	Percent
Calcium	0.042
Iron	.022
Aluminum	.22
Magnesium	.045
Silica	99.04

Both white and pink varieties of sand occur on the Wyatt claims in a sandstone formation. The white sand is loosely consolidated and when crushed consists largely of very fine grains.

Silica in the form of quartzite occurs 13 miles northwest of Crystal in the Arrow Canyon Mountains. The deposit is owned by Seth E. Evans of Goodsprings, Nev., and in 1936 it was under lease to W. M. Tiffany of Long Beach, Calif. While this deposit is not in the Muddy Mountains area, it is included here for convenience. Very little work has been done on the deposit and there is no information on any production.

The silica grains are tightly cemented and the exploitation of this deposit depends on using the material in lump form as ganister or for purposes requiring lump silica. Under the glass the silica appears virtually free from any impurities.

Bentonite Deposits

Small deposits of bentonite types of clay occur in the Muddy Mountains area. One of the deposits, covered by three unpatented lode claims owned by Robert A. Baker of Las Vegas, Nev., is northwest of Muddy Peak 9 miles southeast of Crystal. Development work consists of a shaft 30 feet deep and several scattered open-cuts. The bentonite occurs between limestone and sandstone, and the width varies from 6 to 14 feet. None has ever been produced.

Sodium Sulphate Deposit

A deposit of sodium sulphate owned by B. R. McKenna of Moapa, Nev., outcrops along the side of a prominent cliff in the White Basin about 3 miles south of the former American Borax Co. mine. It is accessible by poor automobile road from Crystal, Nev., a station on the Union Pacific R. R., 24 miles to the northwest. No attempt has been made to exploit the deposit. The sodium sulphate is intimately associated with siliceous impurities.

ST. THOMAS (VIRGIN RIVER) DISTRICT

(Silica Sand, Magnesite, Gypsum, Salt, Sodium Sulphate)

The St. Thomas or Virgin River district comprises a large, vaguely defined area in the vicinity of St. Thomas, Nev. The town of St. Thomas has been abandoned, as eventually it will be flooded by the water impounded

by Boulder Dam. The district is particularly rich in industrial mineral deposits, including silica sand, magnesite, gypsum, salt, and sodium sulphate; but due to their inaccessibility and distance from consuming centers, only silica sand and salt have been produced. The salt deposits have been worked mainly to supply local demand. The Los Angeles & Salt Lake R.R., a part of the Union Pacific System, passes through Moapa, Nev., 14 miles northwest of Overton. From Moapa a branch railroad runs southeast to St. Thomas, a distance of 21 miles. About 5 miles of the southern part of this branch line will be abandoned when the water in Lake Mead reaches its maximum flow line.

The production of silica sand in Clark County is a comparatively recent industry, having been established less than 10 years. Production statistics are not available, but the total from the St. Thomas deposits is probably more than 200,000 tons. During the first quarter of 1937 the average monthly production was 3,500 tons, consisting of 2,500 tons of washed white sand and 1,000 tons of pink sand, the latter shipped without treatment. The bulk of the white sand was produced by the Morledge and Veitch Co., formerly the Sparton Silica Co.

Both white and pink varieties of silica sand occur in the sandstone formations in the Valley of Fire northwest of St. Thomas. These sandstone beds of Jurassic age and of great thickness have been eroded into fantastic shapes that exhibit many hues of red, yellow, brown, pink, and white, which, in the bright light and heat of the desert, give the Valley of Fire its name.

In Clark County the production of a white glass sand suitable for the better grades of glassware depends upon a supply of water for washing to remove small amounts of clay, iron, and amorphous silica. Although extensive deposits occur in other parts of the County, it is doubtful whether they can produce a high-grade glass sand without washing. In the St. Thomas area, water for washing is available from the Muddy River, which joins the Virgin River a little below St. Thomas.

