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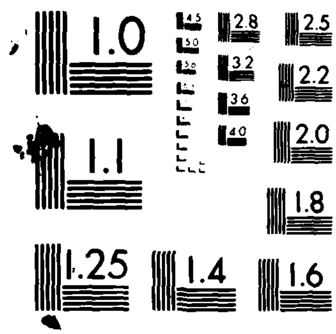

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MX SITING INVESTIGATION
GEOTECHNICAL EVALUATION

AGGREGATE RESOURCES REPORT UTAH-NEVADA STUDY AREA

PREPARED FOR
BALLISTIC MISSILE OFFICE (BMO)
NORTON AIR FORCE BASE, CALIFORNIA

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This report presents the results of a preliminary aggregate resources investigation within selected lands in Utah and Nevada that are for MX system

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FN-TR-34

AGGREGATE RESOURCES REPORT

UTAH-NEVADA STUDY AREA

Prepared for:

U.S. Department of the Air Force
Ballistic Missile Office (BMO)
Norton Air Force Base, California 92409

Prepared by:

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3 March 1980

FOREWORD

This report was prepared for the Department of the Air Force Ballistic Missile Office (BMO) in compliance with Contract No. F-04704-80-C-0006, CDRL Item No. 005A2. It presents the results of a preliminary aggregate resources investigation within and adjacent to selected lands in Utah and Nevada that are under consideration for siting the MX system. The program was funded in June FY 79 through supplemental funding of the FY 79 Geotechnical Program.

Results of the investigation are presented in this volume as text, appendices, and two drawings.

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1.0 INTRODUCTION

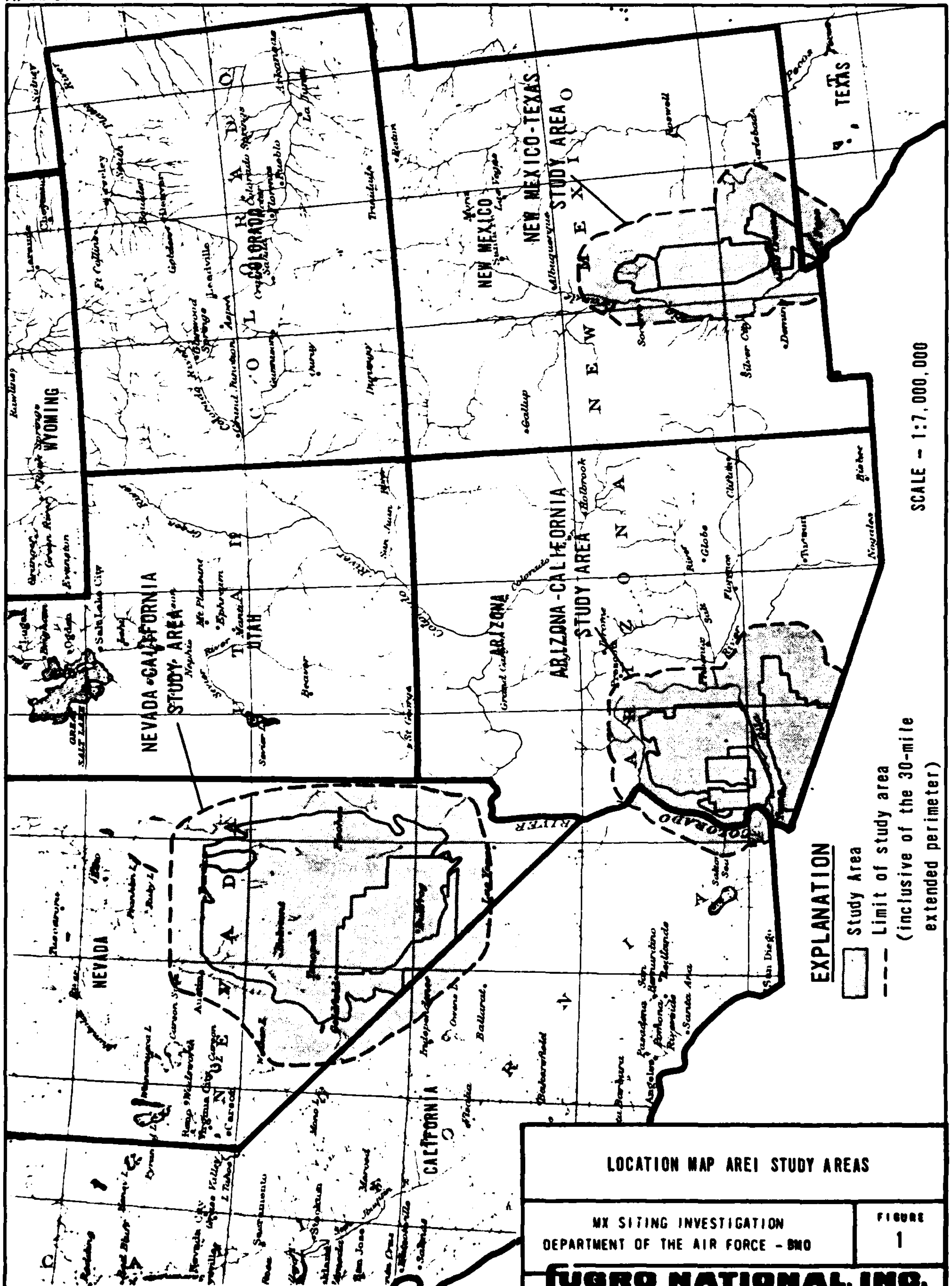
1.1 BACKGROUND

The MX aggregate program began in 1977 with the investigation of Department of Defense (DOD) and Bureau of Land Management (BLM) lands in California, Nevada, Arizona, New Mexico, and Texas (FN-TR-20D). This program identified, on a selected regional basis, potential sources of concrete aggregate that could be used for construction of the MX system and ranked them according to suitability. Economic factors (e.g., mining costs, haul distances, etc.) were not considered.

Refinement of the potential MX siting area in FY 79 added portions of Utah and Nevada that were not studied in the initial Aggregate Resource Evaluation Investigation (AREI) of the Nevada-California areas (Figure 1). This additional area (Figure 2) was defined as the Utah-Nevada Aggregate Resources Study Area (UARSA).

1.2 OBJECTIVES

The primary objective of the Utah-Nevada Aggregate Resources Study is to bring the entire, currently defined potential siting area to a similar level of aggregate investigation. The principal effort is to preliminarily inventory and rank sand, gravel, and rock resources according to their suitability for use as aggregate in concrete (3- to 7.5-kips-per-square-inch compressive strength), railroad ballast, and road base. The initial aggregate study, FN-TR-20D, inventoried and ranked sand,



LOCATION MAP AREI STUDY AREAS

MX SITING INVESTIGATION
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FIGURE 1

FUGRO NATIONAL, INC.

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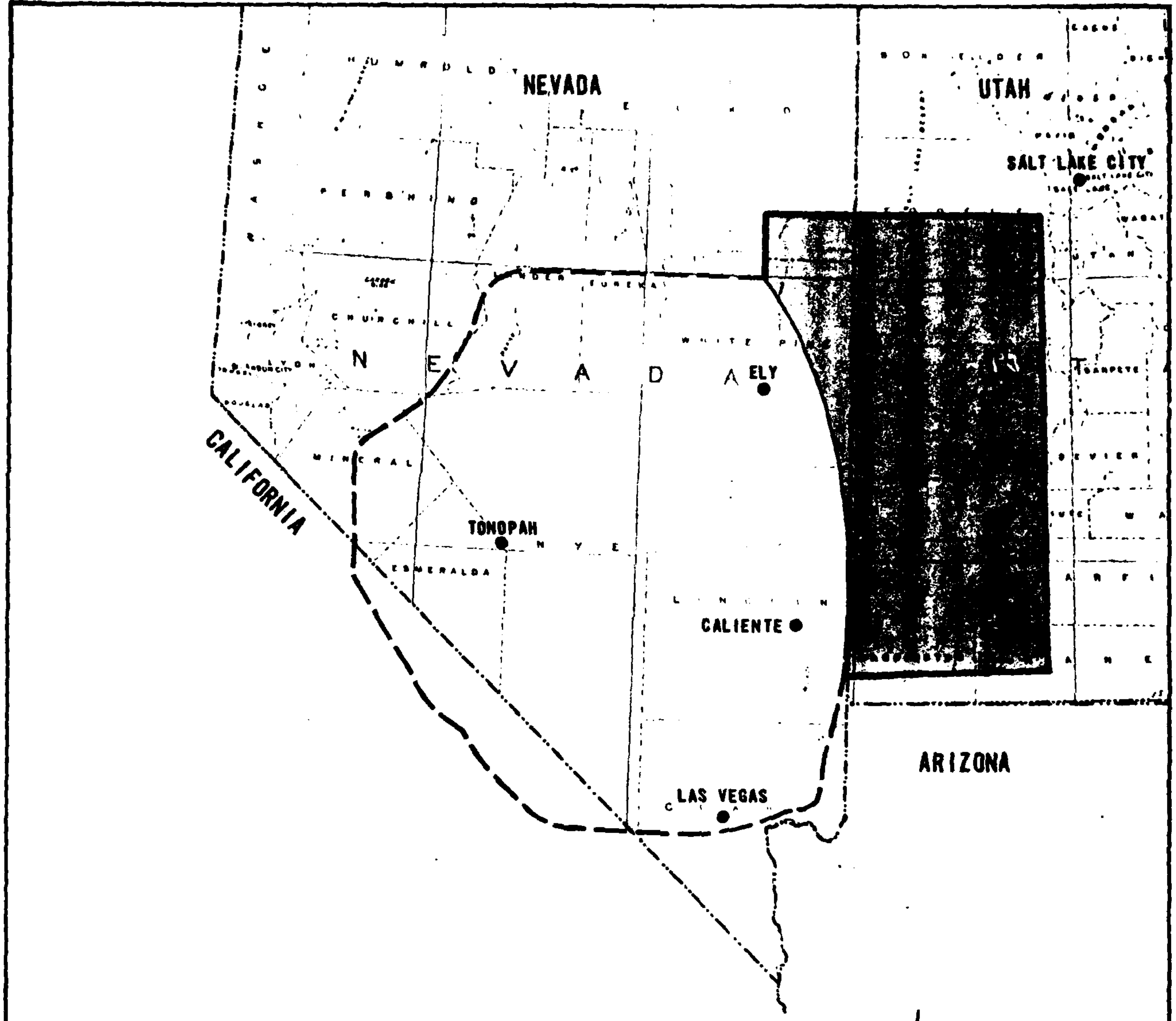

EXPLANATION

— — NEVADA-CALIFORNIA AGGREGATE RESOURCES STUDY AREA, FY 78 (FN-TR-200)

■ UTAH AGGREGATE RESOURCES STUDY AREA, FY 79

SCALE 1: 5,000,000

0 50 100
STATUTE MILES

0 50 100
KILOMETERS

UTAH-NEVADA REGIONAL AGGREGATE STUDIES

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE 2

FUGRO NATIONAL, INC.

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gravel, and rock resources according to their suitability for use as aggregate in concrete to be used in construction of the MX trench system.

Factors which influenced inventory procedures and the ranking of the sources included:

1) Type of deposit: Both rock and basin fill were investigated as potential aggregate sources.

2) Quality of the material: American Society of Testing and Materials (ASTM) standards and Standard Specifications for Public Works Construction (SSPWC) were used to evaluate aggregate quality.

3) Quantity of material: 86.9×10^6 tons of gravel and 5.8×10^6 tons of sand are estimated to be required for construction of the presently conceived MX horizontal MPS system.

4) Size of boundary extension: An approximate 30-mile boundary extension around potential suitable siting area was based on current estimates pertaining to the maximum practical and economical haul distance anticipated for the MX system.

5) Availability of water for aggregate processing: A brief review of existing data on ground and surface water within the study area and visual observations at field station stops were performed.

6) Accessibility: A brief review of major land transportation facilities within the study area and visual observations at field station stops were performed.

This study was designed to provide regional information on the general location, quality, and quantity of aggregate and construction material resources (sand, gravel, and rock) within the study area in a useful and informative format for planning purposes. Detailed information on the actual location and development of proven available suitable aggregate sources was beyond the scope of this study.

1.3 SCOPE

The scope of this investigation required that both office studies and field reconnaissances be performed. The following pertinent steps were included in the investigation:

1) Collection of available existing data on the quality and quantity of potential concrete aggregate, railroad ballast, and road base sources.

2) Analysis and evaluation of collected data with subsequent selection of areas for field reconnaissances.

3) Aerial and ground field reconnaissances of representative basin-fill and rock aggregate sources with sampling of selected representative materials.

4) Limited laboratory testing to supplement available existing data and to provide sufficiently detailed information to assist in predicting suitability of potential aggregate resources over broad areas.

5) Preliminary review of existing data on water availability and land transportation facilities within the study area.

6) Application of the aggregate resources preliminary ranking system developed during the initial aggregate investigation. This system utilizes ASTM and SSPWC standards and specifications.

2.0 STUDY APPROACH

2.1 METHODOLOGY

The study approach was to 1) utilize, to the maximum extent possible, existing data on aggregate sources in the area, 2) supplement the existing data with limited field reconnaissances including collection of representative potential aggregate source materials for laboratory testing, and 3) assess critical physical/chemical properties to support the results of the inventory and ranking.

2.1.1 Existing Data

Collection of existing test data from available sources was a primary factor controlling the study approach. Data were collected from federal, state, and private agencies, institutions, and individuals in Reno, Carson City, and Ely, Nevada, and Salt Lake City, Cedar City, and Richfield, Utah. Principal sources of data directly pertaining to concrete aggregate or related construction materials were the State Highway Departments of Nevada and Utah. The majority of this information is related to the use of aggregate material for asphaltic concrete, base course in road construction, or ballast material. Many of the suitability tests for these types of construction materials are similar to those for concrete aggregate.

2.1.2 Supplemental Field Data

Aerial and ground reconnaissances of the study area were made to collect additional data and to verify conditions determined during the review of existing information. During this phase, 192 basin-fill and rock field station data stops were made in potential aggregate sources as well as existing quarries and borrow pits. Identification of basin-fill materials in the field followed ASTM D2488-69 Description of Soils (Visual-Manual Procedure), and the Unified Soil Classification System (Appendix C). Rock identifications followed procedures described in the Quarterly of the Colorado School of Mines and Standard Investigative Nomenclature of Constituents of Natural Mineral Aggregates (ASTM C294-69).

Selected sources were sampled for additional laboratory testing and/or petrographic thin section analysis. Representative basin-fill samples were collected by channel sampling stream cuts or man-made exposures. Rock samples were obtained from exposures of fresh or slightly weathered material whenever possible. The weight of the samples collected ranged between 100 and 150 pounds. Samples collected for thin sectioning were hand specimens, generally not exceeding five pounds in weight.

2.1.3 Data Analysis

Engineering and geologic criteria were used to analyze and evaluate the existing and field data. This was supplemented by selected laboratory tests (Table 1) and petrographic thin section examinations which emphasized a determination of durability, soundness, and gradation. Because materials suitable for use as concrete aggregate are generally acceptable for use as railroad ballast and road base, concrete aggregate parameters are the principal consideration in this report.

AGGREGATE CLASSIFICATION	ASTM TEST	SAMPLE TYPE AND NUMBER OF TESTS
COARSE	ASTM C-88; SOUNDNESS BY USE OF MAGNESIUM SULFATE	ROCK (7) GRAVEL (6)
	ASTM C-131; RESISTANCE TO ABRASION BY USE OF THE LOS ANGELES MACHINE	ROCK (7) GRAVEL (6)
	ASTM C-136; SIEVE ANALYSIS	GRAVEL (7)
FINE	ASTM C-88; SOUNDNESS BY USE OF MAGNESIUM SULFATE	SAND (4)
	ASTM C-136; SIEVE ANALYSIS	SAND (1)

AGGREGATE TESTS
UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
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TABLE 1

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2.1.4 Presentation of Results

Results of the study are presented in text form, tables, two 1:500,000 scale maps, and appendices. The aggregate resources map (Drawing 1) shows the location, type, and rank of all Class A and Class B aggregate sources (Section 2.2, Preliminary Aggregate Ranking System). Class C materials are only generally depicted, with no assigned geologic unit designation. Drawing 2 presents the 508 existing test data and field station sites within the study area.

Geologic symbols utilized in Drawing 1 relate to standard geological nomenclature whenever possible. Undifferentiated alluvial and rock units were established primarily to accommodate map scale and may contain deposits which could supply significant quantities of high quality materials. A conversion table to relate these geologic symbols to Fugro geologic unit nomenclature is contained in Appendix E.

All contacts which represent distinct boundaries between geologic material types (or classes of aggregate resources) are shown as solid lines in Drawing 1. The contacts are dashed where the depicted data were extrapolated beyond the limits of the source data or where accuracy of the data may be questionable. Local small deposits of one type or class of material may be found in close association with a larger deposit of a different type or class. Due to scale limitations, these smaller deposits could not be shown on the aggregate resources map and have been combined with the more prevalent material.

Appendices contain tables summarizing the basic data collected during the field investigations, the results of Fugro National's supplemental aggregate testing program, existing test data gathered from various outside sources, an explanation of caliche development, the Unified Soil Classification System, photographs of typical material sources, and a geologic unit cross reference table.

2.2 PRELIMINARY AGGREGATE RANKING SYSTEM

After completing field activities and compiling all data, a system to preliminarily rank potential concrete aggregate sources was developed in order to describe their relative merits. Based primarily on physical properties, this ranking system divided the potential aggregate sources into Class A, Class B, and Class C (Table 2). Exposure characteristics of the potential aggregate source, such as extent, accessibility, minability, and water availability were also considered but generally did not alter the physical property ranking.

The specifications for each class of material are based on 1) ASTM C33-74A Standard Specifications for Concrete Aggregate, 2) SSPWC Part II Construction Sections 200-1.1, 1.4, 1.5, and 1.7, 3) a review of the literature applicable to concrete aggregates, 4) contacts with industrial producers of concrete aggregates, 5) contacts with consultants in the field of concrete aggregates, and 6) sound engineering and geologic judgment.

Since a majority of deposits being evaluated either lack test data completely or were previously tested for their suitability

AGGREGATE CHARACTERISTIC[1]			AGGREGATE RANKING		
			CLASS A	CLASS B[2]	CLASS C
ABRASION RESISTANCE, PERCENT WEAR[3]			< 40	40-50	> 50
SOUNDNESS, PERCENT LOSS[4]	COARSE AGGREGATE	$NaSO_4$	< 12	< 12	> 12
		$MgSO_4$	< 18	< 18	> 18
	FINE AGGREGATE	$NaSO_4$	< 10	< 10	> 10
		$MgSO_4$	< 15	< 15	> 15
MATERIAL FINER THAN NO. 200 SIEVE, PERCENT BY WEIGHT	COARSE AGGREGATE		< 1	1-2	> 2
	FINE AGGREGATE		< 3	3-7	> 7
OTHER DELETERIOUS MATERIAL (ALKALI REACTIVE AGGREGATE, MICA, GYPSUM, PYRITE, CHLORITE, CALICHE OR CLAY COATINGS, LOW DENSITY OR ORGANIC MATERIAL, FLAT, PLATY, OR ELONGATE PARTICLES)			< 1	1-3	> 3

1. AGGREGATE CHARACTERISTIC BASED ON ESTIMATED VALUES OR STANDARD TEST RESULTS
2. THIS CLASS MAY BE DIVIDED INTO SUBUNITS B_1 (ONE OR TWO POOR CHARACTERISTICS) OR B_2 (MORE THAN TWO CHARACTERISTICS)
3. ASTM C131 (500 REVOLUTIONS)
4. ASTM C88 (5 CYCLES)

PRELIMINARY AGGREGATE RANKING SYSTEM
UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE 2

FUGRO NATIONAL, INC.

for some other purpose, this preliminary ranking system relies heavily on qualitative evaluations based upon field visual observations. The general physical property characteristics of Class A, Class B, and Class C aggregate sources are as follows:

Class A

Potential sources of high quality concrete aggregate not requiring the use of special cements or admixtures (Table 2). Only minimal processing should be necessary to meet known requirements for concrete aggregate. However, additional testing and case history studies will be needed to confirm adequacy and define exact characteristics.

Class B

Potential source of possible concrete aggregate exhibiting one or more undesirable characteristics which make it of poorer quality than Class A aggregate (Table 2). Detailed investigations will be required to accurately determine aggregate suitability and probable concrete characteristics. Where possible, this class of material was divided into subunits B_1 and B_2. Materials classified as B_1 are considered to be generally adequate for concrete aggregate having only one or two characteristics which cause them to be ranked as Class B material. Those materials ranked as B_2 are considered to be probably suitable but have several characteristics which may make them marginal for use as concrete aggregate. Where these distinctions could not be made with present information, the material is classified as Class B.

Class C

Material considered unsuitable for use as concrete aggregate (Table 2).

3.0 STUDY RESULTS

3.1 LOCATION AND DESCRIPTION OF STUDY AREA

The UARSA is located in western Utah and easternmost Nevada (Figure 2). It includes portions of Tooele, Juab, Millard, Beaver, Iron, and Washington counties, Utah, and Elko, White Pine, and Lincoln counties, Nevada. With a maximum north-south length of approximately 200 miles and a maximum east-west width of 125 miles, the study area encompasses almost 16,000 square miles.

The study area lies totally within the Basin and Range Physiographic Province. The physiography is controlled by, and strongly reflects, the underlying geologic structure. Eroded remnants of uplifted fault-block mountains separated by down-dropped basins characterize the study area. Mountain ranges are commonly composed of Paleozoic carbonate and clastic rocks that exhibit north to northwest trends. Quaternary basalt flows and associated cinder cones are common in the southeastern portion of the study area. Many of the valleys are broad and elongated and have been inundated by various Pleistocene lakes (e.g., Lake Bonneville) that have greatly influenced the Quaternary depositional history. Closed basin conditions are common today, with gently sloping alluvial surfaces grading toward playas in the valley axes. The Sevier Dry Lake is a large closed system that forms the terminus of the area's only major drainage system, the Sevier River.

3.2 POTENTIAL AGGREGATE RESOURCES

3.2.1 Basin-Fill Sources

The principal basin-fill sources of potentially acceptable aggregate within the UARSA are older lacustrine, alluvial fan, stream channel, and undifferentiated alluvial deposits. All exhibit a range in quality, depending primarily upon durability and gradation characteristics. Ideally, a basin-fill concrete aggregate source should be composed of well-graded, hard, durable, subangular to subrounded particles. Railroad ballast durability specifications are similar to concrete aggregate, but typical grain size varies from 1-3/4 to 1-1/2 inch, preferably crushed material. Road subbase material requirements are much less stringent than concrete aggregate requirements. Therefore, all concrete aggregate sources should be acceptable for road material.

Although the gradation may be altered extensively by processing, economics demand that the source material be within certain defined gradation limits. In addition, concrete design specifications may require excessive plus 3/4-inch material to produce 3/8-inch crushed gravel. The gradation of the aggregates in a concrete mix affects not only strength, cement and water content, and workability but also concrete pumping requirements and reinforcing rod spacing. Basin-fill aggregate gradation sizes have been grouped into two general categories for this study: minus 3/8-inch fine aggregate (fine to coarse sand), and plus 3/8-inch coarse aggregate (fine gravel to boulders).

The large areas of basin-fill material designated as Class C in Drawing 1 represent primarily fine-grained deposits deemed unsuitable for aggregate. Most Class C material is deep water older lacustrine, playa, or fine-grained distal alluvial fan material. Small units of higher class basin-fill material occur within the Class C areas but were not depictable in Drawing 1.

3.2.1.1 Older Lacustrine Deposits - Aol

Older lacustrine deposits within the UARSA were deposited in Pleistocene Lake Bonneville and related lakes. Lake Bonneville originally covered vast portions of western and northern Utah but has since receded to become the present Great Salt Lake.

Paleo-nearshore sand bar, sand spit, and delta deposits form major potential fine and coarse aggregate sources. These deposits occur in zones roughly coincident with the paleo-shorelines at the 4800- and 5200-foot topographic contours and are predominantly composed of sand and gravel with lesser amounts of cobbles and boulders. A range of gradations may be present depending on the environment of deposition but generally the selective sorting of sediments by wave action has removed most silt- and clay-sized material. Extensive older lacustrine sediments, deposited in deeper water environments, may be present in the central portions of many of the valleys. However, these contain significant amounts of silt, clay, and alkaline salts or other evaporites and are not considered potential aggregate sources.

The most common deleterious material noted is chert, but it was never observed in excess of five percent by volume. Other deleterious materials noted in these units include potentially alkali reactive, vesicular, or low density volcanic, metamorphic, and sedimentary particles. Test results and field station data indicate that some deposits may be deficient in the plus 3/4-inch size, with an average 78 percent passing the 3/4-inch sieve and a range of 70 to 85 percent.

Locally extensive and widely distributed older lacustrine deposits are generally ranked as Class A or Class B_1, depending on deleterious material content and gradation restrictions. These deposits are presently being widely utilized as sources of fine and coarse aggregates for highway construction in Utah.

Although older lacustrine deposits are locally extensive, they were usually not depictable at the 1:500,000 scale of Drawing 1. They have been grouped with the alluvial fan (Section 3.2.1.2) and undifferentiated alluvium (Section 3.2.1.4) deposits in most instances.

3.2.1.2 Alluvial Fan Deposits - Aaf

Alluvial fans flanking the mountain fronts are widespread throughout the UARSA and provide one of the most extensive reserves of coarse and fine aggregates in the study area. They are formed by the erosion of material from surrounding rock or areas of higher relief. The material is gradually transported downslope under the influence of gravity and water and is deposited in characteristically fan-shaped geomorphic features.

The deposits are typically heterogeneous to poorly stratified mixtures of boulders, cobbles, gravel, sand, silt, and clay that grade from very coarse grained near the rock/alluvium contact to fine grained near the valley interiors. Individual fan units contain poorly to well graded, subangular particles that exhibit great lateral and vertical textural variation. Test data indicate that most of the alluvial fan deposits may be deficient in the plus 3/4-inch sizes. The average percent passing the 3/4-inch sieve was 73 percent and ranged from 65 to 86 percent.

Composition of the surrounding source rock strongly controls the quality of the material found in alluvial fans. Fans surrounding carbonate or quartzitic rocks generally contain the most durable and sound materials, while those surrounding undifferentiated volcanic, metamorphic, and sedimentary rocks are generally less acceptable.

Caliche development, a natural process of soil development in arid climates, ranged from none in the younger fans to Stage IV (Appendix B) in the older fans. The older, more calichified units may be partly or wholly consolidated, contain excessive deleterious carbonate or clay coatings and highly weathered clasts, and be unacceptable for use as aggregate.

Alluvial fan deposits are widespread and extensive and are being actively mined for localized fine and coarse aggregates in the study area. However, because of the restricted particle gradations, content of clay- or silt-sized material, and other deleterious substance, a majority are ranked as Class B.

3.2.1.3 Stream Channel Deposits - Aal

Stream channel deposits associated with secondary ephemeral streams commonly transect alluvial deposits and trend perpendicular to the nearby mountain ranges toward the valley axes. There, they terminate at a central playa area or a primary drainage system. Most are too small to depict in Drawing 1 and have been grouped with the adjacent, more predominant units (i.e., alluvial fan, undifferentiated alluvium).

Stream channel deposits vary from heterogeneous mixtures of sand, gravel, cobbles, and boulders near mountain fronts to fine-grained sands, silts, and clays near valley centers. The quality of the material reflects the properties of the rock types found in the stream source area and along its course and the deposits have been ranked accordingly. The most durable and sound materials are found along streams which drain areas of carbonate or quartzitic rock terrain. The deposits along streams draining volcanic and metamorphic source areas are highly variable and may or may not contain acceptable materials. Near mountain fronts where stream gradients are high, stream channel deposits are generally coarse grained, noncemented, free of deleterious coatings, suitably shaped, contain a low percentage of silt and clay fines, and are relatively durable. The soft and friable materials have largely been removed by the natural abrasive action of stream transport. Further from the mountain fronts suitable fine aggregate sources of sand may be located. Material deposited by streams near valley centers or on the flood-plains of major drainages is generally too fine-grained to make acceptable aggregate. Many stream channel deposits are self-renewing with a fresh supply of sand and gravel being carried downstream during periodic cloudbursts.

A majority of the stream channel deposits have been ranked as Class B. Because of their limited areal extent, they will supply only localized aggregate requirements and are not considered potential major fine or coarse aggregate sources.

3.2.1.4 Alluvial Deposits Undifferentiated - Au

Undifferentiated alluvial deposits consist of various combinations of basin-fill units that could not be separately delineated in Drawing 1 because of the map scale. Included are alluvial fans, older lacustrine, playa, stream channel, stream terrace, and pediment deposits. These alluvial deposits are heterogeneous to stratified mixtures of boulders, cobbles, gravel, sand, silt, and clay comprised of a wide range of rock types and deleterious substances. The composition and quality of the undifferentiated alluvial unit varies according to the characteristics of the individual deposits.

Commercial production of fine and coarse aggregates from this composite unit was noted in Utah and Nevada. The undifferentiated alluvial deposits generally are ranked as Class B material and will require more detailed studies to delineate areas of higher quality.

3.2.2 Rock Sources

Potential sources of acceptable crushed rock within the UARSA include quartzite, limestone, dolomite, undifferentiated carbonate rocks, basalt, granitic rocks, and undifferentiated sedimentary, volcanic, and metamorphic rocks. Each exhibits a range of characteristics that are important to their use as potential aggregate sources.

Ideally, a source rock for concrete aggregate should be easily accessible with favorable bedding and joint patterns and chemical and physical characteristics that, upon mining and crushing, breaks down into optimum-sized, equidimensional particles. Physical and chemical properties for railroad ballast and road base are similar but less exhaustive than those for concrete aggregate. Therefore, with the exception of particle sizes, any source considered acceptable for concrete aggregate will generally exceed requirements for railroad ballast and road base.

3.2.2.1 Quartzite - Qtz

Extensive deposits of Lower Paleozoic and Precambrian quartzites which occur throughout the UARSA are capable of producing large quantities of hard, durable, nonalkali reactive crushed rock for use as aggregate (Drawing 1). Both metamorphic and sedimentary quartzites are present within the UARSA and possess similar aggregate characteristics. They are typically light colored, thin-to-medium bedded, hard to very hard rocks that are composed of 90 to 100 percent quartz grains. Geologic formations comprising the best quality potential quartzite aggregate include Prospect Mountain Quartzite (Class A), Eureka and Swan Peak quartzite (Class A), and Tintic Quartzite (Class A).

The quartzite formations in the UARSA are usually interbedded with shale, sandstone, and siltstone beds. In these locations this unit is generally ranked as Class B. Where the quartzite is extensive, accessible, and the dominant constituent of the mapped unit, it is ranked as Class A.

One existing quartzite rock quarry source located approximately 30 miles northeast of Delta, Utah, was noted during the field study, but it was not field-checked because of restricted access. It appears to be situated in Tintic Quartzite, a unit ranked as Class A elsewhere within the UARSA.

