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AGGREGATE RESOURCES AND SOILS STUDY
NEW MEXICO INTERSTATE ROUTE 25

NEW MEXICO STATE HIGHWAY DEPARTMENT
MATERIALS AND TESTING LABORATORY
RESEARCH AND GEOLOGY SECTION

IN COOPERATION WITH
U. S. BUREAU OF PUBLIC ROADS

SANTA FE, N. M. 1964

AGGREGATE RESOURCES AND SOILS STUDY
NEW MEXICO INTERSTATE ROUTE 25

CONTENTS

AGGREGATE RESOURCES AND SOILS STUDY
NEW MEXICO INTERSTATE ROUTE 25

INTRODUCTION

The Aggregate Resources and Soils Study was started in 1959 by the Soils and Geology Section, Materials and Testing Laboratory, New Mexico State Highway Department. This work was carried on as a Research Project in cooperation with the United States Bureau of Public Roads by the use of 1½% Federal Planning and Research Funds through the Planning Division of the New Mexico State Highway Department. The purpose of this study is to make a survey of soils, geology, and construction materials along Interstate, Primary, and Secondary Routes in New Mexico. The final objective is a compilation of permanent records containing engineering and geologic data relating to soils, rock formation, and construction materials existing along these routes for the construction of highways.

Prior to the work done by the Soils and Geology Section, the search for highway aggregate resources was conducted only as the immediate situation demanded. Thus, only limited areas were surveyed and no over-all picture of aggregate resources in the state was available.

The following report, started in 1962, is a study of Interstate Route 25 which has been divided into 25 sections beginning at Las Cruces, New Mexico and ending at the New Mexico-Colorado State Line. Each section is approximately 19 miles in length and 3 to 4 miles in width on each side of the route. In many places the Construction Materials Inventory Maps cover greater widths in order to include all sources of construction materials which may be hauled economically for use in construction of Interstate Route 25.

All aggregate resources and soils tests were run according to American Society for Testing Materials (ASTM) and American Association of State Highway Officials (AASHO) standard methods by the Materials and Testing Laboratory.

The study is prefaced by the Table of Contents, the Location Map of Interstate Route 25 and the Legends. A Geological Time Chart, four Nomenclature Charts of New Mexico Geologic Names, and a Structural Units Map appear in the appendix.

Each Section of Interstate Route 25 contains information as follows:

Introduction: Brief general description of the section.

General Geology: Principal regional and local geologic features, their expression and development. This work was done with the aid of field reconnaissance, aerial photographs, and geologic publications and maps.

Soils: Derivation, development, and characteristics of the soils. Soils were sampled by augering and by sampling soil profiles in deep arroyos or other cuts. Soil contacts were then mapped separating areas of different soil classification.

Ground Water: Ground water conditions are discussed when significant.

Stratigraphy: Geologic column, age, and description of formations and their members.

Construction Materials: Construction materials column, age, and description of formations from which they are derived. Construction materials were located by field reconnaissance, aerial photographic interpretation and geologic interpretation.

Soil Summary Table: Shows log and classification of soil samples.

Selected References: Literature cited.

Soils and Geology Map: Shows the areal distribution of soils and their related formations. These maps were compiled from Material and Testing Laboratory data on soils, field reconnaissance, aerial photographs, geologic publications and maps, and random sampling of soils and prospective construction materials deposits.

Construction Materials Inventory Table: Description of tested and prospective pit sites.

Construction Materials Inventory Map: Shows the distribution of tested and prospective pit sites.

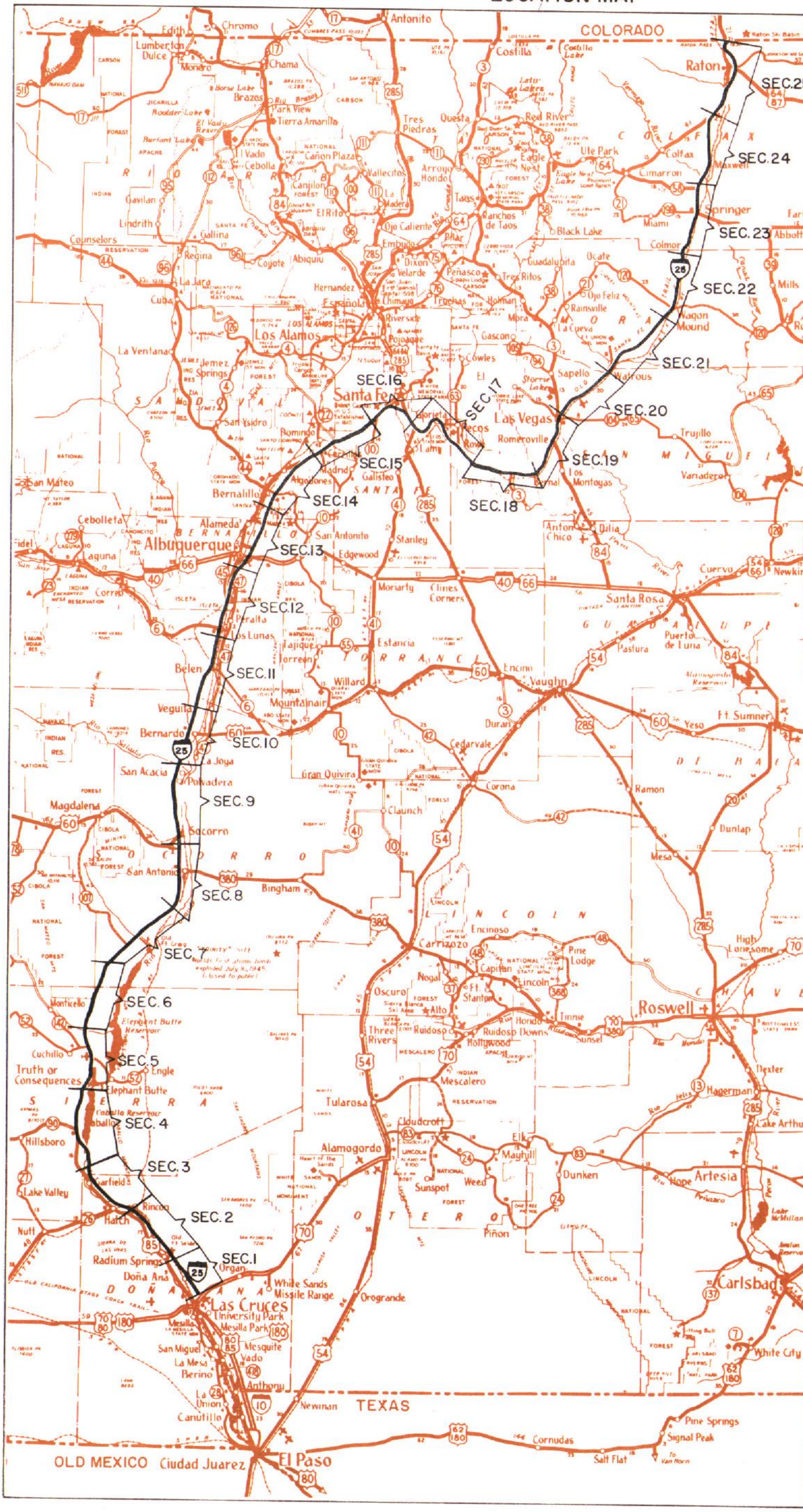
For maximum benefit, the maps, tables, and reports should be studied simultaneously.

It is felt that the information contained in these reports will be of much value to the Maintenance, Location, Design, and Materials Sections of the New Mexico State Highway Department in selecting the most suitable route locations and aggregate materials sources for construction and maintenance of New Mexico highways.

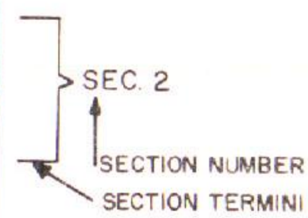
AGGREGATE RESOURCES AND SOILS STUDY
NEW MEXICO STATE HIGHWAY DEPARTMENT

LOCATION MAP

INTERSTATE ROUTE 25
LAS CRUCES TO RATON



— LEGEND —



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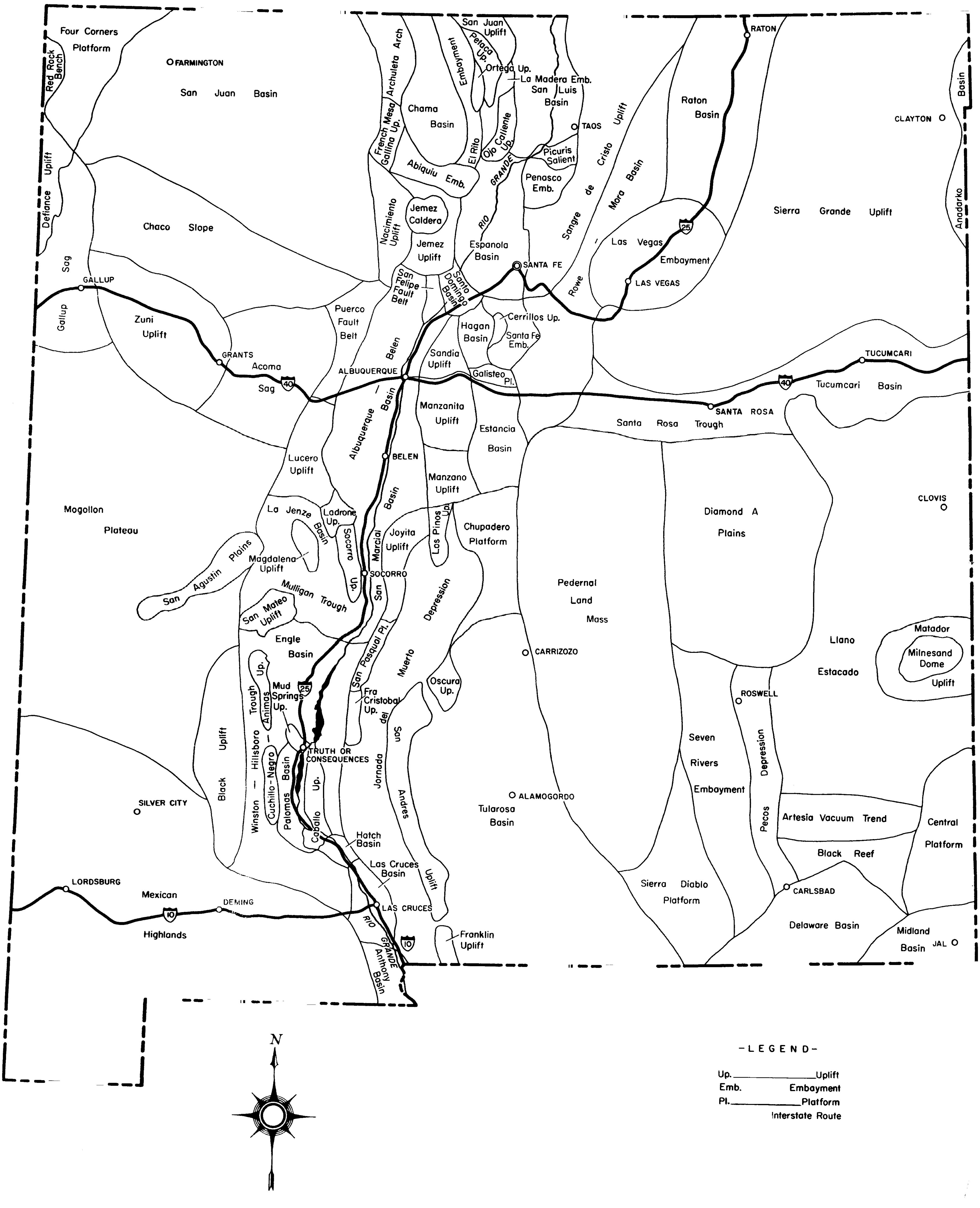
STRUCTURAL UNITS OF NEW MEXICO



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LEGEND

IGNEOUS ROCKS

Intrusive

- *Granite*
- *Monzonite*
- *Gabbro*
- *Intrusive Bodies*
- *Undivided Intrusive Rocks* — All intrusive rocks intermediate in composition between granite and gabbro. Includes syenite, diorite, etc. Also includes all formations of intrusive igneous rocks of varied composition not mappable as a single rock unit.

Extrusive

- *Rhyolite*
- *Basalt*
- *Glasses* — All extrusive glasses. Includes obsidian, pumice, etc.
- *Volcanic Ejecta* — All fragmental volcanic rocks. Includes volcanic breccia, agglomerate, ash, tuff, cinders, etc.
- *Undivided Extrusive Rocks* — All extrusive igneous rocks not listed above. Includes latite, andesite, etc. Also includes all extrusive igneous formations of varied composition not mappable as a single rock unit.

SEDIMENTARY ROCKS

Mechanical or Fragmental Origin Clastic

- *Fine Sand* — Sand that generally falls in the A-3 and A-2-4 groups of the AASHO Soils Classification System. Dune sands, beach sands, stream sands, etc.
- *Coarse Sand* — Sand that generally falls in the A-1-b and A-2-4 groups of the AASHO Soils Classification System. Includes stream sands, terrace sands, etc.
- *Gravel* — Deposits that have an abundance of gravel and, or boulder size particles that generally fall in the A-1 and A-2 groups of the AASHO Soils Classification System. Includes stream gravel, terrace gravel, pediment gravel, fan gravel, etc.
- *Undivided Sediments* — Deposits of clay, silt, and sand. Also includes any combination of clay, silt, sand, and gravel that cannot be mapped as separate particle size units.
- *Undivided Sediments (partly consolidated)* — Heterogeneous deposits of clay, silt, sand, and gravel that may show some degree of induration. Includes older alluvial, aeolian, and lacustrine deposits that cannot be mapped as separate particle size units.
- *Claystone*
- *Shale*
- *Siltstone*
- *Sandstone*
- *Conglomerate*
- *Undivided clastic (fragmental) sedimentary rocks* — Interbedded clastic sedimentary rocks not mappable as a single unit. Includes interbedded shale, siltstone, sandstone, etc.

Chemical or Organic in Origin

- *Caliche*
- *Limestone*
- *Dolomite*
- *Evaporites*
- *Undivided chemical, organic, and clastic (fragmental) rocks.* — Interbedded chemical, organic, and clastic sedimentary rocks not mappable as a single unit. Also includes chalk, marl, chert, flint, oolite, coquina, sinter, travertine, tufa, etc.

METAMORPHIC ROCKS

- *Gneiss*
- *Schist*
- *Quartzite*
- *Undivided Metamorphic Rocks* — All metamorphic rocks not listed above. Includes formations not mappable as a single rock unit. Also includes undivided Precambrian and Cambrian rock that may be igneous in origin.

STRUCTURES

GEOLOGIC CONTACT
Dashed where approximately located

FAULT
Dashed where approximately located
Downthrown side on normal
T Upthrown side on thrust

SOILS CONTACT

OVERTURNED STRATA

A — A1
LINE of CROSS-SECTION

ANTICLINE

SYNCLINE

MONOCLINE

GEOLOGIC AGES

Q	Quaternary	P	Permian	S	Silurian
T	Tertiary	C	Carboniferous	O	Ordovician
K	Cretaceous	₱	Pennsylvanian	Є	Cambrian
J	Jurassic	M	Mississippian	PЄ	Precambrian
Tr	Triassic	D	Devonian		

Small letters are used to indicate specific formations, e.g. Kd, which means Cretaceous Dakota sandstone, or P Єg which means Precambrian granite *wherein that particular granite has no specific formation name.*

SOILS

Location of soil sample or section of geologic formation. *(Number refers to explanation in soils summary table)* 2

Soil type based on AASHO Classification:

A-1-a, A-1-b, Stone Fragments, Gravel & Sand.	1
A-2-4, A-2-5, A-2-6, A-2-7, Silty or Clayey Gravel & Sand	2
A-3, Fine Sand	3
A-4, Silty Soils	4
A-5, Silty Soils	5
A-6, Clayey Soils	6
A-7, Clayey Soils	7

In areas containing two or more soil types, e.g. A-2, A-4, etc., where A-2 is predominate, the soil unit is shown as 2-4. Where A-4 is predominate, the soil unit is shown as 4-2.

In profiles containing two or more soil types, e.g. A-4 over A-6, the soil unit is shown as $\frac{4}{6}$.

Geologic age and formation or landform are depicted in the first portion of the map unit, and the soil type is shown in the second portion, e.g. Qal - $\frac{4}{6}$ which means alluvium that is Quaternary in age is the parent formation with a soil classification of A-4 over A-6. Where geologic age and formation are not followed by a soil unit the area is considered as non soils or the soils are insignificant to area mapped.

CONSTRUCTION MATERIALS INVENTORY

Tested pit or quarry

Prospect pit or quarry

Tested pits are designated by year, pit number, and type of pit, e.g, 57-100-S, means Surfacing Pit (S), number 100 was explored in 1957; 59-39-F, means Filler Pit (F), number 39 was explored in 1959. Prospect pits are designated by route number, section number and prospect number, e.g, 40-16-5, means Interstate Route 40, Section 16, Prospect number 5.

LEGEND

Roads
- Primitive
- Unimproved
- Graded and Drained
- Gravel or Stone-not Graded and Drained
- Gravel or Stone-Graded and Drained
- Bituminous Surfaced
- Paved
- Divided Highway
- Road or Street in congested area

Highway Interchange

Federal Aid Interstate Highway Number 25

U.S. Highway Number 84

State Highway Number 30

Boundaries and Monuments
- National or State Line
- County Line
- Indian Reservation, Military Reservation, National Park, National Monument, National Forest, State Park and Game or Bird Refuge Line
- Land Grant Line
- City Limit Line
- Township Line
- Section Line-Surveyed
- Boundary Monuments
- Triangulation Station
- Identical Lookout and Triangulation Station
- Identical Airway Beacon and Triangulation Station
- Identical Church and Triangulation Station
- Identical Schoolhouse and Triangulation Station
- Identical Building and Triangulation Station
- Permanent Bench Mark and Elevation BM
- Prominent Elevation 7520'
- Township Corner in Place
- Section Corner in Place

State Capital

County Seat

Other City, Town or Village

City, Town or Village
- City, Town or Village (Incorporated)
- Town or Village (Dashed Line denotes limits of Supplementary Vicinity Map)

Farms, Dwellings, Industrial Units, etc.
- Dwelling or Farm Unit
- Group of Dwellings (Figure denotes number of units)
- Hotel
- Store or Small Business House
- Post Office
- Business and Post Office
- City Hall
- Schoolhouse
- Church
- Cemetery
- Hospital
- Factory or Industrial Plant
- Electric Power Station
- Radio Station
- Correctional Institution
- Sawmill
- Drive-in Theater
- Fire Station
- Historic Ruin
- Vacant Units are shown by open symbols, thus :
- Figure denotes number of units of like kind

Mine

Corral

Windmill

Well or Water Tank

Artesian Wells

Oil or Gas Wells

Forest Ranger Station, District

Forest Ranger Station, Yearlong

Forest Ranger Station, Seasonal

Permanent Lookout Station

Camping Ground

Railroad

Narrow Gauge Railroad

Railroad Tunnel

Railroad Station (Local Agent)

Railroad Station (Prepay)

Railroad Crossings
- Grade
- Railroad above
- Railroad below

Bridges
- Railroad
- Highway (over 20' span)

Ford

Dam on Large River

Dam on Small Stream

Reservoir and Dam

Ditch or Canal

Flume

Syphon

Pipe Line or Conduit

Tramway

Telephone or Telegraph Line

Telephone or Telegraph Line along road

Transmission Line

Fence (any type)

Spring

River

Stream

Intermittent Stream

Large Intermittent Stream

Marsh or Swamp

Levee or Dike

Mountain Range, Mesa or Butte

Sink or Depression

Air Navigation
- Air Route
- Army, Navy or Marine Corps Field
- Commercial or Municipal Airport
- Intermediate Field
- Landing Area or Strip
- Airway Light Beacon

SOILS AND GEOLOGY

Introduction:

This strip begins at Fillmore, about five miles south of Las Cruces, and ends near Hill, north of Las Cruces. It includes part of the Mesilla Valley of the lower Rio Grande. The area in general is a part of the Basin and Range province. It lies in the Las Cruces basin near the southern end of the Rio Grande trough. The Robledo Mountains, Organ Mountains, Dona Ana Mountains, and the Las Cruces basin are the main geologic features of the area.

General Geology:

An exceptionally long and eventful geologic history has been recorded in this area. The basement complex which underlies most of the region is primarily a Precambrian granite batholith. Gneiss, schist, quartzite, diorite, and epidiorite are also present.

Erosion had planed the Precambrian rocks to a smooth surface by the time the Cambrian seas inundated the area. This region was the bottom of an epicontinental sea throughout the Paleozoic era. The northern shore, which was in the vicinity of the Oscura Mountains, migrated north and south many times. Each geologic period of the Paleozoic era is represented by a relatively thin accumulation of marine sediments. There was continuous sedimentation in a rather shallow sea from Pennsylvanian to Permian time. Therefore, the Permian beds lie conformably over the Pennsylvanian beds. The Abo sandstone intertongues with the Hueco limestone in the Robledo Mountains. This indicates that there was uninterrupted sedimentation throughout this period.

If there was any sedimentation during the Mesozoic era it was completely removed by erosion before the beginning of the Tertiary period. The next oldest rocks that occur in this region are Tertiary interbedded gypsum, latitic tuff, silty-limy claystone, and limestone cobble conglomerate. Following a period of erosion, rhyolite flows, tuff breccia, and welded tuff were deposited upon these earlier Tertiary rocks. A syenite porphyry intruded these volcanics and later in the Tertiary period rhyolite intruded the sedimentary rocks in the Robledo and Dona Ana Mountains.

Extreme crustal movements during the Cenozoic era caused the formation of most of the depressions and uplifts along the Rio Grande trough. These uplifts and depressions or mountains and basins are the indices for this long complex geologic history. The mountains and basins of the Las Cruces area play a very important roll in the recording of the information.

The dominant relief feature of the area is the Organ Mountains which lie to the east of this strip. This uplifted mass is a part of a continuous line of deformational ranges which border the Rio Grande depression from southern Colorado to El Paso, Texas. These mountains rise abruptly above the plain east of Las Cruces for more than 4,000 feet. Organ Needle, near the center of the range, is 9,012 feet above sea level.

The Organ Mountains are made up primarily of Tertiary volcanics and tilted Paleozoic sedimentary rocks on Precambrian basement rocks. In the center of the range is a Tertiary monzonite batholith which has weathered into columnar spires that resemble organ pipes.

In the northwest part of this strip the Robledo Mountains rise more than 2,000 feet above the flood plain. They are a south-dipping wedge-shaped fault block that becomes broader at the southern end. Along the eastern flanks of the mountains a north-northwest trending fault separates Paleozoic and Cenozoic rocks. Picacho Mountain, a prominent mountain at the southern end of the range, is a rhyolite dome protruding out of a base of latite and andesite lavas and tuffs that formed during Tertiary time. At the north end of the range rocks ranging in age from Ordovician to Permian are exposed. The Hueco limestone, which has a tongue of Abo sandstone and shale, forms the surface of most of the prominent ridges of the range. Tertiary rhyolite sills have intruded these Paleozoic sedimentary rocks. These sills contain inclusions of Mississippian rocks.

The Dona Ana Mountains are similar to the Robledo Mountains. They are fault-block mountains in which a considerable amount of volcanic activity has been recorded. Pennsylvanian and Permian rocks are exposed at much lower elevations than they are in the Robledo Mountains. Tertiary andesite and latite flows, tuff breccias, crystal tuffs, and rhyolite flows have been intruded by syenite porphyry sills and dikes. Some of these syenite dikes form the higher peaks of the range.

Tortuga Mountain, east of State College, is a small, isolated fault block of Hueco limestone and shale.

The Las Cruces basin is one of a series of basins that formed along the Rio Grande trough during the Cenozoic era. It was filled with sediments of sand, silt, clay, and gravel during the Tertiary and Quaternary periods. During the Pleistocene epoch these sediments formed a broad bolson plain that reached from Radium Springs into Mexico. Later during the Pleistocene epoch the Rio Grande was initiated by the integration of the various bolsons along the Rio Grande depression, and the river began its long process of down-cutting the sediments to form the valleys and plains of today. The river has divided the Las Cruces basin into the Jornada del Muerto Plain on the east and the La Mesa Plain on the west.

Sediments of the Las Cruces basin have been assigned by Kottlowski (1958) to the upper and lower Santa Fe group. The lower beds, which are more lithified than the upper ones, are alternate layers of sandstone, clay, and conglomerate that were deposited during Miocene and Pliocene time. The upper beds are alternate layers of poorly consolidated sand, silt, gravel, and clay that were laid down during Pleistocene time. The Pleistocene sediments are contemporaneous with early Rio Grande deposits.

The Rio Grande and its tributaries have dissected the Santa Fe beds more than three hundred feet and the beds now form the rugged hills or "bad lands" that lie east and west of the river.

The Jornada surface is principally a plain of older alluvium covered with wind-blown sand and stream and sheet wash alluvium. The materials which cap the inter-stream areas were laid down by streams that were contemporaneous with the Pleistocene erosion cycle. Except for the Rio Grande and its short intermittent branch streams cutting into these bolson deposits, stream dissection has so little affected the surface that it retains the essential features of an alluvial plain.

As the river scoured its way through the Santa Fe formation, it left a veneer of coarse-grained sand on the terraces it carved in these beds. Near the Robledo Mountains, adjacent to the flood plain, the terrace deposits are more coarse-grained and as much as 150 feet thick. These terraces are highly dissected, and there are exposures of coarse, subangular particles interbedded with well-rounded river sand and gravel. The subangular particles are derived from the Robledo Mountains; whereas, the well-rounded particles are derived from reworked river deposits.

Near the Dona Ana Mountains, adjacent to the flood plain, conditions are similar to those of the Robledo Mountains. The river deposits crop out at various intervals along the toe of the dissected alluvial plain that flanks the Dona Ana Mountains.

The areal distribution of formations is shown on Soils and Geology Map 25-I. Their succession and character are given under the section termed "Stratigraphy."

Soils:

Alluvial deposits (Qal): These deposits grade from a relatively coarse-grained material in the arroyos of the highlands to a finer grained material near the flood plain. The soil profile is very non-uniform; it has alternate braided deposits of silt, sand, and gravel. Lateral bedding is also non-uniform; soil types change or pinch-out in short distances. Soils are predominantly silty sand (A-2-4) in areas adjacent to the flood plain and silty, gravelly sand (A-2-4) or sand and gravel (A-I-a) near the source areas. Pockets and lenses of silt (A-4) occur at irregular intervals. Wind-blown sand masks the surface near the flood plain. This sand is held in place by range grasses, greasewood, and mesquite.

Alluvial fan deposits (Qaf): These deposits occur in the Dona Ana Mountains. The soils that are formed here are derived from a variety of volcanic rocks found in the Dona Ana Mountains. The surface has a moderately steep slope and has been heavily dissected by shallow arroyos. The soils formed are predominantly silty sand and gravel (A-I-b).

Floodplain deposits (Qfp): The flood plain that forms the smooth valley floor of this strip is a product of the Rio Grande. The natural surface of the flood plain has been changed by farm leveling. The present river flow is controlled by dikes along its channel and Caballo Dam. Therefore, the river is no longer allowed to meander aimlessly over the valley and carry on its natural processes.

The floodplain deposits are typical of most large river valleys. The upper materials consist primarily of fine-grained alluvium. Beneath this finer material is found more coarse-grained materials representing channel deposits made at various positions occupied by the stream as it migrated laterally over the valley. Even though most of the surface has been changed by farm leveling, it is still marked by many meander scars and abandoned river channels. When they lie near the surface, the old meander scars appear as crescent-shaped or slightly sinuous strips of coarse-grained alluvium. The deeper ones may be sites of oxbow lakes, bayous, or swamps that have filled with silt and clay during river flood stages.

As the river cut laterally and downward in its process of attaining a profile of equilibrium, its scour and fill have constantly reworked deposits of sand, silt, and clay. Consequently, the deposits consist of alternate layers of these materials. Predominant surface soils are silty sand (A-2-4) and silt (A-4); however, there may be a change to fine-grained sand (A-3) or clay (A-6 and A-7) very near the surface. Clay soils (A-6 and A-7) occupy the old back-water areas.

Aeolian deposits (Qa): Wind-blown sands occur along the flood plain north of Las Cruces. In places these deposits are probably as much as 15 feet thick. The soils are predominantly fine-grained sand (A-3) and silty sand (A-2-4).

Terrace deposits (Qtg): Near the Robledo Mountains river and stream gravel, 50 to 100 feet thick, are interbedded with massive pockets of sand and silt. Part of these deposits were derived from the adjacent mountains and part of them were deposited by the Rio Grande. This dual source is shown by subangular fragments in some levels of the terraces, usually the upper level, and well-rounded particles in lower levels. Soil types vary from sand and gravel (A-I-a) to silty sand and gravel (A-2-4) to clayey sand and gravel (A-2-6). The clayey sand and gravel (A-2-6) are derived from the Abo shale tongue in the Hueco formation west of the terraces. Terraces formed by the outwash from Picacho Peak are made up of subangular volcanic rocks and sand (A-I-a). The terraces east of the river are predominantly clean sand and gravel (A-I-a) derived from reworked river deposits.

Jornada surface (Qj): As stated previously this surface is principally a plain of older alluvium. A veneer of wind-blown sand blankets the surface. Ten to twenty feet of nodular caliche and soft caliche lie below the surface soil. A bolson environment has caused textural variations in the caliche. The soil types vary from silty sand (A-2-4) to silty, clayey sand (A-2-6). Early Rio Grande deposits of coarse-grained sand, silt, and clay lie below the caliche soils.

Upper Santa Fe group (Qsf): These soils are primarily a product of an early Rio Grande. There is no definite delineation in the profile; it is generally an accumulation of sand, silt, and gravel. The soils are divided into almost equal amounts of silty sand and gravel (A-2-4), coarse-grained sand (A-I-b), and fine-grained gravel and sand (A-I-a).

Santa Fe group (QTsf): The Santa Fe group is generally considered as a soil in this area since it is usually covered by a heterogeneous mixture of debris. Slope wash, residual accumulations, stream alluvium, and wind-blown sands make up this cover. The soils vary from silty, sandy gravel (A-2-4) to silty, sandy clay (A-2-6).

Table 25-I-I shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-I.

Ground-water:

The ground-water conditions that exist in the Rio Grande floodplain deposits are of great importance to road construction, since the ground-water table is near or at the surface in many places.

The ground-water is supplied by surface flow and underflow from the bordering areas, seepage from canals and irrigated farm lands, precipitation on the flood plain and adjacent areas, and lateral seepage from the Rio Grande.

The general direction of flow of the underground water in the flood plain is downstream. The medium through which this ground-water flows is chiefly alluvium. The depth and gradient may change when the amount of water supplied varies, when sediments or formations vary and (or) when permeability changes. Conover (1954) states that the level of the water-table in the Mesilla Valley varies from 25 feet below the surface to surface-water.

The flood plain area receives excess water during the irrigation months and during that time the water-table gradually rises until it is thought to be less than 5 feet below the surface in most places. In October, 1961, soil samples were taken in the floodplain deposits and the water-table was found to be 5 feet below the surface in sandy strata.

Stratigraphy:

Quaternary: Alluvium (Qal) - ephemeral stream deposits of subangular gravel, sand, and silt. Includes sand and gravel of the apron that borders the Rio Grande flood plain.
Thickness: 1 to 20 feet.

Alluvial fan deposits (Qaf) - poorly sorted, subangular gravel, sand, and silt bordering the Dona Ana Mountains.

Floodplain deposits (Qfp) - deposits of silt, sand, and clay with minor gravel lenses.
Thickness: 10 to 200 feet.

Terrace deposits (Qtg) - calcium carbonate coated gravel with interbedded sand and silt lenses.
Thickness: 50 to 100 feet.

Aeolian deposits (Qa) - wind-blown sand.
Thickness: 1 to 25 feet.

Basalt (Qb) - basalt flows and cones characterized by large pyroxene crystals and olivine aggregates.

Jornada deposits (Qj) - caliche, gravel, and silt underlying Jornada surface. Aeolian sand locally veneers surface.
Thickness: 10 to 25 feet.

Unconformity--

Upper Santa Fe group (Qsf) - bolson deposits of stream alluvium and aeolian sand. Locally derived unconsolidated sand, gravel, and silt.
Thickness: 10 to 400+ feet.

Quaternary-Tertiary: Santa Fe group (QTsf) - unconsolidated sand and gravel to light-gray sandstone, pink siltstone, brown clayey silts, and lenses of sandy caliche.
Thickness: 1,300+ feet.

Tertiary: Lower Santa Fe group (Tsf) - an upper sequence of light-gray sandstone, pink siltstone, brown clayey silt, lenses of sandy caliche limestone, and a thick tongue of boulder conglomerate; a lower unit of pink, light-gray, and yellow conglomerate, sandstone, sand, and silt.
Thickness: 675+ feet.

Unconformity--

Syenite (Ts) - light-tan to pink sills and dikes of intrusive syenite porphyry.

Rhyolitic volcanics (Trv) - rhyolite flows, tuff breccia, and welded tuff. Also includes some intrusive rhyolite and associated breccia.
Thickness: 1,200 feet.

Unconformity--

Undifferentiated volcanics (Tt) - greenish, grayish, and purplish andesite and latite flows, tuff breccias and crystal tuffs with biotite and hornblende phenocrysts.
Thickness: 1,600 to 2,100 feet.

Unconformity--

Rhyolite (Tr) - predominantly tan and porphyritic intrusive rhyolite and associated breccia. It also includes welded tuffs and tuff breccias.
Thickness: 1,200+ feet.

Unconformity--

Permian: Hueco Limestone (Ph) - light- to dark-gray, dense, fine-grained limestone (includes underlying Bursum limestone).
Thickness: 1,715 feet.

Abo tongue (Pha) - sandy red shale.

Pennsylvanian: Pennsylvanian sedimentary rocks undivided (Pu) - limestone, shale, siltstone, and sandstone.
Thickness: 665 feet.

Construction Materials:

Quaternary: Alluvium (Qal) - Material suitable for highway construction occurs in some of the arroyos east and west of the flood plain. These deposits are finer grained near the flood plain than they are nearer the source areas. East of the flood plain the most desirable gravel is in the arroyos that drain past Tortuga Mountain. Pit 58-12-S is a typical example of this gravel. It is a non-plastic, subangular, igneous sand and gravel that has about 2 percent retained on the 2-inch sieve and more than 60 percent retained on the No. 4 sieve. Prospect 25-1-5, on the west side of the river at the base of Robledo Mountain, is an excellent source of coarse, sandy, limestone gravel. Overburden and vegetative growth are insignificant to stripping depths.

Alluvial fan deposits (Qaf) - Surfacing material may be located in the alluvial aprons on the south side of the Dona Ana Mountains. Pit 55-76-S is representative of this material. It is a fairly well-consolidated gravel made up mostly of volcanic rock. The fans to the north of this pit are less consolidated.

Terrace gravels (Qtg) - West of the flood plain and north of U.S. 70 and 80, are gravel terraces that will produce highway construction materials. These terraces contain lenses of subangular igneous and limestone gravel derived from Robledo Mountain and Picacho Peak.

Construction Materials continued...

Prospect 25-1-1 is a typical example of the subangular, igneous gravel. One to three feet of silty sand overlies about 20 feet of non-plastic gravel and sand. About 20 percent of the material is retained on the 1-inch sieve and about 60 percent is retained on the No. 4 sieve. It has an L.A. Wear of 23. Further exploration may reveal more than 500,000 cubic yards of this gravel.

Upper Santa Fe group (Qsf) - Fine-grained aggregates have been produced from the Upper Santa Fe beds in the vicinity of Las Cruces. This material is generally considered to be too fine-grained for primary construction purposes; however, it has been used recently (1961) for cement treated base course for Interstate Route 10 south of Las Cruces. Pit 55-75-S is a typical example of this material. There is about 20 feet of unevenly bedded coarse-grained sand and fine gravel. Approximately 60 percent of the material is coarse-grained sand. An almost inexhaustable supply of this material is available.

Tertiary: Rhyolitic volcanics (Trv) - Rhyolite is available for surfacing use in two localities within the Construction Materials Map area. One mile northeast of Hill is an old rhyolite quarry which can be greatly expanded. Just north of Pit 55-76-S, approximately 3.5 miles west-northwest of Dona Ana, is a hill of rhyolite suitable for surfacing use.

Permian: Hueco limestone (Ph) - Vast quantities of excellent quarry rock may be produced from Tortuga Mountain and Robledo Mountain. The limestone of these two areas is very similar. Pit 57-8-S ext. is a typical example of the material. It is a dense, crystalline, massively bedded limestone. It has an L.A. Wear of about 17. Further exploration will probably reveal immense supplies of this material in either of the two areas.

Distribution of tested and prospective pit sites for construction materials is shown of Construction Materials Inventory Map 25-1. Test data and other related information are shown in Material Pit Summary Table 25-1-2.

Selected References:

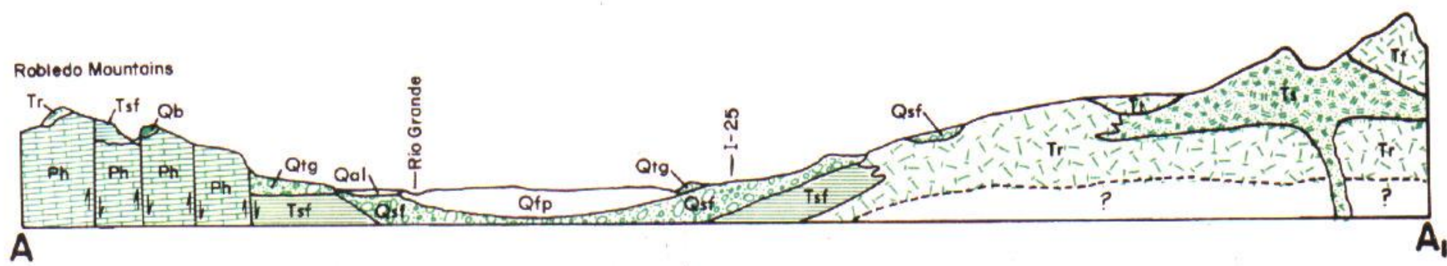
Conover, C. S., 1954, Ground-Water Conditions in the Rincon and Mesilla Valleys and Adjacent Areas in New Mexico, U.S. Geol. Surv., Water-Supply Paper 1230.

Dunham, K. C., 1935, The Geology of the Organ Mountains, with an Account of Dona Ana County, New Mexico, N. M. Bureau of Mines and Mineral Resources, Bull. 11.

Kottlowski, F. E., 1953, Guidebook of Southwestern New Mexico, New Mexico Geol. Soc.

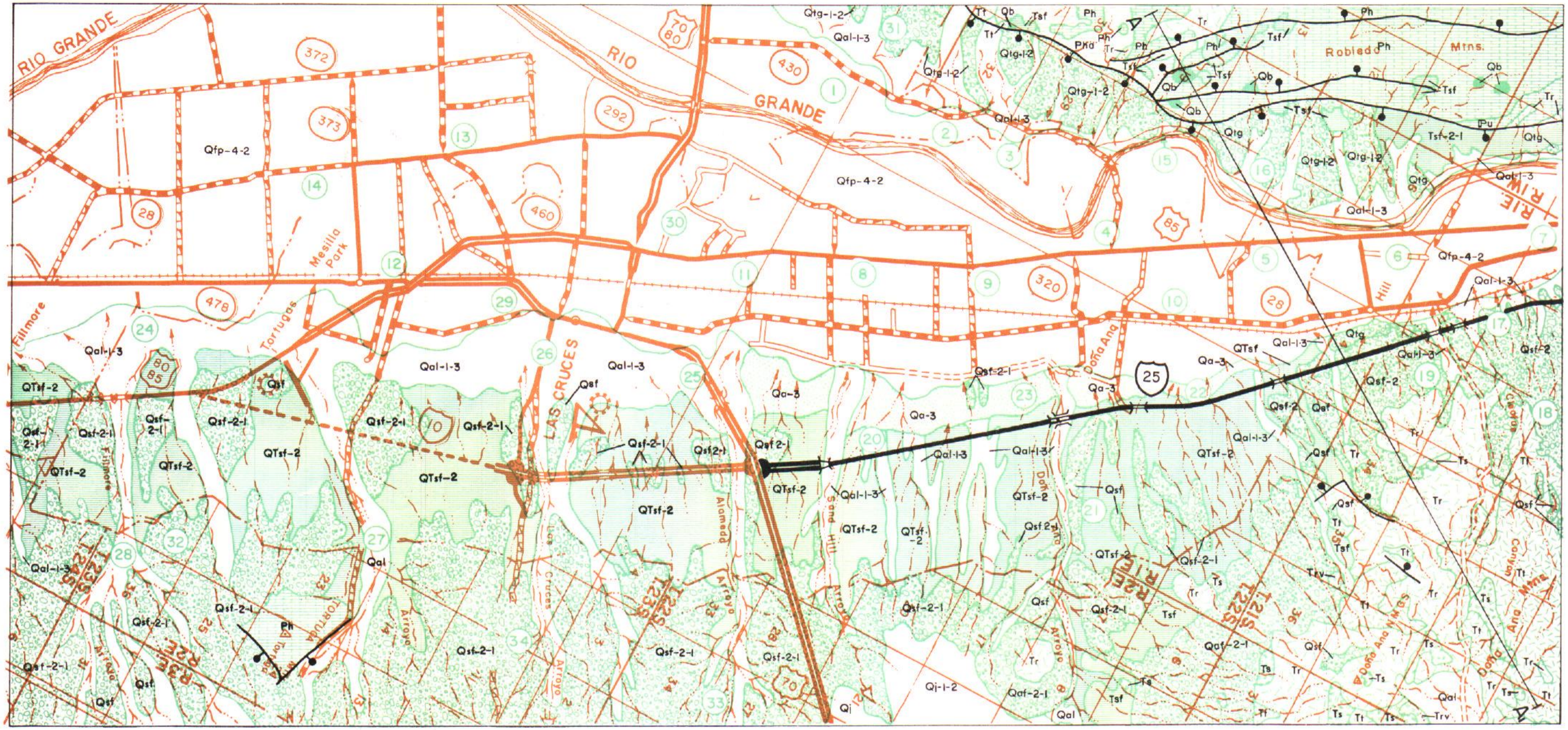
_____, 1960, Reconnaissance Geologic Map of Las Cruces Thirty-Minute Quadrangle, New Mexico, N. M. Bureau of Mines and Mineral Resources, Geol. Map 14.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology Map 25-1

SOILS AND GEOLOGY MAP 25-1



GEOLOGY MAPPED 1963

-LEGEND-

SEDIMENTARY ROCKS

QUATERNARY
- Qal — Alluvium
- Qfp — Flood-plain deposits
- Qtg — Terrace gravel

QUATERNARY
- Qaf — Alluvial fans
- Qa — Aeolian deposits
- Qj — Jornada deposits

QUATERNARY / TERTIARY
- Qsf — Upper Santa Fe group
- QTsf — Santa Fe group
- Tsf — Lower Santa Fe group

PERMIAN
- Ph / Pha — Hueco limestone w/Abo tongue

PENNSYLVANIAN
- Pu — Upper Pennsylvanian limestone

IGNEOUS ROCKS

QUATERNARY
- Qb — Basalt

TERTIARY
- Ts — Syenite
- Trv — Rhyolitic volcanics

TERTIARY
- Tt — Undifferentiated volcanics
- Tr — Rhyolite

0
STATUTE MILES

SOILS AND GEOLOGY

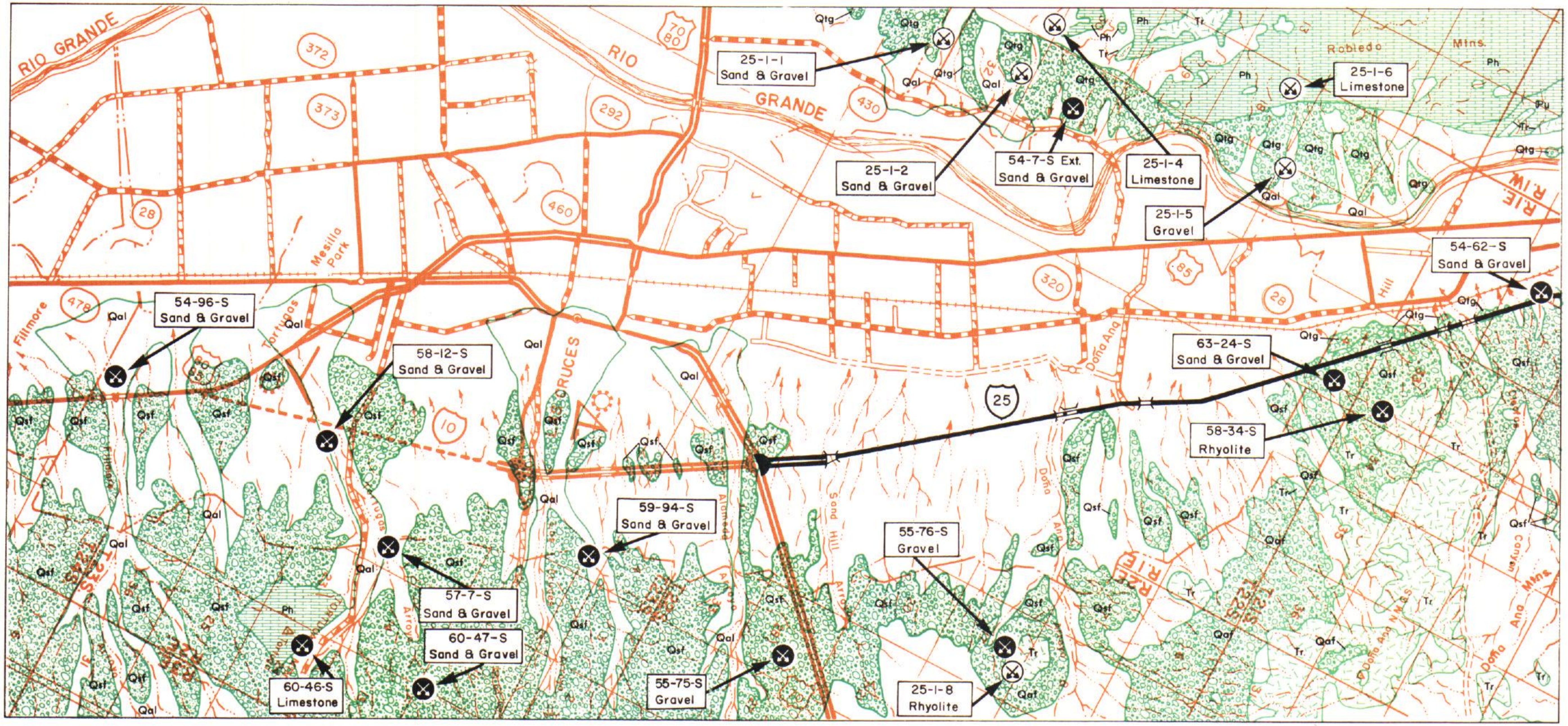
Soils Summary:

Table 25-I-I

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Qfp	I	A	0.0	2.5	A-4	Silt
"		B	2.5	3.5	A-6	Clay
"		C	3.5	5.0	A-4	Pebbly silt
"	2	A	0.0	I.0	A-6	Clay
"		B	I.0	5.0	A-7	"
"	3	A	0.0	5.0	A-4	Silt
"	4	A	0.0	4.0	A-6	Clay
"		B	4.0	5.0	A-2-4	Silty sand
"	5	A	0.0	5.0	A-2-4	" "
"	6	A	0.0	5.0	A-3	Fine-grained sand
"	7	A	0.0	5.0	A-3	" " "
"	8	A	0.0	5.0	A-6	Clay
"	9	A	0.0	5.0	A-4	Silt
"	10	A	0.0	5.0	A-4	"
"	II	A	0.0	3.5	A-7	Clay
"		B	3.5	5.0	A-4	Silt
"	12	A	0.0	5.0	A-4	"
"	13	A	0.0	5.0	A-2-4	Silty sand
"	14	A	0.0	5.0	A-4	Silt
Qal	15	A	0.0	8.0	A-I-b	Fine-grained gravel
Qtg	16	A	0.0	7.0	A-I-a	Gravel
"		B	7.0	15.0	A-2-4	Silty sand and gravel
"		C	15.0	21.0	A-I-a	Gravel
"		D	21.0	32.0	A-3	Fine-grained sand
Tsf		E	32.0	---	Solid rock	Conglomerate
Qsf	17	A	0.0	2.0	A-4	Silty caliche
"		B	2.0	8.5	A-2-4	Silty sand and gravel
"	18	A	0.0	I.5	A-I-a	Sandy gravel
"		B	I.5	2.5	A-2-4	Silty sand
"	19	A	0.0	II.0	A-3	Pebbly sand
Qal	20	A	0.0	5.0	A-3	Sand
Qsf	21	A	0.0	II.0	A-2-4	Pebbly sand
"		B	II.0	19.0	A-I-a	Sandy gravel
Qa	22	A	0.0	5.0	A-I-a	Sandy gravel
"	23	A	0.0	3.0	A-3	Fine-grained sand
Qal	24	A	0.0	7.0	A-4	Silt
"	25	A	0.0	2.0	A-4	"
"		B	2.0	3.5	A-I-b	Coarse-grained sand
"	26	A	0.0	2.5	A-3	Fine-grained sand
"		B	2.5	3.0	A-I-a	Sandy gravel
"	27	A	0.0	I.0	A-I-b	Coarse-grained sand
"		B	I.0	7.0	A-I-a	Sandy gravel

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Qal	28	A	0.0	2.0	A-I-a	Sandy gravel
Qfp	29	A	0.0	3.5	A-4	Silt
"		B	3.5	5.5	A-I-b	Coarse-grained sand
"		C	5.5	10.0	A-4	Silt
"	30	A	0.0	4.0	A-4	"
Qtg	31	A	0.0	4.0	A-I-b	Silty gravel
"		B	4.0	7.0	A-4	Silt
Qsf	32	A	0.0	2.0	A-I-a	Sandy gravel
"	33	A	0.0	2.0	A-I-b	Coarse-grained sand
"	34	A	0.0	2.0	A-I-a	Sandy gravel
"		B	2.0	4.5	A-2-4	Silty sand

CONSTRUCTION MATERIALS MAP 25-1



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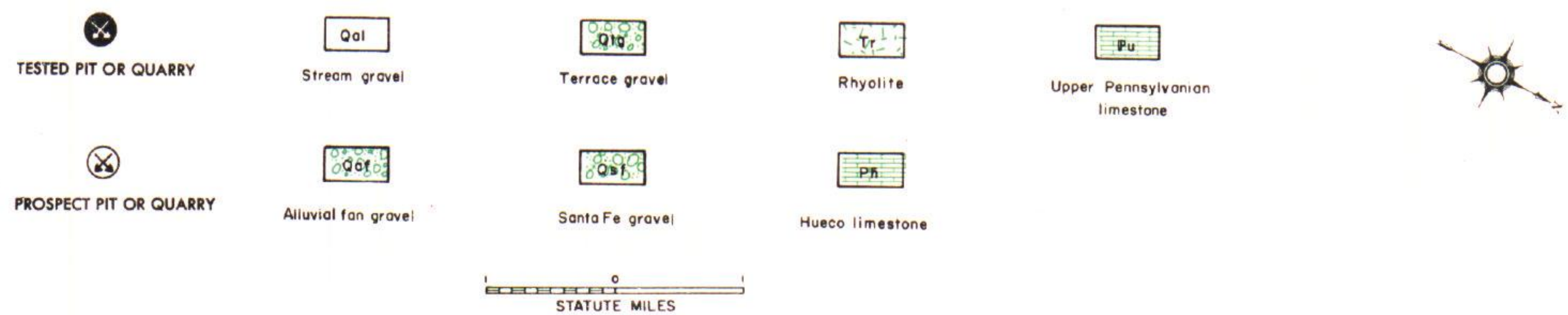


Material Pit Summary:

Table 25-1-2

		54-7-S ext.	54-62-S	54-96-S	55-75-S
Pit or Prospect No.		54-7-S ext.	54-62-S	54-96-S	55-75-S
Location	Section	SE 1/4, sec. 29	SE 1/4, sec. 30	Dona Ana Bend Colony Grant	SW 1/4, sec. 28
	Twnshp. & Range	T 22 S, R 1 E	T 21 S, R 1 E	200' Rt. sta. 234+92, U.S. 85	T 22 S, R 2 E
	County	Dona Ana	Dona Ana	Dona Ana	Dona Ana
	State	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	U.S. Government
Geologic Age		Quaternary	Recent	Quaternary	Quaternary
Formation		Terrace	Terrace	Alluvium	Santa Fe
Type of Pit		Gravel	Gravel	Gravel	Gravel
Kind of Material		Limestone with minor extrusive rocks	Igneous & quartzite	Igneous	Igneous
Quality of Material		Good	Good	Good	Good (fine-grained aggregate)
Thickness of Material		30 feet	10+ feet	12+ feet	20 feet
Thickness of Cap (Caliche)		-	None	-	-
Blasting Qualities		-	None	-	-
Uniformity		Good	Good	Good	Fair
Impurities		Silt lenses	None	Silt lenses	None
Type of Mat'l. Underlying Formation		Santa Fe silts	Santa Fe	Silt and clay	Silt and clay
Moisture Condition		Dry	Dry	Dry	Dry
Vegetation		Mesquite & grasses	Willow, mesquite, cactus, & grass	Creosote bushes & grasses	Creosote bush & grasses
Local Terrain		Dissected terrace	Dissected terrace	Gentle sloping alluvial fan	Dissected terrace
Depth of Overburden		-	None	2.5 feet	1 foot
P.I. (Overburden)		-	-	N.P.	N.P.
Est. Reserve Quantity		90,000 cu. yds.	-	100,000 cu. yds.	See remarks
Approx. Haul to Nearest Point		4.4 miles	1.5 miles to I-25	600 feet to I-25	2 miles
L.A. Wear		22.0	16.8	19.6	24.0
Maximum Size		8"	12"	3"	3"
% Retained on 2" Sieve		Less than 15	-	Less than 2	Less than 1
	Crushed to	3/4"	3/4"	3/4"	3/4"
	2"	-	-	-	-
Pit	1"	-	-	-	-
Average	3/4"	100	100	100	100
% Passing	1/2"	78	71	93	89
	#4	44	36	55	57
	#10	28	23	42	45
	#200	5	3	4	5
P.I.		6	N.P.	N.P.	N.P.
Lab. Numbers		54-1793 — 1819		54-16983 -- 17000	55-11106 -- 11117 & 55-20415 -- 20420

Remarks:

54-7-S ext. - Can be extended to the west and possibly to the north and south. Possible gravel sources on adjoining terraces.

54-62-S - Possible extension to the east across railroad property.

54-96-S - Pit not used to date (5-1-62).

55-75-S - This pit is essentially worked out. However, 200 to 500 cu. yds. may be salvaged. Very little coarse material remains. Large quantities of the fine-grained gravel can be obtained in this vicinity.

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-1-2 continued..

Pit or Prospect No.		55-76-S	57-7-S	63-24-S	58-12-S
Location	Section	NE 1/4, sec. 17	NE 1/4, sec. 22	NE 1/4, Sec. 4	Dona Ana Bend Colony Grant
	Twnshp. & Range	T 22 S, R 2 E	T 23 S, R 2 E	T 22 S, R 1 E	-
	County	Dona Ana	Dona Ana	Dona Ana	Dona Ana
	State	New Mexico	New Mexico	New Mexico	New Mexico
Owner		U.S. Government	U.S. Government	Federal	New Mexico State University
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary
Formation		Alluvial fan deposits	Alluvium	Alluvium	Alluvium
Type of Pit		Gravel	Sand & gravel	Sand & gravel	Gravel
Kind of Material		Conglomerate	Igneous & limestone	Igneous	Predominantly igneous with some limestone
Quality of Material		Good	Good	Fair	Good
Thickness of Material		10+ feet	12 feet	8 feet	13+ feet
Thickness of Cap (Caliche)		None	-	-	-
Blasting Qualities		-	-	-	-
Uniformity		Good	Good	Fair	Good
Impurities		-	Silt lenses	None	None
Type of Mat'l. Underlying Formation		-	Silt or clay	Sand	Silt and clay
Moisture Condition		Dry	Dry	Dry	Dry
Vegetation		Greasewood, cactus	Creosote bush & grasses	Scattered brush	Sparse grass and creosote
Local Terrain		Hillside	Dry arroyo	Arroyo bottom	Dry arroyo
Depth of Overburden		1 foot	-	None	2.0 feet
P.I. (Overburden)		5	-	-	None
Est. Reserve Quantity		100,000 cu. yds.	200,000 cu. yds.	200,000 to 400,000 cu. yds.	?
Approx. Haul to Nearest Point		2.5 miles	1.2 miles	265 feet	2 miles
L.A. Wear		20.0	16.0	22	18.0
Maximum Size		24"	4"	6"	3"
% Retained on 2" Sieve		Over 50 per cent	Less than 2	3	2
	Crushed to	3/4"	1"	-	As received
	2"	-	-	97	98
Pit	1"	-	100	92	92
Average	3/4"	100	90	88	88
% Passing	1/2"	71	75	80	81
	#4	35	42	49	63
	#10	23	24	34	48
	#200	6	2	7	4
P.I.		9	N.P.	N.P.	N.P.
Lab. Numbers		55-11188-11194	57-1546 -- 1559, 57-1568 -- 1583, 57-1588 --1593, 60-548 -- 549	63-11232-11245	

Remarks:

57-7-S - Pit area has not been used to date (2-1-62).

57-8-S ext. - Pit area has not been used to date (2-1-62). Can be extended to the north and east. Almost unlimited supply.

Material Pit Summary:

Table 25-1-2 continued..

Pit or Prospect No.		58-34-S	59-94-S	60-46-S	60-47-S
Location	Section	SE 1/4, sec. 33	See remarks	NW 1/4, sec. 24	N 1/2, sec. 14
	Twnshp. & Range	T 21 S, R 1 E	" "	T 23 S, R 2 E	T 23 S, R 2 E
	County	Dona Ana	Dona Ana	Dona Ana	Dona Ana
	State	New Mexico	New Mexico	New Mexico	New Mexico
Owner		State Land	Private	U.S. Government	U.S. Government
Geologic Age		Tertiary	Quaternary	Permian	Quaternary
Formation		Rhyolitic volcanics	Alluvium	Hueco limestone	Alluvium
Type of Pit		Quarry	Gravel	Quarry	Gravel
Kind of Material		Rhyolite	Igneous & minor limestone	Limestone	Igneous
Quality of Material		Good	Good	Good	Good
Thickness of Material		50+ feet	12+ feet	10+ feet	10+ feet
Thickness of Cap (Caliche)		-	-	-	-
Blasting Qualities		Excellent	-	Good	-
Uniformity		Good	Fair	Good	Good
Impurities		Possibly weathered tuffaceous areas	-	Minor chert & ferromagnesium minerals	-
Type of Mat'l. Underlying Formation		Andesite	Silt and clay	?	Silt and clay
Moisture Condition		Dry	Dry	Dry	Dry
Vegetation		Scattered grasses and creosote	Mesquite	Sparse grass, creosote, & cactus	Mesquite & creosote
Local Terrain		Small, nearly bare rock hills	Dry arroyo	Hilly	Dry arroyo
Depth of Overburden		0.5 foot	-	2 to 8 feet	0.0 to 1.0 foot
P.I. (Overburden)		5	-	None	None
Est. Reserve Quantity		500,000+ cu. yds.	Pit is presently being used	200,000 cu. yds.	See remarks
Approx. Haul to Nearest Point		1.9 miles	0.75 miles	3.0 miles	2.2 miles
L.A. Wear		18.4	18.0	19.6	17.6
Maximum Size		-	4"	-	4"
% Retained on 2" Sieve		-	Less than 2	-	Less than 2
	Crushed to	1"	1"	1"	1"
	2"	-	-	-	-
Pit	1"	100	100	100	100
Average	3/4"	95	93	78	84
% Passing	1/2"	67	83	42	66
	#4	23	64	18	40
	#10	12	52	14	30
	#200	2	5	4	8
P.I.		N.P.	N.P.	N.P.	N.P.
Lab. Numbers		62-1225 -- 1226	59-13886 -- 13894	60-8527 -- 8533	60-8541 -- 8568

Remarks:

58-34-S - This quarry can be extended on a large scale to the north. Numerous rhyolite hills are in that direction.

59-94-S - Pit is in dry channel of stream bed. The northeastern section is presently being worked (2-1-62). It is located 830 feet Rt. of sta. 235+00 on Project I-010-2(6)143 in the Dona Ana Colony Bend Grant.

60-46-S - Quarry has not been worked to date (2-1-62). This material is similar in composition to that of 57-8-S.

60-47-S - Pit is presently being used (2-1-62).

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-1-2 continued...

		25-1-1 (Prospect)	25-1-2 (Prospect)	25-1-4 (Prospect)	25-1-5 (Prospect)
Pit or Prospect No.					
Location	Section	Mesilla Civil Colony Grant	NW 1/4. sec. 32	E 1/2, sec. 31	SE 1/4. sec. 7: SW 1/4. Sec. 8: NW 1/4 sec. 17: NE 1/4. sec. 18
	Twnshp. & Range	-	T 22 S. R 1 E	T 22 S, R 1 E	T 22 S, R 1 E
	County	Dona Ana	Dona Ana	Dona Ana	Dona Ana
	State	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	U.S. Government	U.S. Government	U.S. Government & Private
Geologic Age		Quaternary	Recent	Permian	Quaternary
Formation		Terrace	Terrace	Hueco	Alluvium
Type of Pit		Gravel	Gravel	Quarry	Gravel
Kind of Material		Igneous	Limestone	Limestone	Limestone
Quality of Material		Good	Good	Excellent	Excellent
Thickness of Material		20+ feet	10+ feet	50+ feet	10+ feet
Thickness of Cap (Caliche)		None	-	-	-
Blasting Qualities		-	-	Unexplored	-
Uniformity		Good	Good	Good	Good
Impurities		Minor silt	Silt	None	Minor silt lenses
Type of Mat'l. Underlying Formation		Silty sand	Santa Fe	Sandstone (?)	Santa Fe
Moisture Condition		Dry	Dry	Dry	Dry (except during flash floods)
Vegetation		Sparse grass & creosote	Sparse grass	Scattered greasewood	Creosote, mesquite, cacti, & grass
Local Terrain		Dissected terrace	Dissected terrace	Mountainous	Broad arroyo bottom
Depth of Overburden		None	-	Veneer	None
P.I. (Overburden)		None	9	-	-
Est. Reserve Quantity		500,000+ cu. yds.	-	Unlimited	500,000 cu. yds.
Approx. Haul to Nearest Point		2.0 miles	4.0 miles	5.0 miles	4 miles
L.A. Wear		23.2	-	22.4	22.0
Maximum Size		2"	2"	-	4'
% Retained on 2" Sieve		Less than 10	9	-	25
	Crushed to	1"	-	1"	1"
	2"	-	91	-	-
Pit	1"	100	73	100	100
Average	3/4"	96	62	93	97
% Passing	1/2"	80	48	61	79
	#4	41	24	20	37
	#10	29	16	9	24
	#200	2	5	2	6
P.I.		N.P.	10	N.P.	5
Lab. Numbers		61-17165 -- 17167	61-17163 -- 17164	63-17108	62-1227

Remarks:

Material Pit Summary:

Table 25-1-2 continued..

Pit or Prospect No.		25-1-6 (Prospect)	25-1-8 (Prospect)
Location	Section	W 1/2, sec. 18 12 and 13	8 and 17
	Twnshp. & Range	T 22 S, R 1 E T 22 S, R 1 W	T 22 S, R 2 E
	County	Dona Ana	Dona Ana
	State	New Mexico	New Mexico
Owner		U.S. Government	?
Geologic Age		Permian	Tertiary
Formation		Hueco	Rhyolite
Type of Pit		Quarry	Quarry
Kind of Material		Limestone	Rhyolite
Quality of Material		Excellent	Good
Thickness of Material		50+ feet	?
Thickness of Cap (Caliche)		-	-
Blasting Qualities		Undetermined	Good
Uniformity		Good	Good
Impurities		Minor shale beds	None
Type of Mat'l. Underlying Formation		Undetermined	?
Moisture Condition		Dry	Dry
Vegetation		Cacti & grasses	Scattered greasewood
Local Terrain		Large, abrupt hills	Mountainous
Depth of Overburden		None	-
P.I. (Overburden)		-	-
Est. Reserve Quantity		500,000+ cu. yds.	Unlimited
Approx. Haul to Nearest Point		4.0 miles	2.5 miles
L.A. Wear		21.2	11.2
Maximum Size		-	-
% Retained on 2" Sieve		-	-
	Crushed to	1"	1"
	2"	-	-
Pit	1"	100	100
Average	3/4"	94	90
% Passing	1/2"	62	50
	#4	22	17
	#10	10	8
	#200	2	1
P.I.		N.P.	N.P.
Lab. Numbers		62-1588	63-17109

Remarks:

SOILS AND GEOLOGY

Introduction:

Strip 25-2 begins just south of Leasburg and ends just south of Angostura, New Mexico. It lies in the Rio Grande depression which is part of the Basin and Range province. The main geologic features are the Sierra de las Uvas, Robledo Mountain, the Dona Ana Mountains, and San Diego Mountain.

In this strip the Rio Grande traverses Selden Canyon for about 8 miles. Above the canyon it has expanded to form the Palomas Valley. The fertile flood plain of the valley is farmed extensively. Most of the water for these farms is furnished by the Rio Grande Irrigation Project.

General Geology:

San Diego Mountain has been uplifted and is nearly encircled by faults. Volcanic tuffs and sandstones compose the Tertiary Palm Park formation which forms the western and highest part of the flat-topped mountain. The central core of the mountain is composed of Precambrian granite with minor green schist and gneiss lenses. The Precambrian is overlain to the east by the Bliss sandstone and the lower part of the El Paso formation. Tertiary volcanic deposits occur on the northern and eastern flanks of the uplift. They include rhyolite tuffs and tuffaceous sandstones of the Thurman formation, rhyolitic welded tuff, and andesitic and latite tuffs.

The northern part of the Dona Ana Mountains is composed of Permian Hueco limestone and Yeso formation, Tertiary syenite and andesite and latite tuffs; and a minute Quaternary basalt cone.

The northern part of the Robledo Mountains is composed predominantly of Hueco limestone and a thick rhyolite sill. A thick section of Pennsylvanian strata crops out between these two units. A thin sequence of Mississippian, Devonian, and Silurian sedimentary rocks is present. Two small Quaternary basalt cones occur in the Hueco limestone.

The Rio Grande flows through a constriction caused by the Sierra de las Uvas and has formed Selden Canyon. The canyon was incised through andesite and latite tuffs which have since been covered by Santa Fe deposits and alluvium. The Selden basalt tongue, which is interbedded with Santa Fe deposits, is exposed near the southwest bank of the river in the central part of the canyon. The Uvas basalt also crops out near the river.

Unconsolidated alluvial deposits cover most of the area. The vast Jornada del Muerto surface forms much of the northeastern part of the strip. The high terraces in the southwestern part of the strip are covered with basaltic gravel which was derived from the Sierra de las Uvas.

Many ephemeral streams join the Rio Grande at right angles throughout its course in this strip. Fine-grained sediments comprise the majority of the Rio Grande fill deposits beneath the flood plain.

The areal distribution of formations and their members is shown on Soils and Geology Map 25-2. Their succession and character are given under the section termed "Stratigraphy."

Soils:

Alluvium (Qal): Alluvium in this section is found in the ephemeral stream valleys which join the Rio Grande flood plain. For the most part this material is subangular and poorly sorted, and has been transported from a volcanic terrain. Fine-grained gravel and sand (A-2-4) is most prevalent, but coarse-grained gravel (A-1-b to A-1-a) and silt (A-4) are also present.

Floodplain deposits (Qfp): Floodplain deposits in the upper Mesilla Valley are composed predominantly of silt (A-4); however, there are also deposits of silty sand (A-2-4) and fine-grained sand (A-3). In Selden Canyon poor drainage causes ponding. Extremely fine-grained sediments and plastic clay (A-7) accumulate in these ponds. Above the canyon, in the lower Palomas Valley, silt (A-4) again predominates; however, there are also minor deposits of silty sand (A-2-4) and clay (A-6 to A-7). Fine-grained sand (A-3) occurs here in ancient sand bars. Gravel is scarce in the floodplain deposits of all these areas.

Terrace gravels (Qtg): Coarse basaltic gravel (A-1-a) and wind-blown silty sand (A-2-4) blanket the much finer-grained Santa Fe deposits in the western part of this strip. Much of this gravel is derived from the Sierra de las Uvas. Other deposits were laid down by the Rio Grande. Later the river began down-cutting through these deposits and the gravel remains in dissected terraces near the flood plain.

Jornada deposits (Qj): The Jornada del Muerto surface is veneered by silt (A-4) and silty sand (A-2-4) which is both aeolian and residual. Caliche occurs one to three feet below the surface. The upper two feet of this caliche shows some degree of induration. Below this indurated layer the caliche is soft, and in places, occurs only in the interstices between aeolian sand and silt grains. This third zone is about 20 feet thick. Santa Fe group sand and gravel occur below the soft caliche.

Santa Fe group (Qsf): These are unconsolidated bolson deposits. They are heterogeneous and vary both vertically and laterally. From one to thirty feet of coarse-grained sand and pea-gravel cap most of the hills. Silty sand and gravel (A-2-4), clayey sand and gravel (A-2-6), and local pockets and lenses of silt (A-4) and clay (A-6) lie below the sand and pea-gravel. A veneer of residual soil has formed over this formation, but it is difficult to distinguish a contact between it and the underlying Santa Fe beds.

Tuffs (Tt): Weathered material from this volcanic ash deposit has a P.I. of 16 and a soil classification of clay (A-7). The main clay mineral is probably bentonite.

Table 25-2-I shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-2.

Ground-Water:

The ground-water conditions that exist in the Rio Grande floodplain deposits are of great importance to road construction, since the water table is very near or at the surface in many places.

Ground-Water continued...

The ground-water is supplied by surface flow and underflow from the bordering areas, seepage from canals and irrigated farm lands, precipitation on the flood plain and adjacent areas, and lateral seepage from the Rio Grande.

The general direction of flow of the underground water in the flood plain is downstream. The medium through which this ground-water flows is chiefly alluvium. The depth and gradient may change when the amount of water supplied varies, where sediments or formations vary, and (or) when permeability changes. Conover (1954) states that the level of the water-table in the Mesilla Valley varies from 25 feet below the surface to surface-water, and from zero to 8 feet in the Rincon (Palomas) Valley.

The flood plain area receives excess water during the irrigation months, and during that time the water-table gradually rises until it is thought to be less than 5 feet below the surface in most places. In October, 1961, soil samples were taken in the floodplain deposits and the water-table was found to be 5 feet below the surface in sandy strata.

Stratigraphy:

Quaternary:

Alluvium (Qal) - ephemeral stream deposits of subangular gravel, sand, and silt.
Thickness: 1 to 25 feet.

Floodplain deposits (Qfp) - Rio Grande deposits of silt, sand, and clay with minor gravel lenses.
Thickness: 10 to 150 feet.

Basalt (Qb) - basalt cones characterized by large pyroxene crystals and olivine aggregates.

Terrace gravels (Qtg) - sand and gravel of various composition.
Thickness: 1 to 12 feet.

Jornada deposits (Qj) - gravel cemented by caliche, and silt underlying the Jornada del Muerto surface. Aeolian sand locally veneers the surface.
Thickness: 10 to 50 feet.

Santa Fe formation (Qsf) - sand and gravel.
Thickness: 10 to 20 feet.

Unconformity---

Quaternary-Tertiary:

Santa Fe group (QTsf) - silt, gravel, sand, and clay with older conglomerate in a few localities.
Thickness: 50 to 400+ feet.

Tertiary:

Selden basalt (Tsb) - brown-black aphanitic basalt interbedded with Santa Fe sediments.
Thickness: 5 to 25 feet.

Uvas basalt (Tub) - dense to cellular, brown-black to reddish basalt.
Thickness: 15 to 30 feet.

Thurman formation (Tth) - white to tan-yellow tuffs and tuffeceous sandstones.
Thickness: 2,100 feet.

Rhyolite (Tr) - includes flows, intrusives, and rhyolitic tuffs.
Thickness: 20 to 230 feet.

Palm Park formation (Tpp) - red-brown, blue-gray, and purple-brown sandstone, conglomerate, silt, and clay with interbedded latitic and andesitic tuffs.
Thickness: 1,000 feet.

Syenite (Ts) - light tan-pink sills and dikes of syentite porphyry.

Tuffs (Tt) - light-gray to greenish white andesitic and latitic tuffs, locally containing gravel.
Thickness: 800+ feet.

Unconformity---

Permian:

Yeso formation (?) (Py) - red shales and sandstones.
Thickness: 475 feet.

Hueco limestone (Ph) - light- to dark-gray, fine-grained limestone. Includes underlying Bursum limestone.
Thickness: 1,715 feet.

Pennsylvanian:

Pennsylvanian undivided (Pu) - limestone, shale, siltstone, and sandstone
Thickness; 665 feet.

Unconformity---

Lower Paleozoic:

Lower Paleozoic sediments (LP) - sedimentary rocks in Robledo Mountain. Includes Ordovician El Paso formation (165 feet), Ordovician Montoya beds (310 feet), Silurian Fusselman dolomite (250 feet), and Devonian Percha formation (130+ feet).

Ordovician:

El Paso formation (Oep) - fractured, silty, gray limestone (in San Diego Mountain).
Thickness: 100+ feet.

Unconformity---

Cambrian:

Bliss sandstone (Єb) - very dark-brown, dense, quartzose sandstone containing trilobites (in San Diego Mountain).
Thickness: 65 feet.

Unconformity --

Precambrian: Granite and schist (P€) - pale red granite, green schist, and some green gneiss.

Construction Materials:

Quaternary: Alluvial deposits (Qal) - Streams that drain the western mountainous area of this strip contain heterogeneous mixtures of gravel, silt, and clay. The quantity of gravel to be found can be estimated by the size of the drainage-way. The larger arroyos invariably have greater amounts of gravel. These gravels are predominantly basaltic materials derived from the older terrace deposits which are quite extensive along the flanks of the Sierra de las Uvas. Prospect pit 25-2-11 is representative of most of the larger arroyos west of the river. There are very few access points at which these gravels may be hauled economically to Interstate Route 25; however, they will be useful for maintenance purposes on U.S. 85.

Terrace gravel (Qtg) - There are two distinct elevations of terrace gravels in this strip: (1) terrace deposits adjacent to the flood plain, and (2) the high-level terrace deposits west of the flood plain. The lower deposits are a product of an ancestral Rio Grande; whereas, the higher deposits are a product of the ephemeral streams that fed the Rio Grande. Prospect pit 25-2-10 is representative of the materials found in the high-level deposits. Old pit 61-5-S is representative of the lower level deposits; however, these deposits will vary in different areas along the river. The terraces east of the river are the most economical haul distance for Interstate Route 25.

Santa Fe formation (Qsf) - River gravels form the upper part of this formation in some places. Gravel is exposed below the Jornada surface east of the river, south of Rincon, New Mexico. These deposits probably are a product of an early Rio Grande before it cut through the silts, clays, and sands of the lower Santa Fe formation and formed the valley of today. These deposits are a well-washed sand and gravel with less than 5 percent retained on the 2 inch sieve, and 56 percent passing the No. 4 sieve. It should be very economical to produce concrete sand from this deposit. Pit 62-15-S is representative of this material.

Quaternary-Tertiary: Santa Fe group (QTsf) - The material that might possibly be used in this formation occurs along the flanks of the Dona Ana Mountains. It is a conglomerate that has become weathered to depths of 6 to 8 feet. No material pit sites have been located in this material; however, it is worthy of exploration.

Tertiary: Rhyolite (Tr) - This is a very dense rock that has become highly fractured. Tests have been run on samples of this rock from the old railroad quarry at radium Springs. These tests showed the crusher fines to be highly plastic. It is shown as a construction material since it can probably be used for some phases of construction.