With the present import tariff of $1 per long ton on silica sand, the St. Thomas deposits compete with imported Belgian sand in the growing glass and foundry industries of southern California. The white sand, after washing, is suitable for the manufacture of fancy glassware and sodium silicate; the pink variety is shipped without treatment and is used for molding purposes and manufacture of the cheaper grades of colored glassware. Production of silica sand in Clark County is on a close-margin basis at the present time, with a chance to expand if industries requiring this material are established in the vicinity of Boulder Dam.

Morledge & Veitch Co.

The white silica-sand deposit owned by F. L. Morledge and Lloyd Veitch is covered by two placer locations of 40 acres each 3.8 miles southwest of the washing plant. The washing plant is on the St. Thomas branch of the Union Pacific R.R. 5 miles south of Overton, Nev. In March 1937,

25 men were employed in the production of about 2,500 tons of white sand per month. Production for the past 3 years, taken from the company records, has been as follows:

Year	Tons (2,000 lb.)
1934	16,180
1935	14,935 (closed 4 months)
1936	18,717

The deposit occurs in a small hill covered by capping of iron-stained and cemented detrital material varying in thickness from a few feet to 20 feet. Below the overburden the sandstone consists of rounded crystalline grains fairly uniform in size and loosely consolidated. The sandstone is firm enough so that explosives are necessary to reduce it to a size convenient for handling. However, a light blow will reduce the lump to fragments, and the sandstone disintegrates rapidly in water. The mine-run sand contains about 20 percent waste in the form of hard lumps, clay, and amorphous silica.

A representative analysis made by the Smith Emery Co. of Los Angeles, Calif., on the washed sand was as follows:

	Percent
Silica	99.290
Iron oxide	.051
Aluminum oxide	.220
Titanium oxide	.050
Calcium oxide	.090
Magnesium oxide	.020
Sodium and potassium oxide	.100
Loss on ignition	.180
Total	100.001

The tolerance for iron in silica sand is 0.05 percent when used for better grades of glass, and according to Morledge the finished sand can be maintained within this limit. Some of the sand is shipped for the manufacture of sodium silicate, and for this purpose the iron content is not so important as it is in glass aand. The glass trade desires a product fairly uniform in grain size.

In the initial stages of mining, the overburden is first removed with a horse-drawn scraper, after which the sand is blasted and loaded directly into trucks by hand shoveling. Most of the sand mined in the past has been taken from an open pit approximately 240 feet long, 80 feet wide, and 100 feet deep. From this pit the sandstone is broken to a convenient shoveling size with 12-percent Hercomite No. 6. Holes are drilled with hand augers. The sandstone is hand-shoveled into end-dump mine cars holding 1,500 pounds each and is trammed to a loading pocket at one end of the pit. A skip holding about 3/4-ton, traveling on rails, and operated by Continental hoist powered by 35-horsepower gasoline engine, is used to hoist the sand out of

the pit. The skip dumps on a rail grizzly with 5-inch openings. The grizzly oversize contains some hard lumps of silica cemented with clay, and these are hand-sorted and rejected as waste. From the bin below the grizzly the sand is loaded into 5-ton trucks and hauled to the washing plant. The flow sheet of the washing plant is shown in figure 7.

The sandstone is crushed to 1/2-inch size by a set of rolls. It is disintegrated further by the action of water sprays in the trommel screen. Iron is present in the sand as nodules of ferruginous material resistant to disintegration, so that much of it is eliminated in the trommel oversize.

By successive washings in drag classifiers, the amorphous silica and clay are rejected. In the washing plant the coarser and finer sands are separated by hydraulic and drag classifiers. A screen test on the three sizes of sand produced was as follows:

Retained on (screen size) -	20	40	60	80	100	-100
Molding sand	0.5	49.1	30.6	7.2	6.3	6.8
Glass sand	Trace	13.9	44.4	18.6	14.1	9.2
Sodium silicate sand	.0	Trace	11.8	18.4	29.2	39.6

The finished product is dried in the air on a concrete storage platform. After it is dry it is loaded into railroad cars by a portable belt conveyor.