3.2.2.2 Limestone - Ls

Limestone is a carbonate rock widespread throughout the UARSA (Drawing 1). This hard, durable, medium to massively bedded cliff former is a potential source of high quality, non-alkali reactive crushed rock. The limestones are typically medium-to-dark gray, fine-to-medium grained, fossiliferous, and sparsely cherty with well developed bedding and jointing.

Principal geologic formations comprising the best limestone units include Ely Limestone, Great Blue Limestone, and the Marjum Limestone (Class A and/or Class B_1). These formations may also represent potential sources of cement; however, further work will be required to identify actual sites. Several limestone formations within the UARSA contain nodules or interbeds of chert as well as interbeds of shale and siltstone and thus are ranked as lower quality potential aggregate sources (Class B).

Two existing limestone rock quarries were noted during the field reconnaissances. One abandoned or inactive limestone quarry is located on the eastern flank of the Cricket Mountains in the central portion of the UARSA. Another abandoned or inactive limestone quarry is located approximately six miles north of the Tintic Mountains in the northern portion of the UARSA.

3.2.2.3 Dolomite - Do

Dolomite is a high magnesium carbonate rock that is located throughout the UARSA (Drawing 1) and is a potential source of good quality crushed rock. This rock is characteristically dark-to-medium gray, medium grained, moderately cherty with well developed bedding and jointing. Aggregate/portland cement potential alkali reactivity is suspected because of the rock texture and composition and the generally high chert content.

Principal formations comprising the bulk of this unit include the Simonson Dolomite and Notch Peak Dolomite (Class B_1). Dolomite, while present throughout the UARSA, is less voluminous than the limestone (section 3.2.2.2). Most dolomite formations within the UARSA are Class B_1, or Class B containing nodules or interbeds of chert as well as interbeds of shale, siltstone, sandstone, and cherty limestone.

3.2.2.4 Carbonate Rocks Undifferentiated - Cau

Materials classified as undifferentiated carbonate rocks include thick, complex sequences of limestones and dolomites interbedded with sandstone, shale, and siltstone (Drawing 1). Individual units were not delineated separately because of map scale limitations. Formations included within this unit are typically light-to-dark gray, thinly-to-massively bedded, hard, cherty, and fossiliferous. The undifferentiated carbonate rocks are generally ranked as Class B but range widely in quality, depending primarily upon their chert content and the number of shale, siltstone, and sandstone interbeds. They are generally hard, durable cliff formers that compose many of the major topographic features in eastern Nevada and western Utah.

3.2.2.5 Basalt - Vb

Quaternary basalt within the UARSA is predominantly confined to a narrow zone in the southeastern portion of the study area. These large deposits generally lie in easily accessible mid-valley localities as flows and associated cinder cones (Drawing 1). The basalt is typically a dense, dark gray to black, medium to thick bedded, locally vesicular, poorly jointed rock. Occasionally, interbeds of volcanic agglomerate and pumice are present.

Vesicular and locally scoriaceous (greater than 50 percent vesicles) upper portions and the suspected presence of potentially alkali reactive interstitial glass may make some basalts less desirable sources for concrete aggregate (Class B). However, these sources may provide more acceptable aggregate for railroad ballast and road base.

3.2.2.6 Granitic Rocks - Gr

Extensive exposures of granitic rocks (e.g., granite, monzonite) are located in the northwest portion of the UARSA (Drawing 1). They represent a potential source of nonreactive crushed rock, but their utilization is strongly dependent on the degree and depth to which they have been weathered.

These rocks are typically light colored, medium-to-coarse grained, siliceous-to-intermediate intrusions, with local gneissic or schistose structure developed near contacts and major structures. Where observed in outcrop, the majority of these granitic rocks were moderately weathered.

The degree of weathering observed at the surface and the uncertain depth to which the weathering extends below the surface required most granitic rocks within the UARSA to be ranked as Class B material.

3.2.2.7 Sedimentary Rocks Undifferentiated - Su

Sedimentary and metasedimentary rocks which are located throughout the UARSA in exposures too small to delineate at the map scale of 1:500,000 have been combined into an undifferentiated sedimentary rock unit (Drawing 1). Rocks within this unit include interbedded sandstone, shale, dolomite, limestone, and quartzite that may have been slightly metamorphosed in some areas.

Locally, the limestone, dolomite, and quartzite may represent potential high quality aggregate sources, but due to the extreme variability of the material types, the content of potentially alkali reactive material, and the extent of metamorphism and structural disturbance, undifferentiated sedimentary rocks have generally been ranked as Class B_2 or Class B materials.

3.2.2.8 Volcanic Rocks Undifferentiated - Vu

Throughout the UARSA, exposures of intermediate to silicic igneous rocks that occur as flows, dikes, intrusions, and pyroclastic debris have been combined into an undifferentiated volcanic rock unit (Drawing 1). Individual rock types have not been delineated because of map scale limitations and similarities in composition. This composite unit has generally been ranked as Class B_2 material due to its lack of durability, suspected content of alkalai reactive glass, and low density material. Locally better quality material, not delineated on Drawing 1, may be found within this unit.

3.2.2.9 Metamorphic Rocks Undifferentiated - Mu

Undifferentiated metamorphic rocks that crop out in the northern portion of the UARSA generally include gneiss, schist, and quartzite that could not be separately delineated because of map scale limitations (Drawing 1). The extent to which the gneiss and schist can be utilized as a source of aggregate is strongly dependent upon the depth of weathering and the degree to which they have been weakened by foliation (mineral segregation and orientation). These rocks commonly yield platy and/or elongate particles that contain similarily weak foliation zones. Where foliation is poorly developed or widely spaced, fresh material from these units may produce acceptable crushed rock. Quartzite is typically of higher quality wherever it occurs.

Overall, the undifferentiated metamorphic rocks have been generally ranked as Class B. Locally, higher quality material exists within this unit.

4.0 CONCLUSIONS

Sufficient volumes of material to satisfy the aggregate requirements of the MX system appear to be available from a variety of basin-fill and/or rock sources within the UARSA. The most extensive and highest quality (Class A and Class B_1) potential basin-fill aggregate resources are present in the central and northern portion of the study area where both older lacustrine and alluvial fan deposits are abundant. However, the gradation of the sands and gravels in these deposits may be a limiting factor to the processing of the material for high-strength concrete and railroad ballast. Preliminary indications are that plus 3/4-inch particle sizes are generally lacking (i.e., less than ten percent).

Potential rock sources that will probably yield high quality processed aggregate are widely distributed throughout the study area. Most mountain ranges that border the basin areas are comprised wholly or in part of Paleozoic and Precambrian carbonate and quartzitic rocks with scattered Quaternary basaltic rocks located in valley areas. Quartzitic rocks are typically of higher quality (Class A) than limestone and dolomite carbonate rocks (Class $B_1$and Class B) but are areally more limited. Basaltic outcrops are restricted to the southeastern portion of the study area and are less desirable (Class B) sources for concrete aggregate than either carbonate or quartzitic rocks. Nevertheless, they will probably provide moderate to good aggregates for road base and railroad ballast.

High quality rock sources are generally more readily available than high quality basin-fill sources. However, because of the higher cost of developing aggregate from rock sources, it generally will be more economical to develop available basin-fill sources. Locally it will probably be necessary to supplement basin-fill aggregates with crushed rock aggregates where high-strength concrete or 1-3/4 inch to 1-1/2 inch size railroad ballast material is required, or to augment the necessary quantities of maximum size concrete coarse aggregate.

Adequate supplies of surface water for aggregate treatment are only locally available within the UARSA. Ground-water supplies stored in basin-fill and rock aquifers are expected to supply the water for aggregate plant operations. Studies being conducted for the water resources program will provide the information needed to determine the water supply system for construction operations.

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APPENDIX A

UTAH-NEVADA STUDY AREA DATA SHEETS

EXPLANATION OF FIELD STATION AND SUPPLEMENTARY TEST DATA

Field station were established at locations throughout the UARSA where detailed descriptions of potential basin-fill or rock aggregate sources were recorded (Drawing 2). All field observations and laboratory test data on samples collected at selected stations are presented in Table A-1. Data entries record conditions at specific field station locations that have been generalized in the text and Drawing 1. Detailed explanations for the column headings in Table A-1 are as follows:

Column Heading	Explanation
Map Number	This sequentially arranged numbering system was established to facilitate the labelling of field station locations and existing data sites on Drawing 2 and to list the correlating information on Tables A-1 and A-2 in an orderly arrangement.
Field Station	Field stations were numbered sequentially during field reconnaissances. UGS or NGS are abbreviations denoting Utah or Nevada General Study field stations, respectively. Letters A and B, which preceed the station number, differentiate the two investigative teams.
Location	Lists major physiographic or cultural feature in/or near which field stations or existing data sites are situated.
Geologic Unit	Generalized basin-fill or rock geologic units at field station or existing data locations. Thirteen classifications, emphasizing age and lithologic distinctions were developed from existing geologic maps to accomodate map scale of Drawing 1.
Material Description	Except in cases where soil or rock samples were classified on laboratory results, the descriptions are based on field visual observations utilizing the Unified Soil

Column Heading	Explanation
Material Description (cont.)	Classification System (See Appendix C for detailed USCS information).
Field Observations	
Boulders and/or Cobbles, Percent	The estimated percentage of boulders and cobbles is based on an appraisal of the entire deposit. Cobbles have an average diameter between 3 and 12 inches (8 and 30 cm); boulders have an average diameter of 12 inches (30 cm) or more.
Gravel	Particles that will pass a 3-inch (76 mm) and are retained on No. 4 (4.75 mm) sieve.
Sand	Particles passing No. 4 sieve and retained on No. 200 (0.075 mm) sieve.
Fines	Silt or clay, soil particles passing No. 200.
Plasticity (Index)	Plasticity index is the range of water content, expressed as percentage of the weight of the oven-dried soil, through which the soil is plastic. It is defined as the liquid limit minus the plastic limit. Field classification followed standard descriptions and their ranges are as follows: None - Nonplastic (NP) (PI, 0 - 4) Low - Slightly plastic (PI, 4 - 15) Medium - Medium plastic (PI, 15 - 30) High - Highly plastic (PI, > 31)
Hardness	A field test to identify materials that are soft or poorly bonded by estimating their resistance to impact with a rock hammer; classified as either soft, moderately hard, hard, or very hard.
Weathering	Changes in color, texture, strength, chemical composition or other properties of rock outcrops or rock particles due to the action of weather; field classified as either fresh or slight(ly) moderate(ly) or very weathered.
Deleterious Materials	Substances potentially detrimental to concrete performance that may be present in aggregate; includes organic impurities, low density material, (ash, vesicules,

Column Heading	Explanation
Deleterious Material (cont.)	pumice, cinders), amorphous silica (opal, chert, chalcedony), volcanic glass, caliche coatings, clay coatings, mica, gypsum, pyrite, chlorite, and friable materials, also, aggregate that may react chemically or be affected chemically by other external influences.
Laboratory Test Data	
Sieve Analysis (ASTM C 136)	The determination of the proportions of particles lying within certain size ranges in granular material by separation on sieves of different size openings; 3-inch, 1 1/2-inch, 3/4-inch, 3/8-inch, No. 4, No. 8, No. 16, No. 30, No. 50, No. 100 and No. 200.
Abrasion Test (ASTM C 131)	A method for testing abrasion resistance of an aggregate by placing a specified amount in a steel drum (the Los Angeles testing machine), rotating it 500 times, and determing the material worn away.
Soundness Test (ASTM C 88) CA, FA	CA = Coarse Aggregate FA = Fine Agregate The testing of aggregates to determine their resistance to disintegration by saturated solutions of magnesium sulfate. It furnishes information helpful in judging the soundness of aggregates subject to weathering action, particularly when adequate information is not available from service records of the material exposed to actual weathering conditions.
Ranking	Potential basin-fill and rock aggregate sources were ranked as Class A, Class B (subdivided into B_1 and B_2 whenever possible), and Class C (See text, Section 2.2 for detailed discussion). Although the assigned ranking will generally directly reflect the results presented in Table A-1, its determination is the product of a total assessment of many factors, all of which are not presented. Both fine and coarse basin-fill aggregate sources were evaluated and ranked. The ranking of deposits which are potential fine and/or coarse aggregate sources was made on the predominant size range.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES PERCENT	DIS... MA... T... GRAVEL
1	UGS-A1	Skull Valley	Aol	Sandy Gravel	GW		
2	UGS-A2	Skull Valley	Aol	Sandy Gravel	GP	10	75
3	UGS-A3	Skull Valley	Ls	Limestone			
4	UGS-A4	Dugway Valley	Cau	Dolomite			
5	UGS-A5	Dugway Valley	Vu	Latite			
6	UGS-A6	Dugway Valley	Aol	Sandy Gravel	GP		85
7	UGS-A7	Sevier Desert	Vb	Basalt			
8	UGS-A8	Tule Valley	Aol	Sandy Gravel	GW		
9	UGS-A9	Tule Valley	Aol	Sandy Gravel	GW		
10	UGS-A10	Sevier Desert	Vb	Basalt			
11	UGS-A11	Sevier River	Au	Silty Clay	CL	0	0
12	UGS-A12	Pavant Valley	Vb	Basalt			
13	UGS-A13	Pavant Range	Qtz	Quartzite			
14	UGS-A14	Holden	Aol	Silty Sand	SP-SM	0	25

	FIELD OBSERVATIONS							LABORATORY TEST DATA									
	DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT							SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
PERCENT	GRAVEL	SAND	FINES	PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 1
				Low			<5% chert, caliche coatings	100	93.2	72.8	45.8	31.5	29.5	27.9	25.2	21.8	15.
	75	20	5	None			<5% chert, caliche coatings										
					Hard	Slight	<5% chert										
					Hard	Slight	iron oxide, calcite veins										
					Hard	Moderate	5% volcanic glass										
	85	15	T	None			10% volcanic glass, clay coatings										
					Very Hard	Slight	<10% vesicles										
				None			caliche coatings	100	99.0	85.1	44.1	13.4	6.8	4.2	3.7	3.5	2
				None			caliche coatings	100	97.1	79.4	48.7	17.4	7.2	3.7	2.7	2.2	1
					Very Hard	Moderate	10% vesicles										
	0	5	95	High			clay										
					Very Hard	Fresh	<10% vesicles										
					Very Hard	Fresh	none										
	25	65	10	Low			5% chert, caliche coatings										

... TEST DATA

... G (ASTM C 136)					ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		RANKING
	NO. 30	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS		
						CA	FA	
9	25.2	21.8	15.1	3.1	22.3	2.15		B
								B
								B_1
								B_1
								B
								B
					19.6	1.01		B_1
.2	3.7	3.5	2.4	0.5	22.2	0.73		B
.7	2.7	2.2	1.7	1.1	26.1	1.75		B
					25.8	2.60		B
								C
								B_1
								A
								B

FIELD STATION AND SUPPLEMENTARY TEST DATA
PAGE 1 OF 14
UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

3

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES, PERCENT	DISTRIBU MATERIAL THAN C PERC	
							GRAVEL	SAND
15	UGS-A15	Black Rock	Vb	Basalt				
16	UGS-A16	Sevier Desert	Aol	Sandy Gravel	GP	T	65	30
17	UGS-A17	Cricket Mountain	Cau	Limestone				
18	UGS-A18	Sevier Desert	Aol	Gravelly Sand	SM	0	15	70
19	UGS-A19	Oak City	Su	Conglomerate				
20	UGS-A20	Tule Valley	Cau	Dolomite				
21	UGS-A21	Tule Valley	Ls	Limestone				
22	UGS-A22	Tule Valley	Aol	Sandy Gravel	GP	0	80	20
23	UGS-A23	Tule Valley	Vu	Ash Flow				
24	UGS-A24	The Barn	Qtz	Quartzite				
25	UGS-A25	The Barn Pass	Do	Dolomite				
26	UGS-A26	The Barn	Do	Dolomite				
27	UGS-A27	Marjum Pass	Aol	Sandy Gravel	GP	T	90	10
28	UGS-A28	Tule Valley	Ls	Limestone				
29	UGS-A29	Tule Valley	Aol	Sandy Gravel	GP	T	60	40

FIELD OBSERVATIONS								LABORATORY TEST DATA									
	DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
PERCENT	GRAVEL	SAND	FINES					3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	N 1
					Very Hard	Moderate	none										
	65	30	5	None			caliche coatings										
					Very Hard	Fresh	5% chert, calcite veins										
	15	70	15	Low			caliche coatings										
					Mod. Hard	Moderate	15% friable material										
					Very Hard	Fresh	<5% chert										
					Very Hard	Fresh	<5% chert										
	80	20	T	None			5% chert, caliche coatings										
					Very Hard	Fresh	10% volcanic glass & pumice										
					Very Hard	Fresh	none										
					Very Hard	Fresh	5% chert										
					Very Hard	Fresh	none										
	90	10	0	None			10% mica schist particles										
					Mod.	Moderate	<5% chert										
	60	40	T	None			<5% chert										

LABORATORY TEST DATA												RANKING
[E] ANALYSIS, PERCENT PASSING (ASTM C 136)									ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		
[¾"]	3/8"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	
												B_1
												B
									32.3	0.77		B
												B_2
												B
												B_1
												B_1
												B
												B_2
												B_1
												B
												B
												B
												B_1
												B_1

FIELD STATION AND SUPPLEMENTARY TEST DATA
PAGE 2 OF 14
UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES PERCENT	DISTRI MATERI THAN PE	
							GRAVEL	
30	UGS-A30	Sand Pass	Ls	Limestone				
31	UGS-A31	Fish Spring Flat	Ls	Dolomite				
32	UGS-A32	Fish Springs Valley	Aol	Gravelly Sand	SP	0	20	80
33	UGS-A33	Antelope Ridge	Vu	Rhyolite				
34	UGS-A34	Crate Bench Reservoir	Aol	Gravelly Sand	SP	0	20	80
35	UGS-A35	Pine Wash	Gr	Granite				
36	UGS-A36	Pine Wash	Gr	Granite				
37	UGS-A37	Desert Mountain	Gr	Granite				
38	UGS-A38	Black Mountain	Aol	Silty Gravel	GM	5	60	20
39	UGS-A39	Sevier River	Au	Gravelly Sand	SP	0	20	80
40	UGS-A40	Cove Creek Pass	Vb	Basalt				
41	UGS-A41	Mineral Mountains	Vb	Basalt				
42	UGS-A42	Black Rock	Aol	Gravelly Sand	SP-SM	0	15	7[illegible]

FIELD OBSERVATIONS							LABORATORY TEST DATA									
DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
GRAVEL	SAND	FINES					3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 10
				Hard	Slight	scattered calcite veins										
				Hard	Fresh	5 % chert										
20	80	0	None			50% volcanic glass particles										
				Very Hard	Fresh	10% volcanic glass, zeolites										
20	80	0	None			5% chert										
				Mod. Hard	Very	5% mica										
				Mod. Hard	Very	limonite, copper oxide										
				Mod. Hard	Moderate	5% mica										
60	20	20	Low			10% volcanic glass, clay coatings										
20	80	T	None			10% volcanic particles										
				Very Hard	Fresh	5% volcanic glass										
				Hard	Slight	scattered volc. glass										
15	75	10	None			<10% volcanic glass particles										

2

...RATORY TEST DATA									
...PASSING (ASTM C 136)						ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		RANKING
	NO. 16	NO. 30	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS		
							CA	FA	
									B_1
									B
									C
									B
									B
									B
									B
									B
									B
									B
									B
									B
									A

FIELD STATION AND SUPPLEMENTARY TEST DATA
PAGE 3 OF 14
UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

3

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES PERCENT	DISTRI MATERI THAN PER	
							GRAVEL	SAN
43	UGS-A43	Beaver River	Aol	Gravelly Sand	SP	0	10	90
44	UGS-A44	Big Wash	Au	Gravelly Sand	SP	0	15	85
45	UGS-A45	Wah Wah Valley	Aol	Sandy Gravel	GW			
46	UGS-A46	Star Range	Gr	Granite				
47	UGS-A47	Hamlin Valley	Do	Limestone				
48	UGS-A48	Wah Wah Summit	Cau	Limestone				
49	UGS-A49	Warm Love Ridge	Aaf	Sandy Gravel	GP	T	50	45
50	UGS-A50	Pine Valley	Aal	Sandy Gravel	GP	T	70	30
51	UGS-A51	Ferguson Desert	Do	Dolomite				
52	UGS-A52	Crystal Peak	Vu	Ash Flow				
53	UGS-A53	Crystal Peak	Aaf	Sandy Gravel	GP	5	50	50
54	UGS-A54	Grassey Cove	Ls	Limestone				
55	UGS-A55	Pine Valley	Vu	Latite Ignimbrite				

FIELD OBSERVATIONS							LABORATORY TEST DATA									
ISTRIBUTION OF ATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
GRAVEL	SAND	FINES					3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100
0	90	0	None			5% intermed. volcanic particles										
5	85	T	None			none										
						5% altered volcanic particles,	100	87.0	70.2	54.1	42.1	33.0	26.0	20.2	6.6	2.1
				Very Hard	Fresh	5% edpidote, zeolites										
				Mod. Hard	Moderate	5% chert										
				Very Hard	Slight	scattered calcite veins										
0	45	5	Low			10% intermed. volcanic particles, 5% chert										
0	30	0	None			none										
				Hard	Slight	15 to 50% chert										
				Soft	Slight	75% volcanic glass and pumice										
0	50	T	None			20% intermed. volcanic, caliche coatings										
				Very Hard	Slight	5% chert										
				Mod. Hard	Moderate	5% chal-cedony, 5% volcanic glass										

...T DATA							
...TM C 136)				ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		RANKING
...	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	
							B
							A
.2	6.6	2.1	1.0	22.2	1.08	11.3	B
							B_2
							B
							B
							B
							A
							C
							C
							B
							B
							B_2

FIELD STATION AND SUPPLEMENTARY TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

3

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES, PERCENT	DISTRIBUT[...] MATERIAL [...] THAN CO[...] PERCE[...]	
							GRAVEL	SAND
56	UGS-A56	Pine Valley	Aal	Gravelly Sand	SP	0	15	85
57	UGS-A57	Pine Valley	Aaf	Gravelly Sand	SP	5	35	65
58	UGS-A58	Pine Valley	Au	Gravelly Sand	SP	0	T	95
59	UGS-A59	Pine Valley	Aaf	Sandy Gravel	GP	5	65	30
60	UGS-A60	Pine Valley	Qtz	Quartzite				
61	UGS-A61	Pine Valley	Vu	Rhyodacite				
62	UGS-A62	Pine Valley Ridge	Aaf	Gravelly Sand	SP	T	15	85
63	UGS-A63	Escalante Desert	Aal	Sandy Gravel	GP	10	60	40
64	UGS-A64	Blue Mountain	Vu	Tuff				
65	UGS-A65	Escalante Desert	Aal	Gravelly Sand	SP	5	45	55
66	UGS-A66	Escalante Desert	Vb	Volcanic Flow Breccia				
67	UGS-A67	Escalante Desert	Aaf	Sandy Gravel	GP	5	60	40
68	UGS-A68	Escalante Desert	Vu	Dacite				

FIELD OBSERVATIONS							LABORATORY TEST DATA									
ISTRIBUTION OF ATERIAL FINER THAN COBBLES, PERCENT							SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
GRAVEL	SAND	FINES	PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100
5	85	0	None			>70% intermed. volcanic particles and ash										
5	65	T	None			none										
T	95	5	None			5% chalcedony										
5	30	5	None			none										
				Very Hard	Fresh	none										
				Soft	Very	5% volcanic glass										
5	85	T	None			>80% intermed. volc. & low density particles										
0	40	T	None			<5% intermed. volcanic particles										
				Mod. Hard	Moderate	>70% volcanic glass										
5	55	T	None			80% volcanic and low density particles										
				Mod. Hard	Slight	>50% low density materials										
0	40	T	None			>50% altered volc. & low density particles										
				Mod. Hard	Moderate	none										

RY TEST DATA

NG (ASTM C 136)				ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		RANKING
NO. 30	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS		
					CA	FA	
							C
							A
							B_2
							B_1
							A
							B
							C
							B
							C
							C
							C
							C
							B

FIELD STATION AND SUPPLEMENTARY TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

3

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES, PERCENT	DISTRIBU MATERIAL THAN CO PERCE GRAVEL	SAND
69	UGS-A69	Escalante Desert	Aaf	Sandy Gravel	GP	T	50	45
70	UGS-A70	Escalante Desert	Vu	Rhyodacite				
71	UGS-A71	Iron Mountain	Tailings	Crushed Rock				
72	UGS-A72	Big Mountain	Su	Sandstone				
73	UGS-A73	Enterprise	Vb	Basalt				
74	UGS-A74	Steptoe Valley	Su	Limestone				
75	UGS-A75	Spring Valley	Aaf	Gravelly Sand	SP-SM	T	30	60
76	UGS-A76	Spring Valley	Vu	Rhyolite				
77	UGS-A77	Shelbourne Pass	Ls	Limestone				
78	UGS-A78	Spring Valley	Aaf	Silty Gravelly Sand	SP-SM	T	15	75
79	UGS-A79	Spring Valley	Aaf	Gravelly Sand	SP	T	40	55

FIELD OBSERVATIONS							LABORATORY TEST DATA									
ISTRIBUTION OF ATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
GRAVEL	SAND	FINES					3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100
0	45	5	None			30% volcanic particles, caliche coatings										
				Mod. Hard	Slight	none										
				Hard	Slight	Limonite Magnetite										
				Soft	Moderate	<10% fraiable materials										
				Hard	Slight	5% volcanic glass 5% vesicles										
				Hard	Slight	5% chert										
0	60	10	None			<50% volcanic glass, clay coatings										
				Mod. Hard	Moderate	5% volcanic glass, zeolites										
				Hard	Moderate	iron stain, calcite veins										
5	75	10	None			caliche coatings, clay coatings										
0	55	5	Low			5% to 15% volcanic glass										

T DATA							
TM C 136)				ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		RANKING
D. 0	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS		
					CA	FA	
							B_2
							B
							B_2
							B
							B
							B
							B
							B
							B
							B
							B

FIELD STATION AND SUPPLEMENTARY TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

3

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES, PERCENT	DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT: GRAVEL	DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT: SAND
181	UGS-B70	Spring Valley	Su	Limestone				
182	UGS-B71	Snake Valley	Cau	Limestone				
183	NGS-B72	Spring Valley	Aaf	Gravelly Sand	SP-SM	15	40	50
184	NGS-B73	Spring Valley	Aaf	Gravelly Sand	SM	15	35	60
185	NGS-B74	Spring Valley	Aaf	Gravelly Sand	SM	5	40	60
186	NGS-B75	Schell Creek Range	Vu	Andesite				
187	NGS-B76	Schell Creek Range	Aaf	Sandy Gravel	GW	15	50	30
188	NGS-B77	Antelope Valley	Su	Dolomite				
189	NGS-B78	Antelope Spring	Aaf	Gravelly Sand	SW	10	40	50
190	NGS-B79	Spring Valley	Aaf	Gravelly Sand	SW	T	35	65
191	NGS-B80	Antelope Valley	Ls	Quartzite				
192	NGS-B81	Antelope Valley	Vu	Rhyodacite				

FIELD OBSERVATIONS							LABORATORY TEST DATA									
DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
GRAVEL	SAND	FINES					3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	[illegible]
				Hard	Slight	none										
				Hard	Slight	none										
40	50	10	Low			caliche coatings										
35	60	5	None			caliche coatings										
40	60	T	None			10% chlorite schist particles										
				Hard	Moderate	10% volcanic glass										
50	30	5	None			caliche coatings										
				Hard	Slight	20% chert										
40	50	T	None			caliche coatings										
35	65	T	None			caliche coatings										
				Very Hard	Slight	none										
				Hard	Slight	10% volcanic glass & pumice particles										

EST DATA							
ASTM C 136)				ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		RANKING
NO. 30	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS		
					CA	FA	
							A
							B_1
							B
							B
							B_2
							B_2
							B
							B_2
							B
							B
							B_1
							B_2

FIELD STATION AND SUPPLEMENTARY TEST DATA
PAGE 14 OF 14
UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

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EXPLANATION OF EXISTING DATA

Existing data pertaining to aggregates were extracted from the Utah State Department of Highways' Materials Inventory county reports. These reports are compilations of avaiable site data from existing files and records and are intended to accurately locate, investigate, and catalog materials needed for highway construction. Explanations for column headings which appear in Table A-2, that have not been previously discussed in Table A-1, are given below:

Column Heading	Explanation
Site Number	Utah State Department of Highways pit or site number. Locations correspond to map numbers listed on this table and placed on Drawing 2.
Material Description USCS Symbol	To maintain conformity within the study, the Utah State Department of Highways classification system (A.A.S.H.O.) was converted to the Unified Soil Classification System (USCS) utilizing the sieve analyses' size distribution and the plasticity indices.
Sieve Analysis	The size distribution of fine and coarse aggregate samples was determined by sieving. In some samples, particles greater than 1 inch in size (>1 inch) were crushed to 1 inch maximum size and remixed with the remaining sample before sieving. In these cases, data entries under 1 inch are 100 percent, preceeded by before crushing percentages.
No. 8, No. 5	Samples tested before mid-1963 used No. 10 and No. 40 sieves, respectively. These entries are marked with asterisks.
Soundness Test	The testing of aggregates to determine their resistance to disintegration by saturated solutions of sodium sulfate. It furnishes information helpful in judging the soundness of aggregates subject to weathering action,

Column Heading	Explanation
Soundness Test (cont.)	particularly when adequate information is not available from service records of the material exposed to actual weathering conditions.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
193	23090	USDH Tooele Co.	Rush Valley	Aol	Gravelly Sand
194	23091	USDH Tooele Co.	Rush Valley	Aaf	Sandy Gravel
195	23118	USDH Tooele Co.	Rush Valley	Aol	Sandy Gravel
196	23119	USDH Tooele Co.	Rush Valley	Aol	Silty Sandy Gravel
197	23120	USDH Tooele Co.	Rush Valley	Aol	Silty Sandy Gravel
198	23121	USDH Tooele Co.	Rush Valley	Aol	Sandy Gravel
199	23122	USDH Tooele Co.	Rush Valley	Aol	Gravelly Sand
200	23123	USDH Tooele Co.	Rush Valley	Aaf	Clayey Gravel
201	23124	USDH Tooele Co.	Vernon Creek	Aaf	Clayey Gravel
202	23125	USDH Tooele Co.	Vernon Creek	Aaf	Clayey Gravel
203	23126	USDH Tooele Co.	Rush Valley	Aaf	Sandy Gravel
204	23127	USDH Tooele Co.	Rush Valley	Aaf	Sandy Gravel
205	23128	USDH Tooele Co.	Rush Valley	Au	Silty Sandy Gravel
206	23129	USDH Tooele Co.	Skull Valley	Aol	Sandy Gravel
207	23134	USDH Tooele Co.	Salt Lake Desert	Aol	Sandy Gravel
208	23135	USDH Tooele Co.	Salt Lake Desert	Aol	Sandy Gravel
209	23137	USDH Tooele Co.	Skull Valley	Aol	Sandy Gravel
210	23138	USDH Tooele Co.	Skull Valley	Aol	Sandy Gravel
211	23139	USDH Tooele Co.	Skull Valley	Aol	Sandy Gravel
212	23140	USDH Tooele Co.	Skull Valley	Aol	Sandy Gravel
213	23141	USDH Tooele Co.	Great Salt Lake Desert	Aol	Sandy Gravel
214	23142	USDH Tooele Co.	Great Salt Lake Desert	Aol	Sandy Gravel
215	23143	USDH Tooele Co.	Great Salt Lake Desert	Aol	Sandy Gravel