Permian: Hueco limestone (Ph) - Unlimited quantities of excellent quarry rock may be produced from this formation in the Dona Ana Mountains and the Robledo Mountains. It also crops out in two small fault blocks about four miles south of San Diego Mountain. Access in the Robledo Mountains presents a problem since the exposures are somewhat elevated above the flood plain by faulting. The other locations have an easy access and they will furnish an almost unlimited supply of quarry rock.

Pennsylvanian, Lower Paleozoic and Ordovician: Limestone (IPu, LP, and Oep) - These formations are shown to demonstrate the locations where limestone quarries may be set up should the need arise. The El Paso limestone (Oep) is fairly undesirable because of its irregular outcrop. This limestone has been covered by a highly plastic clay and subsequent erosion has caused many clay filled cracks and crevasses. It would be very difficult to separate this clay from the limestone. Pennsylvanian and Lower Paleozoic rocks are undesireable because of their topographic position.

Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-2. Test data and other related information are shown in Material Pit Summary Table 25-2-2.

Selected References:

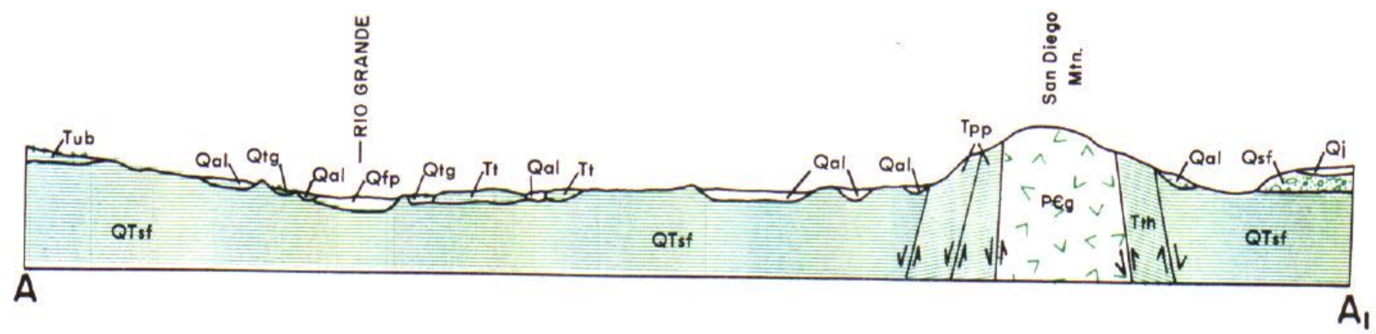
Conover, C. S., 1954, Ground-Water Conditions in the Rincon and Mesilla Valleys and Adjacent Areas in New Mexico, U.S. Geol. Survey, Water-Supply Paper 1230.

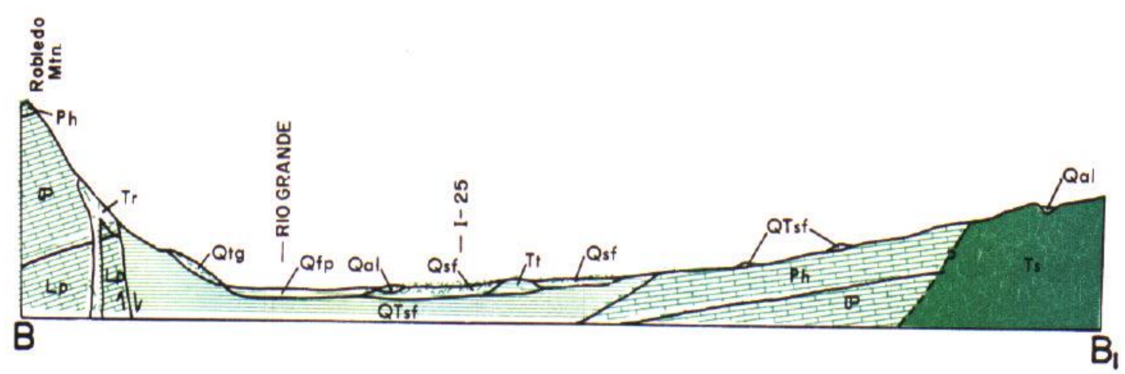
Dunham, D. C., 1935, The Geology of the Organ Mountains, with an Account of Dona Ana County, New Mexico, New Mexico Bureau of Mines and Mineral Resources, Bull. 11.

Kottlowski, F. E., 1953, Guidebook of Southwestern New Mexico, New Mexico Geol. Soc.

_______, 1960, Reconnaissance Geologic Map of Las Cruces Thirty-Minute Quadrangle, New Mexico Bureau of Mines and Mineral Resources, Geology Map 14.

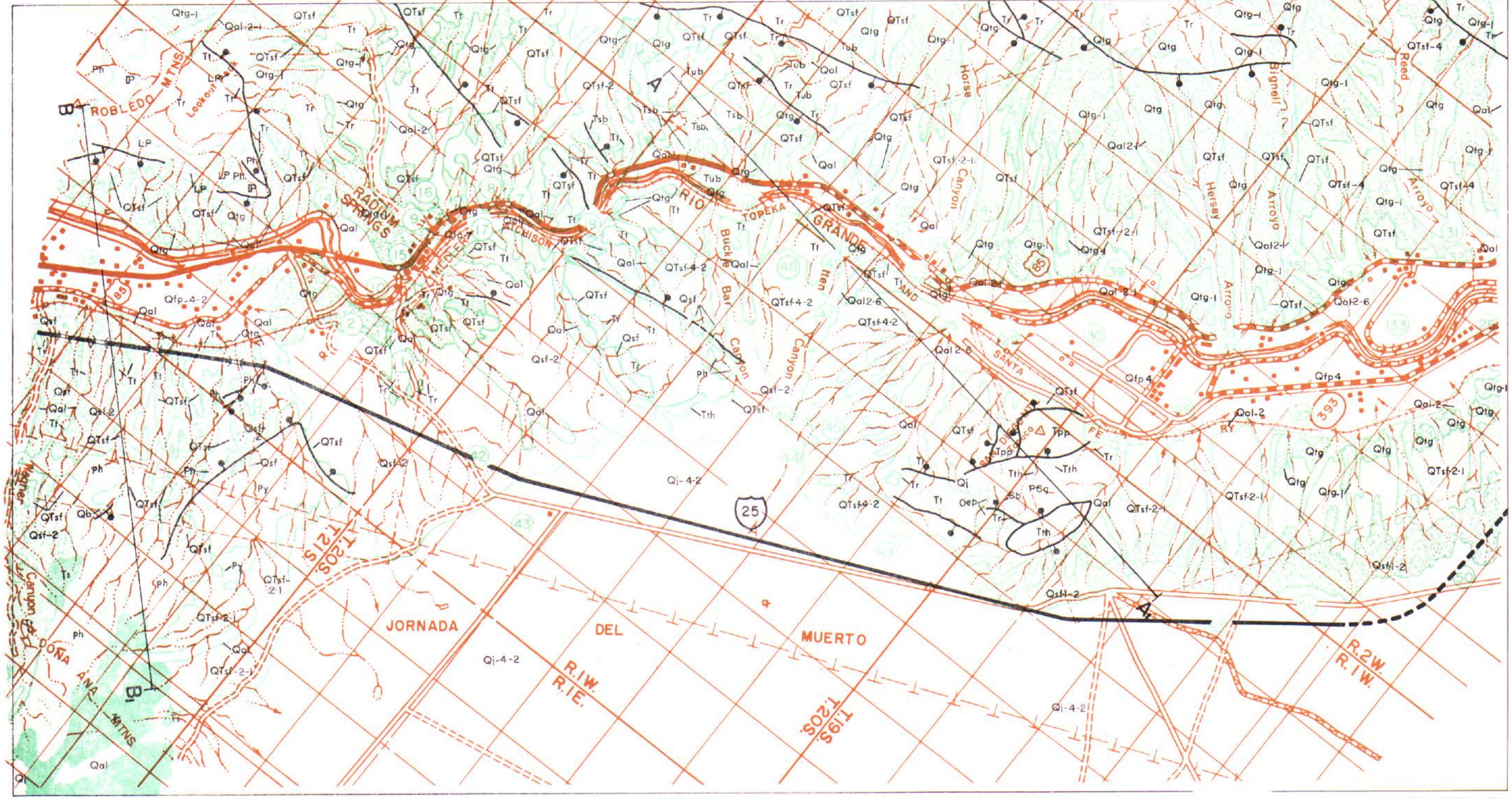
GENERALIZED CROSS-SECTIONS





Note: For explanation of symbols see Soils and Geology map 25-2

SOILS AND GEOLOGY MAP 25–2



GEOLOGY MAPPED 1963

-LEGEND-

SEDIMENTARY ROCKS

- Qal — Alluvium
- Qal — Alluvium
- Qfp — Flood-plain deposits
- QUATERNARY
- Qtg — Terrace gravel
- Qj — Jornada deposits
- Qsf — Santa Fe formation
- QUATERNARY
- Qsf — Santa Fe formation
- QTsf — Santa Fe formation
- Tth — Thurman formation
- Santa Fe group
- TERTIARY
- Tpp — Palm Park formation
- Tt — Tuffs
- TERTIARY
- Py — Yeso formation
- PERMIAN
- Ph — Hueco limestone
- PERMIAN
- IP — Pennsylvanian undivided
- PENNSYLVANIAN
- LP — Lower Paleozoic undivided
- LOWER PALEOZOIC
- Oep — El Paso formation
- ORDOVICIAN
- Єb — Bliss sandstone
- CAMBRIAN

IGNEOUS ROCKS

- Qb — Basalt
- QUATERNARY
- Tsb — Selden basalt
- Tub — Uvas basalt
- TERTIARY
- Tr — Rhyolite
- Ts — Syenite
- TERTIARY
- P€g — Granite
- PRECAMBRIAN

SOILS AND GEOLOGY

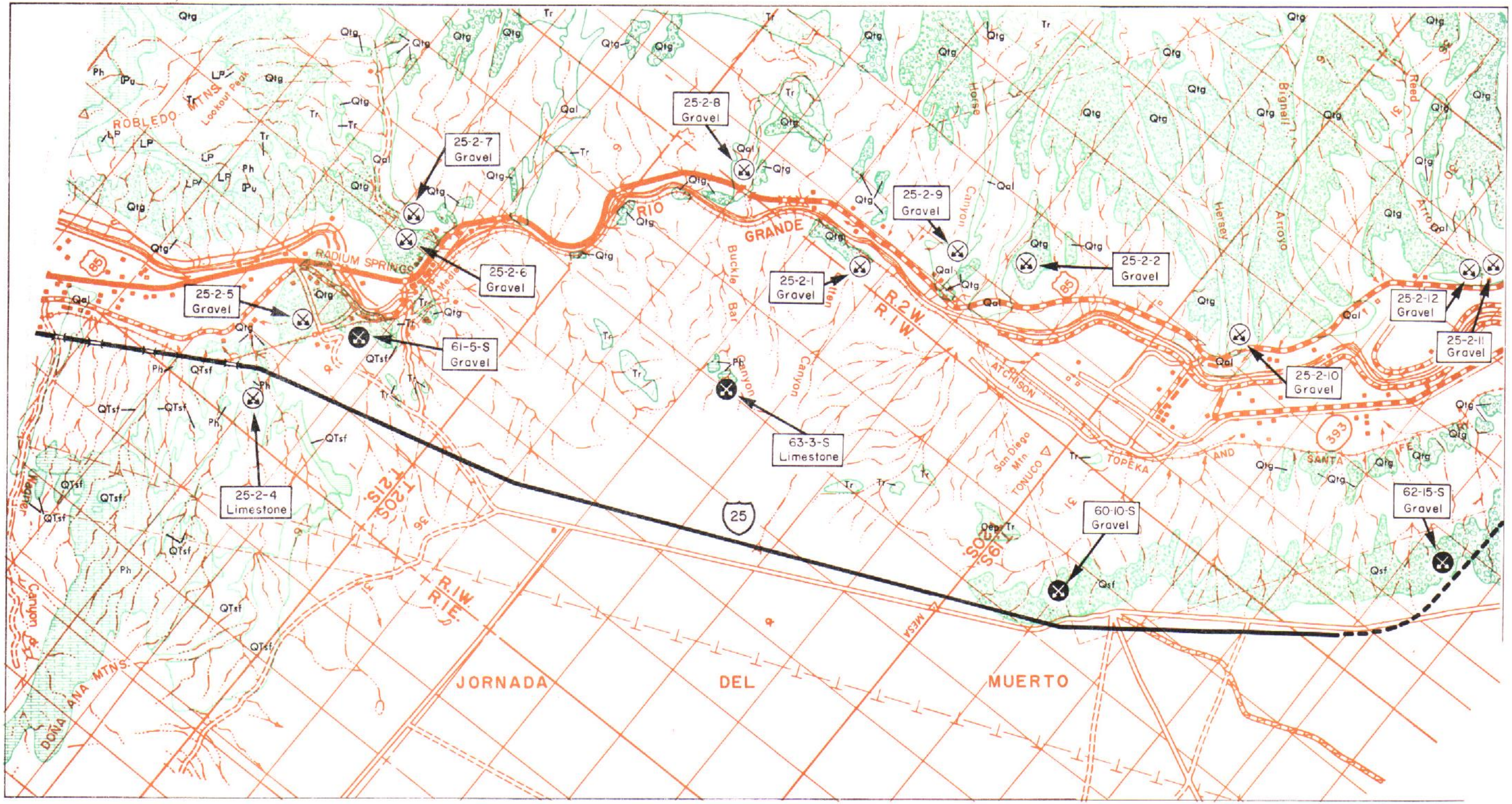
Soils Summary:

Table 25-2-1

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Qal	1	A	0.0	3.0	A-2-4	Pebbly sand
Qsf	2	A	0.0	1.5	A-4	Silt
"		B	1.5	4.5	A-1-b	Fine-grained gravel
"		C	4.5	16.0	A-1-a	Coarse-grained gravel
Qal	3	A	0.0	4.5	A-2-4	Pebbly sand
QTsf	4	A	0.0	19.0	A-2-4	Gravel and silt
Qal	5	A	0.0	3.5	A-1-a	Fine-grained gravel
"	6	A	0.0	2.3	A-1-b	Sandy gravel
"	7	A	0.0	1.5	A-1-a	Angular gravel
Tt	8	A	0.0	25.0	A-7	Bentonite
Qal	9	A	0.0	5.5	A-4	Pebbly silt
Qfp	10	A	0.0	1.5	A-4	Silt
"		B	1.5	4.5	A-3	Fine-grained sand
"	11	A	0.0	5.0	A-2-4	Silty sand
"	12	A	0.0	4.5	A-4	Silt
"	13	A	0.0	2.0	A-4	"
"		B	2.0	5.0	A-2-4	Silty sand
Qtg	14	A	0.0	22.0	A-2-7	Clayey gravel
"	15	A	0.0	6.5	A-1-a	Coarse-grained gravel
"		B	6.5	8.5	A-2-4	Silty sand
"		C	8.5	27.0	A-1-a	Coarse-grained gravel
QTsf	16	A	0.0	40.0	A-2-4	Fine-grained gravel
Qfp	17	A	0.0	2.5	A-7	Clay
"	18	A	0.0	3.5	A-4	Silt
"		B	3.5	4.5	A-7	Clay
"	19	A	0.0	2.5	A-7	"
QTsf	20	A	0.0	30.0	A-2-7	Clayey gravel
Qal	21	A	0.0	17.0	A-2-4	Silty gravel
"	22	A	0.0	3.5	A-2-6	Clayey gravel
"	23	A	0.0	4.0	A-7	Clay
Qfp	24	A	0.0	2.5	A-4	Silt
Qtg	25	A	0.0	6.5	A-1-a	Coarse-grained gravel
"		B	6.5	8.5	A-4	Silt
"		C	8.5	15.0	A-1-a	Pea-gravel
Qfp	26	A	0.0	2.5	A-4	Silt
"		B	2.5	4.0	A-6	Clay
"	27	A	0.0	5.0	A-4	Silt
"	28	A	0.0	4.0	A-4	"
"	29	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	4.5	A-3	Fine-grained sand

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Qfp	30	A	0.0	1.5	A-4	Silt
"		B	1.5	4.5	A-3	Fine-grained sand
Qal	31	A	0.0	4.0	A-4	Sandy silt
Qtg	32	A	0.0	8.5	A-1-a	Coarse-grained sand
"		B	8.5	13.0	A-2-4	Silty sand
Qfp	33	A	0.0	2.5	A-4	Silt
"		B	2.5	4.0	A-7	Clay
Qal	34	A	0.0	3.0	A-2-6	Clayey gravel
"	35	A	0.0	5.5	A-6	Clay
QTsf	36	A	0.0	9.0	A-1-a	Medium-grained gravel
Qtg	37	A	0.0	4.0	A-1-a	Coarse-grained gravel
Qsf		B	4.0	9.5	A-4	Silt
"		C	9.5	13.0	A-1-b	Fine-grained gravel
Qal	38	A	0.0	1.5	A-2-4	" " "
"	39	A	0.0	5.0	A-2-4	Silty sand
"	40	A	0.0	3.5	A-1-b	Sandy gravel
QTsf	41	A	0.0	6.0	A-1-a	Medium-grained gravel
"		B	6.0	10.0	A-4	Aeolian silt
"		C	10.0	18.0	A-1-a	Coarse-grained gravel
Qsf	42	A	0.0	1.5	A-2-4	Silty sand
"		B	1.5	---		Caliche
QJ	43	A	0.0	2.7	A-2-4	Silty sand
"		B	2.7	---		Caliche
"	44	A	0.0	1.5	A-2-4	Silty sand
"		B	1.5	7.0	A-2-4	" "
QTsf	45	A	0.0	6.0	A-7	Clay
Qsf	46	A	0.0	4.5	A-2-4	Silty sand
Qal	47	A	0.0	5.5	A-1-b	Sandy gravel
QTsf	48	A	0.0	50.0	Bedrock	Conglomerate
Qtg	49	A	0.0	3.5	A-1-b	Fine-grained gravel
"		B	3.5	22.0	A-2-4	Silty sand
QJ	50	A	0.0	1.6	A-4	Silt
"		B	1.6	---		Caliche
"	51	A	0.0	1.5	A-4	Silt
"		B	1.5	3.0		Caliche
"		C	3.0	11.0	A-2-4	Sandy caliche
"	52	A	0.0	1.0	A-4	Silt
"		B	1.0	4.0	A-2-6	Hard caliche
"		C	4.0	10.0	A-2-4	Sandy caliche
"	53	A	0.0	0.5	A-4	Silt
"		B	0.5	1.5		Caliche
"		C	1.5	8.0	A-2-6	Silty caliche

CONSTRUCTION MATERIALS MAP 25-2



—LEGEND—

(filled)	TESTED PIT OR QUARRY
(open)	PROSPECT PIT OR QUARRY
Qal	Stream gravel
Qtg	Terrace gravel
Qsf	Sand and gravel
QTsf	Pediment gravel
Tr	Rhyolite
Ph	Hueco limestone
Pu	Pennsylvanian limestone
LP	Lower Paleozoic limestone
Oep	El Paso limestone

STATUTE MILES

Material Pit Summary:

Table 25-2-2

Pit or Prospect No.		60-10-S	61-5-S	62-15-S	63-3-S
Location	Section	Secs. 29 & 32	W 1/2, sec. 11	Sec. 11	SE 1/4, Sec. 20
	Twnshp. & Range	T 19 S, R 1 W	T 21 S, R 1 W	T 19 S, R 2 W	T 20 S, R 1 W
	County	Dona Ana	Dona Ana	Dona Ana	Dona Ana
	State	New Mexico	New Mexico	New Mexico	New Mexico
Owner		U.S. Government	Private	U.S. Government	State Park Comm.
Geologic Age		Quaternary	Quaternary	Quaternary	Permian
Formation		Santa Fe	Terrace gravel	Santa Fe	Hueco
Type of Pit		Sand and gravel	Gravel	Sand and gravel	Quarry
Kind of Material		Igneous	Predominantly igneous	Predominantly igneous	Limestone
Quality of Material		See remarks	Good	Good	Good
Thickness of Material		10+ feet	20+ feet	9+ feet	30 feet
Thickness of Cap (Caliche)		-	None	-	-
Blasting Qualities		-	-	-	Good
Uniformity		Fair	Fair	Fair	Good
Impurities		Minor silt lenses	Minor silt and clay	None	None
Type of Mat'l. Underlying Formation		Undetermined	Rhyolite	Undetermined	Shale
Moisture Condition		Dry	Dry	Dry	Dry
Vegetation		Creosote and mesquite	Creosote and grasses	Mesquite, creosote, cacti, & grasses	Grass & cacti
Local Terrain		Eroded terrace	Arroyo cut through terrace gravels	Eroded terraces	Mountainous
Depth of Overburden		Insignificant	2 to 8 feet	Insignificant	None
P.I. (Overburden)		N.P.	N.P.	N.P.	-
Est. Reserve Quantity		55,000+ cu. yds.	Further exploration necessary	250,000+ cu. yds.	500,000+ cu. yds.
Approx. Haul to Nearest Point		5+ miles	1 mile	5.5 miles	2.55 miles
L.A. Wear		25.2	21.6	19.2	22.0
Maximum Size		2"	24"	3"	-
% Retained on 2" Sieve		1	10	5	-
	Crushed to	As received	As received	As received	2"
	2"	100	84	96	100
Pit	1"	95	59	86	82
Average	3/4"	91	55	80	50
% Passing	1/2"	85	46	73	31
	#4	67	32	56	13
	#10	57	25	44	7
	#200	14	2	3	2
P.I.		N.P.	N.P.	N.P.	N.P.
Lab. Numbers		60-1548 -- 1556	61-1436 -- 1464	62-2592 -- 2603	63-653 -- 658

Remarks:

60-10-S - Pit not used to date (6-1-62).

61-5-S - Presently being worked (6-2-62). Further exploration will reveal in which direction this pit can be extended after present excavation has ceased.

62-15-S - No excavation to date (5-31-62).

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-2-2 continued..

Pit or Prospect No.		25-2-1 (Prospect)	25-2-2 (Prospect)	25-2-4 (Prospect)	25-2-5 (Prospect)	25-2-6 (Prospect)
Location	Section	E 1/2, Sec. 24	NW 1/4, Sec. 13	NE 1/4, sec. 13	NE 1/4, sec. 14	SW 1/4, sec. 9
	Twnshp. & Range	T 20 S, R 2 W	T 20 S, R 2 W	T 21 S, R 1 W	T 20 S, R 1 W	T 21 S, R 1 W
	County	Dona Ana	Dona Ana	Dona Ana	Dona Ana	Dona Ana
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		New Mexico State University	Private	Private	Private	Private
Geologic Age		Quaternary	Quaternary	Permian	Quaternary	Quaternary
Formation		Terrace deposit	Terrace deposit	Hueco	Terrace deposit	Terrace deposit
Type of Pit		Gravel	Gravel	Quarry	Gravel	Gravel
Kind of Material		Mixed aggregate	Predominantly igneous	Limestone	Gravel	Predominantly igneous
Quality of Material		Good	Good	Good	Good	Fair
Thickness of Material		20+ feet	15+ feet	10'+ feet	10+ feet	12 feet
Thickness of Cap (Caliche)		-	-	-	-	-
Blasting Qualities		-	-	-	-	-
Uniformity		Fair	Fair	Good	Good	Fair
Impurities		Silt lenses	Minor silty sand lenses	Minor shale	None noted	Silt
Type of Mat'l. Underlying Formation		Volcanic breccia and flow rocks	Tuff	Shale	?	Tuff
Moisture Condition		Dry	Dry	Dry	Dry	Dry
Vegetation		Mesquite	Mesquite, creosote, cacti, & grasses	Greasewood & mesquite	Grass & mesquite	Greasewood
Local Terrain		Mountainous	Mountainous	Hilly	River valley	River terraces
Depth of Overburden		?	Negligible	Negligible	6+ feet	3 feet
P.I. (Overburden)		?	-	-	N.P.	N.P.
Est. Reserve Quantity		?	?	500,000 cu. yds.	?	?
Approx. Haul to Nearest Point		Approximately 4 miles	0.1 mile to U.S. 85	0.25 miles	0.75 miles	Adjacent to U.S. 85
L.A. Wear		17.6	22.8	15.2	22.4	20.8
Maximum Size		24"	-	-	6"	6"
% Retained on 2" Sieve		50%	10"- 15"	-	30	5 to 10
	Crushed to	1"	-	1"	-	-
	2"	-	72	-	70	94
Pit	1"	100	58	100	58	77
Average	3/4"	88	52	90	54	68
% Passing	1/2"	57	46	51	50	56
	#4	28	34	19	37	35
	#10	18	25	10	26	27
	#200	2	5	2	5	3
P.I.		N.P.	N.P	N.P.	N.P.	N.P.
Lab. Numbers		62-743	62-5966	63-17110	62-14920 -- 14921	63-17148

Remarks:

25-2-3 (Prospect) - This site is a relatively small, isolated fault-block of Hueco limestone. It will be fairly difficult to explore until a road is built to the top of the formation.

25-2-4 (Prospect) - This is an isolated fault-block that dips slightly to the east.

Material Pit Summary:

Table 25-2-2 continued...

Pit or Prospect No.		25-2-7 (Prospect)	25-2-8 (Prospect)	25-2-9 (Prospect)	25-2-10 (Prospect)	25-2-11 (Prospect)	25-2-12 (Prospect)
Location	Section	SE 1/4, sec. 9	36	13 and 14	34	W 1/2, sec. 20	20
	Twnshp. & Range	T 21 S, R 1 W	T 20 S, R 2 W	T 20 S, R 2 W	T 19 S, R 2 W	T 19 S. R 2 W	T 19 S, R 2 W
	County	Dona Ana	Dona Ana	Dona Ana	Dona Ana	Dona Ana	Dona Ana
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	State	Government Land & Private	Government Land	Private	Private
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Alluvium	Alluvium	Alluvium	Terrace deposit	Alluvium	Terrace deposit
Type of Pit		Gravel	Gravel	Gravel	Gravel	Gravel	Gravel
Kind of Material		Predominantly igneous	Predominantly igneous	Predominantly igneous	Basaltic gravel	Predominantly igneous	Igneous
Quality of Material		Fair	Fair	Fair	Excellent	Good	Excellent
Thickness of Material		?	10+ feet	?	30 feet	-	10+ feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	-	-	-	-
Uniformity		Fair	Fair	Fair	Good	Fair	Good
Impurities		Silt	Silt & clay	Silt	None noted	Silt	None noted
Type of Mat'l. Underlying Formation		Tuff	Santa Fe	Silt & clay (Tsf)	Silt, sand & clay	Silt & clay	Silt & clay
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Scattered brush	Scattered brush	Scattered brush	Greasewood	Scattered brush	Greasewood
Local Terrain		Narrow canyon	Narrow canyon	Narrow canyon	Dissected terraces	Dissected terraces	Dissected terraces
Depth of Overburden		?	None	?	0.0 to 2.0 feet	?	?
P.I. (Overburden)		?	-	?	?	-	?
Est. Reserve Quantity		?	?	?	Unlimited	Unlimited	Unlimited
Approx. Haul to Nearest Point		Adjacent to U.S. 85	Adjacent to U.S. 85	Adjacent to U.S. 85	Adjacent to U.S. 85	Adjacent to U.S. 85	Adjacent to U.S. 85
L.A. Wear		28.0	24.8	22.8	22.8	20.4	22.4
Maximum Size		2"	12"	6"	6"	6"	6"
% Retained on 2" Sieve		Less than one	10	35	20	20 - 30	30 - 40
	Crushed to	-	-	-	-	-	-
	2"	100	91	64	78	57	47
Pit	1"	98	85	57	59	47	38
Average	3/4"	96	82	55	47	44	35
% Passing	1/2"	91	77	52	35	41	32
	#4	67	63	42	21	33	24
	#10	48	50	34	16	24	19
	#200	4	5	4	4	3	6
P.I.		N.P.	N.P.	N.P.	N.P.	N.P.	N.P.
Lab. Numbers		63-17111	63-17112	62-14919	62-14922	69-14912	62-14913

Remarks:

SOILS AND GEOLOGY

Introduction:

Strip 25-3 is in south-central New Mexico, in Dona Ana and Sierra Counties. It begins near Rincon and ends about three miles north of Derry where U.S. 85 crosses the Rio Grande.

Structurally, the area lies within the Hatch basin, one of many linked basins which lie along the Rio Grande depression. The Rio Grande depression extends from southern Colorado to El Paso, Texas.

Rugged mountains of Paleozoic sedimentary rocks and Tertiary volcanics rise above the Cenozoic alluvial deposits of the basin. A striking feature in this strip is the thick deposits of terrace gravels on the east side of the Rio Grande.

General Geology:

Precambrian granite, Paleozic sedimentary rocks, and Cenozoic volcanic and sedimentary rocks are exposed in the hills in this strip. Mesozoic rocks are absent because of post-Paleozoic uplift and erosion.

The earliest Paleozoic deposit, Cambrian Bliss formation, was deposited slowly and intermittently. The center of the Bliss depositional basin was in southern New Mexico. The Ordovician and Silurian deposits are alternating beds of limestone, dolomite, and minor sandstone and shale which indicate that seas were transgressing and regressing over southern New Mexico during these periods. Devonian deposits are shales with associated siltstone, sandstone, and limestone and they indicate a period of relative emergence. During the Mississippian and early Pennsylvanian periods thick marine limestones were deposited. During middle and late Pennsylvanian time a land mass emerged in southern New Mexico as indicated by the clastic upper part of the Pennsylvanian Magdalena group which grades into continental Permian deposits of sandstone and siltstone. In late Permian time a marine sea again advanced over southern New Mexico and the San Andres limestone was deposited. This sea was not as extensive as those in early Paleozoic. At the end of the Permian this region emerged from the sea. It remained emergent through most of the Mesozoic era. There are no exposures of Mesozoic rocks in this strip; however, late Cretaceous rocks crop out near Elephant Butte Dam on strip 25-4.

The Rio Grande depression began to form during the Cenezoic era. Hatch basin, one of the many basins of the Rio Grande depression, received a thick accumulation of volcanic and pyroclastic deposits during the early Tertiary period. Examples of these early Tertiary rocks can be seen in the Thurman and Palm Park formations in the Rincon Hills. Conglomerates, red silts, and gypsum are interbedded with andesitic and latitic volcanic rocks. Arkosic, pumiceous, and tuffaceous sandstones are interbedded with rhyolitic volcanic rocks.

Subsidence of the Hatch basin and uplift and erosion of the adjoining highlands has continued through Recent time. Drainage during late Tertiary time was to a closed basin and several thousand feet of alluvial fan, stream and lake deposits of the Santa Fe group accumulated. Later, during the Pliestocene epoch, a wide-spread erosional surface developed over the basin fill, the Rio Grande became a through-flowing stream, and more deposits of sand, gravel, silt, and clay were added to the Santa Fe group.

Further uplift and rejuvenation caused the drainage to become firmly entrenched in its present form. The flood plain of the Rio Grande has reached a stage of maturity in which deposition and erosion are about equal. The position of the river is now controlled by a system of levees.

The areal distribution of formations is shown on Soils and Geology Map 25-3. Their succession and character are given under the section termed "Stratigraphy."

Soils:

Alluvium (Qal): A mixture of sand, silt, clay, and gravel in the channels of the tributary arroyos of the Rio Grande. The material has been reworked from older beds and is transported mainly during flash floods. The alluvial deposits are heterogeneous and they vary from gravel (A-I-a) to clay (A-6) in very short distances. The proportion of silt and clay to sand and gravel depends upon the material in the drainage area and the size of the arroyo. On the west side of the Rio Grande these deposits contain a higher percentage of silt and clay than of sand and gravel since the arroyos drain the Santa Fe group silts and clays. On the east side of the Rio Grande these deposits contain a higher percentage of sand and gravel since the arroyos drain more resistant Paleozoic and Tertiary deposits.

Flood-plain deposits(Qfp): The Rio Grande flood plain is covered by a soil that varies from silt (A-4) to clay (A-7). The cover is underlain by clean sand(A-3) of variable thickness. The rest of the deposit may vary from coarse-grained alluvium to fine-grained silt. The flood plain has been modified by farming and control of the Rio Grande channel.

Terrace deposits (Qtg): The top soil on the terraces varies from silty gravel (A-2-4) to silt (A-4). Samples taken of holes on the east side of the river show a few feet of silty gravel (A-2-4) overlying gravel. The total thickness of the terraces varies from a few inches to 15 or 20 feet. The deposits have been highly dissected and in the topographically higher areas only remnants remain.

Jornada surface (Qj): Only a small part of the Jornada surface extends into this area. The surface is veneered by wind-blown sand (A-3) and silt (A-4) which is both wind-blown and residual. Beneath the cover are several feet of soft, nodular caliche. The caliche is underlain by as much as 20 feet of fine-grained gravel and clean river sand which are assigned to the Santa Fe group.

Santa Fe group (QTsf): In this strip the Santa Fe group is composed predominantly of brownish red silty clay. It crops out extensively along the west side of the river. Here the cover is sandy silt (A-4) underlain by clay (A-6). Locally wind-blown sand covers the surface. In some places, clay balls (A-7) are found near the contact between the silty soil and the clay. This group is made up of alluvial fan and playa deposits and the beds are poorly-sorted and lenticular (Kelley and Silver, 1952, p. 123). East of the river, south of the Rincon Hills below the Jornada surface, is a thick deposit of fine-grained gravel and river sand. This sand and gravel was laid down by an early Rio Grande.

Residual soils: Residual soils have developed on the Tertiary volcanics and Paleozoic rocks where they crop out. The type of soil depends upon the parent formation and the amount and kind of transported soil that may be present. In most cases the residual soils vary from sand to silt.

Table 25-3-I shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-3.

Stratigraphy:

Quaternary:

Alluvium (Qal) - a heterogeneous mixture of sand, silt, clay, and gravel.

Floodplain deposits (Qfp) - interstratified deposits of sand, silt, clay, and gravel.

Terrace deposits (Qtg) - an accumulation of igneous, sedimentary, and metamorphic debris. The fragments are generally rounded; and, in some places, are weakly cemented by clay and caliche. In most outcrops the fines are a non-plastic sand.

Jornada surface (Qj) - a cap of caliche 5 to 10 feet thick. The caliche is soft and nodular and is underlain by silt and gravel. Locally overlying the caliche are thin covers of wind-blown sand.

Santa Fe formation (Qsf) - sand and gravel.
Thickness: 10 to 20 feet.

Unconformity--

Quaternary-Tertiary:

Santa Fe group (QTsf) - a reddish brown mixture of sand, silt, clay, and gravel. Lenticular bedding is common.
Thickness: 2,000+ feet.

Tertiary:

Uvas basalt (Tub) - basalt and basaltic andesite with interbedded scoria and basaltic tuffs.
Thickness: 15 to 30 feet.

Thurman formation (Tth) - a white to buff tuff, tuffaceous sandstone, and sandy clay with interbedded rhyolite breccia, tuff, and basalt.
Thickness: Approximately 2,500 feet.

Rhyolite tuffs and sandstones (Tr) - soft pink rhyolite tuffs, rhyolite flows, and light-brown pumaceous and tuffaceous sandstones.
Thickness: Approximately 2,000 feet.

Palm Park formation (Tpp) - a pyroclastic deposit chiefly of reddish brown rhyolitic arkose, sandstone, and tuff with interbeds of siltstone and thin limestone lenses.
Thickness: Approximately 1,000 feet.

Unconformity--

Permian:

San Andres limestone (Psa) - dark-gray limestone with interbedded sandstone and gypsum.
Thickness: 780 feet.

Abo formation (Pa) - a reddish-brown to dark-red and purplish brown thin- to medium-bedded claystone, siltstone, and sandstone with shale beds.
Thickness: Approximately 1,100 feet.

Unconformity--

Pennsylvanian and Mississippian:

Magdalena group and Lake Valley formation (C) - tan or tan-gray limestone with interbedded shale.
Thickness: 1,640 feet.

Devonian:

Percha formation (Dp) - gray to olive, thin-bedded shale with thin limestone beds.
Thickness: 100 feet.

Unconformity--

Silurian and Ordovician:

Fusselman dolomite and Montoya group (SO) - Light-gray, medium-grained, cherty dolomite with sandstone members.
Thickness: 380 feet.

Ordovician and Cambrian:

El Paso group and Bliss sandstone (O€) - the El Paso group is predominantly thin- to medium-bedded, gray limestone and dolomite. The Bliss sandstone has alternating thin beds and laminations of gray, glauconitic limestone, fine-grained quartzose sandstone, and siltstone.
Thickness: 660 feet.

Unconformity--

Precambrian:

Granite (P€) - dark-red, coarse granite and associated metamorphic rocks.

Construction Materials:

Quaternary:

Alluvium (Qal) - Some of the larger tributaries of the Rio Grande have a fair grade of sand and gravel. The size of the drainage area, the stream gradient, and the materials over which the stream passes are important factors in selecting which arroyo will yield the best materials. Most of the arroyos have cross-bedded, heterogeneous deposits of sand, gravel, silt, and clay; however, the gradient of some has been sufficient to wash the majority of the silt and clay size particles on into the Rio Grande. Streams that drain the Sierra de las Uvas have deposits of coarse-grained, basaltic materials. Streams that drain the scarp slopes of the Derry Hills have coarse-grained limestone and dolomite gravels. Streams that drain the less rugged slopes have finer-grained gravels. Prospect 25-3-1 is an example of the coarse-grained material. Note that it has more than 10 percent retained on the 2-inch sieve and less than 40 percent passing the No. 4 sieve. Prospect 25-3-13 is an example of the fine-grained material. Note that practically all of the material passes the one-inch sieve and about 60 percent passes the No. 4 sieve.

Terrace deposits (Qtg) - On the Construction Materials Inventory Map it will be noted that the terrace gravels are designated "A", "B", and "C". Terrace gravels "A" are very well-washed, well-rounded sand and gravel deposited by an ancient Rio Grande. Very few of the particles are over 12 inches in diameter. These deposits are elongated and discontinuous in outcrop and they are often buried by outwash from the hills to the east. Prospective pits 25-3-14, 25-3-2, and 25-3-12 are examples of this type deposit. Prospective pit 25-3-14 has been selected as Borrow Pit "C" for Project I-025-1(5)26. A series of these terraces are located northeast of Hatch adjacent and parallel to the Rio Grande flood plain.

Terrace gravels "B" are similar to "A" since they owe their origin to an ancient Rio Grande. These deposits grade into and are interbedded with tributary gravels derived from the hills to the east. They are slightly older and are not as well-sorted nor as well-washed as terrace gravels "A". The "B" terrace gravels occupy a higher terrace, they are more extensive in outcrop, and they have more boulder-size particles than "A" terrace gravels. Prospects 25-3-6 and 25-3-9 are examples of the "B" terrace deposits.

Terrace gravels "C" are found southwest of Hatch. They are derived mainly from the volcanic rocks of the Sierra de las Uvas. Some of these deposits may have been partly reworked by the Rio Grande; however, they seem to be primarily a product of the tributaries. They have more clay size particles than the "A" and "B" terrace deposits. Prospect 25-3-11 is an example of this material. Note that this pit has a P.I. of 9; whereas, "A" and "B" terrace deposits are sandy, non-plastic.

Tertiary:

Rhyolite (Tr) - This rock crops out southwest of Hatch in the Sierra de las Uvas. Quarry rock may be obtained from this formation. One should be very selective in developing quarries in this rock because of the interbedded sandstones and tuffs. Prospect 25-3-16 is an example of the rhyolite found in this strip. This material was taken from what is apparently an old plug. Note that after crushing to one inch the fines have a P.I. of 8.

Palm Park formation (Tpp) - This formation crops out extensively in the hills east of Rincon. Microscopic examination of the upper part (the rock selected for quarrying) indicates that it is a rhyolite arkose (a highly indurated, silica-cemented sandstone). It has the durability of quartzite and will make excellent quarry rock. Pit 62-16-S, located at an existing quarry, is an example of this rock. Note that after crushing to 2 inches this rock has a L.A. Wear of 16 and the fines are non-plastic.

Pennsylvanian and Mississippian:

Magdalena group and Lake Valley formation (C) - East of Derry limestone of the Magdalena group crops out extensively. It was noted that this limestone is interbedded with shale and it may be difficult to develop a quarry that is completely free of shale. Prospect 25-3-4 is located at an existing Federal Bureau of Reclamation quarry. The most favorable area for a quarry seems to be north of the existing quarries along the rim of the escarpment of the Derry Hills. Further exploration may reveal an unlimited supply of shale-free limestone.

Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-3. Test data and other related information are shown in Material Pit Summary Table 25-3-2.

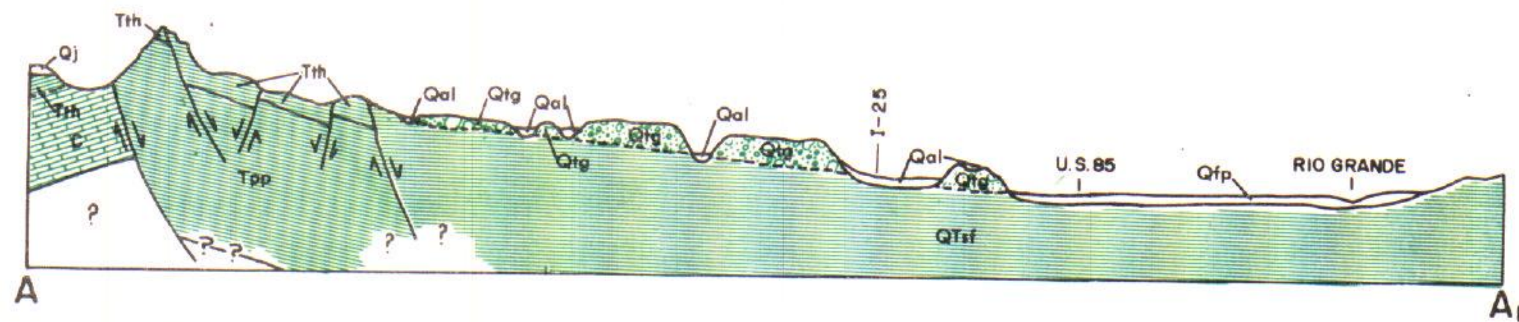
Selected References:

Kelley, V. C. and Silver, C., (1952), Geology of the Caballo Mountains, Univ. of New Mexico Publications in Geology Number 4.

New Mexico Geological Society, Guidebook of the Rio Grande Country, Third Field Conference, 1952.

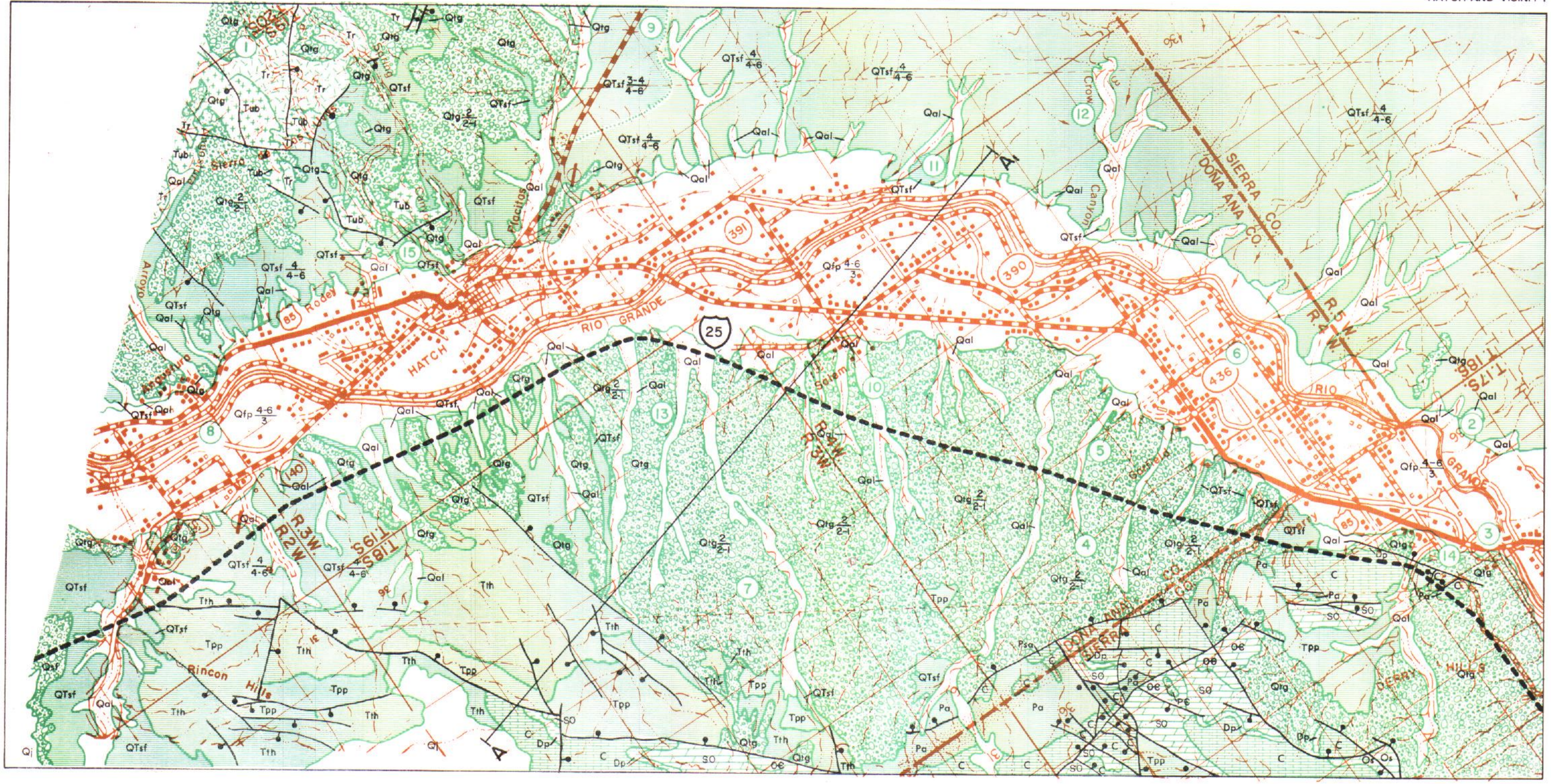
New Mexico Geological Society, Guidebook of Southwestern New Mexico Fourth Field Conference, 1953.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-3

SOILS AND GEOLOGY MAP 25-3



GEOLOGY MAPPED 1963

- LEGEND -

SEDIMENTARY ROCKS

QUATERNARY
- Qal — Alluvium
- Qfp — Flood-plain deposits
- Qtg — Terrace deposits

QUATERNARY
- Qj — Jornada surface
- Qsf — Santa Fe formation
- QTsf — Santa Fe group

TERTIARY
- Tth — Thurman formation
- Tpp — Palm Park formation

PERMIAN
- Psa — San Andres limestone
- Pa — Abo formation

PENNSYLVANIAN / MISSISSIPPIAN
- C — Magdalena group, Lake Valley formation

DEVONIAN
- Dp — Percha shale

SILURIAN / ORDOVICIAN
- SO — Fusselman dolomite and Montoya group

ORDOVICIAN / CAMBRIAN
- O€ — El Paso formation, Bliss sandstone

IGNEOUS ROCKS

TERTIARY
- Tub — Uvas basalt
- Tr — Rhyolite and assoc. tuffs and sandstones

PRECAMBRIAN
- P€ — Precambrian rocks undifferentiated

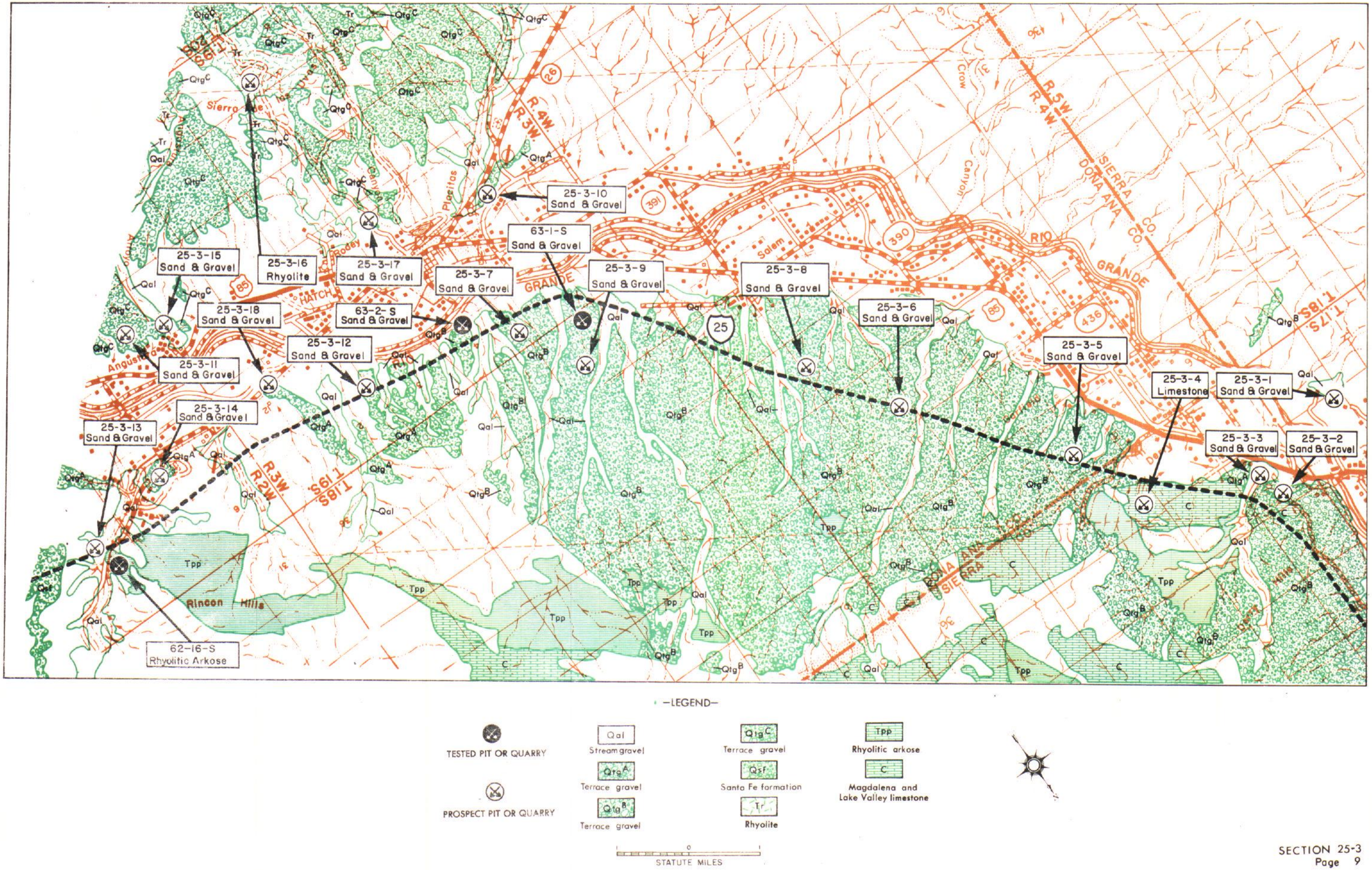
STATUTE MILES

Soils Summary:

Table 25-3-1

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Tr	1	A	0.0	0.5	A-4	Silt
"		B	0.5	---	Bedrock	Rhyolite
QTsf	2	A	0.0	5.0	A-4	Sandy silt
Qfp	3	A	0.0	1.0	A-4	Silt
"		B	1.0	5.0	A-4	Sandy silt
QTsf	4	A	0.0	5.0	A-4	" "
Qtg	5	A	0.0	1.0	A-2-4	Silty gravel
"		B	1.0	15.0	A-2-4	" "
Qfp	6	A	0.0	5.0	A-4	Silt
QTsf	7	A	0.0	5.0	A-7	Clay
"		B	5.0	---	A-4	Silt
Qfp	8	A	0.0	1.5	A-7	Clay
"		B	1.5	5.0	A-3	Sand
QTsf	9	A	0.0	5.0	A-2-4	Silty gravel
"	10	A	0.0	15.0	A-4	Silt
"	11	A	0.0	10.0	A-3	Sand
"		B	10.0	11.0	A-7	Clay
"		C	11.0	13.0	A-6	"
"	12	A	0.0	15.0	A-4	Silt, minor gravel
Qtg	13	A	0.0	2.0	A-2-4	Silty gravel
"		B	2.0	15.0	A-1-a	Sand and gravel
"		C	15.0	---	A-2-4	Silty gravel
"	14	A	0.0	0.8	A-1-b	Sand
"		B	0.8	20.0	A-1-a	Sand and gravel
"	15	A	0.0	1.0	A-2-7	Clayey gravel
"		B	1.0	2.5	A-2-6	" "
"		C	2.5	10.0	A-2-4	Silty gravel
QTsf		D	10.0	---	A-6	Clay

CONSTRUCTION MATERIALS MAP 25-3



CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-3-2

Pit or Prospect No.		62-16-S	63-1-S	63-2-S	25-3-1 (Prospect)	25-3-2 (Prospect)	25-3-3 (Prospect)
Location	Section	SW 1/4, sec. 4	32	S 1/2, sec. 4	NW 1/4, sec. 36	N 1/2 sec. 30	30
	Twnshp. & Range	T 19 S, R 2 W	T 18 S, R 3 W	T 19 S, R 3 W	T 17 S, R 5 W	T 17 S, R 4 W	T 17 S, R 4 W
	County	Dona Ana	Dona Ana	Dona Ana	Sierra	Sierra	Sierra
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Federal	Private	Federal & Private	Private	Federal	Federal
Geologic Age		Tertiary	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Palm Park	Terrace deposit	Terrace deposit	Alluvium	Terrace deposit	Alluvium
Type of Pit		Quarry	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Rhyolitic arkose	Igneous, metamorphic, & sedimentary	Various	Various	Various	Various
Quality of Material		Good	Excellent	Excellent	Good	Excellent	Good
Thickness of Material		30+ feet	10 to 15 feet	15 to 20 feet	10 to 15 feet	20 feet	10 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		Good	-	-	-	-	-
Uniformity		Good	Good	Good	Fair	Good	Good
Impurities		Minor silt & clay veins	Minor silt	Minor silt lenses	Silt lenses	Clay pods	Silt lenses
Type of Mat'l. Underlying Formation		Tuff & tuffaceous sandstone	Clay	Clay	Silt & clay	Silt ?	silt?
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood	Greasewood	Greasewood	Greasewood	Greasewood	Greasewood
Local Terrain		Steep hill	Hilly	Hilly	Hilly	Hilly	Hilly
Depth of Overburden		0 to 1.0 feet	3.0 feet	3.0 feet	None	1.0 feet	-
P.I. (Overburden)		3	9	Sandy, N.P.	-	N.P.	-
Est. Reserve Quantity		300,000+ cu. yds.	250,000 cu. yds.	75,000 cu. yds.	300,000 cu. yds.	150,000 cu. yds.	300,000 cu. yds.
Approx. Haul to Nearest Point		3.8 miles to U.S. 85	1875 feet	88 feet	1.0 mile	0.8 mile	1.0 mile
L.A. Wear		16.0	17.6	16.0	21.2	18.4	19.2
Maximum Size		-	6" to 12"	12"	24"	24"	24"
% Retained on 2" Sieve		-	10 estimated	15	10 to 15	15 to 20	20
	Crushed to	2"	As received	As received	As received	As received	-
Pit Average % Passing	2"	100	86	75	80	76	84
	1"	63	73	55	67	65	62
	3/4"	35	67	48	61	54	52
	1/2"	21	61	40	53	48	42
	#4	8	45	26	38	37	26
	#10	4	35	20	31	32	20
	#200	1	7	2	6	2	6
P.I.		N.P.	Sandy, N.P.	Sandy, N.P.	N.P.	N.P.	N.P.
Lab. Numbers		62-2604 - 2617	63-298 - 333	63-514 - 528	62-9966	62-9665	63-17113

Remarks:

Material Pit Summary:

Table 25-3-2 continued

		25-3-4 (Prospect)	25-3-5 (Prospect)	25-3-6 (Prospect)	25-3-7 (Prospect)	25-3-8 (Prospect)	25-3-9 (Prospect)
Pit or Prospect No.		25-3-4 (Prospect)	25-3-5 (Prospect)	25-3-6 (Prospect)	25-3-7 (Prospect)	25-3-8 (Prospect)	25-3-9 (Prospect)
Location	Section	NW 1/4 sec. 33, SW 1/4 sec. 28	4	NW 1/4 sec. 14	NW 1/4 sec. 4, NE 1/4 sec. 5	23	32
	Twnshp. & Range	T 17 S, R 4 W	T 18 S, R 4 W	T 18 S, R 4 W	T 19 S, R 3 W	T 18 S. R 4 W	T 18 S. R 3 W
	County	Sierra	Dona Ana	Dona Ana	Dona Ana	Dona Ana	Dona Ana
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Federal	Federal	Federal	Private	Federal	Private
Geologic Age		Pennsylvanian	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Magdalena	Terrace deposit	Terrace deposit	Terrace deposit	Terrace deposit	Terrace deposit
Type of Pit		Quarry	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Limestone	Various	Various	Various	Various	Various
Quality of Material		Excellent	Excellent	Good	Excellent	Excellent	Good
Thickness of Material		30+ feet	15 to 20 feet	10 feet	15 feet	15+ feet	15± feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		Good	-	-	-	-	-
Uniformity		Good	Good	Good	Good	Good	Good
Impurities		Interbedded shale	Silt lenses	Irregular clay seams	Irregular clay seams	-	Minor clay
Type of Mat'l. Underlying Formation		Sandstone & shale	Silt ?	Silt & clay	Silt ?	Silt	Silt
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood	Greasewood	Greasewood	Greasewood	Greasewood	Greasewood
Local Terrain		Hilly	Hilly	Hilly	Hilly	Hilly	Hilly
Depth of Overburden		-	-	1 to 2 feet	-	-	0 to 2 feet
P.I. (Overburden)		-	-	9	-	-	?
Est. Reserve Quantity		Unlimited	100,000 cu. yds.	200,000 cu. yds.	150,000 cu. yds.	100,000 cu. yds.	500,000 cu. yds.
Approx. Haul to Nearest Point		1.0 mile	1.0 mile	3.0 miles	3.0 miles	0.8 mile	2.0 miles
L.A. Wear		26.4	19.6	22.8	18	24.4	19.6
Maximum Size		-	12"	24"	8"	18"	24"
% Retained on 2" Sieve		-	20 to 25	20	10 to 20	32	30
	Crushed to	2"	As received	-	As received	As received	As received
	2"	100	63	85	70	68	70
Pit	1"	61	50	75	55	56	60
Average	3/4"	36	46	69	48	50	57
% Passing	1/2"	25	40	58	42	44	51
	#4	11	31	30	31	33	38
	#10	6	26	19	24	29	31
	#200	1	2	3	2	2	1
P.I.		N.P.	N.P.	N.P.	N.P.	N.P.	N.P.
Lab. Numbers		62-9660	62-9663	63-17115	62-9667	62-9662	62-9661

Remarks:

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-3-2 continued

		25-3-10 (Prospect)	25-3-11 (Prospect)	25-3-12 (Prospect)	25-3-13 (Prospect)	25-3-14 (Prospect)	25-3-15 (Prospect)
Location	Section	N 1/2 sec. 18, NW 1/4 sec. 17	19	SW 1/4 sec. 2	4 & 9	8	24 & 25
	Twnshp. & Range	T 19 S, R 3 W	T 19 S, R 2 W	T 19 S. R 3 W	T 19 S. R 2 W	T 19 S. R 2 W	T 19 S, R 3 W
	County	Dona Ana	Dona Ana	Dona Ana	Dona Ana	Dona Ana	Dona Ana
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Federal	Private & Federal	Federal	Federal	Private	Private & Federal
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Terrace deposit	Terrace deposit	Terrace deposit	Alluvium	Terrace deposit	Alluvium
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Various	Basalt gravel	Mixed aggregrate	Various	Various	Basalt gravel
Quality of Material		Good	Excellent	Excellent	Good	Excellent	Excellent
Thickness of Material		20+ feet	15+ feet	15 to 20 feet	12+ feet	15 to 20 feet	15+ feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	-	-	-	-
Uniformity		Good	Good	Poor	Good	Good	Fair
Impurities		Silt lenses	Minor silt	Minor silt	Silt streaks	Silt pockets	Minor silt lenses
Type of Mat'l. Underlying Formation		Silt & clay	Silt	Silt & clay	Silt & clay	Silt & clay	Silt
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood	Greasewood	Greasewood	Greasewood	Greasewood	Greasewood
Local Terrain		Hilly	Hilly, terrace	Hilly	Hilly	Hilly	Flat, arroyo bottom
Depth of Overburden		0 to 2 feet	-	-	-	-	Negligible
P.I. (Overburden)		N.P.	?	-	-	-	-
Est. Reserve Quantity		?	Unlimited	?	375,000 cu. yds.	150,000 cu. yds	500,000 cu. yds.
Approx. Haul to Nearest Point		0.5 mile	0.5 mile	?	150 feet	1.0 mile	?
L.A. Wear		19.2	19.2	19.2	-	?	18.0
Maximum Size		18"	18" to 24"	12"	6"	12"	18" to 24"
% Retained on 2" Sieve		20	15 to 20	10 to 15	None	Less than 5	30 to 40
	Crushed to	-	-	-	As received	As received	-
Pit Average % Passing	2"	82	83	78	100	-	61
	1"	67	67	63	96	96	43
	3/4"	61	61	57	92	92	37
	1/2"	54	54	50	85	88	32
	#4	37	36	30	60	80	23
	#10	29	25	20	41	73	17
	#200	2	4	2	4	4	3
P.I.		N.P.	N.P.	N.P.	N.P.	N.P.	N.P.
Lab. Numbers		63-17117	63-17119	63-17121	62-2801 - 2815	62-2817 - 2830	63-17122

Remarks:

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-3-2 continued

Pit or Prospect No.		25-3-16 (Prospect)	25-3-17 (Prospect)	25-3-18 (Prospect)
Location	Section	NE 1/4 sec. 33	16	NW 1/4 sec. 12
	Twnshp. & Range	T 19 S, R 3 W	T 19 S, R 3 W	T 19 S, R 3 W
	County	Dona Ana	Dona Ana	Dona Ana
	State	N.M.	New Mexico	New Mexico
Owner		Private	Private	Federal
Geologic Age		Tertiary	Quaternary	Quaternary
Formation		Rhyolite	Terrace deposit	Terrace gravel
Type of Pit		Quarry	Sand & gravel	Sand & gravel
Kind of Material		Rhyolite	Various	Various
Quality of Material		Fair	Good	Good
Thickness of Material		Unexplored	10 feet	10 to 15 feet
Thickness of Cap (Caliche)		-	-	-
Blasting Qualities		Unexplored	-	-
Uniformity		Fair	Good	Good
Impurities		Calcic clay veinlets	Silt lenses	Minor silt
Type of Mat'l. Underlying Formation		Unexplored	Clay & silt	Clay
Moisture Condition		Dry	Dry	Dry
Vegetation		Greasewood	Greasewood	Greasewood
Local Terrain		Hilly	Hilly	Low rolling hills
Depth of Overburden		Trace	1 to 2 feet	1.0 feet
P.I. (Overburden)		7	10 to 16	-
Est. Reserve Quantity		Unexplored	200,000 cu. yds.	80,000 cu. yds.
Approx. Haul to Nearest Point		4 miles	1.0 mile	230 feet
L.A. Wear		22.4	18.8	?
Maximum Size		-	12"	12"
% Retained on 2" Sieve		-	20 to 30	14
	Crushed to	1"	As received	As received
Pit Average % Passing	2"	-	58	86
	1"	100	41	75
	3/4"	93	35	70
	1/2"	58	29	63
	#4	25	18	50
	#10	16	12	45
	#200	5	4	5
P.I.		8	9	Sandy, N.P.
Lab. Numbers		63-422	63-423 - 426	63-647 - 652

Remarks:

SOILS AND GEOLOGY

Introduction:

Strip 25-4 lies in the south-central part of Sierra County, New Mexico. The strip begins about 3 miles south of Arrey and ends at the ruins of Las Palomas. It lies in the Rio Grande depression and the Rio Grande flows through the center of the strip. Caballo Dam has impounded the Rio Grande water; and Caballo Reservoir, the lake which has been formed by the dam, is 2 miles wide and 10 miles long and lies in the center of the strip.

Prominent physiographic features are the Caballo Mountains, the Rio Grande valley, the elevated pediment surface to the west, and the incised tributary stream valleys.

General Geology:

The Caballo Mountains and the South Red Hills are a part of the Caballo uplift. The rocks in the uplift range in age from Precambrian through Tertiary and they are exposed in bold and rugged escarpments. The escarpment on the west side of the Caballo Mountains rises 2,000 feet above the Rio Grande valley floor.

Precambrian granite, the oldest rock in this strip, is exposed on the lower slopes of the Caballo Mountains and the South Red Hills. Above the Precambrian granite in the Caballo Mountains lie exposures of limestone, dolomite, sandstone, and shale that range in age from Cambrian through Permian. Rocks of the Mesozoic era are absent in the mapped part of the mountains. Above the Precambrian granite in the South Red Hills lies the same Paleozoic sequence of rocks as in the Caballo Mountains and Mesozoic rocks are absent. However, above the Paleozoic rocks of the South Red Hills lies a thick sequence of Tertiary clastic rocks which contain a high content of volcanic debris as well as a few flows in the Palm Park and Thurman formations.

Late Tertiary rocks of the Santa Fe group cover 90 percent of the strip. They include a complex sequence of gravel, sand, silt, clay, and caliche deposits. These sedimentary rocks were deposited in the Palomas basin, one of a series of north-trending basins arranged en echelon along the course of the Rio Grande. The Palomas basin is confined between the north-south trending Caballo fault and the Black Range fault. Only the central part of the basin is included in this strip. Depression of the basin occurred very slowly during the Pliocene epoch and the basin was kept filled by debris derived mainly from the Caballo Mountains and the mountains to the west.

Near the end of the filling, late Pliocene (?), of the Palomas basin a widespread pediment developed on the Santa Fe sediments and produced the continuous Palomas, Cuchillo, and Jornada surfaces (Kelley and Silver, 1952, p. 183). The Palomas surface lies on each side of the Rio Grande valley and extends eastward to the base of the Caballo Mountains. It extends northward around the northwestern end of the Mud Springs Mountains (see Section 25-5) into the very broad Cuchillo surface. A pediment blanket of sand, gravel, silt, and clay as much as 50 feet thick covers the surface.

East of the Rio Grande, near the base of the Caballo Mountains, Quaternary alluvial fan deposits (Qg) have partly covered the pediment blanket. There are also scattered remnants of Rio Grande terrace deposits here. It is extremely difficult to separate the pediment blanket, alluvial fan deposits, and terrace deposits.

The Rio Grande has carved its present valley in the Santa Fe group and formed a flood plain by meandering across the valley floor. In recent years the flood plain has been greatly modified by flood-control and irrigation projects of the Middle Rio Grande Conservancy District.

Along both sides of the Rio Grande flood plain terraces occur at irregular levels. They were formed at periods of standstill in the Rio Grande downcutting. Following the development of the Palomas surface, uplift and rejuvenation to the west incised the present tributary stream valleys (Kelley and Silver, 1952, p. 188). These valleys are long, deep arroyos with smooth, straight sides that extend for many miles westward from the Rio Grande. Terraces occur along the courses of some of the larger tributary valleys.

The areal distribution of formations is shown on Soils and Geology Map 25-4. Their succession and character are given under the section termed "Stratigraphy."

Soils:

The soils of this strip are predominantly transported. Residual soils occur in the Caballo Mountains and South Red Hills.

Alluvium (Qal): Alluvium occurs in the arroyos and as slope wash on bluffs bordering the Rio Grande. This alluvium is mainly derived from reworked Santa Fe beds and pediment gravels to the west. The veneer of top soil varies from silt and gravelly sandy silt to clay that is underlain by sand and gravel (A-1-a).

Terrace deposits (Qt): Terraces occur along the tributary arroyos to the Rio Grande. They consist of layers of sand, silt, clay, and gravel. The material is predominantly igneous debris derived from the Black Range. The terraces have a high clay content and they usually have a profile of silt (A-4) underlain by silty sandy gravel (A-2-4) or clayey gravel.

The Rio Grande has undercut some of the terraces and deposited some material of its own. These exposed terraces have a profile of 2 feet of gravelly silt (A-4) underlain by over 8 feet of sand and gravel (A-1-a).

Floodplain deposits (Qfp): Caballo Dam has caused a lake to form across the Rio Grande flood plain. The flood plain below Caballo Dam has been leveled and is presently being used for farming. The soil varies laterally and vertically in very short distances. The soil may be a sandy silt (A-4), a silty sand (A-2-4), a clayey soil (A-6), or a sandy soil (A-3). Each soil type is usually about one foot thick. Well logs of the flood plain show the above materials are underlain by a medium- to coarse-grained sand and gravel as much as 30 feet thick.

Undifferentiated gravels (Qg): Between the Rio Grande and the Caballo Mountains a thick deposit of sand, silt, clay, and gravel occurs. This deposit includes the Palomas gravels, terrace gravels, and alluvial fan material. The Palomas gravels are predominantly derived from the igneous rocks of the mountains to the west. The terrace gravels were deposited by a meandering Rio Grande. The alluvial fan material was derived from the Caballo Mountains. The soils developed on these deposits range from gravelly sand (A-1-b) to gravelly, silty sand (A-2-4).

Soils continued...

Santa Fe group (QTsf): These beds are poorly sorted and lenticular. The group is composed of aternate beds of sand, silt, and gravel. It is a typical alluvial fan and playa deposit (Kelley and Silver, 1952, p. 123). A typical soil profile follows:

2.0 feet	A-4	Silty soil (top soil)
50.0 "	A-2-7	Clayey gravel
8.0 "	A-6	Clay
15.0 "	A-2-6	Clayey gravel
2.8 "	A-4	Sandy silt
2.2 "	A-4	Silt

This profile can be seen on the highly dissected slopes that border the Rio Grande flood plain on the west. Westward from these dissected slopes the Santa Fe formation has been heavily mantled by pediment gravels which slope gently toward the Rio Grande.

The surface soils of the pediment deposit are reddish-brown, non-calcareous, silty, clayey gravels (A-2-6) to clayey gravels (A-2-7). The depth of this top soil varies from 6 inches to 2 feet. The top soil is underlain by 3 to 6 feet of highly calcareous (caliche) clayey gravel (A-2-7) that is usually well-cemented and has a high P.I. Below this level the soils are semi- to poorly-consolidated and contain only small amounts of calcium carbonate.

Table 25-4-I shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-4.

Ground-Water:

There are two different occurrences of ground-water that may be a construction problem in this strip: (1) artesian water in the Santa Fe group, and (2) unconfined ground-water of the flood plain. Artesian water may be encountered where bridge soundings are made on the tributaries of the Rio Grande. Artesian water may also be encountered if roads are built on or near the flood plain of the Rio Grande.

The following paragraphs are taken from E. R. Cox and H. O. Reeder (see References Cited):

"Nonthermal water under artesian pressure occurs in sand, gravel, and silt in alluvium west of the Rio Grande from Truth or Consequences at least as far as Arrey, about 18 miles south of Truth or Consequences. The sand, gravel, and silt are interbedded with clay, which confines the water under pressure in the more permeable material. Wells tap these artesian aquifers along valleys of tributaries, mostly within 5 miles of the river. The nonthermal artesian aquifers discharge water indirectly into the Rio Grande by leakage through confining beds into the shallow aquifers near the river and thence into the river. The head in the artesian aquifers declined as much as 30 feet near the river from 1947 to 1960. Lowering the water level in the shallow aquifer near the river would lower the head in the artesian aquifers; but the lowering of head due to lowering water levels near the river probably would be small compared with the expected lowering of head in the artesian aquifers due to continued pumping of water from the artesian system."

"Unconfined water occurs at a depth of less than 10 feet under most of the flood plain of the Rio Grande from Williamsburg to Caballo Reservoir. Locally, water is under artesian pressure at shallow depths in the alluvium, where lenses of clay form imperfect upper confining beds."

"The flood plain in this area is underlain by clay, silt, sand, and gravel. A thin mantle of silt or very fine-grained sand usually less than 5 feet thick covers most of the flood plain. This mantle is underlain by as much as 30 feet of medium-grained to very coarse-grained sand and gravel, the sand becoming progressively coarser with depth. This sand and gravel is lenticular, thinning toward both edges of the flood plain. The alluvium contains large amounts of clay beneath the sand and gravel lens under and along the western edge of the flood plain."

"Ground-water in the alluvium under the flood plain from Williamsburg to Caballo Reservoir moves generally southward toward the reservoir. The configuration of the water table in this area indicates that water moves from the Rio Grande to the shallow aquifer throughout most of the reach during periods of high flow. During periods of low flow, however, water moves from the shallow aquifer to the river."

Stratigraphy:

Quaternary: Alluvium (Qal) - unconsolidated sand, silt, clay, and gravel in stream channels.

Undifferentiated gravels (Qg) - poorly- to well-consolidated sand, silt, clay, and gravel. Includes Palomas gravels, terrace gravels, and alluvial fan materials.

Terrace deposits (Qt) - poorly-consolidated mixture of sand, silt, clay, and gravel deposited by streams and rivers.

Floodplain deposits (Qfp) - unconsolidated fine- to coarse-grained mixture of sand, silt, clay, and gravel found on the valley floor of the Rio Grande.

Unconformity--

Quaternary-Tertiary: Santa Fe group (QTsf) - pink and tan, fine-grained to conglomeratic clay, gravel, silt, sand, and sandstone. Upper part is cemented by calcium carbonate. Locally overlain by a thin blanket of pediment gravel (Palomas gravel).
Thickness: 2,000+ feet.

Unconformity--

Thurman formation (Tth) - cream and tan rhyolite tuff breccia with alternating beds of sandy clay, volcanic ash, and tuffaceous sandstone.
Thickness: 2,500 feet.

Unconformity--

Palm Park formation (Tpp) - reddish, grayish, and purplish-brown tuff and breccia which locally contains a coarse conglomerate.
Thickness: 1,000 feet.

Unconformity--

Permian: San Andres formation (Psa) - dark-gray limestone with interbedded sandstone and gypsum.
Thickness: 780 feet.

Yeso formation (Py) - fine-grained orange-red and buff sandstone and siltstone with gray limestone and gypsum.
Thickness: 600 feet.

Abo formation (Pa) - reddish-brown to dark red and purplish-brown, thin-bedded to medium-bedded claystone, siltstone, and sandstone with shale beds.
Thickness: 550 to 1,100 feet.

Unconformity--

Pennsylvanian and Mississippian:

Magdalena group and Lake Valley formation (C) - predominantly tan or tan-gray limestone with interbedded shale.
Thickness: 1,640 feet.

Devonian:

Percha formation (Dp) - black to greenish or yellowish shales with calcareous nodules and sandstone.
Thickness: 50 feet.

Unconformity--

Silurian and Ordovician:

Fusselman dolomite and Montoya group (SO) - predominantly light- to dark-gray, fine- to coarse-grained dolomite with chert. Includes sandstone at base.
Thickness: 380 feet.

Unconformity--

Ordovician and Cambrian:

El Paso group and Bliss formation (O€) - thin- to medium-bedded, gray- to dark-gray limestone and dolomite. The Bliss formation consists of alternating thin beds and laminations of gray, glauconitic limestone, fine-grained quartzose sandstone, siltstone, and hematite.
Thickness: 660 feet.

Unconformity--

Precambrian:

Granite (P€) - predominantly reddish, coarse-grained granite with associated schist, gneiss, and greenstone.

Construction Materials:

Quaternary:

Alluvium (Qal) - a heterogeneous mixture of sand, silt, and gravel is found in the bottoms of most of the larger arroyos. West of the Rio Grande, from north to south, these arroyos are: Palomas, Seco, Animas, Percha, Trujillo, and Tierra Blanca. These arroyos have cut deep canyons through the Palomas surface and the Santa Fe group; therefore, they have materials similar to the Palomas gravel and the Santa Fe group. Gravel deposits found in the arroyos have less clay size particles than the pediment gravels of the Palomas surface. They also have less clay size particles than most of the terrace deposits adjacent to the arroyos. Sand and gravel also occur in the alluvium of the flood plain of the Rio Grande. It usually occurs near the water table and well logs of the flood plain show it to be as much as 30 feet thick.

