacities of 500 to 20,000 m^3/d.

$$\text{Labor} = 303(X)^{0.254} \cdot F_1$$

$$\text{Supplies} = 1.69(X)^{0.724} \cdot F_2$$

$$\text{Equipment} = 7.45(X)^{0.595} \cdot F_2$$

X = volume, in bank cubic meters, dredged per day.

Depth adjustments

$$F_1 = 0.65 + 3.33(D_A)(X)^{-0.615}$$

$$F_2 = 7.62\ (D_A)(S_A)^{-1.0}(X)^{-0.615}$$

where D_A = actual depth in meters

S_A = swell factor

Mineral processing factors

Labor cost multiplied by 1.52 to 1.63
Supplies cost multiplied by 1.34 to 1.38
Equipment operation cost multiplied by 1.37 to 1.45

For this study the following values were used;

Volume dredged per day	X =	5,000 yd^3/d
		= 3,825 m^3/d
Actual dredging depth	D_A =	120 ft (maximum)
		= 37 m
Mineral processing factors		Labor = 1.57
		Supplies = 1.36
		Equipment operation = 1.41

Dredge operation cost and mineral processing cost

Labor = $\$1.43/m^3$ = $\$1.87/yd^3$

Supplies = $\$0.52/m^3$ = $\$0.68/yd^3$

Equipment operation = $\$0.81/m^3$ = $\$1.06/yd^3$

Total operating and mineral processing cost per cubic yard = $3.61

APPENDIX E.--GEOPHYSICAL SURVEY DATA

Tables in this appendix were derived from the geophysical survey conducted to determine the thickness of fluvial wash gravels. The expected interface in table E-2 represents the expected depth to the boundary between the surface fluvial gravels and the underlying formation.

TABLE E-1. - Summary of geophysical survey data

Locality	Profile line	Expected thickness of fluvial gravel[1]		Velocity statistics[2]	
		Minimum, ft	Maximum, ft	Surface layer, ft/s	Subsurface layer, ft/s
Bouse Wash.....	A	15.9	55.2	1528	5340
	B	16.4	58.3	1477	5533
	C	18.7	50.8	1444	5984
	D	21.5	41.4	1347	5606
	E	26.6	34.7	1319	5855
Gonzales Wash....	A	31.6	38.6	1386	5564
	B	52.5	66.8	1401	5770
Seventy Wash.....	A	30.4	38.7	1423	6438
	B	29.7	97.8	1388	5567
	C	34.1	48.0	1434	4633
	D	33.5	45.0	1453	4220
	E	18.3	31.4	1248	4916
Tyson Wash.....	A	22.8	58.3	1577	6077
	B	25.0	42.9	1420	6044
	C	27.4	45.5	1299	5341
	D	22.1	43.3	1461	4359
	E	30.1	52.6	1754	5854
	F	7.2	32.3	1470	4151
Unnamed Wash.....	A	24.9	34.6	1249	6671

[1]Data from table E-2.
[2]Data from computer analysis of seismic data.

TABLE E-2. - Geophysical survey data

BOUSE WASH

Geophone number	Surface elevation, ft	Depth to expected interface, ft
PROFILE LINE A		
1.....	540.0	23.4
2.....	539.1	18.5
3.....	538.8	19.1
4.....	539.1	19.6
5.....	539.6	22.4
6.....	539.3	22.9
7.....	539.3	22.0
8.....	538.9	15.9
9.....	537.8	17.7
10.....	536.4	20.3
11.....	536.7	23.0
12.....	538.1	34.9
13.....	539.0	40.8
14.....	537.5	47.4
15.....	537.4	50.2
16.....	538.5	50.9
17.....	538.1	51.9
18.....	538.5	54.5
19.....	538.9	55.2
20.....	539.3	54.8
21.....	540.1	53.6
22.....	542.7	44.9
23.....	545.4	41.7
PROFILE LINE B		
1.....	500.0	33.8
2.....	497.9	29.8
3.....	498.4	35.7
4.....	498.4	35.8
5.....	498.3	33.4
6.....	498.3	30.4
7.....	497.9	31.8
8.....	498.2	27.0
9.....	497.8	46.1
10.....	497.2	52.6
11.....	498.4	56.3
12.....	496.4	54.6
13.....	497.2	58.3
14.....	497.2	49.0
15.....	498.3	46.0
16.....	498.5	43.7
17.....	496.0	40.3
18.....	498.8	44.2
19.....	498.0	38.2
20.....	498.7	38.5
PROFILE LINE B--Con.		
22.....	499.0	16.4
23.....	497.7	28.3
PROFILE LINE C		
1.....	490.0	30.2
2.....	488.1	32.9
3.....	487.7	36.2
4.....	485.5	36.1
5.....	484.2	33.8
6.....	482.2	35.0
7.....	480.3	29.5
8.....	476.4	29.4
9.....	476.7	26.2
10.....	475.0	23.3
11.....	473.5	18.7
12.....	471.8	30.6
13.....	471.2	45.7
14.....	471.0	50.1
15.....	469.1	50.8
16.....	470.9	46.8
17.....	471.7	46.5
18.....	471.4	49.4
19.....	470.1	49.6
20.....	470.5	48.7
21.....	469.7	46.3
22.....	470.7	49.0
23.....	469.9	49.6
PROFILE LINE D		
1.....	426.5	22.6
2.....	427.5	24.9
3.....	430.0	21.5
4.....	429.6	22.7
5.....	430.0	28.1
6.....	429.2	26.7
7.....	431.0	27.6
8.....	431.9	27.8
9.....	432.0	26.3
10.....	432.5	27.9
11.....	432.8	32.0
12.....	433.0	34.4
13.....	431.0	36.8
14.....	434.0	25.2
15.....	433.3	31.9
16.....	432.7	30.1
17.....	434.2	30.6

TABLE E-2. - Geophysical survey data--Continued

BOUSE WASH--Continued

Geophone number	Surface elevation, ft	Depth to expected interface, ft
PROFILE LINE D--Con.		
19.....	434.1	23.8
20.....	434.4	25.8
21.....	435.8	29.6
22.....	435.7	30.8
23.....	436.2	32.9
24.....	436.6	35.0
25.....	437.2	41.4
PROFILE LINE E		
1.....	420.0	29.6
2.....	418.9	27.8
3.....	420.1	31.8
4.....	418.8	28.2
5.....	416.2	26.6
6.....	418.1	28.6
7.....	419.1	27.8
8.....	418.7	28.1
9.....	419.0	28.1
10.....	416.8	30.4
11.....	416.8	34.7
12.....	418.7	32.8
13.....	417.8	29.1
14.....	418.8	30.9
15.....	418.5	33.9
16.....	418.9	30.9
17.....	419.6	32.5
18.....	419.1	27.8
19.....	419.4	31.0