	USCS SYMBOL	SIEVE ANALYSIS								ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		PLASTICITY INDEX (ASTM D 423 and D 424)
		BEFORE CRUSHING, PERCENT		PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE						PERCENT WEAR	PERCENT LOSS		
		>3"	>1"	1"	½"	NO. 4	NO. 8	NO. 50	NO. 200		CA	FA	
	SP-SM	0	0	100	95	59	42	11	8.0	27.8	8.62	7.46	NP
	GP-GM	0	14	100	61	26	20	14	8.1	26.7	6.39	15.6	NP
	GP	0	1	100	84	43	27	4	3.3	24.8	2.2	5.4	NP
el	GM	0	12	100	63	27	24	20	14.4	22.7	2.14	2.42	NP
el	GM	0	9	100	70	42	31	21	14.1	25.2	1.20	4.03	1
	GP-GM	0	25	100	54	32	24	15	6.8	27.6	2.16	17.1	NP
	SP-SM	0	13	100	92	65	45	14	8.1	20	5.60	13.5	NP
	GC	7	36	100	60	34	24	11	7.5	21.4	0.69	5.7	20
	GC	16	46	100	52	33	25	9	5.7	21.5	0.84	7.28	14
	GC	4	37	100	53	31	23	8	4.2	20.6	0.58	3.78	13
	GP-GM	18	43	100	60	41	33	22	11.5	22.7	1.4	5.8	NP
	GC	3	24	100	72	49	36	14	5.2	23.8	2.77	8.23	7
el	GM	0	15	100	69	44	35	26	17.4	28.2	1.09	5.31	NP
	GP	0	19	100	57	21	12	4	1.2	18.3	1.34	7.89	NP
	GP	23	73	100	77	22	15	6	2.4	20.1	10.84	22.11	NP
	GP	0	21	100	85	43	24	4	0.9	19.7	1.61	8.69	NP
	GP	23	59	100	63	34	28	19	3.0	17.0	3.09	4.98	NP
	GP	4	23	100	73	43	36	22	4.2	21.9			NP
	GP	0	20	100	49	29	18	8	3.1	28.5	1.55	7.22	NP
	GP	0	16	100	72	42	22	4	1.8	22.8	2.3	6.98	NP
	GP	4	14	100	67	36	18	5	2.0	22.4	0.49	7.80	NP
	GP	0	4	100	42	7	7	5	2.8	23.8	0.87		4
	GC	0	20	100	50	19	14	3	1.6	29.2	0.24	4.88	2

EXISTING TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

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MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
216	23144	USDH Tooele Co.	Great Salt Lake Desert	Aol	Sandy Gravel
217	23145	USDH Tooele Co.	Great Salt Lake Desert	Aol	Gravelly Sand
218	23146	USDH Tooele Co.	Great Salt Lake Desert	Aaf	Gravelly Sand
219	23152	USDH Tooele Co.	Antelope Valley	Aol	Gravelly Sand
220	23153	USDH Tooele Co.	Antelope Valley	Aol	Sandy Gravel
221	23154	USDH Tooele Co.	Antelope Valley	Aol	Sandy Gravel
222	23156	USDH Tooele Co.	Antelope Valley	Aol	Gravelly Sand
223	23157	USDH Tooele Co.	Antelope Valley	Aol	Sandy Gravel
224	23160	USDH Tooele Co.	Antelope Valley	Aol	Sandy Gravel
225	23161	USDH Tooele Co.	Antelope Valley	Aol	Gravelly Sand
226	23162	USDH Tooele Co.	Great Salt Lake Desert	Aol	Gravelly Sand
227	12045	USDH Juab Co.	Leamington Canyon	Aol	Sandy Gravel
228	12046	USDH Juab Co.	N. Sevier Desert	Aol	Silty Gravelly San
229	12047	USDH Juab Co.	N. Sevier Desert	Aol	Sandy Gravel
230	12048	USDH Juab Co.	N. Sevier Desert	Aol	Silty Gravel Sand
231	12049	USDH Juab Co.	N. Sevier Desert	Aol	Sandy Gravel
232	12050	USDH Juab Co.	N. Sevier Desert	Aol	Silty Gravelly San

USCS SYMBOL	SIEVE ANALYSIS: BEFORE CRUSHING, PERCENT		SIEVE ANALYSIS: PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE						ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88) PERCENT LOSS		PLASTICITY INDEX (ASTM D 423 and D 424)
	>3"	>1"	1"	½"	NO. 4	NO. 8	NO. 50	NO. 200	PERCENT WEAR	CA	FA	
GP	2	31	100	42	29	26	16	2.0	20.1	0.19	3.03	NP
SP	0	1	100	91	52	37	6	1.9	23.1	2.1	8.7	NP
SP	0	4	100	88	64	50	14	0.7	32.7	2.1	7.3	NP
SP-SM	0	2	100	89	61	43	12	5.9	30.5		18.3	NP
GP	0	7	100	75	41	30	10	3.1	28.2	0.96	5.81	NP
GP-GM	0	17	100	83	47	30	11	6.7	25.8	0.42	6.91	NP
SP	0	5	100	87	59	42	7	4.0	38.5		6.51	NP
GP	0	23	100	57	29	21	11	5.0	24.3	0.72	3.63	NP
GP	0	3	100	78	42	27	6	2.9	22.6	0.57	6.19	NP
SP	2	13	100	79	57	38	9	1.7	26.7	0.80	5.95	NP
GP-GM	0	7	100	79	49	25	8	6.6	21.0	2.89	9.29	NP
GP		4.7	95.3	92.5	36.6	*13.9	*6.4	4.4	24.7			NP
SM	4.1	10.8	100		61.7	*49.9	*43.2	12.8	20.6			NP
GP-GM			100		38.4	*26.4	*18.8	10.1	23.6			NP
SM	0	3.2	100		61.4	*46.4	*35.6	18.1	24.0			NP
GP-GM	0	10.9	100		51.5	*24.5	*14.8	5.9	18.6			NP
SP-SM	0	3.0	97.0		59.4	*33.3	*30.5	11.6				NP

EXISTING TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
233	12051	USDH Juab Co.	N. Sevier Desert	Aol	Sandy Gravel
234	12052	USDH Juab Co.	N. Sevier Desert	Aol	Sandy Gravel
235	12053	USDH Juab Co.	N. Sevier Desert	Aol	Clayey Sand
236	12054	USDH Juab Co.	N. Sevier Desert	Aaf	Silty Gravel
237	12061	USDH Juab Co.	Tintic Valley	Aol	Sandy Gravel
238	12062	USDH Juab Co.	N. Sevier Desert	Au	Clayey Gravelly Sand
239	12063	USDH Juab Co.	N. Sevier Desert	Au	Gravelly Sand
240	12064	USDH Juab Co.	N. Sevier Desert	Au	Silty Gravelly Sand
241	12065	USDH Juab Co.	N. Sevier Desert	Au	Gravelly Sand
242	12066	USDH Juab Co.	N. Sevier Desert	Aol	Gravelly Sand
243	12067	USDH Juab Co.	N. Sevier Desert	Aol	Gravelly Sand
244	12068	USDH Juab Co.	N. Sevier Desert	Aol	Gravelly Sand
245	14017	USDH Millard Co.	Scipio Pass	Aaf	Silty Sandy Gravel
246	14018	USDH Millard Co.	Scipio Pass	Au	Silty Sandy Gravel
247	14019	USDH Millard Co.	E. Sevier Desert	Aal	Sandy Gravel
248	14020	USDH Millard Co.	E. Sevier Desert	Au	Silty Gravel
249	14021	USDH Millard Co.	E. Sevier Desert	Au	Silty Sandy Gravel

USCS SYMBOL	SIEVE ANALYSIS: BEFORE CRUSHING, PERCENT		SIEVE ANALYSIS: PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE						ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88) PERCENT LOSS		PLASTICITY INDEX (ASTM D 423 and D 424)
	>3"	>1"	1"	½"	NO. 4	NO. 8	NO. 50	NO. 200	PERCENT WEAR	CA	FA	
GM	0	4.2	95.8		53.5	*44.6	*39.6	26.3				NP
GP	2.2	18.7	100	69.2	37.3	22.6	6.7	4.0	28.9	2.16	3.28	NP
SC		13.4	100	85.8	64.4	*56.2	*44.5	25.3	20.5			10
GM	14.0	25.7	100	74.8	54.2	*45.3	*32.0	16.3	27.6			NP
GP-GM		19.1	100		37.2	*25.3	*15.0	8.6	29.2			NP
GC-SC	0	6.8	100	83.8	55.5	41.5	14.2	8.3	27.9	17.0	19.6	8
SP-SM	0	5.3	100	83.4	57.2	44.2	24.3	10.3	34.6	4.26	6.68	3
SP-SM	0.6	4.7	100	88.1	68.3	53.4	18.1	7.4		12.9	15.8	NP
SP	1.0	5.5	100	85.4	64.2	46.7	10.2	4.2	26.1	9.03	15.3	NP
SP	1.1	5.1	100	89.9	64.8	*43.5	*7.2	3.6	26.1	3.16	6.05	NP
SP-SM	0	10.5	100	83.7	57.0	40.7	17.2	7.2	25.1	2.61	8.55	NP
SP	0	10.6	100	83.2	61.6	32.5	5.4	2.3	26.2	2.93	9.95	NP
GM		14.7	100	74.5	46.8	*28.3	*24.1	14.2	37.6			NP
GM			100		49.6	*38.9	*24.2	14.3	40.8			
GP-GM	17.8	42.3	100		38.4	*28.0	*18.9	9.0	23.2			NP
GM	1.8	14.2	100	77.1	52.8	*39.4	*27.8	18.4	34.2	16.3	15.3	NP
GM	14.2	30.6			40.8	*37.6	*28.2	13.4				4

EXISTING TEST DATA

UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
250	14022	USDH Millard Co.	E. Sevier Desert	Aol	Sandy Gravel
251	14024	USDH Millard Co.	E. Sevier Desert	Aol	Sandy Gravel
252	14025	USDH Millard Co.	E. Sevier Desert	Aal	Gravelly Sand
253	14026	USDH Millard Co.	E. Sevier Desert	Aol	Sandy Gravel
254	14027	USDH Millard Co.	E. Sevier Desert	Aol	Sandy Gravel
255	14028	USDH Millard Co.	E. Sevier Desert	Aol	Gravelly Sand
256	14029	USDH Millard Co.	E. Sevier Desert	Aal	Sandy Gravel
257	14030	USDH Millard Co.	E. Sevier Desert	Aol	Silty Sandy Gravel
258	14031	USDH Millard Co.	E. Sevier Desert	Au	Gravelly Sand
259	14032	USDH Millard Co.	E. Sevier Desert	Aal	Gravelly Sand
260	14033	USDH Millard Co.	E. Sevier Desert	Aaf	Sandy Gravel
261	14034	USDH Millard Co.	E. Sevier Desert	Aol	Sandy Gravel
262	14035	USDH Millard Co.	E. Sevier Desert	Aol	Sandy Gravel
263	14036	USDH Millard Co.	E. Sevier Desert	Aol	Sandy Gravel
264	14037	USDH Millard Co.	E. Sevier Desert	Au	Gravelly Sand
265	14038	USDH Millard Co.	E. Sevier Desert	Au	Gravelly Sand

S OL	SIEVE ANALYSIS								ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		PLASTICITY INDEX (ASTM D 423 and D 424)
	BEFORE CRUSHING, PERCENT		PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE							PERCENT LOSS		
	>3"	>1"	1"	½"	NO 4	NO 8	NO 50	NO 200	PERCENT WEAR	CA	FA	
-GM	3.8	57.3	100		33.0	*25.7	*18.3	6.0				NP
GP	0	23.4	100		39.6	*32.7	*22.9	2.7	21.8			NP
SM	0	14.2	100		60.3	*47.5	*35.1	15.8	21.0			NP
-GM	0	13.8	100	65.5	34.1	*21.6	*15.5	5.7	25.8			NP
-GM	0	22.1	100	79.1	46.7	*27.4	*20.5	5.1	20.9			NP
SP			100	97.3	71.3	*33.2	*16.6	2.9				NP
-GM	15.9	39.9	100	62.8	42.0	*35.6	*16.5	8.4	29.0			NP
GM	0	26.7	100	76.5	51.5	*41.6	*31.7	14.2	26.1			NP
GP		4.2	100	88.5	33.7	*18.0	*10.2	2.4	50.0			
-GM	22.4	66.1	100		40.6	*29.7	*19.4	7.3	31.9			NP
-GM			100		45.6		*12.2	7.5				NP
GP	7.7	39.7	100	59.0	37.0	27.0	7.7	4.4	28.8	4.93	5.99	NP
GP		46.2	100	48.1	23.5	*16.9	*9.1	2.3	28.8			NP
P	0	12.3	100	72.2	47.1	37.7	14.2	4.7	21.9	0.99	4.09	NP
P		5.8	100	89.9	64.4	*40.8	*10.7	2.3	42.0			
P			100	93.4	75.2	*57.8	*20.4	1.7				

EXISTING TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

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MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
266	14039	USDH Millard Co.	E. Sevier Desert	Aaf	Sandy Gravel
267	14040	USDH Millard Co.	E. Sevier Desert	Aol	Gravelly Sand
268	14041	USDH Millard Co.	E. Sevier Desert	Aol	Sandy Gravel
269	14042	USDH Millard Co.	White Sage Flats	Aol	Sandy Gravel
270	14043	USDH Millard Co.	White Sage Flats	Au	Sandy Gravel
271	14044	USDH Millard Co.	Dog Valley	Au	Silty Sandy Gravel
272	14045	USDH Millard Co.	Dog Valley	Aaf	
273	14046	USDH Millard Co.	Dog Valley	Au	Gravelly Sand
274	14047	USDH Millard Co.	S. Sevier Desert	Au	Silty Sand
275	14048	USDH Millard Co.	S. Sevier Desert	Au	Silty Gravelly Sand
276	14049	USDH Millard Co.	S. Sevier Desert	Aaf	Clayey Gravelly Sand
277	14050	USDH Millard Co.	S. Sevier Desert	Aaf	Silty Sandy Gravel
278	14051	USDH Millard Co.	Leamington Canyon	Au	Gravelly Sand
279	14052	USDH Millard Co.	Leamington Canyon	Au	Sandy Gravel
280	14053	USDH Millard Co.	Leamington Canyon	Au	Gravelly Sand
281	14054	USDH Millard Co.	Leamington Canyon	Au	Sandy Gravel

USCS SYMBOL	SIEVE ANALYSIS: BEFORE CRUSHING, PERCENT		SIEVE ANALYSIS: PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE						ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88) PERCENT LOSS		PLASTICITY INDEX (ASTM D 423 and D 424)
	>3"	>1"	1"	½"	NO 4	NO 8	NO 50	NO 200	PERCENT WEAR	CA	FA	
GP-GM	8.4	24.8	100	74.2	44.1	32.5	13.5	5.4	23.5	7.19	13.69	NP
SP			100	89.3	53.8	43.1	21.2	3.5	20.5	1.31	3.60	NP
GP	0	0	100	89.8	16.4	12.9	8.9	4.2	26.1	5.08	8.57	NP
GM			100	80.6	53.1	*42.0	*25.4	14.1	34.2			3
GP-GM	18.5	39.9	100	60.5	40.0	*32.3	*12.3	4.5	27.5	7.24	7.24	NP
GM	2.6	23.9	100	78.4	50.4	*41.5	*22.5	13.2	38.0	13.0	15.5	1
SP-SM	0	13.7	100	77.4	55.4	*41.9	*21.7	7.9	31.4			NP
SM	0	6.5	93.5		88.5	*83.1	*56.9	24.1				NP
GM-GC	2.9	35.5	100	64.6	42.2	*34.2	*27.4	17.5	26.6	7.5	3.4	6
SC	0	4.9	95.1		81.2	*68.9	*53.2	41.2				12
GM-GC	6.4	30	100	71.7	45.1	36.0	16.6	9.6	35.6	23.7	36.2	6
SP		8.8	100	89.6	63.1	*46.5	*15.6	1.6	23.8	10.3	26.2	NP
GP	0	2.4	100		47.4	*33.4	*20.0	3.1	20.4	3.27	3.19	NP
SP	0	2.9	100		54.9	*40.7	*26.3	2.8	20.4			NP
GP-GM	0	6.7	100		47.8	*37.7	*26.6	7.8	19.6			NP

EXISTING TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
282	14055	USDH Millard Co.	N. Sevier Desert	Au	Gravelly Sand
283	14056	USDH Millard Co.	Fool Creek	Aol	Sandy Gravel
284	14057	USDH Millard Co.	Fool Creek	Aol	Sandy Gravel
285	14058	USDH Millard Co.	Oak Creek Sinks	Aal	Sandy Gravel
286	14059	USDH Millard Co.	Oak City	Aaf	Sandy Gravel
287	14060	USDH Millard Co.	E. Sevier Desert	Au	Silt/Sand
288	14061	USDH Millard Co.	E. Sevier Desert	Aol	Sandy Gravel
289	10462	USDH Millard Co.	E. Sevier Desert	Au	Silty Sand
290	14063	USDH Millard Co.	Pavant Valley	Au	Coarse-to-Fine Sand
291	14064	USDH Millard Co.	Pavant Valley	Au	Fine Silty Sand
292	14065	USDH Millard Co.	Pavant Valley	Au	Sandy Gravel
293	14066	USDH Millard Co.	Pavant Valley	Au	Silty Sand
294	14067	USDH Millard Co.	Pavant Valley	Aol	Sandy Gravel
295	14068	USDH Millard Co.	Taylor Flat	Au	Sandy Gravel
296	14069	USDH Millard Co.	E. Sevier Desert	Au	Poorly graded Sand
297	14070	USDH Millard Co.	E. Sevier Desert	Au	Poorly graded Sand
298	14071	USDH Millard Co.	E. Sevier Desert	Au	Silty Sand

USCS SYMBOL	SIEVE ANALYSIS: BEFORE CRUSHING, PERCENT		SIEVE ANALYSIS: PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE						ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88) PERCENT LOSS		PLASTICITY INDEX (ASTM D 423 and D 424)
	>3"	>1"	1"	½"	NO. 4	NO. 8	NO. 50	NO. 200	PERCENT WEAR	CA	FA	
SP-SM	0	4.1	100		56.8	36.7*	21.1*	6.6	20.9			NP
GP-GM	3.1	34.1	100		32.0	26.6*	22.1*	6.6	28.4			NP
GP	18.0	39.2	100		29.4	17.1*	9.7*	2.7	31.1			NP
GP	26.9	53.4	46.6		23.9	17.4*	9.4*	4.6				NP
GP-GM	0	24.9	100		36.2	26.2*	20.8*	8.0	29.8			NP
SM-ML		0				100*	99*	51.				NP
GP	1.5	34.1	100	63.9	33.1	27.8*	23.5*	1.4	26.4			NP
SP-SM	0	0				100*	79.5*	6.5				NP
SP					100	99.8*	72.6*	2.2				NP
SP-SM						100*	96.0*	10.0				NP
GP-GM	6.3	23.9	100	70.4	44.8	32.9*	18.5*	6.9				NP
SP-SM					100	99.9*	99.3*	9.4				NP
GP-GM	15.5	49.8	100		34.0	26.2*	18.0*	8.5				2
GP	0	3.9	100		50.2	40.0*	25.6*	3.7	22.6			NP
P-SM						100*	99.8*	6.7				NP
P-SM						100*	90.6*	5.8				
SP						100*	68.4*	3.4				NP

EXISTING TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
299	14072	USDH Millard Co.	Central Sevier Desert	Au	Gravelly Sand
300	14073	USDH Millard Co.	Central Sevier Desert	Au	Gravelly Sand
301	14074	USDH Millard Co.	Central Sevier Desert	Au	Sand with some Silt
302	14075	USDH Millard Co.	Central Sevier Desert	Au	Silty Gravelly Sand
303	14076	USDH Millard Co.	S. Sevier Desert	Aol	Sandy Gravel
304	14077	USDH Millard Co.	S. Sevier Desert	Aal	Sandy Gravel
305	14078	USDH Millard Co.	S. Sevier Desert	Aol	Sandy Gravel
306	14079	USDH Millard Co.	S. Sevier Desert	Aol	Sandy Gravel
307	14080	USDH Millard Co.	S. Sevier Desert	Aol	Clayey Gravel
308	14081	USDH Millard Co.	S. Sevier Desert	Aol	Sandy Gravel
309	14082	USDH Millard Co.	S. Sevier Desert	Aol	Gravelly Sand
310	14083	USDH Millard Co.	S. Sevier Desert	Aol	Sandy Gravel
311	14084	USDH Millard Co.	Beaver Bottoms	Aol	Silty Sand
312	14085	USDH Millard Co.	W. Sevier Desert	Aol	Sandy Gravel
313	14086	USDH Millard Co.	W. Sevier Desert	Aol	Silty Sand

USCS SYMBOL	SIEVE ANALYSIS: BEFORE CRUSHING, PERCENT >3"	>1"	PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE: 1"	½"	NO. 4	NO. 8	NO. 50	NO. 200	ABRASION TEST (ASTM C 131) PERCENT WEAR	SOUNDNESS TEST (ASTM C 88) PERCENT LOSS CA	FA	PLASTICITY INDEX (ASTM D 423 and D 424)
SP-SM	0	0.6	100		77.5	* 67.2	* 54.2	9.6	17.5			
SP-SM			100		76.3	* 62.2	* 39.3	5.8	17.4			NP
SP						* 100	* 84.3	4.7				NP
SP-SM			100		85.5	* 66.3	* 26.0	5.3				NP
GP-GM	1.6	21.4	100		47.0	* 39.3	* 21.1	5.1	33.8			NP
GP-GM	0	6.8	100		48.3	* 31.3	* 20.6	11.1	26.1			NP
GP-GM	0	8.6	100	82.5	48.8	* 32.7	* 21.4	11.2	25.0			NP
CP		8.1	100	70.8	33.8	* 23.8	* 19.3	4.4	26.0			NP
GC	0	3.6	100	86.3	50.5	* 28.2	* 21.1	13.6	23.0			10
GP-GM			100	76.5	39.3	* 30.9	* 21.9	6.3	24.0			NP
GP-GM	0	9.9	100	80.3	50.5	* 36.5	* 26.7	10.1	29.4			NP
GP-GM	0	13.2	100	77.8	36.6	* 20.3	* 15.3	5.4	28.0			NP
SP-SM				100	94.2	80.7	10.8	7.2		8.68	3.42	NP
GP			100		34.4	* 26.2	* 17.3	2.1	23.8			NP
SP-SM		0	100	98.6	96.1	* 78.7	* 62.9	10.0				NP

EXISTING TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
314	14087	USDH Millard Co.	W. Sevier Desert	Aol	Sandy Gravel
315	14088	USDH Millard Co.	W. Sevier Desert	Aol	Gravelly Sand
316	14089	USDH Millard Co.	Long Ridge	Aol	Sandy Gravel
317	14090	USDH Millard Co.	Long Ridge	Aal	Sandy Gravel
318	14091	USDH Millard Co.	Long Ridge	Aal	Sandy Gravel
319	14092	USDH Millard Co.	Long Ridge	Aol	Gravelly Sand
320	14093	USDH Millard Co.	Whirlwind Valley	Aol	Clayey Gravel
321	14094	USDH Millard Co.	Whirlwind Valley	Aol	Clayey Gravel
322	14095	USDH Millard Co.	Whirlwind Valley	Aal	Clayey Gravelly Sand
323	14096	USDH Millard Co.	Sawtooth Cove	Aol	Clayey Gravel
324	14097	USDH Millard Co.	Sawtooth Cove	Aal	Sandy Gravel
325	14098	USDH Millard Co.	Central Tule Valley	Aol	Sandy Gravel
326	14099	USDH Millard Co.	Central Tule Valley	Aaf	Sandy Gravel
327	14100	USDH Millard Co.	Central Tule Valley	Aaf	Sandy Gravel
328	14101	USDH Millard Co.	Central Tule Valley	Aaf	Sandy Gravel
329	14102	USDH Millard Co.	Central Tule Valley	Aol	Sandy Gravel
330	14103	USDH Millard Co.	Kings Canyon	Aaf	Sandy Gravel

USCS SYMBOL	SIEVE ANALYSIS — BEFORE CRUSHING, PERCENT >3"	>1"	PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE — 1"	½"	NO. 4	NO. 8	NO. 50	NO. 200	ABRASION TEST (ASTM C 131) PERCENT WEAR	SOUNDNESS TEST (ASTM C 88) PERCENT LOSS CA	FA	PLASTICITY INDEX (ASTM D 423 and D 424)
GP	0	2.9	100		35.0	*16.3	*7.3	1.8	19.6			NP
SP-SM		1.0	100		78.6	*63.6	*37.1	7.3				NP
GP		7.6	100		13.9	*5.8	*4.8	0.8				NP
GP-GM	1.1	15.4	100	72.8	48.6	38.0	23.2	11.8	22.6	1.87	5.39	NP
GP-GM	2.8	22.7	100		50.7	*41.1	*24.1	5.3				4
SP-SM			100		54.5	*41.9	*18.6	7.3	19.1			NP
GC-GM	3.9	15.0	100		49.4	*27.4	*15.8	8.0	23.9			7
GM-GC	2.9	12.4	100		50.2	*34.7	*21.1	10.4	30.1			6
GM-SM	0	10.6	100		57.8	*44.7	*30.9	12.1	26.0			5
GM-GC	3.0	19.1	100		39.1	*25.6	*12.4	5.2	26.1			4
GP	2.9	24.3	100		38.5	*21.4	*11.5	5.0	24.7			NP
GP	0	28.6	100		38.9	*31.5	*13.7	2.1	24.4			NP
GP-GM	18.5	31.8	100		30.4	*22.7	*16.6	7.8	18.7			NP
GP-GM	0	10.3	100	81.6	49.7	31.1	8.2	6.8	25.1			NP
GP		44.0	100		24.6	*18.9	*8.7	1.6	22.1			NP
GP-GM	0	17.6	100		42.6	*23.8	*15.8	7.7	16.6			NP
GP-GM		13.4	100		47.0	*29.3	*14.3	6.0	22.1			2

EXISTING TEST DATA

UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES, PERCENT	DISTRIBUTION MATERIAL FIN[E] THAN COBBLE[S] PERCENT	
							GRAVEL	SAND
80	UGS-A80	Ford Pass	Vu	Rhyolite				
81	UGS-A81	Spring Valley	Mu	Quartzite				
82	UGS-A82	Spring Valley	Aaf	Sandy Gravel	GW			
83	UGS-A83	Spring Valley	Aaf	Sandy Gravel	GP	5	75	20
84	UGS-A84	Spring Valley	Aol	Sandy Gravel	GP	T	85	15
85	UGS-A85	Spring Valley	Aol	Gravelly Sand	SP	5	45	55
86	UGS-A86	Spring Valley	Do	Limestone				
87	UGS-A87	Spring Valley	Aol	Sandy Gravel	GP	0	65	35
88	UGS-A88	Sacramento Pass	Mu	Limestone				
89	UGS-A89	Sacramento Pass	Ls	Limestone				
90	UGS-A90	Snake Valley	Aaf	Silty Sand	SP			
91	UGS-A91	Snake Valley	Cau	Limestone				
92	UGS-A92	Snake Valley	Qtz	Quartzite				
93	UGS-A93	Ferguson Desert	Aal	Sandy Gravel	GP	T	55	45
94	UGS-A94	Tule Valley	Do	Dolomite				
95	UGS-A95	Tule Valley	Aol	Gravelly Sand	SP	0	40	55

FIELD OBSERVATIONS							LABORATORY TEST DATA									
DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
GRAVEL	SAND	FINES					3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100
				Hard	Moderate	40% volcanic glass, zeolites										
				Very Hard	Fresh	none										
						caliche coatings	100	85.4	65.3	47.9	36.5	30.8	25.6	19.2	10.0	4.3
	20	5	Low			caliche coatings										
	15	0	None			caliche coatings										
	55	T	None			caliche coatings										
				Hard	Moderate	20% chert										
	35	0	None			caliche coatings										
				Very Hard	Slight	caliche veins										
				Hard	Slight	5% chert										
			Low			caliche coatings	100	91.6	86.4	78.8	67.7	51.4	29.5	9.6	2.8	1.1
				Hard	Moderate	5% chert										
				Very Hard	Fresh	none										
	45	0	None			none										
				Very Hard	Fresh	none										
	55	5	None			none										

LABORATORY TEST DATA

SIS. PERCENT PASSING (ASTM C 136)								ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		RANKING
	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	
											C
								27.1	0.25		A
.9	36.5	30.8	25.6	19.2	10.0	4.3	1.3	17.0	0.45	5.45	B_1
											A
											A
											B
											B_2
											B_1
											A
											B
.8	67.7	51.4	29.5	9.6	2.8	1.1	0.5			31.1	B
											B
											A
											A
											A
											A

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES PERCENT	DISTRI MATERI THAN PE
							GRAVEL
96	UGS-A96	Tule Valley	Aal	Sandy Gravel	GP	T	55
97	UGS-A97	Tule Valley	Su	Limestone			
98	UGS-A98	Tule Valley	Aol	Gravelly Sand	GP	T	35
99	UGS-A99	Tule Valley	Su	Limestone			
100	NGS-A100	Antelope Range	Vu	Ash Flow			
101	UGS-A101	Twin Peaks	Su	Limestone			
102	UGS-A102	Great Salt Lake Desert	Gr	Granite			
103	UGS-A103	Great Salt Lake Desert	Aol	Sandy Gravel	GP	T	75
104	NGS-A104	Tippet Pass	Vu	Andesite			
105	NGS-A105	Antelope Valley	Ls	Limestone			
106	NGS-A106	Antelope Valley	Aol	Gravelly Sand	SP	0	50
107	NGS-A107	Antelope Valley	Aol	Gravelly Sand	SP	0	40
108	NGS-A108	Antelope Valley	Vu	Rhyodacite			
109	UGS-A109	Ibapah	Aol	Gravelly Sand	SP	T	35
110	UGS-A110	White Sage Flat	Vu	Dacite			

FIELD OBSERVATIONS								LABORATORY TEST DA							
	DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT							SIEVE ANALYSIS, PERCENT PASSING (ASTM C							
BOULDERS AND/OR COBBLES, PERCENT	GRAVEL	SAND	FINES	PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30
T	55	45	T	None			none								
					Hard	Slight	5 to 15% chert, calcite veins								
T	35	65	T	None			<5% chert, caliche coatings								
					Very Hard	Slight	calcite veins								
					Hard	Slight	10% volcanic glass								
					Hard	Moderate	none								
					Hard	Slight	none								
T	75	25	0	None			<5% chert								
					Very Hard	Fresh	<5% volcanic glass								
					Very Hard	Fresh	copper oxides								
0	50	50	0	None			none								
0	40	60	0	None			caliche coatings								
					Hard	Slight	5% volcanic glass								
T	35	65	0	None			caliche coatings								
					Very Hard	Slight	10% chal-dony								