Terrace deposits (Qt) - Terrace gravels have been deposited along most of the larger tributaries and along the Rio Grande. The terrace gravels formed along the tributaries terminate at the edge of the flood plain of the Rio Grande and many of them grade into a well-washed river gravel.

East of the Rio Grande and south of Caballo Dam there are excellent deposits of river washed sand and gravel (Prospective Pits 25-4-14 and 25-4-15). These pits have about 3 to 5 feet of silty sand over 15 feet of coarse-grained gravel and sand.

West of the Rio Grande most of the well-washed deposits do not exceed 10 feet in thickness; however, they have great lateral extent. Prospective Pits 25-4-4 and 25-4-9 are representative of the better terrace deposits west of the Rio Grande.

Many of the deposits adjacent to the larger tributaries west of the river have clay size particles in the gravels; however, it is believed that usable construction materials can be produced from most of them.

Gravel deposits undifferentiated (Qg) - these deposits lie east of the Rio Grande along the flanks of the Caballo Mountains. They are very heterogeneous and not quite as ideal for material pit sites as the terrace deposits because they are not easily accessible. The best gravel is north of Caballo Dam across the lake from the Interstate route. Should the need arise, this area will produce an almost unlimited supply of excellent material.

South of the dam this deposit seems to be more fine-grained and has a higher percentage of clay and silt size particles. Further exploration may reveal usable construction materials in this deposit; however, there are more select materials in the immediate area.

Quaternary-Tertiary:

Santa Fe group (pediment gravel) (QTsf) - this is the oldest alluvial material of the area. The upper portion of the deposit has become fairly well indurated. It is primarily made up of igneous rocks that, through weathering and breakdown, have produced high percentages of clay. The deposit is a product of stream braiding, sheet wash erosion, and coalescing alluvial fans. In some places it reaches depths of more than 50 feet. There are, no doubt, channels of non-plastic materials in this deposit; however, it is primarily a silt and clay saturated gravel. Extensive exploration may reveal usable deposits of non-plastic materials or further research may develop a use for the clay saturated materials or a means of separating the clay and gravel.

*Permian:

San Andres formation (Psa) - limestone of this formation crops out east of the Caballo Dam. It is dense, dark-gray with interbeds of gypsum and sandstone.

Pennsylvanian and Mississippian:

Magdalena group and Lake Valley formation (C) - Abundant supplies of limestone and dolomite occur in the escarpment of the Caballo Mountains, the South Red Hills, and the Derry Hills. Limestone in the escarpment of the Caballo Mountains would be rather difficult to remove because of the deeply entrenched fans that front the escarpment.

The Derry Hills provide the best access for a limestone quarry (Prospective Pits 25-4-19 and 25-4-20). This limestone has many shale interbeds but it is believed that a quarry with a low percentage of shale might be located along the western crest of the hills.

* actually a freshwater Lms in the Palm Park

Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-4. Test data and other related information are shown in Material Pit Summary Table 25-4-2.

Selected References:

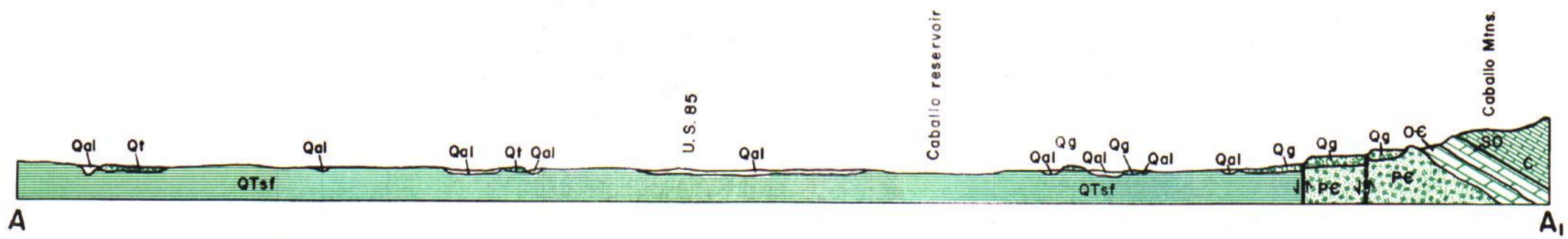
Cox, E. R. and Reeder, H. O., (1962), Ground-Water Conditions in the Rio Grande Valley between Truth or Consequences and Las Palomas, Sierra County, New Mexico, New Mexico State Engineer's Technical Report 25.

Harley, G. T., (1934), The Geology and Ore Deposits of Sierra County, New Mexico, New Mexico Bureau of Mines and Mineral Resources, Bull. 10, 220 p.

Kelley, V. C. and Silver, C., (1952), Geology of the Caballo Mountains, University of New Mexico Publication in Geology, No. 4, 286 p.

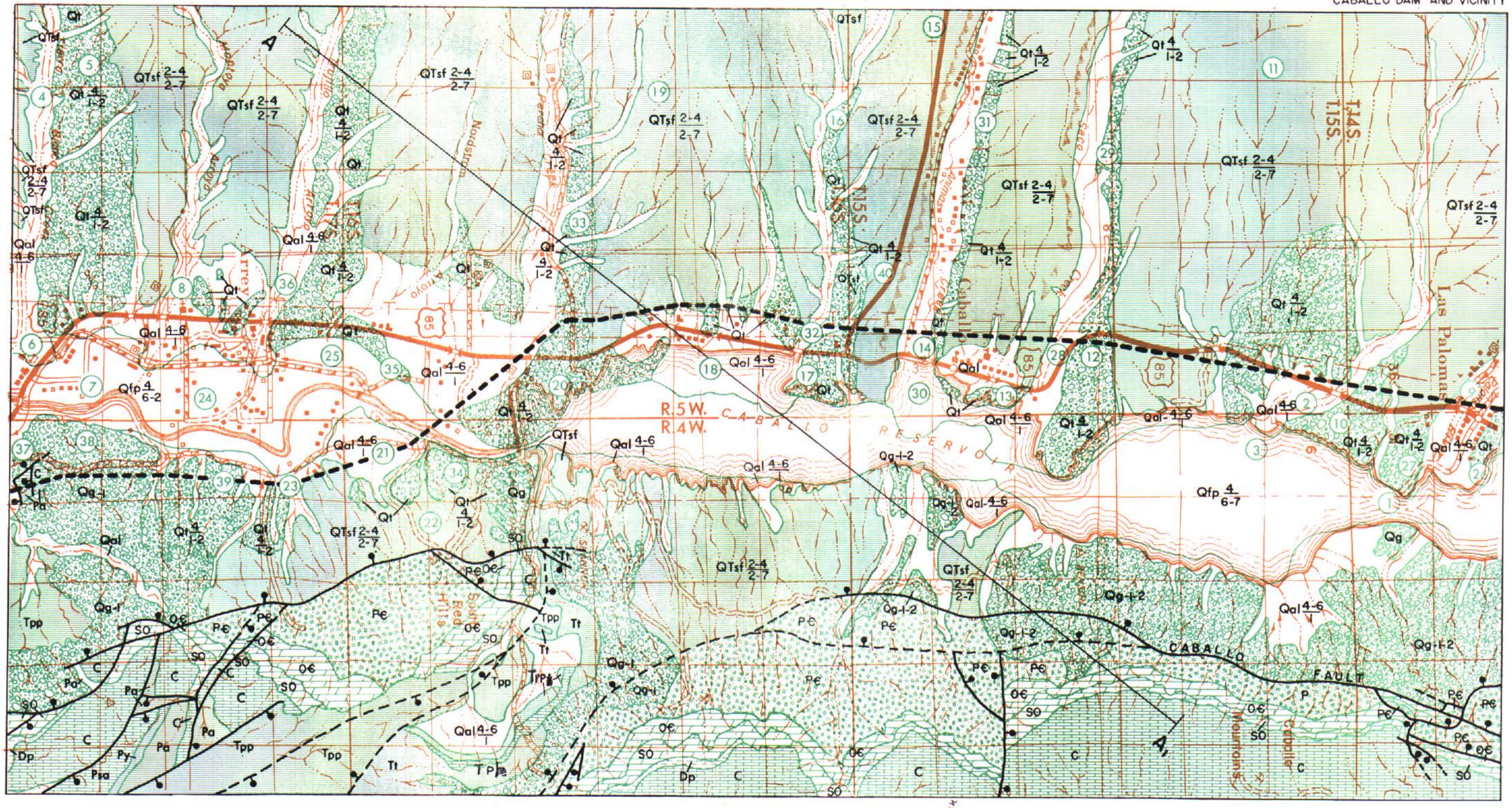
New Mexico Geological Society (1955), Guidebook of South-Central New Mexico, 6th Field Conference, 182 p.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-4

SOILS AND GEOLOGY MAP 25-4



-LEGEND-

SEDIMENTARY ROCKS

QUATERNARY
- Qal — Alluvium
- Qg — undifferentiated gravel
- Qt — Terrace deposits
- Qfp — Flood-plain deposits
- QTsf — Santa Fe group

TERTIARY
- Tt — Thurman formation
- Tpp — Palm park formation
- Tpp — Palm Park Ls.
- Tpp b — Basal Palm Park

Tertiary

PERMIAN
- Pa — Abo formation

PENNSYLVANIAN MISSISSIPPIAN
- C — Magdalena group, Lake Valley formation

DEVONIAN
- Dp — Percha formation

SILURIAN ORDOVICIAN
- SO — Fusselman dolomite, Montoya group

ORDOVICIAN CAMBRIAN
- O€ — El Paso group, Bliss formation

IGNEOUS ROCKS

PRECAMBRIAN
- P€ — Granite, gneiss, schist, and greenstone

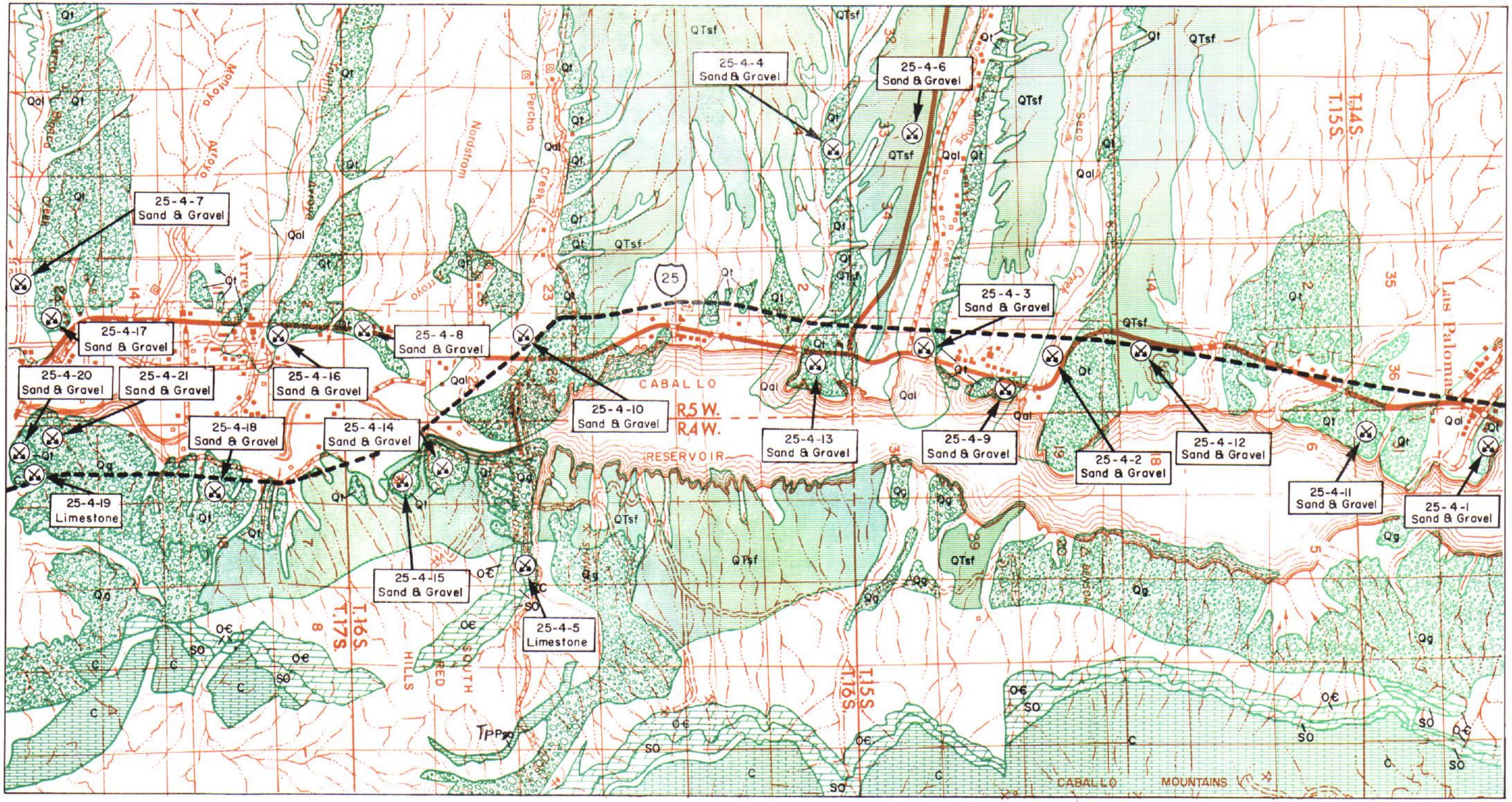
STATUTE MILES

Soils Summary:

Table 25-4-1

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Qfp	1	A	0.0	3.0	A-6	Clay
"		B	3.0	5.0	A-4	Sandy silt
Qal	2	A	0.0	3.0	A-6	Clay
Qfp	3	A	0.0	2.0	A-4	Sandy silt
"		B	2.0	2.5	A-4	" "
"		C	2.5	3.5	A-4	Silt
"		D	3.5	5.0	A-4	Sandy silt
Qal	4	A	0.0	0.8	A-4	Gravelly sandy silt
"		B	0.8	6.0	A-7	Clay
Qt	5	A	0.0	5.0	A-2-7	Clayey gravel
Tsf		B	5.0	20.0	A-2-6	Clayey sand
"		C	20.0	---	Bedrock	Conglomerate
Qal	6	A	0.0	4.0	A-1-a	Sand & gravel
Qfp	7	A	0.0	0.6	A-4	Sandy silt
"		B	0.6	4.0	A-3	Sand
Qal	8	A	0.0	0.6	A-6	Silty clay
"		B	0.6	2.0	A-4	Sandy silt
"		C	2.0	4.0	A-4	" "
"	9	A	0.0	5.0	A-6	Clay
Qt	10	A	0.0	4.0	A-6	"
"		B	4.0	7.0	A-2-4	Silty sand & gravel
"		C	7.0	10.0	A-6	Clay
QTsf	11	A	0.0	3.0	A-2-4	Silty gravel
Qt	12	A	0.0	10.0	A-2-7	Silty clayey gravel
"	13	A	0.0	5.0	A-4	Silt
"		B	5.0	10.0	A-1-a	Sand & gravel
Qal	14	A	0.0	1.0	A-4	Silt
QTsf	15	A	0.0	3.0	A-4	Gravelly silt
Qt	16	A	0.0	10.0	A-1-a	Sand & gravel
"	17	A	0.0	2.0	A-4	Gravelly silt
"		B	2.0	8.0	A-1-a	Sand & gravel
Qal	18	A	0.0	7.0	A-6	Clay
"		B	7.0	9.0	A-1-b	Sand & gravel
QTsf	19	A	0.0	2.0	A-1-b	Silty gravel
"	20	A	0.0	6.0	A-1-a	Sand & gravel
Qal	21	A	0.0	2.0	A-4	Sandy silt
QTsf	22	A	0.0	2.0	A-4	Silt
Qal	23	A	0.0	6.0	A-4	"
Qfp	24	A	0.0	1.6	A-4	Sandy silt
"		B	1.6	3.0	A-4	" "
"		C	3.0	4.0	A-2-4	Silty sand
Qfp	25	A	0.0	1.0	A-6	Clay
"		B	1.0	5.0	A-4	Sandy silt
Qt	26	A	0.0	2.0	A-4	Gravelly silt
"		B	2.0	60.0	A-1-a	Sand & gravel
"	27	A	0.0	1.0	A-2-4	Silty gravel
"		B	1.0	30.0	A-1-a	Sand & gravel
"		C	30.0	40.0	A-2-6	Clayey gravel
Qal	28	A	0.0	5.0	A-1-a	Sand & gravel
Qt	29	A	0.0	11.0	A-2-6	Clayey gravel
"		B	11.0	19.0	A-7	Clay
"		C	19.0	23.0	A-2-4	Sand
Qal	30	A	0.0	2.0	A-1-a	Sand & gravel
Qt	31	A	0.0	8.0	A-2-7	Clayey gravel
Qal	32	A	0.0	1.0	A-1-a	Sand & gravel
Qt	33	A	0.0	8.0	A-2-4	Silty gravel
"	34	A	0.0	20.0	A-1-a	Sand & gravel
"	35	A	0.0	1.0	A-2-4	Sandy silty gravel
"		B	1.0	30.0	A-1-a	Sand & gravel
Qal	36	A	0.0	1.0	A-1-b	Sandy gravel
Qt	37	A	0.0	10.0	A-1-a	Sand & gravel
Qg	38	A	0.0	3.0	A-4	Silt
"		B	3.0	13.0	A-2-6	Clayey gravel
Qt	39	A	0.0	15.0	A-1-b	Sand & gravel
"		B	15.0	21.0	A-2-6	Clayey gravel
QTsf	40	A	0.0	25.0	A-2-7	" "

CONSTRUCTION MATERIALS MAP 25-4



- LEGEND -

TESTED PIT OR QUARRY

PROSPECT PIT OR QUARRY

Qal — Stream gravel

Qt — Terrace gravel

Qg — Fan, terrace and pediment gravel

QTsf — Pediment gravel

TPpa — Palm Park LS

C — Magdalena and Lake Valley Limestone

SO — Fusselman and Montoya dolomite

O€ — El Paso and Bliss Limestone and Dolomite

STATUTE MILES

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-4-2

		25-4-1 (Prospect)	25-4-2 (Prospect)	25-4-3 (Prospect)	25-4-4 (Prospect)	25-4-5 (Prospect)	25-4-6 (Prospect)	25-4-7 (Prospect)
Pit or Prospect No.		25-4-1 (Prospect)	25-4-2 (Prospect)	25-4-3 (Prospect)	25-4-4 (Prospect)	25-4-5 (Prospect)	25-4-6 (Prospect)	25-4-7 (Prospect)
Location	Section	N 1/2 sec. 30	N 1/2 sec. 24	NW 1/4 sec. 36	N 1/2 sec. 3	SE 1/4 sec. 20	N 1/2 sec. 34	S 1/2 sec. 24
	Twnshp. & Range	T 14 S. R 4 W	T 15 S, R 5W	T 15 S, R 5 W	T 16 S, R 5 W	T 16 S, R 4 W	T 15 S, R 5 W	T 17 S, R 5 W
	County	Sierra	Sierra	Sierra	Sierra	Sierra	Sierra	Sierra
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Federal land	Private	Federal land	Federal land	Federal & State land	Federal land	Private
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Pennsylvanian	Quaternary	Quaternary
Formation		Terrace deposit	Alluvium	Alluvium	Terrace deposit	Magdalena	Santa Fe	Alluvium (stream gravel)
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Quarry	Gravel	Sand & gravel
Kind of Material		Various	Igneous	Igneous	Igneous	Limestone	Igneous	Igneous
Quality of Material		Good	Good	Good	Good	Good	Good	Good
Thickness of Material		50+ feet	10 feet	?	10 feet	150 feet	50 feet	10 feet est.
Thickness of Cap (Caliche)		-	-	-	-	-	-	-
Blasting Qualities		-	-	-	-	Good	-	-
Uniformity		Good	Fair	Good	Good	Good	Good	Good
Impurities		Silt & clay lenses	Silt	Silt	Silt (minor)	Minor chert & calcite	Silt & clay lenses	None
Type of Mat'l. Underlying Formation		?	Sand, silt, & clay	Silt, sand, & clay	Silt, clay, & sand	?	Silt & clay	Silt & clay
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood	Greasewood	Greasewood, grass, mesquite	Grass, greasewood	Grass, greasewood	Greasewood, grass	Mesquite, greasewood
Local Terrain		Low-lying flat hills	Stream valley	Stream valley	Hilly	Hilly & rough	Rolling	Stream valley
Depth of Overburden		1.0 to 2.0 feet	1 to 3 feet	0 to 3 feet	0 to 2 feet	None	0 to 3 feet	None
P.I. (Overburden)		N.P.	-	-	-	-	10	-
Est. Reserve Quantity		Unexplored	Unexplored	Unexplored	Unexplored	Unlimited	Unexplored	Unlimited
Approx. Haul to Nearest Point		0.75 mile	0.5 mile	0.2 mile	2.5 miles	2.5 miles	2.0 miles	0.7 mile
L.A. Wear		17.6	24.0	21.2	-	25.2	18.4	23.6
Maximum Size		8"	12"	10"	6"	-	12"	6"
% Retained on 2" Sieve		14	30	12	20 to 30	-	14	Less than 5
	Crushed to	-	-	-	-	1"	-	-
	2"	86	70	75	52	-	60	100
Pit	1"	71	56	64	37	100	45	95
Average	3/4"	64	49	59	34	95	40	89
% Passing	1/2"	54	43	54	32	60	35	81
	#4	32	31	39	23	21	26	58
	#10	20	24	29	16	11	16	43
	#200	4	3	4	2	3	6	6
P.I.		N.P.	N.P.	N.P.	N.P.	N.P.	13	N.P.
Lab. Numbers		63-551 - 552	63-553	63-554	62-3719	63-555	63-556	63-17123

Remarks:

25-4-3 (Prospect) - This site is located at the mouth of Animas Creek. It could provide aggregate along its entire length.

25-4-5 (Prospect) - The Caballo Dam road leads directly to this site. Limestone crops out in the arroyo east of the dam.

Material Pit Summary:

Table 25-4-2 continued

Pit or Prospect No.		25-4-8 (Prospect)	25-4-9 (Prospect)	25-4-10 (Prospect)	25-4-11 (Prospect)	25-4-12 (Prospect)	25-4-13 (Prospect)
Location	Section	W 1/2 sec. 36	NE 1/4 sec. 25	SW 1/4 sec. 24	SW 1/4 sec. 31	13	E 1/2 sec. 1
	Twnshp. & Range	T 16 S. R 5 W	T 15 S, R 5 W	T 16 S, R 5 W	T 14 S. R 4 W	T 15 S. R 5 W	T 16 S. R 5 W
	County	Sierra	Sierra	Sierra	Sierra	Sierra	Sierra
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Federal	Federal land	Federal land
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Terrace deposit	Terrace deposit	Alluvium (Stream gravel)	Terrace deposit	Santa Fe (Pediment gravel)	Terrace deposit
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Gravel	Sand & gravel
Kind of Material		Igneous & metamorphic	Igneous & metamorphic	Igneous	Igneous, metamorphic, & limestone	Igneous	Igneous & metamorphic
Quality of Material		Good	Good	?	Good	Good	Good
Thickness of Material		30+ feet	5 feet	Unexplored	30 feet	50 feet	30 to 40 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	-	-	-	-
Uniformity		Good	Good	Unexplored	Fair to good	Good	Good
Impurities		Silt & clay lenses	Silt & clay lenses	-	Interbeds of clay & silt	Clay & silt	Silt & clay
Type of Mat'l. Underlying Formation		Silt & clay	Silt & clay	Silt & clay	Silt & clay	Clay & silt	Silt & clay
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood, cottonwood	Greasewood	Grass	Greasewood	Greasewood	Greasewood & mesquite
Local Terrain		Rolling	Rolling	Stream valley	Hilly	Dissected plain	Dissected plain
Depth of Overburden		0 to 1 foot	0 to 5 feet	0 to 6 feet	0 to 1 foot	0 to 3 feet	2 to 3 feet
P.I. (Overburden)		N.P.	N.P. to 8	-	5	N.P.	6
Est. Reserve Quantity		Unexplored	Unexplored	Unexplored	Unexplored	Unlimited	Unlimited
Approx. Haul to Nearest Point		1.5 miles	0.2 miles	0.2 mile	0.5 mile	Adjacent to U.S. 85	0.5 miles
L.A. Wear		18.8	-	Unexplored	18.0	19.2	18.4
Maximum Size		6"	6"	8"	14"	12"	10"
% Retained on 2" Sieve		18	10 to 15	Unexplored	11	15 to 20	5 to 15
	Crushed to	-	-	"	-	-	-
Pit Average % Passing	2"	66	82	"	72	84	92
	1"	51	60	"	58	70	73
	3/4"	46	51	"	51	64	64
	1/2"	40	43	"	43	56	55
	#4	28	29	"	28	36	36
	#10	20	22	"	21	26	26
	#200	6	3	"	2	4	6
P.I.		N.P.	Sandy N.P.	"	N.P.	N.P.	11
Lab. Numbers		63-545, 557	62-3715	"	63-558 - 560	63-17125	63-17127

Remarks:

Material Pit Summary:

Table 25-4-2 continued

Pit or Prospect No.		25-4-14 (Prospect)	25-4-15 (Prospect)	25-4-16 (Prospect)	25-4-17 (Prospect)	25-4-18 (Prospect)	25-4-19 (Prospect)
Location	Section	30	SE 1/4 sec. 31	SE 1/4 sec. 2	SE 1/4 sec. 23	E 1/2 sec. 7 & W 1/2 sec. 8	SE 1/4 sec. 19
	Twnshp. & Range	T 16 S, R 4 W	T 16 S, R 4 W	T 17 S, R 5 W	T 17 S. R 5 W	T 17 S, R 4 W	T 17 S, R 4 W
	County	Sierra	Sierra	Sierra	Sierra	Sierra	Sierra
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Federal land	Federal land	Private	Private	Federal land	Federal land
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary	Pennsylvanian
Formation		Terrace deposit	Terrace deposit	Terrace deposit	Terrace deposit	Terrace deposit	Madera
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Quarry
Kind of Material		Igneous & metamorphic	Igneous & metamorphic	Igneous	Igneous	Various	Limestone
Quality of Material		Excellent	?	Fair	Fair	Good	Good
Thickness of Material		10 to 20 feet	10 to 20 feet	5 to 15 feet	10 feet	12 feet	75+ feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	-	-	-	Good
Uniformity		Good	Good	Fair	Fair	Poor	Good
Impurities		Silt & clay lenses (minor)	Silt	Clay	Clay	None	Interbedded shale
Type of Mat'l. Underlying Formation		Sandstone, silt, & clay	Silt, clay, & sandstone	Silt & clay	Silt & clay	Silt & clay	Percha shale
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood	Greasewood	Greasewood	Greasewood	Greasewood	Greasewood
Local Terrain		Rough, broken	Hilly	Flat	Dissected plain	Dissected Terrace	Hilly
Depth of Overburden		3 to 5 feet	2 to 6 feet	2 to 4 feet	3 to 6 feet	Unexplored	Trace
P.I. (Overburden)		8	4	6	7	N.P.	-
Est. Reserve Quantity		Unexplored	Unexplored	?	?	?	-
Approx. Haul to Nearest Point		2.1 miles	2.7 miles	0.5 mile	0.3 mile	2.0 miles	0.8 mile
L.A. Wear		20.4	-	21.6	18.0	18.0	26.4
Maximum Size		8"	10"	9"	9"	12"	-
% Retained on 2" Sieve		24	-	15 to 20	15 to 20	10 to 15	-
	Crushed to	-	Unexplored	-	-	-	2"
	2"	76	"	83	82	63	100
Pit	1"	65	"	62	73	47	61
Average	3/4"	58	"	52	67	43	36
% Passing	1/2"	48	"	42	60	37	25
	#4	27	"	27	45	26	11
	#10	21	"	18	36	21	6
	#200	2	"	3	3	2	1
P.I.		N.P.	"	N.P.	N.P.		N.P.
Lab. Numbers		63-561	63-561	63-17130	63-17132	63-17133	62-9660

Remarks:

25-4-15 (Prospect) - This material is similar to 25-4-14 (Prospect).

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-4-2 continued

Pit or Prospect No.		25-4-20 (Prospect)	25-4-21 (Prospect)
Location	Section	SW 1/4 sec. 19	N 1/2 sec. 19
	Twnshp. & Range	T 17 S, R 4 W	T 17 S, R 4 W
	County	Sierra	Sierra
	State	New Mexico	New Mexico
Owner		Private & Federal	Federal
Geologic Age		Quaternary	Quaternary
Formation		Terrace deposit	Fan, terrace, & pediment deposit
Type of Pit		Sand & gravel	Sand & gravel
Kind of Material		Igneous & metamorphic	Various
Quality of Material		Fair	Good
Thickness of Material		Variable	10+ feet
Thickness of Cap (Caliche)		-	-
Blasting Qualities		-	-
Uniformity		Fair	Good
Impurities		Interbedded silt & clay	Clay
Type of Mat'l. Underlying Formation		Sand, silt, & clay	Sand, silt, & clay
Moisture Condition		Dry	Dry
Vegetation		Greasewood	Greasewood, grass
Local Terrain		Hilly	Dissected fan
Depth of Overburden		Trace	0 to 3 feet
P.I. (Overburden)		-	8
Est. Reserve Quantity		Unexplored	Unexplored
Approx. Haul to Nearest Point		0.7 mile	1.5 miles
L.A. Wear		26.4	24.4
Maximum Size		9"	13"
% Retained on 2" Sieve		16	19
	Crushed to	-	-
	2"	73	67
Pit	1"	63	56
Average	3/4"	58	49
% Passing	1/2"	50	40
	#4	30	24
	#10	20	16
	#200	2	4
P.I.		N.P.	15
Lab. Numbers		63-562	63-563 - 564

Remarks:

SOILS AND GEOLOGY

Introduction:

This strip begins at the ruins of Las Palomas and ends about 14 miles north of Truth or Consequences, Sierra County, New Mexico.

The area is a part of the Basin and Range province. Mountainous uplands, elevated pediment surfaces, and incised stream valleys are the most prominent physiographic features. The Mud Springs Mountains, the Caballo Mountains, the Engle basin, and the Palomas basin are the primary structural features. The Engle basin and the Palomas basin are a part of the Rio Grande depression. This depression or trough extends from southern Colorado to El Paso, Texas.

General Geology:

Rocks ranging in age from Precambrian to Recent are exposed in this strip. Precambrian basement rocks are primarily granite with minor amounts of schist, gneiss, and greenstone. They crop out along the base and lower slopes of the Mud Springs Mountains, the Caballo Mountains, and the low terrace below Carrie Tingley Hospital.

Paleozoic sedimentary rocks are exposed in the Caballo Mountains and the Mud Springs Mountains. These rocks are of varied lithology and each period of the Paleozoic era is represented. Alternate beds of dolomite, sandstone, limestone, and shale are exposed.

Triassic and Jurassic rocks are absent because of a post-Cretaceous erosion cycle. Cretaceous shales and sandstones are exposed on the dip slope of the Caballo Mountains and near Elephant Butte Dam.

Cenozoic rocks are primarily sandstone, conglomerate, silt, clay, and gravel. Most of these sediments are included in the Santa Fe group.

The Palomas basin, in the southern part of the strip, and the Engle basin, in the northern part of the strip, are separated by the Mud Springs fault-block at Truth or Consequences. The Palomas basin is bounded by the north-trending Caballo uplift on the east and the Black Range uplift on the west. The more irregular Engle basin is bounded by the Fra Cristobal, San Mateo, Cuchillo Negro, and Mud Springs uplifts.

During Pliocene time the Engle and Palomas basins were filled with a complex sequence of sand, gravel, silt, and clay. These sediments have been named the Santa Fe group. A wide spread pediment developed on the Santa Fe sediments near the end of the filling of the Palomas and Engle basins. South of the Mud Springs Mountains this pediment is called the Palomas surface and north of the Mud Springs Mountains it is called the Cuchillo surface.

Later the Rio Grande cut through the Santa Fe beds and formed the present valley. The pediment surface now terminates into a line of bluffs near the edge of the valley.

East of the Rio Grande at the base of the Caballo Mountains the pediment gravel grades upward into alluvial fan and terrace deposits. Tributaries of the Rio Grande have incised long, deep canyons that extend northwestward for many miles into the Palomas and Cuchillo surfaces. Terrace deposits occur locally along the courses of these canyons. The deposits are primarily reworked pediment gravels; therefore, they are very similar in texture and composition to the pediment gravels. Dissection of the pediment by tributaries has left mesa segments that terminate in a series of bluffs near the flood plain.

The Rio Grande, during its Quaternary down-cutting, left many terrace deposits throughout this strip. Truth or Consequences is built on a series of relatively wide, irregular levels of these terraces.

The areal distribution of formations is shown on Soils and Geology Map 25-5. Their succession and character are given under the section termed "Stratigraphy."

Soils:

The soils in this strip are both residual and transported.

Alluvium (Qal): Alluvium occurs in arroyo bottoms, tributary washes, and as slope wash on the bluffs along the Rio Grande. The alluvium is derived mainly from the Santa Fe group and pediment deposits A profile of this soil is usually sandy silt (A-4) varying in thickness from a few inches to 2 feet. This cover is sometimes absent. Where the cover is present, it is generally underlain by sand and gravel (A-1-a) inter-fingered with silty sand (A-2-4).

Flood-plain deposits (Qfp): The Rio Grande has formed a flood plain south of Truth or Consequences. The flood plain is from one to two miles wide in this strip. The surface is covered by a thin veneer of silty sand (A-2-4), sandy silt (A-4), and silt (A-4). Clay (A-6) occurs at various depths below the surface. The clay zones may represent old channels or slack water areas. Sand (A-3) and sand and gravel (A-1-a) also occur irregularly.

Terrace deposits (Qt): There are irregular levels of terrace deposits in the vicinity of Truth or Consequences. These terraces were formed by a meandering Rio Grande, debris washed in by tributary arroyos, and sheet wash. The top soil may be five or more feet thick. It varies from silt (A-4) to silty sand (A-2-4). This cover is absent in much of the strip because of removal by wind and rain. The top soil is underlain by sand and gravel (A-1-a) twenty feet thick. Below the sand and gravel lies ten feet of silty sand.

The lower terraces in the Truth or Consequences area are covered by two to three feet of wind-blown sandy silt (A-4). This zone is underlain by clean river-washed sand and gravel (A-1-a) that may be fifty feet thick.

The soils in the terraces of the deep arroyos vary in classification. The terraces are usually covered by silt (A-4) which is underlain by silty gravel (A-2-4) to clayey gravel (A-2-7). Material in these terraces was derived from the Tertiary volcanic mountains to the west.

Soils continued...

Undifferentiated gravels (Qg): A very thick deposit of sand, silt, clay, gravel, and caliche lies between the Rio Grande and the Caballo Mountains. The deposit includes the Palomas pediment gravels, terrace gravels, and alluvial fan materials. The Mud Springs Mountains are surrounded by the same kind of deposit. The Palomas gravels are predominantly igneous pebbles and boulders derived from the mountains to the west. The terrace gravels were deposited by the Rio Grande and are well consolidated in places. The alluvial fan materials were derived from the adjacent mountains. The upper parts of this erratic deposit have been cemented by calcium carbonate. The residual soil overlying this deposit ranges from a gravelly sand (A-1-b) to a gravelly, silty sand (A-2-4).

Santa Fe group (QTsf): The beds of this group are poorly-sorted and lenticular. The group is composed of alternating beds of sand, silt, clay, and gravel. It is a typical alluvial fan and playa deposit (Kelley and Silver, 1952, p. 123). The ancestral Black Range and the Sierra Cuchillo Mountains furnished the material for these beds. A typical soil profile follows: 2 feet of silt (A-4), 50 feet of clayey gravel (A-2-7), 8 feet of clay (A-6), 15 feet of clayey gravel (A-2-6), 2.8 feet of sandy silt (A-4), 2.2 feet of clay (A-7), and 2 feet of silt (A-4).

The surface soils that overlie the Santa Fe group are reddish-brown, non-calcareous silty, clayey gravels (A-2-6) to clayey gravels (A-2-7). They are from 0.5 to 2.0 feet thick. At places Recent erosion has developed broad swales in the Palomas and Cuchillo surfaces. Silt (A-4), silty clay (A-6), and clay (A-7) have accumulated in these depressions.

Below the surface soils there is a highly calcareous (caliche) layer of clayey gravel (A-2-7) that may have a P.I. as high was 24. The high plasticity is probably due to the breakdown of the igneous material in the deposit. Locally the layer is well consolidated and may be 6 feet thick. Below this layer lies clayey gravel (A-2-6 and A-2-7) which contains minor amounts of calcium carbonate.

Along the west shore of Elephant Butte Reservoir, a thick accumulation of wind-blown sand (not mapped) covers the Santa Fe group. The prevailing winds have carried this material here from the flood plain of the Rio Grande, the dry arroyos to the southwest, and adjacent areas. The deposit ranges from silty sand (A-2-4) to sand (A-3) to silty gravel (A-2-4).

The transported and residual soils in the mountainous areas are thin and patchy; therefore, they are not classified.

Table 25-5-I shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-5.

Ground-Water:

A number of mineral hot springs occur on the south side of the limestone hill in the center of Truth or Consequences and manganese and travertine deposits and solution cavities extend for about one-half mile northwest of town. These springs may be detrimental to highway construction. The thermal-water area is poorly defined in the center of town. The presence of the thermal water suggests that a fracture or fault occurs below the surface in this area. Probably hot gases from some igneous source at great depth rises along the fracture or fault and heats the circulating ground-water. This heated water issues from the alluvium as hot springs.

The following paragraphs are taken from E. R. Cox and H. O. Reeder (see Selected References):

> "Nonthermal water under artesian pressure occurs in sand, gravel, and silt in alluvium west of the Rio Grande from Truth or Consequences at least as far as Arrey, about 18 miles south of Truth or Consequences. The sand, gravel, and silt are interbedded with clay, which confines the water under pressure in the more permeable material. Wells tap these artesian aquifers along valleys of tributaries, mostly within 5 miles of the river. The nonthermal artesian aquifers discharge water indirectly into the Rio Grande by leakage through confining beds into the shallow aquifers near the river and thence into the river. The head in the artesian aquifers declined as much as 30 feet near the river from 1947 to 1960. Lowering the water level in the shallow aquifer near the river would lower the head in the artesian aquifers; but the lowering head due to lowering water levels near the river probably would be small compared with the expected lowering of head in the artesian aquifers due to continued pumping of water from the artesian system."

> "Unconfined water occurs at a depth of less than 10 feet under most of the flood plain of the Rio Grande from Williamsburg to Caballo Reservoir. Locally, water is under artesian pressure at shallow depths in the alluvium, where lenses of clay form imperfect upper confining beds."

> "The flood plain in this area is underlain by clay, silt, sand, and gravel. A thin mantle of silt or very fine-grained sand usually less than 5 feet thick covers most of the flood plain. This mantle is underlain by as much as 30 feet of medium-grained to very coarse-grained sand and gravel, the sand becoming progressively coarser with depth. This sand and gravel is lenticular, thinning toward both edges of the flood plain. The alluvium contains large amounts of clay beneath the sand and gravel lens under and along the western edge of the flood plain."

> "Ground-water in the alluvium under the flood plain from Williamsburg to Caballo Reservoir moves generally southward toward the reservoir. The configuration of the water table in this area indicates that water moves from the Rio Grande to the shallow aquifer throughout most of the reach during periods of high flow. During periods of low flow, however, water moves from the shallow aquifer to the river."

Stratigraphy:

Quaternary:	Alluvium (Qal) - sand, silt, clay, and gravel.
	Flood-plain deposits (Qfp) - fine- to coarse-grained mixture of sand, silt, clay, and gravel.
	Terrace deposits (Qt) - a mixture of sand, silt, clay, and gravel. Silty gravel grades into and is interbedded with well-washed deposits near the flood plain of the Rio Grande.
	Undifferentiated gravels (Qg) - a poorly-sorted mixture of Palomas gravel, terrace deposits, and alluvial fan deposits.
Unconformity----------	
Quaternary-Tertiary:	Santa Fe group (QTsf) - pink and tan, fine-grained to conglomeratic deposits of clay, silt, sand, and gravel. Includes a cover of pediment gravel that is highly saturated with clay. Thickness: 2,000+ feet.
Unconformity----------	
Cretaceous:	Mesaverde formation (Kmv) - gray to buff or brown, medium-grained sandstone beds with alternating beds of shale, siltstone, and mudstone. Thickness: 3,300 feet.
	Mancos shale (Km) - gray, friable, calcareous shale with limestone and sandstone. Thickness: 480 feet.

Cretaceous:	Dakota group (Kd) - dark brown, very coarse grained, cross-bedded, quartzose sandstone with a gray shale unit at the base. Thickness: 245 feet.

Unconformity--

Permian:	San Andres formation (Psa) - dark-gray limestone with interbedded sandstone and gypsum. Thickness: 780 feet.
	Yeso formation (Py) - fine-grained, orange-red and buff sandstone and siltstone with gray limestone and gypsum. Thickness: 600 feet.
	Abo formation (Pa) - reddish-brown to dark-red purplish brown, thin- to medium-bedded claystone, siltstone, and sandstone with shale beds. Thickness: 550 to 1,100 feet.

Unconformity--

Pennsylvanian & Mississippian:	Magdalena group and Lake Valley formation (C) - predominantly tan or tan-gray limestone with interbedded shale. Thickness: 1,640 feet.
Devonian:	Percha formation (Dp) - black to greenish or yellowish shales with calcareous nodules and sandstone. Thickness: 50 feet.

Unconformity--

Silurian & Ordovician:	Fusselman dolomite and Montoya group (SO) - predominantly light- to dark-colored, fine- to coarse-grained dolomite with chert. Includes sandstone at the base. Thickness: 380 feet.

Unconformity--

Ordovician & Cambrian:	El Paso group and Bliss formation (OC) - thin- to medium-bedded, gray- to dark-gray limestone and dolomite. The Bliss formation consists of alternating thin beds and laminations of gray, glauconitic limestone, fine-grained quartzose sandstone, siltstone, and hematite Thickness: 660 feet.

Unconformity--

Precambrian:	Granite (PC) - reddish, coarse-grained granite with associated schist, gneiss, and greenstone.

Construction Materials:

Quaternary:	Alluvium (Qal) - Most of the larger tributaries of the Rio Grande are floored with a good quality of sand and gravel. The Palomas, Cuchillo Negro, and Alamosa Rivers seem to be the most ideal for construction materials. The irregular flow and the meandering pattern of these rivers have caused the materials to be somewhat heterogeneous. A fairly clean, coarse-grained gravel grades into the underlying Santa Fe group sediments in some places. The Cuchillo Negro River is representative of these deposits; although, it has not formed as great a silt cover as the other two. Laboratory tests run on a sample from Cuchillo Negro River (Prospect 25-5-6) report a well-sorted, non-plastic sand and gravel with more than 15 percent retained on the 2-inch sieve, a maximum size of about 4 inches, and a L. A. Wear of about 18.
	Terrace deposits (Qt) - Terrace gravel occurs along the tributary rivers of the Rio Grande and along the Rio Grande. Terraces along the tributaries have material similar to that found in the tributary channels; however, the terrace material shows some degree of induration and it is partly cemented by caliche near the top. Near the confluence of the main tributaries and the Rio Grande, tributary terrace deposits grade into and are interbedded with Rio Grande terrace deposits. The Rio Grande terrace deposits contrast to the tributary terrace deposits in particle shape, particle size, and plasticity. As one would expect, the deposits formed by the larger river are well-washed, with very few clay size particles; whereas, the tributary deposits have varying percentages of clay with Plasticity Indicies that exceed 20. Prospects 25-5-1, 25-5-2, and 25-5-3 are representative of the well-washed gravel, and Prospect 25-5-18 and soil sample 15 are representative of the silty and(or) clayey gravel.
	Gravel undifferentiated (Qg) - East of the Rio Grande along the toe of the Caballo uplift is a very complex accumulation of terrace gravel, alluvial fan gravel, and Palomas gravel. In places these deposits are over 100 feet thick. This area is rather remote to the construction of the main highways; however, the need to develop construction materials in this area may arise as the value of real estate increases west of the Rio Grande. A crossing could easily be built over the Rio Grande since the flow of the river is controlled by the Caballo Dam. The terrace gravel is similar to that found west of the river. The fan gravel is quite angular and has limestone, dolomite, and other sedimentary rocks that are not commonly found west of the river. The Palomas gravel is the same as that of the pediment deposit west of the river and has been described under the Santa Fe group (QTsf).
Quaternary-Tertiary:	Santa Fe group (pediment gravel) (QTsf) - Sixty to seventy percent of this strip is covered by pediment gravel. This gravel lies on the pediment surface of the Santa Fe group. It has been referred to by some as the Palomas gravel. It is a mixture of subangular gravels and pebbles of rhyolite, andesite, and basalt in a matrix of silt and clay. Minor amounts of quartzite, limestone, and granite are found in some places. It is more than 50 feet thick and there are, no doubt, channels of sandy, non-plastic materials in this deposit, even though the majority of it is well saturated with clay. Further, extensive exploration may reveal

(Santa Fe group)
usable, non-plastic materials in this deposit. Prospect 25-5-12, 25-5-14, and 25-5-16 represent this deposit. Note that all of these prospects have a P.I. that exceeds 20. Further research may develop a use for the clay saturated materials or an economical means of separating the clay from the gravel.

Permian: San Andres formation (Psa) - Limestone of this formation crops out on the rugged escarpment of the Caballo Mountains. It is a rather remote location for construction materials; however, as the need for quarry rock increases this formation will be worthy of exploration.

Pennsylvanian & Mississippian: Magdalena group and Lake Valley formation (C) - Limestone of these formations occurs in the Mud Springs Mountains and on the rugged escarpment of the Caballo Mountains. In the Caballo Mountains this limestone, like the San Andres limestone, is remote to the existing roads, but is worthy of exploration. In the Mud Springs Mountains it will be an excellent source for quarry rock. Prospect 25-5-8 is one of the better locations for a quarry in this material.

Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-5. Test data and other related information are shown in Material Pit Summary Table 25-5-2.

Selected References:

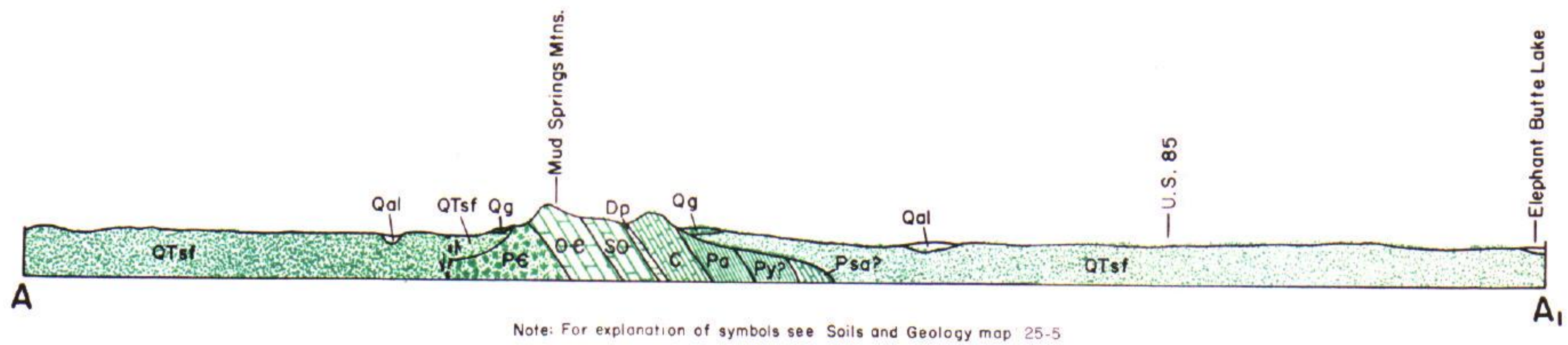
Cox, E. R. and Reeder, H. O., (1962), Ground-Water Conditions in the Rio Grande Valley between Truth or Consequences and Las Palomas, Sierra County, New Mexico, New Mexico State Engineers Technical Report 25.

Harley, G. T., (1934), The Geology and Ore Deposits of Sierra County, New Mexico, New Mexico Bureau of Mines and Mineral Resources, Bull. 10, 220 p.

Kelley, V. C. and Silver, C., (1952), Geology of Caballo Mountains, Univ. of New Mexico Publication in Geology, No. 4, 286 p.

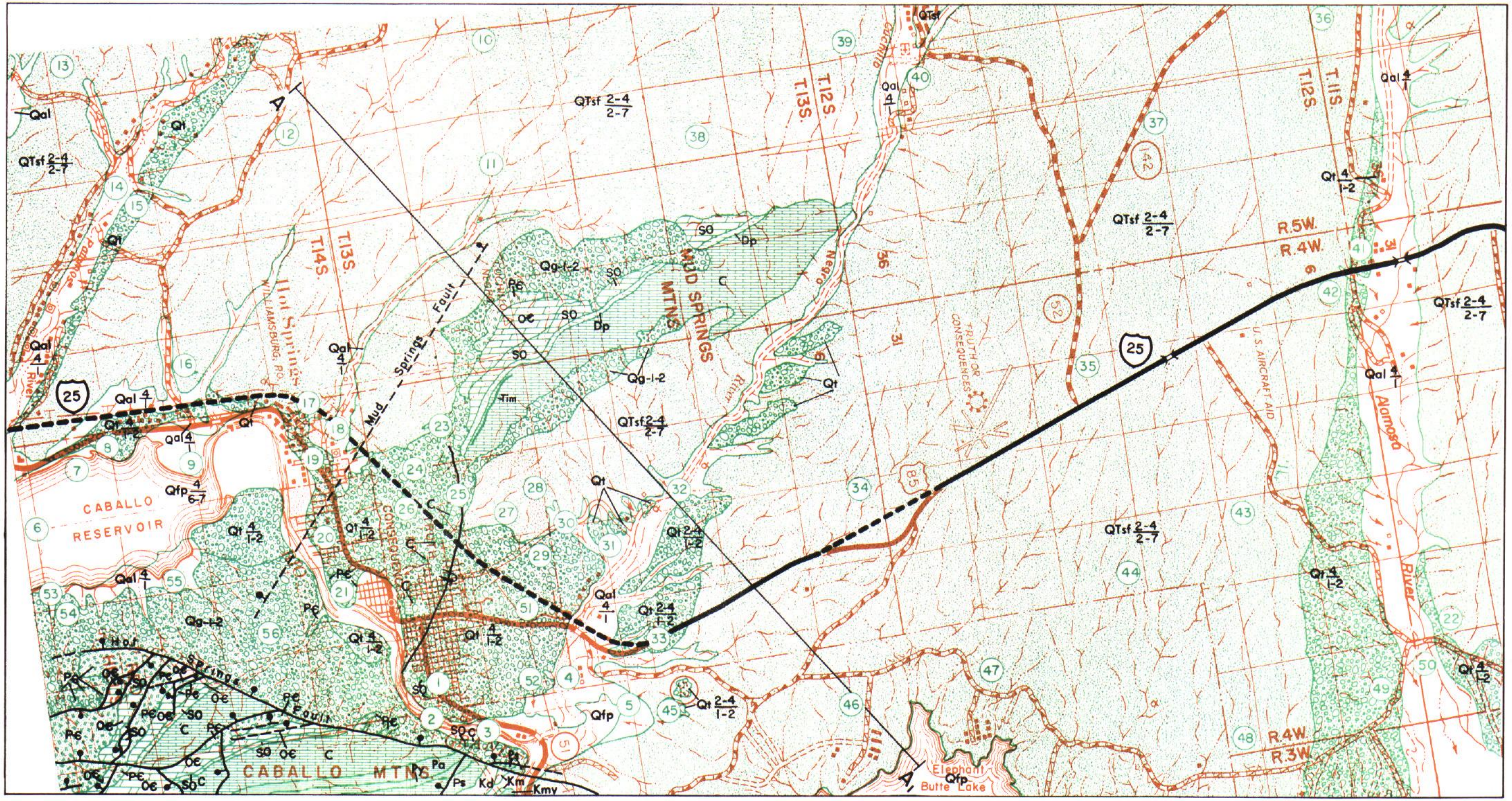
New Mexico Geological Society, (1955), Guidebook of South-Central New Mexico, 6th Field Conference, 182 p.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-5

SOILS AND GEOLOGY MAP 25-5



GEOLOGY MAPPED 1963

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SEDIMENTARY ROCKS

Qal	Alluvium	QUATERNARY
Qg	undifferentiated gravel	QUATERNARY
Qt	Terrace deposits	QUATERNARY
Qfp	Flood-plain deposits	TERTIARY
QTsf	Santa Fe group	TERTIARY
Kmv	Mesaverde formation	CRETACEOUS
Km	Mancos shale	CRETACEOUS
Kd	Dakota group	CRETACEOUS
Psa	San Andres formation	PERMIAN
Py	Yeso formation	PERMIAN
Pa	Abo formation	PERMIAN
C	Magdalena group Lake Valley formation	PENNSYLVANIAN MISSISSIPPIAN
Dp	Percha formation	DEVONIAN
SO	Fusselman dolomite Montoya group	SILURIAN ORDOVICIAN
OЄ	El Paso group Bliss formation	ORDOVICIAN CAMBRIAN

IGNEOUS ROCKS

Tim	Monzonite sill	TERTIARY
PЄ	Granite, gneiss, schist, and greenstone	PRECAMBRIAN

STATUTE MILES

Soils Summary:

Table 25-5-1

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Qt	1	A	0.0	1.0	A-4	Sandy silt
"		B	1.0	50.0	A-1-a	Sand and gravel
Qfp	2	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	2.0	A-1-b	Sand
"		C	2.0	4.0	A-3	Sand
"	3	A	0.0	2.0	A-4	Sandy silt
Qal	4	A	0.0	0.6	A-2-4	Silty sand
"		B	0.6	3.0	A-1-a	Sand and gravel
"	5	A	0.0	2.0	A-4	Sandy silt
"		B	2.0	3.0	A-2-4	Silty sand
"		C	3.0	5.0	A-1-a	Sand and gravel
Qfp	6	A	0.0	1.0	A-4	Sandy silt
"		B	1.0	2.0	A-6	Clay
"		C	2.0	4.0	A-4	Sandy silt
"	7	A	0.0	0.6	A-4	Silt
"		B	0.6	3.0	A-2-4	Silty sand
Qt	8	A	0.0	2.0	A-4	Sandy silt
"		B	2.0	3.0	A-4	Silt
"		C	3.0	10.0	A-1-a	Sand and gravel
Qfp	9	A	0.0	0.8	A-4	Sandy silt
"		B	0.8	2.0	A-7	Clay
"		C	2.0	3.0	A-4	Silt
QTsf	10	A	0.0	3.0	A-6	Clay
"	11	A	0.0	3.0	A-2-4	Silty sand and gravel
"	12	A	0.0	8.0	A-2-7	Clayey gravel
"	13	A	0.0	50.0	A-7	Clay
"		B	50.0	65.0	A-2-6	Clayey gravel
"		C	65.0	115.0	A-4	Silt
Qal	14	A	0.0	7.0	A-1-a	Sand and gravel
"		B	7.0	9.0	A-4	Sandy silt
Qt	15	A	0.0	4.0	A-4	Silt
"		B	4.0	54.0	A-1-a	Sand and gravel
QTsf	16	A	0.0	6.0	A-4	Silt
"		B	6.0	13.0	A-1-a	Sand and gravel
"	17	A	0.0	50.0	A-2-7	Clayey gravel
"		B	50.0	58.0	A-6	Clay
"		C	58.0	73.0	A-2-6	Clayey gravel
"		D	73.0	75.8	A-4	Sandy silt
"		E	75.8	78.0	A-7	Clay
Qal	18	A	0.0	5.0	A-1-a	Sand and gravel

Table 25-5-1 continued

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Qt	19	A	0.0	1.8	A-4	Silt
"		B	1.8	2.5	A-2-4	Silty sand
"		C	2.5	5.0	A-4	Silt
"	20	A	0.0	0.6	A-4	Silt
"		B	0.6	1.5	A-4	Sandy silt
"		C	1.5	2.5	A-6	Silty clay
"		D	2.5	5.0	A-4	Sandy silt
"	21	A	0.0	2.5	A-4	Sandy silt
"		B	2.5	4.0	A-2-4	Silty sand and gravel
"		C	4.0	5.0	A-1-a	Sand and gravel
QTsf	22	A	0.0	18.0	A-7	Clay
Qt	23	A	0.0	5.0	A-2-4	Silty sand and gravel
"	24	A	0.0	0.8	A-2-4	" " " "
"		B	0.8	3.8	Solid rock	Conglomerate
"		C	3.8	9.8	A-1-a	Sand and gravel
"	25	A	0.0	0.6	A-4	Silt
"		B	0.6	3.6	A-4	Sandy silt
"	26	A	0.0	0.6	A-4	Gravelly silt
"		B	0.6	4.6	Solid rock	Conglomerate
QTsf	27	A	0.0	2.0	A-2-4	Silty sand
"		B	2.0	4.0	A-1-a	Sand and gravel
"	28	A	0.0	0.6	A-2-4	Silty sand and gravel
"		B	0.6	3.6	Solid rock	Conglomerate
"		C	3.6	10.0	A-2-6	Clayey gravel
Qt	29	A	0.0	3.0	A-2-4	Silty sand
"		B	3.0	5.0	A-2-4	" "
Qal	30	A	0.0	7.0	A-7	Clay
Qt	31	A	0.0	4.0	A-1-a	Sand and gravel
"		B	4.0	5.0	A-2-4	Silty sand
"		C	5.0	45.0	A-6	Clay
Qal	32	A	0.0	1.8	A-4	Sandy silt
"		B	1.8	3.0	A-4	Silt
"		C	3.0	6.0	A-1-a	Sand and gravel
Qt	33	A	0.0	25.0	A-1-a	Sand and gravel
"		B	25.0	40.0	A-3	Sand
QTsf	34	A	0.0	2.0	A-2-6	Clayey gravel
"		B	2.0	6.0	A-2-4	Silty sand and gravel
"		C	6.0	26.0	A-6	Clay
"	35	A	0.0	1.0	A-2-4	Silty sand and gravel
"		B	1.0	3.0	Solid rock	Conglomerate
"		C	3.0	15.0	A-2-6	Clayey gravel

Soils Summary Table continued...

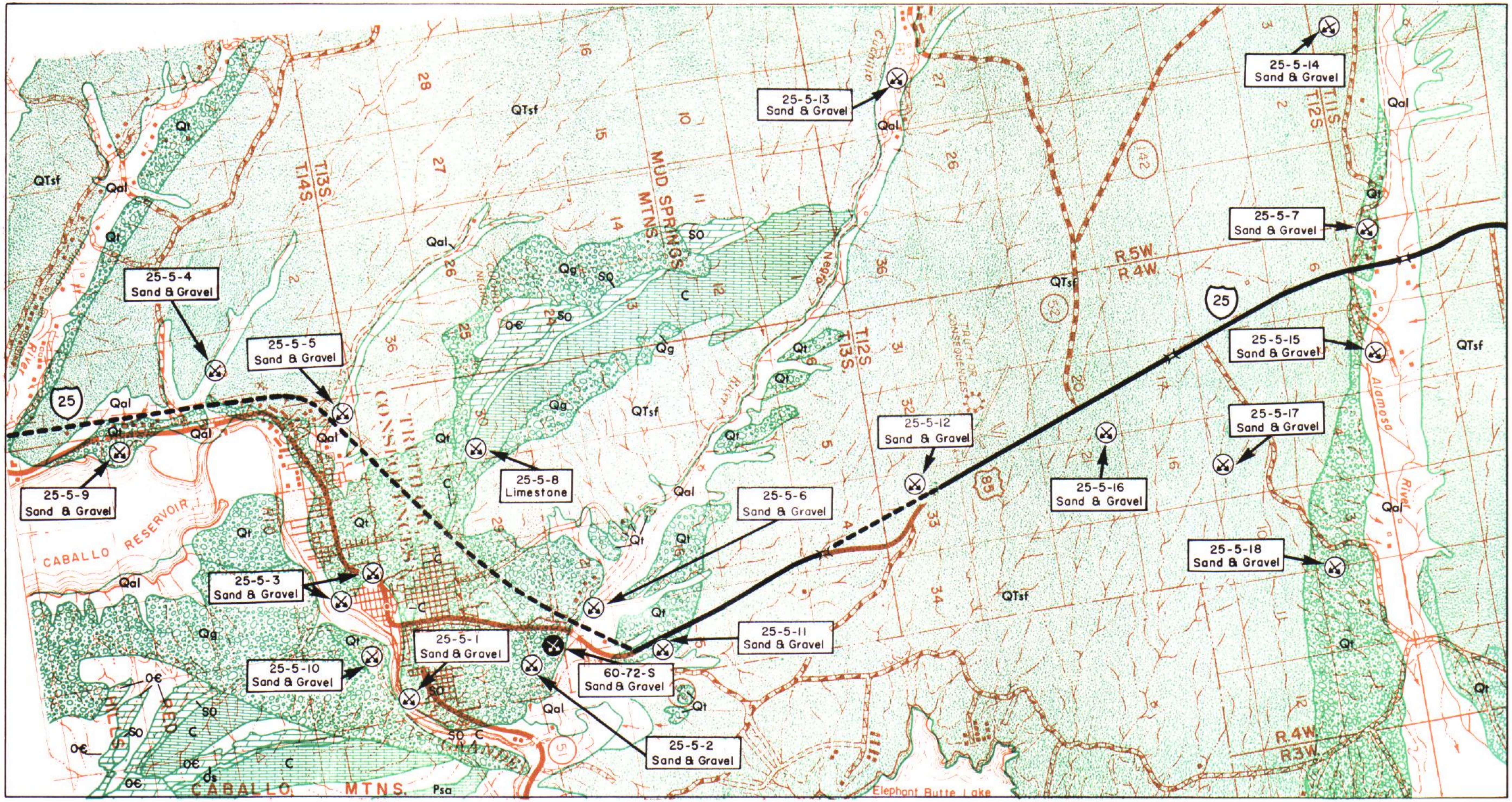
Table 25-5-I continued

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
QTsf	36	A	0.0	5.0	A-7	Clay
"	37	A	0.0	2.0	A-4	Silt
"	38	A	0.0	1.0	A-4	Gravelly silt
"	39	A	0.0	3.0	A-4	" "
"	40	A	0.0	8.0	A-2-4	Silty sand and gravel
Qt	41	A	0.0	30.0	A-2-4	" " " "
"		B	30.0	33.0	A-4	Silt
"		C	33.0	40.0	A-1-a	Silty sand and gravel
QTsf	42	A	0.0	3.0	A-1-a	Sand and gravel
"	43	A	0.0	0.8	A-4	Gravelly silt
"	44	A	0.0	1.0	A-2-4	Silty sand and gravel
Qt	45	A	0.0	10.0	A-2-4	" " " "
QTsf	46	A	0.0	2.0	A-2-4	Silty sand
"		B	2.0	4.0	A-2-4	" "
"	47	A	0.0	4.0	A-2-4	Silty sand and gravel
"	48	A	0.0	5.0	A-3	Sand
Qt	49	A	0.0	15.0	A-2-7	Clayey gravel
Qal	50	A	0.0	5.0	A-4	Silt
Qt	51	A	0.0	20.0	A-1-a	Sand and gravel
"	52	A	0.0	18.0	A-1-a	" " "
"		B	18.0	28.0	A-2-4	Silty sand
"	53	A	0.0	2.0	A-4	Sandy silt
"		B	2.0	9.0	A-1-a	Sand and gravel
Qg	54	A	0.0	3.0	A-1-b	Gravelly sand
Qal	55	A	0.0	2.0	A-4	Sandy silt
Qg	56	A	0.0	0.8	A-2-4	Silty sand and gravel

The following section is from the Santa Fe group:

QTsf	17	A	0.0	50.0	A-2-7	Clayey gravel
"		B	50.0	58.0	A-6	Clay
"		C	58.0	73.0	A-2-6	Clayey gravel
"		D	73.0	75.0	A-4	Sandy silt
"		E	75.0	88.0	A-7	Clay
"		F	88.0	96.0	A-2-7	Clayey gravel
"		G	96.0	120.0	A-7	Clay
"		H	120.0	144.0	A-2-7	Clayey gravel
"		I	144.0	146.0	A-2-4	Caliche sand and gravel
"		J	146.0	148.8	A-2-4	Silty sand
"		K	148.8	151.0	A-7	Clay

CONSTRUCTION MATERIALS MAP 25-5



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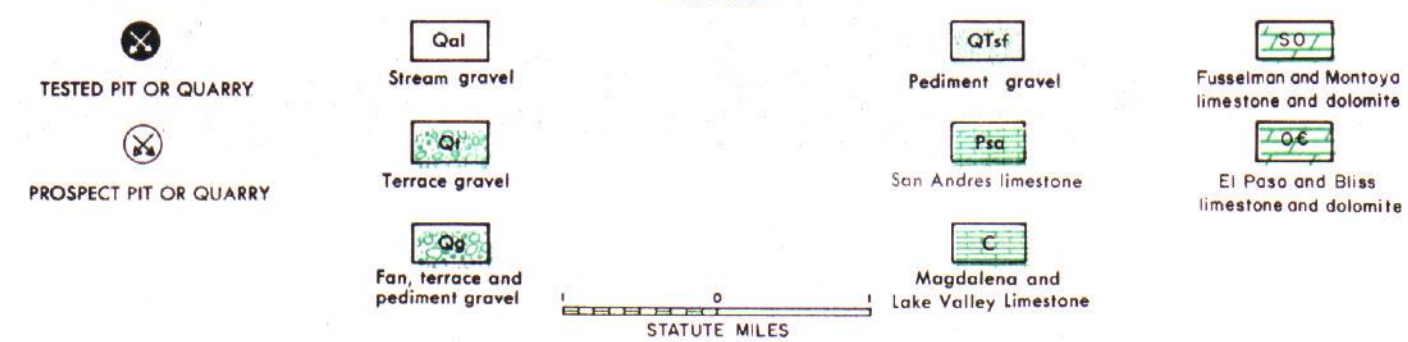


CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-5-2

Pit or Prospect No.		60-72-S	25-5-1 (Prospect)	25-5-2 (Prospect)	25-5-3 (Prospect)	25-5-4 (Prospect)
Location	Section	NE 1/4 NW 1/4 sec. 27	SE 1/4 sec. 34	N 1/2 sec. 27	E 1/2 NE 1/4 sec. 5, W 1/2 NW 1/4 sec. 4	Sec. 12
	Twnshp. & Range	T 13 S, R 4 W	T 13 S, R 4 W	T 13 S, R 4 W	T 14 S, R 4 W	T 14 S, R 4 W
	County	Sierra	Sierra	Sierra	Sierra	Sierra
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Private	Private
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Terrace deposits	Terrace deposits	Terrace deposit	Terrace deposit	Alluvium (stream gravel)
Type of Pit		Sand and gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Igneous, etc.	Igneous, limestone, & metamorphic	Igneous, limestone, & metamorphic	Igneous, limestone, & metamorphic	Igneous, limestone, & metamorphic
Quality of Material		Excellent	Excellent	Good	Good	Good
Thickness of Material		12 feet	50 feet	Approx. 20 feet	Approximately 30.0 feet	?
Thickness of Cap (Caliche)		-	-	-	-	-
Blasting Qualities		-	-	-	-	-
Uniformity		Good	Good	Good	Fair	Good
Impurities		Silt (minor)	Silt lenses (minor)	Silt lenses (minor)	Silt & clay lenses (minor)	Silt & clay lenses
Type of Mat'l. Underlying Formation		Silt & clay	?	Channel sand	Santa Fe	Santa Fe
Moisture Condition		Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood	Range grass, greasewood	Greasewood	Removed	Greasewood & mesquite
Local Terrain		Hilly	Rolling to flat	Rolling	Hilly	Rolling to hilly
Depth of Overburden		0.5 feet	1.0 to 2.0 feet	1.0 foot	Removed	0 to 3 feet
P.I. (Overburden)		7 - 9	N.P.	6	-	N.P.
Est. Reserve Quantity		50,000+ cu. yds.	Unexplored	Unexplored	Unexplored	?
Approx. Haul to Nearest Point		0.2 miles	1 mile	0.5 mile	0.5 mile	Approx. 1.0 mile
L.A. Wear		20.0	-	Unexplored	-	20.0
Maximum Size		6"	6"	6"	6"	10"
% Retained on 2" Sieve		20 to 30	10 to 15	10 to 15	10 to 15	10 to 15
	Crushed to	-	-	-	-	-
Pit Average % Passing	2"	74	-	-	73	100
	1"	58	74	67	62	85
	3/4"	49	64	58	57	76
	1/2"	41	57	52	51	64
	#4	28	43	39	38	39
	#10	22	34	33	32	28
	#200	2	3	12	7	4
P.I.		N.P.	N.P.	5	N.P.	N.P.
Lab. Numbers		60-13630 - 13655	62-1590	62-1852	62-1638	63-17136

Remarks:

Material Pit Summary:

Table 25-5-2 continued

		25-5-5 (Prospect)	25-5-6 (Prospect)	25-5-7 (Prospect)	25-5-8 (Prospect)	25-5-9 (Prospect)	25-5-10 (Prospect)
Pit or Prospect No.		25-5-5 (Prospect)	25-5-6 (Prospect)	25-5-7 (Prospect)	25-5-8 (Prospect)	25-5-9 (Prospect)	25-5-10 (Prospect)
Location	Section	NW 1/4 sec. 6	SE 1/4 sec. 22	36	SE 1/4 sec. 30 & N 1/2 sec. 32	W 1/2 sec. 18	3
	Twnshp. & Range	T 14 S, R 4 W	T 13 S, R 4 W	T 11 S, R 5 W	T 13 S, R 5 W & T 13 S, R 4 W	T 14 S, R 4 W	T 14 S, R 4 W
	County	Sierra	Sierra	Sierra	Sierra	Sierra	Sierra
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	State land	Federal land	Federal land	Federal land
Geologic Age		Quaternary	Quaternary	Quaternary	Pennsylvanian	Quaternary	Quaternary
Formation		Alluvium (stream gravel)	Alluvium	Terrace deposit	Madera	Terrace deposit	Terrace
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel	Quarry	Sand & gravel	Sand & gravel
Kind of Material		Igneous & limestone	Igneous	Igneous	Limestone	Igneous & metamorphic	Igneous, limestone, & metamorphic
Quality of Material		Good	Good	Good	Good	Good	Good
Thickness of Material		25+ feet	6 feet	15+ feet	?	7.0 feet	5 to 10 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	-	Unexplored	-	-
Uniformity		Good	Good	Good	Good	Good	Good
Impurities		Silt & clay lenses	Silt & clay lenses (minor)	Silt & clay lenses	Interbedded shale	-	None
Type of Mat'l. Underlying Formation		Santa Fe	Santa Fe	Santa Fe	?	Clay	Santa Fe formation
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood, mesquite, cactus	Mesquite, willow, greasewood	Mesquite	Greasewood	Mesquite	Greasewood, mesquite
Local Terrain		Hilly	Hilly	Hilly to flat	Dissected plain	Flat	Rough and hilly
Depth of Overburden		Trace	-	1 to 3 feet	-	1 to 3 feet	1 to 3 feet
P.I. (Overburden)		-	-	-	-	10	N.P.
Est. Reserve Quantity		Unexplored	Unlimited	Unexplored	Unlimited	Unexplored	Unexplored
Approx. Haul to Nearest Point		0.5 mile	1 mile	1 mile	2 miles	0.5 mile	1 mile
L.A. Wear		Unexplored	18.4	Unexplored	26.0	Unexplored	17.2
Maximum Size		8"	4"	6"	-	6"	24"
% Retained on 2" Sieve		20	16	20	-	10 to 15	30 to 35
	Crushed to	-	-	-	1"	-	-
	2"	-	84	-	-	89	66
Pit	1"	67	74	65	100	73	57
Average	3/4"	55	69	54	82	65	48
% Passing	1/2"	45	61	41	51	58	39
	#4	29	46	18	20	42	26
	#10	24	40	8	10	38	20
	#200	3	6	2	2	2	3
P.I.		N.P.	N.P.	9	N.P.	N.P.	N.P.
Lab. Numbers		62-1628	62-8310	62-1838	63-17137	62-1607	63-17139

Remarks:

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-5-2 continued

Pit or Prospect No.		25-5-11 (Prospect)	25-5-12 (Prospect)	25-5-13 (Prospect)	25-5-14 (Prospect)	25-5-15 (Prospect)	25-5-16 (Prospect)
Location	Section	SW 1/4 sec. 15	W 1/2 sec. 33	SW 1/4 sec. 27	SE 1/4 Sec. 34	SW 1/4 sec. 32	NE 1/4 sec. 20
	Twnshp. & Range	T 13 S, R 4 W	T 12 S, R 4 W	T 12 S, R 5 W	T 11 S, R 5 W	T 11 S, R 4 W	T 12 S, R 4 W
	County	Sierra	Sierra	Sierra	Sierra	Sierra	Sierra
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Federal land	Private	Federal land	Private	Federal land
Geologic Age		Quaternary-Tertiary	Quaternary-Tertiary	Quaternary	Quaternary-Tertiary	Quaternary	Quaternary-Tertiary
Formation		Terrace deposit	Santa Fe	Alluvium	Santa Fe	Alluvium (stream gravel)	Santa Fe
Type of Pit		Sand & gravel	Gravel	Sand & gravel	Gravel	Sand & gravel	Gravel
Kind of Material		Igneous	Igneous	Igneous	Igneous	Igneous	Igneous
Quality of Material		Good	Poor	Good	?	Fair to good	Poor
Thickness of Material		25 feet	25 feet	6 feet	15 feet	?	15 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	-	-	-	-
Uniformity		Good	Fair	Good	Fair	Fair	Fair
Impurities		Silt & clay lenses	Silt & clay	Silt & clay lenses	Clay	Silt & clay lenses	Silt & clay
Type of Mat'l. Underlying Formation		Sand, silt, clay, & gravel	Silt & clay	?	Sand, silt, & clay	Silt & clay	Silt & clay
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood, cactus, range grass	Greasewood, mesquite	Mesquite, pinon, & grass	Greasewood	Greasewood, mesquite, cottonwood	Greasewood
Local Terrain		Dissected terrace	Dissected plain	Floor of canyon	Flat	Creek bottom	Dissected plain
Depth of Overburden		-	0.0 to 2.0 feet	Trace	0.0 to 2.0 feet	Est. 0 to 6 feet	1.0 to 1.5 feet
P.I. (Overburden)		-	13	-	8 - 15	N.P.	13
Est. Reserve Quantity		See remarks	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
Approx. Haul to Nearest Point		0.2 mile	0.3 mile	0.5 mile	3 miles	1.5 miles	0.5 mile
L.A. Wear		18 to 20	18.8	20.8	Unexplored	-	20 (average)
Maximum Size		5"	4"	4"	8"	6"	5"
% Retained on 2" Sieve		15 to 20	10	6	Unexplored	Less than 5	5 to 20
	Crushed to	-	-	-	"	-	-
	2"	-	90	75	"	100	74
Pit	1"	85	82	63	"	92	58
Average	3/4"	81	58	56	"	86	50
% Passing	1/2"	75	48	48	"	76	41
	#4	56	27	33	"	49	23
	#10	47	17	26	"	33	15
	#200	10	4	7	"	3	6
P.I.		N.P.	24	N.P.	"	N.P.	22
Lab. Numbers		62-1826	62-8311--8312	62-8309	"	63-17141	62-8315

Remarks:

25-5-11 (Prospect) - This terrace lies on the north side of Cuchillo Creek. Ten to fifteen feet of good clean sand (A-3) underlies the gravel in this deposit.

