

NBMG OPEN-FILE REPORT 94-3

AGGREGATE RESOURCE STUDY OF SOUTHERN WASHOE COUNTY, NEVADA

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This information should be considered preliminary.
It has not been edited or checked for completeness

**AGGREGATE RESOURCE STUDY
WASHOE COUNTY, NEVADA**

Prepared For:

Aggregate Resources Planning Committee

and

Washoe County Department of Development Review

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In Cooperation With:

Nevada Bureau of Mines & Geology

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EXECUTIVE SUMMARY

Based on the information gathered for this study, Washoe County consumed between 3.5 and 4.0 million tons of construction aggregate in 1991, which equates to an annual consumption rate of approximately 14 tons per person. There are six major aggregate producers within the County and one producer outside the County that supplied most of the aggregate consumed within the County. Principal construction materials produced include Portland cement concrete aggregate (36 percent of total), aggregate base (26 percent), and asphalt concrete aggregate (21 percent). Common borrow material is not included in the above production statistics but we estimate that the current annual use of borrow in Washoe County is 1.5 to 2.0 million tons per year.

Projections for Washoe County put total population in 2012, twenty years from now, at approximately 419,000. Assuming that consumption rates remain fairly constant, 20 years from now total aggregate consumption will have increased at least 50 percent to an annual rate of 5.5 to 6.0 million tons per year. On the basis of these projections, over the next 20 years approximately 100 million tons of aggregate will be consumed in Washoe County. Combined reserves of the seven largest producers currently furnishing aggregate into the Reno-Sparks area, including one major producer in Storey County with considerable apparent reserves, are probably sufficient to satisfy this demand but confirmation of the reserves by drilling and further evaluation would be necessary to establish these reserves as "proven". It should be noted that not all current producers have sufficient reserves to last 20 years and their future plans may include the identification and development of new aggregate sources. In addition, reserves at existing producers are not necessarily permitted reserves, because permits have to be renewed periodically in most cases. In certain cases, material needed for specialty products may have limited reserves, indicating a need to find additional or alternate sources. In addition, because unforeseen economic or political circumstances as well as specification or quality changes can affect reserves at currently producing sources, they cannot be relied upon.

There are abundant potential aggregate resources in southern Washoe County. High potential sand and gravel resources are associated with the Truckee River and stretch from the California state line on the west to Pyramid Lake to the northeast. High potential bedrock sources are present close to the city as well, concentrated in the Peavine Peak - Cold Springs area immediately northwest of Reno and the western portion of the Pah Rah Range a few miles to the northeast of Sparks. There are other scattered areas of

high aggregate potential throughout the region and there is abundant moderate potential material as well. There are probably sufficient reserves of high quality undeveloped aggregate resources in southern Washoe County to supply the area for hundreds of years.

On the basis of economic considerations for the Reno-Sparks area, there appear to be sufficient high potential, undeveloped aggregate resources in economically favorable locations to last well beyond the next 20 years. A determination of high economic favorability indicates that a potential aggregate source is relatively near its market area so transportation costs are not excessive and that the existing transportation network is relatively close and can adequately service the deposit without the necessity of major capital expenditures.

A major unpredictable factor in the use of these high potential aggregate resources in the future, however, is accessibility to them. By accessibility we refer to all the economic, environmental and political constraints on mining such as: conflicting land uses, environmental concerns, visual impacts, truck traffic, dust, noise, increasing numbers of government regulations, present and future zoning, etc.

In order to assure that the Reno-Sparks metropolitan area has ample supplies of high quality, reasonably priced aggregate for future use it is necessary to plan ahead. Providing now for the future accessibility of some of these resources will ensure an adequate supply of reasonably priced construction aggregate for the next century.

1.0 PURPOSE

The purpose of the Aggregate Resource Study for Washoe County is threefold:

1. To determine current production/consumption rates of construction aggregates and to project future consumption rates.
2. To identify those areas in southern Washoe County which are potentially favorable for future aggregate resource development.
3. To identify economic factors that are the most important in locating, developing and using aggregate resources and to utilize those economic factors to compile a picture of economic favorability in southern Washoe County.

The primary need for the study is to provide Washoe County, and it's governing body with data that will enable them to better understand the local construction aggregate industry. The study is intended to provide Washoe County with baseline information necessary to more effectively evaluate applications for new permits and the periodic review of existing permits.

The identification of possible community impacts of aggregate mining operations and mitigation measures to offset those impacts which may be negative are beyond the scope of this report. These issues are to be addressed as a future addendum as per the original Scope of Work for the project (see Appendix E, Phase IV).

2.0 SCOPE OF WORK

The scope of work of the project was determined in conjunction with consultation with the staff at the Washoe County Department of Development Review and Washoe County's Aggregate Resources Planning Committee. A copy of the original Scope of Work developed in April of 1992 prior to the start of the project is included as Appendix E.

The study focuses on the southern portion of the County, or that portion approximately south of the lower end of Pyramid Lake (Figure 1). The reason for this is that construction aggregate is a high volume - low cost industrial mineral commodity, which means that transportation costs greatly influence the ability of a particular aggregate source to compete in the principal market area. We share the belief of the members of the Aggregate Committee that for at least the next 20 years aggregate resources for the Reno-Sparks area would not be competitive or cost effective if they had to be transported from the northern part of the County.

The scope of work for each phase of the study is as described under the appropriate headings below.

2.1 Existing Resources and Consumption Rates

The agreed upon language of the scope of work for the first phase of the study (Phase Ia, Appendix E) was as follows:

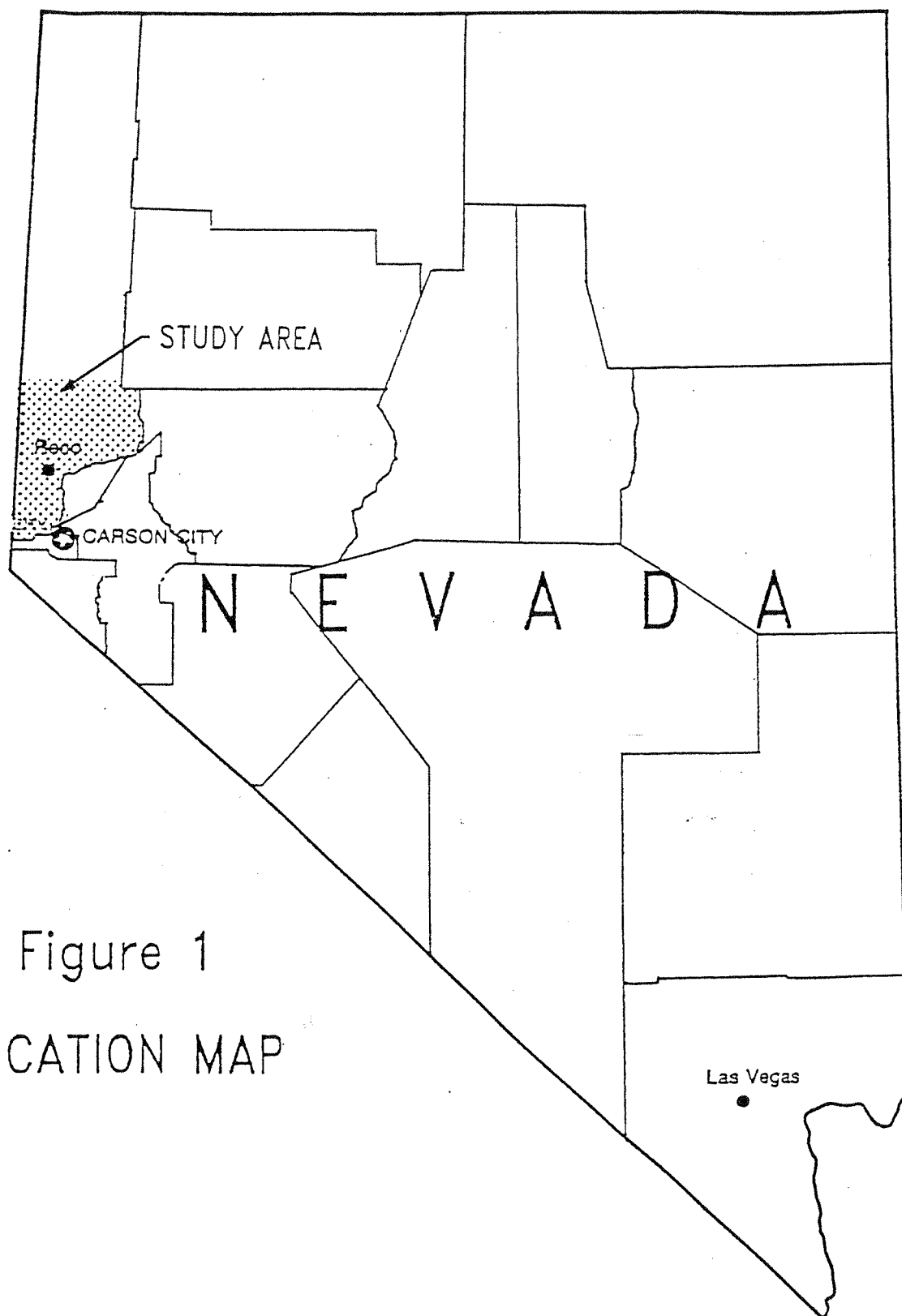


Figure 1
LOCATION MAP

AGGREGATE RESOURCES STUDY
WASHOE COUNTY, NEVADA
SHB JOB NO. E92-8091 6/92

"Develop a current annual per capita consumption rate of aggregate use in Washoe County. The consumption rate shall then be applied to growth projections for the County to help determine future needs for aggregate resources for the 20-year horizon.

- Current production will be determined by consultation with industry sources, published information or other applicable means.
- Types of aggregate materials by use will be identified and described by importance.
- Ordinary 'borrow' material will be discussed and usage estimated but the major focus will be on the higher quality aggregate products i.e. aggregates for concrete, asphalt, base material, etc.
- Aggregate producers outside the County who contribute to the supply within the County will be included in this phase of the study."

This portion of the study was conducted from April through June of 1992 with the following tasks undertaken:

1. Development of a questionnaire which was sent to all aggregate producers to obtain information regarding production, products, prices, future trends, and other specific items relating to aggregates in the area.
2. Personal contact with many of the aggregate producers to whom the Questionnaire was sent to verify or obtain additional information.
3. Procurement from the Washoe County Department of Development Review specific information on population estimates and data from the County's computerized Geographical Information System (GIS) which was used to produce a base map for the study. In addition the Department provided information concerning all holders of Special Use Permits for aggregate operations.
4. Coordination with the Nevada Bureau of Mines and Geology (NBMG) in developing a base map for the study at a scale of 1:100,000 which was produced from GIS information obtained from the County.
5. Contact with federal and state agencies to obtain information on consumption, availability of public aggregate resources, government use of aggregates, and future trends.
6. Site visits to some aggregate producers were made to verify location, activity, products, type of material, etc.
7. Use of Sergent, Hauskins & Beckwith's (SHB's) files pertaining to local aggregate resources and drawing on the experience of SHB's personnel, some of whom have worked in aggregates in the Washoe County area for over 20 years.

8. Preparation of a map showing the locations of all construction aggregate resources in southern Washoe County and those aggregate sources outside the County that sell into the County.
9. Preparation of a draft report entitled: Existing Construction Aggregate Resources and Consumption Rates, Washoe County, Nevada.

2.2 Aggregate Potential

The scope of work for this phase of the study initially included identifying the criteria for locating potential aggregate resources (Phase Ib, Appendix E). These criteria included such things as geographic extent, land ownership considerations, and incompatible use areas. The agreed-upon limitations of factors to be considered in locating potential aggregate resources are described in detail in section 4.1 of this report.

The actual identification of potential resources (Phase II, Appendix E) is based on physical quality and quantity. Sources of information used to identify potential resources included published and unpublished geologic maps, aerial photography, private and government reports pertaining to the availability of aggregate resources, and our own knowledge of and experience with local aggregates. In addition, field investigations were conducted in a study area which encompasses approximately 1000 square miles in southern Washoe County.

A map was prepared which classifies the study area by its potential for furnishing future aggregate resources. It divides this potential into six separate classifications as follows:

- | | |
|--------------------------|----------------------|
| SAND & GRAVEL | - High Potential |
| | - Moderate Potential |
| | - Low Potential |
|
BEDROCK |
- High Potential |
| | - Moderate Potential |
| | - Low Potential |

The only areas not classified for their aggregate potential were urbanized areas and water bodies. A detailed approach to the methodology of how potential resources were classified is described in section 4.2 of this report. The Aggregate Potential Map is Plate 2.

2.3 Economic Factors

The scope of work for this phase of the study (Phase IIb, Appendix E) as originally envisioned was to quantify economic factors that are the most important in locating and developing future aggregate resources. These factors were to include:

- Distance from market and related haul costs
- Remoteness of site from existing transportation routes
- Mining costs
- Processing costs

A scheme was devised to rate the importance of economic factors and to combine them with the previously determined aggregate potential using NBMG GIS facilities. The combined aggregate potential and economic factors were used to prepare an Economic Potential Map for aggregate in the study area (Plate 3). The criteria developed in compiling this map are described in detail in Section 5.1 of this report and include:

- Aggregate potential
- Distance from the Reno-Sparks metropolitan area
- Distance from major and minor roads
- Elevation

2.4 Principal Investigators

Dennis P. Bryan - A geological engineer with SHB Engineers. He served as project manager and principal investigator. Mr. Bryan specializes in industrial minerals and construction materials and has 20 years experience in local aggregate evaluation and testing.

Larry J. Garside - Research geologist with the Nevada Bureau of Mines and Geology. Mr. Garside has 25 years of geological field experience in Nevada and is especially familiar with the geology of Washoe County.

Stephen B. Castor - Research Geologist with the Nevada Bureau of Mines and Geology. Mr. Castor's specialty is industrial minerals, including construction aggregates, in Nevada.

Gary L. Johnson - Geographic Information System (GIS) Processor. Mr. Johnson specializes in utilizing computer data to compile maps.

2.5 Acknowledgements

This report is the result of a cooperative effort between many individuals and four organizations.

Sergent, Hauskins & Beckwith Geotechnical Engineers (SHB) was the prime contractor for Washoe County on the project. The assistance of SHB personnel is gratefully acknowledged, in particular that of Nancy A. Card who collected and compiled much of the material for the phase of the study encompassing the identification of existing aggregate resources and consumption rates.

NBMG was a subcontractor to SHB on the project. NBMG personnel prepared all maps using GIS technology, assisted in planning the scope of the study, participated in field investigation, and helped to write this final report. Lindsay G. Christensen, Ronald H. Hess and Hoang N. Hong are acknowledged for their help in database development and digital cartography. Dick Meeuwig is thanked for editorial assistance.

The Washoe County Department of Development Review was very cooperative in assisting us with the project. Michael Harper, Director, and Gene Martens initially provided us with current information pertaining to the County. They also coordinated meetings with the Aggregate Resource Planning Committee, guided our efforts in producing a product useful to the County Governing Board, reviewed our reports, and assisted with report reproduction.

Washoe County's Aggregate Resource Planning Committee guided the direction of the study and critically reviewed the report and maps. Many of their ideas and suggestions were incorporated in the study. Special thanks goes to Barbara Elkins and Jim Roberts from Granite Construction, Dave Cochran from the Nevada Department of Transportation, Pat Shane from Sha-Neva, Ron Moore of the U.S. Bureau of Land Management, Bruno Benna of CB Concrete Company, and Jim Parker.

In addition we would like to thank all those who returned the questionnaires and/or who otherwise answered questions concerning the local aggregate industry. Without the cooperation of local industry, portions of this study would have been lacking in substance.

3.0 EXISTING AGGREGATE RESOURCES AND CONSUMPTION RATES

3.1 Present Consumption

3.1.1 Response to Questionnaire

Approximately 30 questionnaires were sent out to known or potential aggregate producers in the area. This included producers both within Washoe County and those outside of Washoe County who sell into the County. In addition, the questionnaire was sent to members of the County's Aggregate Resource Planning Committee. A copy of the questionnaire is included in Appendix A. Appendix B is a list of known and potential producers provided by Washoe County and amended by SHB. Appendix C contains major aggregate producer profiles. Individuals who were interviewed during the course of this study or who returned questionnaires are listed in Appendix D.

Approximately half of the questionnaires were returned, and most of the major producers during 1991 responded. Many of those who did not respond were found not to be aggregate producers. Responses to the questionnaires varied from detailed to very generalized. All of the current major aggregate producers responded and all indicated they wished to keep the answers to the questions confidential. For that reason there is no detailed breakdown of products manufactured or tonnages produced for individual aggregate sources. Most information has been combined and summarized for presentation in this report.

A couple of known aggregate producers who were active in 1991, but who are no longer in business, did not respond to the survey so best estimates of their production or consumption had to be made. This was accomplished by interviewing others in the industry and making some assumptions.

3.1.2 Overview of the Market

Total current aggregate consumption in the Reno-Sparks area (within Washoe County) is estimated at 3.5 to 4.0 million tons per year based on the findings of this study. This consumption includes only that sand and gravel or crushed rock that is used in the higher quality applications for

construction aggregates; such as for use in Portland cement concrete, asphalt concrete, aggregate base, etc. More common types of construction material which are not necessarily processed and which are used as common borrow or fill material would boost this total production substantially. A separate section of this report addresses ordinary borrow material.