LABORATORY TEST DATA										
[...]CENT PASSING (ASTM C 136)							ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		RANKING
	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	
										A
										B_2
										B_1
										A
										B
										B
										A
										B_1
										B_1
										B_1
										A
										B
										B
										B
										B_2

FIELD STATION AND SUPPLEMENTARY TEST DATA
PAGE 8 OF 14
UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES PERCENT	DISTRIBUT MATERIAL THAN COB PERCE	
							GRAVEL	SAND
111	NGS-A111	White Horse Pass	Su	Limestone				
112	UGS-B1	Lookout Pass	Ls	Limestone				
113	UGS-B2	Skull Valley	Cau	Limestone				
114	UGS-B3	Onaqui Range	Ls	Limestone				
115	UGS-B4	Rush Valley	Aaf	Sandy Gravel	GM	10	60	25
116	UGS-B5	Rush Valley	Aaf	Silty Sandy Gravel	GW			
117	UGS-B6	Tintic Mountains	Su	Limestone				
118	UGS-B7	Onaqui Mountains	Cau	Limestone				
119	UGS-B8	Gilson Mountains	Su	Limestone				
120	UGS-B9	Sheeprock Mountains	Mu	Quartzite				
121	UGS-B10	Sheeprock Mountains	Mu	Quartzite				
122	UGS-B11	Canyon Mountains	Mu	Quartzite				
123	UGS-B12	Confusion Range	Ls	Limestone				
124	NGS-B13	West of Gandy	Aaf	Sandy Gravel	GP	5	65	35
125	UGS-B14	Confusion Range	Su	Limestone				

FIELD OBSERVATIONS								LABORATORY TEST DATA									
	DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
PERCENT	GRAVEL	SAND	FINES					3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 1[illegible]
					Hard	Fresh	scattered calcite veins										
					Very Hard	Slight	<5% chert										
					Hard	Slight	none										
					Hard	Slight	none										
	60	25	15	Low			caliche coatings, clay coatings										
				None			caliche coatings, clay coatings	100	86.8	67.5	47.5	32.3	26.4	22.7	16.0	12.5	8[illegible]
					Very Hard	Slight	none										
					Hard	Slight	5% chert										
					Hard	Slight	none										
					Very Hard	Slight	none										
					Very Hard	Fresh	none										
					Very Hard	Slight	none										
					Very Hard	Slight	none										
	65	35	5	None			<5% chert										
					Hard	Slight	none										

ORY TEST DATA								
SING (ASTM C 136)					ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		RANKING
NO. 16	NO. 30	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	
								A
								B_1
								B
								B
								B_1
22.7	16.0	12.5	8.2	2.8	26.3	4.27		B_1
								A
								B
								B
								A
								A
								B_1
								B
								B_1
								B

FIELD STATION AND SUPPLEMENTARY TEST DATA

UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

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MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES, PERCENT	DISTI MATE THA F
							GRAVEL
126	UGS-B15	Fish Springs Mountains	Vb	Basalt			
127	UGS-B16	Black Hills	Cau	Limestone			
128	UGS-B17	Topaz Mountains	Vu	Rhyolite			
129	UGS-B18	Desert Resort	Vb	Basalt			
130	UGS-B19	McDowell Mountains	Aaf	Sandy Gravel	GP	15	55
131	UGS-B20	Simpson Range	Aol	Sandy Gravel	GP	15	55
132	UGS-B21	Coyote Hills	Ls	Limestone			
133	UGS-B22	Deep Creek Range	Gr	Granite			
134	UGS-B23	Deep Creek Range	Gr	Granite			
135	UGS-B24	Deep Creek Range	Aaf	Sandy Gravel	GP	T	55
136	UGS-B25	Fish Springs Range	Ls	Limestone			
137	UGS-B26	Swasy Range	Qtz	Quartzite			
138	UGS-B27	Tule Valley	Cau	Dolomite			
139	UGS-B28	White Valley	Aaf	Sandy Gravel	GP	5	60
140	UGS-B29	Sevier Desert	Aol	Sandy Gravel	GP	25	65
141	UGS-B30	Sevier Desert	Vb	Basalt			
142	UGS-B31	Sevier Desert	Mu	Quartzite			

AD-A112 409 FUGRO NATIONAL INC LONG BEACH CA F/G 8/7
MX SITING INVESTIGATION. GEOTECHNICAL EVALUATION. AGGREGATE RES--ETC(U)
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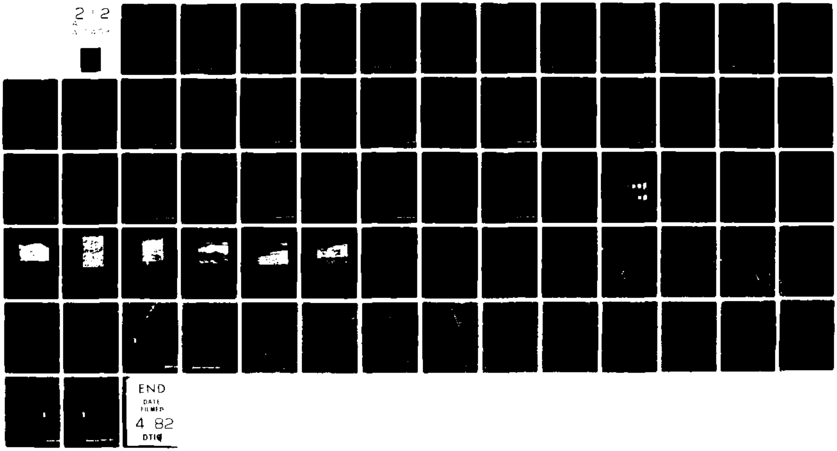
UNCLASSIFIED FN-TR-34 NL

2 of 2



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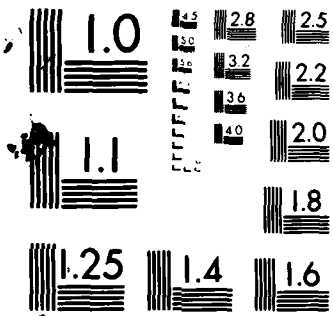
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5.0
5.6
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

FIELD OBSERVATIONS								LABORATORY TEST DATA								
	DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)								
PERCENT	GRAVEL	SAND	FINES					3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50
					Very Hard	Slight	5% vesicles									
					Very Hard	Slight	none									
					Very Hard	Moderate	10% volcanic glass									
					Very Hard	Slight	5% vesicles									
	55	45	T	None			none									
	55	45	T	None			caliche coatings									
					Very Hard	Slight	10 to 30% chert									
					Hard	Slight	none									
					Mod. Hard	Moderate	none									
	55	45	T	None			none									
					Hard	Slight	none									
					Very Hard	Fresh	none									
					Hard	Slight	5% chert									
	60	40	T	None			caliche coatings									
	65	35	0	None			caliche coatings									
					Hard	Slight	10% vesicles									
					Very Hard	Slight	none									

ORATORY TEST DATA								
PASSING (ASTM C 136)					ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		RANKING
NO. 16	NO. 30	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS		
						CA	FA	
								B
					26.9	1.02		B
					32.2	1.60		B
								B
								B
								B_1
								C
					19.2	0.82		B
								B_2
								A
								B
								A
								B
								B_1
								B_1
								B
								A

FIELD STATION AND SUPPLEMENTARY TEST DATA
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UTAH–NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES, PERCENT	DISTRI[illegible] MATERI[illegible] THAN [illegible] PER[illegible] GRAVEL	S[illegible]
143	UGS-B32	Wah Wah Valley	Aol	Sandy Gravel	GW	10	65	35
144	UGS-B33	Swan Peak	Vu	Andesite				
145	UGS-B34	Wah Wah Valley	Vu	Basalt				
146	UGS-B35	Escalante Desert	Gr	Granite				
147	UGS-B36	Mineral Mountains	Vb	Basalt				
148	UGS-B37	Sevier Desert	Ls	Limestone				
149	UGS-B38	Cricket Mountains	Ls	Limestone				
150	UGS-B39	Sevier Desert	Aaf	Sandy Gravel	GP	10	65	3[illegible]
151	UGS-B40	Cricket Mountains	Aaf	Sandy Gravel	GP	20	60	[illegible]
152	UGS-B41	Escalante Desert	Aol	Gravelly Sand	SP	T	30	7[illegible]
153	UGS-B42	Escalante Desert	Vu	Andesite				
154	UGS-B43	Wah Wah Valley	Su	Sandstone				
155	UGS-B44	Escalante Desert	Vu	Ignimbrite				

FIELD OBSERVATIONS							LABORATORY TEST DATA									
DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
GRAVEL	SAND	FINES					3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100
65	35	0	None			caliche coatings										
				Hard	Moderate	none										
				Hard	Slight	15% vesicles										
				Mod. Hard	Moderate	10% mica										
				Hard	Slight	20% vesicles										
						10% volcanic glass										
				Hard	Slight	none										
				Hard	Slight	none										
65	35	T	None			caliche coatings										
60	40	T	None			<5% volcanic glass										
30	70	T	None			10% low density material										
				Hard	Slight	15% low density material										
				Mod. Hard	Slight	Iron sulfides, friable material										
				Soft	Moderate	15% chalcedony, volcanic glass										

2

ATORY TEST DATA								
SSING (ASTM C 136)					ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		RANKING
NO. 16	NO. 30	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	
								A
								B
								B_2
								C
								B_2
								A
								B
								A
								A
								B
								B_2
								B_2
								B_2

FIELD STATION AND SUPPLEMENTARY TEST DATA
PAGE 11 OF 14
UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES, PERCENT	DISTRI MATERI THAN PER	
							GRAVEL	[illegible]
156	UGS-B45	Escalante Desert	Aaf	Gravelly Sand	SP	5	25	75
157	UGS-B46	Escalante Desert	Vu	Ignimbrite				
158	UGS-B47	Escalante Desert	Vu	Rhyolite				
159	UGS-B48	Escalante Desert	Vu	Ignimbrite				
160	UGS-B49	Escalante Desert	Aaf	Sandy Gravel	GP-GM	5	50	40
161	UGS-B50	Sevier Desert	Vu	Rhyodacite				
162	UGS-B51	Sevier Desert	Aaf	Silty Sand	ML	T	10	40
163	UGS-B52	Sevier Desert	Aaf	Sandy Gravel	GW	10	65	35
164	UGS-B53	Wah Wah Valley	Aol	Sandy Gravel	GW	T	60	40
165	UGS-B54	Wah Wah Valley	Vu	Latite				
166	UGS-B55	Wah Wah Valley	Ls	Dolomite				

FIELD OBSERVATIONS							LABORATORY TEST DATA									
ISTRIBUTION OF ATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
GRAVEL	SAND	FINES					3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100
25	75	T	None			5% chert, low density material										
				Soft	Moderate	5% volcanic glass & low density material										
				Hard	Slight	20% volcanic glass & low density material										
				Hard	Slight	20% low density material										
50	40	10	Low			5% low density material										
				Hard	Slight	5% volcanic glass										
10	40	50	Low			20% low density material										
65	35	0				5% low density material										
60	40	0	None			<5% chert, caliche										
				Hard	Slight	5% volcanic glass										
				Hard	Slight	25% chert										

2

TEST DATA							
(ASTM C 136)				ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		RANKING
NO. 30	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS		
					CA	FA	
							B^-
							B_2
							C
							B_2
							B
							B
							C
							B_1
							A
							B
							C

FIELD STATION AND SUPPLEMENTARY TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES, PERCENT	DISTRI[illegible] MATERIA[illegible] THAN [illegible] PER[illegible]	
							GRAVEL	SAN[illegible]
167	UGS-B56	Wah Wah Valley	Aaf	Gravelly Sand	SP	5	45	55
168	UGS-B57	San Francisco Mountains	Aaf	Silty Sand	SM	0	10	60
169	UGS-B58	Beaver Mountains	Aaf	Gravelly Sand	SP	5	40	60
170	UGS-B59	Antelope Valley	Cau	Limestone				
171	UGS-B60	Pine Valley	Aaf	Sandy Gravel	GW	20	60	40
172	UGS-B61	Pine Valley	Cau	Limestone				
173	UGS-B62	Pine Valley	Aaf	Gravelly Sand	SW	15	45	50
174	UGS-B63	Wah Wah Valley	Aaf	Gravelly Sand	SW	T	35	60
175	UGS-B64	Wah Wah Valley	Aaf	Gravelly Sand	SP	T	40	60
176	UGS-B65	Wah Wah Valley	Vu	Rhyolite				
177	UGS-B66	Escalante Desert	Vu	Rhyolite				
178	UGS-B67	Escalante Desert	Aaf	Gravelly Sand	SP-SM	10	30	60
179	NGS-B68	Spring Valley	Aol	Sandy Gravel	GP	T	65	30
180	NGS-B69	Spring Valley	Au	Gravelly Sand	SW	T	30	65

FIELD OBSERVATIONS							LABORATORY TEST DATA									
DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
GRAVEL	SAND	FINES					3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 10[illegible]
45	55	0	None			caliche coatings										
10	60	30	None			caliche coatings										
40	60	T	None			caliche coatings										
				Hard	Slight	5% chert										
60	40	T	None			caliche coatings										
				Hard	Slight	none										
45	50	5	None			<5% low density material										
35	60	5	None			5% low density material										
40	60	T	None			<5% chal-cedony, caliche coatings										
				Hard	Slight	10% vesicles										
				Hard	Slight	10% volcanic glass										
30	60	10	Low			none										
65	30	5	None			caliche coatings										
30	65	5	None			caliche coatings										

...RATORY TEST DATA								
...PASSING (ASTM C 136)					ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		RANKING
NO. 16	NO. 30	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	
								B_1
								B_2
								B
								B
								A
								B
								A
								B_1
								B_1
								B
								B
								B_2
								B_1
								B

FIELD STATION AND SUPPLEMENTARY TEST DATA
PAGE 13 OF 14
UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
331	14104	USDH Millard Co.	Little Valley	Aaf	Sandy Gravel
332	14105	USDH Millard Co.	S. Snake Valley	Aaf	Silty Gravelly Sand
333	14106	USDH Millard Co.	S. Snake Valley	Aaf	Sandy Gravel
334	14107	USDH Millard Co.	Central Snake Valley	Aol	Sandy Gravel
335	14109	USDH Millard Co.	Central Snake Valley	Aol	Sandy Gravel
336	14110	USDH Millard Co.	Central Snake Valley	Aol	Gravelly Sand
337	14111	USDH Millard Co.	Central Snake Valley	Aol	
338	14112	USDH Millard Co.	Central Snake Valley	Aaf	Gravelly Sand
339	14113	USDH Millard Co.	Central Snake Valley	Aal	Gravelly Sand
340	14114	USDH Millard Co.	S. Snake Valley	Aal	Silty Sand
341	14115	USDH Millard Co.	S. Snake Valley	Aal	Sandy Gravel
342	14116	USDH Millard Co.	S. Snake Valley	Aal	Sandy Gravel
343	14117	USDH Millard Co.	S. Snake Valley	Aal	Sandy Gravel
344	14118	USDH Millard Co.	S. Snake Valley	Aaf	Gravelly Sand

	USCS SYMBOL	SIEVE ANALYSIS: BEFORE CRUSHING, PERCENT		PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE						ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88) PERCENT LOSS		PLASTICITY INDEX (ASTM D 423 and D 424)
		>3"	>1"	1"	½"	NO 4	NO 8	NO 50	NO 200	PERCENT WEAR	CA	FA	
	GP-GM			100		42.9	*28.8	*19.1	10.9				
Sand	GM/SM			100		57.6	*43.0	*27.2	14.9				NP
	GM			100		50.3	*37.0	*27.0	13.7				
	GP	0	4.9	100	77.1	43.6	31.0	12.6	4.2	20.9	1.33	3.13	NP
	GP-GM		6.4	100		48.6	*35.7	*23.7	10.1	23.0			NP
	SP		7.7	100	82.6	62.6	*48.3	*6.8	2.5	25.8	1.25	4.08	2
	GP/SP	0	18.6	100	75.0	51.3	39.9	9.4	4.4	25.5	6.6	13.4	NP
	SP-SM	4.4	21.1	100		56.1	*42.6	*19.8	8.0	22.6			NP
	SM						*66.9	*58.6	27.9				2
	GP-GM	0	29.6	100		44.9	*29.2	*15.8	7.9	23.8			NP
	GP-GM	0	22.1	100		36.6	*26.3	*15.9	7.7	22.2			NP
	GP-GM	0	9.7	100		49.6	*38.1	*24.1	5.8	19.0			NP
	SP-SM	6.3	24.9	100		55.2	*46.4	*35.8	6.3	21.4			NP

EXISTING TEST DATA

UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
345	14119	USDH Millard Co.	S. Snake Valley	Aal	Clayey Sandy Gravel
346	14120	USDH Millard Co.	S. Snake Valley	Aal	Silty Gravel
347	14121	USDH Millard Co.	S. Snake Valley	Aaf	Gravelly Sand
348	14122	USDH Millard Co.	S. Snake Valley	Aal	Silty Sand
349	14123	USDH Millard Co.	S. Snake Valley	Aal	Sandy Gravel
350	14124	USDH Millard Co.	S. Snake Valley	Aal	Clayey Gravelly Sand
351	14125	USDH Millard Co.	S. Snake Valley	Aaf	Sandy Gravel
352	14126	USDH Millard Co.	N. Pine Valley	Aal	Gravelly Sand
353	14127	USDH Millard Co.	N. Pine Valley	Aal	Gravelly Sand
354	14128	USDH Millard Co.	N. Pine Valley	Aal	Gravelly Sand
355	01001	USDH Beaver Co.	E. Mineral Mountains	Au	Sandy Gravel
356	01002	USDH Beaver Co.	E. Mineral Mountains	Au	Silty Clay
357	01003	USDH Beaver Co.	E. Mineral Mountains	Aaf	Sandy Gravel
358	01004	USDH Beaver Co.	E. Mineral Mountains	Aaf	
359	01005	USDH Beaver Co.	E. Mineral Mountains	Aaf	Sandy Gravel
360	01006	USDH Beaver Co.	E. Mineral Mountains	Aaf	Silty Sand
361	01007	USDH Beaver Co.	E. Mineral Mountains	Au	Gravelly Sand

	USCS SYMBOL	SIEVE ANALYSIS: BEFORE CRUSHING, PERCENT >3"	>1"	PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE: 1"	½"	NO. 4	NO. 8	NO. 50	NO. 200	ABRASION TEST (ASTM C 131) PERCENT WEAR	SOUNDNESS TEST (ASTM C 88) PERCENT LOSS CA	FA	PLASTICITY INDEX (ASTM D 423 and D 424)
a	GC	0	20.3	100		48.2	*34.7	*23.6	10.0	19.7			9
	GM	0	9.0	100		54.6	*41.3	*30.3	12.7	18.8			NP
	SP-SM	0	17.3	100		70.3	*36.9	*22.3	8.1	21.6			NP
	SM	0	6.6	93.4		61.1	*42.0	*29.3	16.3				NP
	GP-GM	0	16.4	100		45.4	*29.1	*14.8	5.8	25.8			1
ad	GC/SC	0	9.6	90.4		57.7	*36.6	*23.4	14.8				9
	GP-GM	1.7	21.8	100		42.1	*27.7	*13.2	5.1	22.8			4
	SP	5.3	18.3	100		54.0	*31.3	*11.0	4.7	27.1			NP
	SP-SM	11.6	18.4	100		60.0	*45.8	*26.1	8.8	23.4			NP
	SP	0	11.9	100		60.9	*50.0	*23.1	4.9	32.8			NP
	GP	0	27.9	100	71.3	49.2	*36.7	*15.3	4.0	44.5	0.4	5.3	NP
	CL	0	21.6	78.4		67.3	*64.5	*57.5	42.0				12
	GM-GC	16.0	46.0	100	71.7	37.5	29.1	10.2	5.1	28.0	23.9	13.5	5
	GP-GM	30.6	61.1	100	68.8	40.1	31.9	9.9	5.1	30.0	17.9	16.9	NP
	SM	0	6.4	93.6		73.7	*60.1	*40.3	27.6				NP
	SP-SM	0	24.3	100		58.3	*45.0	*21.8	8.9	24.0			4

EXISTING TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
362	01008	USDH Beaver Co.	E. Mineral Mountains	Au	Sandy Gravel
363	01009	USDH Beaver Co.	E. Mineral Mountains	Aaf	Sandy Gravel
364	01010	USDH Beaver Co.	E. Mineral Mountains	Au	Sandy Gravel
365	01011	USDH Beaver Co.	E. Mineral Mountains	Aal	Silty Gravel
366	01012	USDH Beaver Co.	E. Mineral Mountains	Au	Sandy Gravel
367	01013	USDH Beaver Co.	E. Mineral Mountains	Au	Sandy Gravel
368	01014	USDH Beaver Co.	E. Mineral Mountains	Aal	Silty Sand
369	01015	USDH Beaver Co.	E. Mineral Mountains	Au	Sandy Gravel
370	01016	USDH Beaver Co.	E. Mineral Mountains	Aal	Sandy Gravel
371	01017	USDH Beaver Co.	E. Mineral Mountains	Au	Sandy Gravel
372	01018	USDH Beaver Co.	E. Mineral Mountains	Aol	Sandy Gravel
373	01019	USDH Beaver Co.	E. Mineral Mountains	Aaf	Sandy Gravel
374	01020	USDH Beaver Co.	E. Mineral Mountains	Au	Gravelly Sand
375	01021	USDH Beaver Co.	E. Mineral Mountains	Au	Sandy Gravel
376	01022	USDH Beaver Co.	E. Mineral Mountains	Aaf	
377	01023	USDH Beaver Co.	E. Mineral Mountains	Aal	Gravelly Sand
378	01024	USDH Beaver Co.	E. Mineral Mountains	Au	Sandy Gravel

USCS SYMBOL	SIEVE ANALYSIS								ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		PLASTICITY INDEX (ASTM D 423 and D 424)
	BEFORE CRUSHING, PERCENT		PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE						PERCENT WEAR	PERCENT LOSS		
	>3"	>1"	1"	½"	NO. 4	NO. 8	NO. 50	NO. 200		CA	FA	
GP-GM	11.9	30.7	100	69.8	45.5	37.9	20.7	11.2	23.0	8.49	7.56	NP
GP-GM		41.0	100	75.9		*28.5	*11.7	6.0	21.7			
GP	12.7	41.0	100	57.0	29.3	19.2	5.7	2.2	25.6	4.88	8.78	NP
GM	1.0	29.3	100	73.4	52.6	*44.0	*34.3	16.1	22.0	3.4	4.3	NP
GP-GM	6.3	29.3	100	65.7	41.5	32.4	13.1	7.0	24.1	7.18	8.35	NP
GP-GM	3.0	27.0	100	77.3	44.9	*32.1	*16.9	6.2	19.8			NP
SM	0	9.0	91.0		63.0	55.0	35.0	14.0				
GP		48.6	100	60.3	34.6	21.5	4.5	1.6	18.9			NP
GP	0	4.2	58.0		26.0	20.0	9.0	5.0				
GP	12.5	43.0	100	61.6	36.0	*22.0	*10.0	5.0	17.9	1.99	8.0	NP
GP-GM	14.5	46.0	100	68.7	37.8	27.8	12.4	5.3	21.0	0.92	4.48	NP
GP	7.2	36.3	100		47.0	*33.7	*18.0	4.4	29.3			NP
GP/SP	0	30.4	100		51.9	*38.1	*15.2	4.1	21.8			NP
GP-GM	2.9	33.3	100		41.1	*27.7	*13.8	6.1	22.4			NP
SP-SM	0	22.7	100		59.3	*44.7	*24.5	7.8	24.5			NP
GP	7.9	37.2	100	5.3	31.5	22.0	7.3	2.8	23.0			NP

EXISTING TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
379	01025	USDH Beaver Co.	E. Mineral Mountains	Au	Sandy Gravel
380	01026	USDH Beaver Co.	E. Mineral Mountains	Au	Silty Sandy Gravel
381	01027	USDH Beaver Co.	E. Mineral Mountains	Au	Gravelly Sand
382	01028	USDH Beaver Co.	E. Mineral Mountains	Au	Gravelly Sand
383	01029	USDH Beaver Co.	Minersville	Aaf	Silty Sand
384	01030	USDH Beaver Co.	Minersville	Aal	Silty Gravel
385	01031	USDH Beaver Co.	Minersville	Aaf	Gravelly Sand
386	01032	USDH Beaver Co.	Minersville	Au	Silty Sand
387	01033	USDH Beaver Co.	Minersville	Au	Silty Sand
388	01034	USDH Beaver Co.	North Escalante Desert	Au	Silty Sand
389	01035	USDH Beaver Co.	North Escalante Desert	Au	Gravelly Sand
390	01037	USDH Beaver Co.	North Escalante Desert	Aaf	Gravelly Sand
391	01038	USDH Beaver Co.	North Escalante Desert	Au	Silty Gravelly Sand
392	01039	USDH Beaver Co.	North Escalante Desert	Au	Silty Gravelly Sand
393	01040	USDH Beaver Co.	North Escalante Desert	Au	Silty Gravelly Sand

L ON	USCS SYMBOL	SIEVE ANALYSIS: BEFORE CRUSHING, PERCENT		SIEVE ANALYSIS: PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE						ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88) PERCENT LOSS		PLASTICITY INDEX (ASTM D 423 and D 424)
		>3"	>1"	1"	½"	NO. 4	NO. 8	NO. 50	NO. 200	PERCENT WEAR	CA	FA	
	GP	8.9	35.0	100		47.7	*36.9	*21.0	4.2	23.7			NP
avel	GP-GM	7.3	28.3	100	68.7	41.8	29.5	12.6	6.6	23.4	2.58	7.57	NP
	SP-SM	0	9.3	100	80.0	55.2	*38.5	*18.9	7.7	22.6			NP
	SP-SM	0	16.9	100	80.3	54.9	46.8	16.3	6.5	22.0	24.8	29.7	NP
	SM	1.9	6.6	100	88.0	67.8	*52.3	*28.0	13.2	27.4			NP
	GM	5.8	25.1	100	74.9	50.3	42.1	25.8	16.2	27.2	2.48	4.41	NP
	GP/SP	0	9.0	100	83.0	53.0	35.0	10.0	5.0	28.0	4.96	13.0	NP
	SM	0	2.0	98.0		77.0	*68.0	*46.0	21.0				NP
	SM	0	8.0	92.0		63.0	*56.0	*41.0	17.0				NP
	SM	0	7.0	93.0		73.0	*66.0	*51.0	18.0				NP
	SP-SM	0	6.0	94.0		65.0	*55.0	*31.0	11.0				NP
	SP-SM	3.3	15.7	100	79.9	54.6	45.7	20.9	7.0	26.0	7.17	11.7	NP
Sand	GM/SM	0	13.0	87.0		59.0	*53.0	*39.0	17.0				NP
Sand	SM	0	10.0	90.0		61.0	*54.0	*39.0	15.0				NP
Sand	GM/SM	0	17.0	83.0		57.0	*51.0	*37.0	15.0				NP

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
394	01041	USDH Beaver Co.	North Escalante Desert	Aol	Silty Gravelly Sand
395	01042	USDH Beaver Co.	North Escalante Desert	Aol	Sandy Gravel
396	01043	USDH Beaver Co.	North Escalante Desert	Aal	Sandy Gravel
397	01045	USDH Beaver Co.	North Escalante Desert	Aal	Silty Gravelly Sand
398	01046	USDH Beaver Co.	North Escalante Desert	Aal	Sandy Gravel
399	01047	USDH Beaver Co.	North Escalante Desert	Aol	Sandy Gravel
400	01048	USDH Beaver Co.	North Escalante Desert	Aol	Sandy Gravel
401	01049	USDH Beaver Co.	North Escalante Desert	Aal	Gravelly Sand
402	01050	USDH Beaver Co.	North Escalante Desert	Au	Gravelly Sand
403	01051	USDH Beaver Co.	North Escalante Desert	Au	Gravelly Sand
404	01052	USDH Beaver Co.	North Escalante Desert	Au	Sandy Gravel
405	01053	USDH Beaver Co.	North Escalante Desert	Aaf	Sandy Gravel

	USCS SYMBOL	SIEVE ANALYSIS: BEFORE CRUSHING, PERCENT >3"	>1"	PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE: 1"	½"	NO. 4	NO. 8	NO. 50	NO. 200	ABRASION TEST (ASTM C 131) PERCENT WEAR	SOUNDNESS TEST (ASTM C 88) PERCENT LOSS CA	FA	PLASTICITY INDEX (ASTM D 423 and D 424)
d	SM	0	10.5	100	82.0	61.7	53.0	21.6	15.1	28.9	2.75	4.0	NP
	GP-GM	2.7	15.7	100	70.8	47.6	39.1	16.8	8.0	22.9	8.45	10.8	NP
	GP	5.6	28.0	100	67.2	43.0	34.8	11.8	4.8		2.77	4.32	NP
d	GM-SM	0	14.8	100	76.6	56.5	46.7	21.5	13.1	30.4	2.93	7.08	NP
	GP			94.7	62.5	7.9	6.9	2.2		23.2	3.05	4.06	NP
	GP-GM	1.1	15.9	100	74.1	47.4	38.8	16.5	7.2	18.9	2.95	12.0	NP
	GP	0	26.8	100	69.7	36.5	*21.1	*13.3	4.3	38.8			NP
	SP	0	4.6	100	90.9	73.5	57.9	3.6	1.3	31.0	35.2	10.4	NP
	SP-SM	0	11.9	100	78.8	58.0	46.0	13.0	7.2	27.9	4.72	9.25	NP
	SP		12.5	100	84.9	60.1	*39.5	*11.4	3.7	20.6			NP
	GP		37.4	100		47.0	*33.3	*13.8	4.6	21.3			NP
	GP-GM		28.6	100		51.0	*34.4	*13.2	6.1	21.6			NP

EXISTING TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
406	01054	USDH Beaver Co.	North Escalante Desert	Aal	Gravelly Sand
407	01055	USDH Beaver Co.	North Escalante Desert	Aaf	Gravelly Sand
408	01056	USDH Beaver Co.	Central Wah Wah Valley	Aaf	Gravelly Sand
409	01057	USDH Beaver Co.	Central Wah Wah Valley	Aal	Gravelly Sand
410	01058	USDH Beaver Co.	Central Wah Wah Valley	Aol	Sandy Gravel
411	01059	USDH Beaver Co.	Central Wah Wah Valley	Aaf	Sandy Gravel
412	01060	USDH Beaver Co.	Central Wah Wah Valley	Aaf	Gravelly Sand
413	01061	USDH Beaver Co.	Central Wah Wah Valley	Aaf	Sandy Gravel
414	01062	USDH Beaver Co.	Central Wah Wah Valley	Aaf	Sandy Gravel
415	01063	USDH Beaver Co.	N. Pine Valley	Aaf	Gravelly Sand
416	01064	USDH Beaver Co.	N. Pine Valley	Aaf	Sandy Gravel
417	01065	USDH Beaver Co.	N. Pine Valley	Aaf	Sandy Gravel
418	01066	USDH Beaver Co.	N. Pine Valley	Au	Gravelly Sand
419	01067	USDH Beaver Co.	N. Pine Valley	Aol	Gravelly Sand