Material Pit Summary:

Table 25-5-2 continued

Pit or Prospect No.		25-5-17 (Prospect)	25-5-18 (Prospect)
Location	Section	SW 1/4 sec. 9	SE 1/4 sec. 3
	Twnshp. & Range	T 12 S, R 4 W	T 12 S, R 4 W
	County	Sierra	Sierra
	State	New Mexico	New Mexico
Owner		Federal land	Federal land
Geologic Age		Quaternary-Tertiary	Quaternary
Formation		Santa Fe	Terrace deposit
Type of Pit		Gravel	Gravel
Kind of Material		Igneous	Igneous
Quality of Material		Poor	Poor
Thickness of Material		15 feet	15 feet
Thickness of Cap (Caliche)		-	-
Blasting Qualities		-	-
Uniformity		Fair	Fair
Impurities		Silt & clay	Interbedded silt & clay
Type of Mat'l. Underlying Formation		Silt & clay	Silt & clay
Moisture Condition		Dry	Dry
Vegetation		Greasewood	Greasewood
Local Terrain		Dissected Plain	Several terrace levels
Depth of Overburden		0.0 to 1.5 feet	1 to 3 feet
P.I. (Overburden)		13	23
Est. Reserve Quantity		Unlimited	See remarks
Approx. Haul to Nearest Point		1.7 miles	3 miles
L.A. Wear		21.6	-
Maximum Size		5"	6"
% Retained on 2" Sieve		8	15 to 20
	Crushed to	-	-
Pit Average % Passing	2"	92	100
	1"	77	88
	3/4"	69	73
	1/2"	58	60
	#4	34	32
	#10	22	22
	#200	6	9
P.I.		17 - 22	23
Lab. Numbers		62-8313 - 8314, 8316	62-1849

Remarks:

25-5-17 (Prospect) - This area is shown to demonstrate the type material generally found in the pediment deposit of the Santa Fe group.

25-5-18 (Prospect) - This area is shown to demonstrate the variation of P.I. in the terrace deposits; farther upstream this deposit has less clay.

SOILS AND GEOLOGY

Introduction:

This strip lies west of the Rio Grande in northern Sierra County and southern Socorro County. It begins 14 miles north of Truth or Consequences and ends 7 miles north of the Sierra-Socorro County line.

The rugged San Mateo Mountains extend into the central part of the strip. A highly dissected pediment flanks these mountains and slopes gently toward the Rio Grande. Deep canyons have been cut into the pediment. Nogal Canyon is the largest canyon in this strip.

General Geology:

The San Mateo Mountains are a very rugged, inaccessable mass of Tertiary volcanic rocks. They consist of many fault blocks that dip to the east. The entire southwestern side is bounded by a fault scarp. The southern and eastern sides are irregular because of burial by Tertiary and Quaternary sediments which were later dissected by many arroyos.

Paleozoic sedimentary rocks are exposed in Nogal Canyon west of U.S. 85. This exposure is an eastward-dipping fault-block of sandstone, shale, and limestone assigned to the Yeso and San Andres formations.

Volcanic activity began during the middle Tertiary. Molten rock flowed from vents and fissures upon an irregular surface of Upper Paleozoic sedimentary rocks. Rhyolite, andesite, latite, and their associated tuffs and breccias are included in this volcanic mass. These flows are traversed by many cracks and fractures caused by settling of the main mass and adjustment between fault blocks during cooling. They are further complicated by intrusive dikes and sills.

The Rio Grande depression, a structural low through which the Rio Grande flows, began to form during late Tertiary and probably was contemporaneous with the intense faulting in the San Mateo Mountains. This depression is made up of a series of basins formed en echelon along the Rio Grande from Colorado to El Paso, Texas. This strip covers a part of two of these basins: the Engle basin and the San Marcial basin. These two basins are separated by the San Mateo uplift. The Engle basin is to the south of the uplift and the San Marcial basin is to the north of the uplift. As these basins were down-faulted, they were filled with sediments from the adjacent highlands.

Sediments within the San Marcial and Engle basins are primarily sand, silt, clay, and gravel of the Santa Fe group. Locally they are a lacustrine, alluvial fan, and pediment deposit.

The Rio Grande carved its present valley in the Santa Fe group sediments. The river has formed a relatively broad flood plain with deposits of sand, silt, and clay. The confluence of the Rio Grande and Elephant Butte Dam causes variable sedimentation at the confluence of the river and the lake.

Long, deep canyons extend westward from the Rio Grande for many miles into the Santa Fe group sediments. Terrace deposits have formed along the course of these canyons. Near the Rio Grande these deposits grade into well-washed river deposits.

The areal distribution of formations is shown on Soils and Geology Map 25-6. Their succession and character are given under the section termed "Stratigraphy."

Soils:

The soils in this strip are predominantly transported and support a dense growth of greasewood, cacti, and range grass. The moisture is sufficient in stream beds to support pinons, cottonwoods, and cedars.

Alluvium (Qal): Alluvium occurs along the tributary arroyos and washes of the Rio Grande. These transported soils are derived from reworked Santa Fe beds, pediment gravels, and materials from the mountainous uplands. The alluvial surface soil varies from a sandy silt (A-4) to a clay (A-6 and A-7) of variable thickness. The surface soil is underlain by sand and gravel.

Terrace deposits (Qt): Terraces have been cut along the courses of the tributary arroyos. In many cases any gravel that may have been on them has been scoured off. Where this has occured the surface is clay (A-7) and grades directly into Santa Fe beds.

Nogal Canyon has good terrace deposits. The deposits are predominantly sand and gravel (A-1-a) and may be as thick as 10 feet or more.

The Rio Grande terraces have a profile of sandy silt (A-4) underlain by a thick deposit of clean, washed, sand and gravel (A-1-a).

Alluvial fan deposits (Qaf): An alluvial fan has formed along the southern part of the San Mateo Mountains. The fan has been deposited by streams issuing from the mountains. The fan slopes gently eastward toward the Rio Grande and Recent erosion has left numerous washes across it.

The surface soil of the fan is clay and gravel (A-2-7) about 2 feet thick; it is underlain by sand and gravel (A-1-a) and clayey gravel (A-2-7) of undetermined thickness. The upper part of the second zone is cemented by calcium carbonate (caliche).

Flood-plain deposits (Qfp): The Rio Grande flood plain becomes very narrow in this strip and is covered with dense vegetation. No attempt was made to classify the floodplain soils.

Santa Fe group (QTsf): This group covers a very large area in this strip. It is a pediment and alluvial fan deposit in its upper part. The silicic and intermediate volcanic gravels found in the pediment zone are derived from the adjacent mountainous region to the west.

The predominant surface soil is silty gravel (A-2-4) to clayey gravel (A-2-6 and A-2-7) which may be 3 feet thick. Broad swales have developed on the surface due to Recent erosion and they contain accumulations of silt (A-4) and clay (A-7).

A poorly- to well-consolidated layer of clayey gravel (A-2-7) cemented by calcium carbonate (caliche) lies below the surface soils. This caliche zone also includes lenses of sand, silt, and clay. Below the caliche zone are erratic lenses of sand and gravel (A-l-a), beds of gravel cemented by clay (A-2-7), and clay lenses (A-7).

Table 25-6-I shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of soils and their related formations is shown on Soils and Geology Map 25-6.

Stratigraphy:

Quaternary: Alluvium (Qal) - a heterogeneous mixture of sand, silt, clay, and gravel.

Terrace deposits (Qt) - a heterogeneous mixture of sand, gravel, silt and clay.

Flood-plain deposits (Qfp) - subround particles of sand, gravel, silt, and clay.

Basalt (Qb) - massive to vesicular light-gray basalt underlain by a sequence of pyroclastic breccia.
Thickness: 30 to 50 feet.

Unconformity--

Quaternary-Tertiary: Santa Fe group (QTsf) - a poorly-consolidated to well-consolidated mixture of sand, gravel, silt, and clay in its upper portion. The upper part (pediment deposit) unconformably overlies well-consolidated sand, silt, clay, and gravel.
Thickness: 2,000+ feet.

Unconformity--

Tertiary: Monzonite (Tm) - a light-gray, massive monzonite.

Rhyolite (Tr) - a light-gray, fine- to medium-grained, massive rhyolite. Flow banding was noted in some areas.

Andesite (Ta) - andesite flows, tuffs, and breccias; includes extensively altered latite flows and pyroclastic rocks.

Volcanic rocks undifferentiated (Tvu) - latite breccias, andesite flows and breccias, rhyolite with thin tuff beds, and light-colored tuffs and breccias.

Unconformity--

Permian: San Andres formation (Psa) - a light- to dark-gray, thin- to medium-bedded, cherty limestone.
Thickness: 150 feet.

Yeso formation (Py) - pink, gray, and yellow, fine-grained sandstone with limestone, and gypsum.
Thickness: 100+ feet.

Construction Materials:

Quaternary: Alluvium (Qal) - Sand, silt, and gravel occur in the bottoms of most of the larger arroyos and canyons. Residual material from the Santa Fe group sediments and the San Mateo Mountains make up this material. Most of these channels seem to have an abundance of clean, well-washed material. Laboratory tests run on a sample from Nogal Canyon (Prospect 25-6-16) report a non-plastic sand and gravel with 82 percent passing the one inch sieve, 24 percent passing the No. 4 sieve, and 5 percent passing the No. 200 sieve. This material will probably grade into the Santa Fe group sediments at a depth of less than 15 feet.

Terrace deposits (Qt) - Terrace gravel occurs along several of the larger drainageways of this strip. Deposits adjacent to San Jose Arroyo and Nogal Canyon seem to be the most favorable source areas. Gravel in the deopsit west of U.S. 85 (Prospect 25-6-15) is sandy and non-plastic with about 10 percent retained on the 2" sieve, 20 percent passing the No. 4 sieve, and less than 3 percent passing the No. 200 sieve. Near the flood plain of the Rio Grande these terrace deposits grade into river-washed materials.

Alluvial fan deposits (Qaf) - This deposit extends east and south of the San Mateo Mountains. It is a very heterogeneous deposit of sand, gravel, silt, and clay. It is made up of angular particles of igneous rocks and it is cemented by calcium carbonate (caliche) in its upper portion. The upper part has a P.I. of less than 7 which indicates that usable materials may be obtained from this deposit. Prospect 25-6-8 and soil samples 21 and 13 are representative of this material.

Quaternary-Tertiary: Santa Fe group (pediment gravel) (QTsf) - This is the oldest alluvial material of the area and the upper part of the deposit is fairly well indurated. In some places the pediment gravels are over 100 feet thick. It is quite difficult to determine the contact between the pediment gravels and the older Santa Fe group. The pediment gravels are primarily igneous rocks that, through weathering and breakdown, have produced high percentages of clay. There are, no doubt, channels of non-plastic materials in this deposit; however, it is primarily a silt- and clay-saturated gravel. In fact, this material is so well-cemented by clay near Nogal Canyon that vertical cuts withstand weathering quite well. Near the surface of the deposit, recent streams have reworked and redeposited this material; therefore extensive exploration may reveal usable deposits of non-plastic materials.

Prospects 25-6-4, 25-6-12, and 25-6-17 are favorable areas for further materials investigations. Areas adjacent to some of the larger drainageways seem to have non-plastic gravel (see soil sample 7, section of the Santa Fe group). "A", "B", and "C" horizons were, reworked by the stream which now flows through Nogal Canyon.

Santa Fe group continued. . .

Further research may develop a use for the clay saturated pediment deposits or an economical means of separating the clay from the gravel.

Tertiary: Rhyolite (Tr) - This material is exposed in the San Mateo Mountains and in hills and ridges along the edge of the San Mateo Mountains. It is fine- to medium-grained, vesicular to some extent, and flow-banded.

Prospects 25-6-2, 25-6-7, 25-6-9, and 25-6-13 are all excellent sources for quarry rock. Laboratory tests run on samples from these prospects report a L.A. Wear of less than 20, and an excellent grading after crushing to one inch. There is an almost unlimited supply of this rock in this strip.

Permian: San Andres formation (Psa) - A dense, massive- to thin-bedded limestone with minor shale lenses crops out in and to the south of Nogal Canyon, west of U.S. 85. Prospect 25-6-14 is representative of this limestone. Laboratory tests run on a sample from Prospect 25-6-14 report the material to be non-plastic with a L.A. Wear of about 21 after crushing to one inch. An almost unlimited quantity of quarry rock can be produced from this area.

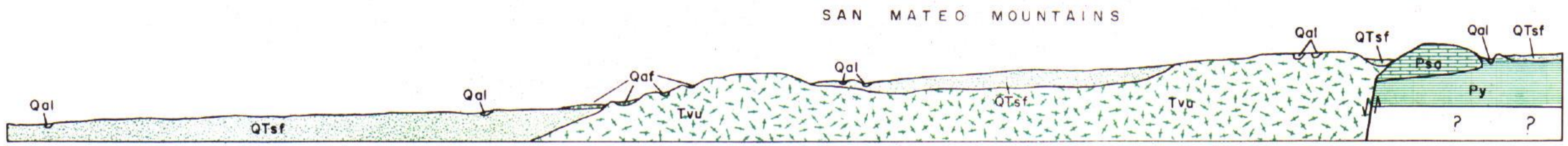
Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-6. Test data and other related information are shown in Material Pit Summary Table 25-6-2.

Selected References:

Harley, G. T., (1954), The Geology and Ore Deposits of Sierra County, New Mexico, New Mexico State Bureau of Mines and Mineral Resources, Bull. 10, pp. 190-193.

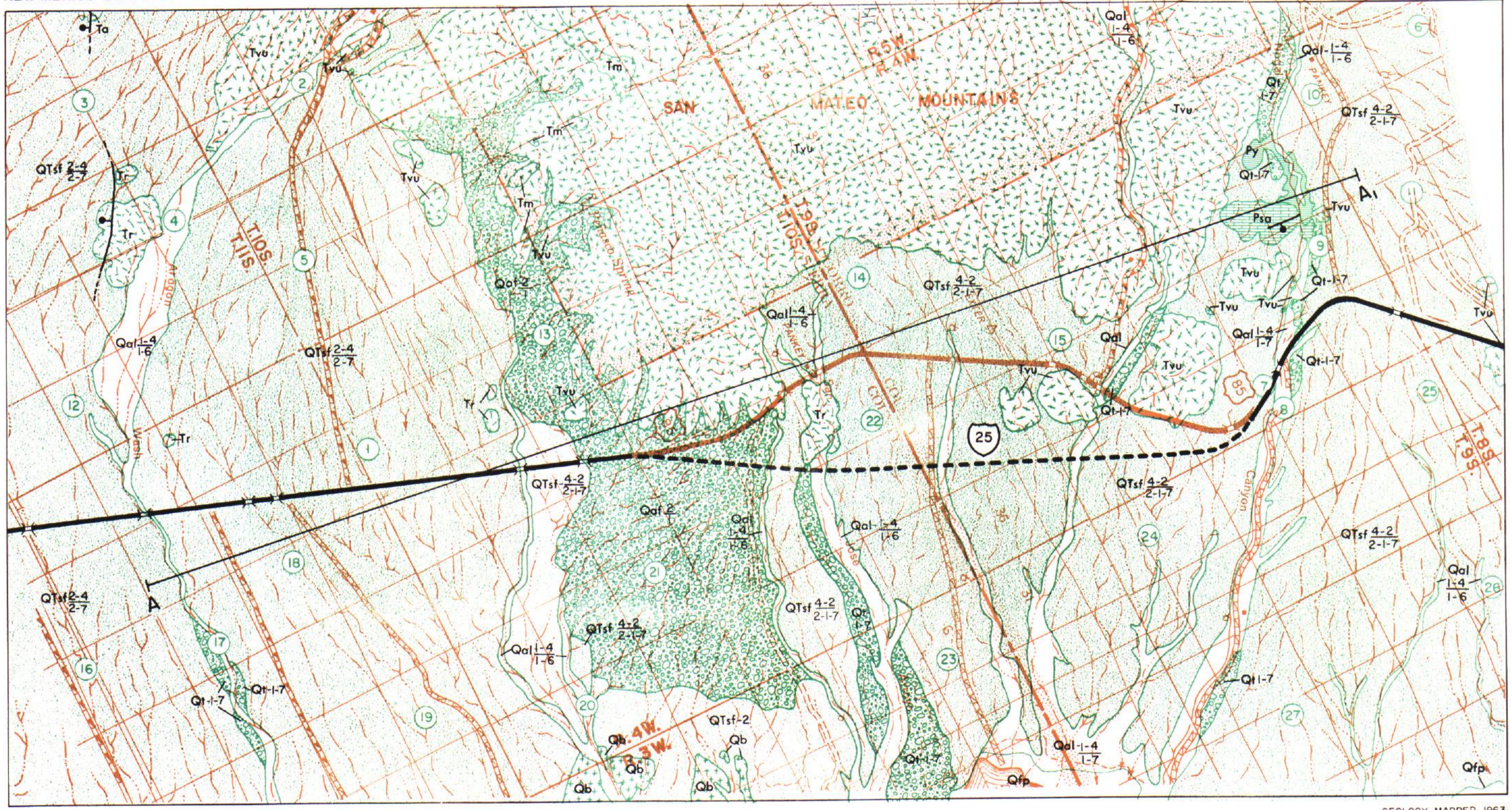
New Mexico Geological Society, (1955), Guidebook of South Central New Mexico, 6th Field Conference, p.101.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-6

SOILS AND GEOLOGY MAP 25-6



GEOLOGY MAPPED 1963

- LEGEND -

SEDIMENTARY ROCKS

QUATERNARY: Qal Alluvium; Qt Terrace deposits; Qfp Flood-plain deposits; Qaf Alluvial fan deposits

TERTIARY: QTsf Santa Fe group

PERMIAN: Py Abo formation; Psa San Andres formation

IGNEOUS ROCKS

QUATERNARY: Qb Basalt

TERTIARY: Tm Monzonite; Tr Rhyolite; Ta Andesite and andesite tuff breccia; Tvu Volcanic rocks undifferentiated

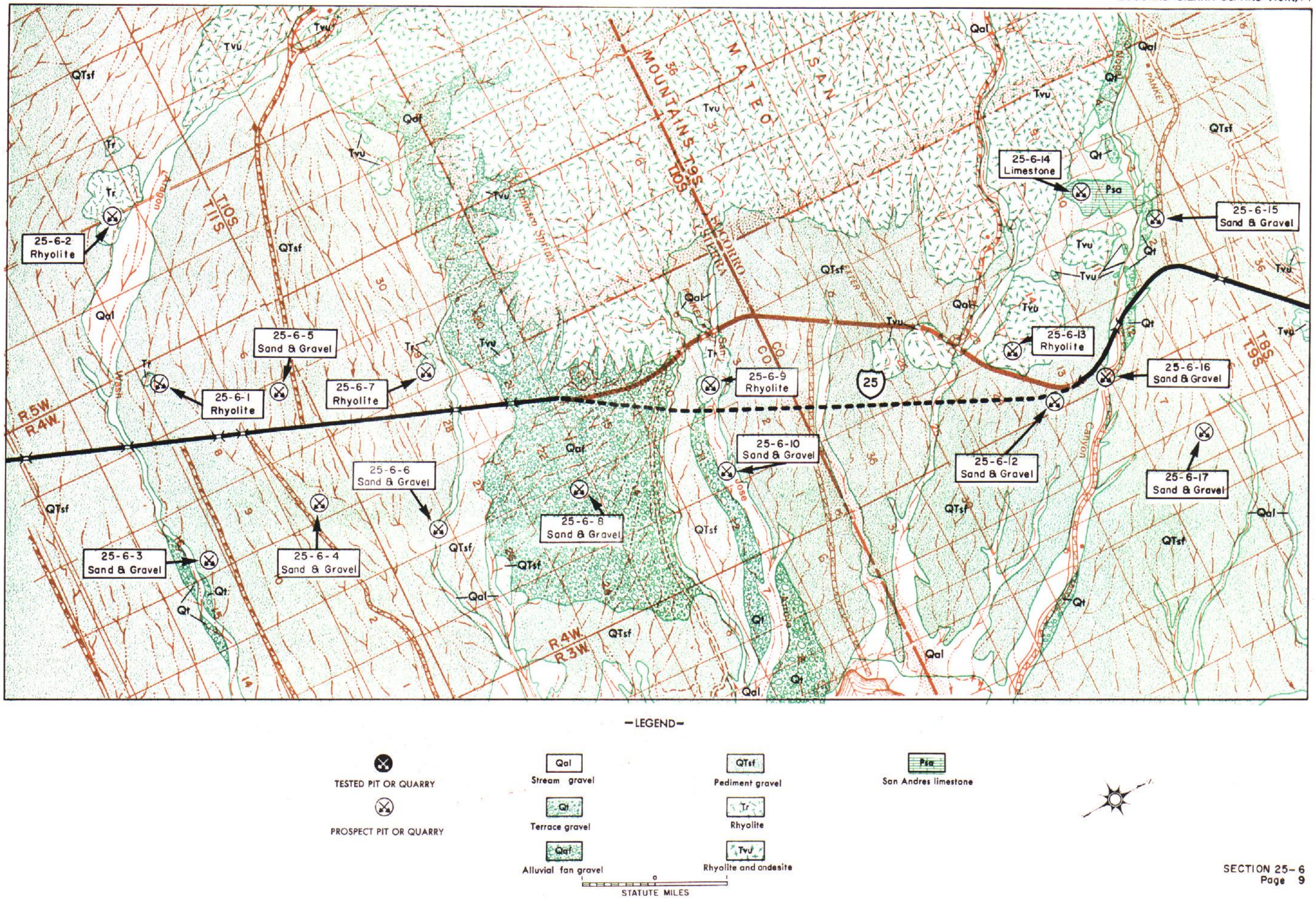
STATUTE MILES

Soils Summary:

Table 25-6-1

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
QTsf	1	A	0.0	2.0	A-4	Gravelly silt
Qal	2	A	0.0	3.0	A-1-b	Coarse-grained sand
QTsf	3	A	0.0	2.0	A-2-4	Silty, sandy gravel
Qal	4	A	0.0	5.0	A-6	Clay
QTsf	5	A	0.0	2.0	A-2-4	Silty, sandy gravel
"	6	A	0.0	3.0	A-2-6	Clayey gravel
Section from Santa Fe group:						
QTsf	7	A	0.0	0.8	A-4	Gravelly silt
"		B	0.8	6.0	A-1-a	Sand and gravel
"		C	6.0	14.0	A-1-a	" " "
"		D	14.0	50.0	A-2-7	Clayey gravel
"		E	50.0	54.0	A-7	Gravelly clay
"		F	54.0	154.0	A-2-6	Clayey gravel
Qal	8	A	0.0	2.0	A-4	Sandy silt
"		B	2.0	4.0	A-1-a	Sand and gravel
Qt	9	A	0.0	6.0	A-1-a	" " "
QTsf	10	A	0.0	2.0	A-4	Sandy silt
"	11	A	0.0	2.5	A-4	Silt
"	12	A	0.0	3.0	A-6	Clay
"		B	3.0	11.0	A-2-4	Silty gravel
Qaf	13	A	0.0	1.0	A-1-b	Silty gravel
QTsf	14	A	0.0	2.0	A-2-4	Silty gravel
"		B	2.0	12.0	A-2-7	Clayey gravel
"	15	A	0.0	2.0	A-4	Gravelly silt
"	16	A	0.0	2.0	A-4	Silt
Qal	17	A	0.0	4.0	A-1-a	Sand and gravel
QTsf	18	A	0.0	1.0	A-4	Silt
"		B	1.0	3.0	---	Caliche
"		C	3.0	53.0	A-2-7	Clayey gravel
"	19	A	0.0	2.0	A-4	Silt
Qal	20	A	0.0	3.0	A-1-a	Sand and gravel
"		B	3.0	5.0	A-6	Clay
Qaf	21	A	0.0	1.0	A-2-4	Silty gravel
"		B	1.0	7.0	---	Sand and gravel
"		C	7.0	20.0	A-4	Gravelly silt
QTsf	22	A	0.0	2.0	A-4	" "
"	23	A	0.0	4.0	A-4	" "
"	24	A	0.0	2.0	A-7	Gravelly clay
"	25	A	0.0	3.0	A-6	" "
"	26	A	0.0	6.0	A-4	Gravelly silt
"	27	A	0.0	4.0	A-4	" "

CONSTRUCTION MATERIALS MAP 25-6



Material Pit Summary:

Table 25-6-2

		25-6-1 (Prospect)	25-6-2 (Prospect)	25-6-3 (Prospect)	25-6-4 (Prospect)	25-6-5 (Prospect)
Pit or Prospect No.						
Location	Section	SW 1/4, sec. 7	NE 1/4, sec. 10 & NW 1/4, sec. 11	NE 1/4, sec. 16	E 1/2, sec. 4	NW 1/4, sec. 5
	Twnshp. & Range	T 11 S, R 4 W	T 11 S, R 5 W	T 11 S, R 4 W	T 11 S, R 4 W	T 11 S, R 4 W
	County	Sierra	Sierra	Sierra	Sierra	Sierra
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Federal land	Federal land	State land	Federal land	Federal land
Geologic Age		Tertiary	Tertiary	Quaternary-Tertiary	Quaternary-Tertiary	Quaternary-Tertiary
Formation		Rhyolite	Volcanic	Santa Fe group	Santa Fe group	Santa Fe group
Type of Pit		Quarry	Quarry	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Rhyolite	Rhyolite	Igneous gravel	Igneous gravel	Igneous gravel
Quality of Material		Good	Good	Fair	?	Fair to poor
Thickness of Material		75+ feet	100+ feet	5 feet	?	3 feet
Thickness of Cap (Caliche)		-	-	-	-	-
Blasting Qualities		Good	Good	-	-	-
Uniformity		Excellent	Good	Fair	Fair to poor	Fair to poor
Impurities		None	None	Silt and clay	Silt & clay lenses	Silt & clay lenses
Type of Mat'l, Underlying Formation		?	?	?	?	?
Moisture Condition		Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood, mesquite, & range grass	Greasewood, mesquite, & range grass	Greasewood & mesquite	Greasewood & range grass	Greasewood
Local Terrain		Dissected plain	Dissected plain	Dissected plain	Dissected plain	Dissected plain
Depth of Overburden		0.0 to 1.0 foot	0.0 to 1.0 foot	3 feet	Unexplored	2 feet
P.I. (Overburden)		-	-	15	"	10,3
Est. Reserve Quantity		Unlimited	Unlimited	?	"	?
Approx. Haul to Nearest Point		0.7 mile	3.4 miles	1.8 miles	1.5 miles	0.7 miles
L.A. Wear		17.2	18.0	17.6	Unexplored	19.6
Maximum Size		-	-	2"	"	?
% Retained on 2" Sieve		-	-	0.0	"	10
	Crushed to	1"	1"	-	"	-
	2"	-	-	100	"	90
Pit	1"	100	100	90	"	79
Average	3/4"	96	94	79	"	72
% Passing	1/2"	63	60	69	"	59
	#4	22	20	43	"	28
	#10	11	10	25	"	17
	#200	3	2	13	"	9
P.I.		N.P.	N.P.	24	"	13
Lab. Numbers		62-14918	62-14917	63-17914-15	"	63-17916-17

Remarks:

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-6-2 continued...

Pit or Prospect No.		25-6-6 (Prospect)	25-6-7 (Prospect)	25-6-8 (Prospect)	25-6-9 (Prospect)	25-5-10 (Prospect)
Location	Section	NE 1/4, sec. 34	Center 1/4, sec. 29	NW 1/4, sec. 23	S 1/2, sec. 3 & NE 1/4 sec. 9	N 1/2, sec. 11
	Twnshp. & Range	T 10 S, R 4 W	T 10 S, R 4 W	T 10 S, R 4 W	T 10 S, R 4 W	T 10 S, R 4 W
	County	Sierra	Sierra	Sierra	Sierra	Sierra
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Federal land	Federal land	Federal land	Private & Federal land	Federal land
Geologic Age		Quaternary	Tertiary	Quaternary	Tertiary	Quaternary
Formation		Stream gravel (Qal)	Volcanic	Alluvial fan	Volcanic	Stream gravel (Qal)
Type of Pit		Sand & gravel	Quarry	Sand & gravel	Quarry	Sand & gravel
Kind of Material		Igneous gravel	Rhyolite	Igneous gravel	Rhyolite	Igneous
Quality of Material		Good	Good	Good	Good	Fair
Thickness of Material		?	60+ feet	?	50+ feet	?
Thickness of Cap (Caliche)		-	-	-	-	-
Blasting Qualities		-	Good	-	Good	-
Uniformity		Good	Good	Fair	Good	Fair to poor
Impurities		Silt & clay lenses	None	Silt & clay	None	Silt & clay
Type of Mat'l. Underlying Formation		Santa Fe group	?	Sand, silt, clay, gravel	?	Sand, silt, clay, gravel (QTsf)
Moisture Condition		Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood & mesquite	Greasewood & mesquite & range grass	Greasewood, mesquite, & range grass	Greasewood	Greasewood & mesquite
Local Terrain		Dissected plain	Dissected Plain & alluvial fan	Dissected fan	Dissected plain	Dissected plain
Depth of Overburden		-	-	0.0 to 1.0 foot	-	-
P.I. (Overburden)		-	-	7	-	-
Est. Reserve Quantity		Unlimited	Unlimited	?	Unlimited	Unlimited
Approx. Haul to Nearest Point		1.7 miles	0.5 mile	1.6 miles	0.5 miles	2.0 miles
L.A. Wear		18.0	16.8	?	17.2	20.0
Maximum Size		8"	-	2"	-	-
% Retained on 2" Sieve		0.0	-	-	-	14
	Crushed to	-	1"	As received	1"	-
	2"	100	-	-	-	86
Pit	1"	82	100	56	100	63
Average	3/4"	73	95	43	95	52
% Passing	1/2"	63	62	25	60	41
	#4	36	21	9	20	23
	#10	24	10	5	10	17
	#200	11	2	2	2	7
P.I.		8	N.P.	?	N.P.	N.P.
Lab. Numbers		63-17918	62-14923	62-10115	62-14916	63-17919

Remarks:

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-6-2

Pit or Prospect No.	25-6-12 (Prospect)	25-6-13 (Prospect)	25-6-14 (Prospect)	25-6-15 (Prospect)	25-6-16 (Prospect)	25-6-17 (Prospect)
Location: Section	SE 1/4, sec. 24	SE 1/4, sec. 14	SE 1/4 sec. 3	SW 1/4 sec. 2	NE 1/4 sec. 13	NW 1/4 sec. 7
Twnshp.	T 9 S,	T 9 S	T 9 S	T 9 S	T 9 S	T 9 S
& Range	R 4 W	R 4 W	R 4 W	R 4 W	R 4 W	R 3 W
County	Socorro	Socorro	Socorro	Socorro	Socorro	Socorro
State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner	State land	Federal land	Federal land	State land	State land	Federal land
Geologic Age	Quaternary-Tertiary	Tertiary	Permian	Quaternary	Quaternary	Quaternary-Tertiary
Formation	Santa Fe group	Volcanic	San Andres	Terrace deposit	Stream gravel (Qal)	Santa Fe group
Type of Pit	Sand & gravel	Quarry	Quarry	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material	Igneous gravel	Rhyolite	Limestone	Igneous gravel	Igneous & limestone gravel	Igneous gravel
Quality of Material	Fair to poor	Good	Good	Good	Good	?
Thickness of Material	?	100+ feet	75+ feet	?	?	?
Thickness of Cap (Caliche)	3 feet	-	-	-	-	-
Blasting Qualities	-	Good	Good	-	-	-
Uniformity	Fair	Good	Good	Good	Good	Fair to good
Impurities	Silt & clay	None	Interbedded shale (minor)	Silt & clay	Silt & clay	Silt & clay
Type of Mat'l. Underlying Formation	?	?	Shale, sandstone, & limestone (Py)	?	Sand, silt, clay, & gravel (QTsf)	?
Moisture Condition	Dry	Dry	Dry	Dry	Dry	Dry
Vegetation	Greasewood	Greasewood	Greasewood, mesquite, & range grass	Greasewood & range grass	Mesquite, greasewood, & range grass	Greasewood
Local Terrain	Dissected plain	Dissected plain	Rolling hills & deep arroyos	Flat land near deep canyon	Deep canyon	Dissected plain
Depth of Overburden	0.0 to 3.0 feet	-	-	?	0.0 to 2.0 feet	0.0 to 2.0 feet
P.I. (Overburden)	6	-	-	-	N.P.	Unexplored
Est. Reserve Quantity	Unlimited	Unlimited	Unlimited	-	Unlimited	"
Approx. Haul to Nearest Point	1.0 mile	0.3 mile	3.8 miles	1.0 mile	0.5 mile	"
L.A. Wear	19.6	22.4	21.6	-	?	"
Maximum Size	8"	-	-	10"	6"	8"
% Retained on 2" Sieve	16	-	-	9	?	Unexplored
Crushed to	-	1"	1"	-	-	"
2"	84	-	-	-	100	"
Pit 1"	66	100	100	56	82	"
Average 3/4"	55	81	81	43	67	"
% Passing 1/2"	45	44	43	34	52	"
#4	27	19	18	20	24	"
#10	17	10	10	12	17	"
#200	6	3	2	1	5	"
P.I.	9	N.P.	N.P.	N.P.	N.P.	"
Lab. Numbers	63-17920-22	62-14915	62-14914	62-10098	62-10097	"

SOILS AND GEOLOGY

Introduction:

This strip begins about 1.5 miles south of Crawford Hollow and ends about 3 miles north of San Marcial, Socorro County, New Mexico.

Structurally the area lies within the San Marcial basin, one of many linked basins in the Rio Grande depression which extends from southern Colorado to El Paso, Texas.

General Geology:

The San Marcial basin is about 30 miles long and 10 to 15 miles wide. The longitudinal axis parallels the course of the Rio Grande. The San Marcial basin is bounded on the east by the San Pascual platform and on the west by the Magdalena uplift. It narrows into the Pankey channel on the south and is bounded on the north by the Socorro constriction.

The strip is characterized by a monotonous pediment which has formed upon the Santa Fe group. The pediment surface is broken by Tertiary flows of latite and rhyolite and long irregular arroyos that drain into the Rio Grande.

In late Miocene time, the San Marcial basin and the mountain ranges to the west were apparently formed by block-faulting. Deposition of Santa Fe sediments was occurring as the basin was forming, and continued after it was formed. These unconsolidated sediments are predominantly clays and silts with minor amounts of sand and gravel.

Renewed faulting occurred after the basin filling. Volcanic activity associated with the faulting produced isolated flows of rhyolite and latite. During and after the volcanic activity a pediment cover of gravel and silt began to accumulate on the basin fill. The material was deposited by sheet wash and meandering streams. The pediment gravel is flat to slightly rounded fragments of volcanic rock with plastic silt and clay.

The present Rio Grande drainage began to develop after the faulting and volcanic activity. At first the river meandered aimlessly over the gravel capped pediment as indicated by the presence of river sand and gravel several miles from the present flood plain. Later the area began to upwarp slowly and the river became entrenched in its present course. The tributaries also became entrenched and formed long, deep, parallel channels.

At the confluence of the larger tributaries and the Rio Grande there are sand and gravel terraces. These were formed by re-washing and deposition of debris brought down by the tributaries.

The areal distribution of formations is shown on Soils and Geology Map 25-7. Their succession and character are given under the section termed "Stratigraphy."

Soils:

Alluvium (Qal): An unconsolidated mixture of sand, silt, clay, and gravel in the channels of arroyos that drain into the Rio Grande. The material is derived from the pediment gravel that covers most of the area and is reworked and deposited. In most cases the alluvium does not contain as much silt and clay as does the pediment sources. The top layer of the alluvium varies from gravel (A-1-a) to silt (A-4). A layer of clay (A-6) lies beneath the top layer. It varies in thickness and may be discontinuous. Near the Rio Grande flood plain the alluvium tends to become sandier where it has been washed by the river.

Flood-plain deposits (Qfp): The top layer of soil in the flood plain varies from fine grained sand (A-3) to silt (A-4) to clay (A-7). There is a great deal of aeolian fine-grained sand (A-3) around the San Marcial flow on the east side of the flood plain.

Terrace gravels (Qtg): These materials grade into the alluvium and the pediment deposits to the west. They have a profile of silt (A-4) from one to about four feet thick over about 20 to 30 feet of well-washed sand and gravel (A-1-a). Underlying the sand and gravel are thick beds of flood-plain clays and silts.

Santa Fe group (QTsf): This group covers a very large part of this strip. It is a pediment and alluvial fan deposit in its upper part. The soil types are very discontinuous. The higher areas represent old stream deposits of fairly granular materials whereas the inter-stream areas are filled with silt and clay.

The granular materials vary from silty gravel (A-2-4) to clayey gravel (A-2-6 and A-2-7). The inter-stream areas or swales have silt (A-4) and clay (A-6).

The poorly-consolidated zone of clayey gravel (A-2-6 and A-2-7) cemented by caliche lies below the surface soils. This caliche zone also has discontinous channels of sand, silt, and clay. Below the caliche zone are erratic lenses of sand and gravel (A-1-a), beds of gravel cemented by clay (A-2-7), and clay (A-7).

Table 25-7-1 shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-7.

Stratigraphy:

Quaternary:

Alluvium (Qal) - sand, silt, clay, and gravel.

Flood-plain deposits (Qfp) - sand, silt, clay, and gravel.
Thickness: 100+ feet.

Terrace gravels (Qtg): well-rounded, well-washed sand and gravel.
Thickness: 30 feet.

Basalt (Qb) - olivine basalt.

Unconformity--

Stratigraphy continued...

Quaternary-Tertiary: Santa Fe group (QTsf) - alluvial fan and pediment deposits in its upper part; light-colored to reddish-brown mixture of sand, silt, clay, and gravel in its lower part.

Unconformity---

Tertiary: Volcanics undifferentiated (Tvu) - flows, sills, and necks of latite, rhyolite, and associated tuffs and breccias.

Construction Materials:

Quaternary: Alluvium (Qal) - Almost all of the larger arroyos of this strip are a potential gravel source. They are filled with angular- to sub-angular fragments of volcanic rock washed from the highlands to the west. Prospects 25-7-2, 25-7-6, and 25-7-8 are representative of the material that can be obtained from these drainageways.

Terrace gravels (Qtg) - Where the larger arroyos debauch onto the Rio Grande flood plain there are excellent terrace gravels. These gravels are primarily igneous materials that have been dumped into the Rio Grande by ephemeral streams.

Prospect 25-7-10 is representative of the material in these terrace deposits. It has about 20 feet of non-plastic, excellent quality sand and gravel. More than 15 percent is retained on the 2 inch sieve, about 25 percent passes the No. 4 sieve, and less than 5 percent passes the No. 200 sieve.

Quaternary-Tertiary: Santa Fe group (pediment gravel) (QTsf) - This is the oldest alluvial material of the area and the upper part is fairly well-indurated. In places the gravels are more than 10 feet thick. The gravels are interlaced stream deposits of angular igneous rocks that, through weathering and breakdown, have produced high percentages of clay. There are, no doubt, channels of non-plastic materials in this deposit; however, it is primarily a silt- and clay-saturated gravel.

Prospects 25-7-4 and 25-7-7 are examples of the non-plastic materials found in this deposit. Even though these two sites have non-plastic materials, it is believed that further exploration may reveal highly plastic clays in the immediate vicinity. The more desirable materials of the pediment surface seem to lie adjacent to the larger drainageways.

Tertiary: Volcanics undifferentiated (Tvu) - There are several exposures of latite and rhyolite that may be used for quarry rock. Plastic clays and tuffs are associated with these materials and one must be very selective in choosing a quarry site in which these materials can be avoided.

Prospects 25-7-5 and 25-7-9 are representative of the usable quarry rock. Note that the L.A. Wear of 25-7-5 is much higher than that of 25-7-9.

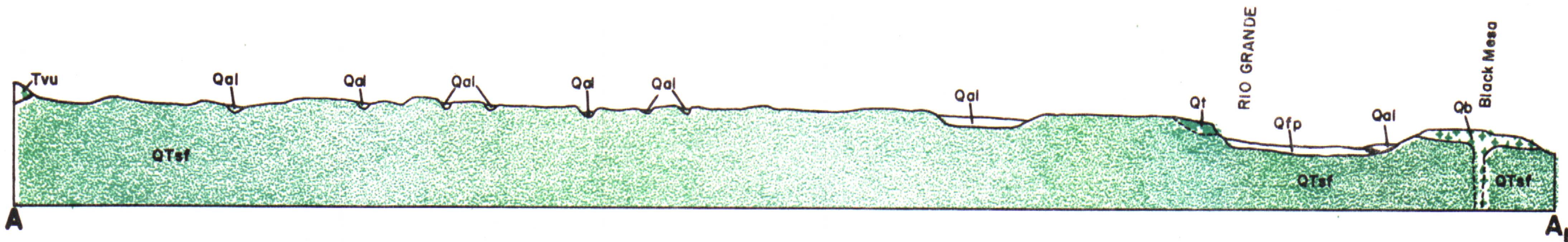
Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-7. Test data and other related information are shown in Material Pit Summary Table 25-7-2.

Selected References:

New Mexico Geological Society, (1952), Guidebook of the Rio Grande Country, Third Field Conference.

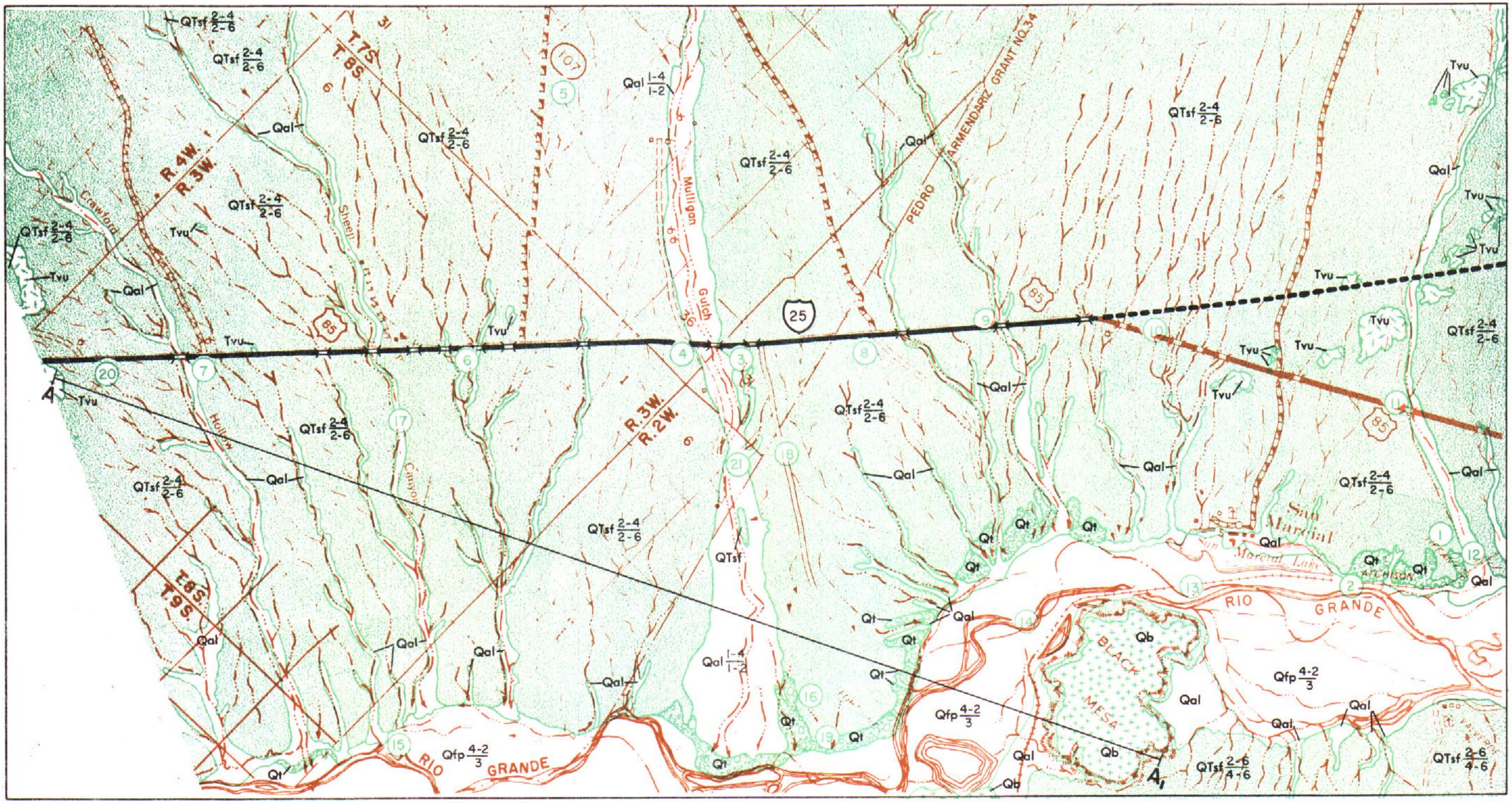
Wright, H.E., Jr., (1946), Tertiary and Quaternary Geology of the Lower Rio Puerco Area, New Mexico, Geol. Soc. Am., v. 57, pp. 383-456.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-7

SOILS AND GEOLOGY MAP 25-7



LEGEND

GEOLOGY MAPPED 1963

SEDIMENTARY ROCKS

Qal	Alluvium	QUATERNARY
Qfp	Flood-plain deposits	QUATERNARY
Qt	Terrace deposits	QUATERNARY TERTIARY
QTsf	Santa Fe group	QUATERNARY TERTIARY

IGNEOUS ROCKS

Qb	Basalt	QUATERNARY
Tvu	Volcanic rocks undifferentiated	TERTIARY

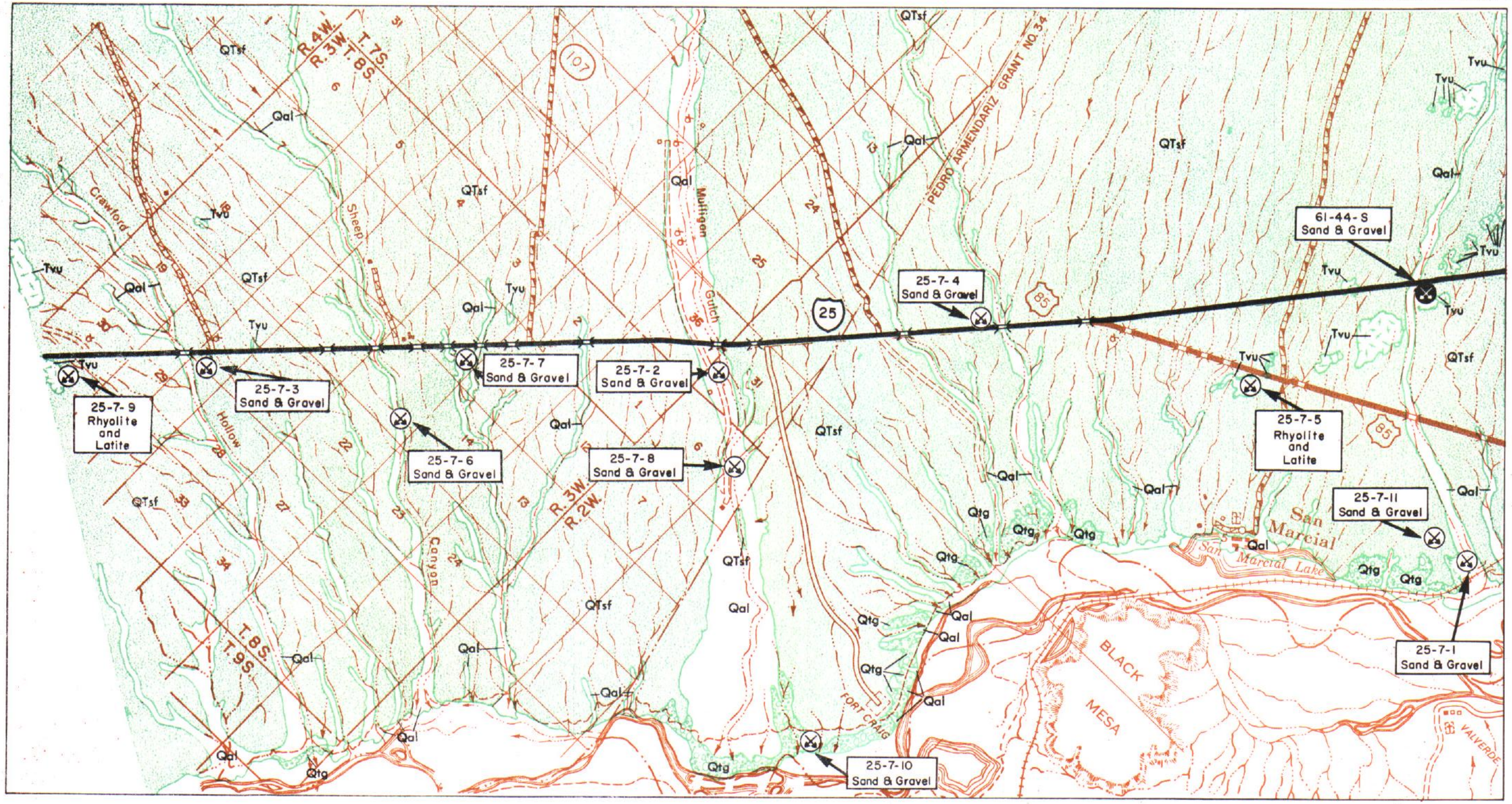
STATUTE MILES

Soils Summary:

Table 25-7-1

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
QTsf	1	A	0.0	1.5	A-4	Silt
"		B	1.5	15.0	A-1-a	Sand and gravel
Qal	2	A	0.0	1.0	A-1-a	" " "
"		B	1.0	7.0	A-4	Silt
QTsf	3	A	0.0	1.0	A-2-4	Silty gravel
"		B	1.0	2.5	A-4	Caliche and silt
"		C	2.5	20.0	A-2-6	Clayey gravel
"	4	A	0.0	1.0	A-2-6	" "
"		B	1.0	5.0	A-2-7	" "
"		C	5.0	9.0	A-6	Clay
"	5	A	0.0	3.0	A-2-6	Clayey gravel
"	6	A	0.0	2.5	A-1-a	Sand and gravel
"		B	2.5	7.0	A-4	Silt
"		C	7.0	10.0	A-2-4	Silty gravel
"	7	A	0.0	1.0	A-2-4	" "
"		B	1.0	15.0	A-2-6	Clayey gravel
"	8	A	0.0	1.5	A-2-6	" "
"		B	1.5	5.0	A-2-6	" "
"		C	5.0	8.0	A-6	Clay
"	9	A	0.0	1.5	A-2-6	Clayey gravel
"		B	1.5	4.0	A-1-a	Sand and gravel
"		C	4.0	9.0	A-4	Silt
"	10	A	0.0	1.0	A-2-4	Silty gravel
"		B	1.0	5.0	A-2-7	Clayey gravel
"		C	5.0	10.0	A-6	Clay
"	11	A	0.0	2.0	A-2-6	Clayey gravel
"		B	2.0	20.0	A-2-7	" "
Qal	12	A	0.0	3.0	A-4	Silt
"		B	3.0	6.0	A-1-a	Sand and gravel
Qfp	13	A	0.0	4.0	A-4	Silt
"	14	A	0.0	6.0	A-3	Sand
"	15	A	0.0	20.0	A-2-4	Silty sand & gravel
Qal	16	A	0.0	0.5	A-4	Silt
"		B	0.5	4.0	A-4	"
"		C	4.0	7.0	A-2-4	Silty gravel
"	17	A	0.0	2.0	A-1-a	Sand and gravel
"		B	2.0	5.0	A-1-a	" " "
"	18	A	0.0	1.0	A-4	Silt
"		B	1.0	3.0	A-2-7	Clayey gravel
"		C	3.0	7.0	A-2-4	Silty gravel
"		D	7.0	8.5	A-2-6	Clayey gravel
Qtg	19	A	0.0	1.5	A-6	Clay
"		B	1.5	20.0	A-1-a	Sand and gravel
QTsf	20	A	0.0	1.0	A-2-6	Clay and gravel
"		B	1.0	3.0	A-2-6	" " "
"		C	3.0	10.0	A-2-6	" " "
"	21	A	0.0	1.0	A-4	Silt
"		B	1.0	5.0	A-1-a	Sand and gravel

CONSTRUCTION MATERIALS MAP 25-7



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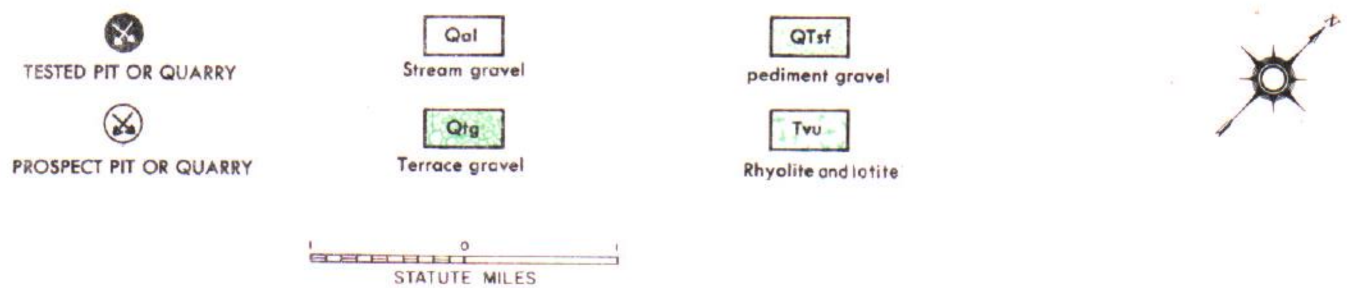


CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-7-2

Pit or Prospect No.		25-7-1 (Prospect)	25-7-2 (Prospect)	25-7-3 (Prospect)	25-7-4 (Prospect)	25-7-5 (Prospect)	25-7-6 (Prospect)
Location	Section	Not sectionalized	31	29	Not sectionalized	Not sectionalized	15
	Twnshp.	Pedro Armendariz Grant	T 7 S	T 8 S	Pedro Armendariz Grant	Pedro Armendariz Grant	T 8 S
	& Range		R 2 W	R 3 W			R 3 W
	County	Socorro	Socorro	Socorro	Socorro	Socorro	Socorro
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Federal	Private	Private	Federal
Geologic Age		Quaternary	Quaternary	Quaternary-Tertiary	Quaternary-Tertiary	Tertiary	Quaternary
Formation		Alluvium	Alluvium	Santa Fe group	Santa Fe formation	Volcanic	Alluvium
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Quarry	Sand & gravel
Kind of Material		Various	Igneous	Igneous	Volcanic fragments	Latite & rhyolite	Igneous
Quality of Material		Good	Good	Fair	Good	Good	Good
Thickness of Material		3 to 6 feet	4+ feet	14+ feet	4 to 8 feet	50+ feet	3 to 6 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	-	-	Unexplored	-
Uniformity		Good	Good	Fair	Fair	Fair	Good
Impurities		Minor silt	Minor silt	Silt lenses	Silt interbeds	Calcic clay veinlets	Silt interbeds
Type of Mat'l. Underlying Formation		Clay	Clay	Clay	Clay & silt	Clay	Clay
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood	Greasewood	Greasewood	Greasewood	Greasewood	Greasewood
Local Terrain		Dissected terraces	Dissected plain	Dissected plain	Dissected plain	Hilly & broken	Dissected plain
Depth of Overburden		0 to 3 feet	1.0 feet	1.0 (Variable) feet	1.5 feet	-	-
P.I. (Overburden)		6	5	10	12	-	-
Est. Reserve Quantity		100,000+ cu. yds.	200,000+ cu. yds.	100,000+ cu. yds.	?	150,000+ cu. yds.	100,000+ cu. yds.
Approx. Haul to Nearest Point		4.0 miles	2.0 miles	1.0 mile	0.5 mile	1.0 mile	0.5 mile
L.A. Wear		?	22.8	?	?	20	?
Maximum Size		12"	18"	12"	1.0 feet	-	1 foot estimated
% Retained on 2" Sieve		20 to 30	20 to 30	10 to 15	10 to 20	-	10 to 20
	Crushed to	-	-	-	-	1"	-
	2"	-	78	-	-	-	-
Pit	1"	90	61	79	73	100	76
Average	3/4"	82	55	71	67	89	65
% Passing	1/2"	72	48	63	55	53	52
	#4	49	34	44	35	20	20
	#10	34	25	28	24	10	7
	#200	3	4	16	5	2	1
P.I.		N.P.	N.P.	10	N.P.	N.P.	N.P.
Lab. Numbers		62-10074 - 10075	63-867 - 868	62-10061 - 10062	62-10066 - 10068	63-661	62-10082 - 10083

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-7-2 continued...

Pit or Prospect No.		25-7-7 (Prospect)	25-7-8 (Prospect)	25-7-9 (Prospect)	25-7-10 (Prospect)	25-7-11 (Prospect)	61-44-S
Location	Section	10	5 & 6	32	Not sectionalized	Not sectionalized	Not sectionalized
	Twnshp.	T 8 S	T 8 S	T 8 S	Pedro Armendariz Grant	Pedro Armendariz Grant	Pedro Armendariz Grant
	& Range	R 3 W	R 2 W	R 3 W			
	County	Socorro	Socorro	Socorro	Socorro	Socorro	Socorro
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Federal	Private	State	Private	Private	Private
Geologic Age		Quaternary-Tertiary	Quaternary	Tertiary	Quaternary	Quaternary	Quaternary
Formation		Santa Fe group	Alluvium	Volcanic	Terrace gravel	Santa Fe group	Alluvium
Type of Pit		Sand & gravel	Sand & gravel	Quarry	Sand & gravel	Gravel	Sand & gravel
Kind of Material		Igneous	Igneous	Rhyolite & latite	Mixed aggregate	Igneous	Igneous
Quality of Material		Good	Good	Good	Excellent	Good	Good
Thickness of Material		7 feet	3 to 10 feet	50+ feet	5 to 20 feet	15 feet	8 to 9 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	Unexplored	-	-	-
Uniformity		Good	Good	Fair	Good	Good	Good
Impurities		Silt lenses	Minor silt	Calcic clay veinlets	Minor silt	Silt & clay	Minor silt
Type of Mat'l. Underlying Formation		Silt	Clay	Clay	Clay	Clay	Clay
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood, cactus	Greasewood	Greasewood, cactus	Greasewood, cactus	Greasewood	Greasewood
Local Terrain		Dissected plain	Dissected plain	Hilly	Hilly & rolling	Dissected plain	Arroyo channel
Depth of Overburden		2.5 feet	1.0 feet	-	1 to 3 feet	1 to 3 feet	-
P.I. (Overburden)		N.P.	5	-	13	4	-
Est. Reserve Quantity		150,000 cu. yds.	150,000+ cu. yds.	200,000+ cu. yds.	Unlimited	Unexplored	300,000+ cu. yds.
Approx. Haul to Nearest Point		1.0 mile	1.0 mile	0.5 mile	5 miles	4.0 miles	1750 feet
L.A. Wear		?	22	39	21	?	22
Maximum Size		1 foot	18"	-	1 foot	10"	10"
% Retained on 2" Sieve		10 to 15	20 to 30	-	15 to 20	5 to 10	20 to 25
Pit Average % Passing	Crushed to	-	-	1"	-	-	-
	2"	-	78	-	77	-	77
	1"	71	61	100	56	80	57
	3/4"	60	55	91	48	72	51
	1/2"	48	48	56	40	59	44
	#4	32	34	27	25	35	29
	#10	21	25	15	18	22	21
	#200	8	4	3	2	2	2
P.I.		N.P.	N.P.	N.P.	N.P.	N.P.	N.P.
Lab. Numbers		62-10058 - 10060	63-867 - 868	63-869	63-670 - 671	62-10047 - 10048	61-18161 - 18180

SOILS AND GEOLOGY

Introduction:

This strip begins about twelve and one-half miles south of San Antonio and ends about three miles south of Socorro, New Mexico. It lies in the San Marcial basin which is bounded on the west by the Chupedera Mountains. The Rio Grande flows through the eastern part of the strip and its flood plain divides the dissected terrace and alluvial fan deposits of the Santa Fe group. The the west the Chupedera Mountains rise above the flood plain about 1,800 feet. A blanket of alluvial fan and terrace deposits skirts the mountain front and forms a sloping plain or bajada that reaches the flood plain of the Rio Grande.

General Geology:

The Chupedera Mountains are a southern extension of the Socorro Mountains. They have a maximum altitude of about 6,300 feet. Like the Socorro Mountains, they are a tilted horst that dips to the west away from the Rio Grande graben. There are several blocks near Chupedera Peak that dip from 30 to 60 degrees to the east. Settlement and adjustment between the main blocks have caused this reverse in dip.

These mountains are primarily an uplifted mass of Tertiary and Quaternary volcanic rocks. Most of the prominent peaks of the range are capped by rhyolite and rhyolitic breccia. Near Chupedera Peak there is a triangular shaped inlier of Precambrian granite and metamorphic rock. There are also a few exposures of Pennsylvanian and Mississippian rocks near Chupedera Peak. The Mississippian rocks are in fault contact with the Tertiary rhyolites and tuffs.

Falting associated with the formation of the Rio Grande trough is marked on the eastern front of the mountains by a north-striking, en echelon fault system. "The range is bounded on the east and west by fault zones and it is uplifted between relatively depressed areas that are covered by fanglomerate. It seems evident that the fanglomerate covered most of the Chupedera Mountains at one time. Where remnants of the erosional surface of the fanglomerate have been preserved by cappings of basalt, the surface is higher than most of the surrounding peaks." (Miesch, A. T., pp. 3 and 15, 1956). There is a large exposure of this fanglomerate in the south-central part of the strip. Local exposures in the Chupedera Mountains are included with the Tertiary volcanics on the map. There fanglomerates are a part of the Santa Fe group of late Miocene and early Pliocene age.

The San Marcial basin is one in a series of linked basins which make up the Rio Grande depression. It is about thirty miles long and ten to fifteen miles wide. The longitudinal axis of the basin trends southwest and it roughly parallels the course of the Rio Grande. It is bounded on the west by the Socorro uplift, to the east is the Joyita uplift, to the south is the Mulligan trough and to the north is the Socorro constriction and the Albuquerque-Belen basin.

The individual basins along the Rio Grande depression began to develop in the Tertiary period and subsequently became linked basins. The Santa Fe group accumulated during the development of these basins. The filling and continual rifting and faulting caused the Rio Grande to become a through-flowing stream and it became fairly well established in its present-day course by mid-Pleistocene time. It has cut through several hundred feet of Santa Fe sediments in the San Marcial basin.

Terrace and alluvial fan deposits of the Santa Fe group (Qtaf and QTsf) cover about one-half of this strip. Ancient alluvial fans interfinger with a thick unit of river sands, gravels, flood-plain silts, and clays which represent the ancestral Rio Grande basin of late Santa Fe time. West of the flood plain, north of the fanglomerate exposure, the river deposits reach the base of the Chupedera block. Well-sorted sands and gravels grade into, and are interbedded with fan materials derived from the Chupedera Mountains. South of the fanglomerate exposure the river deposits seem to pinch out a short distance west of the flood plain. East of the flood plain the river deposits interfinger with alluvial fan materials derived from the highlands to the east. There is a thick sequence of well-indurated alluvial fan debris beyond the river deposits that resembles the material that interfingers with the river deposits. The sinuous path of the ancient river and the similarity of the fan materials make it impossible to determine a definite contact for the eastern migration of the river.

In the eastern part of the basin the surface deposits of late Santa Fe age are finer grained than the western deposits. The source areas are primarily Permian and Triassic rocks which are soft, friable sandstones, limestones and shales. West of the river the source areas have an abundance of rhyolite, basalt, and other igneous rocks.

The flood plain of the present-day Rio Grande traverses the east side of this strip. The natural flow of the river is controlled by a system of levees and channels built by the Rio Grande Conservancy District. There are also many ponds and sloughs that are flooded periodically for the preservation of water fowl. The flood-plain deposits are clay, sand, and silt that exceed 100 feet in thickness.

The tributaries of the Rio Grande have a heteregeneous mixtrue of sand, gravel silt, and clay. These deposits are slightly more coarse-grained west of the river. Like the Santa Fe group, the source areas west of the river are predominantly igneous rocks and the source areas east of the river are predominantly sedimentary rock. Some of the alluvium east of the river has large quantities of wind-blown sands that have been swept up from the flood plain.

The areal distribution of formations is shown on Soils and Geology Map 25-8. Their succession and character are given under the section termed "Stratigraphy".

Soils:

Flood-plain deposits (Qfp): Most of the flow of the Rio Grande is diverted into a large channel near San Acacia and its remains in this channel until it reaches the Elephant Butte reservoir. However, during periods of heavy precipitation the river receives sands, silts and clays from the local tributaries and, in a small way, it is still forming the valley floor.

In the wildlife refuge, where muddy water has been diverted into the lakes and ponds, there is a preponderance of clay soils.

The remainder of the flood plain is more typical of the rest of the lower Rio Grande Valley. The natural surface features have been changed by farm leveling and the construction of dikes, channels and roads. The surface soils are primarily a silt (A-4) or silty-sand (A-2-4) overlying fine sand (A-3). Clay (A-6) occurs locally where waters have ponded in the old back-water areas.

Alluvial deposits (Qal): The soils in the tributaries of the Rio Grande grade from coarse-grained materials in the highlands to fine-grained materials near the flood-plain. The profile is very non-uniform; it has alternate layers of silt and gravel. Soil types are discontinuous, they change or pinch out in short distances. Sand and gravel (A-l-a) predominate in the larger arroyos. Silty-sands and gravels are more abundant in the smaller drainageways. On the alluvial apron east of the river, where small tributaries and slope wash coalesce, the soils are silty sand (A-2-4) with a veneer of fine, wind blown sand (A-3).

Terrace and alluvial fan deposits (Qtaf): These deposits are very heterogeneous and discontinuous. They are a product of an ancient Rio Grande and its tributaries. From 5 to about 20 feet of well-sorted sand and gravel and flood-plain silts and clays are overlain by fan or braided stream deposits of igneous gravels, silts and clays that are derived from the Chupedera Mountains. The fan deposits thicken to the west. Hole number 15 of the soils summary is an example of these deposits. The underlying river deposits do not have any particular order of bedding. Near the flood plain of the Rio Grande the fan and stream gravels grade into and are interbedded with the old river deposits. In many places the well-washed river sand and gravel lie in huge lens-shaped pockets. The upper 15 feet of the deposits generally show from 2 to 4 feet of silty or clayey gravel (A-2-4 or A-2-6) overlying sand and gravel (A-l-a).

Santa Fe formation (QTsf): This group covers the south-central, the southwest, and the northeast parts of the strip. It is a pediment and alluvial fan deposit in its upper part. West of the river the volcanic gravels found in this group are derived from the Chupedera Mountains.

The predominant surface soils west of the river are a silty gravel (A-2-4) and clayey gravel (A-2-6) and (A-2-7) which represent braided stream deposits. The inter-stream areas are filled with silt (A-4) and clay (A-7).

A poorly indurated layer of clayey gravel (A-2-7) cemented by caliche (calcium carbonate) lies below the surface soils. Below the caliche zone are erratic lenses of sand and gravel (A-l-a), beds of gravel cemented by clay (A-2-7), and clay lenses (A-7).

In the northeast corner of the strip the pediment deposits interfinger with river sands and gravel. The surface soils are primarily wind-blown sand (A-3) and coarse, river sand (A-l-b).

Table 25-8-l shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-8.

STRATIGRAPHY:

Quaternary:

Alluvium (Qal) - Angular to sub-angular igneous gravel, sand, silt and minor clay.
Thickness: 0 to 25+ feet.

Flood-plain deposits (Qfp) - sand, silt and clay.
Thickness: 100+ feet.

Unconformity---

Santa Fe group:
Terrace and alluvial fan deposits (Qtaf) - interbedded fan, stream and river deposits of sand, gravel, silt and clay.
Thickness: 50 to 250(?) feet.

Basalt (Qb) - basalt flows, cones and necks.

Unconformity---

Quaternary Tertiary:

Santa Fe formation (QTsf) - interbedded silt, sand, clay and gravel.

Unconformity---

Tertiary:

Santa Fe group (continued)
Fanglomerate (Tfg) - well consolidated, pebble to boulder fanglomerate, predominantly igneous particles with tuffaceous sands; limestone, granite and metamorphic particles in local areas.

Tertiary:

Volcanic rocks undifferentiated (Tvu) -rhyolite, rhyolitic breccia, andesite, tuff and volcanic ash. Includes a basal boulder conglomerate. Note: This formation may post-date the Tertiary fanglomerate of the Santa Fe group.

Unconformity---

Pennsylvanian:

Magdalena group (₱) - Medium to light gray, partly-crystalline, massive limestone; interbedded shales are common.

Unconformity---

Mississipian:

Lake Valley formation (M) - dark to medium-gray sub-crystalline limestone with interbedded shales.

Unconformity---

Precambrian:

Precambrain rocks undifferentiated (P€) - granite, gneiss, schist and associated metamorphic rocks.

CONSTRUCTION MATERIALS:

Quaternary:

Mill tailings: Near the village of San Antonio are two relatively large waste piles derived from the lead mills of the Hansonburg mining district (see prospect 25-8-5). Practically all of this material passes the 1/2 inch sieve and about 90 percent is retained on the 200 sieve. It is primarily a dolomitic limestone of the Magdalena group with minor fluorite, barite and quartz.

Quaternary:

Alluvium (Qal): Almost all of the larger arroyos have potential aggregate resources. The gravel is quite shallow and it grades into the underlying clayey materials very rapidly. Pit 61-41-S is a typical example of the material to be found in the arroyos. The maximum thickness of the usable material is about 9 feet. The material is a non-plastic, sub-angular, igneous sand and gravel that has approximately 10 percent retained on the 2 inch sieve, 50 percent retained on the number 4 sieve, 6 percent passing the number 200 sieve, and a L.A. Wear of 24.4.

Santa Fe group, terrace and alluvial fan deposits (Qtaf): There are almost unlimited supplies of highway aggregates in these deposits. It should not be supposed, however, that the usable aggregates are continuous throughout the entire area shown on the map. One must be very selective in choosing an area for exploration since in many places the usable materials are crossbedded and interbedded with undesirable silts and clays. Well-sorted river sands and gravels lie along the toe of the dissected plain. Angular, igneous gravels are found on the higher terraces toward the Chupedera Mountains.

Pit 61-43-S is a good example of the materials found on the higher terraces. About 20 percent of the gravel is retained on the 2 inch sieve, 32 percent passes the number 4 sieve, 4 percent passes the number 200 sieve, it has a L.A. Wear of about 25, and it is approximately 20 feet thick.

Pit 25-8-3 is an example of the well-washed sand and gravel found on the terraces near the flood plain. The river deposits are crossbedded with outwash from the Chupedera Mountains. The deposits occur in discontinuous channels of an ancient Rio Grande. The place where the sample for laboratory analysis was taken has about 2 feet of silty sand over six feet of sand and gravel. Underlying the clay is a clean fine sand. Laboratory analysis shows better than 35 percent retained on the 2 inch sieve, 29 percent passing the number 4 sieve, no minus 200 material and a L.A. Wear of 21.6.

Distribution of tested and prospective pit sites is shown on Construction Materials Inventory Map 25-8. Test data and other related information are shown in Material Pit Summary Table 25-8-1.

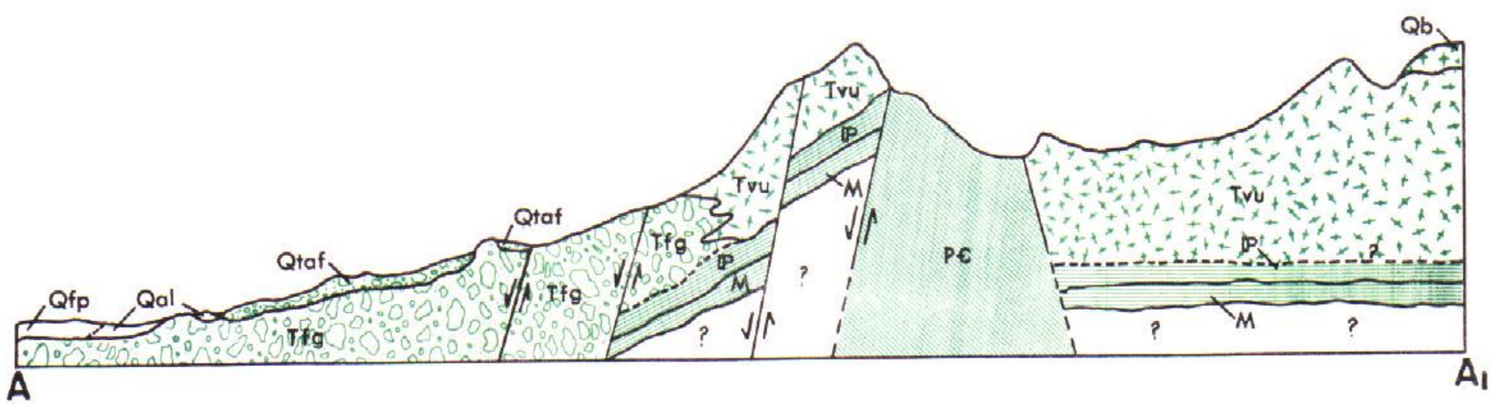
Selected References:

Kottlowski, Frank E., (1960), "Summary of Pennsylvanian Sections in Southwestern New Mexico and Southeastern Arizona," New Mexico Bur. of Mines and Mineral Res., Bull. 66, pp. 56 to 60.

Miesch, A. T., (1956), "Geology of the Luis Lopez Manganese District," Socorro Co., New Mexico Bur. of Mines and Mineral Res., Cir. 38, pp. 3 and 15.