Power for the treatment plant is supplied by a 50-horsepower Western gasoline engine. The capacity of the plant is 10 tons of finished product per hour.

Nevada Silica Sand Co.

A deposit of white silica sand worked by the Nevada Silica Sand Co. is 4 miles west of Tokio Siding, a station on the St. Thomas branch of the Union Pacific R.R. several miles north of Overton, Nev. The deposit, which covers 160 acres, is worked under lease from the owner, Fay Perkins of Overton. The Nevada Silica Sand Co. is controlled by H. J. Stocker of Las Vegas, Nev., and associates.

The washing plant is 5 1/2 miles from the deposit, at a place 1 1/2 miles south of Tokio Siding, where water is available. Several years ago a pneumatic classification plant was erected at the deposit but it proved to be unsuccessful. In the latter part of 1936 eight men were engaged in producing silica sand. Judging from the extent of the open-pit working, the total amount of sand produced from this deposit has been approximately 15,000 tons.

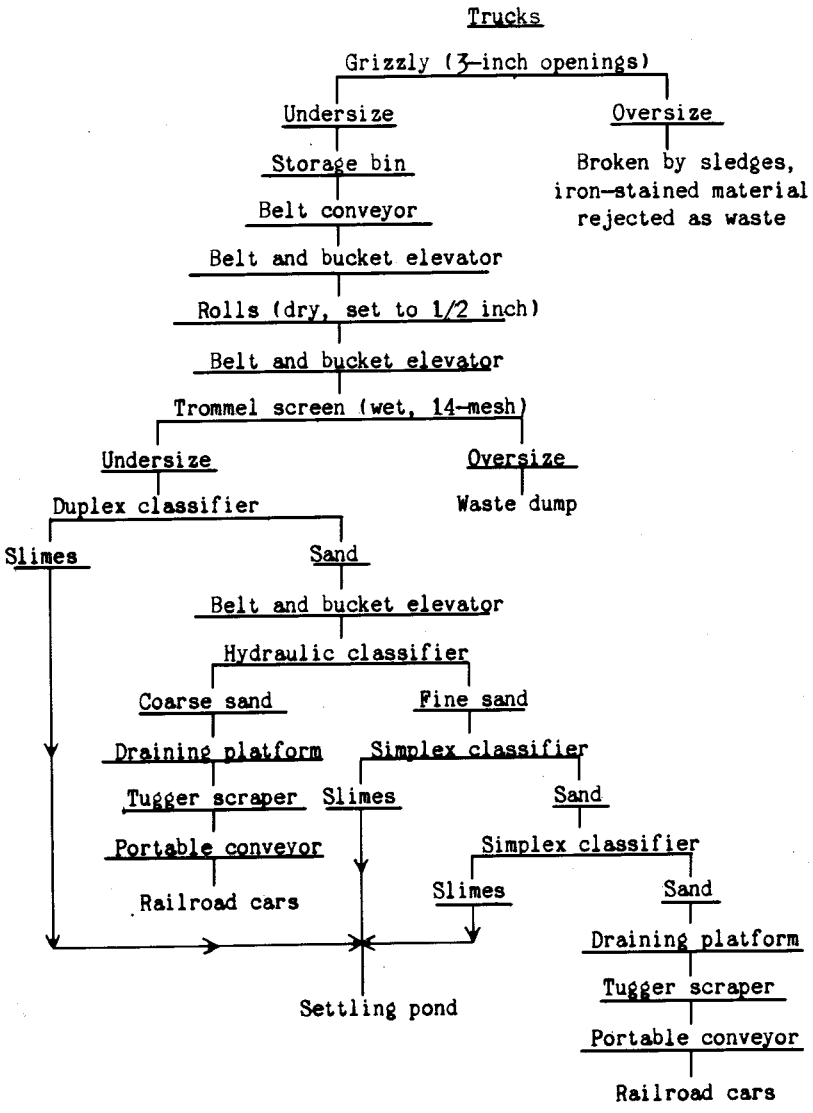

Figure 7.- Flow sheet of Morledge-Veitch silica-sand washing plant near Overton, Clark County, Nev.