GONZALES WASH

Geophone number	Surface elevation, ft	Depth to expected interface, ft
PROFILE LINE A		
1.....	320.0	31.7
2.....	321.2	31.6
3.....	320.0	35.4
4.....	322.2	35.5
5.....	320.5	34.9
6.....	321.3	35.7
7.....	322.7	37.9
8.....	321.8	38.3
9.....	319.7	38.6
10.....	320.2	36.9
11.....	318.5	34.4
12.....	318.2	32.8
PROFILE LINE B		
1.....	380.0	66.8
2.....	381.0	65.3
3.....	379.8	64.3
4.....	380.8	60.9
5.....	379.7	59.0
6.....	380.9	64.1
7.....	381.3	64.3
8.....	381.0	63.6
9.....	379.9	58.6
10.....	382.1	53.0
11.....	379.7	54.2
12.....	381.1	53.2
13.....	380.4	53.9
14.....	380.8	59.3
15.....	380.1	60.1
16.....	379.0	59.0
17.....	380.0	58.0
18.....	378.7	55.1
19.....	379.3	54.1
20.....	377.2	52.5
21.....	376.8	55.8
22.....	378.7	57.5
PROFILE LINE B--Con.		

TABLE E-2. - Geophysical survey data--Continued

SEVENTY WASH					
Geophone number	Surface elevation, ft	Depth to expected interface, ft	Geophone number	Surface elevation, ft	Depth to expected interface, ft
PROFILE LINE A			PROFILE LINE B--Con.		
1.....	320.0	35.4	13.....	378.7	43.7
2.....	319.1	37.4	14.....	379.5	45.9
3.....	317.7	36.6	15.....	378.7	35.9
4.....	318.2	34.9	16.....	379.2	29.7
5.....	318.1	31.8	PROFILE LINE C		
6.....	318.6	33.0	1.....	455.0	48.0
7.....	318.8	32.2	2.....	454.3	45.9
8.....	318.9	31.5	3.....	451.8	47.0
9.....	319.0	34.4	4.....	455.0	45.7
10.....	319.2	37.2	5.....	453.4	35.5
11.....	319.4	38.7	6.....	454.7	35.4
12.....	318.6	34.3	7.....	455.2	39.4
13.....	318.4	32.1	8.....	455.5	37.0
14.....	319.2	32.2	9.....	455.5	36.1
15.....	318.9	32.5	10.....	457.8	34.1
16.....	318.3	34.0	11.....	459.1	40.9
17.....	317.9	33.4	12.....	465.6	40.5
18.....	319.8	35.9	13.....	458.4	34.5
19.....	317.7	35.2	14.....	455.4	36.7
20.....	317.1	35.3	15.....	460.2	42.8
21.....	317.6	36.6	PROFILE LINE D		
22.....	316.1	33.8	1.....	500.0	35.0
23.....	316.1	32.0	2.....	499.9	35.7
24.....	316.3	38.7	3.....	498.2	33.5
25.....	316.2	34.4	4.....	495.8	36.8
26.....	314.9	33.2	5.....	496.4	35.9
27.....	313.0	33.3	6.....	494.5	42.1
28.....	311.7	30.4	7.....	494.5	45.0
29.....	316.1	34.8	8.....	494.6	42.3
PROFILE LINE B			9.....	494.5	36.5
1.....	390.0	97.8	10.....	495.2	38.1
2.....	387.2	85.2	PROFILE LINE E		
3.....	384.7	51.5	1.....	540.0	31.4
4.....	384.1	37.7	2.....	538.8	27.0
5.....	383.4	32.9	3.....	538.2	22.6
6.....	382.9	35.7	4.....	537.7	18.3
7.....	382.7	36.4	5.....	537.7	20.5
8.....	382.9	38.0	6.....	537.6	22.4
9.....	381.6	42.5	7.....	542.4	29.3
10.....	381.1	46.5	8.....	536.0	24.2
11.....	380.3	44.8	9.....	539.3	26.0
12.....	378.7	42.6			

TABLE E-2. - Geophysical survey data--Continued

TYSON WASH					
Geophone number	Surface elevation, ft	Depth to expected interface, ft	Geophone number	Surface elevation, ft	Depth to expected interface, ft
PROFILE LINE A			PROFILE LINE B--Con.		
1.....	360.0	39.2	13.....	400.4	35.5
2.....	360.2	40.2	14.....	399.8	39.1
3.....	352.8	38.6	15.....	401.7	39.2
4.....	347.5	41.3	16.....	400.4	38.7
5.....	356.1	50.6	17.....	398.7	36.7
6.....	346.5	45.9	18.....	400.7	36.4
7.....	345.8	46.3	19.....	398.6	36.0
8.....	345.6	45.1	20.....	399.0	39.3
9.....	353.0	46.5	21.....	401.1	35.2
10.....	351.8	39.7	22.....	400.8	29.9
11.....	351.4	34.9	23.....	401.8	27.9
12.....	351.7	28.0	24.....	401.9	25.0
13.....	351.6	22.8	25.....	401.7	29.4
14.....	351.1	31.8	26.....	401.0	34.6
15.....	351.2	37.0	27.....	401.0	36.9
16.....	349.9	33.8	28.....	400.6	38.5
17.....	350.3	38.1	29.....	400.3	36.8
18.....	350.8	37.7	30.....	399.6	36.3
19.....	352.1	34.9	31.....	399.5	39.4
20.....	353.7	31.4	32.....	399.4	37.0
21.....	352.5	30.8	33.....	401.6	31.9
22.....	352.5	28.0	34.....	403.2	31.9
23.....	352.4	39.1	PROFILE LINE C		
24.....	350.6	54.6	1.....	429.9	36.1
25.....	351.5	58.3	2.....	431.6	27.4
26.....	350.7	53.1	3.....	429.7	29.0
27.....	351.1	50.3	4.....	428.5	29.8
28.....	352.6	53.8	5.....	427.4	30.3
29.....	351.8	47.8	6.....	426.0	31.0
30.....	352.3	50.8	7.....	425.7	32.7
31.....	357.4	54.8	8.....	427.9	33.9
PROFILE LINE B			9.....	428.3	30.0
1.....	400.0	30.4	10.....	429.3	29.0
2.....	400.4	35.5	11.....	430.9	28.6
3.....	400.7	36.7	12.....	430.7	37.2
4.....	401.0	36.3	13.....	432.1	41.8
5.....	400.6	34.1	14.....	432.2	45.5
6.....	400.7	34.8	15.....	432.6	44.3
7.....	399.3	36.9	16.....	433.3	45.1
8.....	400.6	37.9	17.....	433.4	41.8
9.....	398.8	39.8	18.....	434.3	34.9
10.....	398.6	42.0	19.....	435.4	30.4
11.....	400.3	42.9	PROFILE LINE D		
12.....	398.2	40.6	1.....	480.0	32.0