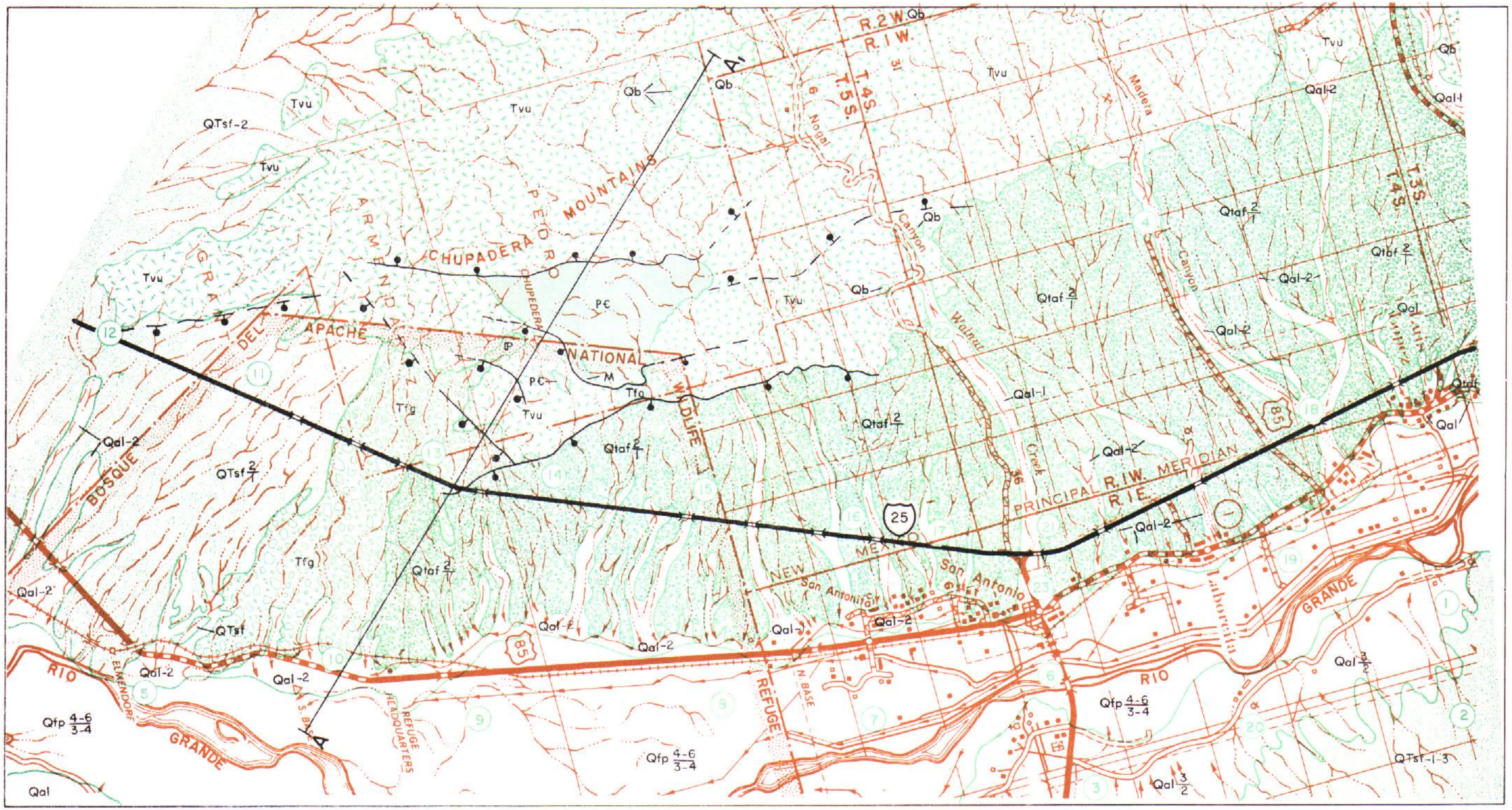
New Mexico Geological Society, (1952), "Guidebook of the Rio Grande Country," Third Field Conference.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-8

SOILS AND GEOLOGY MAP 25-8



GEOLOGY MAPPED 1963

-LEGEND-

SEDIMENTARY ROCKS

QUATERNARY
- Qal — Alluvium
- Qfp — Flood-plain deposits
- Qtaf — Terrace and Alluvial Fan deposits

TERTIARY
- QTsf — Santa Fe group
- Tfg — Fanglomerate

PENNSYLVANIAN
- IP — Pennsylvanian rocks undifferentiated

MISSISSIPPIAN
- M — Mississippian rocks undifferentiated

IGNEOUS ROCKS

QUATERNARY
- Qb — Basalt

TERTIARY
- Tvu — Volcanic rocks undifferentiated

PRE-CAMBRIAN
- PЄ — Granite, gneiss, schist, and associated metamorphic rocks

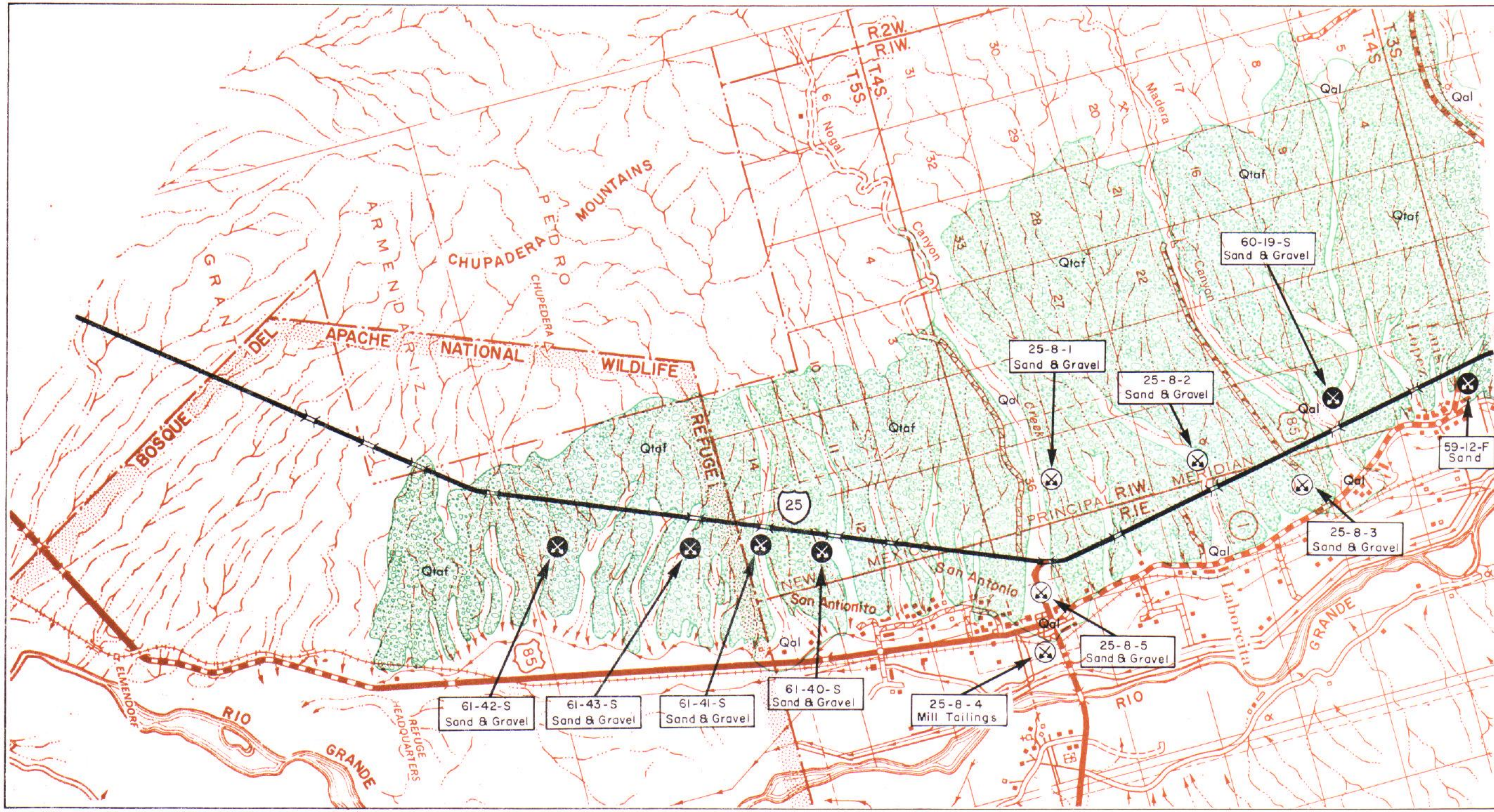
STATUTE MILES

Soils Summary:

Table 25-8-1

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Qal	1	A	0.0	2.0	A-1-a	Sand and gravel
"		B	2.0	5.0	A-4	Silt
QTsf	2	A	0.0	0.5	A-1-b	Coarse sand
"		B	0.5	2.0	A-1-b	" "
Qtaf	3	A	0.0	15.0	A-2-4	Silty gravel
"	4	A	0.0	1.0	A-2-6	Clayey gravel
"		B	1.0	15.0	A-1-a	Sand and gravel
Qfp	5	A	0.0	0.5	A-6	Clay
"		B	0.5	5.0	A-6	"
"	6	A	0.0	1.0	A-4	Silt
"		B	1.0	5.0	A-4	"
"	7	A	0.0	0.5	A-4	"
"		B	0.5	5.0	A-4	"
"	8	A	0.0	0.5	A-7	Clay
"		B	0.5	3.0	A-6	"
"		C	3.0	5.0	A-4	Silt
"	9	A	0.0	0.5	A-4	"
"		B	0.5	2.5	A-7	Clay
"		C	2.5	5.0	A-4	Silt
Qal	10	A	0.0	2.0	A-4	"
"		B	2.0	5.0	A-2-4	Silty sand and gravel
Qtsf	11	A	0.0	4.5	A-2-7	Clay
"		B	4.5	6.5	A-2-4	Silty sand and gravel
"		C	6.5	9.5	A-2-4	" " " "
"		D	9.5	12.5	A-1-a	Sand and gravel
QTsf	12	A	0.0	3.0	A-2-4	Silty sand and gravel
"		B	3.0	6.0	A-2-4	" " " "
"		C	6.0	10.0	A-1-a	Sand and gravel
Qtaf	13	A	0.0	3.0	A-1-b	Coarse sand
"		B	3.0	9.0	A-2-4	Silty sand and gravel
"		C	9.0	12.0	A-1-b	Coarse sand
"	14	A	0.0	4.0	A-2-6	Clayey sand and gravel
"		B	4.0	16.0	A-1-a	Sand and gravel
"	15	A	0.0	2.0	A-2-4	Silty sand and gravel
"		B	2.0	6.0	A-1-a	Sand and gravel
"		C	6.0	9.0	A-4	Silt
"		D	9.0	25.0	A-1-a	Sand and gravel
"		E	25.0	30.0	A-2-4	Silty sand and gravel
"		F	30.0	40.0	A-1-a	Sand and gravel
"		G	40.0	51.0	A-2-4	Silty sand and gravel
"	16	A	0.0	3.0	A-1-a	Sand and gravel
"		B	3.0	20.0	A-1-a	" " "
Qtaf	16	C	20.0	23.0	A-3	Sand
"	17	A	0.0	2.0	A-2-4	Silty sand and gravel
"		B	2.0	8.0	A-1-a	Sand and gravel
"		C	8.0	11.0	A-4	Silt
Qal	18	A	0.0	1.5	A-2-4	Silty sand and gravel
"		B	1.5	4.0	A-1-b	Sand and gravel
Qfp	19	A	0.0	0.5	A-2-4	Silty sand and gravel
"		B	0.5	1.5	A-6	Clay
"		C	1.5	5.0	A-2-4	Silty sand and gravel
Qal	20	A	0.0	1.0	A-3	Sand
"		B	1.0	5.0	A-2-4	Silty sand and gravel
Qtaf	21	A	0.0	1.5	A-4	Silt
"		B	1.5	15.0	A-1-a	Sand and gravel
"		C	15.0	20.0	A-2-4	Silty sand and gravel
"	22	A	0.0	1.5	A-4	Silt
"		B	1.5	25.0	A-1-a	Sand and gravel
Qal	23	A	0.0	6.0	A-1-a	" " "
"		B	6.0	8.0	A-1-a	" " "

CONSTRUCTION MATERIALS MAP 25-8



-LEGEND-

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-8-2

		60-19-S	61-40-S	61-41-S	61-42-S	61-43-S	59-12-F
Pit or Prospect No.		60-19-S	61-40-S	61-41-S	61-42-S	61-43-S	59-12-F
Location	Section	12	SE 1/4, Sec. 12	SW 1/4 SE 1/4, Sec. 3	Bosque del Apache Refuge	Bosque del Apache Refuge	1
	Twnshp. & Range	T 4 S R 1 W	T 5 S R 1 W	T 5 S R 1 W			T 4 S R 1 W
	County	Socorro	Socorro	Socorro	Socorro	Socorro	Socorro
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Federal	Federal	Federal	Federal	Federal	State
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Alluvium	Terrace deposit	Alluvium	Terrace deposit	Terrace deposit	Terrace deposit
Type of Pit		Gravel	Gravel	Gravel	Gravel	Gravel	Sand
Kind of Material		Mixed aggregate	Igneous	Igneous	Igneous	Igneous	Clean river sand
Quality of Material		Good	Good	Good	Good	Good	Fair
Thickness of Material		9.0 feet	8.5 feet	9.0 feet	10.0 feet	20.0 feet	6 to 10 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	-	-	-	-
Uniformity		Fair	Good	Fair	Good	Good	Fair
Impurities		Minor silt	Minor silt & clay	Minor silt & clay	Minor silt & Clay	Minor silt & clay	Silt & clay
Type of Mat'l. Underlying Formation		Silt & clay	Sand	Silt & clay	Silt & Clay	Silt & clay	Caly
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood	Greasewood	Greasewood	Greasewood	Greasewood	Mesquite & greasewood
Local Terrain		Arroyo	Arroyo	Arroyo	Dissected Terraces	Dissected Terraces	Dissected plain
Depth of Overburden		1.0 feet	1.0 feet	1.0 feet	1.0 feet	4.0 feet	2 to 3 feet
P.I. (Overburden)		-	N.P.	N.P.	N.P.	5	8
Est. Reserve Quantity		400,000 cu. yds.	200,000 cu. yds.	200,00 cu. yds.	280,000 cu. yds.	230,000 cu. yds.	?
Approx. Haul to Nearest Point		780 feet	500 feet	620 feet	4805 feet	2060 feet	1/2 mile
L.A. Wear		21.2	25.6	24.4	26.4	25.6	-
Maximum Size		14"	6"	6"	8"	6"	-
% Retained on 2" Sieve		30	5	5 to 10	15	20 to 25	Less than 10
Pit Average % Passing	Crushed to	-	-	-	-	-	-
	2"	72	90	89	92	76	100
	1"	60	85	81	82	63	91
	3/4"	56	81	77	76	57	87
	1/2"	51	76	70	68	51	80
	#4	39	55	49	46	32	62
	#10	31	37	32	34	22	49
	#200	6	4	6	5	4	7
P.I.		1.0	N.P.	N.P.	N.P.	N.P.	N.P.
Lab. Numbers		60-2590-2617	61-17718-17740	61-17789-17808	61-18127-18142	61-18143-18160	59-2126-2133

AGGREGATE RESOURCES AND SOILS STUDY
NEW MEXICO INTERSTATE ROUTE 25
SAN ANTONIO AND VICINITY

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-8-2

Pit or Prospect No.		25 8-1	25-8-2	25-8-3	25-8-4	25-8-5
Location	Section	N 1/2, Sec. 36	24	18	32	36
	Twnshp.	T 4 S	T 4 S	T 4 S	T 4 S	T 4 S
	& Range	R I W	R I W	R I E	R I E	R I E
	County	Socorro	Socorro	Socorro	Socorro	Socorro
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		State	Federal	Private	Private	Private
Geologic Age		Quaternary - Tertiary	Quaternary	Quaternary	-	Quaternary
Formation		Terrace deposit	Alluvium	Terrace deposit	Mill tailings	Alluvium
Type of Pit		Gravel	Gravel	Gravel	Fine aggregate	Sand & gravel
Kind of Material		Igneous	Igneous	Mixed aggregate	Mill tailings	Mixed aggregate
Quality of Material		Good	Good	Good	Good	Good
Thickness of Material		17.0 feet	15+ feet	6 to 10 feet	-	6.0+ feet
Thickness of Cap (Caliche)		-	-	-	-	-
Blasting Qualities		-	-	-	-	-
Uniformity		Fair	Fair	Fair	Good	Good
Impurities		Silt lenses	Silt & minor clay	Silt & clay lenses	-	Silt lenses
Type of Mat'l. Underlying Formation		Sandy silt	Silt & sand	Clay	-	Silt & clay
Moisture Condition		Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood	Greasewood	Greasewood & mesquite	None	Greasewood
Local Terrain		Dissected terrace	Arroyo	Dissected plain	-	Arroyo
Depth of Overburden		5.0 feet	2.0 feet	2 to 6 feet	-	-
P.I. (Overburden)		5.5	5.5	N.P.	-	-
Est. Reserve Quantity		?	500,000 cu. yds.	?	200,000+ cu. yds.	200,000 Cu. Yds.
Approx. Haul to Nearest Point		1/2 mile	1000 feet	1 mile	1.0 mile	0.5 mile
L.A. Wear		26.0	?	21.6	-	21.6
Maximum Size		12"	15"	6"	1/2"	12"
% Retained on 2" Sieve		30	5 to 10	20 to 30	None	20 to 25
	Crushed to	-	-	-	-	-
	2"	70	-	63	-	78
Pit	1"	61	66	54	-	62
Average	3/4"	58	55	49	-	56
% Passing	1/2"	52	47	43	100	50
	#4	37	31	29	75	37
	#10	26	25	20	49	28
	#200	5	4	0	9	6
P.I.		0 to 9	Sandy, N.P.	N.P.	Sandy, N.P.	Sandy, N.P.
Lab. Numbers		62-4807	62-3614 to 3616	63-2761-2762	63-870	63-659 to 63-660

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SOILS AND GEOLOGY

Introduction:

This strip begins four miles south of Socorro and ends one mile north of San Acacia in Socorro County, New Mexico. It lies in the Socorro constriction, a depressed area or channel that forms the linkage between the Albuquerque-Belen basin and the San Marcial basin.

The Socorro uplift is on the western boundary of the strip and the Joyita uplift is on the eastern boundary. The Socorro channel, like the other depressions of the Rio Grande trough, is filled with sediments from the adjoining highlands. The river has cut through this fill and formed a relatively broad valley.

The present landscape is mostly an expression of the Pleistocene and Recent erosion cycles; although, extreme tectonic movement began to form the mountains and valleys as long as 25 million years ago. Therefore, the Socorro area is noted for exceptional examples of Cenezoic geology.

General Geology:

The Socorro uplift includes the Lemitar, Socorro, and Chupadera Mountains. It is a southward extention of the Ladron uplift and it was initiated in Miocene Time. The Socorro and Lemitar Mountains lie to the southwest.

The Socorro Mountains are made up of Tertiary and Quaternary volcanic rocks. Near Socorro Peak there are rhyolite flows, tuffs, and breccias. South of the peak is a Quaternary basalt flow and on the flanks of the peak are extensive deposits of perlite.

The oldest rocks in this strip are exposed in the Lemitar Mountains. Precambrain metasediments, intruded by granite, are exposed throughout the range. Amphibolite, quartz diorite, and gabbro apparently intrude the Precambrian rocks at the southern end of the range.

Shale and limestone of the Magdalena group unconformably overlie the Precambrian rocks. Scattered exposures of the Magdalena group usually show a cover of Tertiary volcanic rocks such as rhyolite and trachyte flows, tuffs, breccias, and conglomerates. This volcanic activity probably occurred during the Miocene epoch.

A thick unit of conglomerate, which represents a transitional period between the Miocene volcanic activity and the Pliocene basin deposits, overlies the volcanic rocks. It was laid down in a relatively small basin and it is locally referred to as the Popotosa formation. The Santa Fe group unconformably overlies the Popotosa formation.

The Socorro channel is about 40 miles long and from 5 to 10 miles wide. It is a relatively narrow depression that began to form in Miocene time and it has since been filled with sediments of the Santa Fe group.

Continual rifting, faulting, and filling of the Rio Grande depression caused the Rio Grande to become a through-flowing stream. It probably became established near its present course by mid-Pleistocene time.

The Santa Fe group includes upper terrace and alluvial fan deposits that interfinger with a thick unit of early-river sands, gravels, and flood-plain deposits.

West of the Rio Grande the river deposits reach the base of the Socorro-Lemitar block. They grade into and are interbedded with fan materials derived from the Socorro and Lemitar Mountains.

East of the Rio Grande, fan materials derived from the highlands to the east overlie old river deposits. These river deposits represent an ancient Rio Grande of late Santa Fe time. Farther to the east is an indefinite contact between the river and fan deposits and a thick unit of well-indurated conglomerate. The particles in the conglomerate resemble the fan materials that overlie the river sands and gravels. The sinuous path of the ancient river and the similarity of the conglomerate and the fan materials make it impossible to determine a definite contact for the eastern migration of the river.

There is an exposure of Tertiary conglomerate that is Santa Fe in age in the northwest corner of the strip. Early river deposits probably lie on this conglomerate over most of this strip.

The flood plain of the Rio Grande has an accumulation of sand, silt, and clay over 100 feet thick. Most of the flow of the river is controlled by a system of dams, levees and ditches; therefore, most of the sedimentation occurs where uncontrolled tributaries debouch onto the flood plain.

The areal distribution of formations is shown on Soils and Geology Map 25-9. Their succession and character are given under the section termed "Stratigraphy".

Soils:

Flood-plain deposits (Qfp): Most of the flow of the Rio Grande is diverted into a large channel near San Acacia and it remains in this channel until it reaches the Elephant Butte reservoir. During periods of local precipitation the river receives some run-off from the tributaries, and in a small way, soils are still accumulating on the valley floor.

The natural surface features have been changed by farm leveling and the construction of dikes, channels and roads. The surface soils are primarily a silt (A-4) or silty-sand (A-2-4) overlying fine sand (A-3). Clay (A-6 & A-7) is found locally where water has ponded in the back-water areas.

Alluvial deposits (Qal): The soils in the tributaries of the Rio Grande grade from coarse-grained materials in the highlands to fine-grained materials near the flood plain. The profile is very non-uniform. It has alternate layers of silt, sand and gravel. Soil types are discontinuous, they change or pinch out in short distances. Sand and gravel (A-1-a) predominate in the larger arroyos. Silty sand and gravel is more abundant in the smaller drainageways.

Most of the tributaries east of the Rio Grande are floored with a coarse sand (A-1-b).

Soils continued. . .
West of the Rio Grande, where a profile exists, there is usually from one to three feet of silt (A-4) over gravel (A-l-a).

Alluvial fan deposits (Qaf): These soils are made up of disintegrated granite and metamorphic rocks to the west. They are braided deposits of sand, silt, clay and gravel. They are slightly finer-grained near the toe of the fans to the east. The upper parts are primarily silty sand (A-2-4) and coarse-grained sand (A-l-b). The lower parts have discontinuous, interbedded deposits of silt, clay and gravel.

Terrace deposits (Qt): These soils are fairly uniform. There is usually from one to three feet of silt or silty sand and gravel overlying three to twenty feet of well-washed, well-sorted sand and gravel which is underlain by an undetermined thickness of silt.

Terrace and alluvial fan deposits (Qtaf): These deposits are heterogeneous and discontinuous. They are a product of an ancient Rio Grande and its tributaries. From 5 to about 20 feet of well-sorted sand and gravel and flood-plain deposits are overlain by fan and braided stream deposits of igneous debris derived from the highlands (Socorro and Lemitar Mountains) to the west. The fan deposits thicken to the west. Near the flood plain of the Rio Grande the fan and stream gravels grade into and are interbedded with the old river deposits.

Santa Fe formation (QTsf): These soils are similar to the terrace and alluvial fan deposits. They have interbeds of well-washed river sands and gravels and flood-plain deposits. The Quaternary and Tertiary sediments have been grouped together since, in most places, it is difficult to separate the two.

The soil profile usually shows a few inches of silty sand and gravel (A-2-4) overlying from 3 to more than 20 feet of sub-angular, fan and stream gravels (A-l-a) which are underlain by river silts, clays, and coarse-grained sand. In many places the river deposits are near the surface.

Along the eastern part of the strip the Santa Fe group has well-indurated sandstones and conglomerate. In some places these indurated materials extend almost to the flood plain. Hole 19 has 20 feet of conglomerate, underlain by 20 feet of loose, coarse-grained sand.

Lower Santa Fe group (Tsf): In the west central part of the strip these soils are lake deposits that have a profile of clay (A-7) over silt (A-4). These Tertiary deposits do not seem to have been disturbed by the river of late Santa Fe age. In the northwestern part of the strip the lower Santa Fe sediments are well-indurated conglomerates and sandstones that have practically no soil cover.

Table 25-9-I shows the log and classification of the soil samples taken along this portion of interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-9.

STRATIGRAPHY:

Quaternary: Flood-plain deposits (Qfp) - irregular, interbedded deposits of sand, silt, clay and coarse-grained sand.

Alluvium (Qal) - gravel, sand, silt, and clay

Alluvial fan deposits (Qaf) - gravel, coarse-grained sand, silt, and clay.

Terrace deposits (Qt) - well-washed deposits of sand and gravel with interbedded silt and clay.

Unconformity---

Santa Fe group

Terrace and alluvial fan deposits (Qtaf) - heterogeneous interbedded, river, fan, and stream deposits of sand, silt, clay, and gravel.

Basalt (Qb) - black, dense, andesitic basalt in dikes and flows.

Unconformity---

Santa Fe group (continued)

Santa Fe formation (QTsf) - unconsolidated, interbedded, fan, stream, and river deposits that tongue into well-consolidated fan deposits to the east.

Unconformity---

Lower Santa Fe group (Tsf) - reddish-brown, unconsolidated deposits of clay with interbeds of gypsum in the west-central part of the strip. A friable, tan-to reddish-brown conglomerate in the northwest part of the strip.

Unconformity---

Conglomerate (Popotosa formation) (Tc) - tan-to reddish-brown, sub-angular to round, well-consolidated fragments of volcanic rock.

Volcanic rocks undifferentiated (Tvu) - reddish-brown and purple flows of rhyolite, latite, andesite, and associated tuffs, agglomerates, and glass.

Unconformity---

Permian: Yeso formation (Py) - alternating beds of orange-red and buff sandstone and siltstone with thin beds of gray limestone and gypsum.
Thickness: 500 feet.

Abo formation (Pa) - light-red-to dark-red and maroon sandstone, conglomerate, and shale.
Thickness: 900 feet.

Unconformity---

Carboniferous: Magdalena group (Cm) - tan to gray, cherty limestone with interbeds of greenish-black shale and siltstone.

Stratigraphy continued. . .

Thickness: 1,000+ feet.

Unconformity--

Precambrian: Precambrian rocks undifferentiated (P€) - coarse-grained granite, quartzite, gneiss, schist and associated metamorphic and igneous rocks.

CONSTRUCTION MATERIALS:

Mill tailings: Coarse aggregate may be produced from the waste products of the manganese mill in section 10, T. 3 S., R. I W. The material is a fairly well-graded crushed rhyolite. A typical sample of this material has less than 10 percent retained on the 2 inch sieve, 14 percent passes the number 4 sieve, one percent passes the number 200 sieve and it has a L.A. Wear of 25.2.

Quaternary: Alluvium (Qal) - Most of the larger arroyos of this strip have materials that are suitable for highway construction. West of the river in the south half of the strip the alluvium is very coarse-grained. The materials are derived from the Socorro Mountains and they are primarily igneous rocks. Pits 25-9-12 and 62-47-S are excellent examples of this material.

West of the river in the north half of the strip the alluvium becomes finer-grained. This may be caused by a lower stream gradient and the abundance of Precambrian granite along the flanks of the Lemitar Mountains. Note that pit 25-9-6 has no 2 inch material and more than 65 percent passes the number 10 sieve.

East of the river the alluvium is more fine-grained than it is to the west. It is primarily re-worked deposits of the Santa Fe group. Pits 25-9-9 and 25-9-15 are examples of this material.

Quaternary: Terrace deposits (Qt): These deposits represent local exposures of well-washed sand and gravel that do not have the thick cover of alluvial fan debris. Pits 54-1-S, 25-9-8 and 25-9-14 are representative of this material.

Santa Fe group (terrace and alluvial fan deposits)(Qtaf): Usable aggregates are not continuous throughout this group; however, unlimited supplies may be developed for highway use. In many places the materials are crossbedded and interbedded with undesirable silts and clays. Well-sorted sands and gravels lie along the toe of this deposit near the flood plain of the Rio Grande. Angular igneous gravels are found on the higher terraces toward the Socorro and Lemitar Mountians. The terraces nearest the larger drainageways seem to have less clay and silt size particles.

Pit 25-9-13 is an example of the excellent material found near Socorro Canyon wash. The gravels are primarily igneous rocks derived from the mountains to the west.

Quaternary-Tertiary: Santa Fe formation (QTsf): These deposits are similar to the terrace and alluvial fan deposits of the Santa Fe group. River sands are interbedded with coarse-grained alluvial fan and stream deposits. The fan deposits are very extensive east of the Rio Grande and farther to the east they tongue into well-indurated materials of the same origin.

Most of the particles in the upper alluvial fan type deposits are derived from the Abo sandstone and the San Andres limestone. The coarse-grained materials are primarily angular fragments of limestone, derived from the San Andres formation. The fine-grained materials are a pinkish-red sand derived from the Abo formation.

A good example of this deposit is shown by pit 25-9-10. Approximately 2 feet of silty sand and gravel overlie about 38 feet of non-plastic sand and gravel. Below this is 20 feet of well-washed river sand.

Carboniferous: Madalena group (Cm): Limestone of this group is exposed in section 18, T. 25., R.I W.. It is a dense, crystalline material that will make an excellent quarry rock. Some interbeds of greenish black shale were noted, but the surface materials seem to be pure limestone to depths of 15 or 20 feet. Further exploration may reveal numerous shale interbeds in the upper portion.

Precamrian: Precambrian rocks undifferentiated (P€): In section 18, T. 2 S., R. I W., near the limestone of the Magdalena group, is a large exposure of a complex Precambrian intrusive. It varies from an amphibolite to gabbro to quartz diorite. These rocks or varieties of them will be encountered in any quarry operation in this locality.

A laboratory analysis of a combination of these rocks showed that they will make an excellent quarry rock (see results for 25-9-1, Construction Materials Inventory).

Distribution of tested and prospective pit sites is shown on Construction Materials Inventory Map 25-9. Test data and other related information are shown in Material Pit Summary Table 25-9-2.

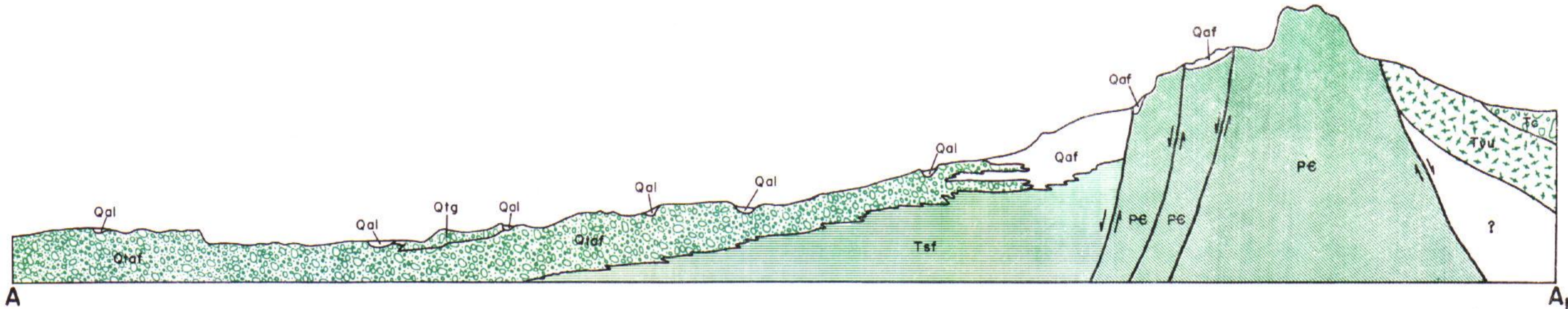
Selected References:

Denny, C. S., (1940), "Tertiary Geology of the San Acacia Area., New Mexico," Journal of Geology, Vol. 48, pp. 73 to 106.

Denny, C. S., (1941), "Quaternary Geology of the San Acacia Area, New Mexico," Journal of Geology, Vol. 48, pp. 225 to 260.

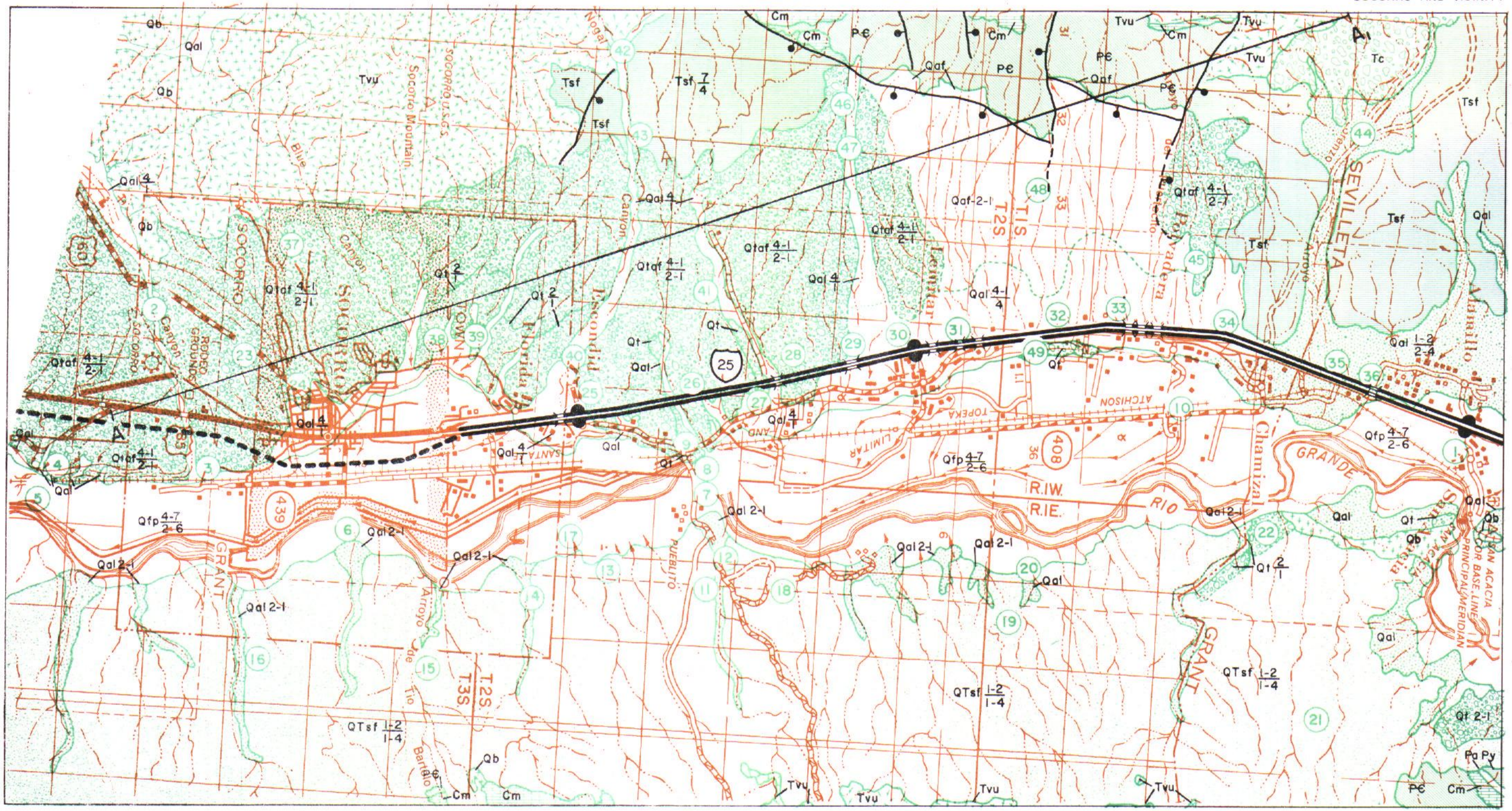
New Mexico Geological Society, (1952), "Guidebood of the Rio Grande Country," Third Field Conference.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-9

SOILS AND GEOLOGY MAP 25–9



GEOLOGY MAPPED 1963

–LEGEND–

SEDIMENTARY ROCKS

QUATERNARY
- Qal — Alluvium
- Qfp — Flood-plain deposits
- Qaf — Alluvial fan deposits
- Qt — Terrace deposits

Santa Fe group (QUATERNARY)
- Qtaf — Terrace & alluvial fan deposits
- QTsf — Santa Fe formation

TERTIARY
- Tsf — Lower Santa Fe group
- Tc — Conglomerate

PERMIAN
- Py — Yeso formation
- Pa — Abo formation

CARBONIFEROUS
- Cm — Magdalena group

IGNEOUS ROCKS

QUATERNARY
- Qb — Basalt

TERTIARY
- Tvu — Volcanic rocks undifferentiated

PRECAMBRIAN
- P€ — Amphibolite, Pyroxenite, Granite & Meta-sediments

0
STATUTE MILES

SOILS AND GEOLOGY

Soils Summary:

Table 25-9-1

Age and Formation	Hole No.	Lift	Depth in Feet From	to	AASHO Classification	Material Type
Qfp	1	A	0.0	3.0	A-4	Silt
"		B	3.0	4.0	A-4	"
"		C	4.0	5.0	A-4	"
Qsf	2	A	0.0	2.0	A-2-6	Clayey gravel
"		B	2.0	8.0	A-1-a	Sand and gravel
"		C	8.0	25.0+	A-2-7	Clay and gravel
Qaf	3	A	0.0	3.5	A-2-4	Silty gravel
"		B	3.5	20.0+	A-1-a	Sand and gravel
"	4	A	0.0	1.0	A-4	Silt
"		B	1.0	3.5	A-1-a	Caliche and gravel
"		C	3.5	20.0	A-1-a	Sand and gravel
Qfp	5	A	0.0	3.5	A-7	Clay
"	6	A	0.0	1.5	A-4	Silt
"		B	1.5	5.0	A-2-4	Silty sand
"	7	A	0.0	5.0	A-2-4	" "
"	8	A	0.0	5.0	A-4	Silt
"""		B	5.0	8.0	A-6	Clay
Qtg	9	A	0.0	3.5	A-4	Silt
"		B	3.5	10.0	A-1-a	Sand and gravel
"		C	10.0	12.0	A-4	Silt
"		D	12.0	-	A-2-4	Silty sand
Qfp	10	A	0.0	2.5	A-2-4	" "
Qsf	11	A	0.0	30.0	A-1-a	Sand and gravel
Qal	12	A	0.0	5.0+	A-1-a	" " "
QTsf	13	A	0.0	4.0	A-2-4	Silty sand
"		B	4.0	12.0	A-1-b	Coarse sand
"		C	12.0	45.0	A-4	Silt
Qal	14	A	0.0	3.0	A-1-a	Sand and gravel
"	15	A	0.0	3.0	A-1-a	Sand and gravel
Qsf	16	A	0.0	1.0	-	Caliche and top soil
"		B	1.0	20.0	A-1-a	Sand and gravel
"		C	20.0	30.0	A-4	Silt
"		D	30.0	35.0	A-6	Clay
"		E	35.0	50.0	A-1-b	Sand and gravel
Qal	17	A	0.0-	5.0	A-4	Silt
QTsf	18	A	0.0	2.0	A-2-4	Silty sand
"		B	2.0	40.0	A-1-a	Sand and gravel
"		C	40.0	50.0	A-3	Sand
"	19	A	0.0	20.0	Bedrock	Conglomerate
"		B	20.0	40.0	A-1-b	Sand and gravel
Qal	20	A	0.0	5.0	A-2-4	Silty gravel
Qsf	21	A	0.0	5.0	A-2-4	" "

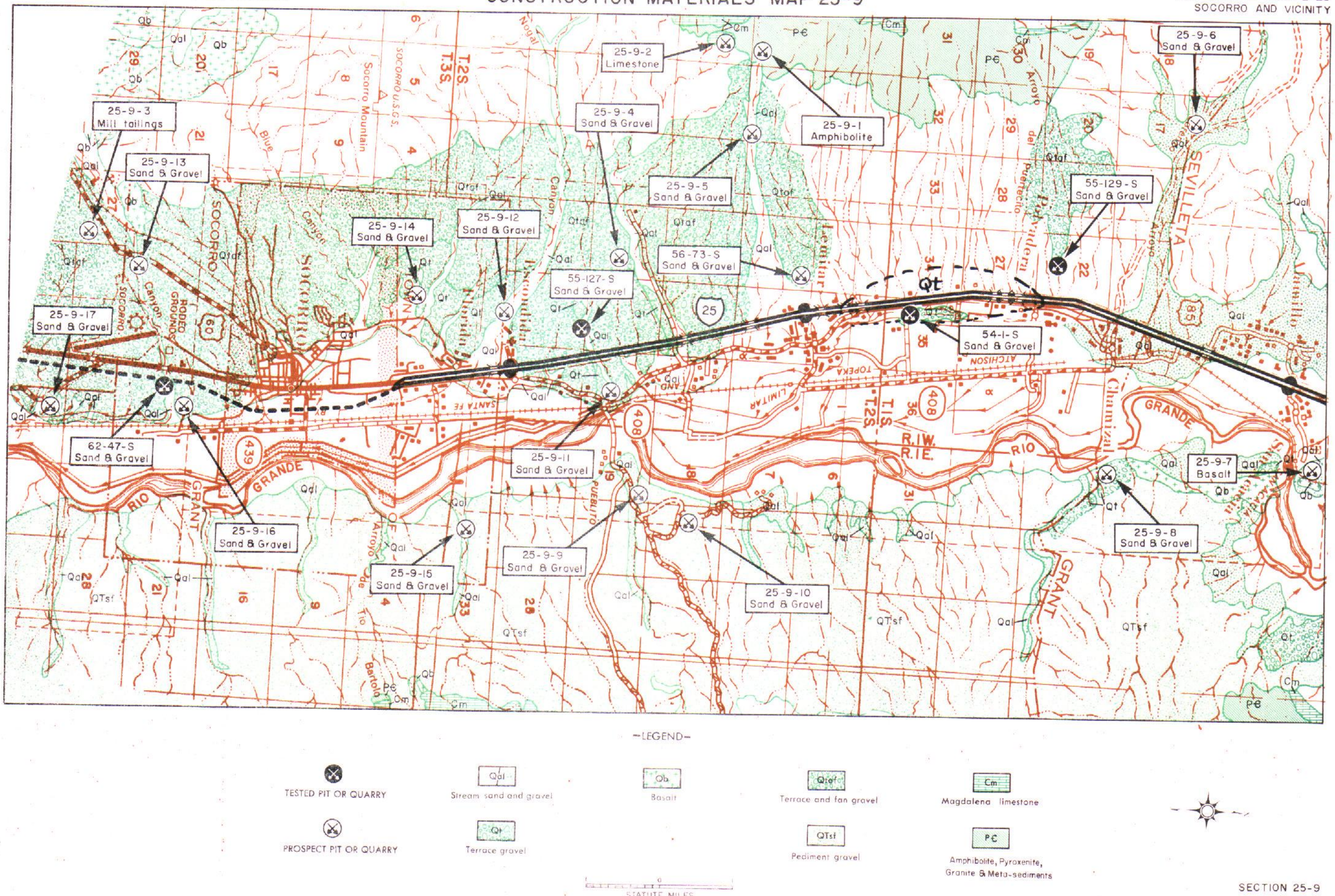
Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Qtg	22	A	0.0	1.0	A-2-4	Silty gravel
"		B	1.0	5.0	A-1-a	Sand and gravel
QTsf		C	5.0	-	A-4	Silt
Qaf	23	A	0.0	3.5	A-2-4	Silty gravel
"		B	3.5	5.0	A-6	Clay
"		C	5.0	10.0	A-1-a	Sand and gravel
Qtaf	24	A	0.0	1.5	A-1-a	" " "
"		B	1.5	3.0	A-2-4	Silty gravel
"	25	A	0.0	20.0	A-2-4	" "
"	26	A	0.0	10.0	A-2-4	" "
Qtg	27	A	0.0	5.0	A-1-b	Coarse sand
Qafp	28	A	0.0	8.5	A-2-4	Silty gravel
Qal	29	A	0.0	3.5	A-1-b	Sand and gravel
"		B	3.5	9.0	A-1-a	" " "
"	30	A	0.0	3.5	A-1-b	" " "
"		B	3.5	10.0	A-1-a	" " "
"	31	A	0.0	7.5	A-4	Silt
"		B	7.5	12.5	A-4	"
"	32	A	0.0	5.0	A-1-b	Sand and gravel
"		B	5.0	9.0	A-4	Silt
"	33	A	0.0	4.0	A-1-a	Sand and gravel
"		B	4.0	9.0	A-4	Silt
"	34	A	0.0	2.5	A-1-b	Sand and gravel
"		B	2.5	8.0	A-1-a	" " "
"		C	8.0	12.0	A-1-b	" " "
"	35	A	0.0	3.5	A-1-a	" " "
"		B	3.5	6.5	A-2-4	Silty gravel
"		C	6.5	9.0	A-1-b	Sand and gravel
"	36	A	0.0	6.5	A-1-b	" " "
"		B	6.5	9.0	A-4	Silt
Qtaf	37	A	0.0	1.0	A-2-6	Clay and gravel
"		B	1.0	4.0	A-4	Silt
Qtg	38	A	0.0	1.0	A-2-4	Silt and gravel
"		B	1.0	3.0	A-1-a	Sand and gravel
"		C	3.0	-	A-4	Silt
"	39	A	0.0	1.0	A-2-4	Silt and gravel
"		B	1.0	5.0	A-1-a	Sand and gravel
Qal	40	A	0.0	1.0	A-4	Silt
"		B	1.0	5.0	A-1-a	Sand and gravel
Qtaf	41	A	0.0	5.0	A-1-a	" " "
"		B	5.0	15.0	A-6	Clay

Soils Summary: continued...

Table 25-9-1

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Qtaf	41	C	15.0	20.0	A-1-a	Sand and gravel
"		D	20.0	30.0	A-1-b	" " "
"		E	30.0	35.0	A-4	Silt
Qal	42	A	0.0	2.5	A-4	"
"		B	2.5	5.0	A-1-a	Sand and gravel
Tsf	43	A	0.0	3.0	A-7	Clay
"		B	3.0	6.0	A-4	Sand and silt
Qal	44	A	0.0	3.5	A-1-b	Sand and gravel
Qtaf	45	A	0.0	3.0	A-1-a	" " "
"		B	3.0	5.0	A-4	Silt
"	46	A	0.0	25.0	A-2-7	Clay and gravel
Qal	47	A	0.0	30.0+	A-1-a	Sand and gravel
Qaf	48	A	0.0	4.0	A-1-b	Coarse sand
Qtg	49	A	0.0	1.0	A-4	Silt
"		B	1.0	10.0	A-1-a	Sand and gravel

CONSTRUCTION MATERIALS MAP 25-9



CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-9-2

Pit or Prospect No.		25-9-1	25-9-2 (Prospect)	25-9-3 (Prospect)	25-9-4 (Prospect)	25-9-5 (Prospect)
	Section	SE 1/4, Sec.7	18	SE 1/4, Sec. 27	22	N 1/2, Sec. 17
	Twnshp.	T 2 S	T 2 S	T 3 S	T 2 S	T 2 S
Location	& Range	R I W	R I W	R I W	R I W	R I W
	County	Socorro	Socorro	Socorro	Socorro	Socorro
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Federal	State & Federal	Private	State	State
Geologic Age		Precambrian	Mississippian	-	Quaternary	Quaternary
Formation		Intrusive	Magdalena group	Mill tailings	Terrace deposit	Terrace deposit
Type of Pit		Quarry	Quarry	Coarse aggregate	Coarse aggregate	Coarse aggregate
Kind of Material		Amphibolite, gabbro, quartz diorite	Limestone	Crushed rhyolite	Igneous gravel	Mixed aggregate
Quality of Material		Excellent	Good	Excellent	Good	Good
Thickness of Material		100+ feet	10 to 15 feet	-	10 to 20 feet est.	30+ feet
Thickness of Cap (Caliche)		-	-	-	-	-
Blasting Qualities		?	?	-	-	-
Uniformity		Good	Fair	Good	Good	Fair
Impurities		None	Shale lenses	None	Silt lenses?	Silt lenses
Type of Mat'l, Underlying Formation		?	Shale	-	?	?
Moisture Condition		Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood	Greasewood	None	Greasewood	Greasewood
Local Terrain		Mountainous	Mountainous	-	Dissected bajada	Dissected bajada
Depth of Overburden		Trace	?	-	3 feet est.	?
P.I. (Overburden)		-	?	-	?	?
Est. Reserve Quantity		Unlimited	?	300,000+ cu. yds.	?	?
Approx. Haul to Nearest Point		5.0 miles	5.0 miles	2.5 to 3 miles	2.0 miles	5.0 miles
L.A. Wear		16.8	25.6	25.2	-	?
Maximum Size		-	-	2"	36"	12"
% Retained on 2" Sieve		-	-	Less than 2	20 to 30	5 to 10
	Crushed to	2"	1"	-	-	-
	2"	100	-	94	79	95
Pit	1"	82	100	62	69	80
Average	3/4"	47	93	43	63	72
% Passing	1/2"	28	59	30	55	63
	#4	11	21	14	36	42
	#10	6	10	6	25	26
	#200	1	3	1	5	4
P.I.		Sandy N.P	Sandy N.P.	Sandy N.P.	Sandy N.P.	Sandy N.P.
Lab. Numbers		63-1829-1842	63-17923	63-1828	63-1380 to 1384	63-1826

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-9-2

Pit or Prospect No.		25-9-6	25-9-7 (Prospect)	25-9-8 (Prospect)	25-9-9	25-9-10	25-9-11 (Prospect)
Location	Section	N 1/2, Sec. 17	Not sectionalized	SW 1/4, Sec. 18 (sevilleta Grant)	N 1/2, Sec. 19 & 20	W 1/2, Sec. 17	W 1/2, Sec. 24
	Twnshp.	T 1 S	Cor. N.M. Base Line	T 1 S	T 2 S	T 2 S	T 2 S
	& Range	R 1 W	& N.M. Prin. Mer.	R 1 E	R 1 E	R 1 E	T 1 W
	County	Socorro	Socorro	Socorro	Socorro	Socorro	Socorro
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Federal	Private	Private	State	State	Private
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary-Tertiary	Quaternary
Formation		Alluvium	Basalt	Terrace deposit	Alluvium	Santa Fe	Terrace deposit
Type of Pit		Fine aggregate	Quarry	Coarse aggregate	Coarse aggregate	Coarse aggregate	Sand & gravel
Kind of Material		Granite sand & gravel	Basalt	Mixed aggregate	Limestone gravel	Limestone gravel	Mixed aggregate
Quality of Material		Fair	Good	Good	Good	Good	Good
Thickness of Material		5 to 10 feet est.	20+ feet	5 to 10 feet	5 to 10 feet est.	38 feet	7.0 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	Unexplored	-	-	-	-
Uniformity		Fair	Good	Fair	Fair	Good	Fair
Impurities		None	Minor clay seams	None	Silt lenses	Silt & clay lenses	Silt & clay lenses
Type of Mat'l. Underlying Formation		?	Silt & sand	Silt	?	Fine-grained sand	Silt & clay
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood, Mesquite, etc.	Greasewood	Greasewood	Mesquite & greasewood	Greasewood	Greasewood
Local Terrain		Dissected bajada	Hilly	Hilly	Dissected bajada	Mesa	Hilly
Depth of Overburden		None	None	1 to 3 feet	-	2.0 feet	4.0 ave.
P.I. (Overburden)		-	-	4	-	7 approx.	Sandy N.P.
Est. Reserve Quantity		100,000+ Cu. Yds.	Unlimited	200,000 cu. yds.	Unexplored	Unlimited	?
Approx. Haul to Nearest Point		4.0 miles	2.5 miles	4.0 miles	5.0 miles	5.0 miles	1.5 miles
L.A. Wear		?	21.2	24.0	22.8	?	-
Maximum Size		6"	-	8"	12"	8"	12"
% Retained on 2" Sieve		Less than one	-	10 to 15 est.	15 to 20 est.	5 to 10 est.	10 to 20
	Crushed to	-	1"	-	-	-	-
Pit Average % Passing	2"	100	-	91	83	96	88
	1"	99	100	76	67	79	78
	3/4"	98	89	69	58	73	73
	1/2"	95	48	59	49	62	67
	#4	85	20	37	36	37	49
	#10	69	11	27	29	23	32
	#200	6	3	3	3	4	2
P.I.		Sandy N.P.	Sandy N.P.	Sandy N.P.	Sandy N.P.	Sandy N.P.	Sandy N.P.
Lab. Numbers		63-1389	63-17924-25	63-1284-1286	62-1282	63-1271-1273	63-1256-1259

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-9-2

Pit or Prospect No.		25-9-12 (Prospect)	25-9-13 (Prospect)	25-9-14 (Prospect)	25-9-15	25-9-16 (Prospect)	25-9-17 (Prospect)
	Section	Not sectionalized	26	Not sectionalized	32	Not sectionalized	31
	Twnshp.	Socorro Grant	T 3 S	Socorro Grant	T 2 S	Socorro Grant	T 3 S
Location	& Range		R I W		R I E		R I E
	County	Socorro	Socorro	Socorro	Socorro	Socorro	Socorro
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	State	Private	Private	Federal
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Alluvium	Terrace deposit	Terrace deposit	Alluvium	Terrace deposit	Terrace deposit
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Igneous	Igneous	Mixed aggregate	Limestone & sandstone	Mixed aggregate	Mixed aggregate
Quality of Material		Good	Good	Good	Good	Good	Good
Thickness of Material		5 to 15 feet	6.0 feet	5 to 15 feet	6 feet approx.	17 feet	17 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	-	-	-	-
Uniformity		Good	Good	Good	Good	Fair	Fair
Impurities		Silt lenses	Silt & clay lenses	Minor silt	Silt	Silt lenses	Silt lenses
Type of Mat'l. Underlying Formation		Silt & clay	Clayey gravel	Silt & clay	Silt & clay	Interbedded clay & gravel	Interbedded silt & gravel
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood	Greasewood	Greasewood	Greasewood	Greasewood	Greasewood
Local Terrain		Wide arroyo	Dissected plain	Dissected terrace	Arroyo bottom	Hilly	Hilly
Depth of Overburden		1.0 to 3.0 feet	2.0 feet	1.0 feet	None	3.0 feet ave.	1.0 feet
P.I. (Overburden)		8.0	13.9	8.3	-	7	8
Est. Reserve Quantity		200,000 cu. yds.	Unlimited	200,000 cu. yds.	100,000 cu. yds.	Unlimited	100,000 cu. yds.
Approx. Haul to Nearest Point		0.5 miles	2.0 miles	2.0 miles	4.0 miles	0.5 miles	0.5 miles
L.A. Wear		-	18.0	-	-	17.6	-
Maximum Size		24"	15"	8"	6"	24"	24"
% Retained on 2" Sieve		40	40	30	5	30	40
	Crushed to	-	-	-	-	-	-
	2"	63	60	68	97	69	57
Pit	1"	41	50	49	85	53	44
Average	3/4"	36	42	39	77	48	40
% Passing	1/2"	31	36	32	65	42	36
	#4	25	24	20	42	28	27
2	#10	21	17	13	31	19	19
	#200	3	2	3	4	3	3
P.I.		Sandy N.P	Sandy N.P.	Sandy N.P.	Sandy N.P.	Sandy N.P.	Sandy N.P.
Lab. Numbers		63-1378-1379	63-1279-1281	63-1376-1377	63-1283	63-1277-1278	63-1247-1249

AGGR$GATE RESOURCES AND SOILS STUDY
NEW MEXICO INTERSTATE ROUTE 25
SOCORRO AND VICINITY

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-9-2

Pit or Prospect No.	54-1-S	55-127-S	55-129-S	56-73-S	62-47-S
Location — Section	SW 1/4, Sec. 35	23 & 26	SW 1/4, Sec 22	NE 1/4, Sec, 10	Not sectionalized
Location — Twnshp.	T 1 S	T 2 S	T 1 S	T 2 S	Socorro Grant
Location — & Range	R 1 W	R 1 W	R 1 W	R 1 W	
Location — County	Socorro	Socorro	Socorro	Socorro	Socorro
Location — State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner	Private	Federal	Private	Private	City of Socorro
Geologic Age	Quaternary	Quaternary	Quaternary-Tertiary	Quaternary	Quaternary
Formation	Terrace deposit	Terrace deposit	Terrace deposit	Terrace	Alluvium
Type of Pit	Sand & gravel	Gravel	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material	Mixed aggregate	Igneous	Igneous gravel	Igneous	Igneous
Quality of Material	Good	Good	Good	Good	Good
Thickness of Material	9 feet	10 feet	5 to 10 feet	20 to 25 feet	11 feet
Thickness of Cap (Caliche)	-	-	-	-	-
Blasting Qualities	-	-	-	-	-
Uniformity	Good	Good	Fair	Good	Good
Impurities	None	Silt lenses	Silt lenses	Silt (minor)	Silt lenses
Type of Mat'l. Underlying Formation	Silt & clay	Silt & clay	Silt & clay	Silt & clay	Sand & gravel
Moisture Condition	Dry	Dry	Dry	Dry	Dry
Vegetation	Sage & greasewood	Greasewood	Greasewood	Greasewood	Greasewood
Local Terrain	Terrace	Dissected terrace	Sloping plain	Dissected sloping plain	Arroyo bottom
Depth of Overburden	1 to 3 feet	3.0 feet ave.	0 to 3 feet	4 to 5 feet	-
P.I. (Overburden)	5	8	-	10	-
Est. Reserve Quantity	See remarks	150,000 cu. yds.	?	Unlimited	200,000 cu. yds.
Approx. Haul to Nearest Point	0.5 miles	0.3 miles	1 mile	1.0 mile	0.1 mile
L.A. Wear	26.0	22.8	20.0	25.6	16.9
Maximum Size	8"	24"	Approx. 1"	24"	24"
% Retained on 2" Sieve	None	25	-	10	30 to 40
Crushed to	-	-	-	-	-
Pit Average % Passing 2"	100	75	-	85	65
1"	87	63	-	73	51
3/4"	78	57	100	67	45
1/2"	67	50	97	59	39
#4	44	33	78	44	30
#10	32	23	55	33	23
#200	2	3	10	5	3
P.I.	Sandy N.P.	Sandy N.P.	Sandy N.P.	Sandy N.P.	Sandy N.P.
Lab. Numbers	63-1843-1844	55-24243-24284; 56-10981-10990; 56-71293-11302	55-24786-24808	56-11692-11704; 56-12570-12572	62-14481-62-14486

Remarks:

54-1-S - Pit presently being used by commercial sand and gravel company (3-21-63).

SOILS AND GEOLOGY

Introduction:

Strip 25-10 lies in Socorro County, New Mexico. It begins one mile south of the Rio Salado bridge on U.S. 85 and ends six and three quarters miles north of Bernardo.

The strip is characterized by broad river valleys which separate a series of veneered pediment surfaces lying at higher altitudes. It lies irregularly between the rugged fault blocks of the Southern Manzano, the Los Pinos, and the Ladron Mountains. The Joyita Hills are also included in the mapped area.

General Geology:

The Rio Grande depression is a structural low which has resulted from a series of down faulted basins arranged en-echelon along the course of the Rio Grande.

The area covered by this report is within the Albuquerque-Belen basin which is bordered on the east by the Manzano and the Los Pinos Mountains, and on the west by the Ladron Mountains. The Socorro constriction marks the southern boundary.

The South Manzano and Los Pinos Mountains are structurally continuous and are formed from an eastward dipping fault block. From the western escarpment the rocks dip gently to the east and southeast. Precambrian igneous and metamorphic rocks form the core of the mountains and they are generally covered by Pennsylvanian limestone and shale.

The Joyita Hills are a complexly faulted area consisting of Precambrian to Quaternary rocks which include granite, limestone, sandstone, shale, conglomerate and volcanics.

The Rio Grande and the Rio Puerco have cut deeply into the basin deposits of unconsolidated sediments which are assigned to the Santa Fe group. Successive levels of older surfaces were formed and remnants of these surfaces are now covered by terrace and pediment deposits.

The Llano de Albuquerque, one of the oldest pediment surfaces in the area, rises between the Rio Salado and the Rio Grande valleys. It is a broad wedge-shaped grassy plain that has been modified by recent erosion and has a thick cover of sandy gravel with a thin caliche capping.

The younger Llano de Sandia is also a broad, smooth, grassy plain. It gradually rises from the Rio Grande valley on the east and extends to the Los Pinos and South Manzano Mountains. The plain is terminated southward by the Joyita Hills and ends northward near Bernalillo.

Wind blown sand mantles much of the mapped area and large sand dunes are found north of the lower Rio Salado.

The areal distribution of formations is shown on Soils and Geology Map 25-10. Their succession and character are given under the section termed "Stratigraphy."

Soils:

Alluvium (Qal): Silty sand (A-2-4) is found in the valley floor of the Rio Puerco and in the alluvium bordering the terraces along the Rio Grande. Clay (A-7) thinly overlies the silty sand of the Rio Puerco valley in some areas.

A deep accumulation of wind-blown sand (A-3) is adjacent to the main channel of the Rio Salado. Sand and gravel (A-1-b) in the arroyos along the Rio Grande is locally overlain by silty sand (A-2-4). Clay (A-7) overlying sandy silt (A-4) is found near the confluence of the Rio Puerco and the Rio Grande. Silt (A-4) overlies sand and gravel (A-1-a) in the Rio Puerco valley in the northern part of the strip.

Aeolian deposits (Qa): Sand dunes in the lower Rio Salado area are composed of a well-sorted quartz sand (A-3) up to 50 feet thick.

Flood-plain deposits (Qfp): In this strip the surface soils of the flood-plain are predominantly clay (A-7); however, this clay may change to silty sand (A-2-4) or fine sand (A-3) at or very near the surface. The preponderance of clay indicates that this is a ponding area and that slack-water conditions have existed for some time. In fact, there are many stagnant ponds and swamp areas from U.S. 60 south to San Acacia.

Terrace deposits (Qt): The top soil of the terrace deposits is a silty sand and gravel (A-2-4) which reaches depths up to 4 feet. Sand and gravel (A-1-a) up to 20 feet thick is found below the silty sand cover. The sand and gravel has local lenses of sand, silt, and clay. A poorly consolidated caliche caps the sand and gravel in some places.

Pediment deposits (Qp): The pediment deposits lie unconformably over various units of the Santa Fe group. A caliche zone is found near the top of most of the pediment deposits.

The Llano de Albuquerque has a moderate to thick cover of wind-blown sand (A-3) which reaches depths to 10 feet. Below this is a layer of silty soil (A-4) which is underlain by 2 to 10 feet of a caliche cemented silt and gravel. The caliche is usually underlain by clay (A-7) that has variable amounts of nodular caliche. Alternate beds of sand (A-3), sand and gravel (A-1-a), silt (A-4), and clay (A-7) are found below the nodular caliche and these beds range up to 40 feet in thickness.

The pediment deposits of this strip are believed to be a product of an early Rio Grande and its tributaries. A part of the material is locally derived but a big percentage of the cobbles and pebbles have been transported for many miles.

Upper Santa Fe group (QTsf): This is a complex of alluvial fan, playa, and river deposits. Most of the surface soils are an alluvial fan type deposit, products from Permian and Pennsylvanian beds. These deposits are fairly coarse-grained limestone and sandstone gravels. A fine-grained, floodplain or playa deposit interfingers with the alluvial fan materials. These deposits vary from silt and clay to a well-washed river sand. They are exposed in the lower reaches of most of the arroyos east of the Rio Grande.

Soil samples from the east side of the Rio Grande, bordering the terrace deposits, show silty sand and gravel (A-2-4) overlying clayey sand and gravel (A-2-6). Below this are irregular exposures of sand and

Soils continued...

gravel (A-1-a), silt (A-4), sand (A-3) and clay. A soft, nodular, caliche horizon is found in some places.

Lower Santa Fe group (Tsf): These sediments are exposed along the eroded bluffs of the Llano de Albuquerque and along the badland type topography that reaches from Interstate Route 25 to the Quaternary pediment that flanks the Ladron Mountains. They are interbedded, poorly consolidated beds of sandstone, siltstone, clay and conglomerate.

Table 25-10-1 shows the log and classification of the soils samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-10.

Stratigraphy:

Quaternary:	Alluvium (Qal) - silt, sand, and gravel. Thickness: 0 to 75+ feet.
	Aeolian deposits (Qa) - fine, well-sorted quartz sand. Thickness: 0 to 50 feet.
	Flood-plain deposits (Qfp) - tan to brown sand, silt and clay. Thickness: 50 to 100 feet.
	Terrace deposits (Qt) - heterogeneous mixture of sand, gravel, silt, and clay. Thickness: 0 to 15+ feet.
	Pediment deposits (Qp) - gravel, sand, silt, and clay. Local indurated caliche zones. Thickness: 10 to 40 feet.
Quaternary-Tertiary:	Upper Santa Fe group (QTsf) - gravel, sand silt and clay. Thickness: 0 to 50(?) feet.

Unconformity--

Tertiary:	Lower Santa Fe group (Tsf) - tan to reddish-brown, unconsolidated to consolidated beds of silt, sand, clay, and gravel. Thickness: 5,000+ feet.
	Conglomerate (Tc) - volcanic and igneous conglomerate with siltstone, clay and local gypsum. Thickness: 4,000+ feet.
	Datil formation (Td) - purple, red, and gray latite, rhyolite, andesite, and welded tuff. Dark red and purple conglomerates of volcanic fragments. Thickness: 2,000+ feet.
	Baca formation (Tb) - red and white sandstone, red clay and coarse-grained conglomerate. Thickness: 100+ feet.

Unconformity--

Triassic:	Dockum group (Trd) - maroon, red, gray and green shale and sandstone. Thickness: 500 feet.

Unconformity--

Permian:	Bernal formation (Pb) - orange-red silty sandstone with thin limestone beds. Thickness: 20 feet.
	San Andres formation (Psa) - light to dark gray, thin-to medium-bedded limestone. Thickness: 275 feet.
	Glorieta sandstone (Pg) - white, buff and light gray, fine-to medium-grained sandstone. Thickness: 140 to 170 feet.
	Yeso formation (Py) - orange-red buff and yellow sandstone, siltstone with interbedded gypsum and thin limestone beds. Thickness: 750 feet.
	Abo formation (Pa) - dark red and maroon shale with sandstone, siltstone, and conglomerate. Thickness: 1,100 feet.
	Bursum formation (Pbu) - purplish-red and green shale with arkose, arkosic conglomerate and gray limestone. Thickness: 80 to 120 feet.

Unconformity--

Carboniferous:	Magdalena group: Madera limestone and Sandia formation (Cm) - cherty, gray limestone, red to gray and gray-green shale and conglomeratic sandstone. Thickness: 200 feet in Joyita Hills. 3,000 feet in Ladron Mountains.

Unconformity--

Precambrian:	(P€) - granite, gneiss and shist.

Construction Materials:

Quaternary:

Alluvium (Qal) - The coarse-grained sand in the arroyos south of U.S. 60 and in the Rio Salado may be used as a fine aggregate for highway construction. Hole 8 on the Soils and Geology map is representative of most of the arroyos south of U.S. 60. It shows 8 feet of coarse sand with 65 percent passing the number 4 sieve and 6 percent passing the number 200 sieve.

Aeolian deposits (Qa) - The dune sand north of the Rio Salado is a well-sorted fine sand that has a small amount of minus 200 material. Pit 25-10-5 is representative of this sand.

Terrace deposits (Qt) - Terrace deposits along the Rio Grande are primarily a coarse-grained sand; however, near the constriction of the river, north of the Rio Salado, they seem to have a greater percentage of plus one inch material. Pits 57-118-S and 57-120-S are typical of the sandy deposits. Pit 25-10-2 is typical of the coarse-grained deposits.

South of the Rio Salado the terrace deposits are similar to those in the vicinity of Contreras. Practically all of the material passes the one inch sieve and more than 60 percent passes the number 4 sieve. Fine aggregate for concrete can probably be produced from most of the terrace deposits of this strip.

Pediment deposits (Qp) - gravel in these deposits is very discontinuous. Test pits and outcrops in the area indicate that the materials are braided stream deposits that terminate in thin lenticular beds and discontinuous channels to the east. The most desirable materials seem to be parallel to the dune deposits from one and one-half to two miles north of the Rio Salado.

Quaternary-Tertiary:

Upper Santa Fe group (QTsf) - these deposits are very similar to the pediment gravels west of the Rio Grande. Outcrops near La Joya show from 2 to 8 feet of fairly coarse-grained, angular gravel and sand overlying 10 to 20 feet of interbedded sand, silt, and clay. Further exploration of this deposit may reveal several hundred thousand tons of usable material.

Permian:

San Andres limestone (Psa) - this limestone is about 275 feet thick in the Joyita Hills. It has some interbeds of sandstone and sandy limestone.

Accessibility is limited into the area by a trail road from La Joya; however, it is believed that this material may be hauled or conveyed across the Rio Grande near the constriction in the river above the Rio Salado.

Carboniferous:

Madera limestone (Cm) - these limestones are typically cherty, massive to medium-bedded and fossiliferous. The thickness varies from about 15 feet to more than 80 feet.

Like the San Andres limestone, access to the area is difficult. It lies from one-half to three-quarters of a mile to the east of the San Andres limestone.

Distribution of tested and propective pit sites for construction materials is shown on Construction Materials Inventory Map 25-10. Test data and other related information are shown in Material Pit Summary Table 25-10-2.

Selected References:

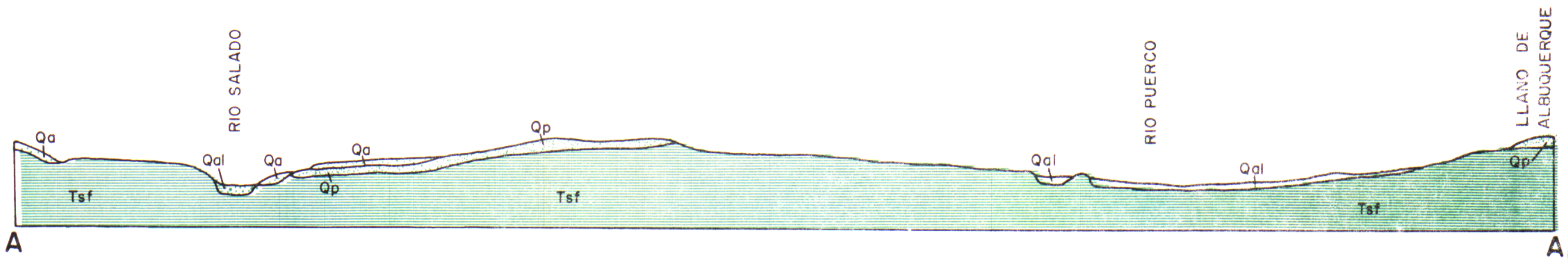
Kelly and Wood, 1946, Geology of the Lucero uplift, Valencia, Socorro, and Bernalillo Counties, N.M.: U. S. G. S. Oil and Gas Prelim. Map 47.

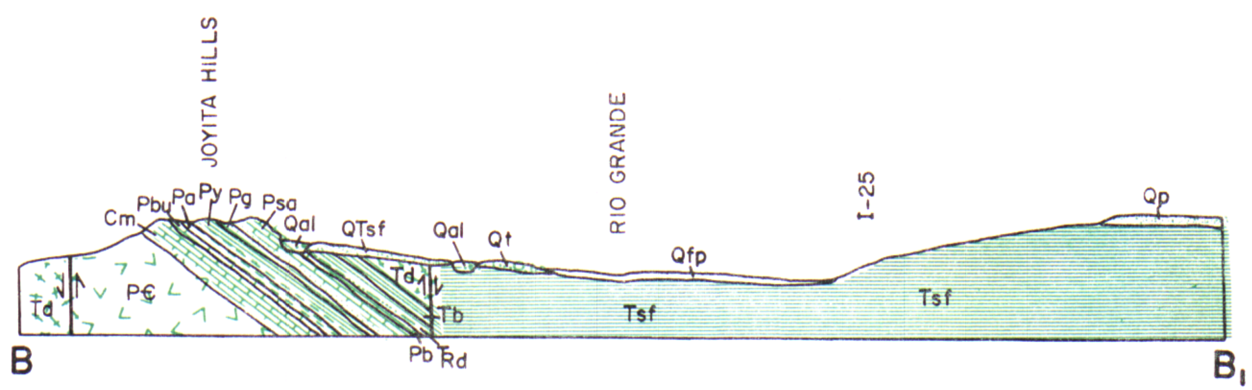
Spiegel, Zane, 1955, Geology and Ground-Water Resources of Northeastern Socorro County N. M., State Bureau of Mines and Mineral Resources, U.S. Geol. Survey Bull. 4, pp. 1-79.

Stark, J. T., 1956, Geology of the South Manzano Mountains, N. M. State Bureau of Mines and Mineral Resources, Bull. 34, pp. 1-45.

Wilpolt, R. H., and others, 1946, Geologic Map and Stratigraphic Sections of Paleozoic Rocks of Joyita Hills, Los Pinos Mountains, and Northern Chupadera Mesa, Valencia, Torrance, and Socorro Counties, N. M., Geol. Survey Oil and Gas Prelim. Inv. Map 61.