Table 1 is a compilation of aggregate production in the Reno-Sparks area based on data from the U.S. Bureau of Mines and from information gathered during the course of this study. The table compares production figures in the Reno-Sparks area to that in Nevada as a whole and also to total production in the United States.

Geologically the construction aggregates in the Reno-Sparks area can be classified as either sand and gravel or crushed bedrock. A description of these aggregate source types is as follows:

Sand and Gravel	<p>Nearly 50 percent of the high quality construction aggregate locally can be considered sand and gravel. This material primarily comes from sources along the floodplain of the Truckee River and includes both river gravels and glacial outwash. Minor amounts of good quality sand and gravel come from beach deposits, originally formed several thousand years ago when inland lakes were common in Nevada. Other sources of sand and gravel are alluvial fan deposits; while these sources provide a lot of the borrow materials and aggregate base locally, they are generally not used as a concrete or asphalt aggregate.</p> <p>Sand and gravel generally can be easily mined but usually must be washed. Oversize material is generally crushed.</p>
Bedrock	<p>Just over 50 percent of the high quality construction aggregate in the Reno-Sparks area comes from bedrock sources. The percentage of bedrock sources being used as aggregate has dramatically increased in the last 20 years because of declining availability of sand and gravel reserves. Bedrock sources are primarily igneous rocks which include both granitic and volcanic rocks. The granitic rock is technically referred to as quartz diorite while the volcanic rocks include rhyolite, basalt and andesite.</p> <p>These materials must be ripped or blasted in order to extract them and they then require crushing. They may or may not have to be washed depending on the nature of the raw material. The trend in the Reno area is toward the use of more bedrock sources in the future because of the limited availability of high quality sand and gravel resources.</p>

TABLE 1

AGGREGATE PRODUCTION*

Source: U.S. Bureau of Mines except where noted

PRODUCTION IN TONS			
YEAR	WASHOE COUNTY	NEVADA	U.S.A.
1991	3,500,000 - 4,000,000 **	21,000,000	1,900,000,000
1990	-----	19,977,000	2,140,000,000
1985	-----	13,530,000	1,800,900,000
1980	-----	7,000,000	1,746,642,000

* Modified from estimates of U.S.B.M.
 ** SHB Estimates, This Study.

Notes:

1. Production figures of U.S.B.M. are based on canvassing of sand and gravel and crushed stone producers. Reporting production is not mandatory. Since 1980 canvassing of sand and gravel production is only on even years. While canvassing of crushed stone is on odd years. According to U.S.B.M., approximately 90 percent of operators do report production, remaining 10 percent is estimated and is reflected in state total.

2. As of 1985 the U.S.B.M. ceased reporting sand and gravel or crushed stone production by county and has gone to reporting production by districts within the state. This has complicated obtaining figures concerning Washoe County alone.

3.1.3 Producers

Table 2 lists the principal construction aggregate producers in the Reno-Sparks metropolitan area that are located in Washoe County or that operate outside the County, but sell material into it. Profiles of each principal producer are included in Appendix C. Locations of principal producers and other aggregate sources are shown on Plate 1.

For the purpose of this report, a principal producer is an individual deposit which currently produces in excess of 100,000 tons of total aggregate product per year (not including borrow or ordinary fill material). There are six principal producers in Washoe County. In no particular order they are:

- Granite Construction, Patrick Pit
- Rocky Ridge, Spanish Spring Valley Quarry
- Rilite Aggregate Quarry
- Sha-Neva, Hungry Valley sand pit
- Paiute Pit at Wadsworth
- Helms 102 Ranch pit

During 1991, Granite Construction expanded operations at its Patrick Pit and started mining sand and gravel across the Truckee River in Storey County. Future production from the Patrick Pit may come principally from Storey County. The only major producer that is located totally outside the County is All Lite Aggregate's Washington Hill Quarry in Storey County, but that deposit contributes most of its production to destinations within Washoe County.

Minor aggregate producers also shown on the accompanying map include the Lemmon Valley sand pit, Seaberry Depaoli's sand pit, Granite's Lockwood pit, Tedford's pit at Hazen (outside Washoe County), the Nevada Department of Transportation (NDOT) pit at Mira Loma, and the Bella Vista pit. Other sources listed on the map have had very little recent production or are presently inactive.

3.1.4 Products

Table 2 lists the primary products manufactured by the principal aggregate producers. The products include only the high quality aggregate materials that are screened and/or washed through a

TABLE 2

Principal Aggregate Producers in the Reno-Sparks Area

(Total Production Currently in Excess of 100,000 Tons Per Year)

PRODUCER	PRIMARY PRODUCTS								
	AGGREGATE BASE	ASPHALT AGGREGATE	BEDDING SAND	CONCRETE AGGREGATE		DRAIN ROCK/ RIP-RAP	DE-ICING SAND	ORNAMENTAL LANDSCAPE	FILL/ BORROW
				COARSE	FINE				
Robert L. Helms Construction & Dev. Co 102-Ranch	X	X	X	X	X	X			
Granite Construction Company Patrick Pit	X	X	X			X		X	X
Rilite Aggregate Company	X			X	X	X		X	X
Sha-Neva, Inc. Hungry Valley & Lemmon Valley					X		X		X
Rocky Ridge, Inc. Spanish Springs Pit	X	X		X	X	X			X
Palute Pit Aggregates Palute Pit	X	X		X	X	X		X	X
All Lite Aggregates ^{**} (Storey County) Washington Hill	X		X	X	X	X			X

* Operations in the Patrick Sand and gravel deposit have recently moved across the Truckee River and a large portion of their material now comes from Storey County

** Located outside of Washoe County but ships most of its production into Washoe County

"plant." These products include three primary materials (concrete aggregate, asphalt aggregate, and base aggregate) and other materials produced in smaller volumes (bedding sand, drain rock, rip-rap, de-icing sand, landscaping material, etc.). Ordinary bank-run borrow or fill material are not included in production totals for aggregate products, but are included in the section of the report on borrow.

Table 3 lists the primary construction aggregate products produced in the Reno-Sparks area by percent of total product and in tons. This table was compiled from the questionnaires only and does not include estimates of production from certain sources where production data was lacking. As can be seen from the table just over a third of the total aggregate produced was for use in concrete. Aggregate base accounted for another 26 percent and asphalt aggregate accounted for 21 percent. Other materials accounted for 17 percent of the total.

3.1.5 Prices

The cost of producing aggregate in the Reno area is influenced by a multitude of factors, a few of which are itemized in the following table:

Land Ownership	Acquisition cost, royalty rates, etc.
Mining Costs	Drilling, blasting, dewatering, rippability, sand and gravel vs bedrock, contamination by deleterious material, overburden removal, etc.
Production Costs	Crushing needs, washing requirements, screening, dust containment, handling, durability of the rock, amount of reject material or fines, etc.
Volume	The higher the volume of material mined and sold, the lower the mining and processing costs become.
Location	Transportation costs to the market, availability of good roads, access to the deposit, etc.
Regulation	Federal, State and Local Government regulations, permits, and taxes. Includes zoning and environmental concerns.
Political	The cost of mitigating perceived public impacts of mining on the community.

TABLE 3

PRIMARY CONSTRUCTION AGGREGATE PRODUCTS
PRODUCED IN RENO-SPARKS AREA

PRODUCT	APPROXIMATE AGGREGATE PRODUCTION	
	PERCENT OF TOTAL PRODUCTION	THOUSANDS OF TONS
Portland Cement Concrete Aggregate	36	1,211
Asphalt Concrete Aggregate	21	707
Aggregate Base	26	875
Other (includes de-icing sand, drain rock, rip rap, landscape, bedding sand)	17	572
TOTAL	100	3,365*
<p>* Approximate total <u>reported</u> aggregate production in the Reno-Sparks area for 1991. Does not include those sources which did not respond to the questionnaire and where production had to be estimated.</p>		

The selling price of aggregate in the Reno area is also influenced by the marketplace. An aggregate must be competitive with others in the same market in order to sell. It is also important to realize that prices fluctuate with the market as a whole and with general economic conditions.

This study was not intended to analyze the pricing in the local aggregate market but a few generalizations can be made based on the results of the questionnaire:

- Asphalt Aggregate sells for between \$4.50 and \$8.00 per ton, F.O.B. Pit.
- Concrete Aggregate sells for between \$4.20 and \$6.50 per ton, F.O.B. Pit.
- Aggregate Base sells for between \$2.70 and \$4.50 per ton, F.O.B. Pit.

3.1.6 Transportation Costs

In general, the further from town the aggregate source, the lower the price of the material F.O.B. at the mine site. This lower selling price reflects the higher cost of transportation to deliver the aggregate to the market and to ensure that it will be competitively priced with other sources of aggregate that may be located nearer the market. This is a very important factor in supply and demand in the aggregate industry. No matter how cheaply the material could be mined or how good the quality, beyond a certain distance from the urban market area, it cannot compete with other sources because transportation costs are too high.

Transportation costs in an urban environment, however, are not based on mileage as much as on the time it takes to transport aggregate to the jobsite or batch plant. Freeway transportation is more economical per mile than urban streets because it is faster. Delivery time, combined with an established hourly rate for a certain capacity truck gives a transportation cost per ton of aggregate.

Much of the local trucking is regulated by the State of Nevada through the Public Service Commission. This agency publishes allowable rates for haulers and for the standard size truck-trailer combination (approximately 24 tons) the current rate is \$63.69 per hour. Such haulage rates are referred to as the "Nevada Motor Transport Tariff Service Rates." Unregulated haulers — a company who has their own aggregate source and delivers material for their own use — will likely have lower transportation costs. Even lower transportation costs can be accomplished by

using triple trailers or "trains" as they are often referred to in the industry. These larger vehicles can carry approximately 38 ton loads at a published rate of \$82.80 which reduces haul costs by approximately 20 percent.

Transportation costs are influenced by the location of the source, type of material, length of haul, time involved, type of road travelled and amount to be delivered. For instance, along a good highway (such as I80) the transportation costs would be on the order of \$2/ton per hour of round trip truck time assuming 38-ton loads.

3.1.7 Present Production/Consumption Summary

On the basis of the results of this study, 1991 production and consumption of aggregates in the Reno-Sparks metropolitan area is estimated at 3.5 to 4.0 million tons per year. Using a 1991 population of approximately 263,000 people, the per capita aggregate consumption rate in Washoe County is approximately 14 tons per person per year. This figure does not include ordinary borrow material used mainly for fill applications. It does include all aggregates which have to be processed in some way for a specialty use, mainly for concrete, asphalt and base aggregate. Table 4 is a production/consumption summary for the production figures obtained for 1991.

Table 5 is a summary of consumption rates for Washoe County in comparison to the State of Nevada and the United States as a whole. The consumption rate in Nevada over the past decade has greatly exceeded the national average, reflecting the rapid population growth in the state and the resulting need for infrastructure and housing. This contrasts with those areas of the country where growth is considerably less and construction aggregate demand is therefore lower.

The year 1991, according to local producers, was a relatively average year for aggregate production. Production figures from the previous five years, according to the questionnaire, were similar overall to the 1991 amounts. In addition, predicted future production forecasts by the suppliers indicates that total production will remain the same or increase slightly in 1992.

Production and consumption figures as shown on Table 4 were arrived at by compiling information from the questionnaires and by making assumptions for those sources that either did not respond

TABLE 4

PRODUCTION/CONSUMPTION SUMMARY - 1991

	MILLIONS OF TONS
Total Construction Aggregate Production Within Washoe County	3.5 - 4.0 *
Production Within Washoe County Which is Consumed Outside County (approximately 13 percent)	0.4 - 0.5
Consumption of Construction Aggregate Within Washoe County (includes producers from both within and outside Washoe County)	3.5 - 4.0 *

- * Production and consumption figures for Washoe County are the same because even though some product from within the county was sold outside the county, an approximate equal amount produced outside the county was consumed within the county.

TABLE 5
CONSUMPTION RATES

CONSUMPTION IN TONS PER CAPITA			
YEAR	WASHOE COUNTY	NEVADA	U.S.A.
1991	14.0	-----	-----
1990	-----	16.1	8.6
1980	-----	8.7	7.7
Nevada and USA population estimates from: Nevada Department of Taxation and Nevada State Demographer, Bureau of Business & Economic Research, College of Business Administration University of Nevada, Reno, February 1992			
Nevada and USA Aggregate Production: U.S. Bureau of Mines			

or supplied incomplete information. The final estimated tonnages are reported as a range because of the variability and/or non-specific nature of some of the collected data.

3.2 Projected Future Consumption Rates

3.2.1 Overview

The construction aggregate market in Washoe County 20 years from now will be over 50 percent larger than it currently is, if estimated population projections and current consumption rates hold true. Recycling of construction materials will probably be more prevalent as costs and environmental concerns increase. Locations of new pits and quarries are likely to be further from the Reno-Sparks area if land-use conflicts intensify and local environmental concerns are emphasized. The possible location of future aggregate resources is one of the objectives of further phases of this study.

On the basis of our projections, over the next 20 years approximately 100 million tons of aggregate will be consumed in Washoe County. If one combines all of the inferred reserves from the seven major producers that provide aggregate into the county there are probably sufficient reserves to satisfy this demand over the next 20 years. However, these reserves are not guaranteed because in most cases the quality of the entire deposit has not been proven by extensive drilling, geologic mapping and testing. In certain cases there may be specialty products that become depleted. Also, this reserve projection is based on the premise that there will be no changes in specifications or accessibility. If specifications change or are "tightened," some of the present sources may no longer be viable. If residential growth impinges on the location of an aggregate source, the political climate in the area could change, resulting in citizen or regulatory pressure to close the operation. A currently permitted aggregate source does not assure that the source and its inferred reserves of millions of tons of aggregate are available for use in the future because Special Use Permits must be reviewed periodically and renewed. In effect, unforeseen circumstances may terminate production by some operators; therefore, existing reserves (whether proven or inferred) cannot be relied upon.

Combined processing plant capacities of all current principal producers are approximately 3000 tons/hr., or about 6.3 million tons per year, indicating that the combined processing capability

exceeds demand. Whether these aggregate sources will still be producing in 20 years depends on many factors, both economic and political.

3.2.2 Plans of Present Suppliers

All of the present major suppliers of aggregate in the Reno area plan to stay in the business of furnishing material for the construction industry. Those with limited reserves have plans to expand operations or open new sources elsewhere to assure themselves of adequate supplies of aggregate. The future political climate and changes in regulations will be important factors for all producers, determining their ability to expand current operations or start new ones.

3.2.3 Future Production/Consumption Summary

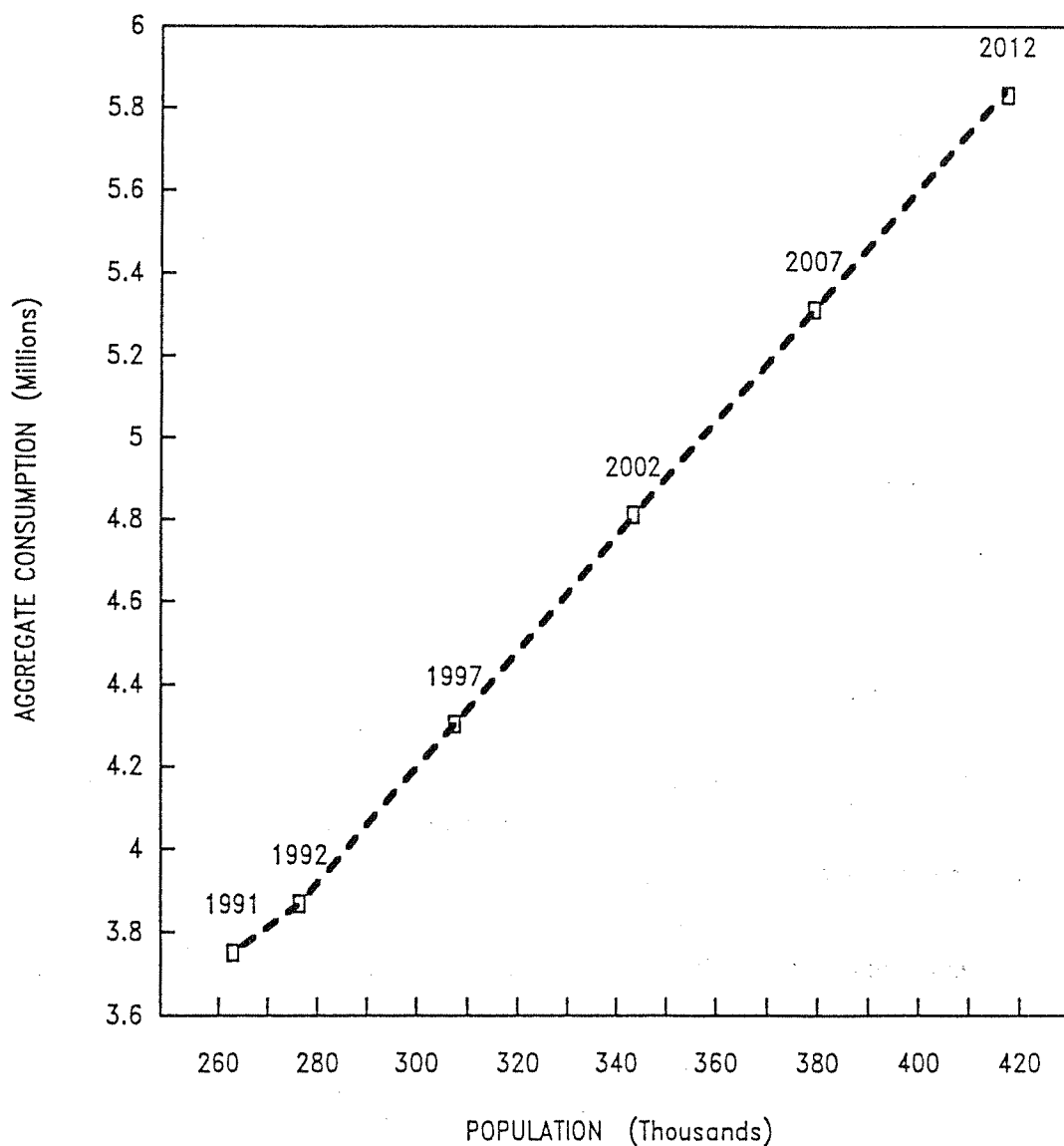
According to the Washoe County Comprehensive Plan the population in the County in 2007 will be approximately 379,000. This compares with a current population of approximately 276,000 indicating that there will be an estimated population increase of 37 percent over the next 15 years. If population is further projected for a total of 20 years, at an increase between the years 2007 and 2012 of approximately 2.0 percent per year, by the year 2012 the population in Washoe County will be approximately 419,000, a total increase of 52 percent over 1992.