TABLE E-2. - Geophysical survey data--Continued

TYSON WASH--Continued					
Geophone number	Surface elevation, ft	Depth to expected interface, ft	Geophone number	Surface elevation, ft	Depth to expected interface, ft
PROFILE LINE D--Con.			PROFILE LINE E--Con.		
2.....	475.8	32.4	7.....	493.7	32.9
3.....	476.1	37.5	8.....	493.7	32.3
4.....	477.4	43.3	9.....	491.5	30.1
5.....	474.7	40.3	10.....	493.6	34.5
6.....	476.6	26.4	PROFILE LINE F		
7.....	474.7	23.3	1.....	500.0	10.8
8.....	473.3	24.9	2.....	498.1	7.2
9.....	474.4	22.1	3.....	496.9	11.5
10.....	476.7	24.9	4.....	496.1	18.9
11.....	476.3	31.7	5.....	496.4	24.6
12.....	474.9	35.5	6.....	485.8	23.6
13.....	476.6	40.8	7.....	495.1	15.3
14.....	475.6	42.2	8.....	495.2	17.2
PROFILE LINE E			9.....	493.8	18.4
1.....	500.0	49.7	10.....	495.3	27.2
2.....	497.1	52.6	11.....	494.1	31.3
3.....	494.4	47.4	12.....	494.1	31.5
4.....	492.5	43.4	13.....	493.5	32.3
5.....	495.1	42.8	14.....	494.2	31.9
6.....	494.3	40.4			

UNNAMED WASH					
Geophone number	Surface elevation, ft	Depth to expected interface, ft	Geophone number	Surface elevation, ft	Depth to expected interface, ft
PROFILE LINE A			PROFILE LINE A--Con.		
1.....	320.0	31.1	12.....	320.4	29.9
2.....	320.3	32.7	13.....	320.4	34.6
3.....	319.8	30.6	14.....	320.7	30.5
4.....	321.2	31.5	15.....	320.5	29.9
5.....	320.6	31.0	16.....	319.9	28.4
6.....	320.4	29.9	17.....	320.1	27.0
7.....	320.4	28.3	18.....	320.2	24.9
8.....	320.5	29.6	19.....	320.5	25.2
9.....	320.7	29.9	20.....	323.3	27.1
10.....	321.1	28.5	21.....	323.7	25.8
11.....	320.5	26.7	22.....	326.0	26.9

APPENDIX F.--DRILL LOGS

This appendix contains drill logs for all holes drilled in Gonzales (G), Seventy (S), and Tyson (T) Washes. Drill hole line designations are given as A-F, and R (as shown on figs. 10, 11, and 12). The logs include gold recovery for each sample interval in milligrams per short ton (mg/st). Lithology entries incude the following abbreviations: alt alternating; c gr coarse grained; f gr fine grained; mr medium grained; rx rock; w/ with. Intervals with no entry in the lithology column indicate no change from the previous entry. Total depth (TD) drilled is given in the last lithology entry for each drill hole.

TABLE F-1. - Drill logs and gold recovery

Sample depth, ft	DRILL HOLE G-A-1		DRILL HOLE G-A-4		DRILL HOLE G-A-6		DRILL HOLE G-B-2	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	0.0	Fluvial sand and gravel	109.44	Fluvial sand and gravel	116.48	Fluvial sand and gravel	13.73	Fluvial sand and gravel
5-10	5.93		8.03		3.64		0.0	
10-15	5.93		13.93		3.30		1.94	
15-20	3.67		15.85		1.94		0.88	Sand at 22 ft
20-25	5.68		14.30		12.36		3.60	Sand and gravel
25-30	0.0		27.64		2.92		2.73	
30-35	9.48		33.24		3.97		1.27	Sand
35-40	9.59		13.24	Sand	2.82	Sand	0.0	
40-45	3.41	Sand	6.49		34.92	Sand, damp	5.33	Mudstone at 43 ft w/ clay
45-50	5.41	Sand, damp	32.47	Sand, wet	2.45		4.77	f gr sand
50-55	20.28		9.13		6.81		4.76	f to m gr sand
55-60	5.90		0.0		4.84		7.50	Sand w/ sandstone chips
60-65	10.43	Sand, wet	15.24		7.20	Sand, wet	12.43	m to c gr sand
65-70	2.40	Sand, saturated	2.21	Sand, saturated	15.00		12.29	f gr sand and gravel
70-75	1.96		8.71		4.81		7.25	m gr sand
75-80	4.31	Sand and gravel, saturated	10.00		4.34	Sand, saturated Clay at 78 ft, TD 80 ft	0.54	f to m gr sand
80-85	5.04	Sand saturated	6.33				9.54	f to m gr sand, damp
85-90	3.01		22.43				10.39	
90-95	5.24		5.85				9.38	
95-100	2.93		10.59				8.61	
100-105	3.52	Clay at 102 ft TD 105 ft	0.0	Sand and gravel, saturated			16.39	Sand, wet
105-110			4.69				6.05	Clay at 107 ft, wet TD 110 ft
110-115			4.50					
115-120			2.71	Clay at 117 ft TD 120 ft				