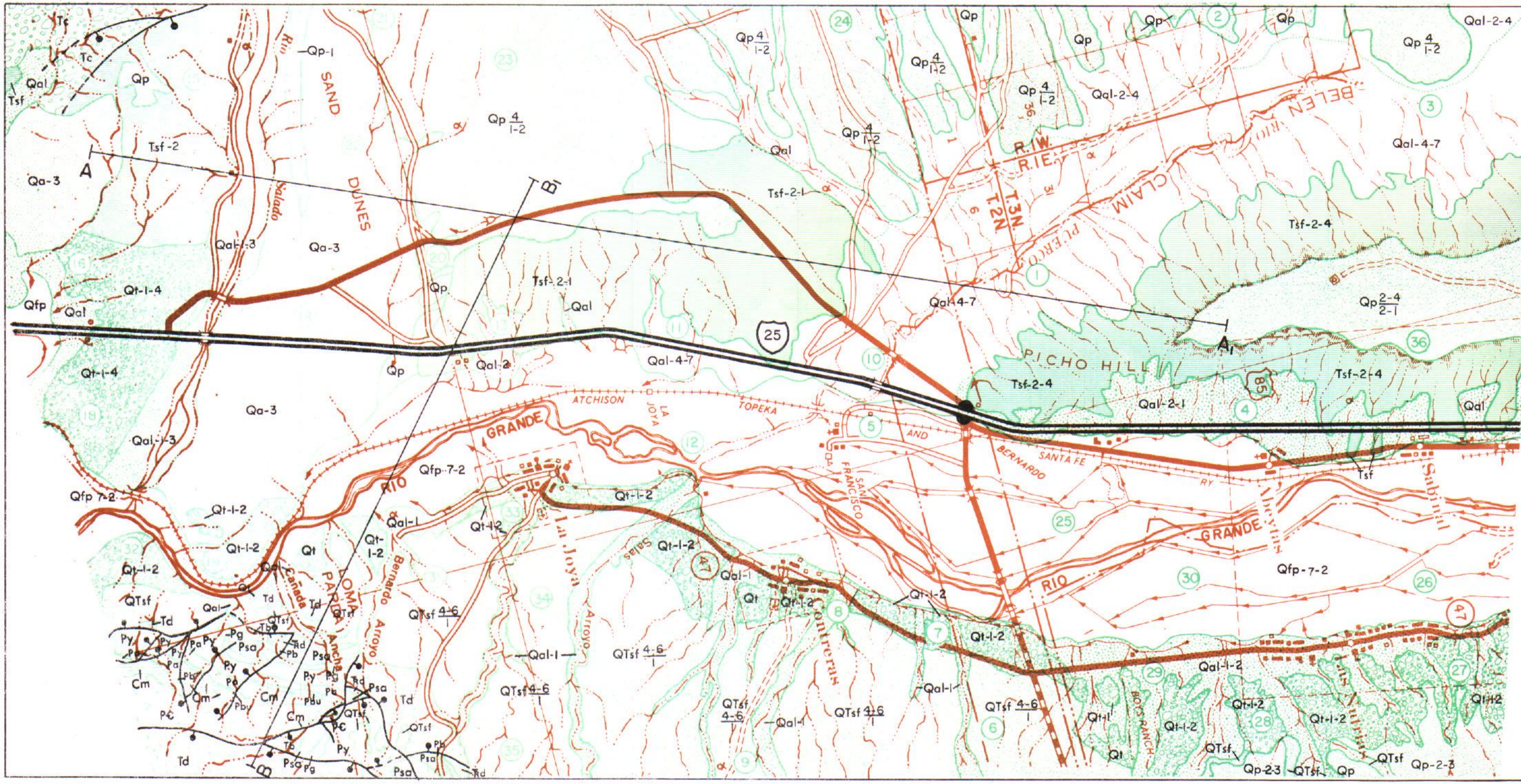
GENERALIZED CROSS-SECTIONS





Note: For explanation of symbols see Soils and Geology map 25-10

SOILS AND GEOLOGY MAP 25-10



GEOLOGY MAPPED 1963

-LEGEND-

SEDIMENTARY ROCKS

Qal	Alluvium	QUATERNARY
Qa	Aeolian deposits	QUATERNARY
Qfp	Flood-plain deposits	QUATERNARY
Qt	Terrace deposits	QUATERNARY
Qp	Pediment deposits	QUATERNARY
QTsf	Upper Santa Fe group	QUATERNARY TERTIARY
Tsf	Lower Santa Fe group	TERTIARY
Tc	Conglomerate	TERTIARY
Td	Datil formation	TERTIARY
Tb	Baca formation	TERTIARY
₹d	Dockum group	TRIASSIC
Pb	Bernal formation	PERMIAN
Psa	San Andres limestone	PERMIAN
Pg	Glorieta sandstone	PERMIAN
Py	Yeso formation	PERMIAN
Pa	Abo formation	PERMIAN
Pbu	Bersum formation	PERMIAN
Cm	Magdalena group	CARBONIFEROUS

IGNEOUS ROCKS

P€	Granite and metamorphic rocks	PRECAMBRIAN

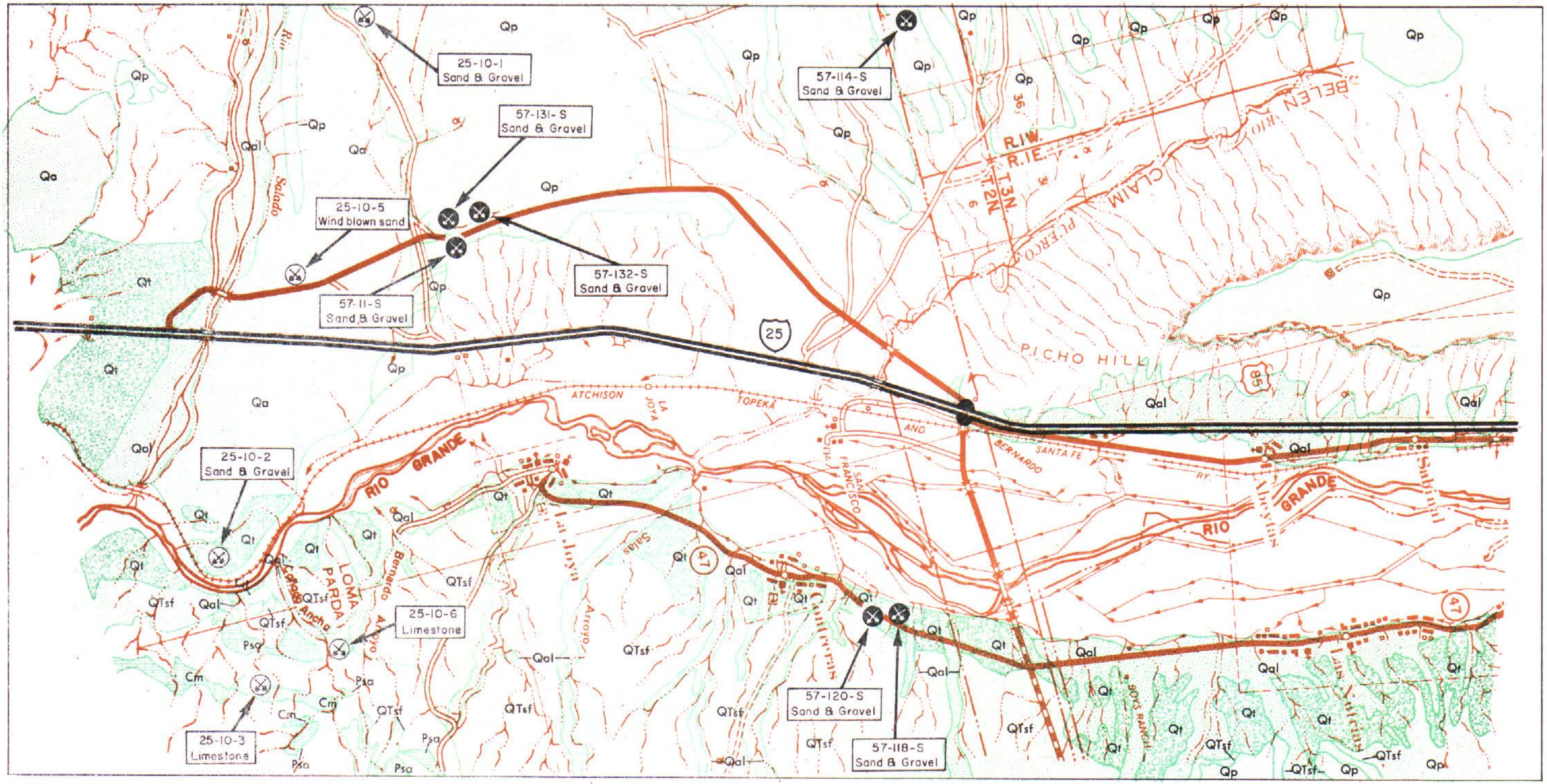
STATUTE MILES

Soils Summary:

Table 25-10-1

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Qal	1	A	0.0	16.0	A-7	Clay
"		B	16.0	20.0	A-2-4	Silty sand
Qp	2	A	0.0	1.0	A-1-b	Coarse sand
"		B	1.0	16.5	A-4	Silt
Qal	3	A	0.0	5.0	A-4	Silt
"		B	5.0	6.0	A-1-a	Sand and gravel
"	4	A	0.0	6.0	A-2-4	Silty sand
"		B	6.0	9.0	A-1-b	Sand and gravel
Qfp	5	A	0.0	5.0	A-7	Clay
QTsf	6	A	0.0	1.0	A-2-4	Silty sand and gravel
"		B	1.0	6.0	A-2-6	Clayey sand and gravel
"		C	6.0	10.0	A-1-a	Sand and gravel
Qt	7	A	0.0	7.0	A-1-a	" " "
Tsf		B	7.0	32.0	A-6	Clay
Qal	8	A	0.0	8.0	A-1-b	Sand and gravel
QTsf	9	A	0.0	6.0	A-4	Gravelly silt
Qal	10	A	0.0	0.7	A-7	Clay
"		B	0.7	5.0	A-4	Sandy silt
"	11	A	0.0	5.0	A-4	" "
Qfp	12	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	5.0	A-7	Clay
Qal	13	A	0.0	6.0	A-2-4	Silty sand
Qa	14	A	0.0	50.0	A-3	Fine sand
Tsf	15	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	4.0	A-2-4	" "
"		C	4.0	14.0	A-6	Clay
Qt	16	A	0.0	2.0	A-4	Sandy silt
Qal	17	A	0.0	3.0	A-3	Fine sand
Qt	18	A	0.0	10.0	A-1-b	Sand and gravel
"	19	A	0.0	15.0	A-1-a	" " "
Qp	20	A	0.0	6.0	A-1-a	" " "
Tsf		B	6.0	12.0	Bedrock	Sandstone
"		C	12.0	18.0	A-7	Clay
"		D	18.0	19.0	A-2-4	Silty sand
"		E	19.0	20.0	Bedrock	Sandstone
"		F	20.0	40.0	A-4	Silt
Qp	21	A	0.0	30.0	A-1-a	Sand and gravel
Qa	22	A	0.0	5.0	A-2-4	Silty sand
Qp	23	A	0.0	1.0	A-4	Silt
"		B	1.0	3.0	A-2-4	Silty sand
"	24	A	0.0	5.0	A-1-b	Sand and gravel
Qfp	25	A	0.0	1.0	A-3	Fine sand
"		B	1.0	3.5	A-4	Sandy silt
"		C	3.5	5.0	A-6	Clay
"	26	A	0.0	1.6	A-7	"
"		B	1.6	2.5	A-4	Silt
"		C	2.5	5.0	A-3	Fine sand
Qt	27	A	0.0	15.0	A-1-a	Sand and gravel
"	28	A	0.0	2.0	A-2-4	Silty sand and gravel
Qal	29	A	0.0	2.0	A-2-4	Silty sand
"		B	2.0	5.0	A-2-4	Silty sand and gravel
Qfp	30	A	0.0	5.0	A-7	Clay
Tsf	31	A	0.0	2.0	A-1-a	Sand and gravel
Qt	32	A	0.0	15.0	A-1-a	" " "
"	33	A	0.0	5.0	A-2-4	Silty sand
QTsf	34	A	0.0	8.0	A-1-a	Sand and gravel
"	35	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	2.0	A-4	Silt
"		C	2.0	4.0	A-4	"
Qp	36	A	0.0	5.0	A-2-4	Silty sand
"		B	5.0	8.0	A-4	Silt
"		C	8.0	12.0	A-6	Silty clay
"		D	12.0	18.0	A-6	Clay
"		E	18.0	22.0	A-2-4	Silty sand
"		F	22.0	26.0	A-4	Silt
"		G	26.0	34.0	A-1-a	Sand and gravel
"		H	34.0	35.0	A-6	Clay
"		I	35.0	40.0	A-3	Fine sand
Tsf		J	40.0	46.0	A-4	Sandy silt
"		K	46.0	51.0	A-6	Clay
"		L	51.0	60.0	A-4	Sandy silt
"		M	60.0	60.8	A-6	Clay
"		N	60.8	65.0	A-4	Sandy silt
"		O	65.0	66.0	A-7	Clay

CONSTRUCTION MATERIALS MAP 25-10



-LEGEND-

TESTED PIT OR QUARRY

PROSPECT PIT OR QUARRY

Qal	Stream sand and gravel
Qa	Wind bown sand
Qt	Terrace gravel
Qp	Pediment gravel
QTsf	Sand and gravel
Psa	San Andres limestone
Cm	Magdalena limestone

STATUTE MILES

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Pit or Prospect No.		57-17-S	57-114-S	57-118-S	57-120-S	57-131-S	57-132-S
Location	Section	Sevilleta Grant	SE 1/4 sec. 3	Sevilleta Grant	Sevilleta Grant	Sevilleta Grant	Sevilleta Grant
	Twnshp.	T 1 N	T 2 N	T 2 N	T 2 N	T 1 N	T 1 N
	& Range	R 1 W	R 1 W	R 1 E	R 1 E	R 1 W	R 1 W
	County	Socorro	Socorro	Socorro	Socorro	Socorro	Socorro
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Federal & State	Private	Private	Private	Private
Geologic Age		Quaternary	Quaternary-Tertiary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Pediment deposit	Santa Fe	Terrace deposit	Terrace deposit	Pediment deposit	Pediment deposit
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Mixed aggregate	Mixed aggregate	Mixed agregate	Mixed aggregate	Mixed aggregate	Mixed aggregate
Quality of Material		Good	Good	Good	Good	Good	Good
Thickness of Material		20.0 feet	25.0 feet	6.0 feet	5.0 to 8.0 feet	0.0 to 20.0 feet	0.0 to 20.0 feet
Thickness of Cap (Caliche)		-	4.0 feet	-	-	-	-
Blasting Qualities		-	-	-	-	-	-
Uniformity		Good	Good	Good	Good	Good	Good
Impurities		Silt & clay lentils	Silty clay fines	None	None	None	None
Type of Mat'l. Underlying Formation		?	?	Clay	Clay	?	?
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Greasewood, range grasses	Range grasses & greasewood	Grass & scattered pinons	Grass & scattered pinon	Greasewood & range grasses	Greasewood & range grasses
Local Terrain		Falt to hilly	Hilly	Dissected terraces	Dissected terraces	Flat to rolling	Flat to rolling
Depth of Overburden		0.0 to 3.5 feet	0.0 to 4.0 feet	2.0 to 7.0 feet	0.0 to 5.0 feet	0.0 to 2.0 feet	0.0 to 3.0 feet
P.I. (Overburden)		N.P. to 10	8	N.P.	N.P.	N.P. to 7	8 to 10
Est. Reserve Quantity		Unlimited	?	Unlimited	Unlimited	171,000, cu. yds.	182,000 cu. yds.
Approx. Haul to Nearest Point		1.3 miles	6 miles	2.0 miles	2.0 miles	1.5 miles	1.5 miles
L.A. Wear		26.0	27.6	26.8	22.0	26.0	28.0
Maximum Size		3"	13"	3"	3"	3"	3"
% Retained on 2" Sieve		15	?	5	-	6	5 to 15
	Crushed to	1"	1"	-	-	1"	1"
Pit Average % Passing	2"	-	-	94	-	-	-
	1"	100	100	67	100	94	93
	3/4"	94	93	56	95	86	90
	1/2"	81	78	45	78	76	82
	#4	58	64	29	57	57	61
	#10	44	47	22	45	46	53
	#200	3	3	2	8	4	12
P.I.		N.P.	N.P.	N.P.	N.P.	N.P.	N.P.
Lab. Numbers		57-2843-2876, 57-2926-2944	57-17401-17420	57-18169-191	63-371	57-18753-782	57-18839-872

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-10-2 continued...

Pit or Prospect No.	25-10-1 (Prospect)	25-10-2 (Prospect)	25-10-3 (Prospect)	25-10-5 (Prospect)	25-10-6 (Prospect)
Section	Sevilleta Grant	Sevilleta Grant	Sevilleta Grant	Sevilleta Grant	Sevilleta Grant
Twnshp.	T 1 N	T 1 N	T 1 N	T 1 N	T 1 N
Location & Range	R 1 E	R 1 E	R 1 E	R 1 W	R 1 E
County	Socorro	Socorro	Socorro	Socorro	Socorro
State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner	Private	Private	Private	Private	Private
Geologic Age	Quaternary	Quaternary	Pennsylvanian	Quaternary	Permian
Formation	Pediment deposit	Terrace deposit	Madera Limestone	Wind-blown deposit	San Andres
Type of Pit	Sand & gravel	Sand & gravel	Quarry	Sand	Quarry
Kind of Material	Mixed aggregate	Mixed aggregate	Limestone	Sand	Limestone
Quality of Material	Good	Good	Good	Good	Good
Thickness of Material	30 feet	20.0 feet	60.0 feet	0.0 to 50.0 feet	50+ feet
Thickness of Cap (Caliche)	-	-	-	-	-
Blasting Qualities	-	-	-	-	?
Uniformity	Good	Fair	Good	Good	Good
Impurities	Silt lenses(?)	None	Shale beds	None	-
Type of Mat'l, Underlying Formation	?	?	?	Sand, silt, clay & gravel	Sandstone
Moisture Condition	Dry	Dry	Dry	Dry	Dry
Vegetation	Greasewood	Greasewood	Greasewood, junipers	None	Range grasses
Local Terrain	Hilly	Hilly	Hilly & rough	Sand hills	Hilly
Depth of Overburden	0.0 to 2.0 feet	0.0 to 3.0 feet	-	-	2 feet
P.I. (Overburden)	N.P.	N.P. to 5	-	-	N.P.
Est. Reserve Quantity	Unlimited	300,000 cu. yds.	Unlimited	Unlimited	Unlimited
Approx. Haul to Nearest Point	4.5 miles	2.8 miles	5 miles	0.1 miles	5 miles
L.A. Wear	24.5	23.6	24.4	-	36.0
Maximum Size	6"	8"	-	-	-
% Retained on 2" Sieve	15	19	-	-	-
Crushed to	-	-	1"	-	1"
2"	85	68	-	-	-
Pit 1"	72	59	100	-	100
Average 3/4"	65	56	96	-	91
% Passing 1/2"	58	50	69	-	53
#4	48	37	24	-	19
#10	43	30	12	100	10
#200	4	2	1	7	3
P.I.	N.P.	N.P.	N.P.	N.P.	N.P.
Lab. Numbers	62-17076	62-17077	63-370	62-17049	63-17926-27

SOILS AND GEOLOGY

Introduction:

This strip begins about 2 miles south of the Valencia-Socorro County Line and ends seven miles north of Belen, New Mexico. It lies within the Albuquerque-Belen basin, a part of the Rio Grande depression.

The Belen area is characterized by a relatively broad river valley, flanked by flat to slightly rolling erosional surfaces on each side. The surface to the east is the Llano de Sandia and the Llano de Albuquerque lies to the west. The course of an ancestral Rio Grande can be traced by outcrops along the arroyos that dissect the pediment or erosional surfaces.

A part of the Manzano Mountains is included on the Construction Materials Map since materials for future construction of Interstate Route 25 may be taken from this area.

General Geology:

The present landscape of the Belen area is mostly an expression of a late Cenozoic erosion cycle. However, extreme crustal movement over the last 25 to 30 million years is responsible for some of the present land forms.

The Albuquerque-Belen basin is the largest basin of the Rio Grande depression. It is about 90 miles long and 30 miles wide. The Manzano Mountains border the basin to the east of this strip and the Puerco platform and the Lucero uplift form the western border.

The Albuquerque-Belen basin and its adjoining uplifts were formed during the latter part of the Cenozoic era. Subsidence of the basin and uplift and erosion of the adjoining highlands has continued through recent time. Drainage during the late Tertiary epoch was to a closed basin and several thousand feet of alluvial fan, stream and lake deposits of the Santa Fe group accumulated. Later a wide-spread ersoional surface developed over the basin fill, the Rio Grande became a through-flowing stream, and more deposits of sand, gravel, silt and clay became a part of the Santa Fe group.

The Manzano Mountains are about 30 miles long and from 10 to 15 miles wide. They are marked by a high-angle fault which is upthrust on the west. This fault lies a short distance west of the crest of the range. The maximum vertical displacement along this fault is as much as 10,000 feet. Generally, these mountains are an uplifted mass of metasediments, rhyolite flows, and interbedded basic sills that have been intruded by quartz. Pennsylvanian limestones, sandstones, and shales lie on the dip slope to the east.

Near the toe of the mountains is a recent fault which separates the Llano de Sandia from an older erosional surface. Fault slices of Triassic and Permian rocks are exposed in the arroyos near this fault.

The undulating, wind-swept surface of the Llano de Sandia slopes gently westward from the mountain front until it is breached by the Rio Grande. West of the Rio Grande a bad-land type topography reaches up to the featureless plain of the Llano de Albuquerque. This plain or mesa continues westward until broken by the Rio Puerco drainage system.

The Santa Fe beds along the escarpment of the Llano de Albuquerque indicate that axial river conditions alternated with playa type deposition. There are well-worn, well-washed sands and gravels alternately bedded with playa silts and clays. These conditions are not obviously repeated east of the river; although, the deposits are quite similar. It is believed that similar conditions existed during two different erosional cycles since the eastern slope is beveled to a lower elevation.

Along the border of the Rio Grande flood plain at the northern end of the strip is an extrusion of basalt. This flow is quite thick and it has interbeds of clay.

Terrace gravels crop out in a discontinuous band along the east side of the flood plain. These are axial river gravels deposited by an early Rio Grande.

The areal distribution of formations is shown on Soils and Geology Map 25-11. Their succession and character are given under the section termed "Stratigraphy."

Soils:

Flood-plain deposits (Qfp): The soils of the flood plain are typical of most large river valleys. They vary from clay to silt to sand. The sandy deposits are found in the old meander scars and the silts and clays are found in the backwater areas.

Aeolian deposits (Qa): Most of the formations of this strip have a cover of wind-blown sand. The sand varies from a few inches to 15 feet in thickness. Most areas have become pretty well stabilized with vegetation and they only form a thin residual cover over the formations of this strip; therefore, the only area mapped as wind-blown sand is a relatively fresh dune area in the northeast part.

Alluvium (Qal): The alluvial soils are very non-uniform in texture. This is caused by the variable way in which they have been deposited. Slope wash along the Santa Fe group is very similar in texture to the Santa Fe group. Where the streams flow onto the flood plain, silts, clays and gravels are mixed with wind-blown sand. The greater part of the alluvium is coarse-grained sand; although, there are many discontinuous deposits of silt and clay.

Terrace deposits (Qt): These deposits are made up of a mixed aggregate (quartzite, igneous, metamorphic, etc.) There is a residual silty sand (A-2-4) cover over a relatively thick (10 to 20 feet) deposit of sand and gravel (A-1-a).

Pediment deposits (Qp): An early Rio Grande and its tributaries are responsible for the gravel deposits of the Llano de Albuquerque and the Llano de Sandia surfaces. Sheet wash erosion has carried the finer particles from the higher slopes of the Llano de Sandia and redistributed them over the flatter surfaces. Sands swept up from the valley floors have also become a part of these surfaces. This accumulation of materials has become indurated and a caliche horizon occurs at irregular depths below the silty sand cover.

Soils continued...

A typical profile of the soils on these two surfaces may show zero to 3 feet of silty sand (A-2-4), over 3 to 6 feet of nodular caliche and silty sand or clayey sand, over an irregular thickness of sand and gravel (A-l-a or A-l-b).

The sand and gravel may be reworked Santa Fe sediments, since in many places it is difficult to determine the contact between the two.

Santa Fe group (Tsf): The upper exposures of the Santa Fe sediments are fine-grained gravel and coarse-grained sand with interlensing silts and clays that may show some degree of induration. Hole 18 shows a typical section of the Santa Fe group.

Table 25-II-I shows the log and classification of the soils samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-II.

Stratigraphy:

Quaternary:	Flood-plain deposits (Qfp) - tan to brown sand, silt and clay. Thickness: 50+ feet.
	Alluvium (Qal) - silt, sand, and gravel. Thickness: 0 to 75 feet.
	Aeolian deposits (Qa) - fine-grained, well sorted quartz sand. Thickness: 0 to 25 feet.
	Terrace deposits (Qt) - unconsolidated sand, silt, and gravel. Thickness: 0 to 50 feet.
	Pediment deposits (Qp) - interbedded clay, silt, sand, and gravel; commonly capped by caliche and wind-blown sand. Thickness: 10 to 40 feet.
	Basalt (Qb) - dark-grey to black, dense, andesitic basalt.
Tertiary:	Santa Fe group (Tsf) - interbedded, buff-to reddish-brown sand, silt clay and poorly consolidated conglomerate. Thickness: 2,000 feet.
Permian:	San Andres limestone (Psa) - vuggy to dense, grey limestone with local, interbedded sandstone. Thickness: 275 feet (Construction Materials Map only)
Precambrian:	Quartzite (P€q) - white to grey very dense quartzite. (Construction Materials Map only)

Construction Materials:

Quaternary:

Alluvium (Qal) - The arroyos that drain the Manzano Mountains have a very coarse-grained sand and gravel. The flow of these arroyos dissipates on the surface of the Llano de Sandia and no coarse-grained materials are carried beyond the fault that parallels the mountain front. Angular particles of quartzite, quartz, a minor amount of limestone and an abundance of schist are found on the floors of these arroyos.

An ideal sample of this material from prospective pit 25-II-3 showed more than 50 percent retained on the 2 inch sieve, about 24 percent passing the 1/2 inch sieve and less than 5 percent passing the number 200 sieve. This particular sample was sandy, non-plastic; however, it is believed that it will be difficult to develop a pit that is completely free of clay since there is a large amount of decomposed schist in the area.

Fine-grained aggregates may be obtained from the streams that drain the alluvial deposits adjacent to the Rio Grande flood plain. Pits 55-104-S and 54-56-S are representative of this material.

Aeolian deposits (Qa) - There are many places, not designated on the map, where sand pits may be located. The Llano de Albuquerque and the Llano de Sandia have local dune areas that have become stabilized. There are also areas in the alluvium adjacent to the flood plain that have wind-blown sands.

Terrace deposits (Qt) - Terrace deposits are exposed along the east flanks of the Rio Grande. They are primarily well-washed, quartzite gravel and sand. The entire surface of the Llano de Sandia seems to be underlain by river sediments that are very similar to those of the terrace deposits but somewhat more fine-grained. It is believed that the terrace gravels represent a later erosional cycle of an ancient Rio Grande.

Pits 57-143-S, 56-97-S, 55-103-S and 56-98-S are representative of the terrace deposits.

Pediment deposits (Qp) - Two distinctly different types of gravel and sand occur as pediment deposits in this strip. Coarse-grained deposits of gravel lie on the slopes adjacent to the Manzano Mountains. Pea-size gravel and coarse-grained sand lie under a mask of sand, caliche, silt and clay on the Llano de Albuquerque and the Llano de Sandia.

The coarse-grained materials on the pediment surface near the Manzano Mountains are similar to the stream deposits of that area. They are predominantly quartzite and schist particles with minor amounts of limestone, sandstone and quartz. Further exploration may reveal large quantities of usable aggregate from this area.

The pea-size gravel and coarse sand are plentiful on both erosional surfaces (Llano de Albuquerque and Llano de Sandia); however, they usually have a thick cover of silty-sand and caliche. The materials on the west surface seem to be

Construct on Materials continued..

a bit more coarse-grained than the materials on the east surface. Prospective pit 25-11-6 is representative of the materials on the west surface. Hole 11 of the Soils Summary Table is representative of the materials on the east surface.

Permian: San Andres limestone (Psa) - Fault slices of limestone are found along the arroyos that drain the pediment near the Manzano Mountains. The areal extent of most of these outcrops is rather limited; however, it is believed that further exploration will reveal several hundred thousand tons of limestone that will be suitable for highway construction. Prospective pit 25-11-1 is representative of this limestone.

Precambrian: Quartzite (P€q) - A very dense, massively bedded, pure quartzite crops out along the escarpment of the Manzano Mountains. An almost inexhaustible supply of quarry rock may be developed in this area. Prospective pit 25-11-2 is representative of this material.

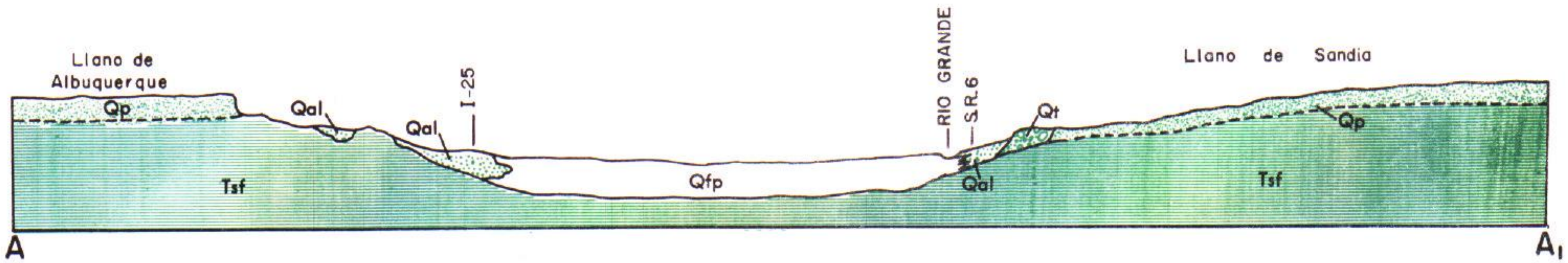
Distribution of tested and prospective pit sites is shown on Construction Materials Inventory Map 25-11. Test data and other related information are shown in Material Pit Summary Table 25-11-1.

Selected References:

Stark, J. T., (1956), Geology of the South Manzano Mountains, New Mexico Bureau of Mines and Mineral Res., Bull. 34.

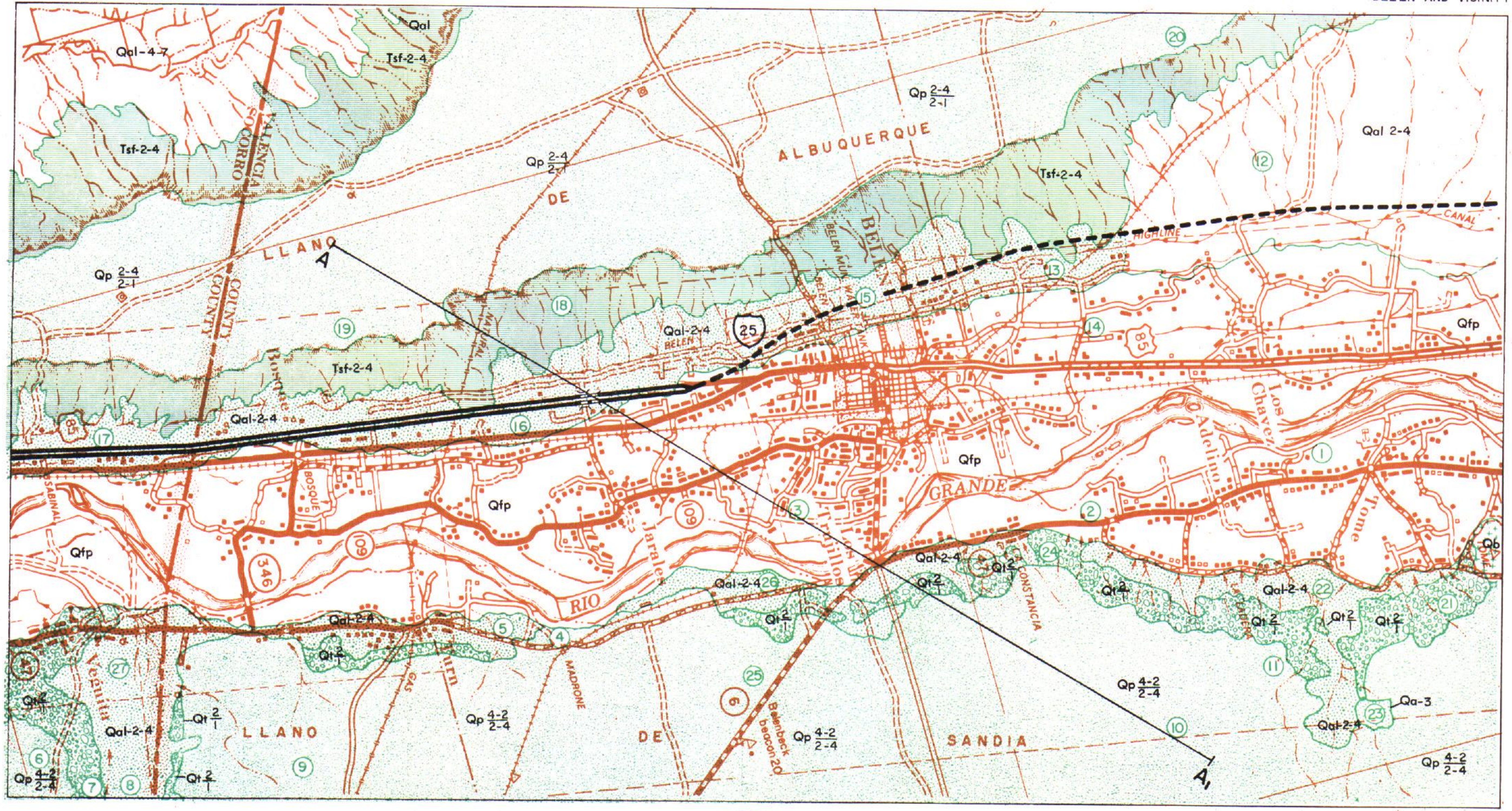
Titus, Frank B. Jr., (1963), Geology and Ground-Water of Eastern Valencia County, New Mexico, New Mexico Bureau of Mines and Minerals Res., Ground-Water Report 7.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-II

SOILS AND GEOLOGY MAP 25-II



GEOLOGY MAPPED 1963

-LEGEND-

SEDIMENTARY ROCKS

- Qal — Alluvium — QUATERNARY
- Qfp — Flood-plain deposits — QUATERNARY
- Qa — Aeolian deposits — QUATERNARY
- Qt — Terrace deposits — QUATERNARY
- Qp — Pediment deposits — QUATERNARY
- Tsf — Santa Fe group — TERTIARY

IGNEOUS ROCKS

- Qb — Basalt — QUATERNARY

1 0 1
STATUTE MILES

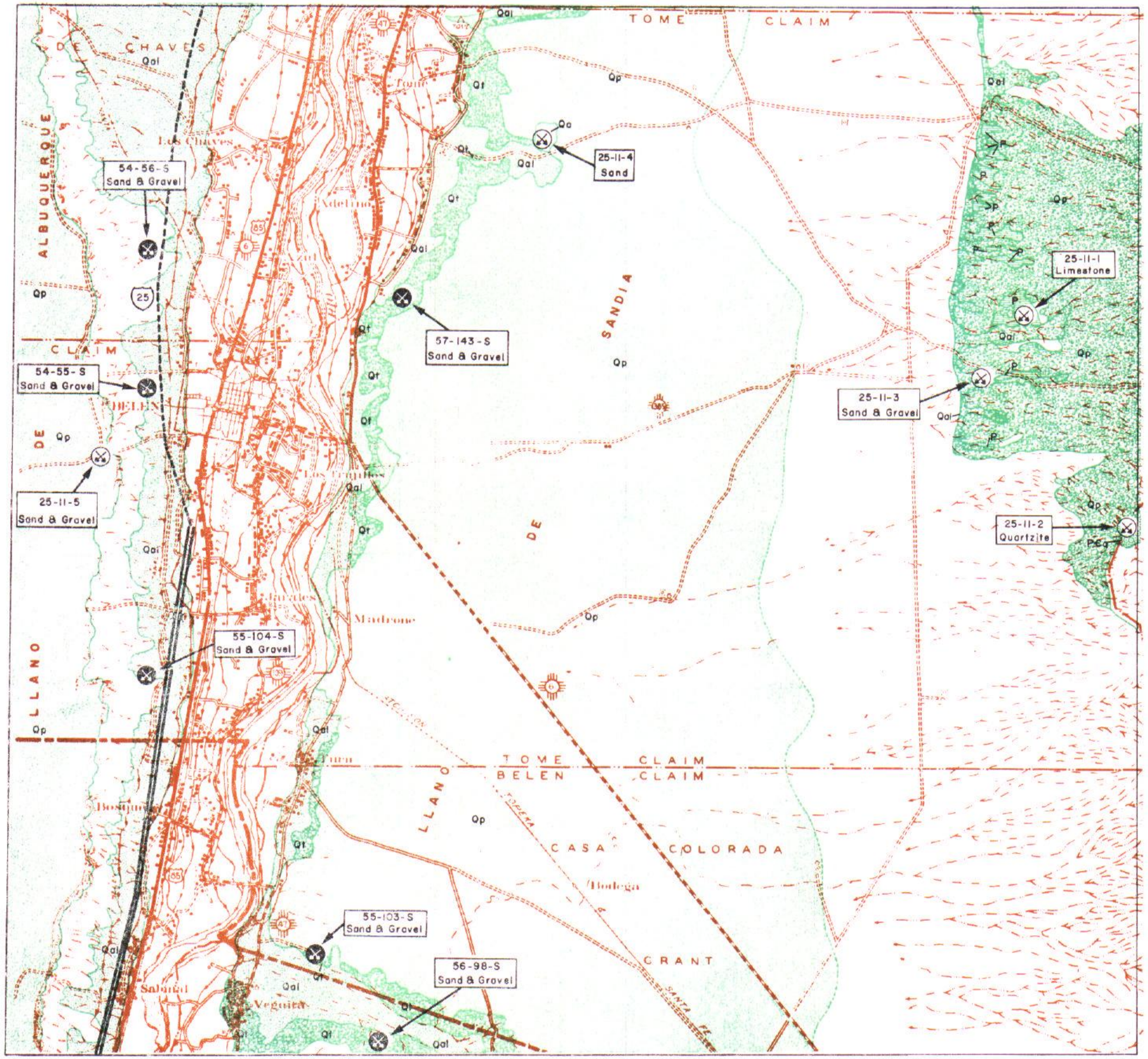
Soils Summary:

Table 25-11-1

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Qfp	1	A	0.0	3.0	A-4	Silt
"		B	3.0	4.0	A-4	"
"		C	4.0	7.0	A-3	Sand
"	2	A	0.0	1.0	A-4	Silt
"		B	1.0	2.0	A-2-4	Silty sand
"		C	2.0	2.6	A-7	Clay
"		D	2.6	5.0	A-4	Silt
"	3	A	0.0	2.0	A-6	Clay
"		B	2.0	5.0	A-4	Silt
Qp	4	A	0.0	1.5	A-4	"
"		B	1.5	3.0	A-6	Clay
"		C	3.0	12.0	A-1-b	Coarse sand
"		D	12.0	18.0	A-7	Clay
Qal	5	A	0.0	3.0	A-2-4	Silty sand
"		B	3.0	8.0	A-4	Silt
Qp	6	A	0.0	4.0	A-4	"
Qt	7	A	0.0	1.0	A-1-b	Coarse sand
"		B	1.0	26.0	A-1-a	Sand and gravel
Qal	8	A	0.0	2.0	A-4	Silt
"		B	2.0	12.0	A-4	"
Qp	9	A	0.0	2.0	A-2-4	Silty sand
"		B	2.0	5.0	A-2-4	Silty sand
"		C	5.0	7.0	A-2-4	" "
"	10	A	0.0	2.0	A-2-4	" "
"		B	2.0	7.0	A-4	Silt
"		C	7.0	10.0	A-2-4	Silty sand
"		D	10.0	12.0	A-6	Clay
"	11	A	0.0	2.0	A-2-4	Silty sand
"		B	2.0	10.0	A-2-6	Clayey sand
"		C	10.0	12.0	A-1-b	Coarse sand
Qal	12	A	0.0	5.0	A-2-4	Silty sand
"	13	A	0.0	5.0	A-2-4	" "
Qfp	14	A	0.0	1.0	A-4	Silt
"		B	1.0	2.0	A-7	Clay
"		C	2.0	4.0	A-4	Silt
Qal	15	A	0.0	3.0	A-2-4	Silty sand
"		B	3.0	13.0	A-1-b	Sand and gravel
"	16	A	0.0	20.0	A-2-4	Silty sand
"	17	A	0.0	2.0	A-2-4	" "
"		B	2.0	4.0	A-1-b	Sand and gravel
Tsf	18	A	0.0	4.0	A-7	Clay

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	ASSHO Classification	Material Type
Tsf	18	B	4.0	6.0	A-1-a	Sand and gravel
"		C	6.0	8.0	A-3	Fine sand
Qp	19	A	0.0	2.0	A-4	Silt
"		B	2.0	6.0	A-2-6	Clayey sand
Qp	20	A	0.0	3.0	A-2-4	Silty sand
"		B	3.0	5.0	A-6	Clay
"		C	5.0	9.0	A-1-a	Sand and gravel
"		D	9.0	12.0	A-2-4	Silty sand
"		E	12.0	15.0	A-4	Silt
Qt	21	A	0.0	5.0	A-1-a	Sand and gravel
"		B	5.0	8.0	A-7	Clay
"		C	8.0	10.0	A-2-4	Silty sand
Qal	22	A	0.0	8.0	A-4	Silt
Qa	23	A	0.0	20.0	A-3	Sand
Qt	24	A	0.0	1.0	A-2-4	Silty gravel
"		B	1.0	20.0	A-1-a	Sand and gravel
Qp	25	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	4.0	A-2-4	" "
"		C	4.0	6.0	A-3	Fine sand
Qal	26	A	0.0	8.0	A-2-4	Silty sand
"	27	A	0.0	3.0	A-6	Clay
"		B	3.0	4.0	A-4	Silt

CONSTRUCTION MATERIALS MAP 25-11



-LEGEND-

Qal — Coarse-grained gravel

Qal — Coarse-grained sand

Qa — Fine sand

Qt — Terrace gravel

Qp — Pediment gravel (Coarse-grained)

Qp — Pediment gravel (Fine-grained)

P — San Andres limestone

PCq — Quartzite

TESTED PIT OR QUARRY

PROSPECT PIT OR QUARRY

STATUTE MILES

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-11-2

Pit or Prospect No.	25-11-1 (Prospect)	25-11-2 (Prospect)	25-11-3 (Prospect)	25-11-4 (Prospect)	25-11-5
Location — Section	Not sectionalized Tome Claim	NE1/4 sec. 27 (Tome Grant)	Not sectionalized	Not sectionalized	Belen Grant
Location — Twnshp.	" " " "	T 5 N	Tome Grant	Tome Grant	T 5 N
Location — & Range		R 4 E			R 1 E
Location — County	Valencia	Valencia	Valencia	Valencia	Valencia
Location — State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner	Private	Federal	Private	Private	Private
Geologic Age	Permian	Precambrian	Quaternary	Quaternary	Quaternary
Formation	San Andres limestone	Quartzite	Alluvium	Aeolian sand dunes	Pediment deposit
Type of Pit	Quarry	Quarry	Sand & gravel	Sand	Sand & gravel
Kind of Material	Limestone	Quartzite	Quartzite. Schist, etc,	Sand	Mixed aggregate
Quality of Material	Good	Excellent	Fair	Good	Fair
Thickness of Material	10 feet est.	75.0 feet	12 feet	10.0 to 20.0 feet	10 feet
Thickness of Cap (Caliche)	-	-	-	-	-
Blasting Qualities	-	Good	-	-	-
Uniformity	Fair	Good	Fair	Good	Fair .
Impurities	?	None	Clay & silt lenses	None	Clay lenses
Type of Mat'l. Underlying Formation	Sandstone & shale	?	Clay & silt	Sand, silt, gravel	Clay
Moisture Condition	Dry	Dry	Dry	Dry	Dry
Vegetation	Greasewood	Pinon, juniper	Greasewood	Greasewood, grasses	Greasewood & grasses
Local Terrain	Hilly	Mountainous	Arroyo bottom	Hilly	Flat
Depth of Overburden	?	None	2.0 feet	None	5.0 feet
P.I. (Overburden)	?	-	N.P.	-	?
Est. Reserve Quantity	?	Unlimited	?	Unlimited	?
Approx. Haul to Nearest Point	12 miles	12.0 miles	10 miles	3 miles	2.0 miles
L.A. Wear	35.2	19.2	-	-	-
Maximum Size	-	-	24"	-	6"
% Retained on 2" Sieve	-	-	40 to 50	-	less than 1
Crushed to	1"	1"	-	-	-
Pit Average % Passing 2"	-	-	48	-	-
1"	100	100	34	-	-
3/4"	96	94	29	-	99
1/2"	64	59	24	-	98
#4	23	17	15	-	78
#10	13	9	11	100	48
#200	3	1.4	2	3	1
P.I.	Sandy, N.P.	Sandy, N.P.	Sandy, N.P.	Sandy, N.P.	Sandy. N.P.
Lab. Numbers	63-2994	63-2997	63-2995 to 63-2996	63-4271	63-4264

Remarks:

25-11-5 - Presently being worked by commercial firm 5-17-63.

Material Pit Summary:

CONSTRUCTION MATERIALS INVENTORY

Table 25-II-2 continued

Pit or Prospect No.		54-55-S	55-103-S	56-97-S	56-98-S	57-143-S
	Section	SWI/4 sec. I2	I7	NWI/4 sec. 4 & SEI/4 sec. 5	SWI/4 sec. 3 & NEI/4 sec. I0	Not sectionalized
	Twnshp.	T 5 N	T 4 N	T 3 N	T 3 N	
Location	& Range	R I E	R 2 E	R 2 E	R 2 E	Tome Grant
	County	Valencia	Valencia	Valencia	Valencia	Valencia
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Private	Private
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Alluvium	Terrace deposit	Pediment deposit	Terrace deposit	Terrace deposit
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Mixed aggregate	Mixed aggregate	Mixed aggregate	Mixed aggregate	Mixed Aggregate
Quality of Material		Fair	Fair	Fair	Fair	Good
Thickness of Material		I00 feet	7.0 feet	I0.0 feet	I0.0 feet	5 feet to I0 feet
Thickness of Cap (Caliche)		-	-	-	-	-
Blasting Qualities		-	-	-	-	-
Uniformity		Fair	Fair	Good	Fair	Fair
Impurities		None	?	Silt & clay lenses	Silt & clay lenses	None
Type of Mat'l. Underlying Formation		Silt & clay	Sand, silt, clay, & gravel	Silt, sand, clay & gravel	Silt & clay	Silt & clay
Moisture Condition		Dry	Dry	Dry	Dry	Dry
Vegetation		Cacti & range grasses	Grass	Cacti & grasses	Cacti & grasses	Range grasses
Local Terrain		Dissected slope	Dissected Terraces	Hilly	Dissected terraces	Dissected terrace
Depth of Overburden		0.0 to 5.0 feet	I.0 to 6.0 feet	I.0 to 4.0 feet	I.0 to 6.0 feet	None
P.I. (Overburden)		Sandy, N.P.	Sandy, N.P.	N.P. to 9	N.P. to 6	-
Est. Reserve Quantity		Unlimited	200,000 cu. yds.	?	?	?
Approx. Haul to Nearest Point		I.4 miles	3.0 miles	6.0 miles	7.0 miles	4.8 miles
L.A. Wear		29.4	-	28.8	29.0	27.2
Maximum Size		2"	3.0"	3.5"	3"	3"
% Retained on 2" Sieve		-	5	20 ave.	I5	7
	Crushed to	I"	I"	I"	I"	I"
	2"	-	-	-	-	93
Pit	I"	I00	I00	I00	I00	90
Average	3/4"	98	95	84	97	82
% Passing	I/2"	91	76	68	81	69
	#4	68	50	47	57	51
	#10	45	39	31	38	I0
	#200	5	5	2	3	0
P.I.		Sandy, N.P.	Sandy, N.P.	Sandy, N.P.	Sandy, N.P.	Sandy, N.P.
Lab. Numbers		57-16955, 16968	56-15279, 15296	56-16016, 16053	56-16105	57-20274, 20314

Remarks:

56-97-S - Old pit worked out, further exploration needed to determine quantity available.

56-98-S - Old pit worked out, further exploration needed to determine quantity available.

Material Pit Summary:

Table 25-II-2 continued

Pit or Prospect No.		55-104-S	54-56-S
Location	Section	SW1/4 sec. 23	Not sectionalized
	Twnshp.	T 4 N	Nicholas Duran de
	& Range	R I E	Chavez Grant
	County	Valencia	Valencia
	State	New Mexico	New Mexico
Owner		Private	Private
Geologic Age		Quaternary	Quaternary
Formation		Alluvium	Alluvium
Type of Pit		Sand & gravel	Sand & gravel
Kind of Material		Mixed aggregate	Mixed aggregate
Quality of Material		Fair	Fair
Thickness of Material		?	9.0 feet
Thickness of Cap (Caliche)		-	-
Blasting Qualities		-	-
Uniformity		Fair	Fair
Impurities		?	None
Type of Mat'l. Underlying Formation		Silt & clay	Silt & clay
Moisture Condition		Dry	Dry
Vegetation		Greasewood & grasses	Pinon trees & grasses
Local Terrain		Dissected gentle slope	Sandy wash
Depth of Overburden		0.0 to 6.0 feet	None
P.I. (Overburden)		N.P.	-
Est. Reserve Quantity		200,000 cu. yds.	?
Approx. Haul to Nearest Point		0.3 miles	1.7 miles
L.A. Wear		26.0	28.0
Maximum Size		2"	1/2"
% Retained on 2" Sieve		Less than 5	-
	Crushed to	-	-
	2"	100	-
Pit	1"	98	-
Average	3/4"	97	100
% Passing	1/2"	92	92
	#4	74	70
	#10	57	57
	#200	3	3
P.I.		Sandy, N.P.	Sandy N.P.
Lab. Numbers		56-15257, 15271	54-10371, 10400

SOILS AND GEOLOGY

Introduction:

This strip begins 3 miles south of Los Lunas and ends near Tijeras Arroyo south of Albuquerque. It lies in the Albuquerque-Belen basin, a structural feature of the Rio Grande depression. The most prominent physiographic features of the area are: the Manzano Mountains; the Llano de Albuquerque; the Llano de Sandia; and the Rio Grande Valley. The Rio Grande flows through the central part of the strip and its flood plain divides the Llano de Albuquerque and the Llano de Sandia surfaces. The formations exposed in the mapped area are of Quaternary and Tertiary age. There are a few exposures of pre-Tertiary rocks in the construction materials area; however, they are insignificant to this report and therefore are not designated on the map.

General Geology:

The present landscape and the associated formations of this strip are highly affected by the adjoining uplifted areas in which rocks dating back to Precambrian time are exposed. There are several interpretations of the Precambrian history of this country because of the variable, complex exposures of Precambrian rock. Fitzsimmons (1961) concluded that the following sequence of events took place: a period of accumulation of clastic sediments, markedly quartzose; preceded by or possibly accompanied by accumulations of basic to intermediate igneous rocks; followed by accumulations of rhyolitic rocks; followed by deformation, metamorphism, and emplacement of granitic masses and associated rocks (aplites, pegmatites, etc.). A period of erosion followed that lasted well into the Paleozoic era.

"During Pennsylvanian and Permian time sandstone, limestone, siltstone, and gypsum were deposited in alternating marine and continental environments." (Bjerklund and Maxwell, 1961, p. 13).

This area was on a shelf between an eastern and western basin during the Triassic period and clays, shales, sandstones, and conglomerates were deposited in a continental environment. Continental deposition continued through most of Jurassic time except for the interval when the Sundance-Curtis sea reached down from the north to cover northwestern and north-central New Mexico. The Todilto limestone and gypsum were precipitated from this enormous salt lake. Later, sands, silts, and clays of the Summerville and Morrison formations washed from the highlands to the south and covered the limestone and gypsum.

Cretaceous time saw another submergence of the land in New Mexico. The shoreline advanced and retreated many times in the Albuquerque area. A preponderance of clays, shales, limestones, and coal accumulated in the muddy seas and swamplands of the north central part of the state.

The present day landscape of the Albuquerque-Belen area is primarily an expression of the upheaval and erosion of the Neogene period which is the last one-third of the Cenozoic era. During the first two-thirds of the Cenozoic era central New Mexico was made up of gravelly plains and scattered mountain ranges, spotted with lakes and inter-mountain basins.

The latter part of the Cenozoic era was much more dramatic, many volcanoes exploded and several thousand feet of lava piled up to form completely new mountain ranges. The earth's crust gave way through the central part of the state and the Manzano, Sandia, and many other fault-block mountains appeared. As the mountains rose the adjoining land sank and formed the Rio Grande depression. The depression was filled with debris from the newly uplifted areas. A few volcanic eruptions appeared in the vicinity of Isleta during Quaternary time. They mark the present day sky line along the eroded bluffs of the Llano de Albuquerque. Finally, the Rio Grande was born and began its long process of cutting through the basin fill.

The Sandia and Manzano fault-blocks dip steeply to the east. Precambrian granite and metamorphic rocks are exposed along the western escarpment and Pennsylvanian and Permian limestones, shales, and sandstones are exposed on the dip slope to the east. The debris washed from these mountains onto the Llano de Sandia surface is primarily granite and metamorphic rock, except where tectonic movement has caused the western drainage to cross the Pennsylvanian and Permian beds. Hell Canyon Wash and Tijeras Arroyo are two of the drainageways that cut through Pennsylvanian and Permian beds. The areas marginal to these drainageways have thick deposits of limestone enriched gravels.

There are a few exposures of down-faulted pre-Tertiary rocks along the western flanks of the Manzano and Sandia Mountains. These exposures crop out below a fairly thick cover of alluvial fan and pediment deposits.

The Albuquerque-Belen basin is about 90 miles long and 30 miles wide. It is the largest basin of the Rio Grande depression. It is bounded on the east by the Manzano, Manzanito, and Sandia uplifts and on the west by the Puerco platform and the Lucero uplift. Subsidence of the basin and uplift and erosion of the adjoining highlands has continued through recent time. Drainage during late Tertiary time was to a closed basin and several thousand feet of alluvial fan and stream and lake deposits of the Santa Fe group accumulated. Later, during the Pleistocene epoch, a wide-spread erosional surface developed over the basin fill, the Rio Grande became a through-flowing stream, and more deposits of sand, gravel, silt, and clay were added to the Santa Fe group. Intermittent volcanic activity also contributed to the basin fill.

About 250 feet of Santa Fe sediments are exposed along the flanks of the Llano de Albuquerque and the Llano de Sandia. An upper unit of loose, well-sorted sand and gravel and flood-plain silts and clays represents an early Rio Grande of late Santa Fe time. Below the river sediments are alluvial fan, stream, and lake deposits that usually show some degree of induration. In many places it is difficult to determine the difference in these deposits especially where the flood-plain muds are in contact with the lake deposits. The river facies reach as far west as the Rio Puerco. To the east near the center of the Llano de Sandia they merge with the outwash from the Manzano Mountains.

The Llano de Sandia and Llano de Albuquerque surfaces have a thick cover of caliche and wind-blown sand. The sands are derived from the flood plains of the Rio Puerco and the Rio Grande and the eroded bluffs adjacent to the surfaces.

Terrace deposits, representing intervals of stabilization in the downcutting and stripping of the Rio Grande occur on each side of the inner valley. They are in various stages of preservation because of local differences in drainage and dissection. They also vary widely in texture. Some of them are interbedded silt, clay, and sand and some are primarily coarse-grained sand and gravel. The coarse-grained materials vary from a few feet to about 30 feet in thickness. The fine-grained materials probably exceed 100 feet in thickness in some places.

General Geology continued...

The Rio Grande flood plain averages about 4 miles in width in this strip. It has about 120 feet of interbedded sand, silt, and clay that overlie similar sediments of the Santa Fe group. The surface has been greatly modified by farm leveling and other cultural development; however, air photos still show the original meander scars, levees, and backwater areas of the old Rio Grande.

The areal distribution of formations is shown on Soils and Geology Map 25-12. Their succession and character are given under the section termed "Stratigraphy."

Soils:

Flood-plain deposits (Qfp): Most of the Rio Grande flood plain shows a profile of silt (A-4) or silty sand (A-2-4) over a fine-grained, well-washed, river sand (A-3). There are many variations in this profile caused by deposition in the backwater areas when the river floods its banks and deposits silty clay (A-6).

Aeolian deposits (Qa): Almost all of the formations of this strip have a cover of wind-blown sand. The sand varies from a few inches to 15 feet in thickness. Only the largest, most prominent accumulations of wind-blown materials have been mapped for this report. Northwest of the Parea Mesa volcano is a thick deposit of fine-grained, wind-blown sand (A-3). Northeast of the Los Lunas volcano is a relatively small deposit of fresh dune sand (A-3). It has been shown by sampling and testing that the wind-blown materials are only slightly more fine-grained than the river deposits which are so abundant in this strip.

Alluvium (Qal): The alluvial soils are very non-uniform in texture. This is caused by the variable way in which they were deposited. Slope wash along the flanks of the Santa Fe group is very similar in texture to the Santa Fe group. Where streams debouch onto the flood plain, silts, clays, and gravels are mixed with wind-blown sand. The greater part of the alluvium tends toward coarse-grained materials; although, there are many discontinuous deposits of silt and clay.

Terrace deposits (Qt): As previously mentioned, under General Geology, the terrace deposits of this strip vary in texture. These textural differences are shown by the shading patterns on the Soils and Geology Map. The terraces bearing the gravel pattern have a cover of silty sand (A-2-4) overlying relatively thick deposits of sand and gravel (A-1-a). The sand and gravel is slightly more coarse-grained but very similar to that of the Santa Fe group (QTsf). The gravels in the deposits parallel to the flood plain are a mixed aggregate (quartzite, igneous, metamorphic, etc.). Parallel to Hell Canyon Wash the gravels are primarily limestone. The terrace deposits that have no shading pattern are similar to the present flood-plain deposits, interbedded sands, silts, and clays.

Pediment deposits (Qp): The Llano de Albuquerque and the Llano de Sandia surfaces were cut by an early Rio Grande and its tributaries. Local fans and pediment gravels continued to accumulate during and after the waning stages of the river. Sheet wash erosion has carried the fine-grained particles from the higher pediment slopes and redistributed them over the flatter slopes of the mesa. These surfaces have also been subjected to harsh winds. Sands swept up from the Rio Grande and the Rio Puerco have become a part of the cover. The cover soils have become indurated. Erosion along the bluffs of the two surfaces shows an excellent profile development. Hole 32 is a typical example of the profile. There is about 3 feet of silty sand (A-2-4) overlying 3 feet of fine-grained sand and nodular caliche (A-2-4) overlying coarse-grained river sand (A-1-b).

Note that the river sand is a part of the Santa Fe group (QTsf). Occasionally this uniformity is broken by Recent stream deposition which is shown by Hole 31. Note the variation in texture of the different strata above the Santa Fe group.

Santa Fe group (QTsf): The upper exposures of the Santa Fe group are predominantly fine-grained gravel or coarse-grained sand (A-1-b) that have interlensing flood-plain silt and clays (A-4 and A-6). The lower exposures are sands, gravels, silts, and clays that usually show some degree of induration.

Table 25-12-1 shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-12.

Ground Water:

Ground water conditions of the Rio Grande flood plain may be significant in relation to possible engineering problems. Sources of ground water are: (1) underflow from bordering mesas; (2) seepage from the river; (3) seepage from canals and irrigated lands; and (4) local precipitation.

There is doubtless general percolation of water toward the flood plain throughout the length of the valley, but the major contributions come from the arroyo channels which intermittently carry large quantities of water. The medium through which ground water moves in the Rio Grande Valley is chiefly alluvium and in this way it is slowly and constantly moving in a down stream direction. It receives new supplies at some places and loses water at others. This movement can be explained in that the aggrading Rio Grande deposits coarse material in its channel and deposits finer material on the adjacent flood plain. When a shift in course occurs, it scours out some of the finer flood-plain material and deposits coarse material in its place while simultaneously depositing fine material over the coarse material in its abandoned channel. Water moves through the coarse deposits with relative ease.

The irrigated areas receive water during the growing season in excess of what they normally hold; consequently, the water table rises in the summer. In nonirrigated areas vegetation draws heavily on the ground water and the water table falls. After the growing season the reverse is true; the water table falls in irrigated areas and rises in nonirrigated areas.

In the flood plain water was encountered in sandy strata from 4.5 to 5.0 feet. A ground water report by Theis (1938) on the Middle Rio Grande Valley states that in 50% of the valley the water table is encountered from 4 to 6 feet and in 13% of the valley it is encountered at over 8 feet.

Stratigraphy:

Quaternary:	Flood-plain deposits (Qfp) - interlensing clay, silt, and sand. Thickness: 120 feet.
	Aeolian deposits (Qa) - fine-grained, wind-blown sand.
	Alluvium (Qal) - sand, silt, and clay. Thickness: 0 to 50 feet.
	Terrace deposits (Qt) - sand, gravel, silt, and clay. Thickness: 0 to 100 feet.

Quaternary contd.. Pediment deposits (Qp) - sand, gravel, silt, and clay. Thickness: 0 to 20 feet.

Basalt (Qb) - basalt flows, cones, and dikes. Varies from very dense to extremely vesicular.

Quaternary-Tertiary: Santa Fe group (QTsf) - loose, well-rounded, river gravels and coarse-grained sands, interbedded with floodplain silts and clays in its upper part. Poorly indurated sand, silts, clays, and local water-laid pumice in the lower exposures.

Construction Materials:

Practically all of the formations of this strip have some characteristic that would make them suitable for some phase of highway construction. There are areas in the flood plain that could possibly be developed for a fine, sandy aggregate; however, the materials adjacent to the flood plain have similar materials and if this type material is desired, it can be obtained without disturbing the rich, fertile soils of the flood plain. The more desirable materials are as follows:

Quaternary: Aeolian deposits (Qa) - There are many places, not designated on the map, where sand pits may be located. The Llano de Albuquerque and the Llano de Sandia have local dune areas that have become stabilized. There are also areas in the alluvium adjacent to the flood plain that have wind-blown materials. The younger dune sands northwest of the Parea Mesa basalt flow and east of the Los Lunas basalt flow seem to have less minus 200 particles than the older deposits.

Terrace deposits (Qt) - The old Rio Grande terrace deposits have been the main source of supply for gravel in the Albuquerque-Belen area for many years. These deposits become progressively more fine-grained down stream from Albuquerque. Compare Prospect Pit 25-12-6 with Pit 57-133-S for the quality of these deposits. Prospect 25-12-6 has 66 percent passing the one-inch sieve, 33 percent passing the No. 4 sieve, and a L.A. wear of 22.4. Old Pit 57-133-S has 70 percent passing the one-inch sieve, 31 percent passing the No. 4 sieve, and a L.A. Wear of 25.6. Tests were run on ideal samples from both pit areas. Pit 57-133-S has a greater amount of sand strata and pockets over the general area.

Terrace deposits along Hell Canyon Wash are relatively small but they have several hundred thousand tons of excellent limestone gravel in them, as much as 15 feet thick. Prospect Pit 25-12-5 is a good example of this material. More than 35 percent is retained on the 3-inch sieve and the boulders reach about one foot maximum size. About 54 percent passes the one-inch sieve, 34 percent passes the No. 4 sieve, and the fines (less than 2 percent minus 200) are non-plastic. The L.A. Wear is 19.6.

Pediment deposits (Qp) - The pediment deposits near Hell Canyon Wash are excellent well-washed limestone gravels. They are very similar to the Hell Canyon terrace deposits except they have more boulder size particles. Pit 56-115-S is a typical example of the better material on the pediment. It should not be supposed that the area designated on the Construction Materials Inventory Map is a continuous deposit of usable construction material. Test pits in the area indicate that the materials are braided stream deposits that terminate in thin, lenticular beds in discontinuous channels to the west.

The other pediment deposits are coarse-grained sands which are an equivalent of the Santa Fe group and are described under Santa Fe group.

Basalt (Qb) - An excellent quality of basalt occurs at Los Lunas peak. The flow itself is a columnar, dense rock that will make an excellent quarry. None of the rock has been quarried to date. Pit 54-100-S was located in the talus debris along the bluffs of the flow. The size of the talus blocks varies from a few inches to about 10 feet across. Further to the north Pit 57-136-S, also in the talus material, has an abundance of smaller, crusher-size blocks. The material in Pit 57-136-S seems to extend under the flow. Perhaps it is debris from an older cone or flow that was picked up as flow breccia by a later flow.

There are other basalt flows and cinder cones in this strip. They have not been explored for highway use to date because of their vesicular nature.

Quaternary-Tertiary: Santa Fe group (QTsf) - Coarse-grained sands occur abundantly along the bluffs of the Llano de Albuquerque and the Llano de Sandia surfaces. These sands also occur below a 3 to 15 foot cover of sandy soil and caliche of the surfaces. A typical example of the material is shown by Prospect Pit 25-12-7. There is about 4 feet of fine-grained sand overlying 8 feet of coarse-grained sand.

Selected References:

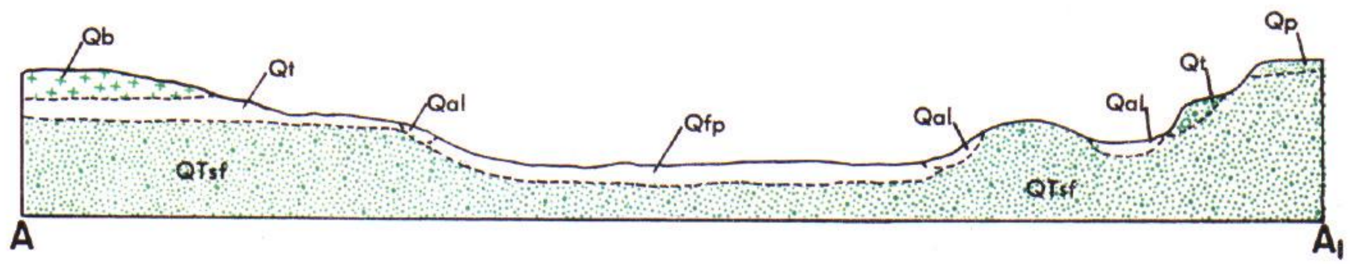
Bjorklund, L. J. and Maxwell, W., 1961, Availability of Ground Water in the Albuquerque Area, Bernalillo and Sandoval Counties, New Mexico, New Mexico State Engineer's Technical Report No. 21, 117 p.

Fitzsimmons, J. P., 1961, Precambrian Rocks of the Albuquerque Country, New Mexico, New Mexico Geological Soc., 12th Field Conference, pp. 90-96.

Kelley, V. C., 1951, Tectonics of the Rio Grande Depression of Central New Mexico, New Mexico Geological Soc., p. 93-105.

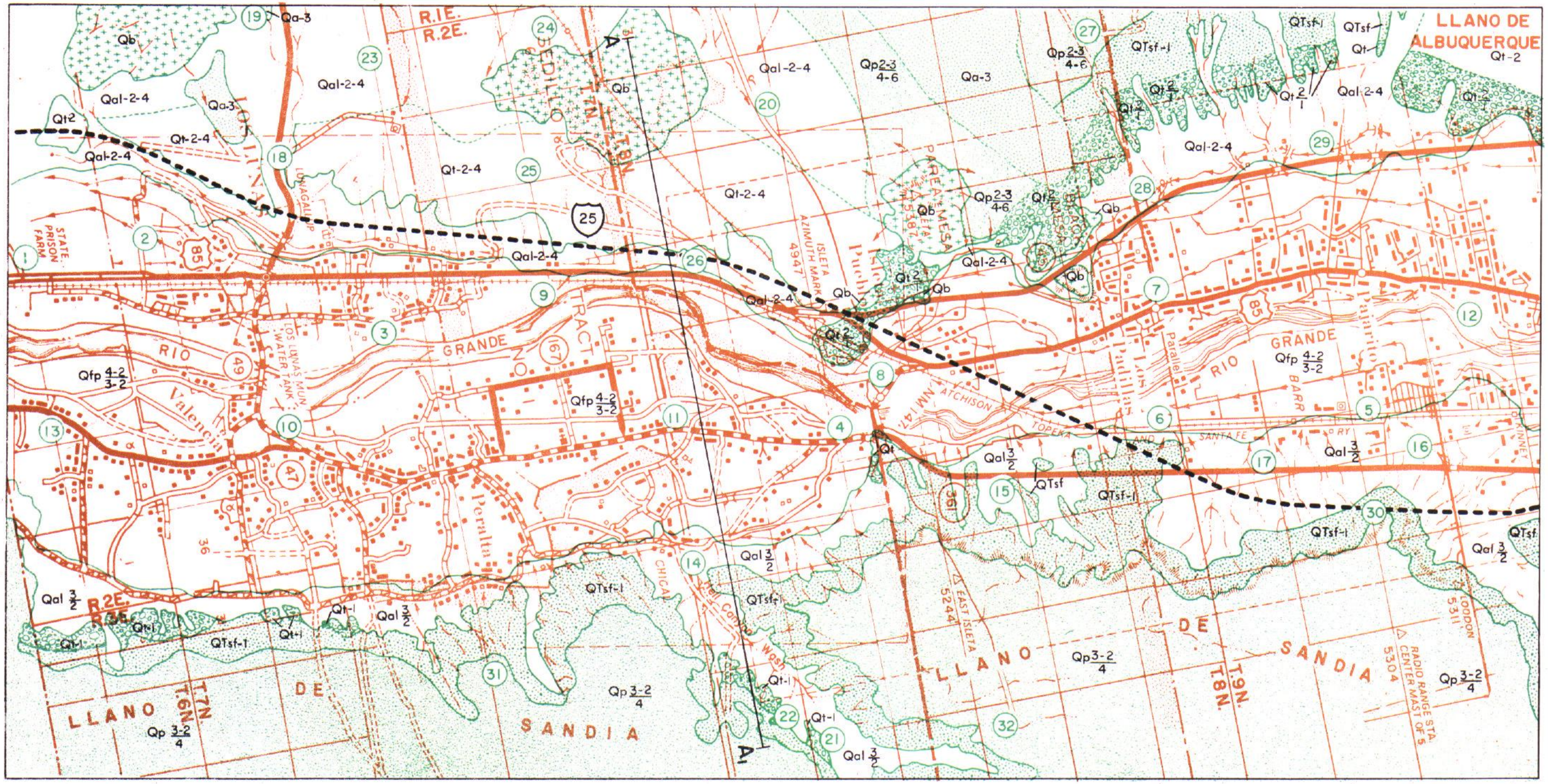
New Mexico Geological Society, 1961, Guidebook of the Albuquerque Country, 12th Field Conference.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-12

SOILS AND GEOLOGY MAP 25-12



GEOLOGY MAPPED 1963

—LEGEND—

SEDIMENTARY ROCKS

QUATERNARY:
- Qfp — Flood-plain deposits
- Qa — Aeolian deposits
- Qal — Alluvium
- Qt — Terrace deposits
- Qp — Pediment deposits

TERTIARY:
- QTsf — Santa Fe group

IGNEOUS ROCKS

QUATERNARY:
- Qb — Basalt

STATUTE MILES

SOILS AND GEOLOGY

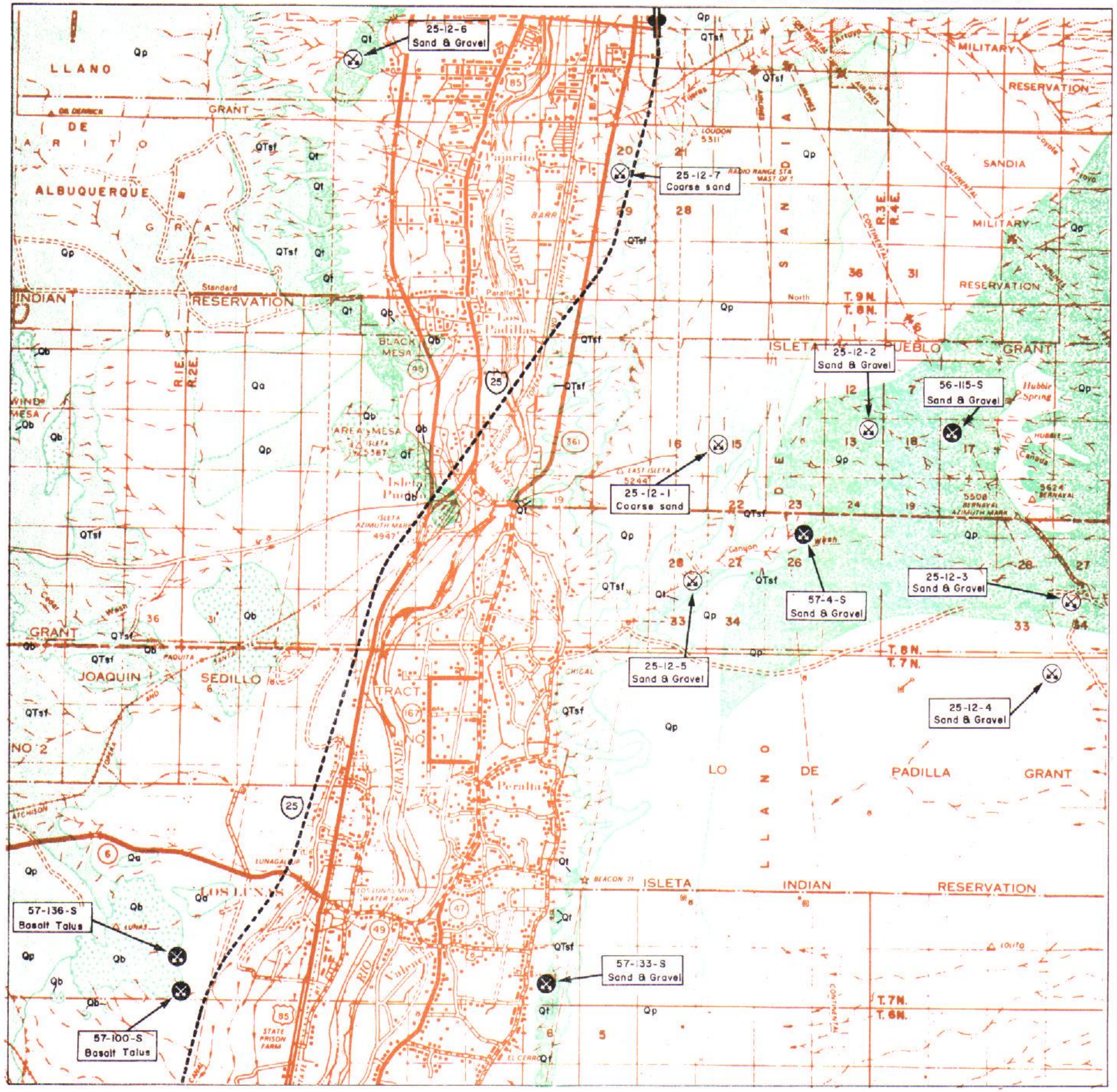
Soils Summary:

Table 25-12-1

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Qfp	1	A	0.0	3.5	A-2-4	Silty sand
"		B	3.5	5.5	A-3	Sand
"	2	A	0.0	0.5	A-2-4	Silty sand
"		B	0.5	1.5	A-6	Clay
"		C	1.5	3.0	A-4	Silt
"		D	3.0	5.0	A-4	"
"	3	A	0.0	3.0	A-4	"
"		B	3.0	5.0	A-3	Fine sand
"	4	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	5.0	A-3	Fine sand
"	5	A	0.0	5.0	A-6	Clay
"	6	A	0.0	4.0	A-4	Silt
"		B	4.0	5.0	A-7	Clay
"	7	A	0.0	1.5	A-6	"
"		B	1.5	2.0	A-2-4	Silty sand
"		C	2.0	5.0	A-3	Fine sand
"	8	A	0.0	0.5	A-2-4	Silty sand
"		B	0.5	3.5	A-2-4	" "
"		C	3.5	4.5	A-4	Silt
"		D	4.5	6.0	A-4	"
"	9	A	0.0	1.5	A-4	"
"		B	1.5	2.5	A-4	"
"		C	2.5	5.5	A-3	Fine sand
"	10	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	4.0	A-3	Fine sand
"		C	4.0	5.0	A-4	Silt
"	11	A	0.0	1.5	A-4	"
"		B	1.5	2.5	A-2-4	Silty sand
"	12	A	0.0	1.7	A-4	Silt
"		B	1.7	4.5	A-2-4	Silty sand
"	13	A	0.0	2.5	A-6	Clay
"		B	2.5	4.0	A-2-4	Silty sand
Qal	14	A	0.0	6.0	A-4	Silt
"		B	6.0	9.0	A-2-4	Silty sand
"	15	A	0.0	1.5	A-3	Fine sand
"		B	1.5	5.0	A-2-4	Silty sand
"	16	A	0.0	1.0	A-4	Silt
"		B	1.0	6.0	A-3	Fine sand
"	17	A	0.0	2.0	A-3	" "
"		B	2.0	3.5	A-2-4	Silty sand
"	18	A	0.0	2.5	A-4	Silt
"		B	2.5	3.5	A-6	Clay
"		C	3.5	6.0	A-4	Silt

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Qa	19	A	0.0	2.0	A-3	Fine sand
Qt	20	A	0.0	1.5	A-2-4	Silty sand
"		B	1.5	3.0	A-2-4	" "
"		C	3.0	4.5	A-4	Silt
Qal	21	A	0.0	6.0	A-4	"
"		B	6.0	8.0	A-1-a	Sand and gravel
Qt	22	A	0.0	1.5	A-1-b	" " "
"	23	A	0.0	0.5	A-4	Silt
"		B	0.5	4.0	A-6	Clay
"		C	4.0	5.0	A-2-4	Silty sand & gravel
"	24	A	0.0	5.0	A-2-4	" " " "
"	25	A	0.0	2.0	A-2-4	" " " "
"		B	2.0	5.0	A-2-4	" " " "
Qal	26	A	0.0	5.0	A-2-4	" " " "
Qt	27	A	0.0	1.0	A-2-4	" " " "
"		B	1.0	5.0	A-6	Clay
Qal	28	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	5.0	A-2-4	" "
"	29	A	0.0	5.0	A-2-4	" "
QTsf	30	A	0.0	4.0	A-3	Fine sand
"		B	4.0	12.0	A-1-b	Coarse sand
"		C	12.0	15.0	A-4	Sandy silt
Qp	31	A	0.0	1.0	A-3	Fine sand
"		B	1.0	6.0	A-1-a	Sand & gravel
"		C	6.0	16.0	A-2-4	Silty sand & gravel
"		D	16.0	18.0	A-6	Clay
QTsf		E	18.0	22.0	A-4	Silt
"		F	22.0	28.0	A-1-b	Coarse sand
"		G	28.0	34.0	A-3	Fine sand
Qp	32	A	0.0	3.0	A-2-4	Silty sand
"		B	3.0	6.0	A-2-4	Fine sand & nodular caliche
QTsf		C	6.0	10.0	A-1-b	Coarse sand

CONSTRUCTION MATERIALS MAP 25-12



-LEGEND-

Qa — Aeolian deposits

Qt — Terrace gravel

Qp — Pediment gravel

QTsf — Coarse sand

Qb — Basalt

TESTED PIT OR QUARRY

PROSPECT PIT OR QUARRY

STATUTE MILES

AGGREGATE RESOURCES AND SOILS STUDY
NEW MEXICO INTERSTATE ROUTE 25
ISLETA AND VICINITY

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-12-2

Pit or Prospect No.	54-100-S	57-4-S	57-133-S	57-136-S	25-12-1 (Prospect)	25-12-2 (Prospect)	25-12-3 (Prospect)
Location — Section	36	NE 1/4 sec. 26	SW 1/4 sec. 31	36	15	13	34
Location — Twnshp.	T 7 N	T 8 N	T 7 N	T 7 N	T 8 N	T 8 N	T 8 N
Location — & Range	R 1 E	R 3 E	R 3 E	R 1 E	R 3 E	R 3 E	R 3 E
Location — County	Valencia	Bernalillo	Valencia	Valencia	Bernalillo	Bernalillo	Bernalillo
Location — State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner	Private	Isleta Indian Pueblo	Private	Private	Indian Land	Indian Land	Indian Land
Geologic Age	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation	Lava flow	Pediment deposit	Terrace	Lava flow	Santa Fe group	Pediment gravel	Pediment deposit
Type of Pit	Talus rock	Gravel	Gravel	Talus rock	Fine aggregate	Coarse aggregate	Gravel
Kind of Material	Basalt	Limestone	Mixed aggregate	Basalt	Coarse sand	Limestone	Limestone
Quality of Material	Good	Good	Good	Good	Good	Fair	(?)
Thickness of Material	Varies (6 to 15 feet)	13+ feet	20+ feet	30 to 70 feet	10 to 15 feet	6 feet	(?)
Thickness of Cap (Caliche)	-	-	-	-	-	-	-
Blasting Qualities	-	-	-	-	-	-	-
Uniformity	Poor	Good	Good	Good	Fair	Fair	(?)
Impurities	Silt	None	None	Silt	Clay lenses	Clay lenses	(?)
Type of Mat'l, Underlying Formation	Silt & sand	Silt & clay (?)	Silt & clay	Silt & sand	Clay	Clay (?)	(?)
Moisture Condition	Dry	Dry	Dry	Dry	Dry	Dry	Dry
Vegetation	Broom weed & grasses	Range grass	Sage & grass	Tumble weed & grass	Grass	Grass & sage	Grass
Local Terrain	Hill side	Dissected sloping plain	Dissected terrace	Side of hill	Flat plain	Flat sloping plain	Flat sloping plain
Depth of Overburden	-	0 to 5 feet	2.5 feet	None	6 feet	4 feet	13 feet
P.I. (Overburden)	-	N.P.	N.P.	None	N.P.	6	(?)
Est. Reserve Quantity	?	100,000+ cu. yds.	-	150,000 cu. yds.	Unlimited	Unknown	(?)
Approx. Haul to Nearest Point	3.7 miles	7.7 miles	4.5 miles	3.5 miles	?	5 to 6 miles	(?)
L.A. Wear	27.6	24.4	25.6	26.4	-	21.6	Not tested
Maximum Size	10.0 feet	16"	6"	8.0 feet	1"	4"	" "
% Retained on 2" Sieve	90	25	5 to 10	95	-	Approx. 10	" "
Crushed to	3/4"	2"	2"	2"	-	-	" "
Pit Average % Passing 2"	-	100	100	100	100	87	" "
1"	-	71	70	54	99	67	" "
3/4"	100	62	55	39	96	58	" "
1/2"	75	53	40	28	90	47	" "
#4	30	37	31	15	74	30	" "
#10	19	31	26	10	63	21	" "
#200	6	2	1	2	6	4	" "
P.I.	N.P.	N.P.	N.P.	N.P.	N.P.	N.P.	" "
Lab. Numbers	54-17758 - 17767	57-707 - 735	57-19598 - 19625	57-19785 - 19791	63-3596 - 3598	63-36-4 - 3607	" "

Remarks:

57-133-S - This pit is presently under commercial lease. (12-31-63)

25-12-3 (Prospect) - This area is shown to demonstrate the increase of overburden to the south of Hell Canyon Wash. A hole was dug for exploratory purposes to determine the approximate contact between limestone gravel and granite gravel. See Prospect Pit 25-12-4.