Figure 2 depicts the projected annual aggregate consumption in the County through 2012. If it is assumed that present consumption rates of aggregates (approximately 14 tons per capita) will continue at approximately the same levels for the next 20 years, then by 2012 total annual consumption of aggregate in Washoe County should be between 5.5 to 6.0 million tons. This amounts to an increase of at least 50 percent over 1992 levels.

3.3 Present & Future Consumption - Borrow Materials

Borrow is defined as "earth material taken from one location to be used for fill at another location." For the purposes of this study, borrow includes all earth materials that are not included in the aggregate production figures that were discussed in the previous portion of this report. They primarily include those materials that are used as common fill for highways, building sites, dams or dikes, etc. For instance, a common use for borrow in the industrial area of Sparks is as fill, to bring ground

FIGURE 2
PROJECTED ANNUAL AGGREGATE CONSUMPTION
WASHOE COUNTY, NEVADA



- NOTES:
- Based on a consumption rate of 14 tons per year per capita.
 - Population figures for 1992 through 2012 adapted from the Comprehensive Plan, Population Element, Washoe County Department of Comprehensive Planning, May 1991.
 - Population estimate for 1991 adapted from Nevada Population Estimates from the State Demographer's Office, Bureau of Business and Economic Research, College of Business Administration, University of Nevada, Reno, April 10, 1991.

elevation up to or above the 100-year flood level at building sites. Construction then takes place on this fill "pad." Perhaps the largest use of borrow is in new road construction such as the recent extension of the U.S. Highway 395 South Freeway. For instance, the current 395 extension to Mays Lane along South Virginia Street will require more than 500,000 tons of fill material. The Nevada Department of Transportation estimates that in the next two years 4 to 6 million tons of fill will be required for planned highway projects in southern Washoe County. Much of this material will come from the state's Mira Loma pit in the southeast Truckee Meadows. The accompanying map, Plate 1, lists all the known active borrow pits in southern Washoe County and shows their locations.

In most cases, borrow does not need to be high quality material, hence there are abundant sources of borrow locally available. Usually a specification for fill material has an upper particle size limit (i.e. there can be no rocks larger than 1 ft.), a size distribution limit (there must be a balance between fine and coarse material) and it cannot be too plastic (it cannot have too much clay).

In the Reno area borrow sources are typically located in easily minable material such as sand and gravel from nearby alluvial fans, or in similarly easily minable bedrock units such as the locally abundant volcanic or igneous intrusive rocks. DG (decomposed granite) pits are common in the area and are often sources of ordinary borrow material. However, some DG pits are actually sources of cleaner material that has uses with specifications that ordinary borrow material would not be able to equal. Borrow pits are typically located as close as possible to sites where fill material will be used because even though the cost of such material may be low, the cost of transporting large amounts of it is high.

The cost of fill material in Washoe County varies between \$1.50 to \$3.00 per ton F.O.B. at existing aggregate deposits. At other private sources of borrow where no loading facilities exist a contractor may obtain the material for 1/3 to 1/2 that price if he mines and loads it himself. BLM borrow pits charge \$.30-\$.40/yard in 1991 to private parties whereas they furnish the material free to other government agencies such as the County, NDOT and the cities of Reno and Sparks.

Transportation costs for borrow material are similar to those for other aggregate materials previously mentioned. For example, if the average fill material costs \$2.00/ton loaded into a truck and haul costs for a 38-ton load (triple trailers) are roughly \$80/hr, then the cost of the fill will double when it is approximately an hour away or triple when it is two hours away.

In 1991, consumption of borrow material in Washoe County was approximately 500,000 tons, based on responses to the questionnaires. This includes fill sold by all the producers that responded, but does not include some major borrow sources that failed to respond to the questionnaire or who did not provide complete information. Because the acquired information on borrow consumption was sketchy, we feel the reported 500,000 tons per year is very low based on additional interviews and our own familiarity with the industry. Also, the demand for fill material on a yearly basis may fluctuate greatly depending on the amount of roadwork and other construction being undertaken during that year.

Based on the projections and talking to others knowledgeable in the industry we have estimated that a current annual demand for fill or borrow material in southern Washoe County is on the order of 1.5 to 2.0 million tons per year. This would yield a current consumption rate of approximately 5 to 7 tons per person per year. Twenty years from now, if consumption rates are similar, the total average demand for fill material would be 2 to 3 million tons per year.

4.0 AGGREGATE POTENTIAL IN SOUTHERN WASHOE COUNTY

4.1 Areas Included in the Study

Limitations on the area of the aggregate resource study in Washoe County are listed below. These were developed in conjunction with the Washoe County Department of Development Review and the Aggregate Resource Planning Committee.

1. Identification of potential aggregate sources was to be confined to Washoe County. No field time or research was to be conducted on potential resources outside the County. It should be noted, however, that there are currently sources of aggregate outside Washoe County that furnish material for consumption within the County. Storey County is especially important as a provider of aggregate into Washoe County due to its close proximity and favorable geology.
2. The northern limit of the study area is as shown on the accompanying maps (Plates 1 through 3). This limit is at approximately the southern end of Pyramid Lake. The northern portions of the County were not included as it was agreed that, at least for the next 20 years, any potential aggregate sources north of this line would likely not be able to compete economically in the Reno-Sparks metropolitan area because of the haulage distances involved.
3. Potential aggregate sources on both private and public land would be included. Indian Reservation land was also included.

4. Initially, it was felt that certain incompatible use areas should not be included in the study area if their presence would preclude aggregate development. As the study developed, however, it was decided for the sake of simplicity to include all of southern Washoe County except that which is urbanized or under water. The resulting maps (Plates 2 & 3) therefore classify the entire study area except that portion which is presently developed or is an existing lake (Washoe Lake is still considered an existing lake even though it is currently dry). It is recognized that some parts of the study area may have conflicting land uses which are incompatible with aggregate mining (such as parks and Wilderness Areas). In addition, other possible incompatible features such as scenic corridors, cultural resources, wetlands, wildlife habitat, environmentally sensitive areas, urban buffer zones, proximity of rural residents, current and/or planned zoning, etc. were not taken into consideration. Identifying and ranking the impact of these possible incompatible uses on aggregate mining was beyond the scope of this initial resource assessment but are to be addressed in some fashion at a future date.

4.2 Methodology Used to Identify Potential Resources

The classification of materials as potential aggregate resources and compilation of a potential map was based on existing information, the investigators' own experience, and limited field investigation. Budgeting and time constraints for the project were such that only a minimal amount of field time was allotted for confirmation and/or raw exploration. A detailed field examination of the entire southern portion of Washoe County was beyond the scope of this study.

4.2.1 Research

The first phase of this portion of the study was to compile all known technical information which would help to identify potential aggregate resources in the County. This primarily included published geologic maps of the study area, unpublished geologic mapping based on current research at the Nevada Division of Mines & Geology, aerial photography, and selected reports on aggregate resources in the study area from the files of SHB Engineers.

Much of the published geologic mapping had been previously digitized and was included with GIS files from Washoe County.

4.2.2 Field Work

Field work was undertaken during May, June, and July of 1992. A total of 21 man-days of field work was performed throughout southern Washoe County. The field work was undertaken to

observe first hand the aggregate potential of different geologic units. Additional field time was spent visiting most of the principal aggregate producers to become familiar with the geology and aggregate characteristics of each deposit.

The total area classified for its aggregate potential was in excess of 1000 square miles or approximately 50 square miles for every man-day in the field. Mapping such an area in the limited amount of field time available necessitated considerable generalization. It was impossible to visit every square mile or evaluate every mapped geologic unit for its aggregate potential. Most of the field time was spent evaluating those areas where aggregate mining was likely to occur in the future. For instance, field work was not undertaken in the Lake Tahoe basin or on the top of Mt. Rose because the likelihood of mining taking place at these locations is remote.

In general, field time was utilized for the following:

- To field check existing aggregate sources to determine their geology and if that geology could be used to help determine aggregate potential in the same or similar geologic units throughout the County.
- To field check geologic units similar to those whose aggregate potential was known.
- To field check geologic units that are unknown as far as their potential for aggregate resources.
- To better delineate aggregate potential in those areas with available published geologic maps where the geologic map units are highly generalized. For example, a large area in the Pah Rah Range to the northeast of Sparks has only been mapped in reconnaissance fashion. This area was field checked to determine the extent and aggregate potential of different types of volcanic rock. During the field work we found that some of the volcanic rocks in this area had high potential for aggregate (i.e., basalts), whereas other volcanics in the area had very low potential (i.e., tuffs).

The field work allowed us to determine the physical properties and extent of the rock units. Weathering characteristics and geomorphologic interpretation were used to help visualize the physical characteristics of rock units below the ground surface. Much of our interpretation was based on past experience with surface expression and outcrop patterns of known aggregate sources.

4.2.3 Criteria Used to Determine Aggregate Potential

"Potential" of a rock unit for use as an aggregate, according to our definition, refers to its potential for use as a high quality construction material such as in Portland cement and asphalt concrete. There are many uses for aggregate, some of which require only minimal specifications to be met. For instance, ordinary borrow is a construction material yet almost any quality of material can be used. At the other end of the scale are Portland cement and asphalt concrete, for which high quality aggregate is needed in order to ensure that the end product will have sufficient strength, durability and longevity. Aggregate base, on the other hand, is sometimes referred to as requiring high quality aggregate, but even though some aggregates may easily meet specifications for aggregate base, they may fail to meet the requirements for concrete and asphalt aggregate.

The aggregate potential classification utilized on Plate 2 is based on the suitability of the material for use in typical Portland cement and asphalt concrete mixes. Rating geologic units, including both unconsolidated and bedrock units, according to their potential for use as sources of high-quality aggregate is based on determinations of pertinent physical properties. The most important features of high quality aggregate are hardness (resistance to abrasion), soundness (resistance to deterioration, particularly by the effects of weathering), and durability (resistance to deterioration with time). Aggregate quality is usually determined by detailed testing prior to use, and such testing is well beyond the scope of this project. However, quality may generally be estimated on the basis of overall competence during hand specimen examination, in conjunction with subsurface geologic interpretation of the site. Competent rock at the surface does not always mean the deposit as a whole would provide an adequate aggregate source. The following characteristics may be used as indicators of quality:

Weathering - Different rock types have variable reactions to long-term surface exposure. Most Mesozoic granitic rocks in the Reno area are deeply weathered, resulting in weakened strength along grain boundaries. Such material, which is referred to as decomposed granite (DG) in the construction industry, is generally not suitable for use in Portland cement and asphalt concrete. However, metamorphic rock types that are as old as, or older than, the granitic rocks and were exposed to the same weathering environment, are not decomposed as are the granites because their mineralogy and texture is different. Tertiary volcanic rock in southern Washoe County is of variable potential; basalt is generally of higher quality than the more siliceous volcanic rocks. Some siliceous rhyolites, however, have been found to make suitable concrete aggregates. In addition to rock type, the extent of weathering is also dependent upon the age of the rock and the length of time that it has been exposed, as well as upon the weathering environment. For example,

granitic rocks at higher elevations in the Sierra Nevada are considerably more competent than their weathered counterparts at lower elevations in the Reno area. This is probably due to the fact that the Sierra Nevada has been uplifted several thousands of feet over a geologically short period of time and much of the deeply weathered material has been eroded away, leaving unweathered material more suitable for high quality aggregate exposed at the surface. In general, the extent of weathering can be determined from long-range or aerial photograph examination. Deeply weathered material underlies relatively smooth, low-angle slopes, whereas competent rock forms craggy, steep slopes.

Alteration - Rock underlying large areas in southern Washoe County has been altered by hydrothermal processes, rendering it useless for high quality aggregate, mainly because of the transformation of more resistant silicate minerals to clay. Some metamorphic rock units on Peavine Mountain that have high aggregate potential are locally altered to relatively incompetent material. Other areas of intense hydrothermal alteration include rocks in the Wedekind Heights and Geiger Grade areas. Because of the favorability of such altered areas for metallic mineral deposits, their extent is well known and is shown on detailed geologic maps in the Reno area.

Age of Sand and Gravel Units - The age of sand and gravel deposits can be used as a rule-of-thumb gauge of aggregate potential. Most sand and gravel units in southern Washoe County are composed of a mixture of rock types. If some of the gravel clasts are composed of rock that is relatively susceptible to decomposition, this may preclude the entire unit from being economically useful as a source of high quality aggregate. In general, material in older alluvial fans and glacial outwash deposits in the Reno area includes more decomposed rock because of longer exposure to weathering processes, and the highest quality gravels are the youngest alluvial deposits associated with the Truckee River.

Volume of Movable Material - In general, a major aggregate deposit must contain millions of tons of movable material (reserves) in order to support long-term return and defray capital start-up costs. Smaller deposits of unique material, however, such as clean beach sand may also be economical. Areas containing deposits smaller than a few million tons generally were not considered to have high potential.

4.2.4 Criteria Differentiating Low - Medium - High Potential

The classification used to differentiate between high, moderate, and low aggregate potential (Plate 2) is explained as follows.

High Potential - Areas where favorability for high quality aggregate deposits (that can be used in Portland cement and asphalt concrete) is high. At least 70 percent of this area is likely to contain high quality aggregate material.

Moderate Potential - Areas where favorability for high quality aggregate deposits (that can be used in Portland cement and asphalt concrete) is fair. Less than 30 percent of this area is likely to contain high quality aggregate material.

Low Potential - Areas where favorability for high quality aggregate deposits (that can be used in Portland cement and asphalt concrete) is low. Less than 10 percent of this area is likely to contain high quality aggregate material.

It should be understood that, because of the limited scope of the field work and the generalizations that are necessary to compile a map at 1:100,000 scale, the boundaries for potential areas are approximate or sometimes speculative. Therefore, there may be portions of high potential areas shown on plate 2 that do not contain high quality material, and there may be some areas within low potential areas that contain excellent aggregate material.

4.2.5 Map Compilation - GIS System

The Nevada Bureau of Mines and Geology (NBMG) Geographic Information Systems (GIS) lab uses work station based ARC/INFO, TINS, and NETWORK on a SUN SPARC II system and PCARC/INFO running on three PC DOS compatible micro computers. The work station operation under SUN OS 4.1.1 has 2.6 gigabytes of dedicated disk space, 2.3 gigabyte and 150 megabyte tape drives, and a CD ROM reader. Digitizing is accomplished via two Calcomp 9500 series digitizing tablets and one 9100 series backlit digitizer. Hard copy map plots are produced using an HP-7585B or HP-7550A pen plotter.

The database used in the preparation of Plate 2 was modified by NBMG personnel from information furnished by Washoe County. Available published geologic mapping that had been previously digitized for use by the County GIS System was used as the geologic base for this study. The aggregate potential areas are generally based on the mapped geologic boundaries but in some areas potential boundaries and mapped geologic boundaries differ substantially. NBMG digitized all aggregate potential boundaries shown on Plate 2.

All data layers that were digitized in-house or modified from existing files were checked for accuracy by staff members that were not involved in the original digitizing process, then edited by project investigators. Project maps can be supplied as hard copy plots or as a digital file. Digital output files can be exported in an ARC/INFO format or USGS DLG3-optional format as well as MOSS, GRASS, TIGER, or ASCII formats.

4.3 Sand and Gravel Potential

4.3.1 High Potential Areas

The vast majority of the high potential sand and gravel reserves in Washoe County are located along, and associated with, the Truckee River drainage as shown on Plate 2. They consist of a minor amount of very recent stream gravels and much more abundant and somewhat older glacial outwash deposits. The glacial outwash was deposited during the most recent glacial advances in the Sierras (10,000 to 100,000 years ago) when abundant melt water was pouring out of the mountains and carrying great volumes of sand and gravel. The Truckee Meadows is mostly underlain by the glacial outwash deposits and if it weren't for the presence of urbanized areas the high potential area would include most of the valley (Plate 2). All of the abandoned sand and gravel deposits in the Truckee Meadows were in these glacial outwash deposits; examples are the Helms pit in Sparks, Nevada Aggregate's old pit at the site of the Hilton (alias Bally's, alias MGM), and Paradise Pond. In addition, most of the sand and gravel presently being mined along the river to the east of Sparks includes glacial outwash material (Granite's Patrick Pit, Helm's 102 Ranch Pit, and the Paiute Pit near Wadsworth).