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE G-B-5		DRILL HOLE G-B-7		DRILL HOLE G-B-10		DRILL HOLE S-A-2	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	9.49	Fluvial sand and gravel	48.89	Fluvial sand and gravel	1.05	Fluvial sand and gravel	11.43	Fluvial sand and gravel
5-10	0.80		0.0		1.38		2.62	
10-15	0.0		1.23		1.72		2.13	f gr sand w/ minor m to c gr sand
15-20	0.0	m gr sand w/ few rx chips	0.0	m gr sand w/ few rx chips	0.33		0.57	f gr sand w/ gravel
20-25	4.71		2.83		1.96	f gr sand	0.71	m to c gr sand w/ gravel
25-30	0.0		2.67	m gr sand w/ few sandstone chips	2.83		4.35	
30-35	0.0	c gr sand w/ few rx chips	3.70	c gr sand w/ minor gravel and sandstone chips	3.96	f gr sand w/ few sandstone chips	4.70	Gravel w/ m gr sand
35-40	3.20	f gr sand w/ few sandstone chips	0.0	f gr sand w/ few rx chips sand at 37 ft	8.78	f gr sand w/ minor clay	2.83	f gr sand, damp
40-45	2.81		4.66	f gr sand	1.90		3.43	f gr sand, clay at 44 ft
45-50	5.37	Clay at 48 ft w/ sand	4.07	f to m gr sand w/ mudstone chips	4.36	Clay w/ silt	2.11	Sand and gravel, wet
50-55	5.71	Sandstone at 52 ft	6.89	f to m gr sand w/ sandstone chips	1.71	Silt to m gr sand w/ minor clay	1.82	f to c gr sand w/ minor gravel, saturated
55-60	4.21	m gr sand	1.26	f gr sand w/ silt and chert and sandstone chips	5.29	Silt w/ pebbles	1.87	
60-65	5.75	f gr sand, damp	3.71	f gr sand w/ minor gravel	4.83	Silt to m gr sand w/ pebbles	0.88	TD 65 ft
65-70	1.69	f gr sand, dry	0.0	f to m gr sand	0.88	f gr sand and silt w/ sandstone chips		
70-75	3.80	f to c gr sand w/ chips of chert, clay, gravel	3.13	f gr sand w/ mudstone chips	0.91			
75-80	1.74	f to m gr sand w/ minor gravel	0.0	f gr sand w/ chert chips	0.0	f gr sand w/ mudstone and sandstone chips		
80-85	4.81	Mudstone chips at 82 ft sand and silt	5.52	f gr sand, damp	2.63			
85-90	6.04	f gr sand w/ silt	4.42		7.33	Clay at 87 ft TD 89 ft		
90-95	3.19	f gr sand	12.33	f gr sand w/ minor mudstone chips				
95-100	1.56	Clay at 97 ft TD 100 ft	1.76	Clay at 95 ft TD 97.5 ft				
100-105								
105-110								
110-115								
115-120								

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE S-A-3		DRILL HOLE S-A-5		DRILL HOLE S-A-7		DRILL HOLE S-A-8	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	2.50	Fluvial sand and gravel	1.45	Fluvial sand and gravel	10.33	Fluvial sand and gravel	17.97	Fluvial sand and gravel
5-10	3.41		0.0		3.26		14.00	
10-15	1.33	m to c gr sand w/ few rx chips	7.23		4.20		5.26	f to c gr sand w/ minor gravel
15-20	3.68		2.31	f to c gr sand w/ minor gravel	2.62		7.27	
20-25	5.99		1.56		3.64	f gr sand w/ minor gravel	5.07	
25-30	3.42	m to c gr sand	1.33	f to c gr sand and small gravel	1.07	Gravel w/ sand	0.68	
30-35	7.67		0.73		5.42	f to c gr sand w/ gravel	10.68	
35-40	0.0	f to m gr sand w/ few rx chips	3.93	f gr sand and small gravel, damp	6.53	f gr sand and gravel, damp	5.53	m to c gr sand w/ few pebbles, damp
40-45	2.83		5.63	f gr sand	0.96	m to c gr sand, damp	4.21	
45-50	7.25		0.74		1.60	c gr sand	22.00	
50-55	1.28	c gr sand and small gravel	4.39	f gr sand, wet	1.30	f to c gr sand	10.61	Clay at 50 ft, wet TD 51 ft
55-60	1.57	Gravel w/ sand, liquid	2.68	f gr sand and gravel, liquid	3.44	Sand, gravel, and clay, liquid		
60-65	3.43	Gravel, very damp	1.76	c gr sand and gravel	3.73			
65-70	3.38	Sand and gravel layers, liquid, TD 70 ft	3.68		0.83	f to c gr sand w/ minor gravel		
70-75			1.55	m to c gr sand w/ few pebbles	0.81			
75-80			1.15	TD 80 ft	1.13			
80-85					0.28	f to c gr sand and small gravel		
85-90					1.31			
90-95					2.61			
95-100					0.50			
100-105					0.83	f to c gr sand w/ minor gravel		
105-110					0.66			
110-115					1.40			
115-120					0.71	TD 120 ft		

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE S-A-10		DRILL HOLE S-A-11		DRILL HOLE S-A-12		DRILL HOLE S-B-2	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	21.21	Fluvial sand and gravel	3.11	Fluvial sand and gravel	1.60	Fluvial sand and gravel	1.71	Fluvial sand and gravel
5-10	9.70		2.27	Clay at 10 ft	2.92		0.57	
10-15	0.0		1.72	c gr sand and gravel	7.91		5.87	
15-20	0.67		0.20	f to c gr sand w/ minor gravel and clay	7.85	f to c gr sand w/ few rx chips	1.06	f gr sand w/ minor gravel
20-25	5.29	Gravel and sand layers, damp	1.68	Gravel w/ sand	0.17	Gravel and sand	7.79	
25-30	9.33	f gr sand w/ minor clay	1.36		0.74	m gr sand, damp, clay at 29 ft	6.60	f gr sand and gravel layers
30-35	10.86	f gr sand	1.11	m gr sand w/ few rx chips, damp	1.67	m to c gr sand, small gravel, wet	6.67	
35-40	11.48	Gravel layer, f gr sand layer	1.82		5.92		5.77	f to c gr sand
40-45	19.44	c gr sand w/ small gravel, wet	8.75	c gr sand w/ minor clay	1.13	f gr sand, clay at 41 ft, then sand	3.57	f to c gr sand w/ minor gravel
45-50	0.0	m to c gr sand and small gravel	6.90		6.67	f gr sand, clay at 48 ft, then sand	1.30	
50-55	5.90		6.44	c gr sand, small gravel	9.57	Sand and clay mix	5.22	
55-60	5.35	Liquid sand and gravel mix, clay at 58 ft	13.33	Clay at 55 ft TD 57.5 ft	0.73	f gr sand w/ sandstone chips	3.20	f gr sand and coarse gravel layers
60-65		TD 60 ft			5.11		3.66	f gr sand
65-70					1.31	f gr sand	7.05	f to c gr sand
70-75						f gr sand and clay TD 72 ft (included in	6.32	f to c gr sand w/ gravel
75-80						65 to 70 ft sample)	0.85	
80-85							2.81	f gr sand
85-90							0.90	f gr sand, damp
90-95							11.01	f gr sand w/ few pebbles
95-100							4.09	
100-105							3.27	
105-110							0.0	m gr sand w/ few pebbles
110-115							4.28	f gr sand
115-120							5.71	m gr sand TD 120 ft