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-12-2 continued..

Pit or Prospect No.		25-12-4 (Prospect)	25-12-5 (Prospect)	25-12-6 (Prospect)	25-12-7 (Prospect)
Location	Section	Lo de Padilla Grant	27 & 28	Atrisco Grant	20
	Twnshp.	T 7 N	T 8 N	T 9 N	T 9 N
	& Range	R 3 E	R 3 E	R 1 W	R 2 E
	County	Valencia	Bernalillo	Bernalillo	Bernalillo
	State	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Indian Land	Indian Land	Private commercial pit	Private
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary
Formation		Pediment deposit	Terrace deposit	Terrace	Santa Fe group
Type of Pit		Coarse aggregate	Sand & gravel	Sand & gravel	Fine aggregate
Kind of Material		Granite & schist gravel	Limestone	Mixed aggregate	Mixed aggregate (Coarse sand)
Quality of Material		Poor	Excellent	Excellent	Good
Thickness of Material		?	15 feet	15+ feet	6 to 10 feet
Thickness of Cap (Caliche)		-	-	-	-
Blasting Qualities		-	-	-	-
Uniformity		Poor	Good	Good	Good
Impurities		Clay	None	None	Clay lenses
Type of Mat'l. Underlying Formation		Clay	Clay, silt, & sand	(?)	Clay
Moisture Condition		Dry	Dry	Dry	Dry
Vegetation		Sage & grass	Mesquite, sage, grass	Grass	Grass
Local Terrain		Flat sloping plain	Wide deep canyon	Mesa	Dissected slope
Depth of Overburden		6 feet	4 feet	1 to 3 feet	None
P.I. (Overburden)		N.P.	7	N.P.	None
Est. Reserve Quantity		?	500,000 tons	500,000+ tons	Unlimited
Approx. Haul to Nearest Point		-	?	Approx. 7 miles	0.5 mi.
L.A. Wear		26.4	19.6	22.4	25.2
Maximum Size		6"	12"	6"	3/4"
% Retained on 2" Sieve		Approx. 30	Approx. 30	10	None
	Crushed to	-	-	-	-
Pit Average % Passing	2"	65	60	88	-
	1"	54	54	66	100
	3/4"	50	51	55	98
	1/2"	45	46	45	94
	#4	34	34	33	79
	#10	21	24	28	66
	#200	8	2	1	1
P.I.		17	N.P.	N.P.	N.P.
Lab. Numbers		63-3599 - 3603	63-3593 - 3595	62-4293 - 4294	63-4280 - 4282

Remarks:

25-12-4 (Prospect) - This pit is shown to demonstrate the type of material to be found on the pediment slopes which receive drainage from the granite and schist escarpment of the Manzano Mountains.

SOILS AND GEOLOGY

Introduction:

Strip 25-13 is in Bernalillo and Sandoval Counties, New Mexico. It extends from 4 miles south of Interstate Route 40 to about one mile north of Sandia Pueblo. The City of Albuquerque covers the center of the strip.

This strip is in the Albuquerque-Belen basin, a complex structural basin filled with alluvium. The outstanding features are the Rio Grande flood plain, the bordering terraces, and the surfaces above the terraces.

General Geology:

The Rio Grande depression is not a single trough, but a series of north-south trending basins arranged en echelon along the course of the Rio Grande. This strip lies in the Albuquerque-Belen basin, which is the largest of this series of basins. The Sandia Mountains (not in the mapped area) border the basin on the east.

The Tertiary Santa Fe formation is the oldest deposit exposed in the strip. It is poorly- to partly-consolidated buff silt, sand, and gravel. Most of it is covered by the Sandia pediment (Qp) on the east side of the strip.

Adjacent to the Rio Grande flood plain are terrace gravel deposits (Qtg). Above the terrace gravels east of the flood plain lies the Sandia pediment. The pediment is composed of debris washed out of the Sandia Mountains. The debris is mainly granitic; however, in places it may contain metamorphic and limestone rocks. The pediment surface rises about 150 feet per mile from the flood plain to the base of the mountains.

A Quaternary terrace deposit (Qt) lies west of the flood plain. The surface slopes eastward toward the flood plain and the deposit consists of sand, silt, clay, and gravel. A basalt flow (Qb) covers part of the surface of this terrace deposit. The surface has been dissected very little; however, it has broad lows.

The Rio Grande flood plain was initiated by the meandering Rio Grande. Alternating spurs developed; later, when grade was attained, lateral cutting became dominant and the valley floor was widened by sharpening, blunting, and trimming off the spurs in turn. The stream or streams flowed freely over the flood plain shifting channels frequently. This action caused sediments of various natures to be deposited on the plain. At times of high water when the stream overflowed its banks, its velocity was checked at the edge of its channel and deposits of gravel and coarse material were immediately dropped producing natural levees. The finer sediments were carried out farther and spread over the flood plain.

The areal distribution of formations is shown on Soils and Geology Map 25-13. Their succession and character are given under the section termed "Stratigraphy."

Soils:

The main divisions of the strip are the East Mesa, the Rio Grande flood plain, and the West Mesa.

Alluvium (Qal): The alluvium is sand, silt, and gravel. Near the flood plain and in the arroyos it is predominantly silty sand (A-2-4). In the northwest part of the strip the alluvium is predominantly silt (A-4). Here it is a cover over the Santa Fe formation. The arroyos have cut into the Santa Fe formation in places. Much of the alluvial cover has been reworked and redeposited by the wind. In places there are accumulations of wind-blown sand. In Arroyo de las Calabacillas, Arroyo de las Negras, and Arroyo de los Montoyas there are limited outcrops of rounded river gravel (indicated by an x on the map). The gravel does not continue over the interfluves and may be only a few feet thick.

Aeolian deposits (Qa): Wind-blown sand and silt cover a small area just west of the Rio Grande and north of Interstate Route 40.

Flood-plain deposits(Qfp): The flood-plain deposit is composed of various soils from gravel to clay. Since the Rio Grande has meandered and changed the course of its channel many times, the deposits are braided. Along the western and eastern margins of the flood plain the soils are silt (A-4) and silty sand (A-2-4). In the center of the flood plain the soils are more clayey and clay (A-6) occurs in the slack water areas.

Pediment deposit (Qp): An alluvial apron spreads westward from the Sandia Mountains. The material is derived from the Precambrian granite of the mountains. The cover varies from less than a foot to about 2 feet thick, and is predominantly silt (A-4). Underlying the silt is a layer of sand and gravel (A-1-b). It varies in thickness, is sometimes absent, is poorly-sorted, and is composed of granitic debris. This layer contains micaceous metamorphic rocks north of the Bernalillo-Sandoval County line since Rincon Ridge lies east of this area and is composed of metamorphic rocks cut by quartzite and feldspar dikes. South of Embudo Arroyo the pediment cover is silt (A-4) and silty sand (A-2-4). Test holes in this area cut into clay (A-6) and sand (A-3) below the cover.

Numerous arroyos and sheet wash have deposited and reworked the material of the pediment. There is a thin veneer of granite wash over most of the surface. The material becomes more coarse-grained eastward. At the northern end of the pediment the Santa Fe formation lies only a few feet below the pediment deposit.

Basalt (Qb): The basalt mesa on the western margin of the strip is covered by silt (A-4). The slopes of the mesa are covered by landslide debris (Qls).

Terrace deposits (Qt): The terrace slopes gently eastward toward the Rio Grande flood plain. The cover is about 4 feet thick and is predominantly silty sand (A-2-4). The surface is subject to a great deal of wind action and in places there are accumulations of wind-blown sand and silt. Below the silty sand is a layer which may vary from sand and gravel to clay (A-6). This is a typical terrace deposit of sand, silt, clay, and gravel. It is non-uniform and varies both laterally and vertically in short distances.

Terrace gravel deposits (Qtg): The terraces bordering the Rio Grande flood plain contain rounded quartzite river gravel. They are usually 15 or more feet thick. They may be covered by silty sand (A-2-4) which is from zero to 9 feet thick. They are underlain by sand, silt, and (or) clay.

Soils continued...

Santa Fe formation (QTsf): The Santa Fe formation is covered by the pediment deposit (Qp) in most places. Where it is exposed it has the physical appearance of a terrace. It consists of beds of sand, silt, clay, gravel, and conglomerate.

Table 25-13-I shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-13.

Ground-Water:

Ground water conditions of the Rio Grande flood plain may be significant in relation to possible engineering problems. Sources of ground water are: (1) underflow from bordering mesas; (2) seepage from the river; (3) seepage from canals and irrigated lands; and (4) local precipitation.

There is doubtless percolation of water toward the flood plain throughout the length of the valley, but the major contributions come from the arroyo channels which intermittently carry large quantities of water. The medium through which ground water moves in the Rio Grande Valley is chiefly alluvium and in this way it is slowly and constantly moving in a down stream direction. It receives new supplies at some places and loses water at others. This movement can be explained in that the aggrading Rio Grande deposits coarse material in its channel and deposits finer material on the adjacent flood plain. When a shift in course occurs, it scours out some of the finer flood plain material and deposits coarse material in its place while simultaneously depositing fine material over the coarse material in its abandoned channel. Water moves through the coarse deposits with relative ease.

The irrigated areas receive water during the growing season in excess of what they normally hold; consequently, the water table rises in the summer. In nonirrigated areas vegetation draws heavily on the ground water and the water table falls. After the growing season, the reverse is true; the water table falls in irrigated areas and rises in nonirrigated areas.

In May 1960, samples were taken in the valley vicinity. At Holes 3 and 7 (see map), water was encountered in sandy strata from 4.5 to 5.0 feet. A ground water report by Theis (1938) on the Middle Rio Grande Valley states that in 50% of the valley the water table is encountered from 4 to 6 feet and in 13% of the valley it is encountered at over 8 feet.

Stratigraphy:

Quaternary:

Alluvium (Qal) - sand, silt, clay, and gravel.

Aeolian deposit (Qa) - wind-blown sand.

Landslide debris (Qls) - large boulders of basalt (derived from the basalt flow in the western part of the strip).

Flood-plain deposits (Qfp) - deposits of sand, silt, and clay with minor gravel lenses.

Pediment deposit (Qp) - poorly sorted, subangular silt, sand, and gravel.

Basalt (Qb) - a small flow of basalt which came from the Albuquerque volcanoes. Thickness: 20 to 30 feet.

Terrace deposit (Qt) - a heterogeneous deposit of sand, silt, clay, and gravel.

Terrace gravel deposits (Qtg) - highly dissected gravel deposits with interbedded sand, silt, and clay.

Unconformity--

Tertiary:

Santa Fe formation (QTsf) - unconsolidated to poorly-consolidated sand, silt, clay, and gravel. The formation varies abruptly both laterally and vertically from coarse-grained conglomerate and gravel to sand, silt, and clay. The silt and clay beds are buff, light-brown, pink, and reddish brown.

Construction Materials:

Quaternary:

Alluvium (Qal) - The sand and gravel in the alluvial deposits may be suitable for highway construction material. A sample taken in Pit 60-2-S has 56 percent passing the No. 4 sieve, 45 percent passing the No. 10 sieve, and 5 percent passing the No. 200 sieve. It is non-plastic and has a L.A. Wear of 27.2. This deposit is too small to map.

Terrace gravel deposits (Qtg) - Terrace gravel deposits are located on both sides of the Rio Grande, adjacent to the basalt flow in the western part of the strip, and in scattered exposures along the channels of Arroyo de las Calabacillas, Arroyo de los Montoyas, and Arroyo de las Negras. They are indicated on the map by the symbol x.

The terrace gravel deposits on the east side of the Rio Grande flood plain are usually more than 15 feet thick. To the east the overburden thickens rapidly to depths exceeding 30 feet. Pit 58-56-S has zero to 9 feet of non-plastic overburden underlain by 20+ feet of quartzite gravel of which 42 percent passed the No. 4 sieve, 36 percent passed the No. 10 sieve, and 5 percent passed the No. 200 sieve. The gravel is non-plastic and has a L.A. Wear of 24.4. Other samples taken in these gravel deposits have an average L.A. Wear of 25.

The terrace gravel deposits on the west side of the Rio Grande flood plain are similar to those on the east side. In Pit 60-23-S, 45 percent passed the No. 4 sieve, 33 percent passed the No. 10 sieve, and 3 percent passed the No. 200 sieve. The gravel is more than 20 feet thick, is non-plastic, and has a L.A. Wear of 25.6. This pit had about 10 feet of overburden with a P.I. that ranged from zero to 7.

The terrace gravel deposits adjacent to the basalt flow in the western part of the strip are also composed of rounded quartzite river gravel. They have an average L.A. Wear of 25. In Pit 54-89-S there was 1.0 to 3.0 feet of non-plastic overburden. Of the underlying gravel, 45 percent passed the No. 4 sieve, 36 percent passed the No. 10 sieve, and 2 percent passed the No. 200 sieve. It has an L.A. Wear of 25.2 and was non-plastic.

Tertiary:

Santa Fe formation (QTsf) - There may be moderate amounts of sand and gravel in the Santa Fe deposits exposed in the southeastern part of the strip. It may be suitable fine aggregate for highway construction.

Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-13. Test data and other related information are shown in Material Pit Summary Table 25-13-2.

Selected References:

Bryan, Kirk and McCann, F. T., 1937, The Ceja del Rio Puerco, a Border Feature of the Basin and Range Province in New Mexico, Jour. of Geol., V. 46, p. 1-16.

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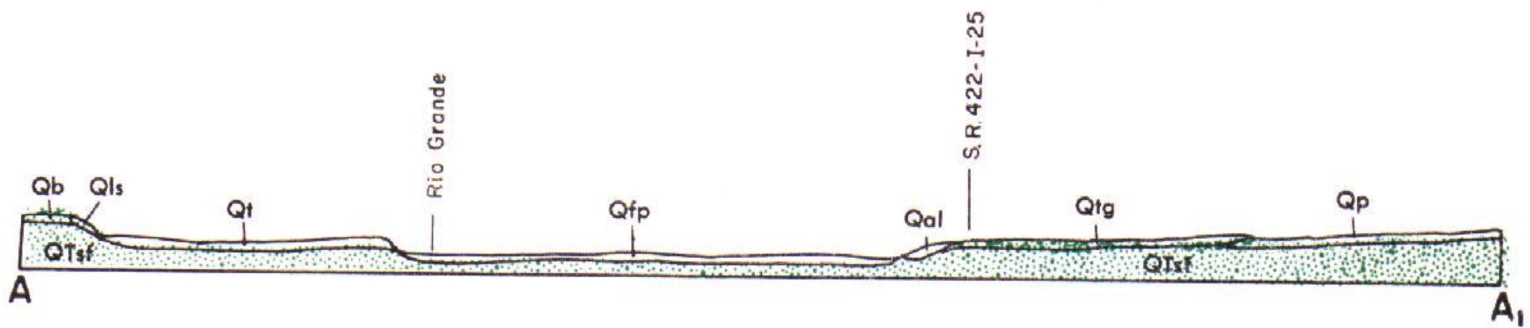
Kelley, V. C., 1951, Tectonics of the Rio Grande Depression of Central New Mexico, N.M. Geol. Soc., p. 93-105.

New Mexico Geological Society, 1961, Guidebook of the Albuquerque Country, 12th Field Conference.

Theis, Charles V., 1938, Ground Water in the Middle Rio Grande Valley, New Mexico, Natl. Resources Commission, Regional Planning, pt. 6, Upper Rio Grande, p. 268-291, 10 figs.

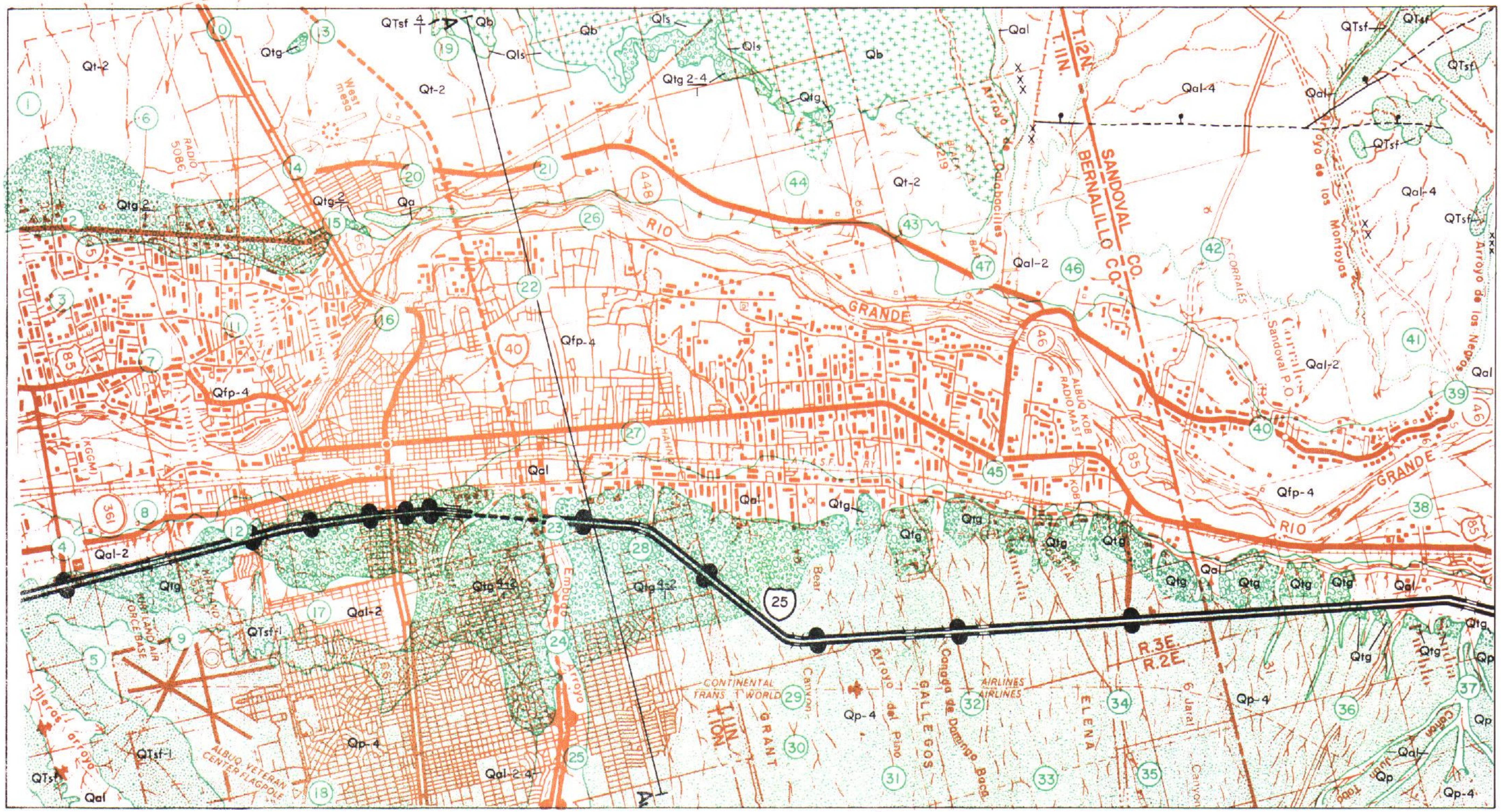
Wright, H. E., 1946, Tertiary and Quaternary History and Geology of the Lower Rio Puerco, New Mexico, Geol. Soc. Am., Bull., v. 57, p. 383-456.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-13

SOILS AND GEOLOGY MAP 25-13



GEOLOGY MAPPED 1963

-LEGEND-

SEDIMENTARY ROCKS

Qal	Alluvium	QUATERNARY
Qa	Aeolian deposits	QUATERNARY
Qls	Landslide debris	QUATERNARY
Qfp	Flood-plain deposits	QUATERNARY
Qp	Pediment deposits	QUATERNARY
Qt	Terrace deposits	QUATERNARY
Qtg	Terrace gravel deposits	QUATERNARY
QTsf	Santa Fe formation	QUATERNARY TERTIARY

IGNEOUS ROCKS

Qb	Basalt	QUATERNARY

STATUTE MILES

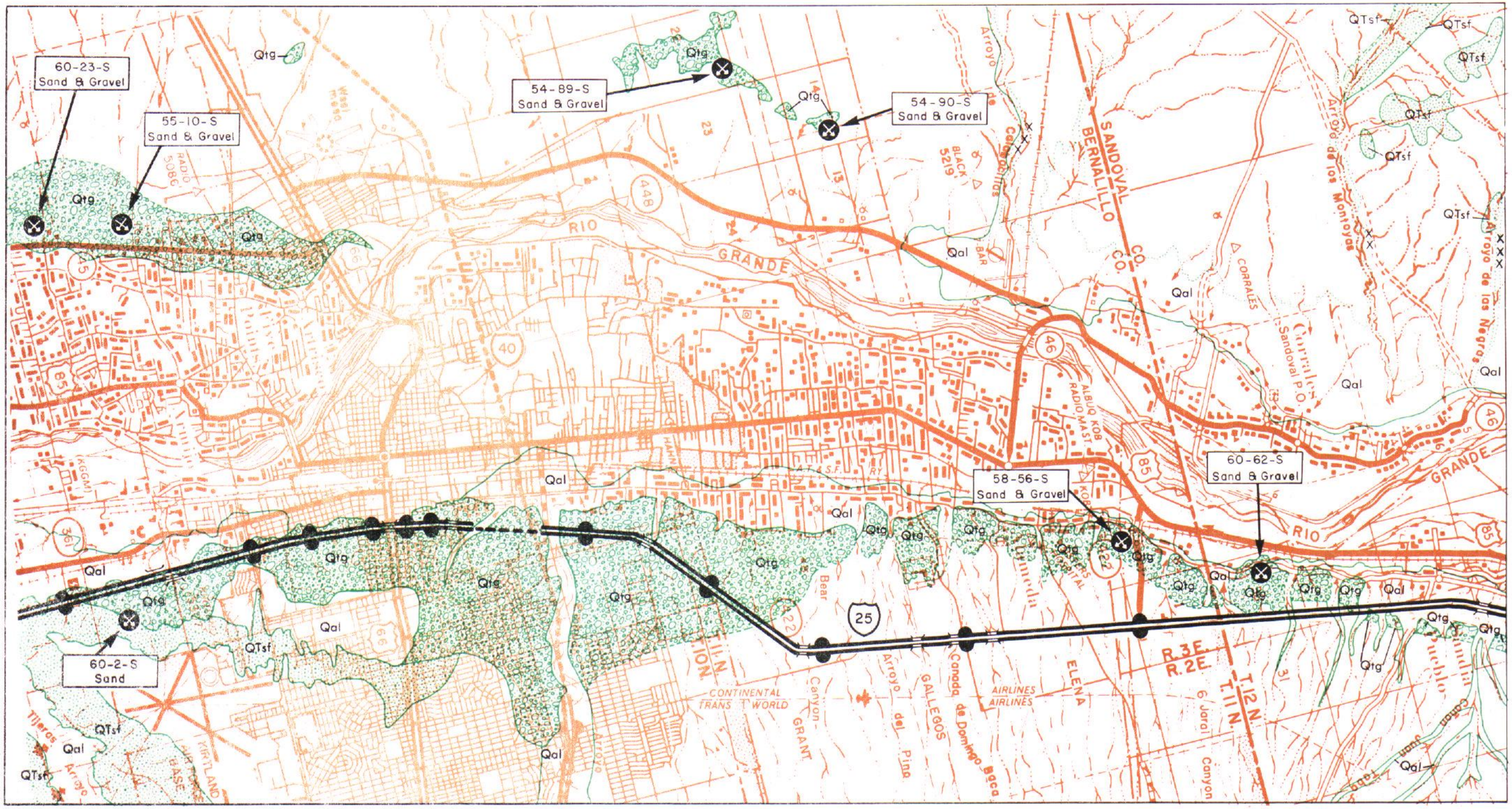
Soils Summary:

Table 25-13-1

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Qt	1	A	0.0	4.5	A-2-4	Silty sand
Qtg	2	A	0.0	5.0	A-2-4	" "
Qfp	3	A	0.0	4.5	A-4	Silt
Qal	4	A	0.0	4.0	A-2-4	Silty sand
Qp	5	A	0.0	3.0	A-4	Silt
"		B	3.0	4.0	A-6	Clay
Qt	6	A	0.0	4.5	A-2-4	Silty sand
Qfp	7	A	0.0	3.0	A-4	Silt
"		B	3.0	4.5	A-3	Fine sand
"	8	A	0.0	4.0	A-6	Clay
Qp	9	A	0.0	3.5	A-4	Silt
"		B	3.5	5.0	A-3	Fine sand
Qt	10	A	0.0	4.5	A-2-4	Silty sand
Qfp	11	A	0.0	1.0	A-6	Clay
"		B	1.0	---	Unclassified	Clay
Qal	12	A	0.0	4.0	A-3	Fine sand
Qt	13	A	0.0	2.5	A-2-4	Silty sand
"		B	2.5	9.0	A-1-b	Sandy gravel
"	14	A	0.0	4.5	A-2-4	Silty sand
Qtg	15	A	0.0	4.5	A-2-4	" "
Qfp	16	A	0.0	3.0	A-4	Silt
Qal	17	A	0.0	4.2	A-2-4	Silty sand
Qp	18	A	0.0	3.0	A-4	Silt
"		B	3.0	4.0	A-6	Clay
Qt	19	A	0.0	4.0	A-2-4	Silty sand
"	20	A	0.0	2.5	A-4	Silt
"		B	2.5	4.0	A-6	Clay
"	21	A	0.0	1.5	A-2-4	Silty sand
"		B	1.5	3.0	A-4	Silt
"		C	3.0	4.0	A-2-4	Silty sand
Qfp	22	A	0.0	1.5	A-6	Clay
"		B	1.5	2.5	A-4	Silt
Qal	23	A	0.0	8.0	A-4	"
"	24	A	0.0	3.5	A-2-4	Silty sand
"		B	3.5	8.0	A-4	Silt
"	25	A	0.0	1.5	A-4	"
"		B	1.5	8.0	A-1-b	Sandy gravel
Qfp	26	A	0.0	8.0	A-4	Silt
"	27	A	0.0	4.5	A-4	"
QTsf	28	A	0.0	3.5	A-4	"
"		B	3.5	10.0	A-1-b	Sandy gravel

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Qp	29	A	0.0	2.0	A-4	Silt
"		B	2.0	---	A-1-b	Gravelly sand
"	30	A	0.0	0.6	A-2-4	Silty sand
"		B	0.6	3.6	A-1-a	Gravel
"		C	3.6	4.6	A-1-b	Gravelly sand
"		D	4.6	4.9	A-4	Silt
"		E	4.9	---	A-1-b	Gravelly sand
"	31	A	0.0	0.8	A-4	Silt
"		B	0.8	3.5	A-2-4	Silty sand
"	32	A	0.0	0.6	A-4	Silt
"		B	0.6	3.6	A-1-b	Gravelly sand
"	33	A	0.0	1.5	A-4	Silt
"	34	A	0.0	2.5	A-1-b	Gravelly sand
"	35	A	0.0	1.0	A-1-b	" "
"		B	1.0	1.8	A-1-b	" "
"		C	1.8	---	A-1-a	Gravel
"	36	A	0.0	4.0	A-4	Silt
"	37	A	0.0	5.0	A-2-4	Silty sand
QTsf		B	5.0	19.0	A-1-b	Gravel & sand
"		C	19.0	23.0	A-2-4	Silty sand
"		D	23.0	30.0	A-1-a	Gravel
Qfp	38	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	3.0	A-4	Silt
"	39	A	0.0	1.0	A-4	"
"		B	1.0	4.0	A-3	Fine sand
"	40	A	0.0	1.0	A-4	Silt
"		B	1.0	3.0	A-4	"
"		C	3.0	5.0	A-7	Clay
Qal	41	A	0.0	5.0	A-2-4	Silty sand
"	42	A	0.0	1.0	A-4	Silt
"		B	1.0	4.0	A-3	Fine sand
Qt	43	A	0.0	1.0	A-4	Silt
"		B	1.0	5.0	A-2-4	Silty sand
"	44	A	0.0	2.0	A-2-4	" "
"		B	2.0	4.0	A-2-4	" "
Qfp	45	A	0.0	0.8	A-2-4	" "
"		B	0.8	5.0	A-3	Fine sand
Qal	46	A	0.0	2.5	A-2-4	Silty sand
"		B	2.5	6.0	A-2-4	" "
"	47	A	0.0	15.0	A-2-4	" "

CONSTRUCTION MATERIALS MAP 25-13



-LEGEND-

TESTED PIT OR QUARRY

Qal — Stream sand and gravel

Qtg — Terrace gravel

QTsf — Coarse sand

PROSPECT PIT OR QUARRY

STATUTE MILES

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-13-2

Pit or Prospect No.		54-89-S	54-90-S	55-10-S	58-56-S	60-2-S
	Section	NE 1/4 sec. 27	SE 1/4 sec. 14, NE 1/4 sec. 23	SE 1/4 sec. 34, SW 1/4 sec. 35	Not sectionalized	NW 1/4 sec. 4
	Twnshp.	T 11 N	T 11 N	T 10 N	Sandia Indian Pueblo	T 9 N
Location	& Range	R 2 E	R 2 E	R 2 E		R 3 E
	County	Bernalillo	Bernalillo	Bernalillo	Bernalillo	Bernalillo
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Private	Private
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Terrace	Terrace	Terrace	Terrace	Alluvium
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand
Kind of Material		Quartzite & various	Quartzite & various	Quartzite & various	Quartzite & various	Quartzite & various
Quality of Material		Excellent	Excellent	Excellent	Excellent	Fair
Thickness of Material		11 feet	20+ feet	13+ feet	20+ feet	15+ feet
Thickness of Cap (Caliche)		-	-	-	-	-
Blasting Qualities		-	-		-	-
Uniformity		Good	Excellent	Excellent	Excellent	Fair
Impurities		None	None	None	None	None
Type of Mat'l. Underlying Formation		Silt & clay	Silt & clay	Silt & clay	Sandstone, siltstone, & clay	Siltstone & sandstone
Moisture Condition		Dry	Dry	Dry	Dry	Dry
Vegetation		None	None	None	Grass	None
Local Terrain		Terrace	Terrace	Terrace	Terrace	Terrace
Depth of Overburden		1.0 to 3.0 feet	0.0 to 2.0 feet	4 feet	0.0 to 9.0 feet	None
P.I. (Overburden)		N.P.	N.P.	0 to 5	N.P.	-
Est. Reserve Quantity		75,000 cu. yds.	150.000 cu. yds.	250.000 cu. yds.	50,000 cu. yds.	100.000 cu. yds.
Approx. Haul to Nearest Point		12 miles	10 miles	-	1.0 mile	0.5 mile
L.A. Wear		25.2	27.2	25.6	24.4	27.2
Maximum Size		6"	8"	6"	8"	2"
% Retained on 2" Sieve		-	Not reported	Less than 5	Less than 35	-
	Crushed to	3/4"	" "	3/4"	-	-
	2"	-	" "	-	73	100
Pit	1"	-	" "	-	61	98
Average	3/4"	100	" "	100	57	87
% Passing	1/2"	77	" "	83	51	77
	#4	45	" "	50	42	56
	#10	36	" "	36	36	45
	#200	2	" "	3	5	5
P.I.		N.P.	" "	N.P.	N.P.	N.P.
Lab. Numbers		54-15728-15742	" "	55-1383-1392	58-10905	60-18-43

Remarks:

54-89-S - See letter and sketch of this area or recommendations for acquiring this property.

54-90-S - Located approximately 5.0 miles north of junction of present U.S. 66 and Coors Road, thence 1.1 miles west of Station 364+55. Refer to letter and new sketch of area for recommendations. Gradation is similar to pit 54-89-S.

55-10-S - Located immediately west of Sta. 541+62.6 on Project No. S-22(1). This pit may be extended north, south, and west provided the landowners are agreeable.

58-56-S - Located 40 feet south R/W Sta. 53+34.5 on Project No. FI-001-4(9) in the Sandia Pueblo Grant. This pit is now a commerical source and is no longer available under the original terms.

60-2-S - Located 7115 feet south of Sta. 193+00 on Project I-025-4(13)219. This pit is listed to show the type of material that may be located in local areas of the outwash from the Santa Fe formation.

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-13-2 continued...

Pit or Prospect No.		60-23-S	60-62-S
Location	Section	Not sectionalized	36
	Twnshp. & Range	" "	T 12 N R 3 E
	County	Bernalillo	Sandoval
	State	New Mexico	New Mexico
Owner		Private	Indian Land
Geologic Age		Quaternary	Quaternary
Formation		Terrace	Terrace
Type of Pit		Sand & gravel	Sand & gravel
Kind of Material		Quartzite & various	Quartzite
Quality of Material		Excellent	Excellent
Thickness of Material		20+ feet	20+ feet
Thickness of Cap (Caliche)		-	-
Blasting Qualities		-	-
Uniformity		Excellent	Excellent
Impurities		None	None
Type of Mat'l. Underlying Formation		Silt & clay	Silt & clay
Moisture Condition		Dry	Dry
Vegetation		None	Grass
Local Terrain		Terrace	Terrace
Depth of Overburden		10 feet average	0.0 to 8.0 feet
P.I. (Overburden)		0 to 7	0 to 6
Est. Reserve Quantity		300,000 cu. yds.	500,000 cu. yds.
Approx. Haul to Nearest Point		-	1380 feet
L.A. Wear		25.6	25.2
Maximum Size		6"	12"
% Retained on 2" Sieve		Less than 5	15
Pit Average % Passing	Crushed to	-	-
	2"	95	73
	1"	80	57
	3/4"	72	52
	1/2"	62	46
	#4	45	36
	#10	33	29
	#200	3	3
P.I.		N.P.	N.P.
Lab. Numbers		60-3234-3247	60-11449-11466

Remarks:

60-23-S - Located 2990 feet west of the junction of Barcelona Road and State Road 45 (Coors Road), thence 880 feet north in the Atrisco Grant. The pit may be extended provided the landowner is agreeable.

60-62-S - Located 1380 feet left of Sta. 559+22 on Project I-025-4(15)230.

SOILS AND GEOLOGY

Introduction:

This strip begins about 4 miles south of Bernalillo and ends about 9.5 miles northeast of Algodones.

Prominent geologic features include the Sandia uplift, basalt capped mesas, the Rio Grande flood plain, and the dissected erosional surfaces that slope from the Rio Grande flood plain up to the adjoining highlands.

Three fairly large drainageways flow into the Rio Grande in this strip. The Jemez River drains part of the Jemez Mountains and enters the Rio Grande near Bernalillo. The Las Huertas Creek drains the back slopes of the Sandia Mountains and flows into the Rio Grande near Algodones. The Tonque Arroyo drains the western slopes of the Ortiz Mountains and enters the Rio Grande at the San Felipe Pueblo.

General Geology:

This strip lies in the Albuquerque-Belen basin, the largest basin of the Rio Grande depression. The complex Sandia fault block lies to the east and the Jemez uplift and the Puerco fault zone lie to the west.

The geology of this area is an expression of extreme, late-Tertiary crustal movement and the Pleistocene and Recent erosion cycles.

The Sandia Mountains are primarily an eastern dipping fault block that become quite complex at the northern end by many secondary transverse faults. Precambrian granite and metamorphic rocks are exposed on the western scarp of the mountains and Carboniferous limestones, shales, and sandstones are on the dip slope to the east. Secondary faulting at the north end of the range has exposed rocks that range from Tertiary through Carboniferous in age.

The Albuquerque-Belen basin began to form during the early part of the Neogene period (last one-third of the Cenezoic era.) Subsidence of the basin and uplift and erosion of the adjoining highlands has continued through recent time. Drainage during late Tertiary time was to a closed basin and several thousand feet of alluvial fan, stream, and lake deposits of the Santa Fe group accumulated. Later, during the Pleistocene epoch, an erosional surface developed over the basin fill, the Rio Grande became a through-flowing stream, and more deposits of sand, gravel, silt, and clay were added to the Santa Fe group. Intermittent volcanic activity also contributed to the basin fill.

Volcanic activity during Quaternary time formed the basalt flow which today caps Santa Ana Mesa. Late Tertiary volcanic activity formed the dikes in the Placitas area.

Terrace deposits, representing intervals of stabilization in the downcutting and stripping of the Rio Grande are on each side of the inner valley. They are in various stages of preservation because of local differences in drainage and dissection. Fan and sheet-wash deposits from the adjoining highlands have migrated over these deposits and it is difficult to determine the exact contact for the eastern migration of the river. Several different levels of river deposits can be seen in the canyon walls north of State Road 44.

The Rio Grande flood plain varies from one to two miles wide in this strip. It has about 120 feet of sand, silt, and clay that overlie similar sediments of the Santa Fe group. Much of the flood-plain area is farmed and the natural surface has been changed by farm leveling. The primary surface materials are clays and silts.

The areal distribution of formations is shown on Soils and Geology Map 25-14. Their succession and character are given under the section termed "Stratigraphy."

Soils:

Alluvium (Qal): The alluvial soils are non-uniform in texture. Slope wash along the terrace deposits is made up of silty sand (A-2-4) and silt (A-4). Where streams debouch onto the flood plain, silts, clays, and gravels are mixed with wind-blown sand. The soils in the stream bottoms are primarily coarse-grained materials; although, there are some discontinuous deposits of silt and clay.

Landslide debris (Ql): These deposits are made up of basalt boulders and debris from the Santa Fe group; sands, silts, and clays.

Flood-plain deposits (Qfp): Most of the Rio Grande flood plain shows a profile of clay and silt over a silty sand. There are many variations in this profile caused by the meandering nature of the river.

Alluvial fan deposits (Qaf): These soils are made up of very coarse-grained poorly sorted materials derived from the granite slopes to the east.

Terrace deposits (Qt): These deposits usually show a profile of silty sand (A-2-4) over a well-washed, well-sorted, sand and gravel (A-1-a). The materials adjacent to the Rio Grande flood plain are primarily quartzite. The deposits adjacent to Las Huertas Creek are locally derived and they have a high percentage of sub-rounded limestone materials.

Pediment deposits (Qp): These soils are derived from the scarp slope of the Sandia mountains. They show a weak profile development of gravelly silt (A-4) over coarse-grained granite sand. These materials may have migrated over an old river cut terrace. It is impossible to determine the exact contact of the eastern migration of the river, but part of the area seems to have been beveled to a relatively flat surface before the present surface materials were deposited.

Santa Fe group (QTsf): The upper exposures of the Santa Fe group are a mixture of locally derived materials and well-washed river sand and gravel. The soil profile usually shows a silt (A-4) or silty sand (A-2-4) cover over sand and gravel (A-1-a). The lower exposures are sands, gravels, silts, and clays that usually show some degree of induration and some degree of tectonic movement.

Basalt (Qb): The basalt-capped Santa Ana Mésa has a cover of silty sand (A-2-4) that was transported from the west by the wind. There is also evidence of river deposited materials in local areas over the mesa.

Table 25-14-1 shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-14.

Ground Water:

Ground-water conditions of the Rio Grande flood plain may be significant in relation to possible engineering problems. Sources of ground water are: (1) underflow from bordering mesas; (2) seepage from the river; (3) seepage from canals and irrigated lands; and (4) local precipitation.

The irrigated areas receive water during the growing season in excess of what they normally hold; consequently, the water table rises in the summer. In nonirrigated areas vegetation draws heavily on the ground water and the water table falls. After the growing season the reverse is true.

In the flood plain, water was encountered in sandy strata from 3 to 5 feet. According to Theis (1938) in 50 percent of the valley the water table is encountered from 4 to 6 feet and in 13 percent of the valley it is encountered at over 8 feet. It has also been noted that in local areas of the valley the water table is at the surface during periods of heavey precipitation.

Stratigraphy:

Quaternary:

Alluvium (Qal) - sand, silt, clay and gravel.
Thickness: 0 to 30 feet.

Landslide debris (Ql) - large basaltic boulders mixed with Santa Fe debris.

Flood-plain deposits (Qfp) - fine- to medium-grained sand, silt, and clay.
Thickness: 120 feet.

Alluvial fan deposits (Qaf) - angular to subangular, poorly-sorted gravel and sand.
Thickness: 0 to 50 feet.

Terrace deposits (Qt) - well-rounded, well-washed, well-sorted quartzite gravel and sand near the Rio Grande flood plain; subangular gravel and sand with an abundance of limestone gravels by Las Huertas Creek.
Thickness: 0 to 150 feet.

Pediment deposits (Qp) - poorly-sorted, fine- to coarse-grained sand, silt, and clay.
Thickness: 0 to 50 feet.

Basalt (Qb) - dense, dark-brown to black basalt.
Thickness: 10 to 30 feet.

Volcanics undifferentiated (Qvu) - a consolidated, complex mixture of ash, cinders, bombs and Santa Fe sediments.

Unconformity--

Quaternary-Tertiary:

Santa Fe group (QTsf) - unconsolidated sand, gravel, silt and clay in upper part; consolidated sand, gravel, silt, and clay in lower part.
Thickness: 6,000 feet maximum.

Unconformity--

Tertiary:

Intrusive rocks (Ti) - basaltic dikes.

Extrusive rocks (Te) - a greenish-maroon to light-gray, very fine-grained rhyolite (?).

Galisteo formation (Tg) - gray, buff, and reddish-brown sandstone, conglomeratic sandstone, and gray to reddish-brown purple mudstones.
Thickness: 2,300 to 3,000 feet.

Unconformity--

Cretaceous:

Mesaverde formation (Kmv) - grayish sandstone, dark-brown to black shale, coaly shale.
Thickness: 2,900 feet.

Mancos shale (Km) - black shale, light-gray to rusty weathering sandstone and siltstone; has some thin coal beds in the upper part and near the base.
Thickness: 1,500 to 1,800 feet.

Dakota formation (Kd) - light-gray to buff sandstone and black shale.
Thickness: 5 to 250 feet.

Unconformity--

Jurassic:

Morrison formation (Jm) - variegated mudstone, sandstone, conglomerate, and some limestone, includes Todilto formation at base. Todilto formation, gypsum with laminae of limestone overlying laminated black, fetid limestone, 4 to 11 feet thick.
Thickness: Morrison formation - 480 to 750 feet.
Todilto formation - 30 to 230 feet.

Wingate sandstone (Jw) - buff to tan-brown sandstone.
Thickness: 100 to 145 feet.

Unconformity--

Triassic:

Dockum group (Trd) - Chinle formation, mudstone with linticular sandstone beds; variegated in lower part and tan-brown to reddish-brown in upper part; Santa Rosa formation, light-gray to reddish-brown sandstone and reddish-brown mudstone; conglomerate locally near base.

Stratigraphy continued...

Dockum group continued...
Thickness: Chinle formation - 1,500 to 2,000 feet.
Santa Rosa formation - 70 to 400 feet.

Permian: San Andres formation and Glorieta sandstone (Pgsa) - San Andres formation, limestone and buff to tan sandstone; Glorieta sandstone, light gray.
Thickness: San Andres formation - 0 to 190 feet.
Glorieta sandstone - 0 to 150 feet.

Yeso formation (Pg) - buff, tan-brown to red sandstone, siltstone, and minor limestone.
Thickness: 300 to 550 feet.

Abo formation (Pa) - reddish-brown, linticular sandstone and mudstone; locally light-gray sandstone, pellet limestone, and black shale.
Thickness: 700 to 950 feet.

Carboniferous: Magdalena group (Cm) - Madera limestone, prominent ledges of gray fossiliferous limestone commonly cherty; dark-gray, reddish-brown and green shales; greenish, reddish-brown sandstones; some arkosic conglomerate; Sandia formation, black shale, dark-gray limestone, gray to greenish-gray and brown sandstones; locally conglomeratic, occasional streaks of coal.
Thickness: 1,200 to 2,000 feet.

Unconformity--

Precambrian: Precambrian rocks undifferentiated (P€) - gneiss, schist, quartzite, and qranite.

Construction Materials:

Quaternary: Alluvium (Qal) - Sand and gravel and coarse-grained sand occur in most of the streams of this strip.

Tonque Arroyo and the arroyo about one and one half miles to the north have a coarse-grained sand. Pit 25-14-4 is representative of this material.

Las Huertas Creek and some of the streams to the south have much coarser material. Pits 25-14-7 and 54-95-S are representative of these materials.

Terrace deposits (Qt) - There are two varieties of terrace gravels in this strip: (1) quartzite gravels deposited by an early Rio Grande and (2) a mixed aggregate of locally derived maferials with a high percentage of limestone particles.

Vast quanties of well-washed, well-rounded, quartzite gravels lie along each side of the Rio Grande flood plain. About 2 miles south and from 5 to 10 miles north of Tonque Arroyo the terrace deposits are as much as 150 feet thick. Beds of sand and gravel from 15 to 30 feet thick are separated by 3 to 15 feet of silt and clay. Pits 25-14-2 and 25-14-3 are representative of these deposits. Farther south near Pits 61-48-S and 56-91-S the deposits become thinner.

The mixed aggregate with limestone lies parallel to Las Huertas Creek. These materials are angular to sub-angular and even though they are non-plastic they have a greater percentage of silt than the river-washed materials. They are also less uniform and they have irregular lenses of silt and clay. Pits 25-14-6 and 54-54-S are representative of these materials.

Quaternary-Tertiary: Santa Fe group (QTsf) - The upper part of the Santa Fe group includes a mixture of alluvial fan, stream, and early Rio Grande deposits.

The early Rio Grande deposits are equivalent to the quartzite gravels described under (Qt). They crop out locally to the north of S.R. 44 and they usually have a thick cover of locally derived fan materials. Pit 25-14-5 is representative of this material.

A blanket of angular to sub-angular materials, very similar to the terrace deposits along Las Huertas Creek, has migrated over the above described river deposits. It is a heterogeneous deposit of mixed aggregate with a high percentage of limestone particles. Pit 56-78-S is located in this material.

Tertiary: Extrusive rocks (Te) - a very dense greenish-maroon to light-gray rhyolite lies in section 20, T. 14 N., R. 6 E. This material will make an excellent quarry rock and there seems to be an almost unlimited supply. Pit 25-14-9 is representative of this rock.

Carboniferous: Magdalena group (Cm) - An excellent quarry may be located in the block of Madera limestone about one mile south of S.R. 44 in the Sandia Mountains. About 50 feet of pure, gray fossiliferous limestone rises above the alluvial fan deposits at the edge of the mountains. Pit 25-14-1 is in this limestone.

Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-14. Test data and other related information are shown in Material Pit Summary Table 25-14-2.

Selected References:

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New Mexico Geological Society, 1961, "Structural Problems Of The Rio Grande Trough In The Albuquerque Country", Guidebook of The Albuquerque Country, New Mexico Geol. Soc. 1961, Twelfth Field Conf., P-144.

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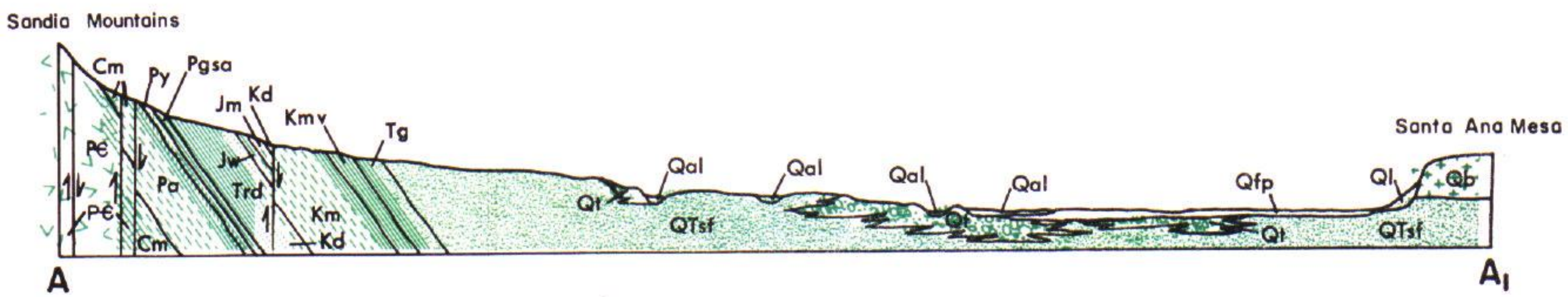
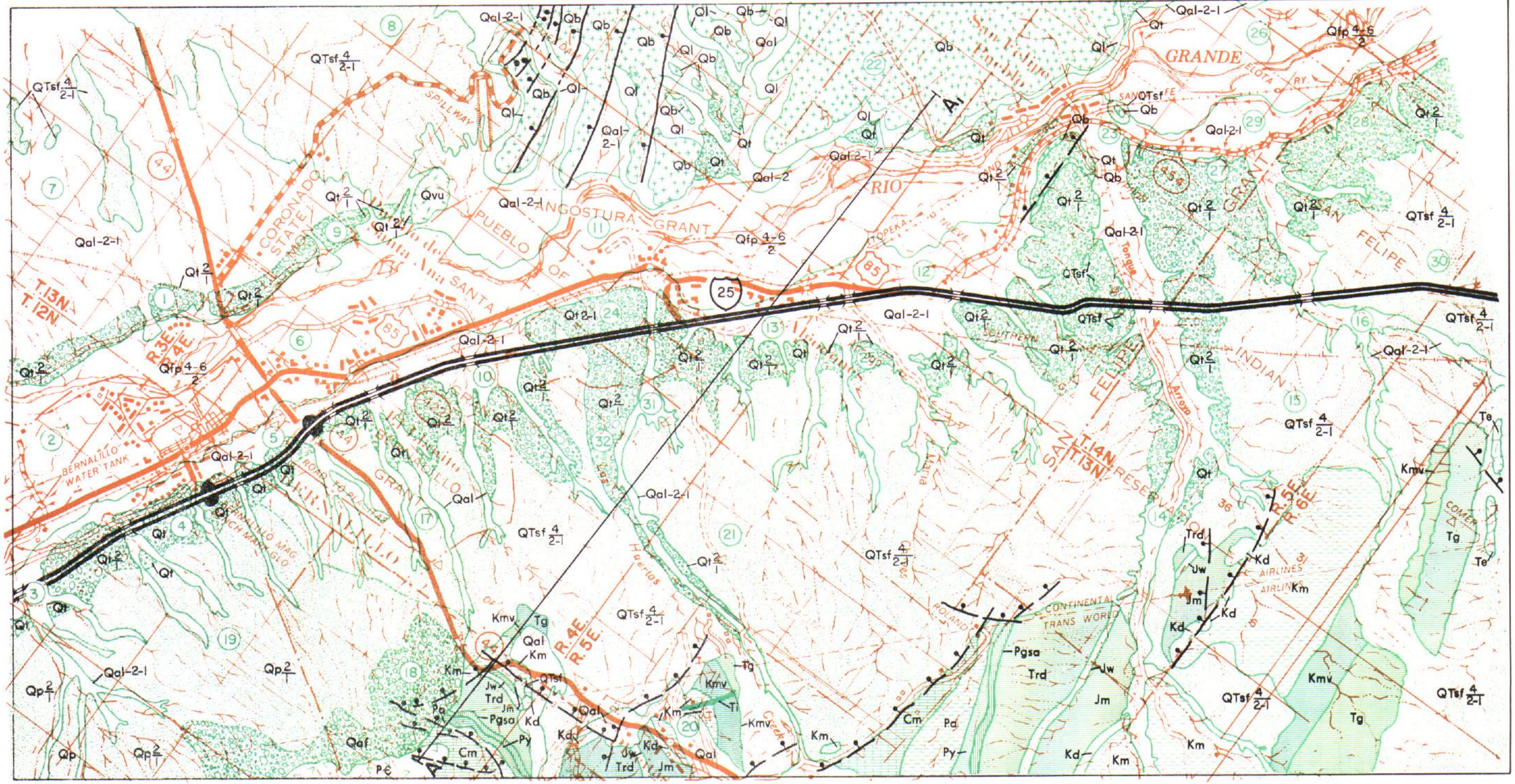
Theis, Charles V, 1938, Ground Water in the Middle Rio Grande Valley, New Mexico, Natl. Resources Commission, Regional Planning, pt. 6, Upper Rio Grande, p. 268-201. 10 figs.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-14

SOILS AND GEOLOGY MAP 25-14



GEOLOGY MAPPED 1964

-LEGEND-

SEDIMENTARY ROCKS

QUATERNARY:
- Qal — Alluvium
- Ql — Landslide debris
- Qfp — Flood-plain deposits
- Qaf — Alluvial fan deposits
- Qt — Terrace deposits
- Qp — Pediment deposits

QUATERNARY / TERTIARY:
- QTsf — Santa Fe group

TERTIARY:
- Tg — Galisteo formation

CRETACEOUS:
- Kmv — Mesaverde formation
- Km — Mancos shale
- Kd — Dakota sandstone

JURASSIC:
- Jm — Morrison formation
- Jw — Wingate sandstone

TRIASSIC:
- Trd — Dockum group

PERMIAN:
- Pgsa — San Andres limestone, Glorieta sandstone
- Py — Yeso formation
- Pa — Abo formation

CARBONIFEROUS:
- Cm — Magdalena group

PRE-CAMBRIAN:
- P€ — Precambrian undifferentiated

IGNEOUS ROCKS

QUATERNARY:
- Qb — Basalt
- Qvu — Volcanics undifferentiated
- Ti — Intrusive dike

TERTIARY:
- Te — Extrusives

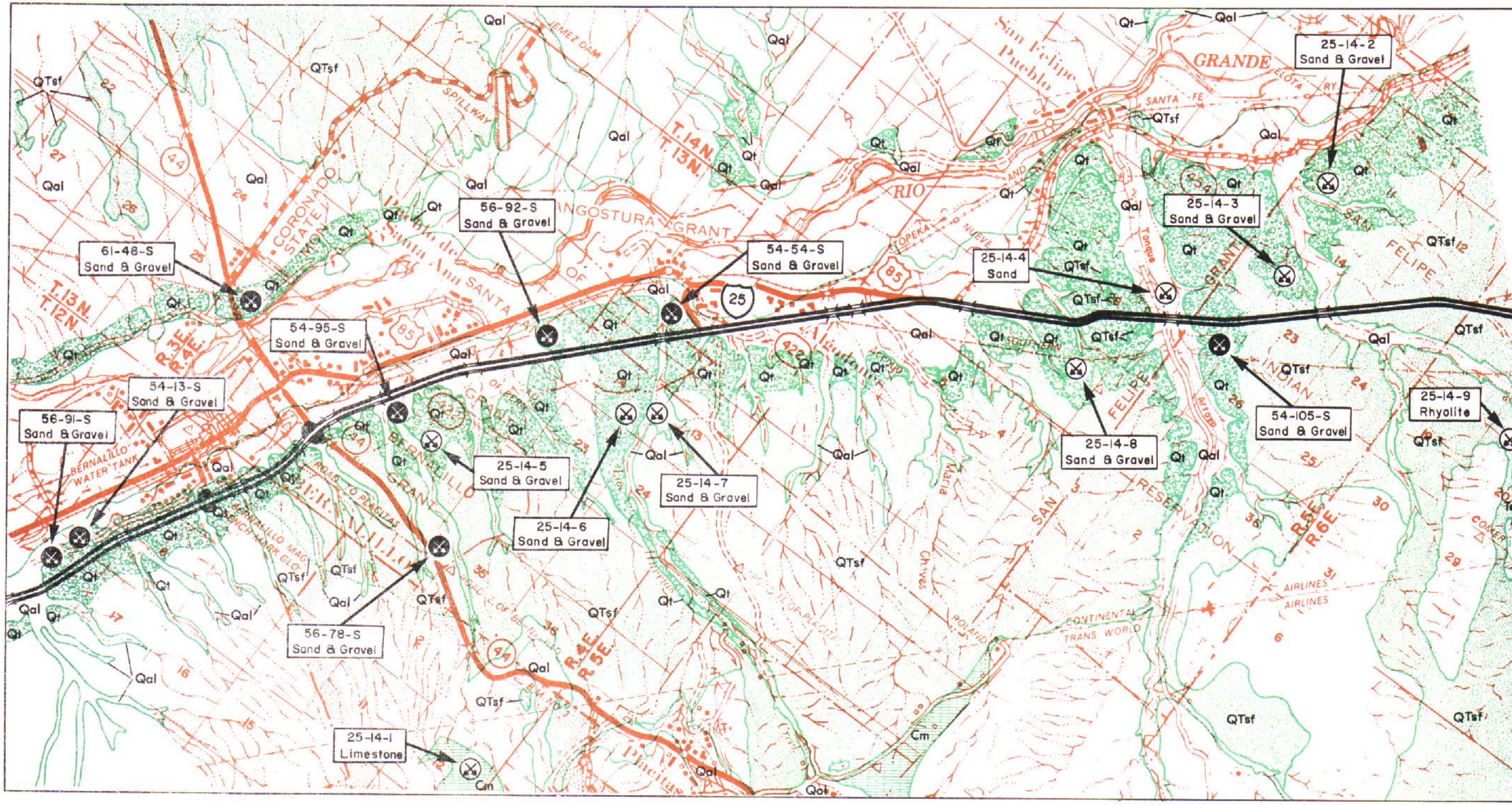
STATUTE MILES

Soils Summary:

Table 25-14-1

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Qt	1	A	0.0	5.0	A-2-4	Silty sand
"		B	5.0	7.0	A-4	Sandy silt
"		C	7.0	15.0	A-1-b	Sand and gravel
Qfp	2	A	0.0	0.6	A-6	Clay
"		B	0.6	3.0	A-4	Sandy silt
Qal	3	A	0.0	0.8	A-2-4	Silty sand
"		B	0.8	6.0	A-1-b	Sand and gravel
Qt	4	A	0.0	7.0	A-2-4	Silty sand
"		B	7.0	10.0	A-6	Clay
"		C	10.0	25.0	A-1-b	Sand and gravel
"		D	25.0	29.0	A-4	Silt
"		E	29.0	35.0	A-4	Sandy silt
"		F	35.0	42.0	A-4	" "
"		G	42.0	47.0	Bedrock	Sandstone
"		H	47.0	52.0	A-4	Silt
"		I	52.0	77.0	A-1-a	Sand and gravel
"		J	77.0	87.0	A-4	Gravelly silt
"		K	87.0	107.0	A-2-4	Silty sand
Qal	5	A	0.0	12.0	A-2-4	Silty sand
Qfp	6	A	0.0	2.0	A-4	Sandy silt
"		B	2.0	5.0	A-4	" "
Qal	7	A	0.0	3.0	A-3	Fine sand
"		B	3.0	8.0	A-4	Sandy silt
QTsf	8	A	0.0	2.0	A-2-4	Silty sand
"		B	2.0	4.0	A-4	Sandy silt
"		C	4.0	8.0	A-2-4	Silty sand
Qt	9	A	0.0	3.0	A-4	Silt
"		B	3.0	12.0	A-1-a	Sand and gravel
Qal	10	A	0.0	3.0	A-4	Sandy silt
"		B	3.0	8.0	A-1-b	Sand and gravel
Qfp	11	A	0.0	1.0	A-6	Silty clay
"		B	1.0	2.0	A-4	Sandy silt
"		C	2.0	4.0	A-4	Silt
Qal	12	A	0.0	2.0	A-4	Sandy silt
"		B	2.0	10.0	A-4	Silt
"	13	A	0.0	4.0	A-1-a	Sand and gravel
"	14	A	0.0	5.0	A-2-4	Silty sand
"		B	5.0	9.0	A-1-a	Sand and gravel
QTsf	15	A	0.0	1.0	A-4	Sandy silt
"		B	1.0	5.0	A-4	Clayey silt
Qal	16	A	0.0	7.0	A-2-4	Silty sand
Qal	16	B	7.0	11.0	A-1-b	Sand and gravel
QTsf	17	A	0.0	7.0	A-4	Silt
"		B	7.0	20.0	A-4	Sandy silt
"		C	20.0	35.0	Bedrock	Conglomerate
"		D	35.0	45.0	A-4	Sandy silt
"		E	45.0	55.0	A-1-a	Sand and gravel
Qaf	18	A	0.0	4.0	A-1-a	" " "
Qp	19	A	0.0	3.0	A-2-6	Clayey sand and gravel
"		B	3.0	13.0	A-1-a	Sand and gravel
Qal	20	A	0.0	15.0	A-6	Clay
QTsf	21	A	0.0	2.0	A-1-a	Gravel
Qb	22	A	0.0	1.0	A-2-4	Silty sand and gravel
Qal	23	A	0.0	5.0	A-4	Sandy silt
"		B	5.0	8.0	A-1-b	Sand and gravel
Qt	24	A	0.0	7.0	A-1-a	" " "
"	25	A	0.0	1.0	A-2-4	Silty sand and gravel
"		B	1.0	30.0	A-1-b	Sand and gravel
Qfp	26	A	0.0	5.0	A-4	Sandy silt
Qt	27	A	0.0	2.0	A-2-4	Silty sand and gravel
"		B	2.0	15.0	A-1-a	Sand and gravel
"	28	A	0.0	2.0	A-2-4	Silty sand and gravel
"		B	2.0	18.0	A-1-a	Sand and gravel
Qal	29	A	0.0	2.0	A-1-a	" " "
QTsf	30	A	0.0	5.0	A-4	Silt
Qal	31	A	0.0	4.0	A-1-a	Sand and gravel
Qt	32	A	0.0	2.0	A-4	Sandy silt
"		B	2.0	17.0	A-1-a	Sand and gravel
"		C	17.0	42.0	A-3	Fine sand

CONSTRUCTION MATERIALS MAP 25-14



—LEGEND—

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-14-2

Pit or Prospect No.		25-14-1 (Prospect)	25-14-2 (Prospect)	25-14-3 (Prospect)	25-14-4 (Prospect)	25-14-5 (Prospect)	25-14-6 (Prospect)
Location	Section	12	10 & 11	14, 15, 21 & 22	27	Not sectionalized	E 1/2 Sec. 14
	Twnshp.	T 12 N	T 14 N	T 14 N	T 14 N	Bernalillo Grant	T 13 N
	& Range	R 4 E	R 5 E	R 5 E	R 5 E		R 4 E
	County	Sandoval	Sandoval	Sandoval	Sandoval	Sandoval	Sandoval
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Federal Land	Indian Land	Indian Land	Indian Land	Private	Indian Land
Geologic Age		Carboniferous	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Madera limestone	Terrace deposit	Terrace deposit	Alluvium	Santa Fe	Terrace deposit
Type of Pit		Quarry	Sand & gravel	Sand & gravel	Fine aggregate	Sand & gravel	Sand & gravel
Kind of Material		Limestone	Quartzite & various	Quartzite & various	Coarse sand	Quartzite	Mixed aggregate & limestone
Quality of Material		Good	Good	Good	Good	Good	Good
Thickness of Material		50 feet	16 feet	15 feet	?	30 feet	15 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		?	-	-	-	-	-
Uniformity		Good	Good	Good	Good	Good	Good
Impurities		Good	Silt lenses	Silt lenses	Silt lenses	Silt lenses	Silt lenses
Type of Mat'l. Underlying Formation		Shale	Silt or clay	Silt & clay	Silt & clay	Silt & clay	Clean sand
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Pinon, juniper & cedar	Scattered cedar	Scattered cedar	Sage	Scattered cedar	Pinon, cedar & juniper
Local Terrain		Mountainous	Dissected terrace	Dissected terrace	Stream valley	Dissected terraces	Dissected terraces
Depth of Overburden		Trace	2 feet	0 to 2 feet	None	See remarks	2 to 4 feet
P.I. (Overburden)		-	N.P.	N.P.	-	-	N.P.
Est. Reserve Quantity		Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
Approx. Haul to Nearest Point		5 miles	2 miles	1 mile	0.25 mile	1 mile	1 mile
L.A. Wear		19.2	24	24	-	24	22
Maximum Size		-	6"	6"	1"	6"	12"
% Retained on 2" Sieve		-	5 to 10	5 to 10	-	10 to 15	15 to 25
	Crushed to	1"	-	-	-	-	-
	2"	-	100	100	-	90	72
Pit	1"	100	77	73	-	77	56
Average	3/4"	84	72	63	97	66	50
% Passing	1/2"	47	67	52	94	45	44
	#4	17	55	34	85	23	32
	#10	9	48	27	78	16	23
	#200	2	4	6	6	2	4
P.I.		N.P.	N.P.	N.P.	N.P.	N.P.	N.P.
Lab. Numbers		63-7198	63-5014-5015	63-5012-5014	63-5006-5007	63-8150	63-8147-8149

Remarks:

25-14-5 (Prospect) - In many places this material has as much as 15 to 20 feet of overburden; however, there are several hills in this area that seem to have less than 3 feet of overburden.

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-14-2

Pit or Prospect No.		25-14-7 (Prospect)	25-14-8 (Prospect)	25-14-9 (Prospect)	54-13-S	54-54-S	54-95-S
Location	Section	14	33	20	NE 1/4 Sec. 18	11	Not sectionalized
	Twnshp.	T 13 N	T 14 N	T 14 N	T 12 N	T 13 N	Bernalillo Grant
	& Range	R 4 E	R 5 E	R 6 E	R 4 E	R 4 E	
	County	Sandoval	Sandoval	Sandoval	Bernalillo	Sandoval	Sandoval
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Indian Land	Indian Land	Federal Land	Indian Land	Private	?
Geologic Age		Quaternary	Quaternary	Tertiary	Quaternary	Quaternary	Quaternary
Formation		Alluvium	Terrace deposit	Extrusive	Terrace deposit	Terrace deposit	Alluvium
Type of Pit		Sand & gravel	Sand & gravel	Quarry	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Mixed aggregate & limestone	Quartzite	Rhyolite(?)	Quartzite	Mixed aggregate	Mixed aggregate
Quality of Material		Good	Good	Good	Good	Good	Good
Thickness of Material		?	6 to 15 feet	?	25 feet	25 feet	3 to 6 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	Fractures easily	-	-	-
Uniformity		Good	Good	Good	Good	Fair	Good
Impurities		Silt lenses	Silt lenses	?	None	Silt & clay lenses	Silt
Type of Mat'l. Underlying Formation		Silt & clay	Sandstone	-	Sandstone	Silt & clay	Silt & clay
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Scattered cedar & pinon	Scattered cedar & pinon	Scattered cedar	Scattered cedar	Juniper. cedar & pinon	Sage
Local Terrain		Stream valley	Dissected terrace	Mountainous	Dissected terrace	Dissected terraces	Stream valley
Depth of Overburden		None	0 to 3 feet	Trace	None	1 to 4 feet	None
P.I. (Overburden)		-	N.P.	-	-	6	-
Est. Reserve Quantity		?	Unlimited	Unlimited	See remarks	Unlimited	Unlimited
Approx. Haul to Nearest Point		1 mile	3/4 mile	2.0 miles	-	0.3 mile	500 feet
L.A. Wear		25	26.4	18	24	26.4	29
Maximum Size		12"	6"	-	6"	8"	24"
% Retained on 2" Sieve		10 to 20	10 to 15	-	10 to 20	6	5 to 10
	Crushed to	-	-	-	-	-	-
	2"	77	76	-	67	94	81
Pit	1"	57	52	100	59	80	64
Average	3/4"	50	44	85	56	70	56
% Passing	1/2"	43	37	45	50	60	48
	#4	28	21	14	40	39	35
	#10	20	16	7	35	28	27
	#200	3	3	1	5	3	4
P.I.		N.P.	N.P.	N.P.	N.P.	N.P.	N.P.
Lab. Numbers		63-8151	64-2515-2516	64-2517	56-15021-15041	64-2512 -2513	64-2514

Remarks:

54-13-S The upper part of this particular pit has been removed. There is an almost unlimited supply of this material along the roadway. In many places it has a very heavy overburden.

54-54-S Pit may be extended to the N.W. and S.E. Similar materials occur across arroyo to S.W.

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-14-2

Pit or Prospect No.		54-105-S	56-78-S	56-91-S	56-92-S	61-48-S
Location	Section	NE 1/4 Sec. 27; NW 1/4 Sec. 26	Not sectionalized	N 1/2 Sec. 18	S 1/2 Sec. 15	NE 1/4 SW 1/4 Sec. 30
	Twnshp. & Range	T 14 N R 5 E	Bernalillo Grant	T 12 N R 4 E	T 13 N R 4 E	T 13 N R 4 E
	County	Sandoval	Sandoval	Sandoval	Sandoval	Sandoval
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Indian Land	Private	Indian Land	Indian Land	University of N. M.
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Terrace deposit	Santa Fe group	Terrace deposit	Terrace deposit	Terrace deposit
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Mixed aggregate	Limestone & various	Quartzite	Mixed aggregate	Quartzite
Quality of Material		Good	Fair	Good	Good	Good
Thickness of Material		10 to 20 feet	20 feet	?	20 feet	20 feet
Thickness of Cap (Caliche)		-	-	-	-	-
Blasting Qualities		-	-	-	-	-
Uniformity		Good	Fair	Good	Good	Good
Impurities		Silt lenses	Silt lenses	None	Silt	None
Type of Mat'l. Underlying Formation		Silt, clay & sand	Silt & clay	Red sandstone	Red sandstone & clay	Silt & clay
Moisture Condition		Dry	Dry	Dry	Dry	Dry
Vegetation		Grass	Juniper & grass	-	Scattered juniper	Sage & grass
Local Terrain		Dissected terrace	Hilly	Dissected terraces	Dissected terrace	River terrace
Depth of Overburden		2 to 4 feet	1 to 6 feet	-	1 to 6 feet	2 to 7 feet
P.I. (Overburden)		7 to 10	6 to 11	-	10	N.P.
Est. Reserve Quantity		Unlimited	Unlimited	?	?	40,000+ cu. yds.
Approx. Haul to Nearest Point		0.7 mile	2.0 miles	0.1 mile	0.1 mile	2.0 miles
L.A. Wear		26.4	24.8	24.0	26	26
Maximum Size		3/4"	12"	6"	5"	5"
% Retained on 2" Sieve		-	20	15 to 20	40	20 to 30
	Crushed to	-	-	-	-	-
Pit Average % Passing	2"	-	80	68	73	71
	1"	-	72	49	50	56
	3/4"	100	68	43	44	50
	1/2"	81	62	34	35	43
	#4	44	47	22	22	33
	#10	31	33	18	18	28
	#200	5	8	4	1	1
P.I.		N.P.	N.P.	N.P.	N.P.	N.P.
Lab. Numbers		54-19047-19065; 54-20047-20065	56-12938	56-15021-15041	56-15076-15094	61-18479-18487

Remarks:

56-78-S Similar materials occur across the dissected deposits to the north for many miles. The good materials seem to be in braided channels.

56-91-S The upper part of this pit has been removed.

61-48-S Pit presently being worked (2-28-64).

SOILS AND GEOLOGY

Introduction:

Strip 25-15 lies in Santa Fe and Sandoval Counties, New Mexico. It begins 2.5 miles southwest of the junction of Interstate Route 25 and the road to Santo Domingo and it ends 1.25 miles northeast of the junction of Interstate Route 25 and State Road 479.

The strip is structurally complex. Prominent geologic features include the La Bajada fault escarpment, basaltic flows, the Cerrillos Hills, and the intrusives and associated volcanics of the Cienega area.

General Geology:

This strip lies within the Rio Grande depression which contains a series of linked basins. The western part of the strip lies within the Santo Domingo basin, a northern division of the Albuquerque-Belen basin. The eastern part lies in the Espanola basin. These basins are separated by the north-south trending arcuate La Bajada fault escarpment.

The eastern one-half of this strip is structurally complex. Igneous intrusions of monzonite have formed stocks, plugs, laccoliths, sills, and dikes. The most outstanding features formed by the igneous activity are the Cerrillos Hills and associated outliers, Cerro Seguro, and the complexly faulted La Bajada Hill. West of the La Bajada escarpment lies the dissected surface of Quaternary and Tertiary deposits.

Sedimentary rocks range in age from Triassic through Quaternary. The igneous intrusions and extrusions occurred during Tertiary and Quaternary time.

The sedimentary sequence of rocks is best exposed on the La Bajada escarpment. The Triassic Chinle formation is predominantly a continental deposit. The rest of the formations which represent the Mesozoic era indicate repeated advance and retreat of the seas. Most of the sequence is continental except for a few thin beds of limestone and a thick unit of gypsum in the Todilto formation.

At the end of the Mesozoic era or early in the Cenozoic era (Tertiary) an uplift occurred in the vicinity of the present Sangre de Cristo Mountains. This uplift became a source of detritus for the clastic Galisteo formation. In mid-Tertiary time a series of intrusions and extrusions of igneous rock occurred. These igneous rocks penetrated and deformed the sedimentary rocks; however, they were mainly emplaced in the relatively soft Mancos shale. Intrusions of monzonite formed the Cerrillos Hills and outliers, Cerro Seguro, and other similar remnants, such as, Las Tetillitas and Cerro de la Cruz. The intrusive igneous masses which form the main body of these features are mapped as a single unit of porphyritic monzonite. The associated extrusive or volcanic and pyroclastic rocks have been mapped as the Espinaso formation. The Espinaso formation is mainly breccia and tuff which occasionally contains flows.