AFTER IMUM SIZE		ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		PLASTICITY INDEX (ASTM D 423 and D 424)
			PERCENT LOSS		
NO. 50	NO. 200	PERCENT WEAR	CA	FA	
13.3*	4.1	24.0			NP
24.1*	9.9	24.6			NP
18.9*	8.4	25.8			NP
30.9*	11.4	26.0			NP
25.0*	7.8	24.8			NP
22.8*	9.2	22.6			NP
21.9	9.7	29.2	4.43	10.9	NP
11.7*	3.7	28.3			NP
18.4*	5.8	24.6			NP
20.9*	7.6	28.8			NP
13.2*	5.7	27.9			NP
21.4*	8.1	28.3			NP
13.1*	3.6	23.8			NP
5.7*	0.5	26.1			NP

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
420	01068	USDH Beaver Co.	E. Mineral Mountains	Au	Sandy Gravel
421	11001	USDH Iron Co.	Parowan Valley	Aaf	
422	11002	USDH Iron Co.	Parowan Valley	Aaf	Sandy Gravel
423	11003	USDH Iron Co.	Parowan Valley	Aaf	Sandy Gravel
424	11004	USDH Iron Co.	Parowan Valley	Au	Sandy Gravel
425	11005	USDH Iron Co.	Parowan Valley	Aaf	Silty Gravel
426	11006	USDH Iron Co.	Parowan Valley	Aaf	Gravelly Sand
427	11007	USDH Iron Co.	Parowan Valley	Aaf	Silty Sandy Gravel
428	11008	USDH Iron Co.	Parowan Valley	Aaf	Sandy Gravel
429	11009	USDH Iron Co.	Parowan Valley	Aaf	Gravelly Sand
430	11010	USDH Iron Co.	Buckskin Valley	Aaf	Gravelly Sand
431	11011	USDH Iron Co.	Bear Valley Junction	Aal	Sandy Gravel
432	11012	USDH Iron Co.	Bear Valley Junction	Aal	Sandy Gravel
433	11013	USDH Iron Co.	Bear Valley Junction	Aal	Sandy Gravel
434	11014	USDH Iron Co.	Bear Valley Junction	Aal	Sandy Gravel
435	11015	USDH Iron Co.	Parowan Valley	Aal	Silty Sand
436	11016	USDH Iron Co.	Parowan Valley	Aal	Silty Sand

	USCS SYMBOL	SIEVE ANALYSIS								ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		PLASTICITY INDEX (ASTM D 423 and D 424)
		BEFORE CRUSHING, PERCENT		PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE									
		>3"	>1"	1"	½"	NO. 4	NO. 8	NO. 50	NO. 200	PERCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	
	GP-GM	30.6	53.5	100	89.2	43.7	32.8	11.2	5.2	22.7	3.71	7.12	NP
	GP	0	27.7	100	70.1	35.7	29.8	12.9	5.0	24.3	5.49	11.3	NP
	GP-GM	0	41.6	100		45.9	*33.8	*18.5	7.2	23.04			NP
	GP-GM	4.6	38.2	100		45.6	*30.1	*15.5	5.7	22.42			NP
	GM	10.0	35.0	100		56.0	*48.0	*35.0	18.0	22.1			NP
	SP-SM	1.9	14.2	100	85.6	64.8	56.6	21.7	9.3	28.4	12.23	25.49	NP
	GM-SM	10.0	36.0	100		57.0	*49.0	*24.0	13.0	28.1			NP
	GP		39.1	100		44.9	*34.1	*14.4	3.4	26.7			NP
	SP-SM	0.5	13.5	100	78.0	55.0	44.0	16.0	7.0	27.0	14.58	23.79	NP
	SP-SM	1.3	9.2	100	86.0	64.4	52.9	25.4	11.0	27.5	22.35	19.53	NP
	GP-GM	22.8	55.7	100		40.5	*31.5	*20.1	8.3	23.9			NP
	GP-GM	0	20.8	100		49.3	*38.8	*25.7	9.6	29.16			NP
	GP	9.9	29.0	100		45.7	*29.4	*16.4	4.8	22.0			4
	GP	7.9	32.4	100		43.3	*27.5	*12.1	3.8	23.9			NP
	SM	0	10.1	89.9		73.9	*67.6	*51.6	13.7				NP
	SM	0	6.2	93.8		68.0	*67.3	*44.3	12.0				NP

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
437	11017	USDH Iron Co.	Parowan Valley	Aal	Silty Sand
438	11018	USDH Iron Co.	Parowan Valley	Aaf	Sandy Gravel
439	11019	USDH Iron Co.	Parowan Valley	Aal	Silty Sand
440	11020	USDH Iron Co.	Parowan Valley	Aal	Sandy Gravel
441	11021	USDH Iron Co.	Parowan Valley	Aaf	Sandy Gravel
442	11023	USDH Iron Co.	Parowan Valley	Aal	Gravelly Sand
443	11024	USDH Iron Co.	Parowan Valley	Aal	Sandy Gravel
444	11025	USDH Iron Co.	Parowan Valley	Aaf	Sandy Gravel
445	11037	USDH Iron Co.	Cedar Valley	Aaf	Silty Sand
446	11038	USDH Iron Co.	Cedar Valley	Aaf	Silty Gravelly Sand
447	11039	USDH Iron Co.	Cedar Valley	Aaf	Silty Gravel
448	11040	USDH Iron Co.	Cedar Valley	Aaf	Sandy Gravel
449	11041	USDH Iron Co.	Cedar Valley	Aal	Sandy Gravel
450	11042	USDH Iron Co.	Cedar Valley	Aal	Sandy Gravel
451	11043	USDH Iron Co.	Cedar Valley	Aal	Silty Sand
452	11044	USDH Iron Co.	Cedar Valley	Aaf	Clayey Sand
453	11045	USDH Iron Co.	Cedar Valley	Aal	Silty Sand

	USCS SYMBOL	SIEVE ANALYSIS: BEFORE CRUSHING, PERCENT >3"	>1"	PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE: 1"	½"	NO. 4	NO. 8	NO. 50	NO. 200	ABRASION TEST (ASTM C 131): PERCENT WEAR	SOUNDNESS TEST (ASTM C 88): PERCENT LOSS CA	FA	PLASTICITY INDEX (ASTM D 423 and D 424)
	SM	0	3.8	96.2		68.6	59.9*	45.3*	16.1				NP
	GP		38.2	100		28.2	20.3*	10.1*	2.2	21.16			NP
	SM	3.2	9.4	93.8		68.0	67.3*	44.3*	12.0				NP
	GP		25.0	100		30.5	24.1*	12.8*	3.0	25.14			NP
	GP		25.7	100		39.4	28.2*	13.0*	3.4	23.7			NP
	SP-SM	0	0	100	85.5	56.0	41.5	16.0	8.5	17.2	6.42	11.4	NP
	GP	3.2	21.3	100		40.5	29.5*	19.0*	4.1	30.0			NP
	GP-GM	0	13.9	100	76.2	48.4	42.2	29.3	6.4	30.1	12.13	6.10	NP
	SM			100		70.6	54.1*	31.5*	14.9				NP
d	SM	5.2	14.2	100	86.0	64.5	54.3	29.4	15.6	24.18	6.68	13.14	2
	GM	0	17.0	83.0		58.0	51.0*	42.0*	19.0				NP
	GP-GM		11.8	100	61.8	21.7	16.8*	13.6*	6.1	29.8	16.29	4.8	
	GP	7.7	32.3	100	62.2	35.5	29.3	11.8	3.1	30.8	13.4	13.7	NP
	GP	0	22.1	100	67.0	38.8	27.6*	18.8*	3.3	29.2	17.2	13.3	NP
	SM		8.0	92.0		66.0	61.0*	52.0*	24.0				NP
	SM-SC	0	7.3	92.7		74.8	69.7*	59.7*	34.0				4
	SM	0	6.0	94.0		69.0	60.0*	48.0*	24.0				NP

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
454	11046	USDH Iron Co.	Cedar Valley	Aal	Sandy Gravel
455	11047	USDH Iron Co.	Cedar Valley	Aal	Clayey Gravel
456	11048	USDH Iron Co.	Cedar Valley	Aaf	Clayey Sandy Gravel
457	11049	USDH Iron Co.	Cedar Valley	Aaf	Silty Gravel
458	11050	USDH Iron Co.	Cedar Valley	Aaf	Sandy Gravel
459	11051	USDH Iron Co.	Cedar Valley	Aaf	Sandy Gravel
460	11052	USDH Iron Co.	Cedar Valley	Aaf	Sandy Gravel
461	11053	USDH Iron Co.	Cedar Valley	Au	Silty Gravel
462	11054	USDH Iron Co.	Cedar Valley	Aaf	Silty Sand
463	11055	USDH Iron Co.	Cedar Valley	Aaf	Gravelly Sand
464	11056	USDH Iron Co.	Cedar Valley	Aaf	Silty Sand
465	11057	USDH Iron Co.	Cedar Valley	Aal	Clayey Sand
466	11058	USDH Iron Co.	Cedar Valley	Aaf	Clayey Silt
467	11059	USDH Iron Co.	Cedar Valley	Au	Sandy Gravel
468	11060	USDH Iron Co.	Cedar Valley	Au	Clayey Silty
469	11061	USDH Iron Co.	Cedar Valley	Aaf	Sandy Gravel
470	11062	USDH Iron Co.	Cedar Valley	Aal	Sandy Gravel

USCS SYMBOL	SIEVE ANALYSIS								ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		PLASTICITY INDEX (ASTM D 423 and D 424)
	BEFORE CRUSHING, PERCENT		PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE						PERCENT WEAR	PERCENT LOSS		
	>3"	>1"	1"	½"	NO. 4	NO. 8	NO. 50	NO. 200		CA	FA	
GP-GM	0	41.0	59.0		33.0	29.0*	22.0*	9.0				NP
GC	0	4.0	96.0		63.0	56.0*	45.0*	28.0				9
GM-GC	0	24.0	76.0		45.0	40.0*	32.0*	16.0				5
GM	4.4	17.5	100	82.3	55.8	46.2	33.2	12.9		10.2	8.7	NP
GP	0	18.6	71.4		36.4	30.6*	21.4*	4.3				NP
GP-GM	13.8	26.8	73.2		49.8	45.3*	38.1*	11.5				NP
GP	6.2	32.7	100	70.3	40.9	32.5	20.1	3.9	26.0	7.1	16.0	NP
GM	8.2	36.6	100	81.5	51.6	43.3*	37.6*	12.2	26.0	9.5	7.6	NP
SM	0	4.4	95.6		76.1	67.0*	48.8*	21.5				NP
SP-SM	0	19.5	100	82.2	61.3	54.0	37.0	9.5	47.5	41.0	21.6	NP
ML	0	0	100		88.7	86.2*	79.8*	52.9				1
SC	0	6.0	94.0		77.0	69.0*	49.0*	29.0				8
ML	0	0	100		99.5	97.1*	86.8*	73.8				3
GP-GM	13.3	50.0	100	71.3	46.1	39.0	23.6	10.1	37.0	12.6	14.7	NP
ML	0	0	100		100	99.7*	94.0*	60.5				3
GP-GM	3.7	31.4	100	65.8	34.7	27.5	17.4	10.1	30.0	16.4	16.4	2
GP-GM	0	21.0	100	76.1	48.9	42.2	30.4	10.8	32.2	8.99	5.34	NP

EXISTING TEST DATA

UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
471	11063	USDH Iron Co.	Cedar Valley	Aal	Gravelly Sand
472	11064	USDH Iron Co.	Cedar Valley	Au	Sandy Gravel
473	11065	USDH Iron Co.	Cedar Valley	Au	Clayey Gravelly Sand
474	11066	USDH Iron Co.	Black Mountains	Aaf	Sandy Gravel
475	11067	USDH Iron Co.	Black Mountains	Au	Sandy Gravel
476	11068	USDH Iron Co.	Cedar Valley	Au	Sandy Gravel
477	11069	USDH Iron Co.	Cedar Valley	Au	Silty Sand
478	11070	USDH Iron Co.	Cedar Valley	Aaf	Gravelly Sand
479	11071	USDH Iron Co.	South Escalante Desert	Aaf	Gravelly Sand
480	11072	USDH Iron Co.	South Escalante Desert	Au	Sandy Gravel
481	11073	USDH Iron Co.	South Escalante Desert	Aol	Gravelly Sand
482	11074	USDH Iron Co.	South Escalante Desert	Aaf	Gravelly Sand
483	11075	USDH Iron Co.	South Escalante Desert	Aaf	Gravelly Sand
484	11076	USDH Iron Co.	South Escalante Desert	Aaf	Sandy Gravel
485	11077	USDH Iron Co.	South Escalante Desert	Aaf	Gravelly Sand

USCS SYMBOL	SIEVE ANALYSIS: BEFORE CRUSHING, PERCENT		SIEVE ANALYSIS: PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE						ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88) PERCENT LOSS		PLASTICITY INDEX (ASTM D 423 and D 424)
	>3"	>1"	1"	½"	NO. 4	NO. 8	NO. 50	NO. 200	PERCENT WEAR	CA	FA	
SP			100	92.1	85.0	67.9	18.3	4.1	40.9	32.2	25.0	NP
GM-GC	6.3	40.6	100	72.3	42.5	33.4	19.4	11.8	34.0	24.1	10.0	5
SM-SC	16.9	29.6	87.3		66.6	* 55.3	* 41.9	30.8				5
GP-GM	0	0	100	80.2	52.4	41.9	17.1	8.8	25.5	11.0	11.0	NP
GP	0	10.1	89.9	73.1	49.0	39.8	14.8	3.1			35.7	NP
GP			100	73.0	18.7	8.8	3.7	2.1	24.0	2.94	12.27	
SM	0	0	100	90.5	74.5	64.8	39.0	18.2			16.9	NP
SP-SM		3.8	100	85.9	68.3	* 56.4	* 36.0	9.4	32.0			NP
SP	0	0	100	93.4	83.2	72.2	20.9	3.9	24.8	12.5	12.5	NP
GM-GC		20.4	100	69.9	31.0	* 24.9	* 17.2	7.5	29.82			6
SP			100		70.1	* 52.0	* 25.1	4.8	30.4			NP
SP		6.1	100	90.3	75.2	* 54.2	* 13.9	3.8	27.1			NP
SP-SM	0	14.7	100	84.9	61.7	* 47.9	* 26.5	9.0	30.0			NP
GP		34.0	100	69.3	32.3	* 22.0	* 9.2	3.8	28.1			NP
SP	0	25.0	100	91.0	64.0	43.0	10.5	5.0	23.1	14.3	15.25	NP

EXISTING TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
486	11078	USDH Iron Co.	South Escalante Desert	Aaf	Gravelly Sand
487	11079	USDH Iron Co.	South Escalante Desert	Aaf	Clayey Sand
488	11080	USDH Iron Co.	South Escalante Desert	Aol	Silty Sand
489	11080	USDH Iron Co.	South Escalante Desert	Au	Silty Sand
490	11082	USDH Iron Co.	South Escalante Desert	Aol	Gravelly Sand
491	11083	USDH Iron Co.	South Escalante Desert	Aol	Gravelly Sand
492	11084	USDH Iron Co.	South Escalante Desert	Aol	Silty Sand
493	11085	USDH Iron Co.	South Escalante Desert	Aol	Gravelly Sand
494	11086	USDH Iron Co.	South Escalante Desert	Aaf	Sandy Gravel
495	11087	USDH Iron Co.	South Escalante Desert	Au	Gravelly Sand
496	11088	USDH Iron Co.	South Escalante Desert	Aaf	Gravelly Sand
497	11089	USDH Iron Co.	South Escalante Desert	Aal	Sandy Gravell
498	11090	USDH Iron Co.	South Escalante Desert	Au	Gravelly Sand

USCS SYMBOL	SIEVE ANALYSIS								ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		PLASTICITY INDEX (ASTM D 423 and D 424)
	BEFORE CRUSHING, PERCENT		PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE						PERCENT WEAR	PERCENT LOSS		
	>3"	>1"	1"	½"	NO. 4	NO. 8	NO. 50	NO. 200		CA	FA	
SP		8.2	100		70.5	*56.4	*17.4	3.7	29.1			NP
SC			100			*91.3	*69.4	45.6				8
SM			100		91.9	*82.4	*52.1	22.7				NP
SM			100	100	100	*98.3	*83.2	48.9				2
SP-SM			100		69.3	*58.0	*25.3	7.5	26.7			NP
SP			100		72.4	*54.3	*13.7	2.3	29.9			NP
SP-SM			100		93.1	*78.8	*41.2	11.0				NP
SP-SM		1.5	100		65.3	*48.6	*17.6	6.6	28.6			NP
GM	0.7	11.7	100	79.7	55.0	45.2	21.2	13.6	21.4	8.42	10.62	3
SM-SC		18.8	100	80.7	57.7	49.0	17.7	11.2	24.9	8.34	10.38	5
SP-SM	11.0	27.7	100		68.6	*57.6	*33.6	11.6	26.6			
GP-GM		23.5	100		53.4	*41.9	*23.4	9.7	29.8			NP
SP		29.5	100	83.6	61.0	*42.2	*12.7	4.6	26.8			

EXISTING TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

FUGRO NATIONAL, INC.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION
499	11091	USDH Iron Co.	South Escalante Desert	Aaf	Gravelly Sand
500	27070	USDH Washington Co.	Kane Spring Draw	Au	Sandy Gravel
501	27071	USDH Washington Co.	Kane Spring Draw	Aaf	Clayey Sand
502	27072	USDH Washington Co.	Kane Spring Draw	Au	Silty Sand
503	27073	USDH Washington Co.	Kane Spring Draw	Au	Sandy Gravel
504	27074	USDH Washington Co.	Kane Spring Draw	Au	Sandy Gravel
505	27075	USDH Washington Co.	South Escalante Desert	Au	Gravelly Sand
506	27076	USDH Washington Co.	South Escalante Desert	Aaf	Sandy Gravel
507	27077	USDH Washington Co.	South Escalante Desert	Aaf	Gravelly Sand
508	27078	USDH Washington Co.	South Escalante Desert	Aal	Silty Gravelly Sand

USCS SYMBOL	SIEVE ANALYSIS: BEFORE CRUSHING, PERCENT		SIEVE ANALYSIS: PERCENT PASSING AFTER CRUSHING TO 1" MAXIMUM SIZE						ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88) PERCENT LOSS		PLASTICITY INDEX (ASTM D 423 and D 424)
	>3"	>1"	1"	½"	NO. 4	NO. 8	NO. 50	NO. 200	PERCENT WEAR	CA	FA	
SP-SM	4.3	14.3	100	89.1	69.1	60.0	23.5	10.1	26.5	10.50	10.40	NP
GP	0	0.8	100	92.5	43.9	26.4	7.8	1.6	42.1	0.71	41.7	NP
SM-SC	0	9.7	90.3		70.6	*54.7	*44.4	27.9				4
SP-SM	6.6	17.1	100	82.7	55.4	*40.4	*14.4	5.4	41.6	0.36	2.65	NP
GP		43.0	100	76.8	42.2	*17.2	*9.0	2.6	25.8			NP
GP-GM	3.3	16.5	100	78.3	41.0	29.7	14.7	8.4	34.5	1.65	4.27	NP
GP/SP	8.4	26.9	100		52.1	*39.8	*14.4	3.3	27.4			NP
GP	10.2	45.8	100	73.9	40.0	30.8	6.9	2.9	29.0	24.2	23.0	NP
GP/SP		38.5	100		50.7	*39.8	*6.0	0.9	30.5			NP
GM/SM	5.1	17.5	100	78.1	58.0	*51.5	*25.5	15.0	24.3	10.9	12.1	NP

EXISTING TEST DATA
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UTAH-NEVADA STUDY AREA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2

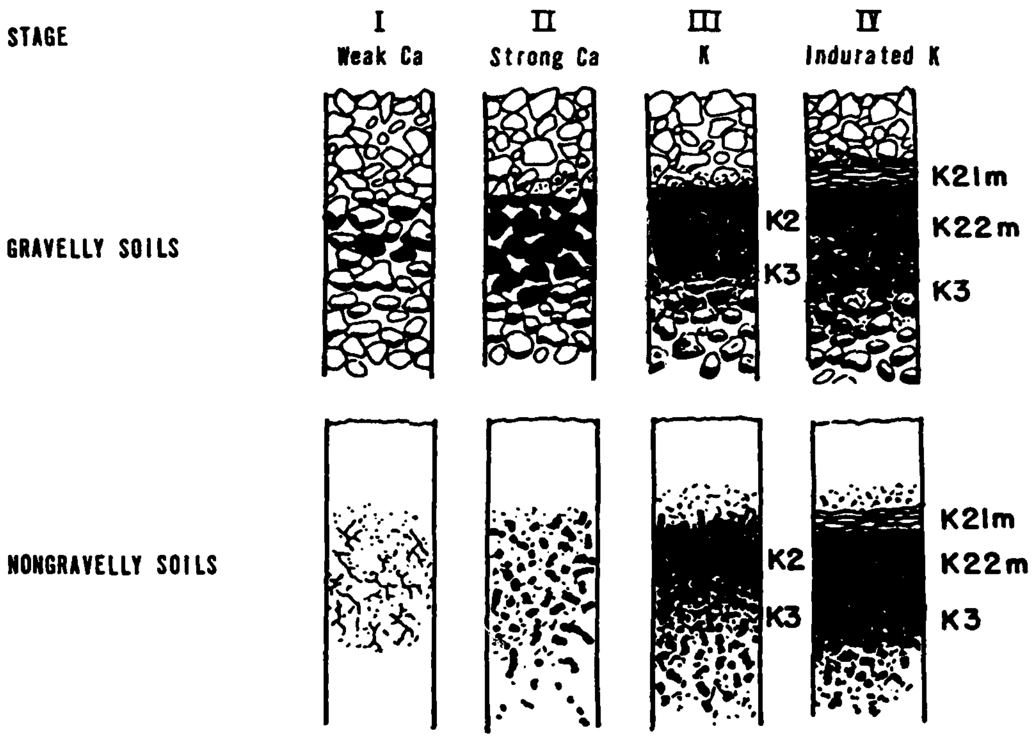
FUGRO NATIONAL, INC.

APPENDIX B

SUMMARY OF CALICHE DEVELOPMENT

DIAGNOSTIC CARBONATE MORPHOLOGY

STAGE	GRAVELLY SOILS	NONGRAVELLY SOILS
I	Thin, discontinuous pebble coatings	Few filaments or faint coatings
II	Continuous pebble coatings, some interpebble fillings	Few to abundant nodules, flakes, filaments
III	Many interpebble fillings	Many nodules and internodular fillings
IV	Laminar horizon overlying plugged horizon	Laminar horizon overlying plugged horizon



Stages of development of a caliche profile with time. Stage I represents incipient carbonate accumulation, followed by continuous build-up of carbonate until, in Stage IV, the soil is completely plugged.

Reference: Gile, L.H. Peterson, F.F., and Grossman, R.B., 1965, The K horizon: A master horizon of carbonate accumulation: Soil Science, v. 99, p. 74-82.

SUMMARY OF CALICHE DEVELOPMENT	
MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - BMO	FIGURE B-1
FUGRO NATIONAL, INC.	

APPENDIX C

UNIFIED SOIL CLASSIFICATION SYSTEM

Coarse-grained soils — More than half of material is *larger* than No. 200 sieve size[b] (The No. 200 sieve size is about the smallest particle visible to naked eye)

(For visual classification, the ¼ in. size may be used as equivalent to the No. 4 sieve size)

Use grain size curve in identifying the fractions as given under field identification

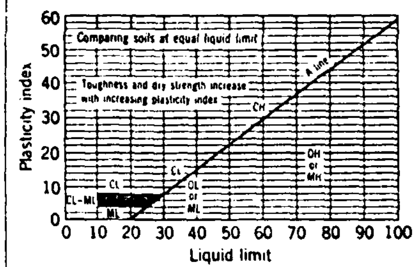
Major Division	Fines	Field Identification Procedures (Excluding particles larger than 3 in. and basing fractions on estimated weights)	Group Symbols[a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria
Gravels: More than half of coarse fraction is larger than No. 4 sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
		Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics	Not meeting all gradation requirements for *GW*
	Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures	Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles ½-in. maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; *well compacted and moist in place*; alluvial sand; (*SM*)	Atterberg limits below "A" line, or *PI* less than 4 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
		Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures		Atterberg limits above "A" line, with *PI* greater than 7
Sands: More than half of coarse fraction is smaller than No. 4 sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	*SW*	Well graded sands, gravelly sands, little or no fines		$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
		Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for *SW*
	Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures		Atterberg limits below "A" line or *PI* less than 5 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
		Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures		Atterberg limits below "A" line with *PI* greater than 7

Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP*; More than 12% *GM, GC, SM, SC*; 5% to 12% *Borderline* cases requiring use of dual symbols

Fine-grained soils — More than half of material is *smaller* than No. 200 sieve size

Identification Procedures on Fraction Smaller than No. 40 Sieve Size

Major Division	Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency *near plastic limit*)	Group Symbols[a]	Typical Names	Information Required for Describing Soils
Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses
	Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions
	Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)
Silts and clays liquid limit greater than 50	Slight to *medium*	Slow to *none*	Slight to *medium*	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
	High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	
	Medium to high	None to *very slow*	Slight to *medium*	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils	Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	



Plasticity chart for laboratory classification of fine grained soils

From Wagner, 1957.
[a] *Boundary classifications.* Soils possessing characteristics of two groups are designated by combinations of group symbols. For example *GW–GC*, well graded gravel-sand mixture with clay binder.
[b] All sieve sizes on this chart are U.S. standard.

Field Identification Procedure for Fine Grained Soils or Fractions

These procedures are to be performed on the minus No. 40 sieve size particles, approximately 1/64 in. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

Dilatancy (Reaction to shaking):
After removing particles larger than No. 40 sieve size, prepare a pat of moist soil with a volume of about one-half cubic inch. Add enough water if necessary to make the soil soft but not sticky.
Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.
Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

Dry Strength (Crushing characteristics):
After removing particles larger than No. 40 sieve size, mould a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.
High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

Toughness (Consistency near plastic limit):
After removing particles larger than the No. 40 sieve size, a specimen of soil about one-half inch cube in size, is moulded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about one-eight inch in diameter. The thread is then folded and re-rolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached.
After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.
The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.
Highly organic clays have a very weak and spongy feel at the plastic limit.

UNIFIED SOIL CLASSIFICATION SYSTEM

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE C-1

FUGRO NATIONAL, INC.

APPENDIX D

UTAH-NEVADA STUDY AREA PHOTOGRAPHS

Older Lacustrine Deposit (Aol), widely scattered in the northern and western portions of the study area. Note typical moderately well to well-developed stratification in this 50-foot exposure. Class B_1 material.

UTAH–NEVADA STUDY AREA PHOTOGRAPH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

PHOTO
D-1

FUGRO NATIONAL, INC.

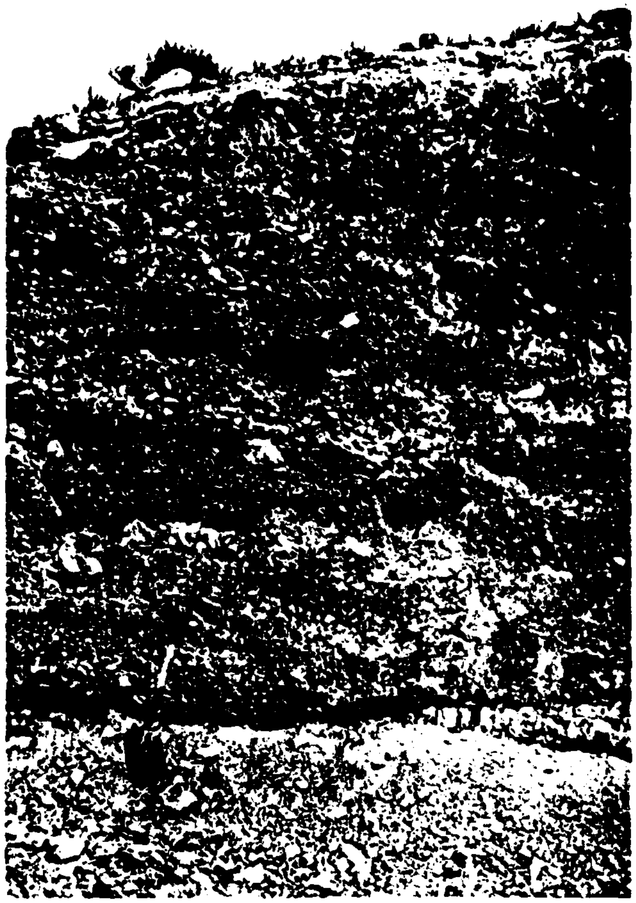
Older Lacustrine Deposit (Aol), illustrating rounded, moderately well graded sand- and gravel-sized particles with characteristic lack of fines.

UTAH-NEVADA STUDY AREA PHOTOGRAPH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

PHOTO
D-2

FUGRO NATIONAL, INC.



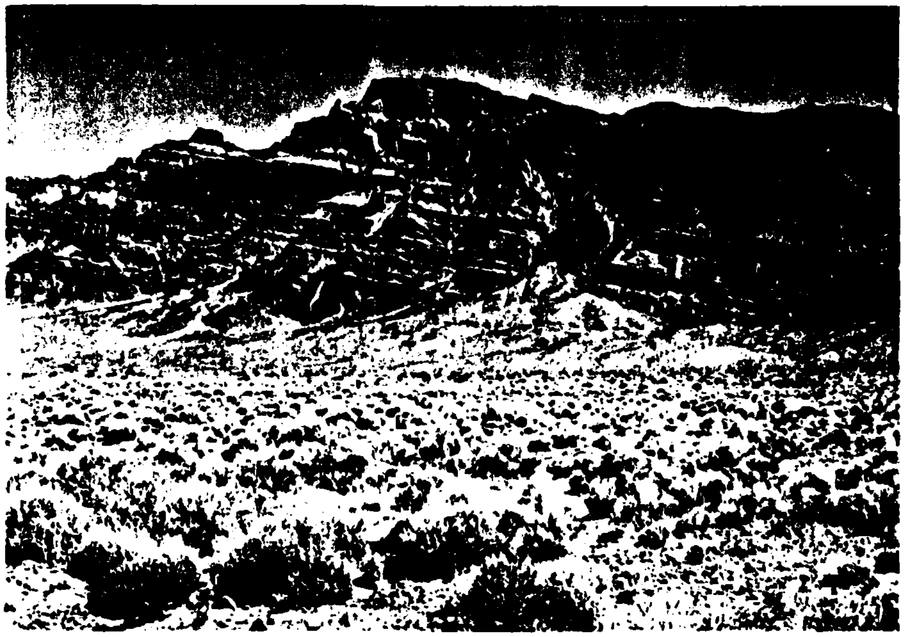
Stream-cut in Alluvial Fan Deposit (Aaf). View illustrates the crudely stratified, poorly graded mixture of cobbles, gravel, sand, and fines typical of this deposit. Note caliche coatings on cobbles and gravels. Class B material.

UTAH-NEVADA STUDY AREA PHOTOGRAPH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

PHOTO
D-3

FUGRO NATIONAL, INC.