Other high potential sand and gravel include old beach deposits associated with extinct Pleistocene lakes. Sand and gravel deposition in these lakes coincided with the relatively wet climates of past glacial periods. Wave action along some shorelines washed and concentrated sands along beaches or in sand bars. There are three examples of this type of high potential sand and gravel deposit in southern Washoe County: the Sha-Neva sand pit in Lemmon Valley, and similar sand bars in Cold Springs and on the north end of Washoe Lake (Plate 2).

4.3.2 Moderate Potential Areas

Areas of moderate potential for sand and gravel include some of the older glacial outwash, alluvial fans emanating from high potential bedrock sources, certain landslide deposits on Slide Mountain, and a probable sand bar deposit. Most of the areas of moderate potential for sand and gravel contain alluvial fan deposits emanating from high potential bed rock sources. It is logical to assume that if a rock unit can furnish high quality aggregate then the erosional material derived from it may be able to furnish at least a moderate quality material as long as it is not contaminated with low

quality material. The alluvial fan deposits are rated as moderate potential because they generally contain abundant fine material. The older glacial outwash deposits are classified as moderate potential because in the geologic literature they are described as having some decomposed clasts. Landslide deposits on Slide Mountain are believed to have moderate aggregate potential because they were naturally washed and abraded during flow down the mountain. In addition, a sand bar that was interpreted (from aerial photographs) to be present north of Lemmon Valley is also considered to have moderate potential.

4.3.3 Low Potential Areas

Low potential areas for sand and gravel include most of the alluvium in the County, which mainly occurs in the form of alluvial fans. The low potential alluvial fans, for the most part, contain clasts of rock which are not themselves high quality material. They may be deeply weathered and may contain abundant clays which are detrimental to aggregate production or coat more competent particles.

Playa deposits, old lake deposits and Tertiary sediments are also included in low potential sand and gravel. These are primarily fine grained, consisting of fine sands, silts, and clays which are not suitable for use as aggregate. The sediments of old Lake Lahonton between Wadsworth and Pyramid Lake are included in this classification. Exposures of Tertiary sediments which are scattered throughout the County are lithologically variable, and include diatomite, dirty sandstones, and mudstones, but do not contain appreciable amounts of high quality aggregate.

4.4 Bedrock Potential

4.4.1 High Potential Areas

High potential bedrock covers approximately 10 percent of southern Washoe County. The rock types are mostly volcanic rocks, consisting primarily of basalts, or are metamorphic rocks. There are minor amounts of high quality igneous rocks.

The basalts occur in the Pah Rah Range just to the northeast of Sparks, near the top of the Carson Range north of Mount Rose, and in the Truckee Range along the eastern border of the County

north of Fernley. The basalts are relatively young, dense, fine-grained, dark colored rocks. The largest and most easily accessible area of basalts is that in the Pah Rah Range just north of the Truckee River and east of Sparks, while the other large areas of high potential volcanic rock have more difficult access. Rillite Aggregate's semi-lightweight rhyolite deposit to the east of Steamboat is shown as high potential because it is used extensively in Portland cement concrete. Similar rhyolites to the east of Sparks also have a high potential designation.

Metamorphic rocks demonstrating high potential are found primarily on Peavine Peak, immediately northwest of Reno, and in the Cold Springs area near the California state line. The high potential rocks consist of both metavolcanic and metasedimentary units. A small area of metamorphic rocks has previously been mined for aggregate near Steamboat Springs.

The only igneous plutonic rock in southern Washoe County that has a high potential designation is quartz diorite (a granitic-type rock) which is found north of the Reno-Sparks area. The Rocky Ridge quarry in Spanish Springs Valley is in this material.

4.4.2 Moderate Potential

Moderate potential bedrock units consist of volcanic and granitic rocks. The volcanic rocks are mainly basalts and andesites, and are found primarily south and east of the Truckee Meadows. The moderate potential granitic rocks are found primarily to the southwest in the Carson Range at higher elevations.

4.4.3 Low Potential Areas

The low potential bedrock units in southern Washoe County consist of weathered granites, hydrothermally altered bedrock, and volcanic sequences that consist mainly of either tuffs or breccias. These rock types dominate the bedrock units to the north of the Reno-Sparks area and in the Pyramid Lake area. There are vast areas of the County where weathered granitic rocks could furnish considerable amounts of DG that can be used as fill but not as high quality construction aggregate.

5.0 ECONOMIC POTENTIAL

5.1 Criteria

The criteria or variables used to prepare the economic potential overlay (Plate 3) include the potential areas as shown on Plate 2 (and as simplified on Figure 3) as well as the economic factors that influence the cost of mining and delivering aggregate to the market place. The five criteria, as described below, were chosen as those having the highest influence on economic potential and each criteria is represented by a working GIS generated map (Figures 3 through 7). The various map units were assigned numerical values, as described below, and the Economic Potential Map was generated utilizing the formula described in Section 5.2. The criteria do not include, nor are they influenced by, incompatible use areas other than urbanized areas.

1. Aggregate Potential (P)

The aggregate potential map (Plate 2) was the basis for input on this criterion (see Figure 3). Obviously, areas of high potential bedrock and sand and gravel are considered the most important areas in terms of economic potential because those areas are thought to have the highest favorability for aggregate production. It does not matter, for instance, how close a low potential area is to the market; if there is no high quality aggregate present, other economic factors can not make low quality into high quality aggregate.

Bedrock is generally more expensive to mine because it is necessary to drill and blast the material or to use heavy equipment to rip it. Sand and gravel costs less to mine because it is less consolidated. For the purpose of determining economic potential, the aggregate potential classifications shown on Plate 2 were ranked as follows:

CLASSIFICATION	RANK
High potential, sand and gravel	6
High potential, bedrock	5
Moderate potential, sand and gravel	4
Moderate potential, bedrock	3
Low potential, sand and gravel	2
Low potential, bedrock	1

2. Distance from Reno-Sparks Market Area (D)

The intersection of highways I 80 and U.S. 395 was chosen as the center of the Reno-Sparks market area. From this central point, circles with radii that varied in 10-mile increments were utilized to define four zones representing transportation costs for aggregate products delivered into

the city (see Figure 4). The outermost zone extends to the furthest point in the study area from the central point chosen. It should be noted that aggregate consumed in the Reno-Sparks area currently comes from sources that are spread throughout the three closest zones (see Plate 1). For the purpose of determining economic potential, the distance zones were ranked as follows:

ZONE	RANK
0-10 miles	4
10-20 miles	3
20-30 miles	2
30-40 miles	1

3. Distance from Major Roads (R_1)

Using amended GIS data on road locations provided by Washoe County, buffer zones were constructed around major roads to delineate proximity to available transportation routes (see Figure 5). In addition to the distance from the market, this variable is a major influence upon transportation costs for aggregate delivery.

For the purpose of determining economic potential, the distance of an area from major roads was ranked as follows:

DISTANCE	RANK
0-1 mile	4
1-2 miles	3
2-3 miles	2
3-4 miles	1
4+ miles	0

4. Distance from Minor Roads (R_2)

Using amended minor road GIS data provided by Washoe County, buffer zones were also constructed around minor roads (see Figure 6). This variable is a major influence upon development costs leading to aggregate production. For the purpose of determining economic potential, the distance of an area from minor roads was ranked identically to the ranking for major roads.

5. Elevation (E)

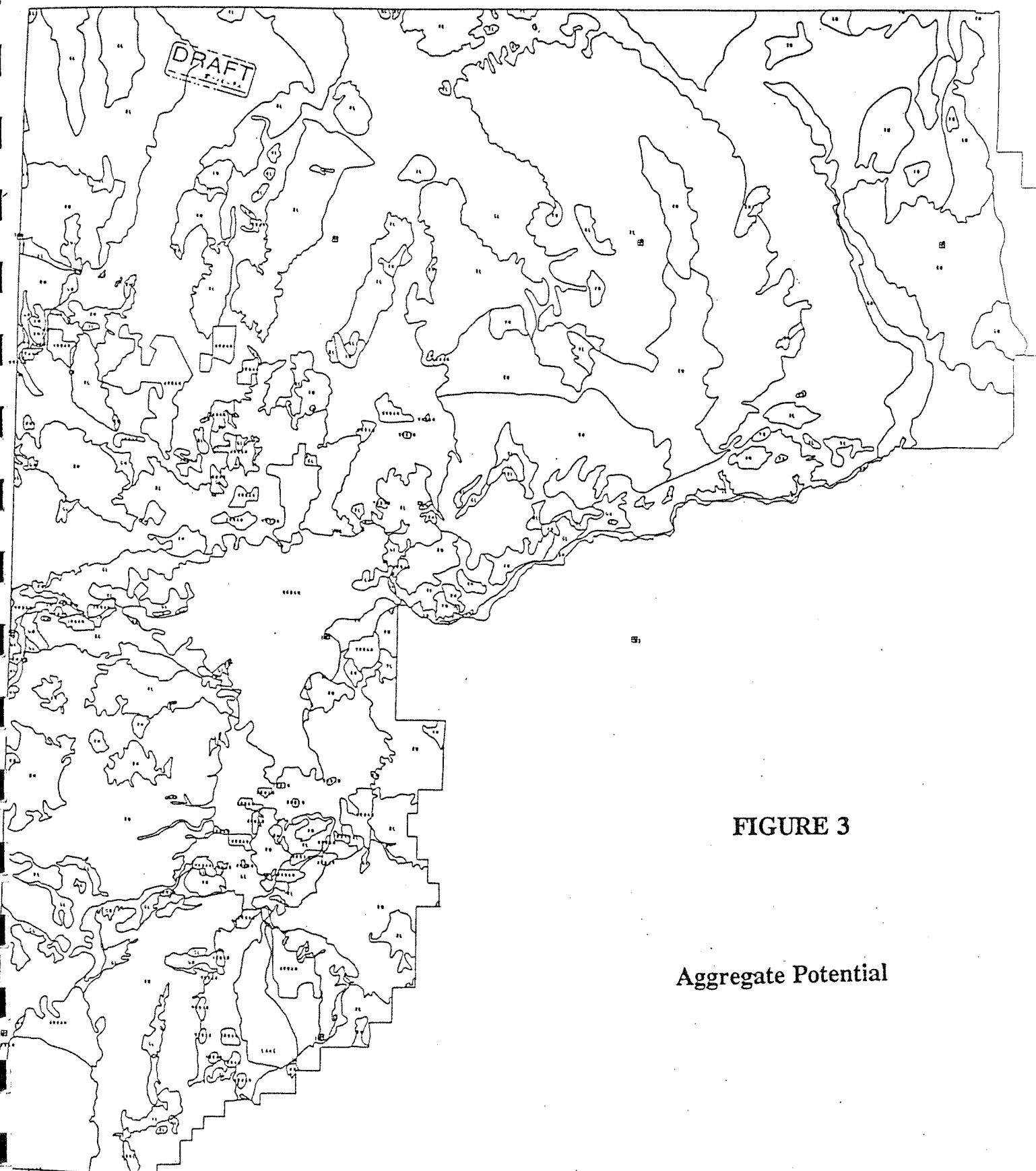
Higher elevations in mountainous terrain surrounding the Reno-Sparks area (see Figure 7) are disadvantageous to aggregate mining. Weather conditions at high elevations may preclude mining during winter months because of excessive moisture, low temperature effects on equipment and high snow removal costs. In addition, haulage from high elevations is more expensive because of steep grades, abundant curves, and generally greater travel time. For the purpose of determining economic potential, elevation of an area was ranked as follows:

ELEVATION	RANK
0-6500 feet	2
6500 + feet	1

5.2 Generation of the Economic Overlay (Plate 3)

The economic overlay (Plate 3) was constructed by NBMG GIS personnel utilizing the criteria (or variables) described in Section 5.1 and presented in Figures 3 through 7. Files containing ranked polygons for each criterion were combined using the formula $EP = P(2D + 0.5R_1 + 0.5R_2 + E)$ where EP is the economic potential for aggregate production. The highest possible EP score for any area is 84 and the lowest is 3. The highest half of the calculated economic potential scores were subdivided into three approximately equal categories representing areas with very high, high, and moderate potential which were then color coded and shown on Plate 3. Areas that scored in the lower half of the economic potential range are shown on Plate 3 as areas with low economic potential for aggregate.

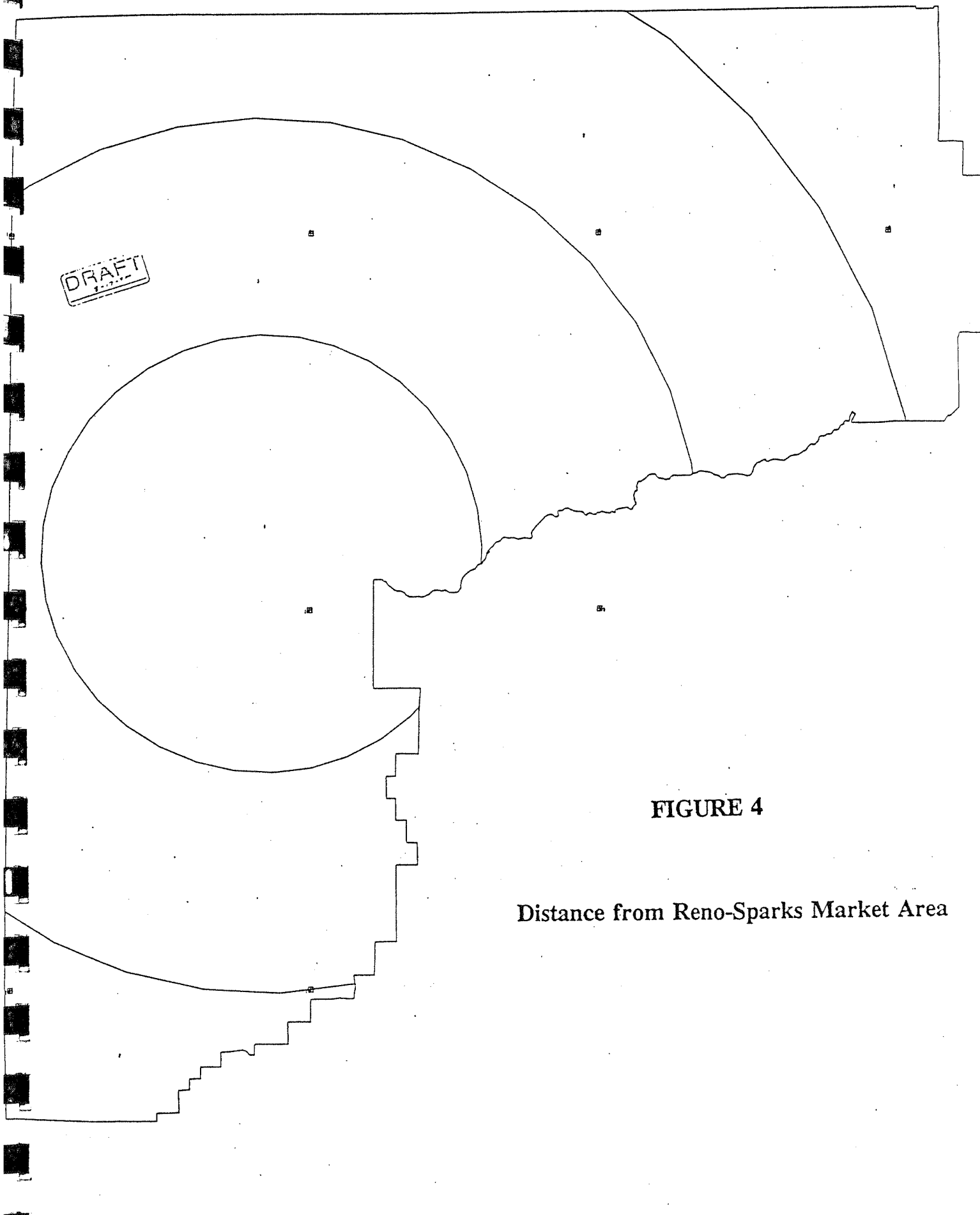
The results of the economic analysis, as shown on Plate 3, are strongly influenced by the aggregate potential (P) as shown on Plate 2 and Figure 3. Uncertainties that are inherent in delineating aggregate potential will therefore carry over into economic potential. Consequently, economic deposits of high quality aggregate may occur within areas shown as having low economic potential on Plate 3, and all of the material within areas of high economic potential will not necessarily be usable as high quality construction aggregate.