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE S-B-5		DRILL HOLE S-B-7		DRILL HOLE S-C-2		DRILL HOLE S-C-4	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	8.82	Fluvial sand and gravel	7.67	Fluvial sand and gravel	10.43	Fluvial sand and gravel	5.33	Fluvial sand and gravel
5-10	2.70		1.11		4.81		2.56	
10-15	3.06		5.05		0.68		4.04	
15-20	5.08		1.31	f gr sand w/ minor gravel	2.09		4.12	f gr sand w/ minor gravel
20-25	1.60	f to m gr sand	3.86		2.13	f gr sand	0.51	
25-30	6.67	m to c gr sand and gravel	2.57	f to c gr sand w/ minor gravel	5.17		0.0	
30-35	2.63		4.12	f gr sand, damp	0.98		0.63	
35-40	6.13	f gr sand	3.00		1.06	f gr sand, damp	0.47	f gr sand
40-45	24.66	f gr sand w/ few rx chips	0.83		4.40		0.45	f gr sand w/ minor gravel damp
45-50	7.82		1.71	f gr sand, gravel	3.80		0.42	
50-55	4.09		11.96	f to c gr sand, small gravel	2.83		0.82	Alt small gravels and f to c gr sands
55-60	8.67		3.45		6.80		0.66	
60-65	1.98		3.75		1.76		0.49	
65-70	0.65	c gr sand w/ gravel	5.84		0.0		0.44	
70-75	0.75	f gr sand w/ few pebbles	4.00	Alt layers of small gravel and f to c gr sand	0.88	f gr sand w/ minor gravel	2.32	
75-80	1.59	f gr sand	3.10		9.85	Clay at 76 ft, sand at 79 ft	0.43	
80-85	4.81		3.27		3.21	f to c gr sand	0.19	
85-90	7.02		5.95		3.82	Alt small gravels and f to c gr sands	0.20	
90-95	3.43	f gr sand w/ minor clay	2.38		1.67		0.21	
95-100	4.21	f to c gr sand and gravel	2.11		1.53		0.58	
100-105	6.25	f gr sand	Trace		1.03		0.85	
105-110	6.47	f gr sand, damp	1.80		1.55		0.22	
110-115	8.65	f to m gr sand w/ minor gravel	3.54		1.46		0.19	
115-120	5.96		6.19	TD 120 ft	4.07	TD 120 ft	0.54	TD 120 ft
120-122.5	9.43	TD 122.5 ft						

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE S-D-3		DRILL HOLE S-E-3		DRILL HOLE T-A-3		DRILL HOLE T-A-4	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	0.0	Fluvial sand and gravel	0.28	Fluvial sand and gravel	0.0	Fluvial sand and gravel	0.77	Fluvial sand and gravel
5-10	0.99		0.40		0.66		0.53	
10-15	0.0		0.70		0.96		0.56	f to c gr sand and gravel, damp
15-20	0.42	f to m gr sand	0.43	f gr sand w/ few pebbles	0.59		0.84	
20-25	8.35	Very f gr sand	0.87		0.55	f to c gr sand w/ few pebbles and minor clay	0.73	
25-30	1.14		3.96	f to c gr sand w/ few pebbles	0.39		1.10	f to m gr sand
30-35	0.49		4.71		0.47	f to m gr sand, damp	1.15	
35-40	0.45		5.45		0.40	f to m gr sand w/ few pebbles	0.96	
40-45	1.06		0.90		0.72		0.56	f to m gr sand w/ few pebbles
45-50	0.82		0.60		0.57	Clay at 50 ft TD 50 ft	0.35	
50-55	0.92		0.88	Very f gr sand			0.38	
55-60	2.33		1.25	Very f gr sand w/ few pebbles			0.78	Clay at 59 ft TD 60 ft
60-65	0.43		0.0	f gr sand w/ few pebbles				
65-70	0.22		1.04					
70-75	0.21	Very f gr sand w/ few pebbles	1.26					
75-80	0.59		1.02					
80-85	0.41		0.48					
85-90	Trace		0.68	Very f gr sand				
90-95	0.67		0.78					
95-100	0.70		0.0	f gr sand w/ few pebbles				
100-105	0.41	f to c gr sand, damp	0.68	f to c gr sand w/ few pebbles				
105-110	0.73		0.35					
110-115	0.81		0.37					
115-120	1.86	TD 120 ft	0.53	TD 120 ft				

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE T-A-5		DRILL HOLE T-A-6		DRILL HOLE T-A-7		DRILL HOLE T-A-9	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	1.18	Fluvial sand and gravel	2.44	Fluvial sand and gravel	1.09	Fluvial sand and gravel	1.07	Fluvial sand and gravel
5-10	0.64		0.66		0.63		0.84	
10-15	0.66		0.93		0.57		0.40	
15-20	0.75		0.71		0.95		0.98	f to c gr sand w/ some gravel
20-25	0.43		1.04		0.58		0.50	
25-30	0.43		0.64		0.59		1.09	
30-35	0.44		0.57		1.04		0.73	
35-40	0.45		0.64	f to c gr sand	0.70		0.41	
40-45	0.58		1.05	f to c gr sand w/ few pebbles	0.75	f gr sand w/ minor gravel	0.68	
45-50	0.38	f to m gr sand w/ few pebbles	0.72	Very f to f gr sand	0.37		0.69	
50-55	0.81	Very f to f gr sand w/ few pebbles	0.75		0.53	f to m gr sand w/ gravel	0.37	
55-60	1.63		0.82	f to c gr sand w/ some gravel	0.62		0.59	
60-65	0.0	f to c gr sand w/ few pebbles	0.56		0.41	m to c gr sand, damp	0.58	f to c gr sand w/ few pebbles
65-70	1.35	Clay at 68 ft, TD 70 ft	0.68	f to c gr sand w/ some gravel, damp	0.44	TD 70 ft	0.77	
70-75			0.58				0.51	
75-80			0.60	TD 80 ft			0.06	c gr sand and gravel, wet
80-85							0.48	
85-90							1.82	Gravel and c gr sand
90-95							0.56	
95-100							0.40	Clay at 100 ft TD 100 ft
100-105								
105-110								
110-115								
115-120								

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE T-A-11		DRILL HOLE T-A-13		DRILL HOLE T-B-2		DRILL HOLE T-B-3	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	1.13	Fluvial sand and gravel	1.56	Fluvial sand and gravel	0.63	Fluvial sand and gravel	0.53	Fluvial sand and gravel
5-10	0.70		0.73		0.75		0.52	
10-15	0.71	f to c gr sand w/ little gravel	0.58		0.18		0.0	
15-20	0.20		0.94		0.73		0.54	
20-25	0.33		0.35		0.38		0.0	
25-30	0.33		0.65		0.32		0.83	
30-35	0.50		1.38		0.79		0.33	
35-40	0.33		0.33	f to m gr sand w/ little gravel	0.0	Gravel w/ some sand	2.20	
40-45	0.40		0.62		0.62	f to c gr sand w/ some gravel	0.34	f gr sand
45-50	0.49		0.0		0.41	f to m gr sand w/ gravel, damp	0.63	TD 50 ft
50-55	0.53	f to c gr sand and gravel	0.65		1.40	TD 52 ft		
55-60	1.24		1.26					
60-65	0.85		1.00	Gravel w/ minor sand, damp				
65-70	0.55		0.83	TD 70 ft				
70-75	0.73	f gr sand w/ few pebbles, Damp TD 75 ft						
75-80								
80-85								
85-90								
90-95								
95-100								
100-105								
105-110								
110-115								
115-120								