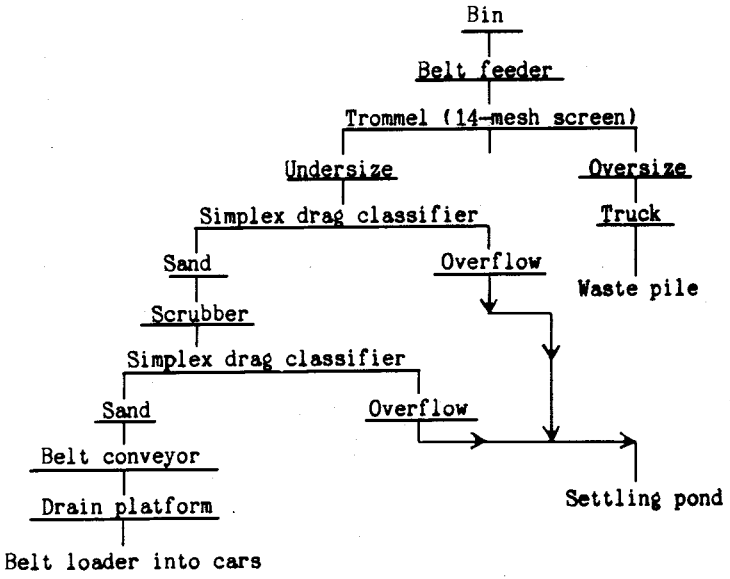

Figure 8.- Flow sheet of the Nevada Silica Sand Co. washing plant near Tokio Siding, Clark County, Nev.

The deposit is covered by an iron-stained sandstone capping whose depth ranges from a few feet to 10 feet. Below this capping the sand is fairly uniform in texture, loosely cemented, and in places stained with iron oxide. When the writer visited the property in November 1936 the workings comprised an open pit 100 feet long, 75 feet wide, and about 40 feet deep at the lower end. As depth is attained, the sandstone will probably contain less iron-stained material.

Mining is done with a 1/3-cubic-yard-capacity dragline scraper operated by a 35-horsepower, 4-cylinder, gasoline engine. The sand is broken with Hercomite No. 6 explosives. Hand-drilling is employed. The dragline transports the broken sandstone to an elevated bin equipped with rail grizzly having 5-inch openings. Some of the grizzly oversize is either iron-stained or too hard to be broken easily by hand-sledging, and this material is rejected by hand-sorting. The grizzly undersize drops into a 9- by 12-inch Blake-type crusher, which reduces it to a minus 1-inch product. From the bin the sand is loaded into either of two International trucks holding 8 and 4 tons, respectively, which haul it to the washing plant. The flow sheet of the washing plant is shown in figure 8.

From the mill bin, a belt-feeder delivers the sand to a trommel 3 1/2 feet in diameter and 8 feet in length equipped with a 14-mesh screen and water sprays. The trommel oversize is rejected as waste. The trommel undersize is discharged into a home-made simplex drag classifier. The classifier sand passes into a scrubber consisting of a wooden cylinder 5 feet in diameter and 18 feet long, which turns at a speed of 18 revolutions per minute. The scrubber discharges into a second home-made simplex drag classifier, which makes the finished product. The finished product is carried by belt conveyor to a draining platform, and after the sand is drained and dried in the open air it is loaded directly into railroad cars by belt loader.

The capacity of the washing plant is 60 tons of finished product in 9 hours with a crew of three men. Power for the plant is furnished by a 40-horsepower gasoline engine.