Typical carbonate rock (Cau, Ls, Do), exposure and associated alluvial fans (Aaf). Both represent potential high quality aggregate sources. Amount and type of deleterious material will cause these units to be ranked as Class B material.

UTAH-NEVADA STUDY AREA PHOTOGRAPH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

PHOTO
D-4

FUGRO NATIONAL, INC.

Quaternary Basalt (Vb), middle foreground. Note flat lying exposure of this 300-foot thick, mid-valley flow. Class B material.

UTAH-NEVADA STUDY AREA PHOTOGRAPH

MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - BMO	PHOTO D-5

FUGRO NATIONAL, INC.

Granitic Rock (Gr) outcrop illustrating typical jointing and weathering characteristics. Near surface portions of this unit are generally unacceptable crushed rock sources because of the high degree of weathering.

UTAH-NEVADA STUDY AREA PHOTOGRAPH

MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - BMO	PHOTO D-6

FUGRO NATIONAL, INC.

APPENDIX E

FUGRO NATIONAL GEOLOGIC UNIT CROSS REFERENCE

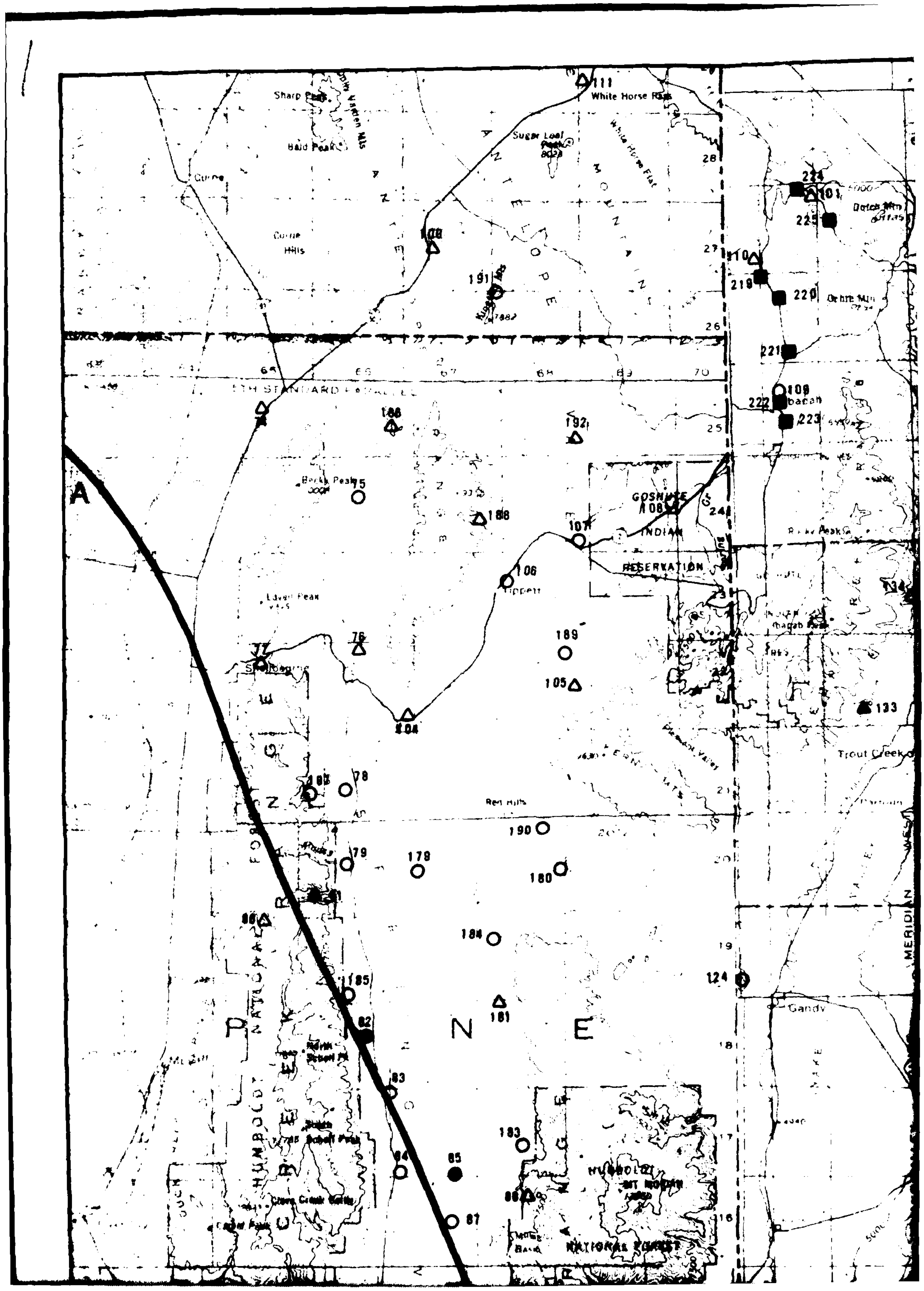
UARSA POTENTIAL AGGREGATE SOURCE SYMBOLS	FUGRO NATIONAL GENERAL GEOLOGIC UNIT EXPLANATION	
		ROCK
		Shown in regions where rock is exposed, the areally predominant (greater than 70 percent) rock type is indicated. In those areas where two rock types occur the predominant rock type is shown followed by the subordinate rock type (e.g., $S_{2_{UP}}/I_{4_T}$). Rock may be subdivided into bedrock [B].
	I	IGNEOUS (UNDIFFERENTIATED) Rocks formed by solidification of a molten or partially molten mass
Gr	I_1	Intrusive. Plutonic rocks formed by solidification of molten material beneath the surface (e.g., granite, granodiorite, diorite, gabbro)
Vu	I_2	Extrusive (intermediate and acidic) Volcanic rocks of intermediate and acidic composition formed by solidification of molten material at or near the surface (e.g., rhyolite, latite, dacite, andesite)
Vb	I_3	Extrusive (basic) Volcanic rocks of basic composition, generally formed by solidification of molten materials at or near the surface (e.g., basalt).
Vu	I_4	Extrusive (pyroclastic) Rocks formed by accumulation of volcanic ejecta (e.g., ash, tuff, welded tuff, agglomerate)
Su	S	SEDIMENTARY (UNDIFFERENTIATED) Rocks formed by accumulation of clastic solids, organic solids and/or chemically precipitated minerals
Su, QTz	S_1	Arenaceous and/or Siliceous Rocks. Composed of sand-size particles (e.g., sandstone, orthoquartzite) or of cryptocrystalline silica (e.g., opal, chert)
Ls, Do, Cau	S_2	Carbonate Rocks. Composed predominantly of calcium carbonate detritus or chemical precipitates (e.g., limestone, dolomite, chalk)
	S_3	Argillaceous Rocks. Composed of clay and silt-sized particles (e.g., siltstone, shale, claystone)
	S_4	Evaporite Rocks. Precipitated from solution as a result of evaporation (e.g., halite, gypsum, anhydrite, sylvite)
Su	S_5	Coarse Clastic Rocks. Composed of gravel-sized or larger clasts (e.g., conglomerate, breccia)
Mu	M	METAMORPHIC (UNDIFFERENTIATED) Rocks formed through recrystallization in the solid state of preexisting rocks by heat and pressure
Mu	M_1	Coarse grained: rocks formed by higher-grade regional metamorphism, either banded or granular (e.g., gneiss, granulite, amphibolite)
Mu	M_2	Fine grained: schistose rocks formed by lower grade regional metamorphism (e.g., schist, slate, phyllite)
Mu	M_3	Nonfoliated: rocks formed chiefly by contact metamorphism (e.g., hornfels, marble)
QTz	M_4	Metaquartzite: rocks formed by metamorphism of highly siliceous rocks
		BASIN-FILL
	A	BASIN-FILL DEPOSITS. Fine- to coarse-grained materials deposited principally by wind, water or gravity
Aal	A_1	Younger Fluvial Deposits. Major modern stream channel and flood-plain deposits
Au, Aal	A_2	Older Fluvial Deposits. Older incised stream channel and flood-plain deposits in elevated terraces bordering major modern drainages
Au	A_3	Eolian Deposits. Wind-blown deposits of sand occurring as either thin sheets (A_{3s}) or dunes (A_{3d})
Aol	A_4	Playa and Lacustrine Deposits. Deposits occurring in modern, active playas (A_4) or in either inactive playas or older lake beds and abandoned shorelines associated with extinct lakes (A_{4o})
Aaf	A_5	Alluvial Fan Deposits. Alluvial deposits consisting of debris flow and water-laid alluvium near mountain fronts, grading into predominantly water-laid alluvium deposited in shifting distributary channels near the basin center. Younger (A_{5y}), intermediate (A_{5i}) and older (A_{5o}) alluvial fans are differentiated by surface soil development, terrain conditions and present depositional/erosional environment
Au	A_3/A_5	Mixed non-rock units. Most areally extensive unit is listed first
Aaf	A_{5y} (A_{5i})	Parenthetic unit underlies thin veneer of overlying mapped unit

FUGRO NATIONAL GEOLOGIC UNIT CROSS REFERENCE

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

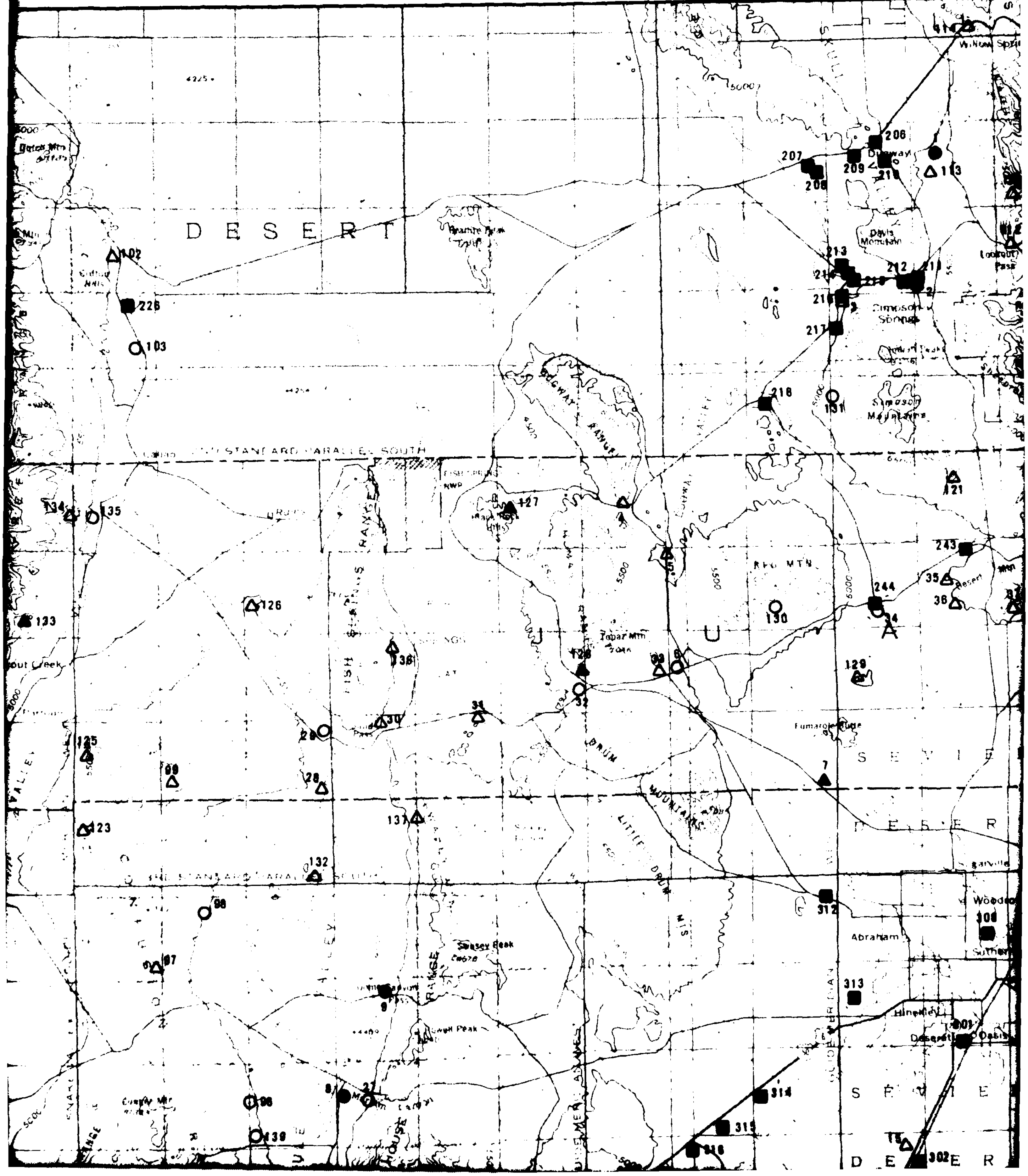
FIGURE E-1

FUGRO NATIONAL, INC.



White Horse Pass
Sharp Peak
Bald Peak
Sugar Loaf Peak
White Horse Flat
Currie
Currie Hills
Dutch Mtn
Ochre Mtn
5TH STANDARD PARALLEL
Ibapah
Becky Peak
GOSHUTE
INDIAN
RESERVATION
Lavan Peak
Red Hills
Trout Creek
Gandy
MERIDIAN
HUMBOLDT
North Schell Pk
South Schell Peak
NATIONAL FOREST

2



D E S E R T
Dutch Mtn
Willow Springs
Dugway
Davis Mountain
Lookout Pass
Simpson Springs
Simpson Mountains
Granite Peak
Dugway Range
STANDARD PARALLEL SOUTH
Fish Springs NWR
Black Rock Hills
Fish Springs Range
Keg Mtn
Topaz Mtn
Drum Mountains
Little Drum Mountains
Fumarole Butte
S E V I E R
D E S E R T
Swasey Peak
Howell Peak
Notch Peak
Marjum Pass
Crater Mtn
Abraham
Woodrow
Sutherland
Hinckley
Deseret
Oasis
House Range
Confusion Range
Tule Valley
Snake Valley
Whirlwind Valley
Trout Creek
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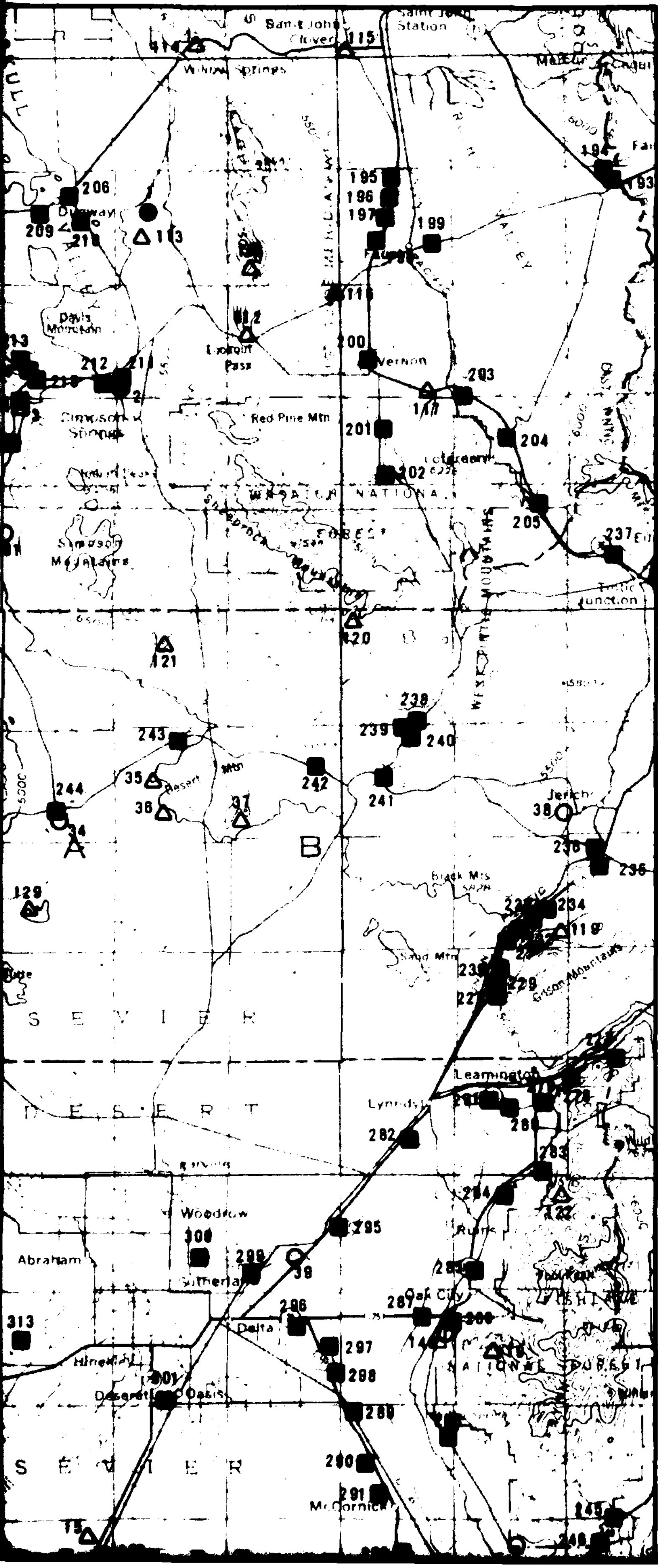

Saint John
Clover
Saint John Station
Willow Springs
Dugway
Davis Mountain
Lookout Pass
Vernon
Red Pine Mtn
Simpson Springs
Simpson Mountains
Lofgreen
Tintic Junction
Jericho
Black Mts
Sand Mtn
Gilson Mountains
Leamington
Lynndyl
Woodrow
Abraham
Sutherland
Delta
Oak City
Hinckley
Deseret
Oasis
McCornick
A
B
S E V I E R
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S E V I E R

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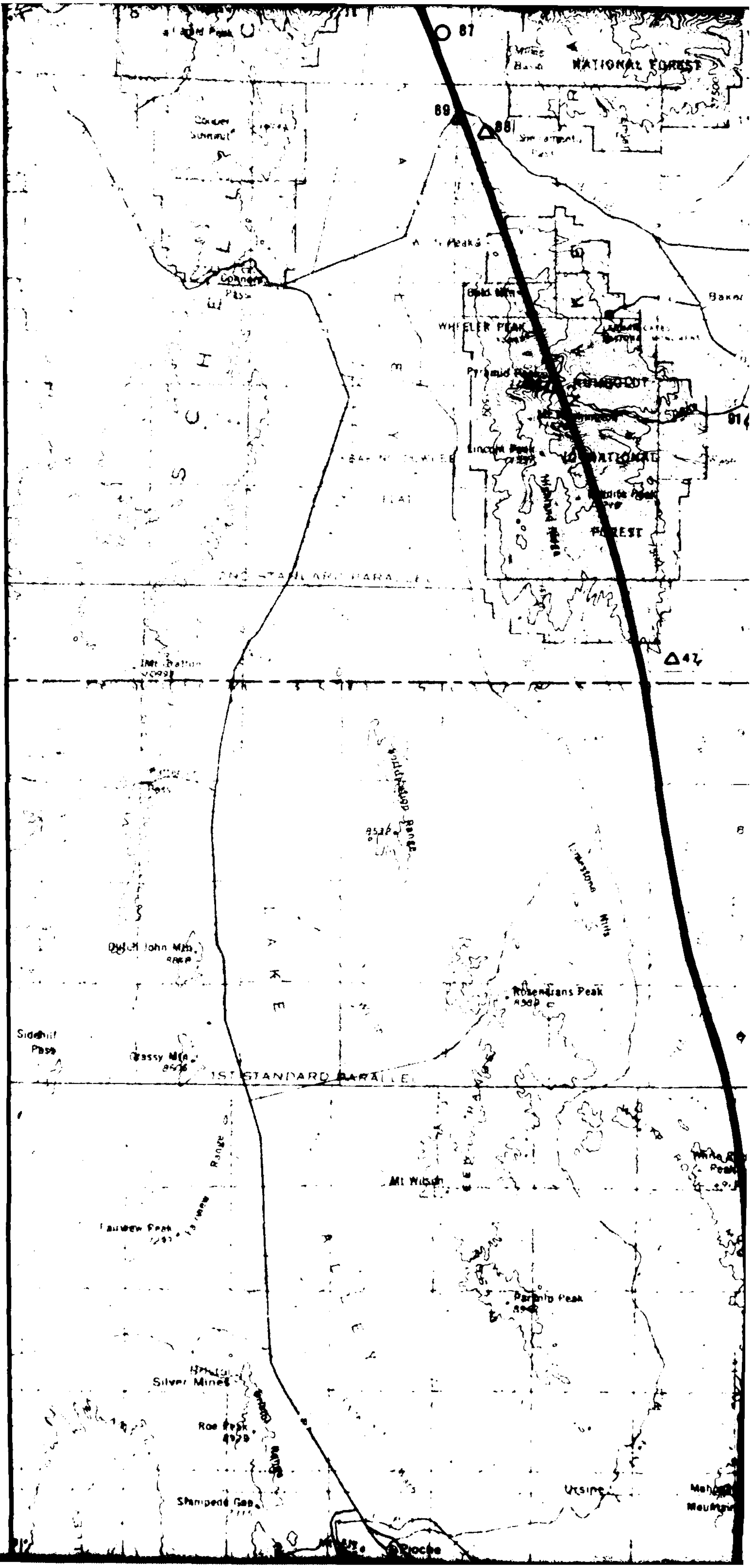

87
NATIONAL FOREST
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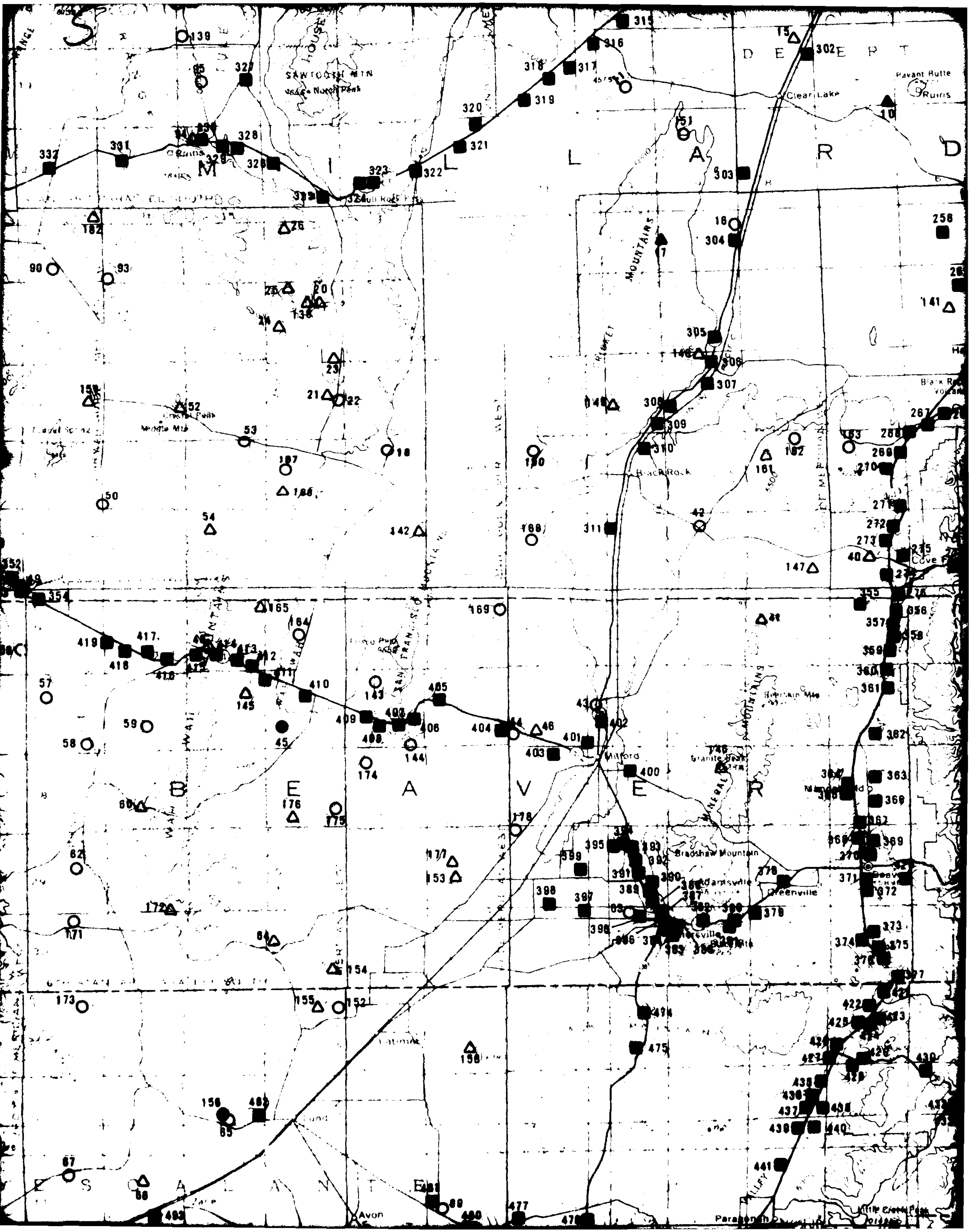
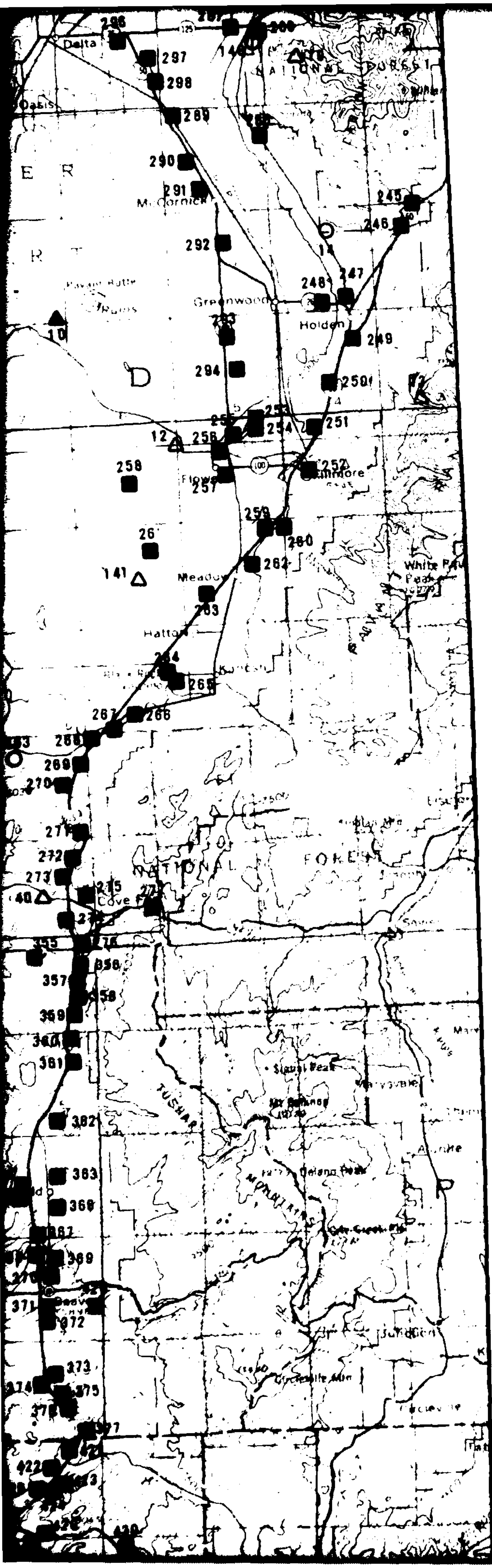
88
Conners Pass
WHEELER PEAK
Pyramid
Lincoln Peak
FOREST
Baker
2ND STANDARD PARALLEL
42
Limestone Hills
Dutch John Mtn
Rosencrans Peak
Sidehill Pass
Grassy Mtn
1ST STANDARD PARALLEL
Range
Mt Wilson
Parsnip Peak
Silver Mines
Roe Peak
Stampede Gap
Ursine
Pioche



DESERT
MILLARD
BEAVER
SAWTOOTH MTN
Notch Peak
Clear Lake
Pavant Butte
Ruins
MOUNTAINS
Black Rock
Black Rock Volcano
Crystal Peak
Middle Mtn
Cove Fort
Frisco Peak
Milford
Granite Peak
Bradshaw Mountain
Adamsville
Greenville
Beaver
Avon
Paragonah
Little Creek Peak



Delta
Oasis
McCornick
Greenwood
Holden
NATIONAL FOREST
Hatton
Cove Fort
White Pine Peak
Signal Peak
Marysvale
TUSHAR MOUNTAINS
Delano Peak
Junction
Circleville
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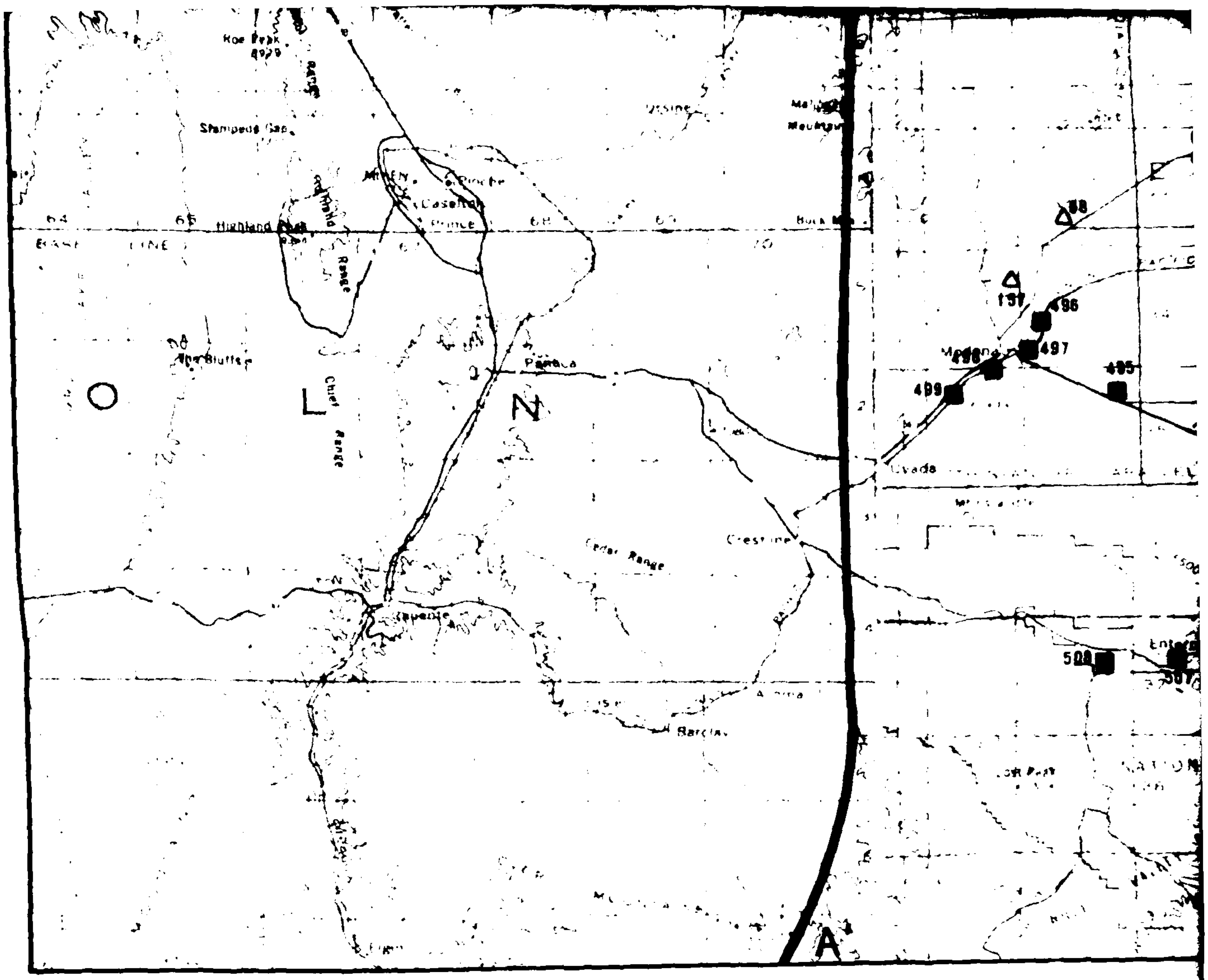