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FIGURE 4

Distance from Reno-Sparks Market Area



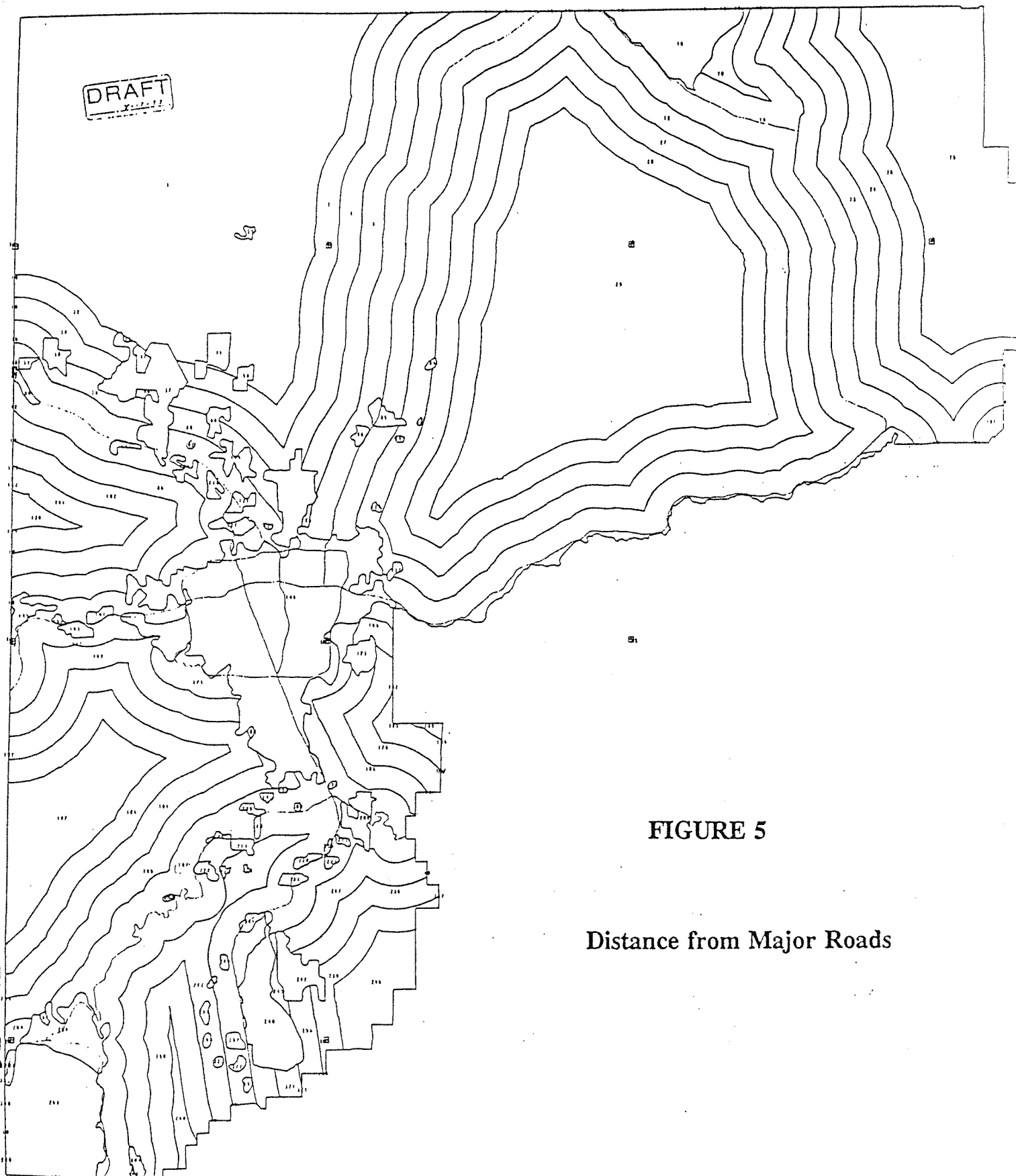


FIGURE 5

Distance from Major Roads

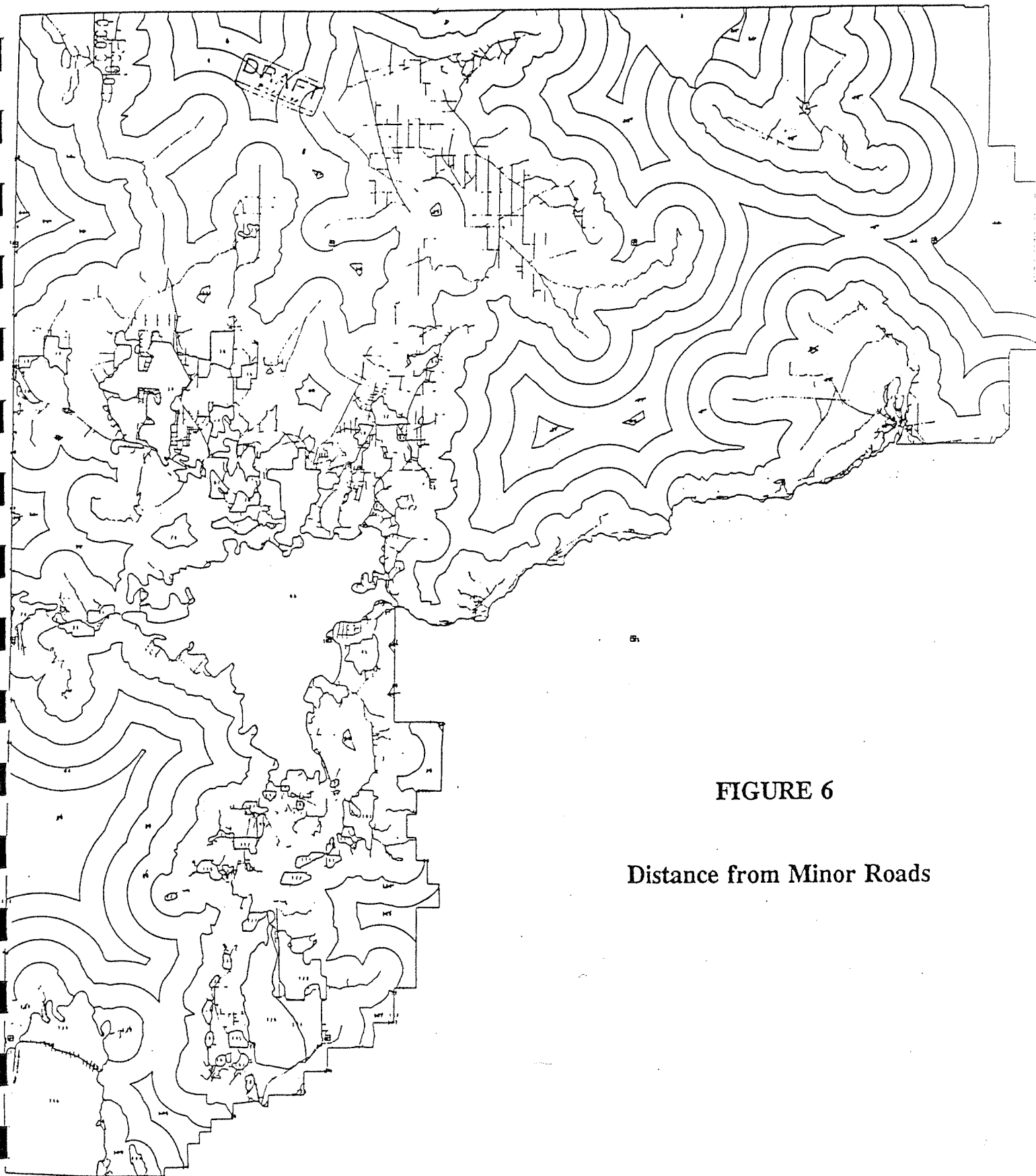


FIGURE 6

Distance from Minor Roads

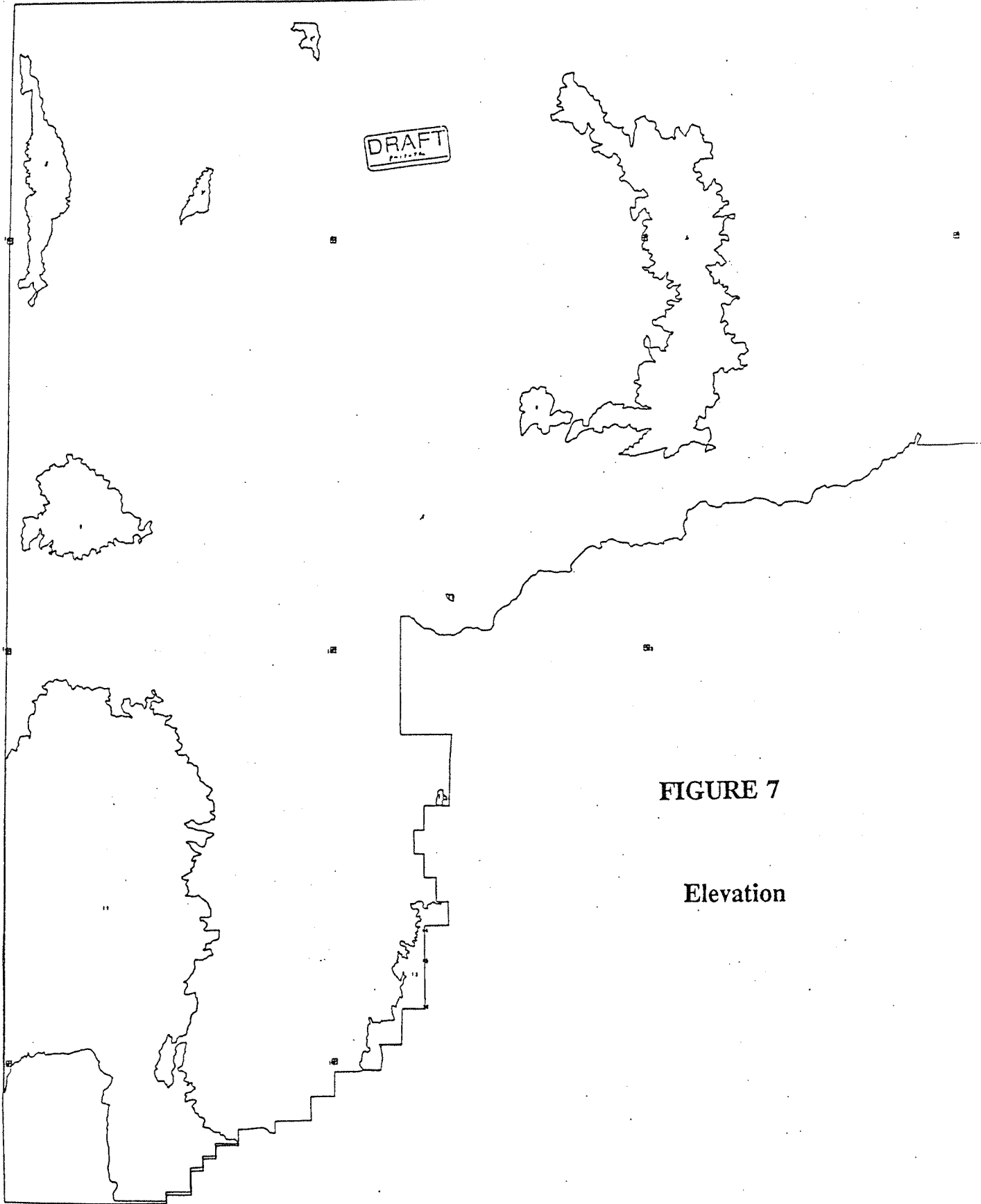


FIGURE 7

Elevation

6.0 CONCLUSIONS

The Aggregate Resources Study for Washoe County consisted of identifying the present aggregate suppliers to the Reno-Sparks metropolitan area (including both those within Washoe County and outside Washoe County), determining present and future consumption rates, mapping southern Washoe County's aggregate potential, identifying general economic factors which would impact on that potential, and preparing an economic favorability map for aggregate. Conclusions that can be derived from the study are as follows:

SUPPLIERS AND PRESENT & FUTURE CONSUMPTION RATES

1. There are currently seven principal aggregate suppliers for the Reno-Sparks area, one of which is located outside the County. In addition there are numerous smaller suppliers.
2. In 1991, Washoe County consumed between 3.5 and 4.0 million tons of aggregate for a consumption rate of approximately 14 tons per person.
3. Principal aggregate products are Portland cement concrete aggregate, asphalt concrete aggregate and aggregate base.
4. Aggregate consumption in 20 years (2012) should be approximately 50 percent higher at 5.5 to 6.0 million tons per year, assuming that the per capita consumption rate remains the same.
5. Approximately 100 million tons of aggregate is projected to be needed to satisfy demand in the Reno-Sparks area during the next 20 years. Although combined reserves of the current major aggregate suppliers are probably sufficient, a more detailed physical evaluation program would be necessary to prove the quality and quantity of material. Some of the current major producers do not have sufficient reserves to last 20 years, and plan to identify and develop new sources. In addition, reserves at currently productive deposits cannot be taken for granted because they are not "permitted" reserves, specifications may change, the economic and political climate may not favor further mining at these locations, conflicting land uses, and environmental concerns may preclude mining and the cost of meeting government regulations may be too high.

POTENTIAL FOR AGGREGATE RESOURCES

1. There are sufficient reserves of high quality, undeveloped aggregate resources in southern Washoe County to satisfy future demand well into the 21st century.
2. Economic considerations in developing future aggregate resources indicate that reserves of high quality construction aggregates do exist in economically favorable locations to satisfy demand far beyond the next 20 years.

3. The unpredictable factor affecting the use of these aggregate resources in the future is accessibility. Economic, environmental and political pressures on the aggregate mining industry could preclude much or even possibly all of the identified high quality aggregate from being used in the future.
4. To assure that the community has ample supplies of high quality, reasonably priced aggregate for the future, it is prudent to plan ahead, recognizing the need for an economical supply of construction aggregates.

PLATE 1 EXPLANATION



Shading represents urbanized areas within county. Information provided by Washoe County Department of Development Review and accurate as of 1991.

MAP NO.	OWNER OR PRODUCER	PIT NAME	WASHOE CO. PERMIT NO.	COMMENTS
MAJOR PRODUCER = Active pit that produced over 100,000 tons of product in 1991 excluding borrow material. <input checked="" type="radio"/> Active <input type="radio"/> Inactive				
1	Sha-Neva, Inc.	Hungry Valley	SPB5-12-89	
2	Granite Construction Company	Patrick	SP-8-64W SP-47-80W	Operating Batch Plant
3	Robert L. Helms Construction & Development Co.	102 Ranch	SPB11-46-85	
4	Rocky Ridge, Inc.	Spanish Springs	MPR7-6-88 SPB9-39-84	Operating Batch Plant
5	Rilite Aggregate Company	Rilite Aggregate	SP-34-76W	
6	Paiute Pit Aggregates	Paiute	Nonconforming use	
MINOR PRODUCER = Active pit that is believed to have produced less than 100,000 tons of material in 1991 excluding borrow material, permitted inactive pits are also included. <input checked="" type="radio"/> Active <input type="radio"/> Inactive				
7	Robert L. Helms Construction & Development Co.	102 North	MPR10-6-90	Future Source
8	Sha-Neva, Inc.	Lemmon Valley	SP30-65-W	
9	Granite Construction Company	Lockwood	SPB 6-18-86 SPB 3-3-82 SPB 3-9-82	Batch Plant Permitted
10	Sha-Neva, Inc.	Mustang Basalt	SPB9-32-84 SPB3-6-82	Currently inactive Permitted for Batch Plant
11	Rocky Ridge, Inc.	Mustang Rhyolite	SPB824-84	Currently Inactive
12	Robert L. Helms Construction & Development Co.	Sparks	SP26-68W	Operating Batch Plant Pit inactive
13	Smith Family Trust	Wadsworth	SPB3-4-82 SPB3-5-82	
14	Eagle Valley Construction	Mt. Rose Quarry	SPB5-23-85	Permit Expired - Inactive
15	Seaberry Depoail	Patrick Sand	Nonconforming	Topsoil Only
16	Washoe County	Silver Knolls	SP-28-77W	
17	Granite Construction Company	Bella Vista	Nonconforming	
18	NDOT	Mira Loma	SPB6-17-82	
PRODUCER OUTSIDE OF WASHOE COUNTY = Active pit that delivers material into Washoe County and inactive pits likely to be reactivated that have been known to deliver material into Washoe County in the past. <input checked="" type="radio"/> Active <input type="radio"/> Inactive				
19	All Lite	Washington Hill	N/A	Major Producer
20	Tedford	Hazen Pit	N/A	
21	Storey County Properties	Old Golden West Pit	N/A	Currently Inactive
22	Rocky Ridge, Inc.	Carson Cinder	N/A	Currently Inactive
23	Nick Mansfield	Sand Pit	N/A	
24	Peri Brothers	Lockwood	N/A	Currently Inactive
KNOWN BORROW PITS (MAY OCCASIONALLY PRODUCE AGGREGATE BASE OR BEDDING SAND) = Borrow pits with recent activity and/or with non-expired Washoe County special use permits. <input checked="" type="radio"/> Active <input type="radio"/> Inactive				
25	U.S.F.S.	Mt. Rose Common Use Area	N/A	DG, to be closed 6/92
26	Sha-Neva, Inc.	Golden Valley DG	Nonconforming	
27	Robert L. Helms Construction	Rail Road Property DG	SP23-81W	
28	Eagle Valley Construction	Mt. Rose DG	SPB5-22-85	Permit Expired - Inactive
29	Washoe County	Sun Valley	N/A	DG
30	Donovan		Nonconforming	
31	BLM	Red Rock Common Use Area	N/A	
32	Washoe County	Jumbo Grade	N/A	DG
33	Red Rock Owners Association		SPB6-17-83	Inactive
34	NDOT		SPB6-18-82	Inactive
35	NDOT		SPB-70W	Inactive
36	NDOT		SPB2-4-84	Inactive
37	NDOT		SPB6-77W	Inactive



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APPENDIX A

AGGREGATE RESOURCES STUDY
WASHOE COUNTY, NEVADA

PRODUCER'S QUESTIONNAIRE
APRIL 28, 1992

1. Aggregate Producer's Name: _____
2. Mailing Address: _____
Phone: _____
3. Aggregate Pit Name: _____
4. Pit Location: _____
5. If within Washoe County:
Section _____ Township _____ Range _____
Is the pit under a Special Use Permit? _____ or a non-conforming use? _____
Special Use Permit Case No. _____
Use Permit Expiration Date _____
Will you reapply after expiration? _____
6. Pit Currently Active? _____ Inactive? _____
7. If inactive are there plans to reactivate? _____
8. Land Ownership: Private Property? _____
Property ownership (if other than Producer)

Federal Property? _____ Which Agency? _____

PRODUCTION INFORMATION

The following information may be as specific as you deem appropriate. Only fill in those areas that are pertinent to your operation.