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE T-B-4		DRILL HOLE T-B-6		DRILL HOLE T-B-8		DRILL HOLE T-B-10	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	2.37	Fluvial sand and gravel	0.60	Fluvial sand and gravel	1.43	Fluvial sand and gravel	Trace	Fluvial sand and gravel
5-10	0.98		0.39		0.36		0.58	f to c gr sand w/ some gravel
10-15	0.17		0.55		0.34		0.62	
15-20	0.79	f gr sand w/ some gravel	0.93	f to c gr sand w/ little gravel	0.53		0.59	
20-25	1.33		0.77		0.0	f gr sand w/ gravel	0.70	
25-30	0.86	f to c gr sand w/ some gravel	0.61		0.38		0.58	
30-35	0.49		0.60		Trace		0.19	
35-40	Trace		0.63		0.58		0.59	
40-45	0.17		0.92		0.0	m gr sand w/ gravel	Trace	
45-50	0.77	f gr sand w/ few pebbles, TD 50 ft	0.48		Trace		0.40	
50-55			0.71	f gr sand w/ few pebbles	0.21	c gr sand w/ gravel	0.38	
55-60			0.95	f gr sand w/ few sandstone chips	0.43	f gr sand w/ gravel, damp, TD 60 ft	0.44	
60-65			0.70	f to c gr sand, damp			0.78	
65-70			0.49	f gr sand w/ few pebbles			0.21	
70-75			0.56				0.87	f to m gr sand, damp
75-80			0.44				0.47	
80-85			0.79	f gr sand			0.54	
85-90			0.43	f gr sand w/ few pebbles			0.71	f to m gr sand w/ few pebbles
90-95			0.78	f to m gr sand w/ few pebbles			0.73	
95-100			0.45				1.10	
100-105			0.94	Clay at 103 ft TD 105 ft			0.18	Clay at 103 ft TD 105 ft
105-110								
110-115								
115-120								

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE T-B-11		DRILL HOLE T-B-12		DRILL HOLE T-B-13		DRILL HOLE T-B-14	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	0.35	Fluvial sand and gravel	1.15	Fluvial sand and gravel	1.07	Fluvial sand and gravel	0.0	Fluvial sand and gravel
5-10	0.49		0.32		0.73		0.53	
10-15	0.33		0.75		0.16	f gr sand w/ gravel	0.41	
15-20	0.74	f to c gr sand w/ some gravel	0.53		0.52	f to m gr sand w/ gravel	0.34	f to c gr sand w/ little gravel
20-25	0.54		0.57	m to c gr sand w/ gravel	0.50		0.0	
25-30	0.88		0.38		0.99	f gr sand w/ gravel	0.69	Very f to c gr sand w/ little gravel
30-35	0.44		0.19		0.82		0.51	
35-40	0.0		0.0		0.70		0.97	
40-45	0.71		0.54	f gr sand w/ minor gravel	0.52		0.57	
45-50	0.78		0.58		0.61	f to c gr sand w/ minor gravel	0.91	Very f to f gr sand w/ few pebbles
50-55	0.0		1.80		0.61		0.73	
55-60	0.58		1.58		0.85		0.45	Very f to c gr sand w/ little gravel
60-65	0.43		0.20		0.65		0.22	f to c gr sand w/ small gravel
65-70	0.60		0.0	c gr sand and gravel	0.92		0.38	
70-75	1.82	Gravel and sand, damp TD 75 ft	0.87		1.00		0.62	
75-80			0.06	Very f gr sand w/ minor gravel, damp. TD 80 ft	0.61		0.39	
80-85					0.47		0.41	f gr sand and gravel
85-90					1.41	f gr sand, damp	0.61	Very f gr sand w/ little gravel, damp. TD 90 ft
90-95					0.86			
95-100					0.67			
100-105					1.45	f to m gr sand		
105-110					0.82			
110-115					0.77			
115-120					0.67	Clay at 118 ft TD 120 ft		

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE T-C-2		DRILL HOLE T-C-3		DRILL HOLE T-C-4		DRILL HOLE T-C-5	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	1.19	Fluvial sand and gravel	2.00	Fluvial sand and gravel	1.54	Fluvial sand and gravel	1.47	Fluvial sand and gravel
5-10	0.75		Trace		0.56		0.91	
10-15	0.58	f to c gr sand w/ some gravel	1.05	f to c gr sand, gravel w/ minor clay, damp	0.68		0.82	
15-20	0.69		2.09		1.01		1.15	f to m gr sand w/ minor gravel
20-25	0.96		1.03	f to c gr sand w/ some gravel	0.48		0.67	f gr sand w/ gravel
25-30	0.85		1.07		0.50	f to c gr sand w/ some gravel	0.85	f to m gr sand
30-35	0.62		0.58	f to c gr sand and gravel w/ minor clay	0.85	f to c gr sand w/ some gravel, damp	0.89	f to m gr sand w/ gravel
35-40	0.92		0.76	f to c gr sand and gravel	1.21		1.09	f to c gr sand w/ gravel
40-45	1.04	f gr sand w/ minor gravel TD 45 ft	0.78		0.56		0.80	
45-50			2.20	TD 50 ft	2.48		1.64	
50-55					1.00		0.55	
55-60					0.84	f gr sand w/ few pebbles, TD 60 ft	0.44	f gr sand
60-65							0.43	f gr sand, damp
65-70							2.50	
70-75							0.43	
75-80							0.74	
80-85							0.50	f to m gr sand
85-90							0.37	f to m gr sand w/ minor gravel
90-95							1.89	Clay at 92 ft TD 92.5 ft
95-100								
100-105								
105-110								
110-115								
115-120								

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE T-C-6		DRILL HOLE T-C-7		DRILL HOLE T-C-8		DRILL HOLE T-D-4	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	0.56	Fluvial sand and gravel	1.90	Fluvial sand and gravel	0.94	Fluvial sand and gravel	1.29	Fluvial sand and gravel
5-10	1.50		0.70		0.82		0.72	
10-15	0.58		0.54		0.82	f to c gr sand w/ few pebbles	0.92	
15-20	0.58	f gr sand w/ minor gravel	0.57		0.84		0.49	
20-25	0.63		0.48		0.47		0.71	f to c gr sand and gravel w/ clay at 25 ft
25-30	0.56	Very f gr sand w/ minor gravel	0.33		0.53		0.83	
30-35	0.81		0.56	f gr sand w/ few pebbles	0.65		0.0	Very f to f gr sand w/ minor gravel and clay
35-40	1.57		0.54		1.05	TD 40 ft	0.0	f gr sand w/ some gravel, damp
40-45	0.56		0.50	f to c gr sand and gravel			0.84	f to c gr sand
45-50	0.82		1.37				0.67	f to c gr sand w/ few pebbles
50-55	0.65	TD 55 ft	0.86				0.91	
55-60			0.64	TD 60 ft			0.55	f to c gr sand, damp
60-65							0.0	f gr sand w/ few pebbles
65-70							0.0	f gr sand
70-75							0.0	
75-80							0.96	
80-85							0.96	
85-90							0.85	f gr sand w/ few pebbles
90-95							0.92	f to m gr sand w/ clay at 95 ft
95-100							0.44	f to c gr sand
100-105							1.59	
105-110							1.10	f to m gr sand w/ few pebbles
110-115							1.12	
115-120							1.07	TD 120 ft