EXPLANATION

SYMBOLS

FUGRO NATIONAL FIELD STATIONS

Basin-Fill Units

○ Not sampled

● Sampled and tested

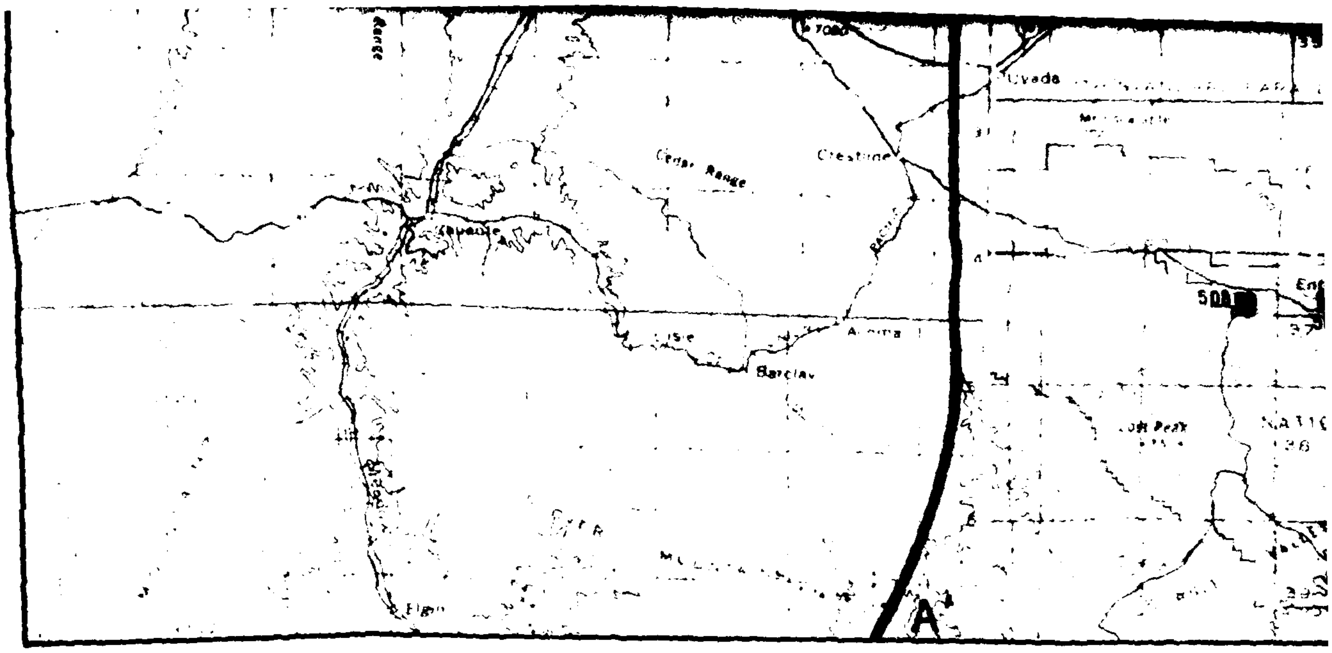
Rock Units

△ Not sampled

▲ Sampled and tested

EXISTING TEST DATA SITES

■ Test data available



EXPLANATION

SYMBOLS

FUGRO NATIONAL FIELD STATIONS

Basin-Fill Units

○ Not sampled

● Sampled and tested

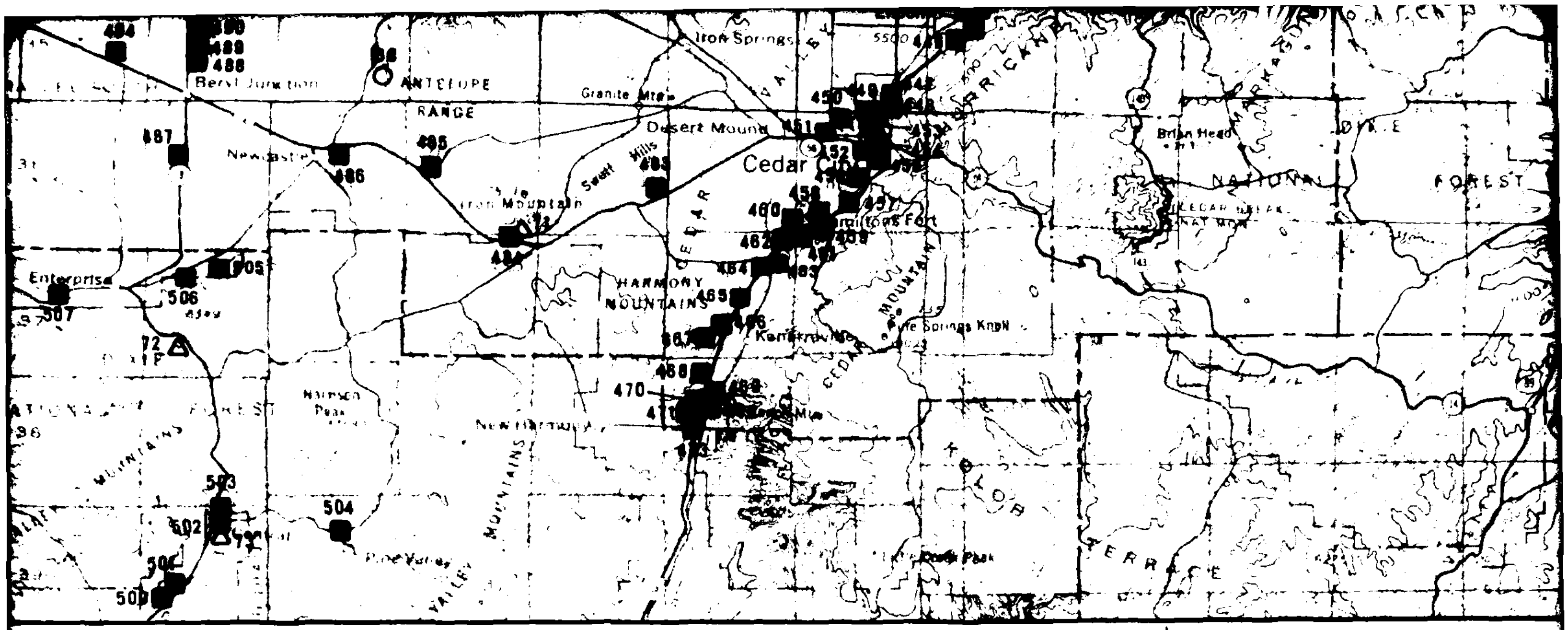
Rock Units

△ Not sampled

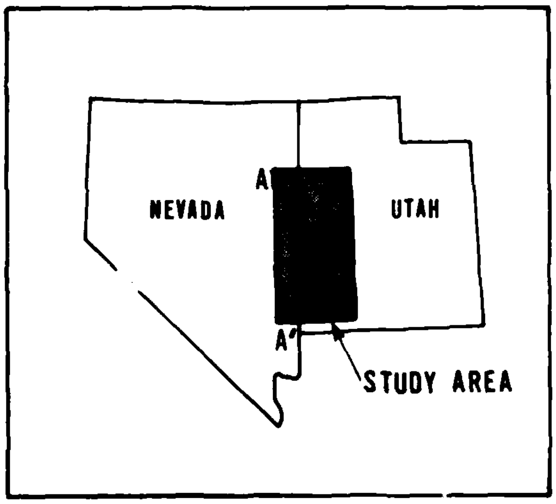
▲ Sampled and tested

EXISTING TEST DATA SITES

■ Test data available



LOCATION MAP



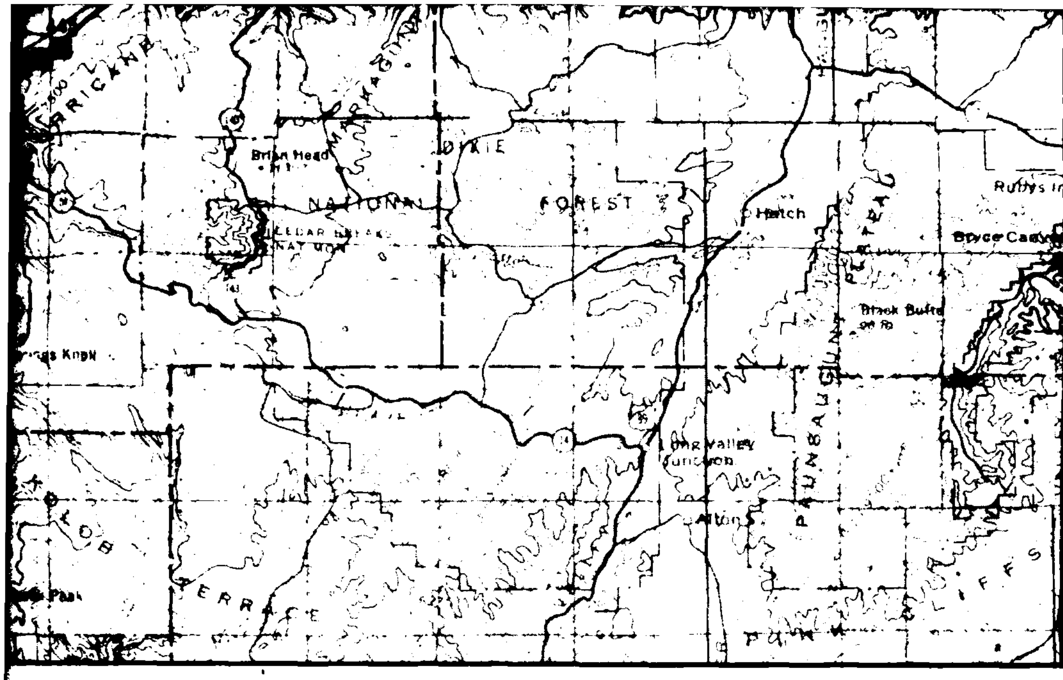
SCALE 1:500,000

0 10 20
STATUTE MILES

0 10 20
KILOMETERS

FIELD STATION
DATA SIT
UTAH-NEVAD

MX SITING INVES
DEPARTMENT OF THE AIR
FUGRO NA



1:500,000

10 20

TE MILES

10 20

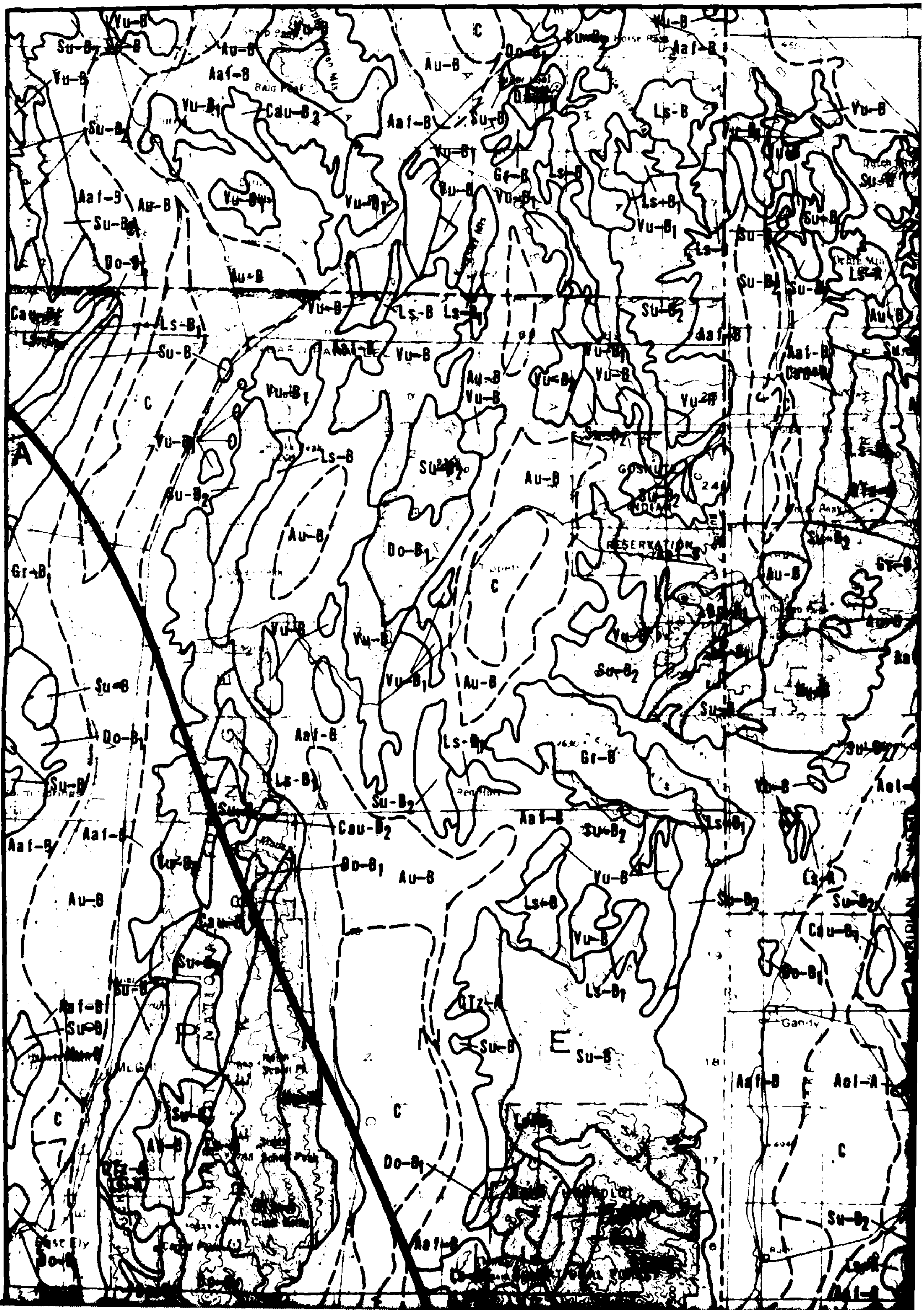
METERS

FIELD STATION AND EXISTING TEST
DATA SITE LOCATIONS
UTAH-NEVADA STUDY AREA

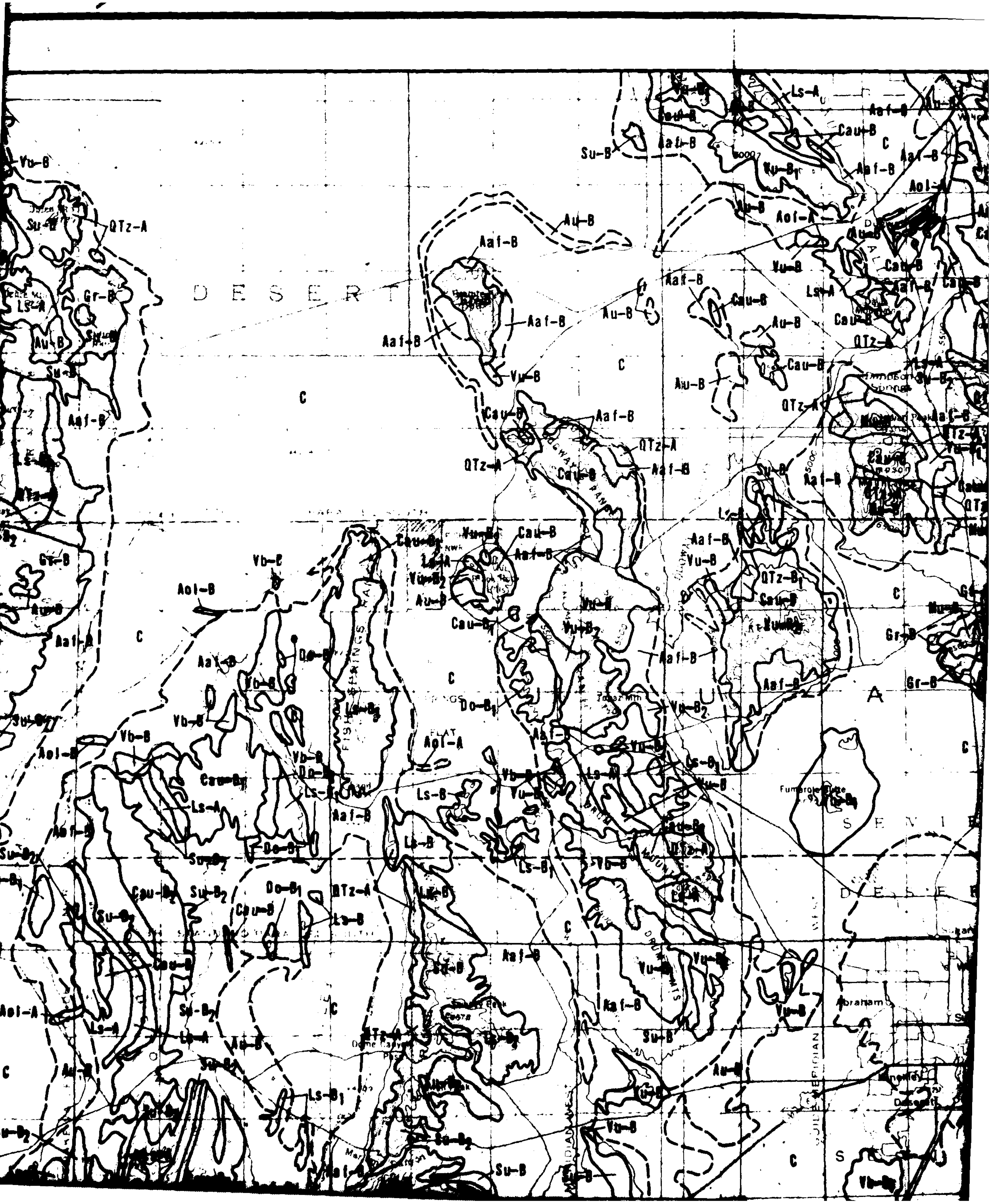
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

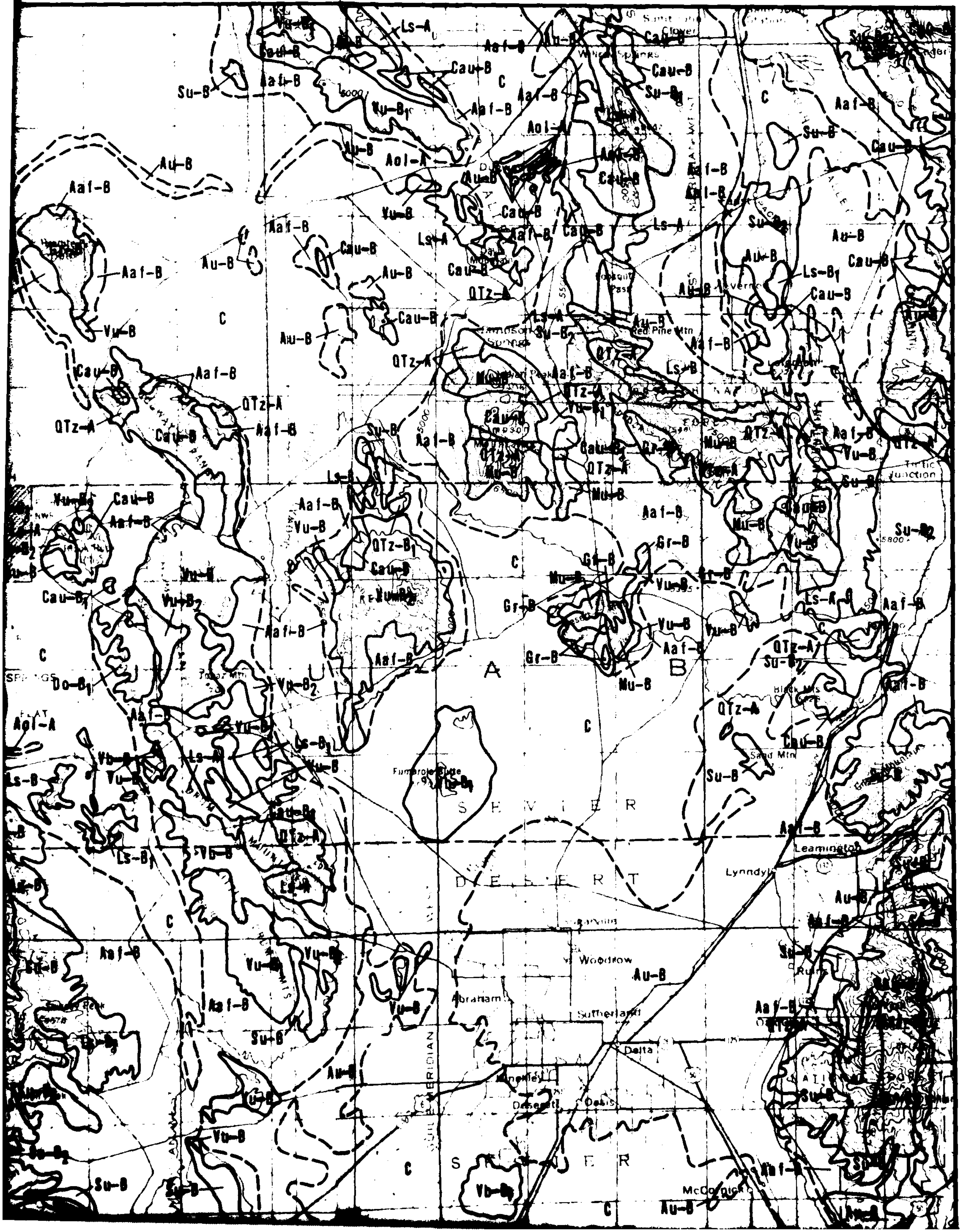
DRAWING 2

FUGRO NATIONAL, INC.



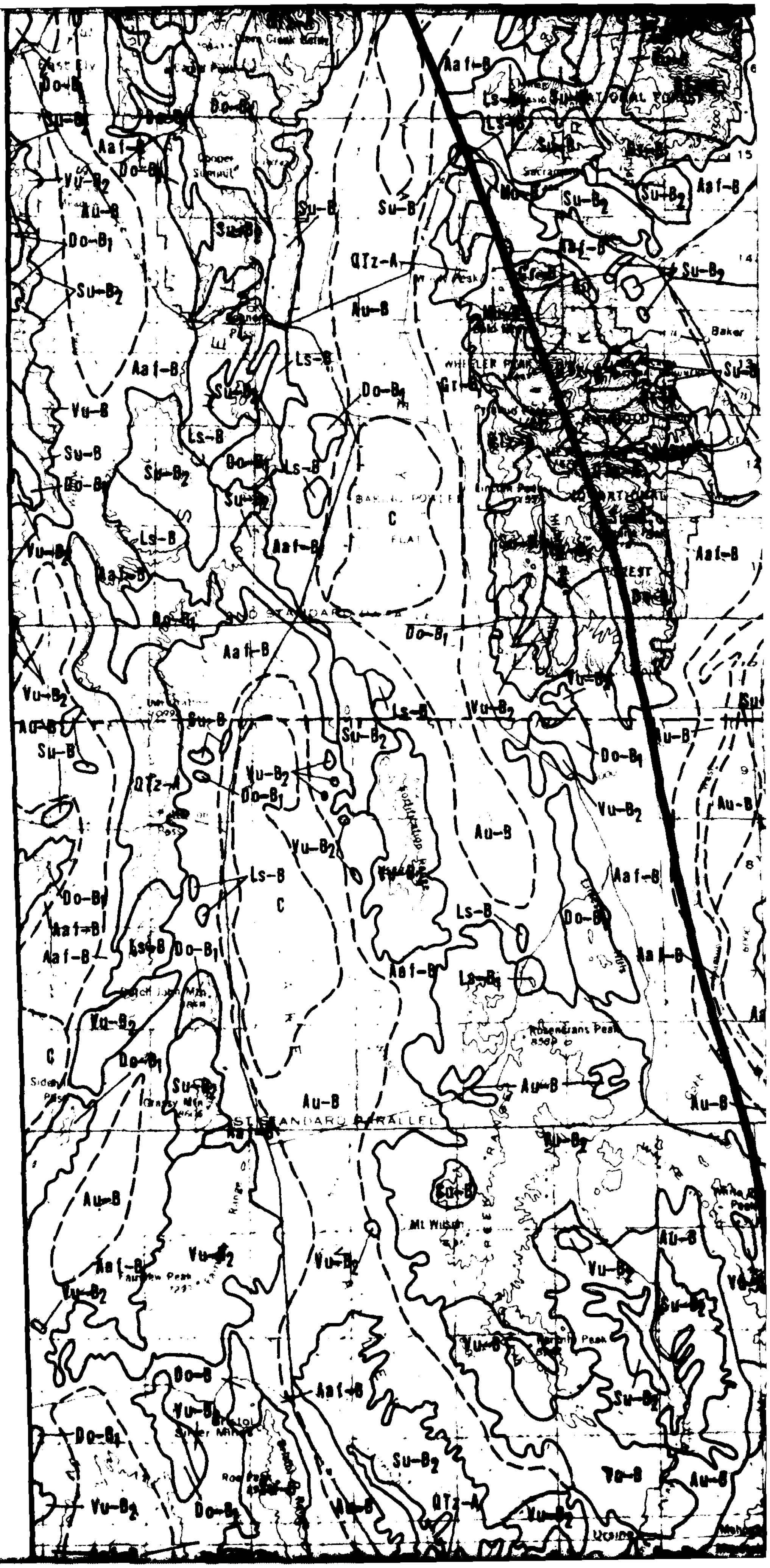
Vu-B
Su-B2
Au-B
Aaf-B
C
Do-B1
Cau-B2
Vu-B1
Ls-B
Su-B
Gr-B
Ls-B1
Su-B1
Aaf-B
A
Au-B
GOSHUTE
INDIAN
RESERVATION
Gr-B1
Red Hill
Cau-B2
Do-B1
QTz-A
N
E
Su-B
Aol-A
Gandy
C
Do-B1
Aaf-B


D E S E R T
C
Vu-B
Su-B
QTz-A
Gr-B
Ls-A
Au-B
Aaf-B
Aaf-A
Aol-B
Aol-A
Vb-B
Cau-B
Do-B
Ls-B
Vu-B
Cau-B
Ls-A
Su-B
Au-B
Aaf-B
QTz-A
Gr-B
Fumarole Butte
A
S E V I E
D E S E R
Abraham
C
S



S E V I E R
D E S E R T
Fumarole Butte
Leamington
Lynndyl
Woodrow
Abraham
Sutherland
Delta
Deseret
Oasis
Sand Mtn
Black Mts
Tintic Junction
Red Pine Mtn
Topaz Mtn
Sugarville
C
Aaf-B
Cau-B
Au-B
Su-B
Vu-B
QTz-A
Ls-A
Mu-B
Gr-B
Aol-A
Do-B1