9. If you give specific information do you want it kept confidential? Yes _____ Not Necessary _____
(If to be kept confidential, the information will only be used for generalized production data and grouped with others. Please identify the specific information you would like to be kept confidential).
10. Approximate number of employees involved with the aggregate operation exclusive of batch plants or trucking

11. Please fill in the following production information:

MATERIAL	PRODUCTION DATA (TONS)		
	1991	ESTIMATED AVERAGE PRODUCTION DURING PREVIOUS 5 YEARS	ESTIMATED 1992
Aggregate Base			
Asphalt Aggregate			
Bedding Sand			
Concrete Aggregate Coarse Fine			
Drain Rock/Rip-Rap			
De-icing Sand			
Ornamental/Landscape Products			
Fill/Borrow			
Other			
TOTALS			

12. What percentage of the above total production is used within Washoe County? _____

13. Approximate Reserve Estimate in tons: _____

14. Life of Deposit based on Average Yearly Production: _____

15. If you have an aggregate processing plant on site, what is its capacity, in tons per hour? _____

16. Is an expansion in production capability planned? _____

17. If the life of your aggregate source is limited, are you planning to find and develop another source once your current resource is depleted? _____

18. Is there a special use permit for an Asphalt Plant at the pit location? _____

19. Is there a special use permit for a Concrete Plant at the pit location? _____

20. Do you have an Asphalt Batch Plant off-site that uses material from this site? _____

21. Do you have a Concrete Batch Plant off-site that uses material from this site? _____

AGGREGATE DEPOSIT DESCRIPTION

22. Sand & Gravel Deposit? _____ Bedrock Source? _____
23. If Bedrock what type of Rock? _____
(Basalt, Rhyolite, Granite, DG, etc.)
24. Does the material meet NDOT, Washoe County, and ASTM Specifications for asphalt aggregate?

25. Does the material meet NDOT, Washoe County, and ASTM Specifications for concrete aggregate? _____

26. Are there any deleterious constituents in the material that either have to be avoided or which are processed out of the finished product? _____

27. Do you have to wash some of your material to get it into specification? _____
28. What is your source of water? _____
29. Approximately how much water (gallons) do you consume on a daily basis for washing and for dust control when you are operating? _____

30. Please estimate the amount of your total product that goes to the various consumers as outlined below.

CONSUMER	APPROXIMATE PERCENT OF TOTAL PRODUCTION
In-house or affiliated companies	
Private Contractors	
City of Reno and City of Sparks	
Washoe County	
State of Nevada (NDOT)	
Federal Agencies (BLM, USFS, etc.)	
Public Utilities	
Other:	
Other:	

MISCELLANEOUS INFORMATION

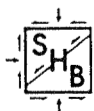
31. Do you haul your own material? _____ Use Others for hauling? _____ Both? _____
32. What is the average transportation time (round trip) to deliver your product into a central location in the Reno-Sparks area? _____
33. What is the tonnage of the typical load delivered? _____
34. What are the current selling prices of your products?

	F.O.B. PIT	DELIVERED TO RENO/SPARKS
Concrete Aggregate		
Concrete Sand		
Asphalt Aggregate		
Aggregate Base		
Fill Material		

Thank you very much for your cooperation in this Questionnaire. Do you have any other comments concerning this questionnaire? _____

Please mail your response in the envelope provided by May 8, 1992.

Mail To: SHB Engineers
737 E. Glendale Avenue
Sparks, Nevada 89431



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APPENDIX B

KNOWN & POTENTIAL PRODUCERS OF RECORD (As modified from information provided by Washoe County)

CONTACTED FOR STUDY y=yes n=no	OWNER OR MOST RECENT OPERATOR ADDRESS	CONTACT	AGGREGATE PIT	WASHOE COUNTY USE PERMIT NO.	STATUS
Y	Robert L. Helms Construction & Development Co. Drawer 608 Sparks, Nevada 89432	Bobby Morrison	102 North 102 Ranch Sparks Sec. 9, T20N, R20E	MP10-6-90 SPB11-46-85 SP-26-68W SP-23-81W	Active Active Batch Plant Active
Y	Granite Construction P. O. Box 2087 Sparks, Nevada 89432	Jim Roberts	Patrick Bella Vista	SP-8-64W WP-47-80W Noncon. use	Active Batch Plant Active
Y	Paiute Pit Aggregates P. O. Box 159 Wadsworth, Nevada 89442	Dave Hamelton	Paiute Pit	Noncon. use	Active
Y	Rilite Aggregate Co. P. O. Box 11767 Reno, Nevada 89510	Bruno Benna	Rilite Aggregate	SP-34-76W	Active
Y	Rocky Ridge, Inc. 10655 Sha-Neva Rd. Truckee, CA 96161	Pat Shane	Spanish Springs DG Mustang Rhyolite Spanish Springs Carson Cinder Batch Plant Site	SPB-39-84 SPB8-24-84 MPR7-6-88 N/A SPB3-6-82	Active Inactive Active Inactive Batch Plant
Y	Sha-Neva, Inc. 10655 Sha-Neva Rd. Truckee, CA 95734	Pat Shane	Lemmon Valley Golden Valley DG Hungry Valley Mustang Basalt	SP-30-65W None SPB5-12-89 SPB9-32-84	Active Active Active Inactive
Y	Seaberry Depaoli 1420 Deming Way Sparks, Nevada 89431	Fred Depaoli	Patrick Sand		Active
Y	All Lite Aggregates 2302 Larkin Circle Sparks, Nevada 89431	Bill Pautler	Washington Hill	N/A	Active
Y	Jack Tedford, Inc. P. O. Box 1505 Fallon, Nevada 89406	Jack Tedford	Hazen	N/A	Unknown
N	Reno-Sparks Disposal		Sec 4, T19N, R20E	SP-10-66W	Abandoned
N	Casci		Sec 11, T19N, R20E (off Vista)	SP-11-74W	Abandoned
N	Cameron		Sec 17, T23N, R21E (near Warm Springs Val- ley)	SP-35-74W	Abandoned

CONTACTED FOR STUDY y=yes n=no	OWNER OR MOST RECENT OPERATOR ADDRESS	CONTACT	AGGREGATE PIT	WASHOE COUNTY USE PERMIT NO.	STATUS
N	Garson		Sec 16, T19N, R18E	SP-19-76W	Abandoned
N	Pagni		Sec 13, T27N, R19E (Pleasant Valley)	SP-22-76W	Abandoned
N	McLeod		Sec 18, T19N, R19E (Chalk Bluff)	SP-5-77W	Abandoned
Y	Red Rock Estates Property Owners Association P.O. Box 10606 Reno, NV 89509		Sec 21 & 28, T22N, R19E	SPB6-17-83	Unknown
Y	Smith Family Trust P.O. Box 8266 Incline Village, NV 89450	Lee Smith	Sec 3, T20N, R24E Sec 3, T20N, R24E	SPB3-4-82 SPB3-5-82	Active Active
N	Josey Kean		Sec 4, T19N, R21E	SPB11-40-83	Inactive
N	Lands of Sierra	Sam S. Arentz III	Sec 28 & 29, T20N, R22E (Tracy)	SPB9-33-84	Unknown
Y	T.K. Meredith 1210 Kleppe Lane Sparks, NV 89431 (operated by Granite)	T.K. Meredith	Lockwood Pit Sec. 17, T19N, R21E	SPB3-2-82 SPB3-9-82 SPB6-18-86	Active Batch Plant Active
Y	Washoe County		Sec 14, T21N, R18E	SP-28-77W	Inactive
Y	Dept. of Transportation 1263 South Stewart St. Carson City, Nevada 89712	Dave Cochran	Mira Loma Sec 29, T20N, R22E Sec 14, T19N, R20E Sec 17, T19N, R19E Sec 15 & 22, T21N, R20E Sec 22, T20N, R19E	SPB6-17-82 SPB2-4-84 SPB6-18-82 SPB6-77W SP-8-70W None	Inactive Inactive Inactive Inactive Inactive Inactive
Y	Eagle Valley Construction Co. 5894 Sheep Carson City, NV 89701	Ron MacIntosh	Sec 31, T18N, R20E Sec 6, T17N, R20E	SPB5-22-85 SPB5-23-85	Expired Expired
Y	Bureau of Land Management 1535 Hot Springs Road Carson City, NV 89702	Dan Jacquet/ Ron Moore	Red Rock Common Use Area	None	Active
Y	Basalite 355 Greg Street Sparks, Nevada	Bill Booth	Naturalite Pit	N/A	Unknown
Y	USFS - Toiyabe National Forest Carson Ranger District 1536 S. Carson Street Carson City, NV 89701		Mt. Rose Community Pit Sec 36, T18N, R19E 7th Street Pit Sec 31, T20N, R19E	None	Active Abandoned
N	Lemmon Valley Land Co.	George Peek	DG Pit	SP-26-66W	Abandoned

CONTACTED FOR STUDY y=yes n=no	OWNER OR MOST RECENT OPERATOR ADDRESS	CONTACT	AGGREGATE PIT	WASHOE COUNTY USE PERMIT NO.	STATUS
Y	Washoe County	Gene Martens	Silver Knolls Winneucca Ranch Road Cold Springs Sun Valley Jumbo Grade	SP-28-77W None None None None	Active Active Active Active Active
Y	Donovan		Borrow Pit	Noncon. use	
Y	Nick Mansfield		Sand Pit	N/A	Active
	Peri Brothers		Lockwood Pit	N/A	Inactive
	Storey Co. Properties		Old Golden West Pit	N/A	Inactive
Notes: 1. BLM Pits were generally reported under operator. 2. For locations of Aggregate Pits refer to Plate 1.					



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APPENDIX C

PRINCIPLE AGGREGATE PRODUCER PROFILES

1. Robert L. Helms Construction & Development Company
Drawer 608
Sparks, Nevada 89431

Description: Helms, one of the largest general contracting companies in the Reno/Sparks area, has historically been one of the largest aggregate producers. Currently, Helm's largest aggregate source is located about 15 miles east of Reno and is known as the 102 Ranch Pit. The 102 Ranch Pit is permitted to have an asphalt hot plant and a concrete batch plant, however it is believed that Helms primarily uses batch plants at their Sparks location at this time.

2. Granite Construction Company
P. O. Box 2087
Sparks, Nevada 89432

Description: As one of the largest general contractors in the Reno/Sparks area, Granite produces considerable quantities of asphalt aggregate and aggregate base. Granite's primary aggregate source is located east of Sparks at Patrick where a sand and gravel source is mined. In 1991, mining was initiated across the Truckee River in Storey County but all processing still takes place in Washoe County. Asphaltic concrete is produced at their Sparks plant and their Patrick pit. Granite also operates the Bella Vista Pit.

3. Rilite Aggregate Company
P. O. Box 11767
Reno, Nevada 89510

Description: Rilite operates a pit known as the Rilite Aggregate Pit located southeast of Reno. The deposit consists of rhyolite and basalt from which a variety of aggregate products are produced. The rhyolite, which is lighter in weight than most rock types mined in the Reno area, is used by companies affiliated with Rilite to produce concrete which is often used in high rise buildings because of its favorable semi-lightweight quality.

4. Sha-Neva, Inc./Rocky Ridge, Inc.
10655 Sha-Neva Road
Truckee, California 96161

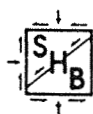
Description: Sha-Neva, Inc. and Rocky Ridge, Inc. are sister companies which combined produce substantial quantities of aggregate in the Reno/Sparks area. Sha-Neva's primary aggregate operation is in the Lemmon Valley area where a sand source is mined. Sand from this site is known to be unique in this area because of its very low dust content. Rocky Ridge's primary pit in the Reno/Sparks area is located in Spanish Springs. Aggregate from this pit is used for a variety of aggregate products including aggregate base, asphalt aggregate and concrete aggregate.

6. **Paiute Pit Aggregates**
P. O. Box 159
Wadsworth, Nevada 89442

Description: Located on the Paiute Indian Reservation near Wadsworth, Nevada, Paiute Pit Aggregates produces aggregate products from a sand and gravel source. The vast majority of their production goes into concrete sand and rock which is sold to ready mix companies in the Reno/Sparks area. However, the Paiute Pit operation can produce all of the standard aggregate products.

7. **All-Lite Aggregates**
2302 Larkin Circle
Sparks, Nevada 89431

Description: All-Lite Aggregates operates a pit in Storey County in the Washington Hill area south of Lockwood. Virtually all the production from this pit is delivered to the Washoe County area. The source is a rhyolitic dome from which a semi-lightweight concrete aggregate is produced that is sold to local ready-mix companies. A variety of other aggregate products are produced at the site.



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APPENDIX D

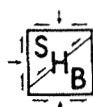
LIST OF INDIVIDUALS WHO WERE INTERVIEWED, OR WHO RETURNED QUESTIONNAIRES

NAME	AFFILIATION
Donovan, Richard	R.T. Donovan
Tedford, Jack Jr.	Jack N. Tedford, Inc.
Elkins, John	Granite Construction
Elkins, Barbara	Granite Construction
Morrow, Ed	Asamera, Inc.
Shane, Pat	Sha-Neva, Inc.
Parker, Jim	Meredith - Parker
Cochran, Dave	Nevada Dept. of Transportation
Herschbach, Bob	Sierra Stone
Benna, Bruno	Rilite Aggregate Company
Carrillo, Fred	U.S. Bureau of Mines
Steward, Larry	U.S. Bureau of Land Management
Moore, Ron	U.S. Bureau of Land Management
Jacquet, Dan	U.S. Bureau of Land Management
Caster, Steve	Nevada Bureau of Mines & Geology
Rucknagel, Eric	Bureau of Business & Economic Research, UNR
Willett, Mary	Sierra Pacific Resources
Hamelton, Dave	Paiute Pit Aggregates
Morrison, Bob	Robert L. Helms Construction & Development Company
Green, Clint	Robert L. Helms Construction & Development Company
Martens, Gene	Washoe County, Dept. of Develop. Review
Pautler, Bill	Sierra Stone
Peek, George	Lemmon Valley Land Company

APPENDIX D (CONT'D)

LIST OF INDIVIDUALS WHO WERE INTERVIEWED, OR WHO RETURNED
QUESTIONNAIRES

[illegible]



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April 14, 1992

EXHIBIT A

SCOPE OF WORK

AGGREGATE RESOURCE STUDY
WASHOE COUNTY, NEVADA

Scope of Work

	Percent of Total Study	Estimated Dollar Equivalent*	Task	Approximate Duration	Proposed Completion Date**
Phase Ia	15.0	\$6,750.00	Develop Consumption Rate		
Phase Ib	2.5	1,125.00	Identify Location Criteria (5%)	6 weeks	June 1
Phase IIa	42.5	19,125.00	Locate Aggregate Resources		
Phase IIb	15.0	6,750.00	Economic Consideration	7 weeks	July 14
Phase III	7.5	3,375.00	Final Report	4 weeks	August 15
Phase IV	17.5	7,875.00	Assist in Identifying Impacts and Mitigation	----	
	100.0	\$45,000.00			

* Assumes total contract of \$45,000.00

** Assumes contract signed and work begins by April 14, 1992

- Note:
- 1 Individual phases may be initiated prior to completion of phases listed earlier with the agreement of department and committee.
 - 2 "Department" as referred to herein means Washoe County's Department of Development Review
 3. "Committee" as referred to herein means Washoe County's Aggregate Resource Planning Committee

PHASE Ia

DEVELOP ESTIMATES OF CURRENT AND PROJECTED AGGREGATE CONSUMPTION

Develop a current annual per capita consumption rate of aggregate use in Washoe County. The consumption rate shall then be applied to growth projections for the county to help determine future needs for aggregate resources for the 20-year horizon.

- Current production will be determined by consultation with industry sources, published information or other applicable means.
- Types of aggregate materials by use will be identified and described by importance.
- Ordinary "borrow" material will be discussed and usage estimated but the major focus will be on the higher quality aggregate products i.e. aggregates for concrete, asphalt, base material, etc.
- Aggregate producers outside the County who contribute to the supply within the County will be included in this phase of the study.

County Support: The department will provide current and projected land use and population estimates. The department will also provide a base map at a scale of 1:100,000 utilizing the GIS System. The map will include coverage of the entire area of the study, have a Township grid showing sections, urbanized areas and other agreed upon cultural features. The map will be compatible for use with the Nevada Bureau of Mines and Geology GIS System.

Estimated Proportion of Work Program: 15%

PHASE Ib
IDENTIFY CRITERIA FOR LOCATING POTENTIAL AGGREGATE RESOURCES
IN WASHOE COUNTY

The consultant, in conjunction with the department and the committee, will develop the criteria with which aggregate resources will be identified in the county. The identification of potential aggregate resources will take into consideration some of the factors noted below:

- Washoe County only
- Northern limit of study approximately south end of Pyramid Lake
- Identify areas not suitable for aggregate mining such as incompatible uses, i.e. urbanization, parks, wilderness, etc. that would not be included in the study
- Inclusion of potential sources on both public and private lands
- Inclusion of Indian Reservation land
- Scenic corridors, cultural resources, and certain other incompatible uses will not be taken into consideration in the identification of potential resources during this phase of the study.