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE T-D-6		DRILL HOLE T-E-2		DRILL HOLE T-E-3		DRILL HOLE T-E-4	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	0.67	Fluvial sand and gravel	0.38	Fluvial sand and gravel	0.77	Fluvial sand and gravel	0.88	Fluvial sand and gravel
5-10	0.82		1.44		0.53		1.44	
10-15	0.83		0.67		1.08		0.51	
15-20	0.78	f to m gr sand w/ minor gravel	0.40		0.42		0.50	
20-25	1.29	f gr sand, damp	0.47	f gr sand w/ minor gravel and clay	1.21	f to c gr sand w/ minor pebbles	0.55	
25-30	2.00		0.94	f gr sand w/ few pebbles	0.71		0.57	f gr sand, damp
30-35	0.50		0.48		0.67		0.62	Hard sandstone
35-40	0.48		0.44	f gr sand, damp	0.78		1.36	TD 37.5 ft
40-45	0.80		0.22		0.71			
45-50	0.59	f to c gr sand w/ few pebbles	0.53		0.96	Very f to f gr sand, damp		
50-55	0.59	f gr sand, damp	0.41		0.82	Very f to f gr sand w/ few pebbles		
55-60	0.65	f to c gr sand w/ few pebbles	0.40		0.47			
60-65	0.40	f gr sand w/ few pebbles	0.62		0.65	Very f to f gr sand		
65-70	1.00	f gr sand	0.62		0.20			
70-75	0.88		0.59		0.47			
75-80	0.78	f gr sand w/ minor clay	0.57	f gr sand w/ minor gravel	0.20	Very f to f gr sand w/ few pebbles		
80-85	1.43		0.62		0.29	Clay at 84 ft		
85-90	0.94	f gr sand	0.75		0.41	f to c gr sand w/ few rx chips		
90-95	0.36		0.99		0.56	Very fine dust, granitic rock		
95-100	0.45		0.55		0.83			
100-105	0.66		0.62		0.0	TD 102.5 ft		
105-110	1.05		0.51					
110-115	0.95	f gr sand w/ minor gravel	0.41					
115-120	1.84	TD 120 ft	0.52	TD 120 ft				

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE T-E-5		DRILL HOLE T-F-2		DRILL HOLE T-F-4		DRILL HOLE T-F-5	
	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology	Gold recovered, mg/st	Lithology
0-5	1.03	Fluvial sand and gravel	0.51	Fluvial sand and gravel	1.33	Fluvial sand and gravel	0.62	Fluvial sand and gravel
5-10	0.57		0.31		0.67		0.67	
10-15	0.59		0.31		0.89		1.98	
15-20	0.49		0.44		0.52		0.30	
20-25	0.78		2.00	f gr sand w/ minor gravel	0.57		0.38	f gr sand
25-30	0.31	Granitic rock at 28.5 ft	0.0	f to m gr sand w/ minor gravel	0.59	f to c gr sand w/ minor gravel	0.40	
30-35			0.40		0.81	f to c gr sand w/ minor gravel and sandstone	0.42	f gr sand w/ minor gravel
35-40			0.38		0.74	f to c gr sand w/ minor gravel and clay chips	Trace	
40-45			0.63	TD 45 ft	0.92	f to m gr sand w/ few pebbles and sandstone	0.20	
45-50					0.65		0.18	m to c gr sand w/ minor gravel
50-55					0.67	f to c gr sand w/ minor gravel	0.51	TD 55 ft
55-60					1.34			
60-65					0.73	Silt to very f gr sand w/ few pebbles		
65-70					0.19	f to m gr sand w/ few pebbles		
70-75					0.65			
75-80					0.40	f to m gr sand w/ few pebbles, damp		
80-85					0.78			
85-90					0.98			
90-95					0.60			
95-100					0.33			
100-105					0.68			
105-110					0.69			
110-115					0.52			
115-120					0.97	TD 120 ft		

TABLE F-1. - Drill logs and gold recovery--Continued

Sample depth, ft	DRILL HOLE T-R-1	
	Gold recovered, mg/st	Lithology
0-5	0.54	Fluvial sand and gravel
5-10	0.91	
10-15	0.92	
15-20	0.23	
20-25	0.80	
25-30	0.0	
30-35	0.44	c gr sand and small gravel
35-40	0.24	
40-45	0.91	
45-50	0.75	
50-55	1.54	Granitic rock at 50 ft, TD 52 ft
55-60		
60-65		
65-70		
70-75		
75-80		
80-85		
85-90		
90-95		
95-100		
100-105		
105-110		
110-115		
115-120		

APPENDIX G.--GEOLOGIC ENVIRONMENT OF GOLD DEPOSITION

This appendix contains supplemental information about the probable environment of deposition and source areas of gold and other metals in the fluvial wash drill hole samples.

GEOLOGIC ENVIRONMENT OF GOLD DEPOSITION

Because time permitted, a study of the source areas of gold and other metals was undertaken. Conducting such a study required an examination of the environment of deposition of the sediments associated with gold and other metals to avoid the mistake of treating sediments that might be quite different as if they were the same. If the sediments were all of the same type, they all could be considered as one group when geochemical statistics were calculated. If the drill samples included several different types of sediments (such as marine, desert stream, and beach sediments), separate statistics would be required for each different type. Research into environments of deposition led to the conclusion that the sediments best fit one type of geologic depositional environment; the desert wash or wadi environment.