Other Silica-Sand Deposits

W. R. Cozart, of Overton, Nev., owns 800 acres of white silica sand several miles southwest of Overton. Only 112 carloads of this sand has been mined and was shipped in 1927-28. In 1937 this deposit was under lease to Paul and Fred Nunn, who were engaged in constructing a washing plant on the St. Thomas branch of the Union Pacific R.R. several miles south of Overton.

There is deposit of wind-blown pink sand (owned by U. V. Perkins of Overton, Nev.) 3 1/2 miles west of Logandale, Nev. The deposit is covered by two unpatented claims under lease to Morledge & Veitch Co., who were shipping about 500 tons of sand per month. This deposit consists of sand fairly uniform in grain size and with a silica content averaging about 97 percent. The material is shoveled by hand into trucks and hauled 3 1/2 miles to a railroad spur for shipment.

In addition to the foregoing deposits, a number of small operators ship pink sand intermittently from dune deposits several miles west of Kaolin, Nev. The pink sand is used in the manufacture of colored glassware and for foundry purposes, and it is shipped without treatment. The deposits of pink sand are large and production is limited only by lack of market.

Magnesite Deposits

Extensive deposits of impure magnesite occur on the northeast side of the Muddy Mountains, 5 miles by road west of Kaolin, Nev., a station on the St. Thomas branch of the Union Pacific R.R. Magnesite claims were first located in 1915, although the deposits probably were known prior to that time because of their conspicuous outcrops.

The Success group of six unpatented lode claims, also covered by a placer location, is owned by Mrs. John F. Perkins, the Gentry estate, and others. The Prosperity group of five unpatented lode claims is owned by John F. Perkins and associates. The South group of three unpatented lode claims is held by Levi Syphus and associates. Most of the owners live at Overton, Nev.

The deposits have been prospected by a number of adits but no commercial shipments of magnesite have been made.

A detailed report of the geology of these magnesite deposits has been made by W. W. Rubey and Eugene Callaghan[27].

The magnesite occurs in white, fine-grained, sedimentary beds interbedded with white clayey dolomite and ranging in dip from 25° to 42°.

According to Rubey and Callaghan, the estimated tonnage of the magnesite in the Overton area is as follows:

Minimum grade of ore	Magnesite (short tons)			
	In beds 4 feet or more thick	In beds 2 feet or more thick	In beds 1 foot or more thick	In beds 6 inches or more thick
38 percent of MgO	290,000	430,000	760,000	850,000
34 percent of MgO	3,100,000	3,500,000	3,600,000	3,700,000
30 percent of MgO	4,500,000	4,900,000	5,000,000	5,100,000

These deposits have received attention as a source of magnesium in connection with the power from Boulder Dam. When the reservoir (Lake Mead) formed by Boulder Dam reaches its maximum flow line, the magnesite deposits will be only a short distance from the shore of the lake. To be commerci-

27/ Rubey, W. W., and Callaghan, Eugene, Mineral Resources of the Region Around Boulder Dam: U. S. Geol. Survey Bull. 871, 1936, pp. 119-139.

ally valuable, the lime and silica impurities that occur in the magnesite would have to be removed by some method of beneficiation. The magnesite is so fine-grained that physical methods of separating it from the impure constituents do not appear feasible.

Gypsum Deposits

There are large reserves of gypsum on the east side of the Virgin River, 10 miles below St. Thomas, Nev. Although the fact that these deposits were there has been known for many years, they have not been mined due to their inaccessibility and distance from market. However, when the water in Lake Mead reaches its maximum flow line the gypsum can easily be transported by barges to the Union Pacific R. R. at Boulder City. Very little work has been done on the deposits.

The Colorado River Exploration Co. owns nine patented claims comprising 1,440 acres. Another group of 11 unpatented claims of 160 acres each is owned by C. C. McDonald, of Overton, Nev., and associates.