County Support: The department will provide maps on the GIS System showing incompatible uses.

Estimated Proportion of Work Program: 2.5%

Phase I Conclusion: Present a draft report on current and projected aggregate consumption and criteria for locating potential aggregate resources to the department and committee at a review meeting. This will include a map on the GIS System (1:100,000) showing the aggregate producers both inside and outside the County that contribute to consumption within the County.

PHASE IIa
LOCATE AND MAP POTENTIAL AGGREGATE RESOURCES

The consultant shall identify those areas in the County which are favorable for potential future aggregate resources consistent with the criteria as agreed upon in Phase Ib. The areas identified shall be classified according to their relative potential based on physical quality and quantity. Sources for use in identifying and mapping potential aggregate resources include: published and unpublished geologic maps, aerial photography, private and government data concerning available aggregate resources, the consultants knowledge of the area's resources, and field investigations.

The field investigation would be the majority of this phase of the study and would include a field reconnaissance of approximately 1,000 square miles in Southern Washoe County. Certain areas previously identified as incompatible uses would not be included in the field investigations, i.e. urbanized areas, parks and others that were previously identified. Actual time spent in the field is proposed to be approximately 75 percent of Phase IIa or 33 percent of the entire project. The remaining portion of Phase IIa would include research and map compilation.

County Support: Consultation

Estimated Proportion of Work Program: 42.5% - The field investigative phase of the study could begin immediately upon the identification of Location Criteria in Phase Ib. It does not have to wait for completion of Phase Ia.

The anticipated classification system for identifying areas where potential aggregate resources might exist can be summarized as follows:

	SAND AND GRAVEL	BEDROCK
Known Resource	X	X
High Potential	X	X
Moderate Potential	X	X
Low Potential	X	X

PHASE IIb
IDENTIFY AND OVERLAY GENERAL ECONOMIC FACTORS
ASSOCIATED WITH POTENTIAL AGGREGATE RESOURCE AREAS

The consultant will, in conjunction with the committee, identify those economic factors that are the most important in locating and developing future aggregate resources. Such factors could include:

- distance from market and related haul costs
- remoteness of site from existing transportation routes
- mining costs
- processing costs

A system would be developed to rate the importance of the economic factors and to relate them to the potential aggregate resources previously identified. For instance the distance from the market (Reno-Sparks area) influences the economics of utilizing a particular deposit, therefore, a classification system could be devised that gave a higher potential to those identified aggregate resources closer to the market. The classification system could be weighted with various economic factors and an economic potential could be assigned to definable elements in the study area. The result would be an "economic feasibility" map influencing potential aggregate resources.

County Support: Consultation

Estimated Proportion of Work Program: 15%

Phase II Conclusion: Present the following two draft maps on the GIS System at a scale of 1:100,000 at a review meeting with the department and committee.

1. Potential Aggregate Resources in Southern Washoe County
2. Economic factors affecting potential aggregate Resources in Southern Washoe County.

The classification system can be used to identify where potential future aggregate resources may be anticipated and where aggregate protection actions may be appropriate.

PHASE III
FINAL REPORT

A final report will be completed summarizing the conclusions of Phase I and II. The report shall also address concerns relative to the purpose of the study contained in separate documentation provided by the department.

A draft and the final report with accompanying maps shall be submitted to the department and committee for review. If required the consultant shall present report to the Board of County Commissioners. The consultant shall also be available to attend meetings of the department, committee, and the Board of County Commissioners to answer questions regarding the report.

County Support: All draft and final reports are to be submitted to the department which will reproduce and disseminate them.

Estimated Proportion of Work Program: 7.5%

PHASE IV

IDENTIFY EXTRACTION IMPACTS AND MITIGATION MEASURES

This would be a joint effort between the consultant and the department and committee. The scope of this phase of the project on the consultant's part remains to be determined but in general the consultant would assist the department in identifying the possible community impacts of aggregate mining operations and identifying mitigation measures to offset those which may be negative.

In preparation for this phase, the department will identify the legal and regulatory factors that affect aggregate operations and the issues from their experience, that have community impacts.

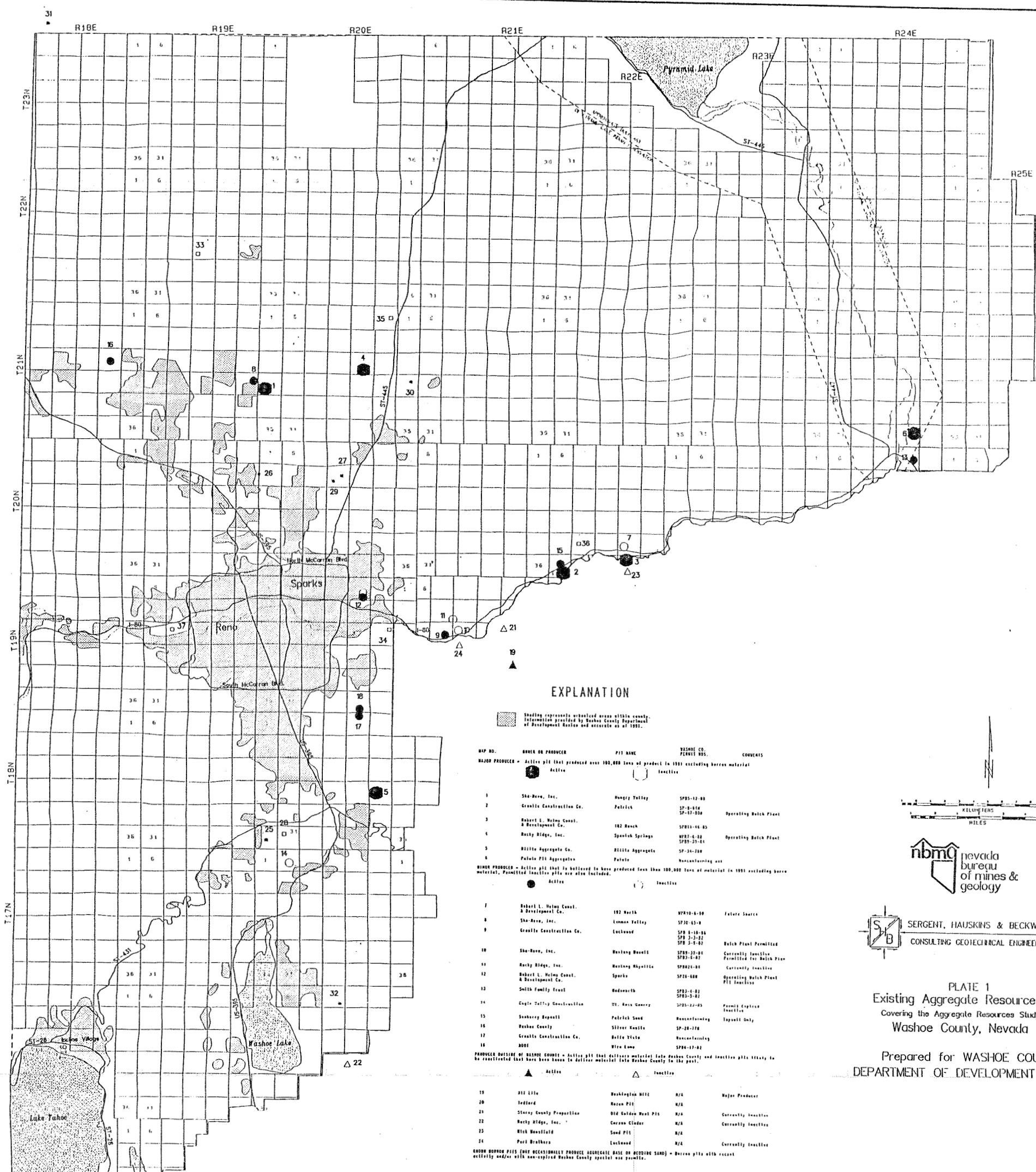
The consultant will help in identifying the impacts that can reasonably be anticipated from both present and potential future aggregate resources within the County, prepare special reports on specific topics, provide information to the Department and Committee, and other activities as requested.

This phase of the study could be initiated at any time following the award of the contract and does not necessarily have to follow in sequence behind Phases I through III.

Examples of the types of issues that could be addressed are as follows:

- visual impacts and scenic corridors
- noise
- dust
- access requirements
- security requirements
- potential for surface and/or groundwater degradation
- truck traffic
- blasting
- bonding
- reclamation
- economic impact to community

Estimated Proportion of Work Program: 17.5%



EXPLANATION

Shading represents urban areas within county boundaries as of 1991. Information provided by Washoe County Department of Development Review and accurate as of 1991.

MAP NO.	OWNER OR PRODUCER	PIT NAME	WASHOE CO. PERMIT NOS.	COMMENTS
MAJOR PRODUCERS - Active pit that produced over 100,000 tons of product in 1991 excluding borrow material				
1	Sho-Rene, Inc.	Hungry Valley	SP85-12-88	Operating Batch Plant
2	Granite Construction Co.	Patrick	SP-8-88A SP-13-88B	Operating Batch Plant
3	Robert L. Helms Const. & Development Co.	182 Ranch	SP85-14-88	Operating Batch Plant
4	Rocky Ridge, Inc.	Spanish Springs	SP87-6-88 SP87-25-88	Operating Batch Plant
5	Altilia Aggregate Co.	Altilia Aggregate	SP-26-88B	Nonconforming use
6	Palacio Pit Aggregate	Palacio		Nonconforming use
MINOR PRODUCERS - Active pit that is believed to have produced less than 100,000 tons of material in 1991 excluding borrow material. Permitted inactive pits are also included.				
7	Robert L. Helms Const. & Development Co.	182 Ranch	SP85-14-88	Future Source
8	Sho-Rene, Inc.	Loman Valley	SP-13-88	
9	Granite Construction Co.	Lockwood	SP8-18-88 SP-3-88 SP8-3-88	Batch Plant Permitted
10	Sho-Rene, Inc.	Washong Basin	SP85-14-88	Currently inactive
11	Rocky Ridge, Inc.	Washong Basin	SP85-14-88	Currently inactive
12	Robert L. Helms Const. & Development Co.	Sparks	SP85-14-88	Operating Batch Plant
13	Smith Family Trust	Madawatch	SP85-14-88	Operating Batch Plant
14	Engle Valley Construction	W. Ross Quarry	SP85-14-88	Permit Expired
15	Sho-Rene, Inc.	Patrick Sand	Nonconforming	Inactive Only
16	Sho-Rene, Inc.	Silver Knolls	SP-28-88B	
17	Granite Construction Co.	Belle Vista	Nonconforming	
18	NOPI	Wine Camp	SP85-17-88	
PRODUCERS OUTSIDE OF WASHOE COUNTY - Active pit that delivers material into Washoe County and inactive pits likely to be reactivated that have been shown to deliver material into Washoe County in the past.				
19	NOPI	Washington Hill	N/A	Major Producer
20	NOPI	Hayden Pit	N/A	
21	Sho-Rene, Inc.	Old Golden Wash Pit	N/A	Currently inactive
22	Rocky Ridge, Inc.	Corona Cluster	N/A	Currently inactive
23	Wick Brothers	Sand Pit	N/A	
24	Paul Brothers	Lockwood	N/A	Currently inactive
NON-PRODUCING PITS (NOT NECESSARILY PRODUCED AGGREGATE BASE OR BEDDING SAND) - Borrow pits with recent activity and/or with non-activated Washoe County special use permits.				
25	U.S.F.S.	W. Ross Common	N/A	OG, to be closed 8/92
26	Sho-Rene, Inc.	Golden Valley OG	Nonconforming	
27	Robert L. Helms Const.	Half Road Property OG	SP83-88	
28	Engle Valley Construction	W. Ross OG	SP85-17-88	Permit Expired
29	Washoe County	Sea Valley	N/A	OG
30	Washoe County	Washoe	Nonconforming	
31	NOPI	Red Rock Common	N/A	
32	Washoe County	Junco Brook	N/A	OG
33	Red Rock Quarry Association		SP85-17-88	Inactive
34	NOPI		SP85-18-88	Inactive
35	NOPI		SP8-78B	Inactive
36	NOPI		SP83-1-88	Inactive
37	NOPI		SP85-17B	Inactive

Notes: 1. Non-conforming Use means the pit is grandfathered and does not require a Special Use Permit.
 2. Urban areas as of 1991 supplied by Washoe County Department of Development Review.
 3. Road localities from the United States Census Bureau TIGER FILES.
 4. Legal grid supplied by Washoe County Department of Development Review.

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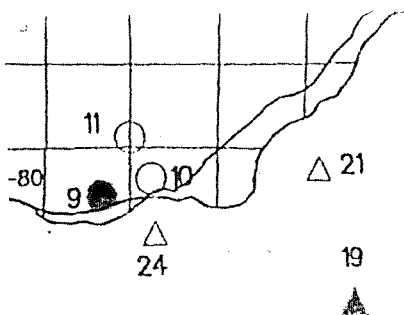
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CONSULTING GEOTECHNICAL ENGINEERS

PLATE 1
Existing Aggregate Resource Sites
Covering the Aggregate Resources Study Area
Washoe County, Nevada

Prepared for WASHOE COUNTY
DEPARTMENT OF DEVELOPMENT REVIEW

September 1992

See enlargement
of "Explanation"
next page



EXPLANATION



Shading represents urbanized areas within county.
Information provided by Washoe County Department
of Development Review and accurate as of 1991.

MAP NO.	OWNER OR PRODUCER	PIT NAME	WASHOE CO. PERMIT NOS.	COMMENTS
MAJOR PRODUCER = Active pit that produced over 100,000 tons of product in 1991 excluding borrow material				
	Active	Inactive		
1	Sho-Neva, Inc.	Hungry Valley	SPBS-12-89	
2	Granite Construction Co.	Patrick	SP-8-64W SP-17-80W	Operating Batch Plant
3	Robert L. Helms Const. & Development Co.	102 Ranch	SPB11-16-85	
4	Rocky Ridge, Inc.	Spanish Springs	WPR7-6-88 SPB9-32-84	Operating Batch Plant
5	Hillie Aggregate Co.	Hillie Aggregate	SP-34-76W	
6	Palute Pit Aggregates	Palute		Nonconforming use
MINOR PRODUCER = Active pit that is believed to have produced less than 100,000 tons of material in 1991 excluding borrow material. Permitted inactive pits are also included.				
	Active	Inactive		
7	Robert L. Helms Const. & Development Co.	102 North	WPR10-6-90	Future Source
8	Sho-Neva, Inc.	Lenmon Valley	SP30-65-W	
9	Granite Construction Co.	Lockwood	SPB 6-18-86 SPB 3-3-82 SPB 3-9-82	Batch Plant Permitted
10	Sho-Neva, Inc.	Mustang Basalt	SPB9-32-84 SPB3-6-82	Currently Inactive Permitted for Batch Plant
11	Rocky Ridge, Inc.	Mustang Rhyolite	SPB824-84	Currently Inactive
12	Robert L. Helms Const. & Development Co.	Sparks	SP26-68W	Operating Batch Plant Pit Inactive
13	Smith Family Trust	Madsworth	SPB3-4-81 SPB3-5-82	
14	Eagle Valley Construction	Wt. Rose Quarry	SPB5-23-85	Permit Expired Inactive
15	Seaberry Depeoli	Patrick Sand	Nonconforming	Topsoil Only
16	Washoe County	Silver Knolls	SP-28-77W	
17	Granite Construction Co.	Bella Vista	Nonconforming	
18	NDOT	Mira Loma	SPB6-17-82	

PRODUCER OUTSIDE OF WASHOE COUNTY = Active pit that delivers material into Washoe County and inactive pits likely to be reactivated that have been known to deliver material into Washoe County in the past.



Active



Inactive

19	All Lite	Washington Hill	N/A	Major Producer
20	Tedford	Hazen Pit	N/A	
21	Storey County Properties	Old Golden West Pit	N/A	Currently Inactive
22	Rocky Ridge, Inc.	Carson Cinder	N/A	Currently Inactive
23	Nick Mansfield	Sand Pit	N/A	
24	Perl Brothers	Lockwood	N/A	Currently Inactive

KNOWN BORROW PITS (MAY OCCASIONALLY PRODUCE AGGREGATE BASE OR BEDDING SAND) = Borrow pits with recent activity and/or with non-expired Washoe County special use permits.