Wadis (desert washes) are characterized by sporadic fluvial activity in the form of flash floods and are typically filled with water-laid sediments alternating with sediments reworked by and deposited by winds. Glennie (13), in his study of wadi sedimentation, listed several criteria that aid the distinction between wind- and water-deposited materials. Eolian (wind) materials, for example, comprise grain sizes ranging from silt to coarse sand; grains over 1/8 in are rare. Such sands are free of clay, gravel, and, usually, also of mica. Clays, in particular, are rare in eolian deposits and always represent fluvial materials. In contrast, fluvial (stream related) sediments are more varied. Fluvial sands may be unsorted to well sorted but are often argillaceous and pebbly. Sands are commonly cemented by calcite during early diagenesis (process involving physical and chemical changes in sediments after deposition that converts them to consolidated rocks). Poorly sorted mixtures of silt, sand, clay, and gravel are often dumped as debris flow deposits in the wadi channels. Clay laminae and lenses are more common, as are clay pebbles mixed with sands. Graded conglomerates may lack sand or silt because of removal of the finer sediments by winds. In general, the presence of gravel or clay with sediments indicates that the sediments were water-laid. Both wind-laid and water-laid wadi sediments commonly contain frosted sand grains resulting from abrasion of sand by winds.

The drill hole sediments can be easily categorized as two sediment packages. One package consists of moderately to well-sorted, fine- to medium-grained quartz sands containing less than 1% gravel. The second package is of interbedded sediments consisting of poorly sorted, silty or gravelly sands, mudstone lenses, calcite-cemented sandstone seams within uncemented sands of similar composition, clay pebble-bearing sands, and graded sediments ranging in grain size from fine-grained sand to gravel fragments several inches in diameter. The sands were feldspathic quartz sands occasionally containing chert and, more rarely, muscovite. Gravels consisted of locally derived subangular to subrounded granite, granite gneiss and other metamorphic rocks, chert, and occasionally volcanics. Frosted quartz grains occurred in both sediment packages. The first sediment package most closely resembles eolian sands, whereas the other more variable sequence probably represents fluvial deposits.

Many holes bottomed in a thick clay which was identified at the time as being the top of the Bouse Formation. Most holes on the downstream-most lines on the washes also contained a thick sequence of fine- to medium-grained sands above the thick clay zone. Few drill holes upsteam of the A and B lines contained the homogeneous thick sands. Some thick sands were interbedded occasionally with gravelly lenses or with sporadic thin clay seams and, therfore, are partly water-laid distal fan sands and are probably not part of the Pliocene Bouse Formation. Similar sand concentrations presently occur at the surface near the mouths of the washes, and their fine size reflects only their distance from the sediment source area. Other thick sands are, however, undoubtedly dune sands. The dunes may have formed by winnowing of Pleistocene to Recent fluvial sediments, or they may have formed during the Pliocene Epoch along the Gulf of California as part of the Bouse Formation. Several gold anomalies are associated with these thick sand sequences of undetermined age and origin (holes G-A-1, G-A-4, G-A-6, G-B-2).

Correlation of drill hole sediments with other deposits in the Colorado River area is difficult because detailed subsurface stratigraphic information is sparse for wells located in Colorado River tributaries. Metzger and others (24) included few lithologic logs, the closest (LCRP-22) being from Trigo Wash, located 6 miles south of Ehrenberg. Sediments encountered in the placer drilling program best match Metzgers' descriptions of Holocene "younger alluviums" and "Unit B" of the underlying Pliocene-Pleistocene "older alluviums". The thick sands may either correlate with "Unit B" or they may, as noted earlier, represent the top of the Bouse Formation. It was concluded in this study that the thick clay encountered at the bottom of some of the drill holes represents the top of the Bouse Formation and that the thick sands properly belong to a thick sand sequence Metzger and others assigned to "Unit B".

APPENDIX H.--INDEX TO TOPOGRAPHIC MAP COVERAGE

Figure H-1 is provided as an index to U.S. Geological Survey topographic map coverage of the Colorado River Indian Reservation. Plates 1 through 10 in the pocket of the report are based on the topographic maps indicated on figure H-1.

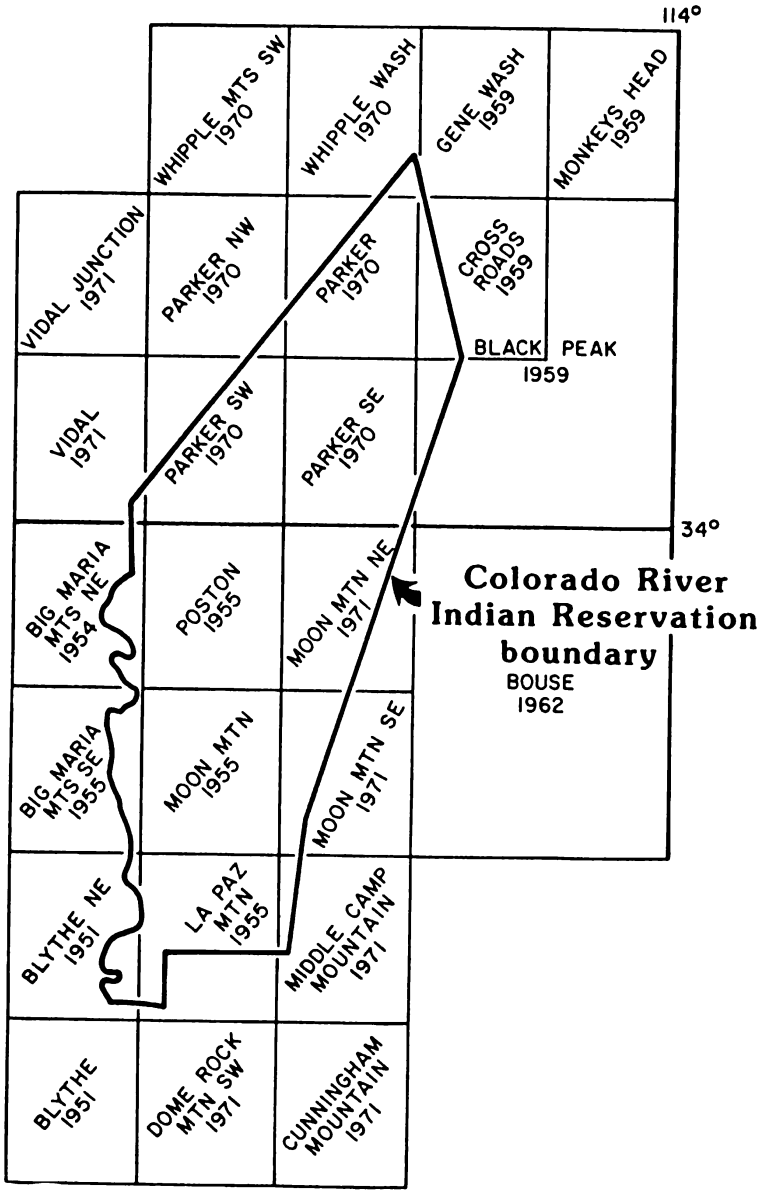

FIGURE H-1. - U.S. Geological Survey topographic map coverage of Colorado River Indian Reservation.