Salt Deposits

Remarkable deposits of rock salt are exposed on the cliffs along the west side of the Virgin River for a distance of 10 miles south from a point 4 miles below St. Thomas, Nev. These deposits have been acquired by the Federal government, since they will eventually be submerged as the water rises in the reservoir behind Boulder Dam.

The salt beds were mined by a tribe of Indians living in the Virgin River Valley about 1,500 years ago. Evidence of this ancient mining activity may be seen on the walls or floors of a natural cave in one of the salt mountains 4 miles below St. Thomas. The Indians mined the salt by chipping circular channels with stone hammers and prying off the slabs. A number of stone hammers found in the cave by archeologists may be seen in the Lost City museum, a short distance south of Overton, Nev.

White men mined salt in this locality as far back as 1866 in order to supply salt for the chlorination mills in the Mineral Park district, Ariz., and the Eldorado Canyon district, Nev. Although the salt deposits are virtually inexhaustible, little has been produced because of transportation difficulties and distance from large markets in competition with other sources of supply.

About 1932 some rock salt was shipped to Los Angeles by a company called the Virgin River Salt Co. Judging from the old workings, no large amount of salt was produced. For many years an average of about 200 tons of salt has been mined annually to satisfy local demands for stock purposes. This salt is very desirable for stock use because it weathers slowly.

In February 1937 the Civilian Conservation Corps at Moapa, Nev., was engaged in hand-mining the salt for stock use. Several thousand tons of this salt will be mined and stored before the deposits are flooded.

The salt bed of probably greatest commercial value is 4 miles south of St. Thomas and is about 100 feet thick. It is covered with a coating of sand and silt, but under this coating it is hard and solid and in order to be mined must be blasted. Some specimens of the salt are nearly as transparent as plate glass, but the bulk of it is mixed with clay and silt.

Sodium Sulphate (Glauberite) Deposit

Sodium sulphate (glauberite) occurs on the west side of the Virgin River about 5 miles south of St. Thomas. This deposit is on patented land formerly owned by the Stewart brothers. This land has been purchased by the Federal Government, since it will be submerged when water rises to the crest of Boulder Dam. The deposit has been explored by an adit 200 feet long, near the end of which is a winze 40 feet deep. No production has ever been made.

The sodium sulphate occurs as a crystalline mass of glauberite in horizontal sedimentary beds. Composite samples of the material analyzed 46.8 percent sodium sulphate, 45.85 percent calcium sulphate, and 7.35 impurities, including sodium chloride, iron, alumina, and silica. Glauberite when pure is composed of 51.1 percent sodium sulphate and 48.9 percent calcium sulphate, and the foregoing samples indicate that the deposit is fairly pure. The reserves are probably large.

SEARCHLIGHT DISTRICT

(Gold, Silver)

The Searchlight district is in southeastern Clark County, 40 miles south of Boulder City, Nev., and 22 miles east of Nipton, Calif. Nipton, on the main line of the Union Pacific R.R., is the nearest shipping point. The town of Searchlight, with a population of about 200, is 16 miles west of the Colorado River at an elevation of 3,600 feet.

The first claims in this area were located in 1897 by G. F. Colton, John Swickard, and others. The first important discovery was made on the Searchlight claim, now part of the Duplex mine, and the Quartette mine was discovered shortly after. The latter was financed by Col. C. Hopkins of Buffalo, N. Y. In 1902 the Quartette Mining Co. erected a 20-stamp mill on the Colorado River, 16 miles east, and built a narrow-gage railroad to connect the mine and the mill. In 1903 water was encountered in the Quartette shaft and a second mill of 20-stamp capacity was built at Searchlight.

The greatest activity occurred from 1902 to 1916, during which period a large number of companies were organized, many of which were merely stock-selling ventures. From 1916 to the present time mining has been principally in the hands of lessees. In 1936 an average of 60 men were employed on various properties in the district.