4



Do-B1
Vu-B2
Aaf-B
Do-B2
Conner Summit
Su-B
Su-B2
Au-B
QTz-A
Ls-B
Au-B
Baker
Do-B1
C
FLAT
Vu-B
Aaf-B
2ND STANDARD
Su-B
Do-B1
Ls-B
Vu-B2
C
Au-B
Ls-B1
Rosencrans Peak
Sidehill Pass
Mt Wilson
Vu-B2
Do-B
Aaf-B
Bristol Silver Mines
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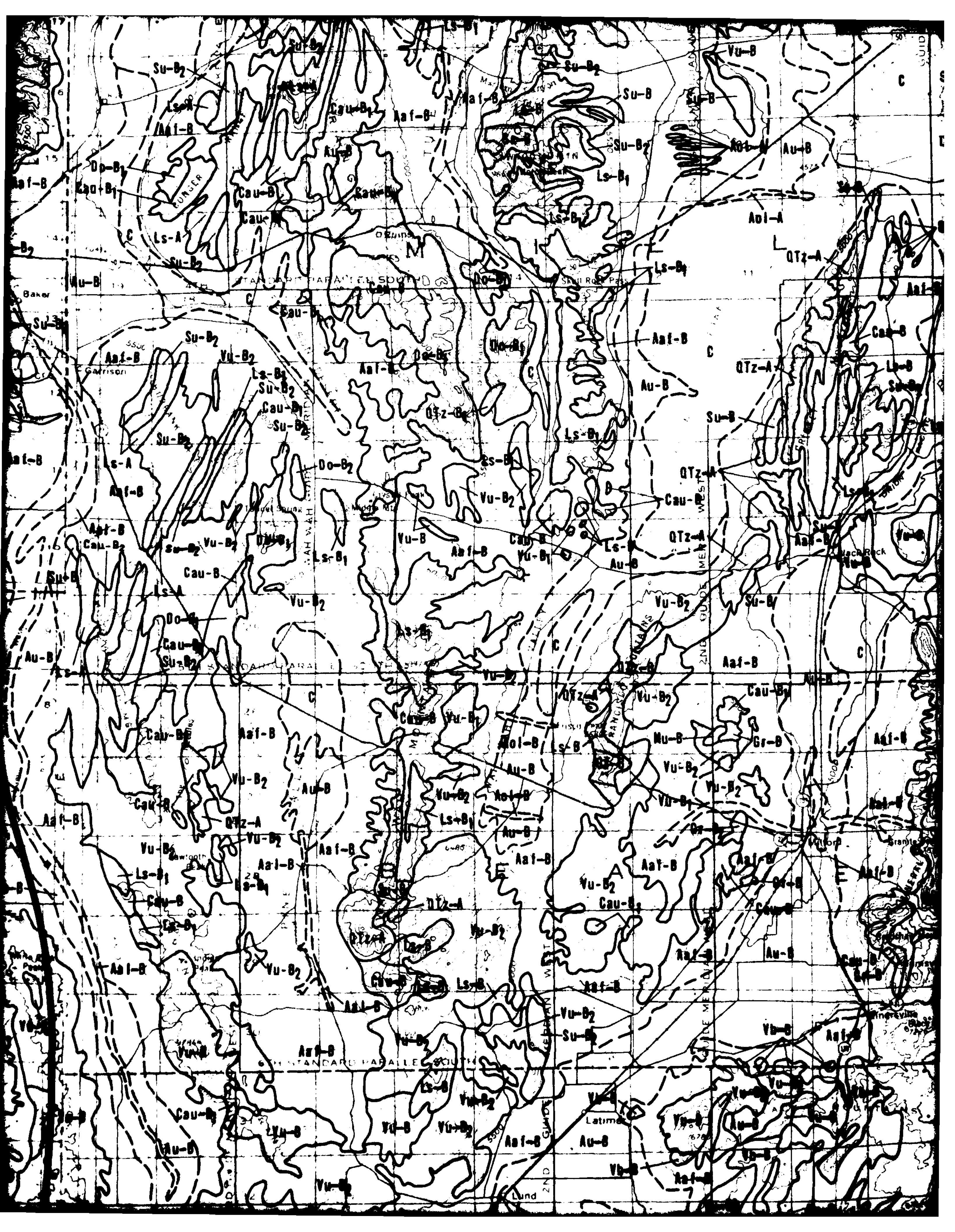
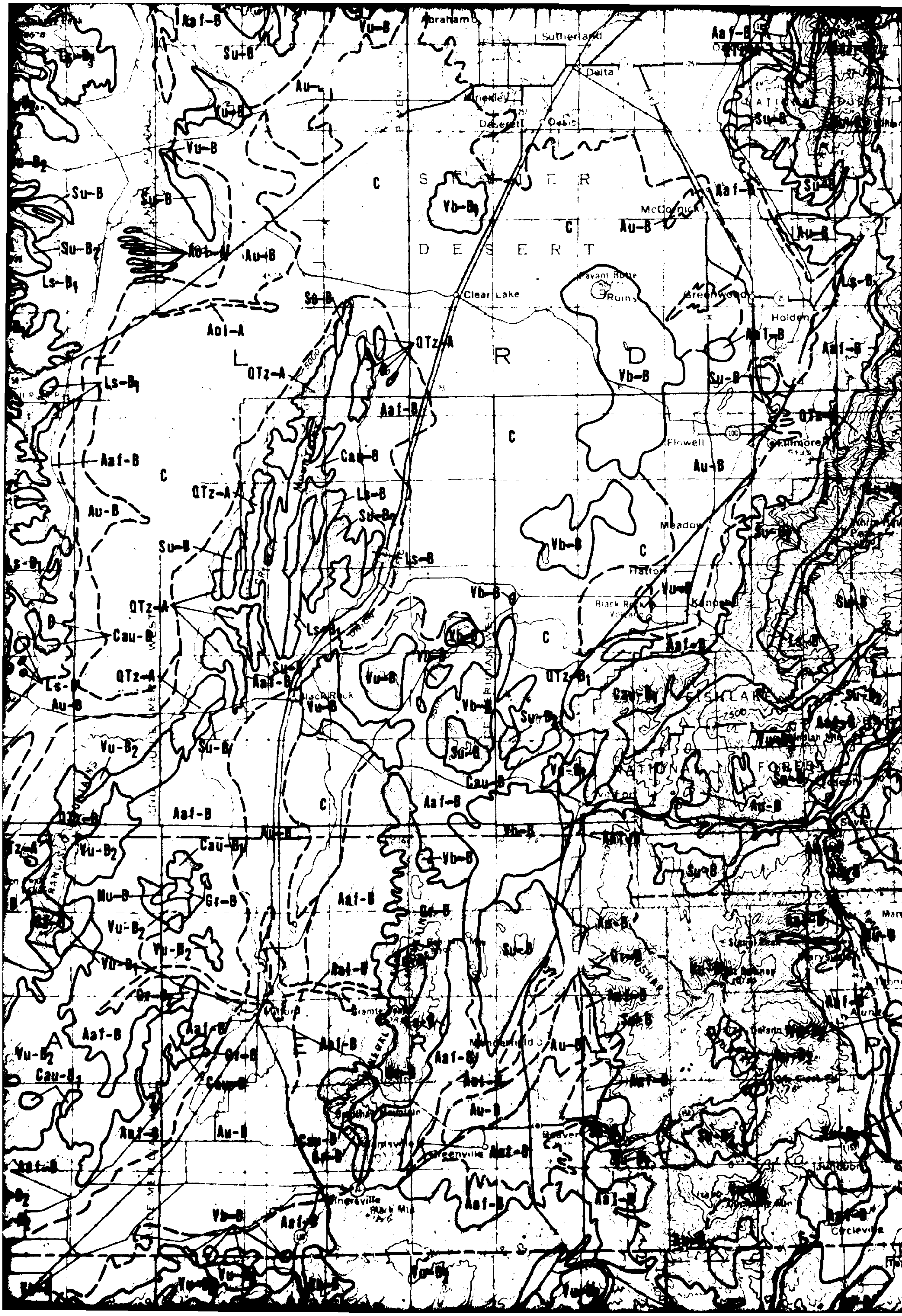
Au-B
Do-B1
Vu-B

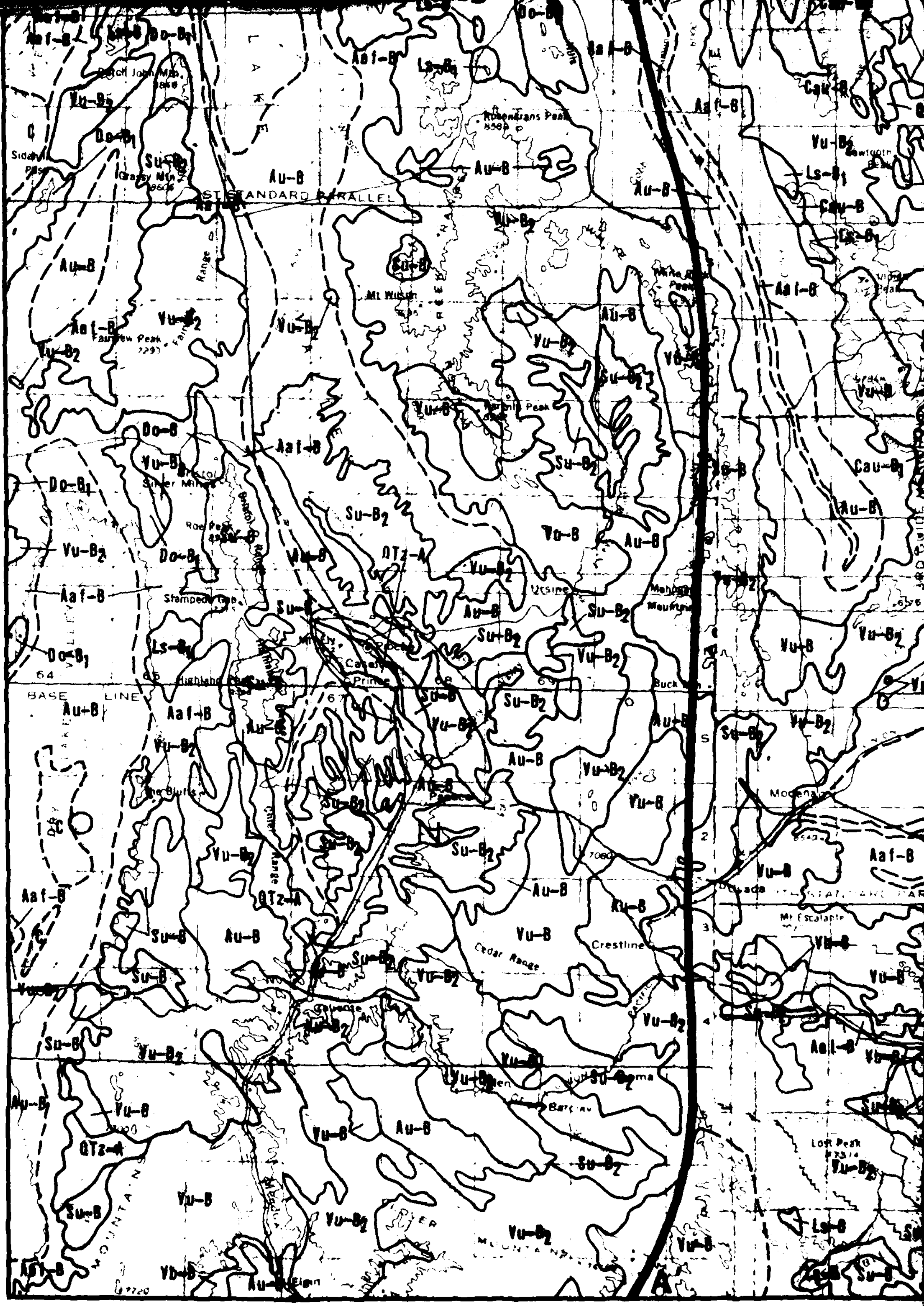


Su-B2
Ls-A
Aaf-B
Do-B1
Kau-B1
Cau-B1
Cau-B
Au-B
Ls-B1
Su-B
Aol-A
QTz-A
Vu-B
C
Baker
Garrison
Vu-B2
Do-B2
Aaf-B
QTz-B2
Au-B
Cau-B2
Vu-B1
Ls-B
Gr-B
Mu-B
Aol-B
Sawtooth Peak
Milford
Minersville
Latimer
Lund
Vb-B
6TH STANDARD PARALLEL SOUTH
2ND GUIDE MERIDIAN WEST
Black Rock


Abraham
Sutherland
Delta
Hinckley
Deseret
Oasis
McCornick
D E S E R T
Clear Lake
Pavant Butte
Ruins
Greenwood
Holden
Flowell
Fillmore
Meadow
Hatton
Kanosh
Black Rock
Milford
Minersville
Greenville
Beaver
Circleville
Su-B
Vu-B
Au-B
Aaf-B
Aol-A
QTz-A
Ls-B
Cau-B
Vb-B
Gr-B
Mu-B
C

6

7



EXPLANAT

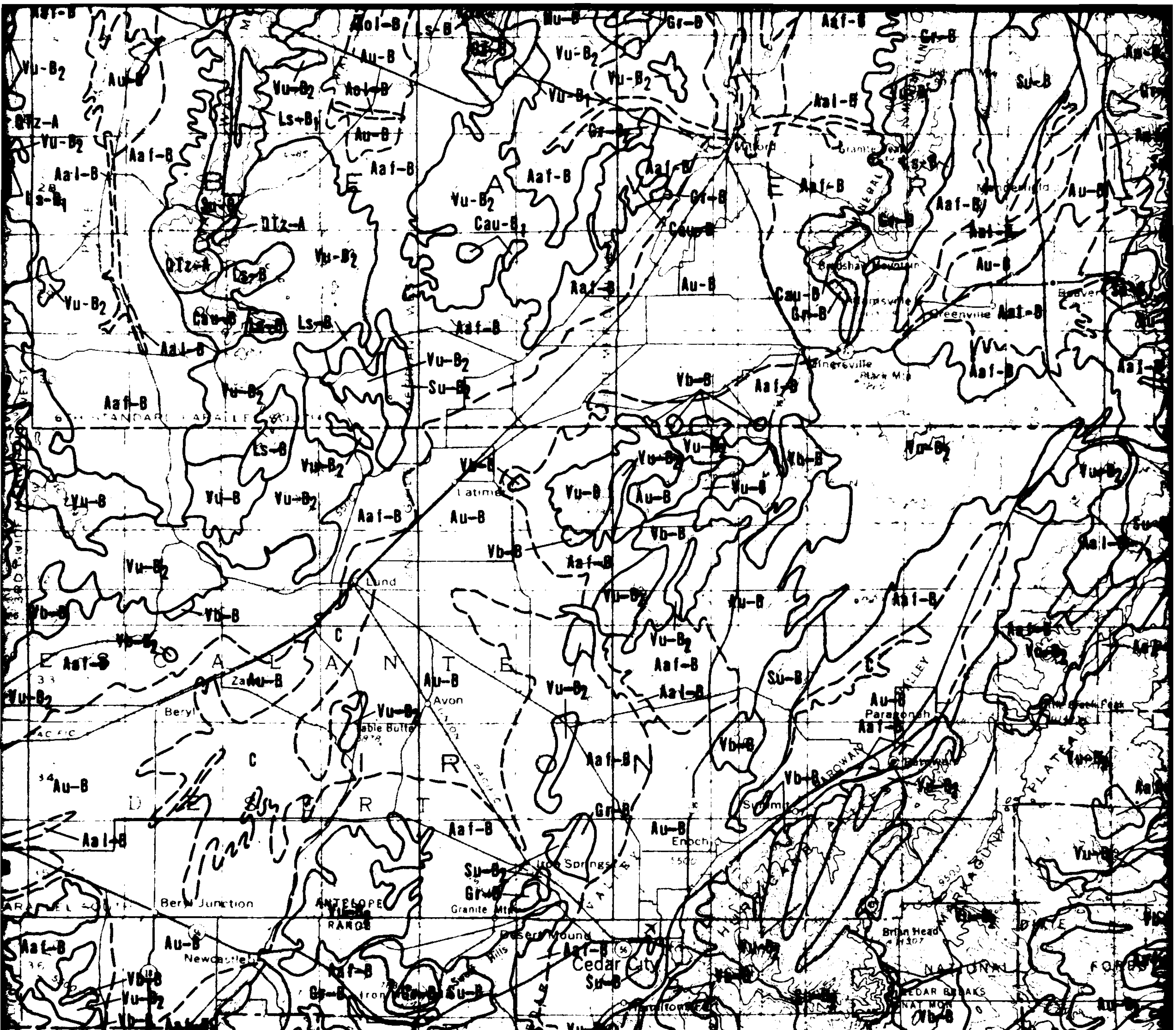
SOURCES OF POTENTIAL AGGREGATE

BASIN-FILL UNITS*

Aal	Stream Channel Deposits (Al)

SYMBOLS

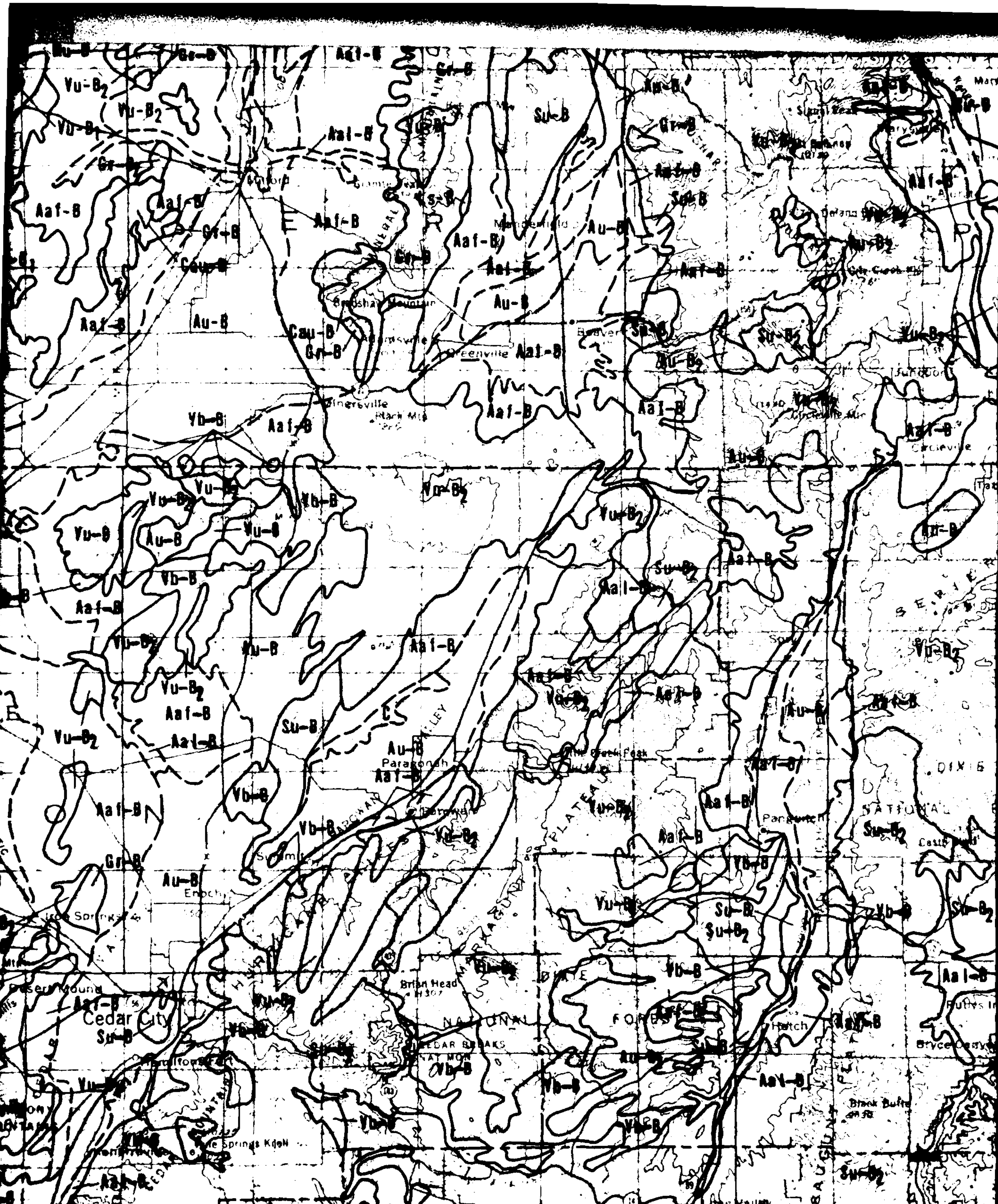
Cau

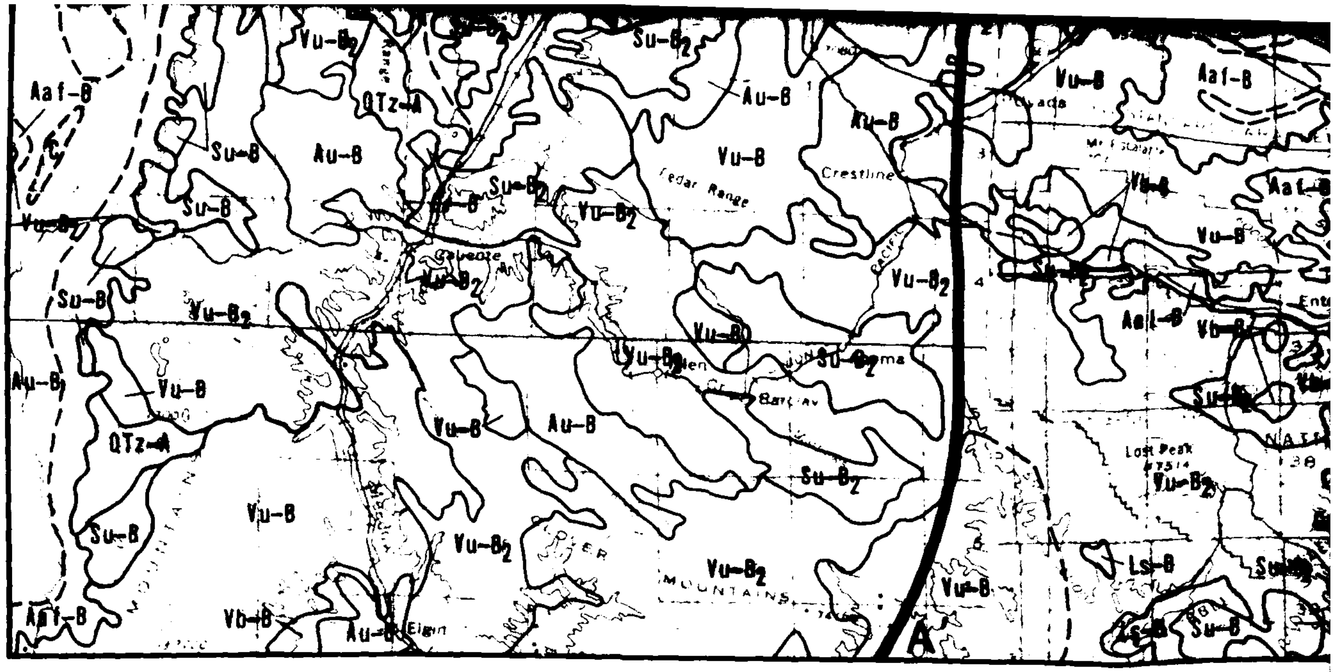


TION

Material type-ranking (See system below)

LOCATION MAP


Cedar City
Su-B
Paragonah
Au-B
Aaf-B
Minersville
Adamsville
Greenville
Beaver
Circleville
Panguitch
Hatch
Enoch
Summit
Brian Head
Cedar Breaks
Bryce Canyon
Long Valley Junction
Black Butte
Vu-B
Vb-B
Gr-B
Cau-B
Su-B
Vu-B
Au-B
Aal-B
DIXIE
NATIONAL
FOREST
TERRACE
CLIFFS
PAUNSAUGUNT
Bradshaw Mountain
Black Mtn
Iron Springs
Desert Mound



EXPLANATIO

SOURCES OF POTENTIAL AGGREGATE

BASIN-FILL UNITS*

Aal	Stream Channel Deposits (A1)
Aaf	Alluvial Fan Deposits (A5)
Aol	Older Lacustrine Deposits (A4o)
Au	Alluvial Deposits Undifferentiated

ROCK UNITS*

Vb	Basalt (I3)
Vu	Volcanic Rocks Undifferentiated (I2 and or I4)
Gr	Granitic Rocks (I1)
Mu	Metamorphic Rocks Undifferentiated (M)
QTz	Quartzite (M4 and or S1)
Ls	Limestone (S2)
Do	Dolomite (S2)
Cau	Carbonate Rocks Undifferentiated (S2)
Su	Sedimentary Rocks Undifferentiated (S)

*Reference Appendix E for symbol explanation and comparison

SYMBOLS

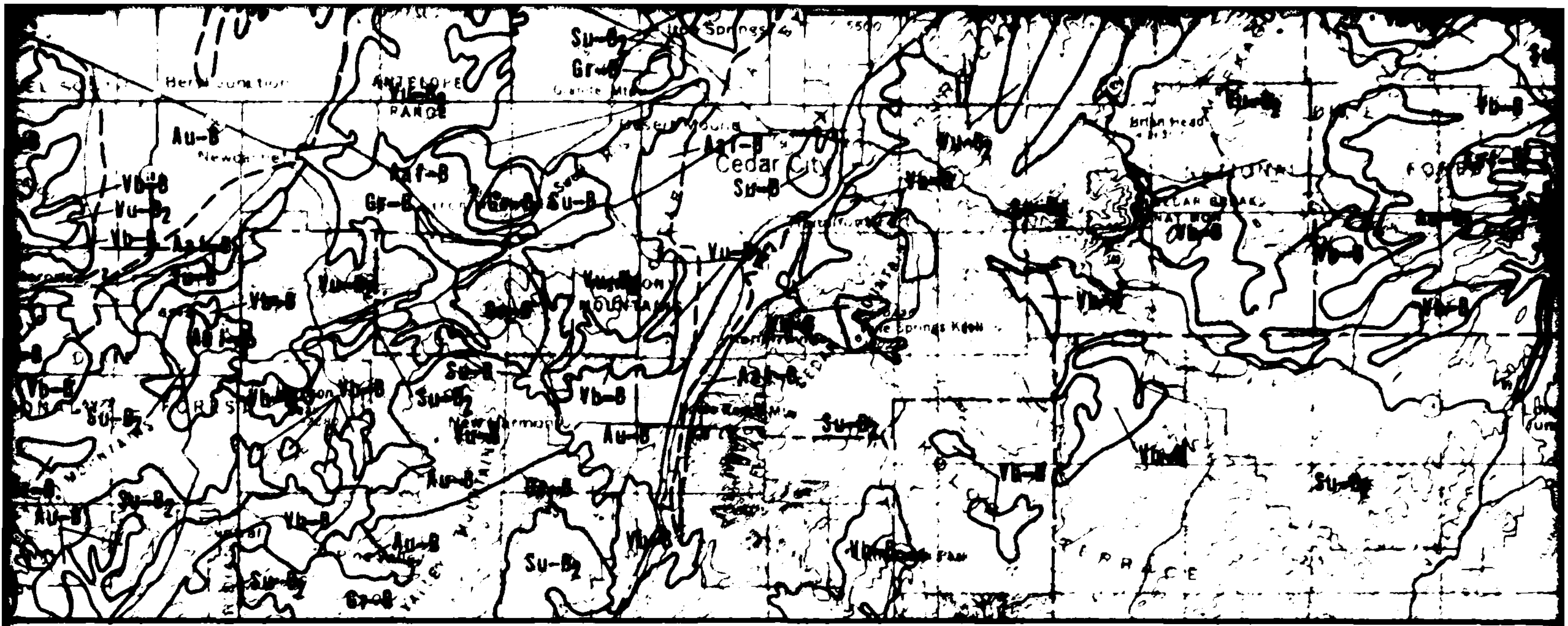
Cau-B

RANKING S

CLASS A:

CLASS B:

CLASS C:



ON

11

Material type-ranking (See system below)

Geologic Contact, dashed where approximate

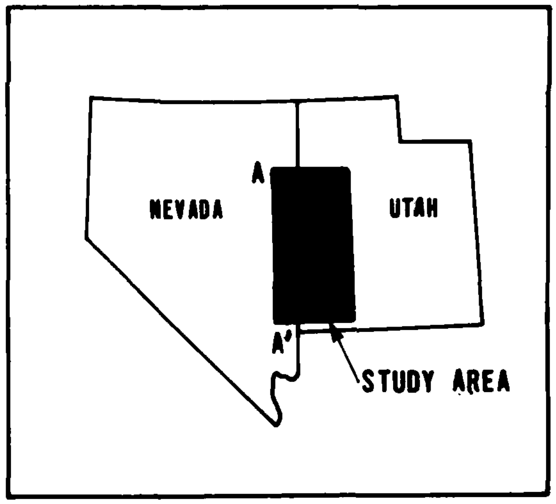
STEM

tential sources of high quality aggregate not requiring the
e of special cements or admixtures. Only nominal processing
cessary to meet known requirements for concrete aggregate.
te: Additional testing and case history studies needed to
nfirm adequacy and define exact characteristics of material.

tential sources of concrete aggregate exhibiting one or more
desireable characteristics which make it of poorer quality
an Class A aggregate. Detailed investigation would be
quired to accurately define aggregate suitability and probable
ncrete characteristics. Where possible this class of material
s divided into subunits B_1 and B_2. Materials classified as B_1
considered to be generally adequate for concrete aggregate.
material is considered to be probably suitable but has
veral characteristics which may make it marginal for use as a
ncrete aggregate.

terial considered undesireable for use as concrete aggregate;
geologic unit designation assigned.

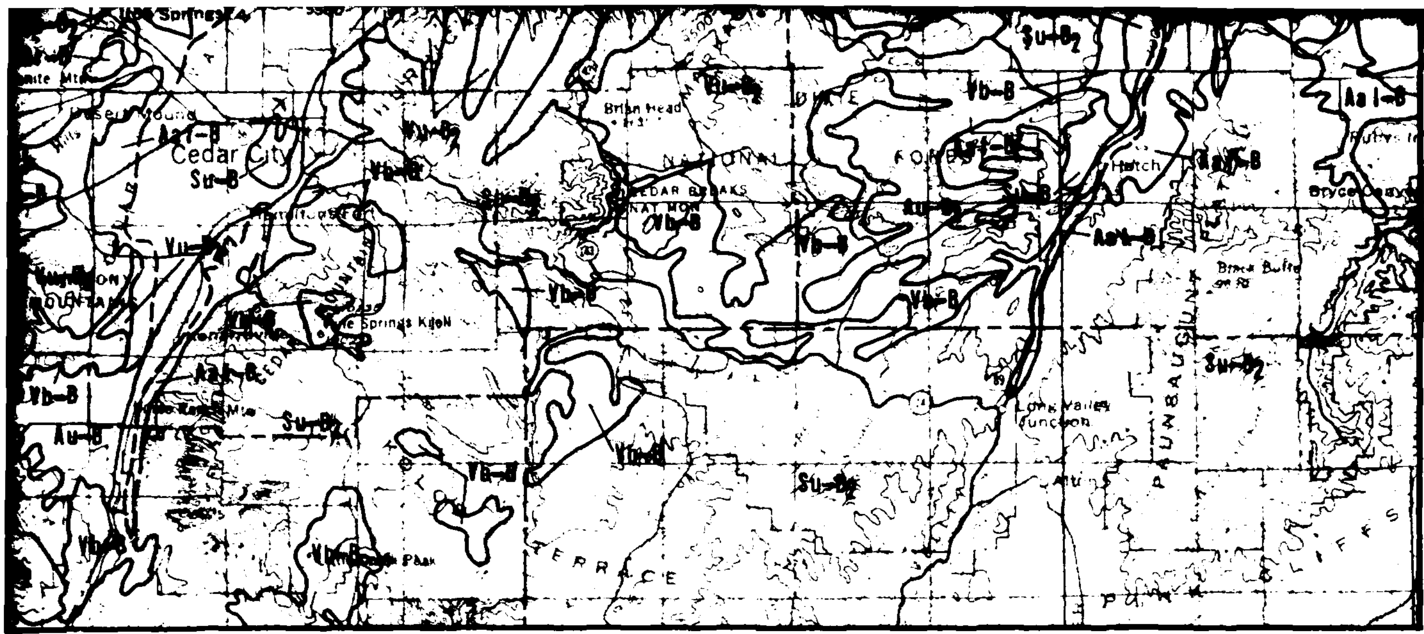
LOCATION MAP



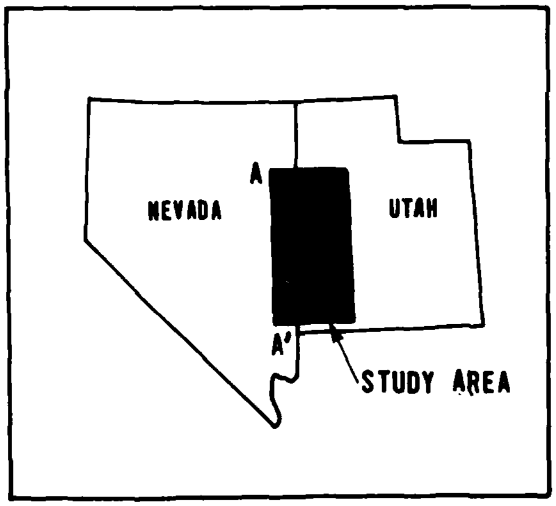
UTAH-NEVADA AGGRE

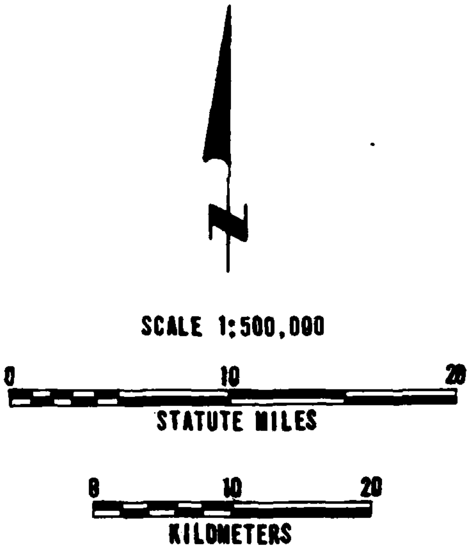
MX SITING INVEST
DEPARTMENT OF THE AIR

FUGRO NA



LOCATION MAP





requiring the
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UTAH-NEVADA AGGREGATE RESOURCES MAP

MX SITING INVESTIGATION
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DRAWING
1

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DAT
FILM