Active



Inactive

25	U.S.F.S.	Wt. Rose Common Use Area	N/A	DG, to be closed 6/92
26	Sho-Neva, Inc.	Golden Valley DG	Nonconforming	
27	Robert L. Helms Const.	Rail Road Property DG	SP23-81W	
28	Eagle Valley Construction	Wt. Rose DG	SPB5-22-85	Permit Expired Inactive
29	Washoe County	Sun Valley	N/A	DG
30	Danavan		Nonconforming	
31	BLW	Red Rock Common Use Area	N/A	
32	Washoe County	Jumbo Grade	N/A	DG
33	Red Rock Owners Association		SPB6-17-83	Inactive
34	NDOT		SPB6-18-82	Inactive
35	NDOT		SPB-70W	Inactive
36	NDOT		SPD2-4-81	Inactive
37	NDOT		SPB6-77W	Inactive

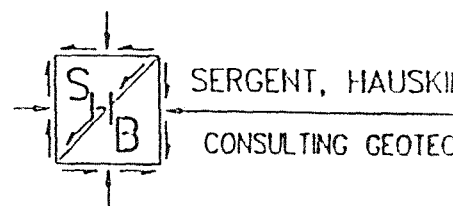
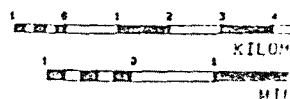


PLATE
Existing Aggregate
Covering the Aggregate R
Washoe County,

Prepared for WA
DEPARTMENT OF DEV

September

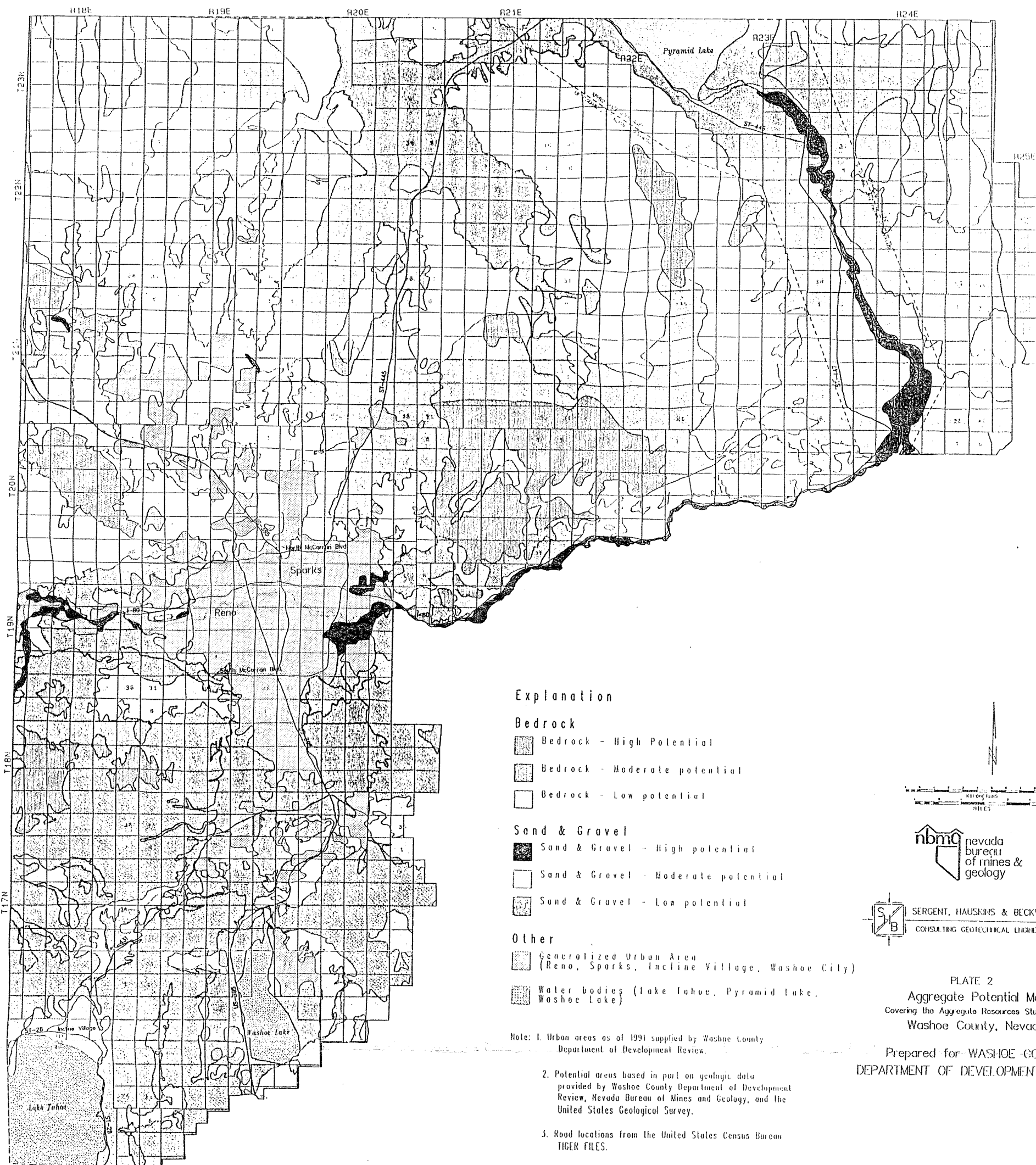
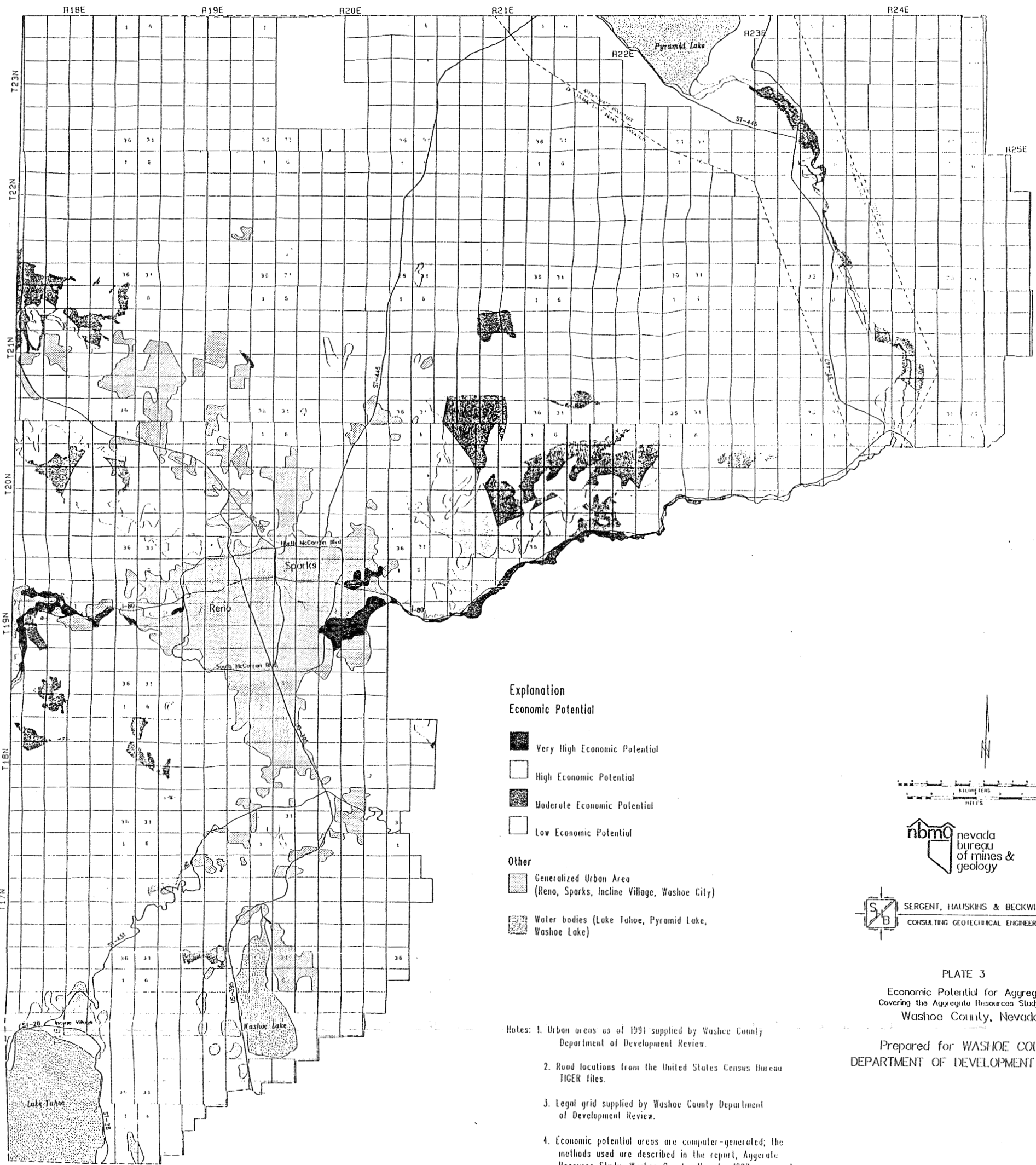


PLATE 2
Aggregate Potential Map
Covering the Aggregate Resources Study Area
Washoe County, Nevada

Prepared for WASHOE COUNTY
DEPARTMENT OF DEVELOPMENT REVIEW

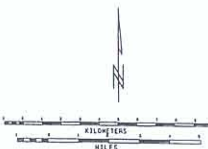
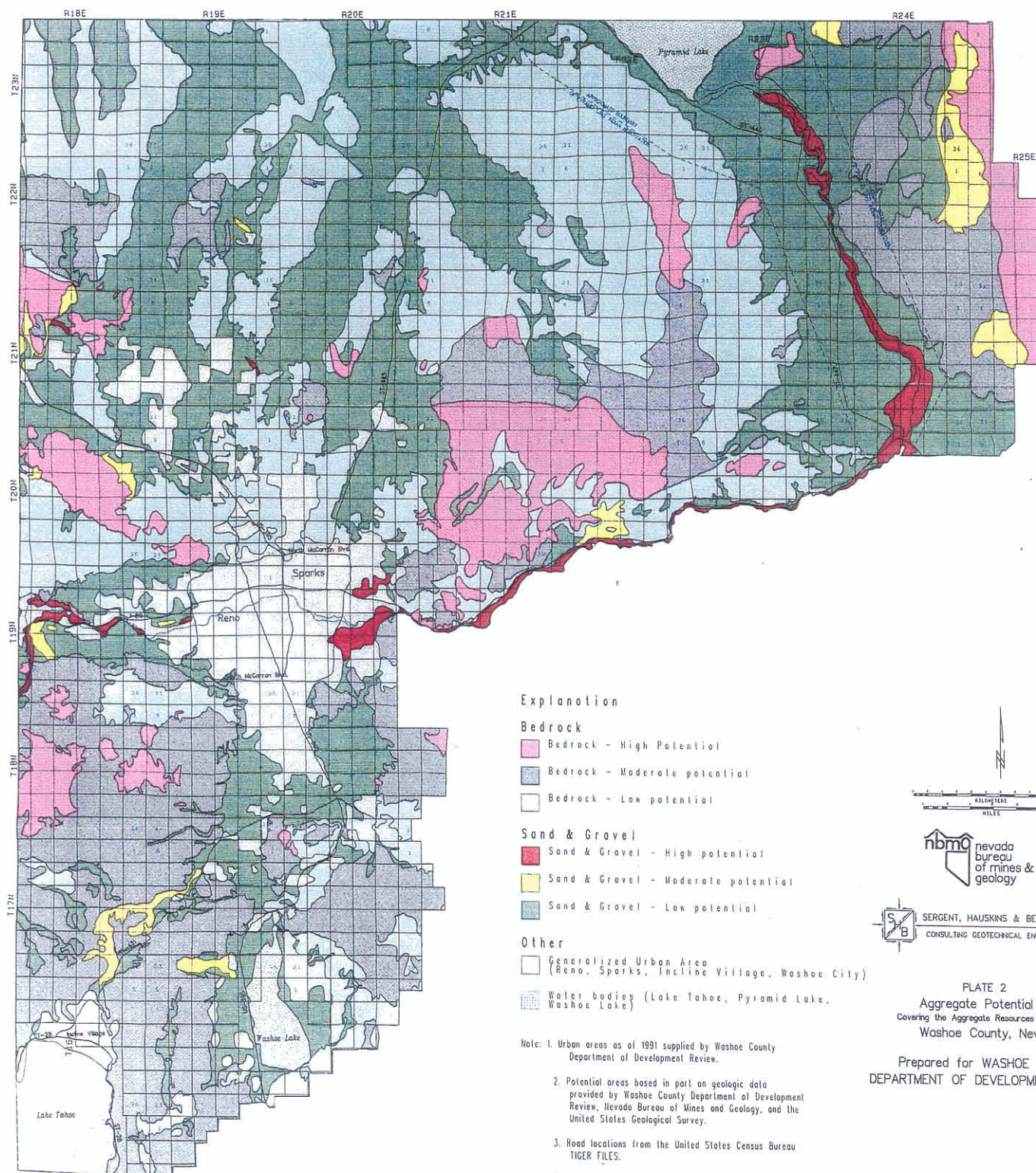


- Notes: 1. Urban areas as of 1991 supplied by Washoe County Department of Development Review.
2. Road locations from the United States Census Bureau TIGER files.
3. Legal grid supplied by Washoe County Department of Development Review.
4. Economic potential areas are computer-generated; the methods used are described in the report, Aggregate Resource Study, Washoe County, Nevada, 1992, prepared by SHB and NBMG for the Washoe County Department of Development Review.

PLATE 3
Economic Potential for Aggregate
Covering the Aggregate Resources Study Area
Washoe County, Nevada

Prepared for WASHOE COUNTY
DEPARTMENT OF DEVELOPMENT REVIEW

September 1992



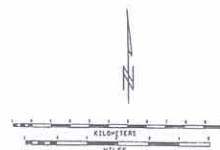
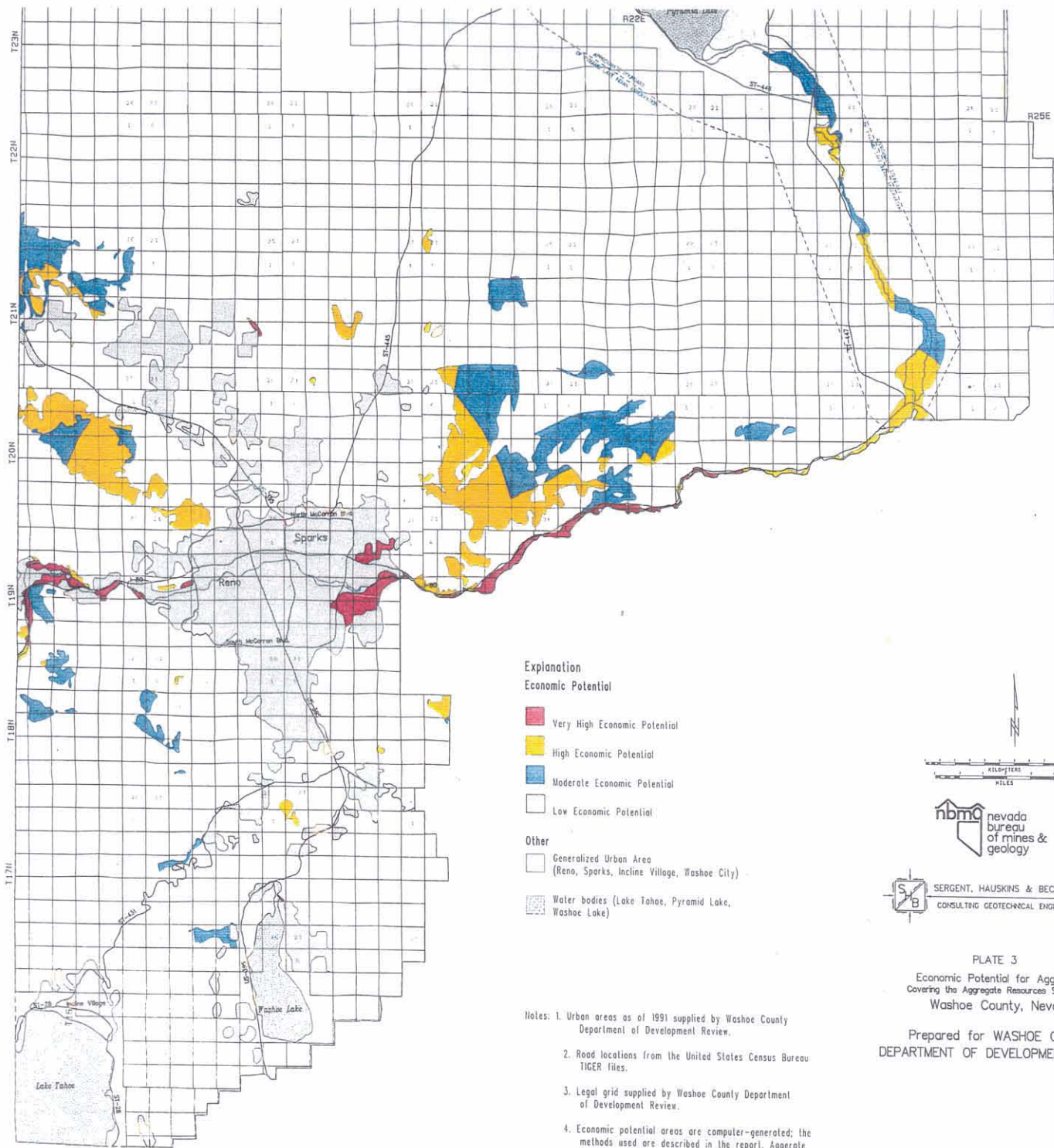
nbmg nevada
bureau
of mines &
geology

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CONSULTING GEOTECHNICAL ENGINEERS

PLATE 2
Aggregate Potential Map
Covering the Aggregate Resources Study Area
Washoe County, Nevada

Prepared for WASHOE COUNTY
DEPARTMENT OF DEVELOPMENT REVIEW

September 1992



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CONSULTING GEOTECHNICAL ENGINEERS

PLATE 3

Economic Potential for Aggregate
Covering the Aggregate Resources Study Area
Washoe County, Nevada

Prepared for WASHOE COUNTY
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September 1992