In late Tertiary time the Cieneguilla limburgite formed flows, plugs, tuffs, and breccias which lie unconformably on the Espinaso volcanics.

In late Tertiary and Quaternary time the Santa Fe group was deposited. In this strip it contains five members which differ in derivation and lithology. The member formations are: (1) Abiquiu (?) formation, (2) Santa Fe formation, (3) Ancha formation, (4) Quaternary terrace gravel, and (5) Cuerbio basalt.

Downfaulting of the Rio Grande depression occurred subsequent to the deposition of the Abiquiu (?) formation and the surface was eroded. The Ancha formation was then deposited on this surface. The Cuerbio basalt flows occurred contemporaneously with the deposition of the Ancha formation. At places the basalt is interbedded with the upper part of the Ancha formation and at other places it overlies the Ancha formation.

The areal distribution of formations and their members is shown on Soils and Geology Map 25-15. Their succession and character are given under the section termed "Stratigraphy."

Soils:

Alluvium (Qal): Recent alluvium occurs along all the main drainages and their tributaries. Heterogeneous layers of silt, sand, clay, and gravel occur in the banks and channels of the main streams. The channel alluvium is mainly gravelly sand (A-1-b). In the La Cienega area Cienega Creek has formed a flood plain and a moist green valley. The creek has cut through as much as 15 feet of its alluvial fill. Galisteo Creek has cut through 10 feet of its alluvial fill.

The Recent alluvium along the base of La Bajada escarpment is discontinuous and heterogeneous. It is derived from the various rocks exposed in the escarpment and is mapped as Santa Fe formation. The alluvium contains gypsum derived from the Todilto formation.

Flood plain deposits (Qfp): The Rio Grande forms a broad flood plain, a part of which is mapped near Santo Domingo Pueblo. The deposit is alternating layers of silty sand (A-2-4) and silty soil (A-4). The flood plain of Cienega Creek is similar but much less extensive.

The following soils are mostly residual:

Cuerbio basalt (Qb): The Cuerbio basalt is covered by a silty soil (A-4) in the area where Interstate Route 25 crosses it; however, north of the Santa Fe River Canyon the basalt is covered by clay soil (A-6). Contamination by debris derived from the cinder cone which rises above the basalt south of the Santa Fe River Canyon is probably the reason for the difference in classification of these soils.

Ancha formation (Qsfa): In the eastern part of the strip the Ancha formation is covered by silty soil (A-4); however, near the monzonite intrusives of the Cerrillos Hills it becomes more clayey.

Santa Fe formation (QTsf): The Santa Fe formation underlies an old erosion surface which slopes gently westward. The surface is dissected, but where remnants of the surface remain it is covered by silty sand (A-2-4). The soils will vary locally because of the heterogeneous nature of the formation.

Mancos shale (Km): The broad valley formed in the Mancos shale east of the La Bajada escarpment is covered by silty soil (A-4). Occasional sandstone ridges crop out in the valley.

Table 25-15-1 shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-15.

Ground-Water:

In the vicinity of La Cienega the bedrock floor is exposed. Water which moves westward through the Ancha formation comes to the surface as seeps and springs in the Cienega area where a ground-water barrier has been formed by the volcanic rocks. The following profile taken along the bank of one of the springs has 4.5 feet of silty soil (A-4) underlain by 5.0 feet of clay soil (A-7).

Stratigraphy:

Quaternary: Recent alluvium (Qal) - talus deposits and post-Cuerbio stream channel deposits. Accumulations containing blocks of monzonite or latite on the sides of most of the exposed intrusive masses. The alluvium consists of silt, sand, clay, and gravel along the Santa Fe River, Galisteo Creek, Cienega Creek, and other tributary drainages.
Thickness: 0 to 20+ feet.

Floodplain deposits (Qfp) - silty sand and silty soil which form the floodplains of the Rio Grande and Cienega Creek.

Santa Fe group:

Terrace deposits (Qtg) - river gravel composed of various types of rock.

Volcanic ejecta (Qv) - cinder cones and associated volcanic ejecta. Pyroclastic, angular fragments of scoria, and a few large bombs and blocks.

Cuerbio basalt (Qb) - two distinct flows of porphyritic olivine-basalt interbedded with and elsewhere overlying the upper part of the Ancha formation. The basalt is columnar jointed. There are pipe vesicles at the base of each flow and the tops are vesicular and scoriaceous. The centers are dense and dark-gray or black. Some Ancha gravel may cover this basalt.
Thickness: 20 to 100+ feet.

Ancha formation (Qsfa) - silt, sand, and angular gravel. Clastic and reworked pyroclastic material. Usually schist and granite pebbles interbedded with fine-grained clastics. Color varies from pink to tan.
Thickness: 0 to 300 feet.

Unconformity--

Quaternary-Tertiary: Santa Fe formation (QTsf) - deposits of silt, sand, clay, and gravel.

Unconformity--

Tertiary: Abiquiu (?) formation (Ta) - variously colored tuffaceous sandstone and clay with lesser amounts of limestone. It is chiefly a gray-white tuffaceous sand in this strip.
Thickness: 800 feet.

Unconformity--

Tertiary continued... Cieneguilla volcanics (Tc) - flows, dikes, and plugs of dense, dark-gray limburgite which weathers brown.
Thickness: 25 to 730 feet.

Unconformity--

Espinaso volcanics (Te) - mostly latitic tuffs, tuff-breccias, and flows. At the type locality along Arroyo Pinovetito, 11 miles southwest of Cerrillos, it is 1,450 feet of water-laid tuff, tuff-breccia, and volcanic conglomerate.
Thickness: 1,450 to 2,000 feet.

Intrusive rocks (Tm) - porphyritic hornblende monzonite, porphyritic hornblende-augite monzonite, porphyritic hornblende-augite latite, and porphyritic augite-biotite monzonite. Most of the monzonite is dense and medium-gray.

Unconformity--

Galisteo formation (Tg) - about two-thirds sandstone and conglomerate, and about one-third clay. The sandstone beds are gray, white, buff, yellow, brown, pink, or red. They may be fine- to coarse-grained and cross-bedded. The clays are vivid reds, purples, and greens; brown and gray clays are also present.
Thickness: 1,200 to 3,000 feet.

Unconformity--

Cretaceous: Upper Cretaceous (Ku) - a wedge of shale, mudstone, and siltstone crops out near La Cienega.

Mancos shale (Km) - mainly gray and olive-drab shale. Interbedded sandstones are buff and brown and cross-bedded. The Tres Hermanos sandstone member is buff, thin-bedded, and cemented by silica. The Greenhorn limestone member is brown, thin-bedded, and has shale partings.
Thickness: 2,350 feet.

Dakota (?) formation (Kd) - hard, gray, cross-bedded sandstone with minor amounts of shale.
Thickness: 50 to 100 feet.

Unconformity--

Jurassic: Morrison formation (Jm) - variegated sandstone and shale.
Thickness: 850 feet.

Todilto formation (Jt) - gypsum and limestone with minor amounts of black shale.
Thickness: 86 feet.

Wingate sandstone (Jw) - the upper unit is cream-colored, massive and cross-bedded sandstone. The lower unit is a pink, massive and cross-bedded sandstone.

Unconformity--

Stratigraphy continued...

Triassic: Chinle formation (Trc) - sandstone, sandy shale, and shale, red-brown and variegated. Flat-pebble limestone conglomerate beds are present.
Thickness: 400+ feet.

Construction Materials:

Quaternary: Alluvium (Qal) - The alluvium in the Galisteo Creek channel may be suitable for fine aggregate to improve grading of quarry rock. It is sand and gravel (A-1-a and A-1-b) interbedded with silt and fine-grained sand. Tests run on samples taken from the channel average 71 percent passing the No. 4 sieve, 60 percent passing the No. 10 sieve, and 37 percent passing the No. 40 sieve, and 5 percent passing the No. 200 sieve.

Northeast of Cieneguilla in the Santa Fe River channel, the alluvium has a gradation similar to that of Galisteo Creek and may also be suitable for fine aggregate.

Terrace deposits [Qtg(1)] - An extensive deposit of axial river gravel occurs south of Santo Domingo Pueblo and Domingo. Laboratory tests run on Prospect 25-15-1 taken 2.7 miles northwest of Interstate Route 25 show it to be sandy, non-plastic gravel covered by one foot of silty sand. After crushing to 1-inch, 38 percent passed the No. 4 sieve, and 5 percent passed the No. 200 sieve. The gravel is from 12 to 15 feet thick where exposed and has an L.A. Wear of 24.8.

Cuerbio basalt (Qb) - This dense, dark-gray rock may be suitable for quarry rock. Most of the flow is covered by residual soil several feet thick; however, it may be quarried along the edge of the flow. There are two flows each about 20 feet thick. "A zone of pipe vesicles occurs at the base of each flow. Flow tops are highly vesicular and scoriaceous. The center zone of each flow is dense, dark gray or black, and contains few vesicles." (Disbrow and Stoll, 1957). Laboratory tests run on Prospect 25-15-7 showed 28 percent passing the No. 4 sieve, 3 percent passing the No. 200 sieve, and an L.A. Wear of 15.6. It is sandy and non-plastic. This material is easily accessible and may be suitable for surfacing.

Ancha formation (Qsfa) - The Ancha formation forms a series of gravel terraces [Qtg(2)] northest of Interstate Route 25. The terraces nearest the highway are now being used as maintenance pits. Farther to the northwest, between Interstate Route 25 and the Santa Fe River, lie more terraces of the Ancha formation. They have been dissected by the Santa Fe River, Cienega Creek and their tributaries. The highest levels of all these terraces may produce suitable materials for highway construction. They are covered by about one foot of silty sand and gravel.

Quaternary-Tertiary: Santa Fe formation (Qtsf) - The gravel in the Santa Fe formation is heterogeneous and discontinuous. Gravel lenses are exposed along the south bank of Galisteo Creek near Interstate Route 25.

Prospect 25-15-2 lies in a gravel terrace of the Santa Fe formation. It is about 30 feet thick and is underlain by Chinle shale. Laboratory tests show 70 percent passing the No. 4 sieve, 6 percent passing the No. 200 sieve, and it is non-plastic. It is about 2.5 miles from Interstate Route 25 and a haul road will have to be built to the site.

Southeast on State Road 22 to its junction with State Road 10, dissection has exposed terrace gravel deposits. The most favorable terraces of the Santa Fe formation lie in this part of the strip. Sample 28 was taken at Prospect 25-15-4 where the gravel is about 30 feet thick. Laboratory tests of the upper 15 feet show 19 percent passing the No. 4 sieve, 2 percent passing the No. 200 sieve, a P.I. of 7, and an L.A. Wear of 18.4. Laboratory tests run on the lower 15 feet were very similar, 20 percent passed the No. 4 sieve, 5 percent passed the No. 200 sieve, a P.I. of 7, and an L.A. Wear of 17.6. This gravel is five miles from Interstate Route 25 and is easily accessible by trail road.

Tertiary: Cieneguilla volcanics (Tc) - This material covers a large area northeast of La Cienega. There are several flows of dense, dark-gray amygdaloidal limburgite (resembles basalt). The material may be suitable for quarry rock. Prospect 25-15-10 is located about 2.5 miles from Interstate Route 25 and is easily accessible by road.

Monzonite (Tm) - The monzonite of the Cerrillos Hills may be suitable for quarry aggregate. Where the monzonite is not mineralized, it is a dense, medium-gray rock. A sample taken at Prospect 25-15-3, at Middle Hill, was crushed to 1-inch. The laboratory tests show 15 percent passing the No. 4 sieve, and one percent passing the No. 200 sieve. It has an L.A. Wear of 18.8 and is non-plastic. Middle Hill is about 4 miles from Interstate Route 25 and there is a graded dirt road to the site. There is no road to Prospect 25-15-6 and it is accessible only with difficulty.

There is an extensive deposit of monzonite north of La Cienega at Cerro Seguro. A sample taken at Prospect 25-15-11 was crushed to one-inch and the tests showed 19 percent passing the No. 4 sieve and 3 percent passing the No. 200 sieve. It is non-plastic and has an L.A. Wear of 22.4. This deposit is easily accessible by road. The material may be suitable for quarry rock.

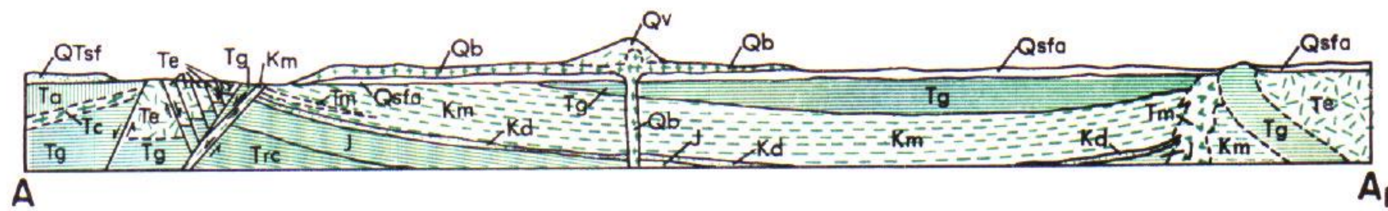
Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-15. Test data and other related information are shown in Material Pit Summary Table 25-15-2.

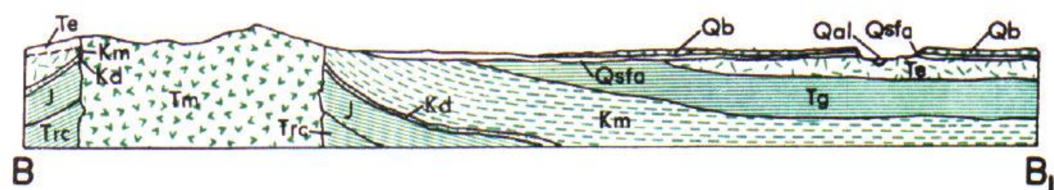
Selected References:

Disbrow, Alan E. and Stoll, Walter C., 1957, Geology of the Cerrillos Area, Santa Fe County, New Mexico, New Mexico State Bureau of Mines and Mineral Resources, Bull. 48, pp. 1-73.

Sun, Ming-Shan and Baldwin, Brewster, 1958, Volcanic Rocks of the Cienega Area, Santa Fe County, New Mexico, New Mexico State Bureau of Mines and Mineral Resources, Bull. 54, pp. 1-80.

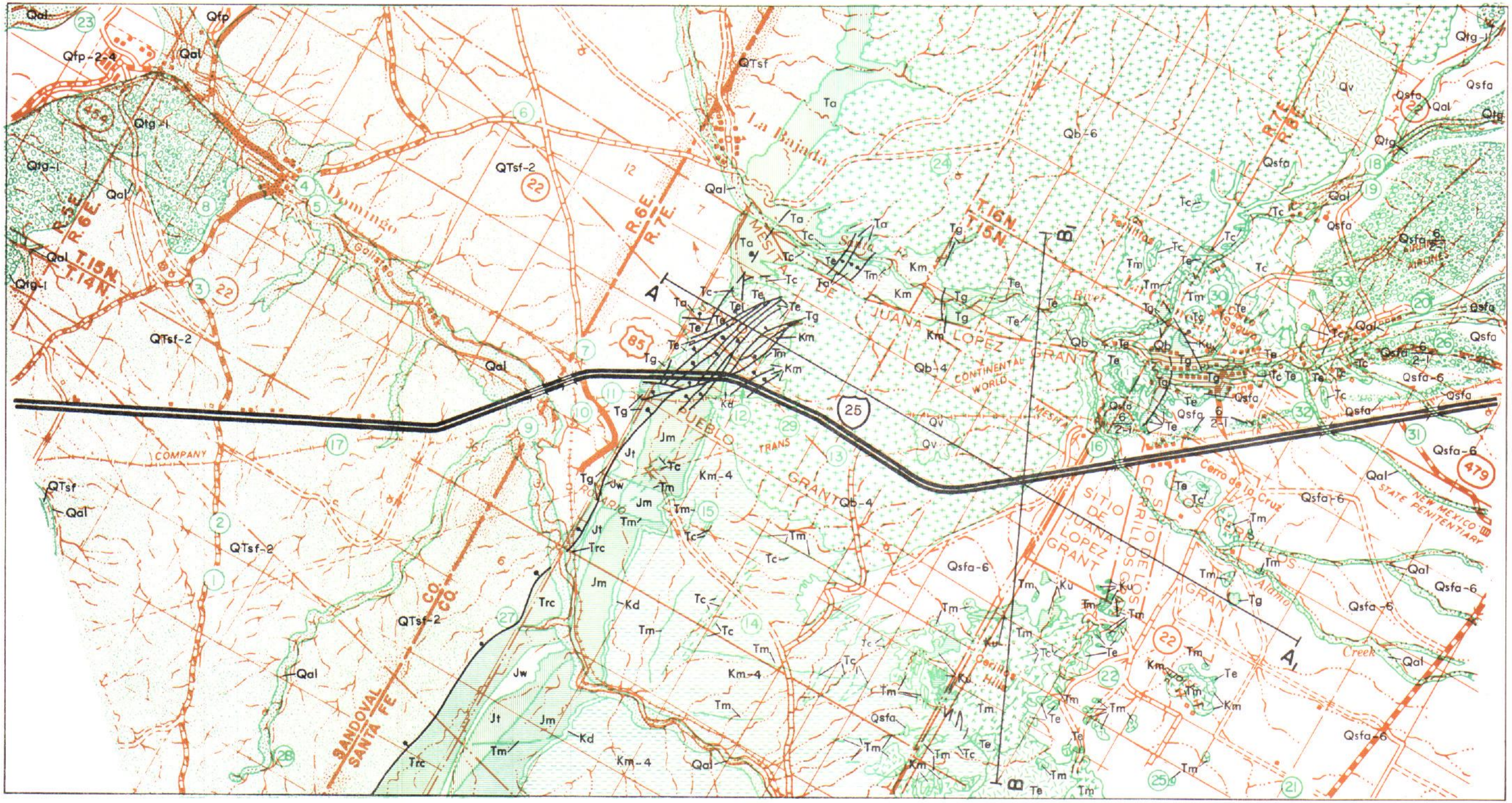
GENERALIZED CROSS-SECTIONS





Note: For explanation of symbols see Soils and Geology map 25-15

SOILS AND GEOLOGY MAP 25-15



GEOLOGY MAPPED 1963

-LEGEND-

SEDIMENTARY ROCKS

Qal	Alluvium	QUATERNARY
Qfp	Flood-plain deposits	QUATERNARY
Qtg	Terrace gravels	QUATERNARY
Qsfa	Ancha formation	QUATERNARY (Santa Fe group)
QTsf	Santa Fe formation	QUATERNARY, TERTIARY (Santa Fe group)
Ta	Abiquiu (?) formation	TERTIARY (Santa Fe group)
Tg	Galisteo formation	TERTIARY
Ku	Cretaceous undifferentiated	CRETACEOUS
Km	Mancos shale	CRETACEOUS
Kd	Dakota(?) formation	CRETACEOUS
J	Jurassic undifferentiated	JURASSIC
Jm	Morrison formation	JURASSIC
Jt	Todilto limestone and gypsum	JURASSIC
Jw	Wingate sandstone	JURASSIC
Trc	Chinle formation	TRIASSIC

IGNEOUS ROCKS

Qb	Cuerbio basalt	QUATERNARY (Santa Fe group)
Qv	Volcanic ejecta	QUATERNARY (Santa Fe group)
Tc	Cienegullia volcanics	TERTIARY
Te	Espinaso volcanics undifferentiated	TERTIARY
Tm	Monzonite, Syenite etc. undifferentiated	TERTIARY

STATUTE MILES

SOILS AND GEOLOGY

Soils Summary:

Table 25-15-1

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
QTsf	1	A	0.0	1.5	A-2-4	Silty sand
"		B	1.5	3.0	A-2-4	Silty sand and gravel
"		C	3.0	4.5	A-4	Silt
"	2	A	0.0	1.7	A-2-4	Silty sand
"		B	1.7	3.7	A-4	Silt
"	3	A	0.0	3.0	A-4	"
"		B	3.0	6.0	A-2-4	Silty sand
"		C	6.0	9.0	A-1-b	Coarse sand
"		D	9.0	10.0	A-3	Fine-grained sand
"		E	10.0	13.0	A-4	Silt
"		F	13.0	19.0	A-2-4	Silty sand
"		G	19.0	21.0	A-1-a	Gravel and sand
"		H	21.0	23.0	A-2-4	Silty sand
"		I	23.0	25.0	A-7	Clay
"		J	25.0	27.0	A-2-4	Silty sand
Qal	4	A	0.0	4.0	A-4	Silt
"		B	4.0	8.0	A-4	"
"		C	8.0	12.0	A-7	Clay
"		D	12.0	16.0	A-7	"
"	5	A	0.0	2.0	A-1-b	Gravelly sand
QTsf	6	A	0.0	3.0	A-6	Clay
"		B	3.0	3.8	A-6	"
"	7	A	0.0	2.0	A-2-4	Silty sand
"		B	2.0	4.0	A-4	Silt
"		C	4.0	6.0	A-6	Clay
"		D	6.0	9.0	A-4	Silt
"		E	9.0	12.0	A-1-b	Gravelly sand
"		F	12.0	16.0	A-6	Clay
"		G	16.0	18.0	A-7	"
"		H	18.0	20.0	A-6	"
"		I	20.0	24.0	A-7	"
Qtg	8	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	12.0	A-1-a	Gravel
"		C	12.0	15.0	A-1-a	"
"		D	15.0	18.0	A-4	Silt
"		E	18.0	20.0	A-7	Clay
Qal	9	A	0.0	2.0	A-4	Silt
"		B	2.0	7.0	A-1-b	Gravelly sand
"		C	7.0	10.0	A-2-4	Silty sand
"		D	10.0	13.0	A-1-b	Gravelly sand
"		E	13.0	14.5	A-4	Silt
"		F	14.5	17.0	A-7	Clay

Table 25-15-1 continued...

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Qal	10	A	0.0	10.0	A-2-4	Silty sand
Tg	11	A	0.0	6.0	A-4	Shale
Km	12	A	0.0	3.0	A-7	Mudstone
Qb	13	A	0.0	1.5	A-4	Silty soil
Km	14	A	0.0	4.0	A-4	Silt
"		B	4.0	6.0	A-4	"
"		C	6.0	10.0	A-4	"
"	15	A	0.0	5.0	A-4	"
"		B	5.0	7.5	Bedrock	Limestone
"		C	7.5	8.5	"	Shale
"		D	8.5	9.0	"	Calcareous shale
"		E	9.0	10.0	"	Shale
"		F	10.0	---	"	Limestone
Qal	16	A	0.0	1.5	A-4	Silt
"		B	1.5	4.5	A-4	"
"		C	4.5	9.5	A-7	Clay
QTsf	17	A	0.0	1.0	A-6	"
"		B	1.0	4.0	A-1-b	Coarse-grained sand
"		C	4.0	14.0	A-1-b	" " "
"		D	14.0	16.0	A-1-b	" " "
Qal	18	A	0.0	1.5	A-2-4	Silty sand
"		B	1.5	4.5	A-1-a	Pebbly sand
"		C	4.5	7.5	A-1-b	Gravelly sand
"		D	7.5	11.5	A-1-a	Sand and gravel
"	19	A	0.0	1.5	A-1-b	" " "
"	20	A	0.0	4.0	A-4	Silt
"		B	4.0	9.0	A-6	Clay
"		C	9.0	11.0	A-6	"
"		D	11.0	16.0	A-4	Silt
Qsfa	21	A	0.0	1.5	A-4	Silt
"		B	1.5	4.0	A-4	"
"	22	A	0.0	1.5	A-6	Clay
"		B	1.5	4.5	A-4	Silt
Qfp	23	A	0.0	1.5	A-2-4	Silty sand
"		B	1.5	2.0	A-4	Silt
"		C	2.0	4.5	A-2-4	Silty sand
"		D	4.5	5.0	A-4	Silt
Qb	24	A	0.0	1.8	A-6	Clay
"		B	1.8	4.2	A-6	"
"		C	4.2	5.0	A-7	"

Soils Summary continued...

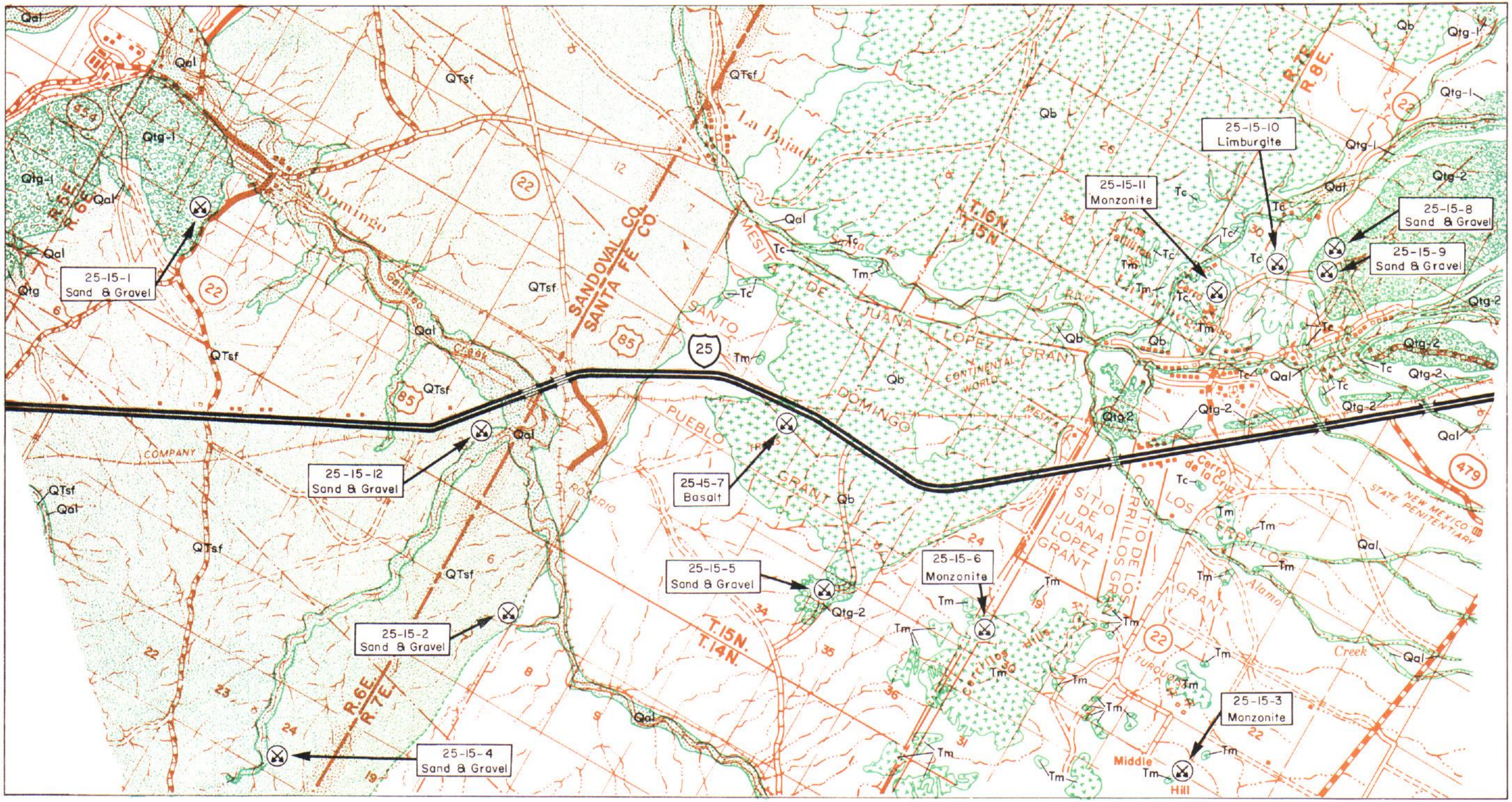
Table 25-15-I continued...

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Tm*	25	A	---	---	A-1-a	Monzonite
Qsfa	26	A	0.0	0.8	A-2-7	Clayey sand
"		B	0.8	3.3	A-2-6	Clayey gravel
"		C	3.3	---	A-2-6	" "
QTsf	27	A	0.0	2.0	A-1-a	Sand and gravel
"		B	2.0	15.0	A-1-b	" " "
"		C	15.0	30.0	A-1-a	" " "
Trc		D	30.0	---	A-4	Shale
QTsf	28	A	0.0	15.0	A-2-4	Sand and gravel
"		B	15.0	30.0	A-2-4	" " "
Qb*	29	A	0.0	5.0	Bedrock	Basalt
Tm*	30	A	---	---	A-1-a	Monzonite

*NOTE: Samples 25, 29, and 30 are bedrock or talus samples.

Qsfa	31	A	0.0	1.5	A-6	Clay
"		B	1.5	3.0	A-6	"
"	32	A	0.0	3.0	A-7	"
"		B	3.0	5.0	A-6	"
"		C	5.0	6.5	A-4	Silt
"	33	A	0.0	1.0	A-7	Gravelly clay
"		B	1.0	---	---	Gravel

CONSTRUCTION MATERIALS MAP 25-15



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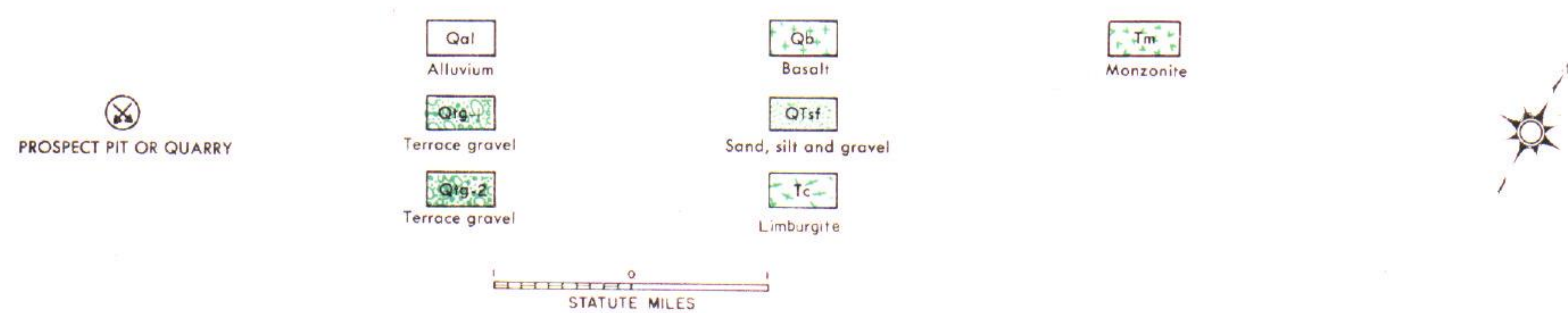


CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-15-2

Pit or Prospect No.		25-15-1 (Prospect)	25-15-2 (Prospect)	25-15-3 (Prospect)	25-15-4 (Prospect)	25-15-5 (Prospect)	25-15-6 (Prospect)
Location	Section	29	SE 1/4, sec. 6	SE 1/4, sec. 28	24	26, 27, 34, and 35	30
	Twnshp. & Range	T 15 N, R 6 E	T 14 N, R 7 E	T 15 N, R 8 E	T 14 N, R 6 E	T 15 N, R 7 E	T 15 N, R 8 E
	County	Sandoval	Santa Fe	Santa Fe	Sandoval	Santa Fe	Santa Fe
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Private	Private	Private
Geologic Age		Quaternary	Quaternary-Tertiary	Tertiary	Quaternary-Tertiary	Quaternary	Tertiary
Formation		Terrace gravels	Santa Fe	Monzonite	Santa Fe	Ancha	Monzonite
Type of Pit		Gravel	Gravel	Quarry	Sand & gravel	Sand and gravel	Quarry
Kind of Material		Various	Various	Monzonite	Various (abundant monzonite)	Various	Monzonite
Quality of Material		Good	Good	Excellent	-		Good
Thickness of Material		1.0 to 15.0 feet	20 feet	-	15 feet	?	?
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	?	-	-	?
Uniformity		Good	Good	Good	Good	-	Good
Impurities		None	?	None	Silt and clay	-	?
Type of Mat'l. Underlying Formation		Silt	Siltstone	-	Sand, clay, and gravel	Mancos shale	-
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Scattered juniper	Grass	Juniper & grasses	Scattered juniper	Scattered juniper	Juniper
Local Terrain		Terraces	Terrace	Hilly	Terrace	Terrace	Mountainous
Depth of Overburden		0.0 to 1.0 feet	0.0 to 2.0 feet	-	Trace	None	0.0 to 6.0 inches
P.I. (Overburden)		9	2	-	-	-	-
Est. Reserve Quantity		-	-	-	500,000 cu. yds.	-	Unlimited
Approx. Haul to Nearest Point		2.7 miles to I-25	2.5 miles to I-25	4.0 miles to I-25	5.1 miles to I-25	1.75 miles to I-25	1.5 miles
L.A. Wear		24.8	-	18.8	18.4	-	14.8
Maximum Size		-	-	-	6"	6"	-
% Retained on 2" Sieve		-	8	-	50	-	-
	Crushed to	1"	-	1"	-	-	1"
	2"	-	92	-	50	-	-
Pit	1"	100	87	100	38	-	100
Average	3/4"	95	85	81	34	-	87
% Passing	1/2"	70	82	43	29	-	47
	#4	38	70	15	19	-	17
	#10	28	56	8	14	-	9
	#200	5	6	1	2	-	2
P.I.		N.P.	N.P.	N.P.	7	-	N.P.
Lab. Numbers		62-1803	62-4663 - 4666	62-4659	62-14173 - 14174	-	64-39

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-15-2 continued...

Pit or Prospect No.		25-15-7 (Prospect)	25-15-8 (Prospect) 53-69-S	25-15-9 (Prospect) 53-70-S	25-15-10 (Prospect)	25-15-11 (Prospect)	25-15-12
	Section	21	29	29	29 and 30	31	36
	Twnshp.	T 15 N	T 16 N	T 16 N	T 16 N	T 16 N	T 15 N
Location	& Range	R 7 E	R 8 E	R 8 E	R 8 E	R 8 E	R 6 E
	County	Santa Fe	Santa Fe	Santa Fe	Santa Fe	Santa Fe	Sandoval
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Government	Private	Private	Indian Land
Geologic Age		Quaternary	Quaternary	Quaternary	Tertiary	Tertiary	Quaternary
Formation		Basalt	Ancha	Ancha	Cienequilla volcanics	Monzonite	Santa Fe
Type of Pit		Quarry	Gravel	Gravel	Quarry	Quarry	Fine aggregate
Kind of Material		Basalt	Sand and gravel	Sand and gravel	Limburgite	Monzonite	Mixed aggregate
Quality of Material		Good	Fair	Fair	Good	-	Fair
Thickness of Material		20 feet	?	?	20 to 25+ feet	-	12 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		?	-	-	?	-	-
Uniformity		Good	-	-	Good	-	Poor
Impurities		-	Silt	Silt	None	-	Silt
Type of Mat'l. Underlying Formation		Silt, sand, and gravel	Silt ?	Silt ?	?	?	Clay
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Sparse	Grass	Grass	Sparse juniper	Sparse juniper	Grass
Local Terrain		Lava flow	Terrace	Terrace	Mountainous	Mountainous	Terrace
Depth of Overburden		0 to 5 feet	?	?	None	None	2 to 6 feet
P.I. (Overburden)		-	-	-	-	-	3 to 8
Est. Reserve Quantity		Unlimited	-	-	Unlimited	Unlimited	?
Approx. Haul to Nearest Point		On I-25	3.0 miles to I-25	3.0 miles to I-25	2.0 miles	2.0 miles	0.5 mile
L.A. Wear		15.6	34	38	8.8	22.4	26.8
Maximum Size		-	-	-	-	-	2"
% Retained on 2" Sieve		-	-	-	-	-	Less than 5
	Crushed to	1"	-	-	1"	1"	3/4
	2"	-	-	-	-	-	-
Pit	1"	100	-	-	100	100	-
Average	3/4"	97	-	-	88	79	100
% Passing	1/2"	68	-	-	47	42	88
	#4	28	-	-	16	19	67
	#10	16	-	-	7	11	19
	#200	3	-	-	1	3	3
P.I.		N.P.	-	-	N.P.	N.P.	N.P.
Lab. Numbers		62-14175	-	-	64-38	62-15940	-

SOILS AND GEOLOGY

Introduction:

Strip 25-16 lies in Santa Fe County, New Mexico. It begins 1.5 miles southwest of the junction of Interstate Route 25 and State Road 10, and ends 2.0 miles southeast of the entrance to Seton Village.

The most outstanding feature in the strip is the Sangre de Cristo Range. West of the range lies a broad pediment that slopes gently westward.

General Geology:

This strip lies on the east side of the Rio Grande trough, a regional depression formed in late Cenozoic time.

The oldest rocks in the area form the high peaks and foothills of the Sangre de Cristo Range. They are Precambrian granite, schist, and gneiss. This complex of intrusive igneous rocks covers one-half of the strip.

Paleozoic late Mississippian and Pennsylvanian sedimentary rocks are exposed northeast of Santa Fe in the foothills of the Sangre de Cristo Range. They are mapped as Magdalena group and consist of alternating beds of limestone, sandstone, and shale. They lie unconformably on the Precambrian surface and, at places, are badly fractured by tectonic movements.

West of the Sangre de Cristo Range lies a broad plain that slopes gently toward the Rio Grande. It is a piedmont slope and can be divided into three physiographic units: (1) the Divide surface north of the Santa Fe River; (2) the Airport surface near the Santa Fe Airport and south to Arroyo Hondo, and (3) the Plains surface which extends south and southeast of Arroyo Hondo. The Divide surface has been formed on the Tesuque formation and is characterized by pinnate drainage. The Airport surface is more complex. "North of Arroyo Hondo is a partly dissected shallow valley about 3 miles wide. Remnants of the valley floor form the Airport surface and the Santa Fe River and its terraces form an inner valley on the north side. The Plains surface is a smooth rolling plain that slopes southwest and is dissected by widely spaced, broad valleys that drain to the Santa Fe River or Galisteo Creek." (Spiegel and Baldwin, 1958, p. 26).

The piedmont slope is composed of debris derived from the Sangre de Cristo Range. "Underneath the recent fanglomerates and pediment gravels there are strata that are assigned to the Santa Fe group of Miocene and Pliocene age. These consist of buff to tan and brown siltstone in this area and appear to be several thousand feet thick. Locally patches of volcanic tuff occur beneath the Santa Fe group. This tuff may be equivalent to the Espinaso formation (see Strip 25-15) of Oligocene age." (Panhandle Geological Society, 1959).

There are two exposures of the Tertiary volcanic tuff (Tu): (1) in Arroyo Hondo and (2) just north of Arroyo Hondo. These rocks lie unconformably on Precambrian granite. The sequence includes siltstones, conglomerate, some shale, and andesitic flows and interbedded pyroclastics. The rocks are usually deep red-brown or red.

The Tesuque formation which is a member of the Santa Fe group lies with angular unconformity on the Tertiary rocks undivided. It was deposited in mid-Miocene and consists of thousands of feet of pinkish tan, soft, arkosic silty sandstone and minor conglomerates and silts. At the base there may be 50 to 530 feet of tuffaceous and other volcanic sediments and thin flows of olivine basalt. The greater part of the formation was derived from the Sangre de Cristo Range and laid down by streams. Later faulting and tilting of the formation occurred and it was beveled to a plain. (Spiegel and Baldwin, 1958, p. 9).

The Ancha formation, a member of the Santa Fe group, lies with angular unconformity on the Tesuque formation. It was deposited after rejuvenation of the Sangre de Cristo Range and forms the broad piedmont slope. "It lies on the west sloping Pliocene erosion surface that bevels beds of the Tesuque formation. It is late Pliocene or early Pleistocene and is from 100 to 300 feet thick." (Spiegel and Baldwin, 1958, p. 10). The formation is poorly-bedded and is characteristically red in its upper part.

Four terraces have formed along the Santa Fe River and its larger tributaries. The total thickness of the terraces is from zero to about 60 feet. They are well developed and have been mapped as a single unit (Qt).

The areal distribution of formations and their members is shown on Soils and Geology Map 25-16. Their succession and character are given under the section termed "Stratigraphy."

Soils:

The soils in this strip include: Quaternary alluvium; residual soils of the Santa Fe group; and residual soils of the Paleozoic and Precambrian rocks.

Alluvium (Qal): Alluvium occurs in the main streams and arroyos which drain westward and eventually into the Rio Grande. The alluvium is composed of sand, silt, and gravel. The most extensive alluvial deposit occurs in the Santa Fe River channel.

Terrace deposits (Qt): There are well developed terraces along the Santa Fe River. Terrace deposits also occur along Arroyo de los Chamisos and Arroyo Hondo. There are three terrace levels mapped as a single unit: (1) a low terrace; (2) a middle terrace; (3) a high terrace. There is a fourth terrace level five feet above the Santa Fe River channel which has been mapped with the alluvium. The terraces parallel the courses of the present drainages. The lower terrace is discontinuous since it has been removed in places by recent erosion. The middle terrace is almost a mile wide and is the most extensive. The high terrace occurs only in the mountains and foothills and is also discontinuous due to removal by erosion. The lower terrace is 10 to 15 feet above the river; the middle terrace is 20 to 30 feet above the river, and the high terrace is 45 to 60 feet above the river.

The terrace deposits are non-uniform. Samples indicate that the terrace cover is from one to four feet thick and is usually silty to clayey sand (A-2-4 to A-2-6) or silt (A-4). The cover is underlain by 6 or 7 feet of sand and gravel (A-1-a and A-1-b). Along the Santa Fe River bank sections of terrace deposits are exposed in contact with the Tesuque formation. In Arroyo de los Chamisos the terrace is 20 to 40 feet above the arroyo channel. In the Arroyo Hondo canyon the terrace deposit lies on the complex Precambrian basement rock and is from 40 to 65 feet above the arroyo channel. This gravel is angular and contains a large amount of feldspar.

Soils continued....

Ancha formation (Qsfa): The Ancha formation covers about 30 percent of the strip. It is variable and no definite profile exists in the deposit. The surface soil may be silt (A-4), clayey sand and gravel (A-2-6) or clay (A-6). Hole 2 had 9.5 feet of clay overlying 5 feet of sand and gravel (A-l-b). Hole 3 had 2.5 feet of clay (A-6) overlying 4.0 feet of silt (A-4) overlying 2.0 feet of coarse-grained sand and gravel (A-l-b). There is probably a fairly thick deposit of gravel under the Airport surface. The deposit is clay (A-6) overlying sand and gravel (A-l-a and A-l-b).

Tesuque formation (Tt): There is no soil profile developed in the Tesuque formation. The surface soil varies from coarse-grained clayey sand to silty sand (A-2-4). At places it is covered by a thin veneer of gravel, and, at other places, there may be 5 to 10 feet of gravel underlying the surface (Spiegel and Baldwin, 1958, p. 92). The surface soil is of variable thickness.

Residual soils: No samples were taken of the residual soils lying on the Magdalena group (Pm). Residual soils lying on the granite are silt (A-4) to clay (A-7) mixed with weathered granite rock (see Holes 8 and 9).

Table 25-16-l shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-16.

Stratigraphy:

Quaternary: Alluvium (Qal) - sand, silt, clay, and gravel in the main streams and arroyos.

Terrace deposits (Qt) - silt, sand, and gravel deposits which parallel the major drainages.
Thickness: 0 to 45+ feet.

Santa Fe group:
Ancha formation (Qsfa) - silt, sand, and gravel. Clastic and reworked pyroclastic material. Usually schist and granite pebbles interbedded with fine-grained clastics. Color varies from pink to tan.
Thickness: 0 to 300 feet.

Unconformity--

Tertiary: Tesuque formation (Tt) - principally a pinkish-tan silty sandstone. Locally contains olivine basalt flows and volcanic sediments.

Sedimentary and volcanic rocks undifferentiated (Tu) - a sequence which rests unconformably on Precambrian rocks. Mainly in Arroyo Hondo.
Thickness: 580 feet.

Unconformity--

Pennsylvanian & Mississippian: Magdalena group (Pm) - Includes the Madera limestone and Sandia formations. The Madera limestone is dark- to medium-gray and massive in the lower part; the upper part is arkosic limestone with shale interbeds. The underlying Sandia formation contains siltstone, sandstone, and limestone.

Unconformity--

Precambrian: Granite (P€) - predominantly red granite although there are bodies of schist, quartzite, and gneiss.

Construction Materials:

Quaternary: Alluvium (Qal) - Coarse-grained sand and gravel in the Santa Fe River and the arroyo channels may be suitable for highway construction material. Most of the river alluvium has been leased commercially.

Terrace deposits (Qt) - Terrace deposits parallel the Santa Fe River, Arroyo de los Chamisos, and Arroyo Hondo. Along the river the deposit is almost a mile wide. The deposit is non-uniform and consists of interlensing sand, silt, and gravel.

Sample 20 is a good example of the terrace deposit. There are 3.0 feet of silt (A-4) overlying 7.0 feet of sand and gravel (A-l-a). The gravel is sandy and non-plastic, and has a L.A. Wear of 42.8. Twenty-two percent passed the No. 4 sieve, 14 percent passed the No. 10 sieve, and one percent passed the No. 200 sieve.

Tests run on Sample 21 reported 69 percent passing the No. 4 sieve, 54 percent passing the No. 10 sieve, and 4 percent passing the No. 200 sieve. The gravel is 6 feet thick and is sandy, non-plastic. It is overlain by one foot of silty sand (A-2-4).

Pits 59-9-S and 54-80-S are shown on the Construction Materials Inventory Map as examples of the type deposits that exist in the Santa Fe River terraces. These pits are now commercial.

Ancha formation (Qsfa) - There is probably a fairly thick deposit of gravel underlying the Airport surface. The gravel is exposed where Arroyo de los Chamisos has cut through the surface.

Tertiary: Tesuque formation (Tt) - The Tesuque formation is predominantly a silty sandstone. It is covered in places by a thin veneer of gravel, and, at other places there may be 5 to 10 feet of gravel underlying the surface (Spiegel and Baldwin, 1958, p. 92).

Pennsylvanian & Mississippian: Magdalena group (Pm) - Some of the limestone in the Magdalena group has been used for quarry rock. However, it is impure or interbedded with shale and is probably unsuitable for use as a highway construction material.

Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-16. Test data and other related information are shown in Material Pit Summary Table 25-16-2.

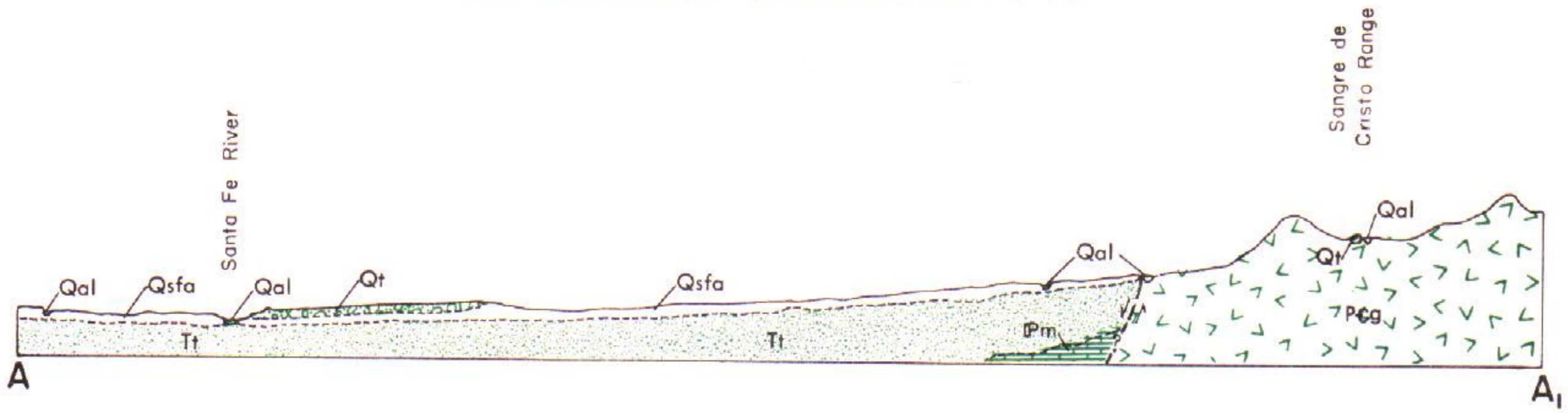
Selected References:

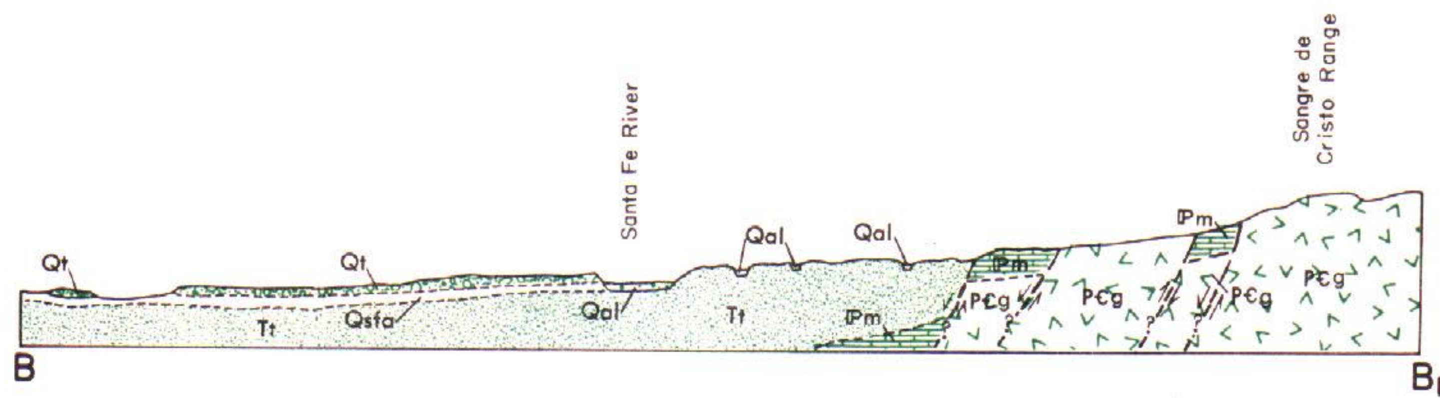
New Mexico Geological Society, 1961, Guidebook to the Albuquerque Country, 12th Field Conference.

Panhandle Geological Society, 1959, Guidebook to Northeastern New Mexico.

Spiegel, Zane and Baldwin, Brewster, 1958, Geology and Water Resources of the Santa Fe Area, New Mexico, U.S. Geol. Surv., Open File Report, 403 p.

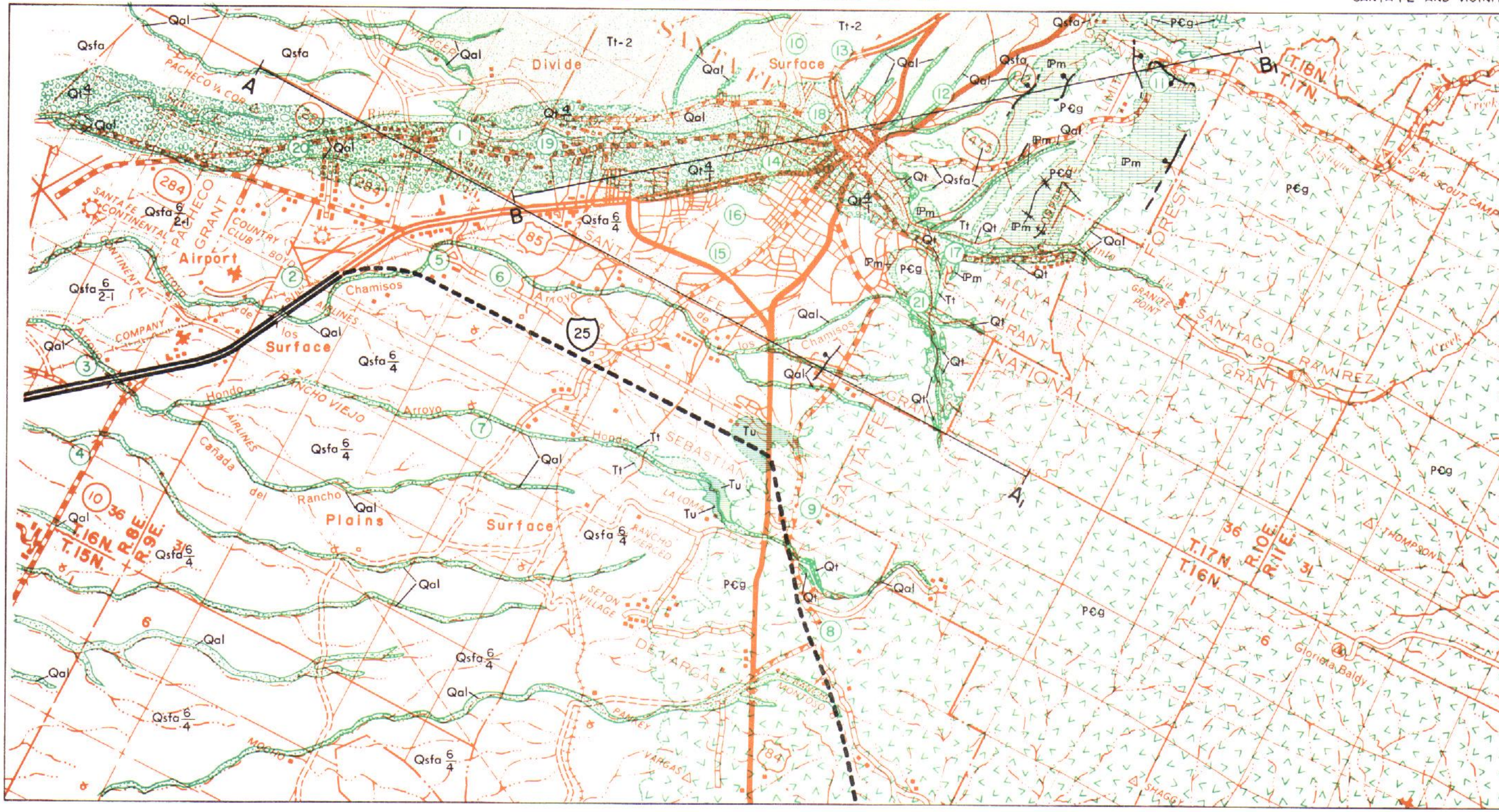
GENERALIZED CROSS-SECTIONS





Note: For explanation of symbols see Soils and Geology map 25-16

SOILS AND GEOLOGY MAP 25-16



-LEGEND-

GEOLOGY MAPPED 1963

SEDIMENTARY ROCKS

Qal	Alluvium	QUATERNARY	
Qt	Terrace deposits	QUATERNARY	
Qsfa	Ancha formation	Santa Fe group	TERTIARY
Tt	Tesuque formation	Santa Fe group	TERTIARY
Tu	Tertiary rocks undivided		TERTIARY
IPm	Magdalena group	PENNSYLVANIAN MISSISSIPPIAN	

IGNEOUS ROCKS

PC	Granite, gneiss, schist	PRECAMBRIAN

1 0 1
STATUTE MILES

SOILS AND GEOLOGY

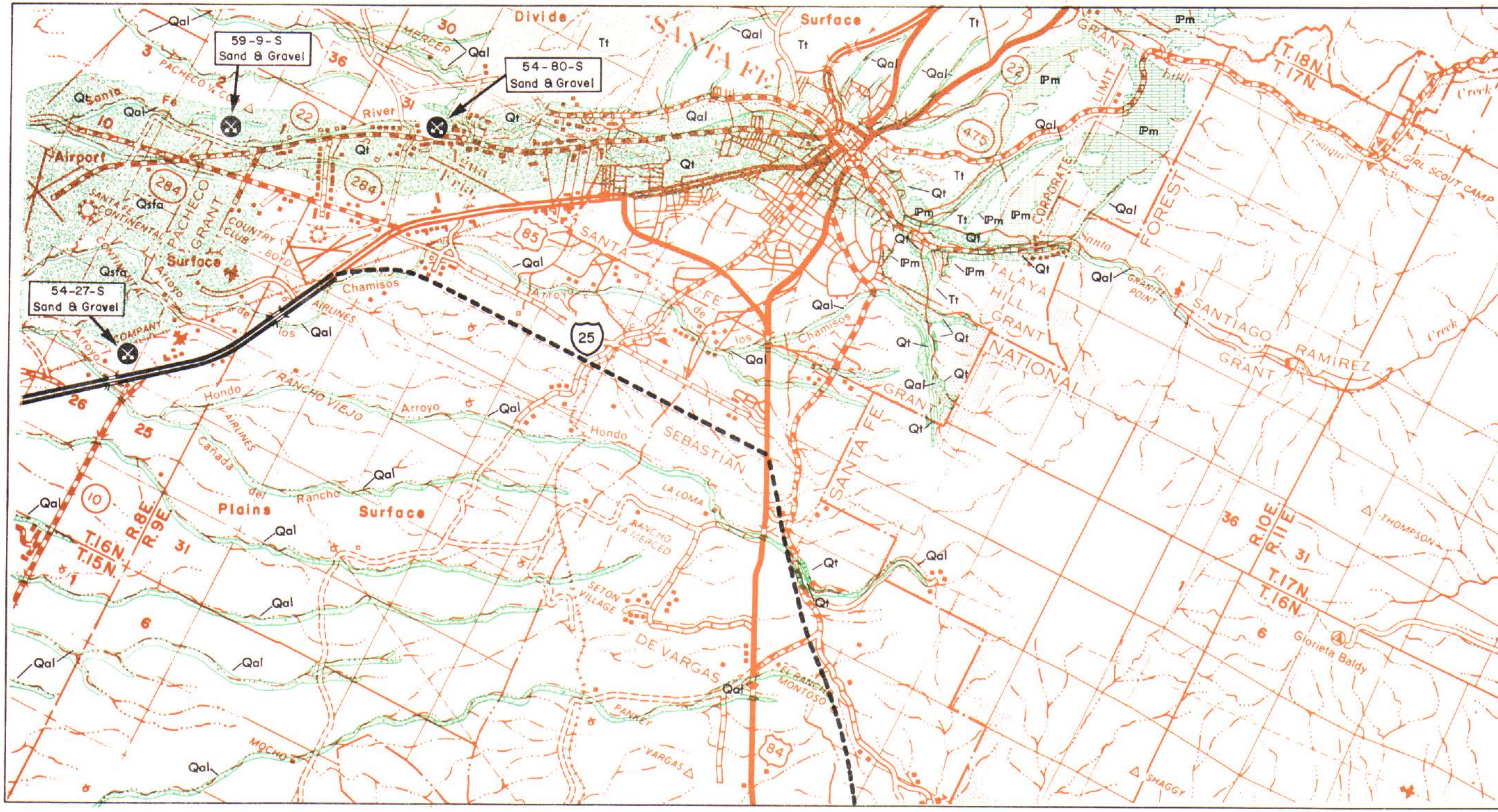
Soils Summary:

Table 25-16-1

Age and Formation	Hole No.	Lift	Depth in feet From	To	AASHO Classification	Material Type
Qal	1	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	3.5	A-2-4	Silty sand and gravel
"		C	3.5	4.5	A-2-4	Silty sand and gravel
"		D	4.5	5.5	A-2-4	" " " "
"		E	5.5	6.5	A-1-a	Sand and gravel
Qsfa	2	A	0.0	1.5	A-6	Clay
"		B	1.5	3.5	A-7	"
"		C	3.5	6.5	A-6	"
"		D	6.5	9.5	A-6	"
"		E	9.5	14.5	A-1-b	Sand and gravel
"	3	A	0.0	1.5	A-6	Clay
"		B	1.5	2.5	A-6	"
"		C	2.5	6.5	A-4	Clayey silt
"		D	6.5	8.5	A-1-b	Coarse-grained sand and gravel
Qsfa	4	A	0.0	1.5	A-4	Silt
"		B	1.5	3.0	A-6	Clay
"		C	3.0	6.0	A-4	Silt
"		D	6.0	9.0	A-7	Clay
"		E	9.0	12.0	A-6	"
Qal	5	A	0.0	5.0	A-1-b	Sand and gravel
Qsfa	6	A	0.0	1.5	A-6	Clay (calcareous)
"		B	1.5	3.0	A-4	Silt
"		C	3.0	5.0	A-4	"
"		D	5.0	7.0	A-1-a	Sand and gravel
Qal	7	A	0.0	5.0	A-1-b	Coarse-grained sand
P€g	8	A	0.0	1.0	A-4	Silt
"		B	1.0	3.5	A-6	Clay
"		C	3.5	---	Bedrock	Granite
"	9	A	0.0	1.0	A-7	Clay
"		B	1.0	3.0	A-5	Silt
Tt	10	A	0.0	1.0	A-2-6	Clayey sand
"		B	1.0	2.0	A-2-6	" "
"		C	2.0	7.0	A-1-b	Sand
IPm	11	A	0.0	3.0	A-7	Mudstone
"		B	3.0	5.0	Bedrock	Limestone
"		C	5.0	5.3	"	Shale
"		D	5.3	5.8	"	Limestone
"		E	5.8	6.0	"	Shale
"		F	6.0	9.0	"	Limestone
"		G	9.0	12.0	A-7	Mudstone
"		H	12.0	14.0	Bedrock	Limestone
"		I	14.0	24.0	"	Calcareous shale

Age and Formation	Hole No.	Lift	Depth in feet From	To	AASHO Classification	Material Type
Tt	12	A	0.0	20.0	A-2-6	Clayey sand
"	13	A	0.0	20.0	A-2-4	Silty sand
Qt	14	A	0.0	4.0	A-4	Silt
Qsfa	15	A	0.0	3.5	A-2-6	Clayey sand
"	16	A	0.0	1.5	A-4	Silt
Qt	17	A	0.0	2.0	A-2-6	Clayey sand
"		B	2.0	5.0	A-1-a	Gravel
P€g		C	5.0	---	Bedrock	Granite
Qal	18	A	0.0	6.0	A-1-a	Sand and gravel
Qt	19	A	0.0	1.5	A-4	Silt
"		B	1.5	10.0	A-1-a	Sand and gravel
Tt		C	10.0	---	A-1-b	Coarse-grained sand
Qt	20	A	0.0	1.5	A-4	Silt
"		B	1.5	3.0	A-4	"
"		C	3.0	10.0	A-1-a	Sand and gravel
"	21	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	7.0	A-1-b	Sand and gravel
"		C	7.0	9.0	A-4	Gravelly silt

CONSTRUCTION MATERIALS MAP 25-16



-LEGEND-

TESTED PIT OR QUARRY	Qal: Alluvium - Sand, silt and gravel	Qt: Terrace deposits - gravel	Qsfa: Ancha formation - sand, silt and gravel	Tt: Tesuque formation - sand and gravel	Pm: Magdalena group - limestone

STATUTE MILES

AGGREGATE RESOURCES AND SOILS STUDY
NEW MEXICO INTERSTATE ROUTE 25
SANTA FE AND VICINITY

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-16-2

Pit or Prospect No.		54-27-S	54-80-S	59-9-S
	Section	SE 1/4 sec. 23	NE 1/4 SE 1/4 sec. 31	S 1/2 sec. 2
	Twnshp.	T 16 N	T 17 N	T 16 N
Location	& Range	R 8 E	R 9 E	R 8 E
	County	Santa Fe	Santa Fe	Santa Fe
	State	New Mexico	New Mexico	New Mexico
Owner		Private	?	State Land
Geologic Age		Quaternary	Quaternary	Quaternary
Formation		Ancha formation	Terrace	Terrace
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Various	Various	Various
Quality of Material		Good	Good	Good
Thickness of Material		7.9 feet	7 feet	4.7 feet
Thickness of Cap (Caliche)		-	-	-
Blasting Qualities		-	-	-
Uniformity		Good	Poor	Fair
Impurities		Silt lenses	Silt & clay	Silt & clay
Type of Mat'l. Underlying Formation		Clay, sand, & gravel	Clay	Clay, sand, & gravel
Moisture Condition		Dry	Dry	Wet
Vegetation		Grasses	None	None
Local Terrain		Undulating plain	Santa Fe River	River bed
Depth of Overburden		0.0 to 6.0 feet	None	0.0 to 5.0 feet
P.I. (Overburden)		10	-	N.P.
Est. Reserve Quantity		Unlimited (see remarks)	See remarks	See remarks
Approx. Haul to Nearest Point		3.0 miles	1.8 miles	2.8 miles
L.A. Wear		29.6	34.8	34.4
Maximum Size		6"	-	-
% Retained on 2" Sieve		20	-	32
	Crushed to	3/4"	3/4"	-
	2"	-	-	68
Pit	1"	-	--	57
Average	3/4"	100	100	52
% Passing	1/2"	80	85	45
	#4	50	50	33
	#10	35	35	25
	#200	6	6	1
P.I.		N.P.	N.P.	N.P.
Lab. Numbers		54-4477 - 80, 54-4488 - 91 54-4497 - 4510, 56-1930 - 31	54-14242 - 14249	59-1907 - 1920

Remarks:

54-27-S - Can be extended to southwest and to northwest.

54-80-S - This pit is worked out (6/1/62).

59-9-S - This pit has become a commercial source and is shown to demonstrate the type of material along the river channel.

SOILS AND GEOLOGY

Introduction:

Strip 25-17 lies in Santa Fe and San Miguel Counties, New Mexico. It begins 2.0 miles southeast of the entrance to Seton Village and ends about 4.0 miles southeast of Rowe, New Mexico.

In this strip Interstate Route 25 lies between the southernmost tip of the Sangre de Cristo Range and Glorieta Mesa. They are the most prominent physiographic features in this area.

General Geology:

The southern tip of the Sangre de Cristo Range is faulted and otherwise a modified asymmetrical synclinorium. The range is bounded on the west by the fault system of the Rio Grande depression. On the east side of the range the central depression is occupied by the Pecos River. The rocks in the range dip gently eastward off the high mountains. However, locally the structure is complicated with faults and folds.

South of the Sangre de Cristo Range and south of Interstate Route 25 lies Glorieta Mesa which rises several hundred feet above the valley floor. It is capped by Triassic formations.

The oldest rocks are complex Precambrian igneous rocks. Pink granite predominates; however, there are also greenstone, gneiss, schist, and various metasedimentary rocks.

Lower Paleozoic rocks have not been definitely identified in the southern Sangre de Cristo Range; however, it is believed that the metasedimentary rocks and some of the lower limestone beds may be Devonian and Mississippian in age.

In late Mississippian and Pennsylvanian time a sea advanced over the area and deposition of the Magdalena group began. The earliest deposit, the Sandia formation, is dominantly clastic. Gradually the positive elements were worn down by erosion and the seas covered a greater area. The lower gray limestone member of the Madera formation was deposited in the marine environment created by the seas. Late in lower Madera time positive elements began to form again and alternating limestone, calcarenite, arkose (coarse-grained feldspathic sandstone), and shale beds of the upper arkosic limestone member of the Madera formation were deposited. By late Madera time the area was almost completely emergent and continental deposition of thousands of feet of clastic Sangre de Cristo formation occurred.

During Permian time transgressing seas deposited sandstones, siltstones, shales, a thin limestone bed, and minor amounts of gypsum.

In the Mesozoic era the area was again subjected to transgressing and regressing seas. The Dockum group represents a thick Triassic sequence of continental deposition. In late Cretaceous or early Tertiary time renewed tectonic activity caused upwarp of the Sangre de Cristo positive element. Several thousand feet of Santa Fe group clastics were deposited as erosion of the range took place. These deposits now underlie the recent fanglomerates and pediment gravels (Qsfa).

The areal distribution of formations and their members is shown on Soils and Geology Map 25-17. Their succession and character are given under the section termed "Stratigraphy."

Soils:

The soils in this strip include: Quaternary alluvium, residual soils of the Ancha formation, and residual soils of Mesozoic, Paleozoic, and Precambrian rocks.

Alluvium (Qal): Sand, silt, clay, and gravel in the arroyos. These deposits are limited in areal extent except in the major drainages such as Galisteo Creek and the Pecos River valley. The alluvium is mainly sand and gravel (A-1-a).

Ancha formation (Qsfa): The Ancha formation is composed of beds of silt, sand, and gravel. It is covered by a thin veneer of granite and schist pebbles. It has no definite soil profile. The cover is predominantly silty sand (A-2-4). There are ridges and hills of sand and gravel (A-1-a) throughout the area of the Ancha formation.

Dockum group (Trd), San Andres group, and the Yeso formation (Py): The soils covering these formations were not classified because they are not pertinent to this report.

Sangre de Cristo formation (Psc): The depth of cover varies considerably and ranges from silt (A-4) to clay (A-6). The following sections are representative of this formation:

Depth in Feet From	To	AASHO Classification	Material Type
0.0	8.0	Solid rock	Limestone
8.0	21.0	A-6	Shale
21.0	26.0	A-2-4	Silty sandstone
26.0	41.0	Solid rock	Limestone
41.0	45.0	A-7	Shale
0.0	3.5	A-2-4	Silty sand
3.5	6.0	A-4	Siltstone
6.0	12.0	A-2-4	Silty sandstone
12.0	14.0	A-4	Siltstone
14.0	18.0	A-4	"
18.0	20.0	A-6	Shale
20.0	22.0	A-4	Siltstone

No attempt was made to classify the residual soils covering the Magdalena group.

Granite (P€): The granite soil cover is generally not more than a few feet deep. The upper few feet of soil cover is most often clay (A-6). Below the clay lies a zone of partly decomposed granite and soil on bedrock.

Table 25-17-1 shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formation is shown on Soils and Geology Map 25-17.

Ground-Water:

The arroyos and creeks west of the Santa Fe-San Miguel County line are part of the Rio Grande drainage system in New Mexico. The arroyos and creeks east of the line flow into the Pecos River. Normally only small amounts of water flow in the western drainage area. However, heavy rains will cause torrential

Ground-Water continued...

discharges from Glorieta Mesa. During rain storms deep gullying occurs in the Sangre de Cristo formation and when the ground-water is sufficiently recharged, it will migrate and produce seeps.

Stratigraphy:

Quaternary: Alluvium (Qal) - sand, silt, clay, and gravel mainly in the arroyos and major drainages.

Santa Fe group:

Ancha formation (Qsfa) - silt, sand, and gravel. Clastic and reworked pyroclastic material. Usually schist and granite pebbles interbedded with fine-grained clastics. Color varies from pink to tan.
Thickness: 0 to 300 feet.

Unconformity--

Triassic: Dockum group (Trd) - contains the Chinle formation underlain by the Santa Rosa sandstone. The Chinle formation consists of dominantly soft materials which are mainly shale and sandstone. In the center there are thick to moderately thick beds of sandstone. The beds are brown to red although some are variegated. "Locally there may be thin beds of gray shale and siltstone indicating local lack of oxidation after deposition." (Panhandle Geological Society, 1959).
Thickness: 1,000 feet.

The Santa Rosa sandstone is a sequence of alternating sandstone, shale, and siltstone. The sandstone is gray to buff and brown. The shale and siltstone are mainly red to brownish-red. The basal beds are commonly coarse-grained and conglomeratic. The uppermost sandstone is considered to be part of the Santa Rosa sandstone.
Thickness: 500 feet.

Unconformity--

Permian: The uppermost Bernal formation (Pb) - "consists of a sequence of terra cotta colored fine-grained sandstone and siltstone with some interbedded gypsum in the lower part of the sequence." (Panhandle Geological Society, 1959).
Thickness: 125 feet.

San Andres limestone (Psa) - is dark gray, has a fetid odor, and at some places contains thin layers of gypsum.
Thickness: 0 to 10 feet.

Glorieta sandstone (Pg) - a clean, fine-grained, quartz sandstone in massive to thin beds. It weathers buff or brown but is white to light-gray on a fresh fracture.
Thickness: 150 to 200 feet.

Permian continued: Yeso formation (Py) - consists of two members, the San Ysidro member and the underlying Mesita Blanca member.

The San Ysidro member consists of evenly bedded, fine-grained, sandstone and siltstone which are light-red or orange red. It has thin beds of light-gray dolomitic limestone.
Thickness: 250 feet.

The Mesita Blanca member is a cross-bedded, fine-grained sandstone with some silty interbeds (Panhandle Geological Society, 1959).
Thickness: 250 feet.

Sangre de Cristo formation (Psc) - alternating arkosic sandstone, siltstone, and shale. It may be brown, gray, red, or variegated.
Thickness: 400 to 2,500 feet.

Carboniferous: Magdalena group - consists of the Madera limestone and the Sandia formation.

Madera limestone has two members, the upper arkosic member (Cma) and the lower gray limestone member (Cml). The upper arkosic limestone member consists of carbonaceous shale and sandstone with beds of limestone. The upper part of this member contains numerous red beds interbedded with calcarenite.
Thickness: 1,000 feet.

Lower gray limestone member (Cml) consists of tan to light-gray to dark-gray, fine-grained cherty limestone interbedded with shale.
Thickness: 900 feet.

Sandia formation contains two members. The upper clastic member (Csu) consists of carbonaceous shale and sandstone.
Thickness: 0 to 300 feet.

The lower limestone member (Csl) is coarsely crystalline, light-gray limestone containing light-gray to gray nodular chert.
Thickness: 0 to 100 feet.

Unconformity--

Precambrian: Granite (P€) - usually red granite through which bodies of schist, quartzite, and gneiss are locally present.

Construction Materials:

Quaternary: Alluvium (Qal) - Recent alluvium exists only in the drainages in this strip. There are good gravel deposits in and along the Pecos River channel. Pit 59-17-S had excellent sand and gravel. Tests reported 36 percent passing the No. 4 sieve, 30 percent passing the No. 10 sieve, and 4 percent passing the No. 200 sieve. It is non-plastic and has a L.A. Wear of 35.2.

Quaternary: Alluvium (Qal) continued....

The gravels along Galisteo Creek may be suitable material for highway construction. See Pit 56-103-S for an example of the type of material found in this creek.

Ancha formation (Qsfa) - There are gravel deposits throughout the Ancha formation. South of the contact between the granite and the Ancha formation there are thick deposits of gravel which is predominantly granitic. Farther south low gravel hills dot the plain.

Carboniferous: Upper arkosic limestone member of the Madera limestone (Cma) - There are thick limestone beds in this member that are suitable for quarry rock. The beds are flat lying and are separated by layers of shale. Excellent exposures of these beds may be seen in the Pecos River canyon.

Prospect 25-17-1 is located on a gravel terrace. The terrace is underlain by limestone. The bed is about 15 feet thick and is underlain by shale.

Lower gray limestone member of the Madera limestone (Cml) - Prospect 25-17-2 is located in this member. The limestone beds are from 15 to 20 feet thick and are separated by shale beds. At this locality the beds dip steeply eastward.

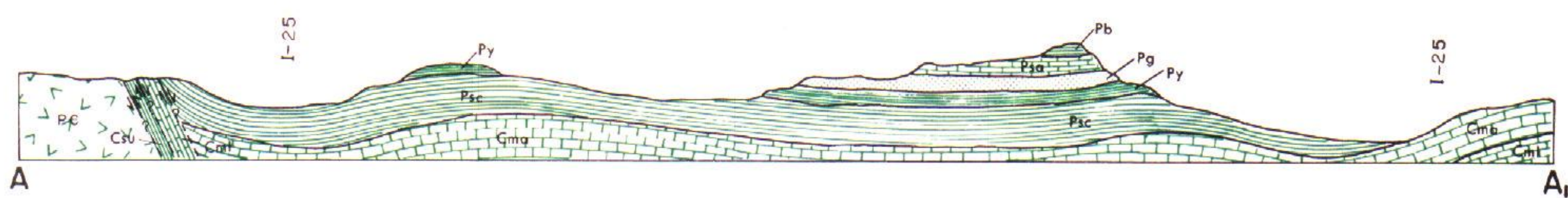
Precambrian: Granite (P€) - Some of the granite hills south of Interstate Route 25 may have suitable material for highway construction. The granite does not appear to be deeply weathered and is highly siliceous and gneissic. Prospect 25-17-3 is located on a talus slope. The material is sandy and non-plastic and has a L.A. Wear of 30.8.

Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-17. Test data and other related information are shown in Material Pit Summary Table 25-17-2.

Selected References:

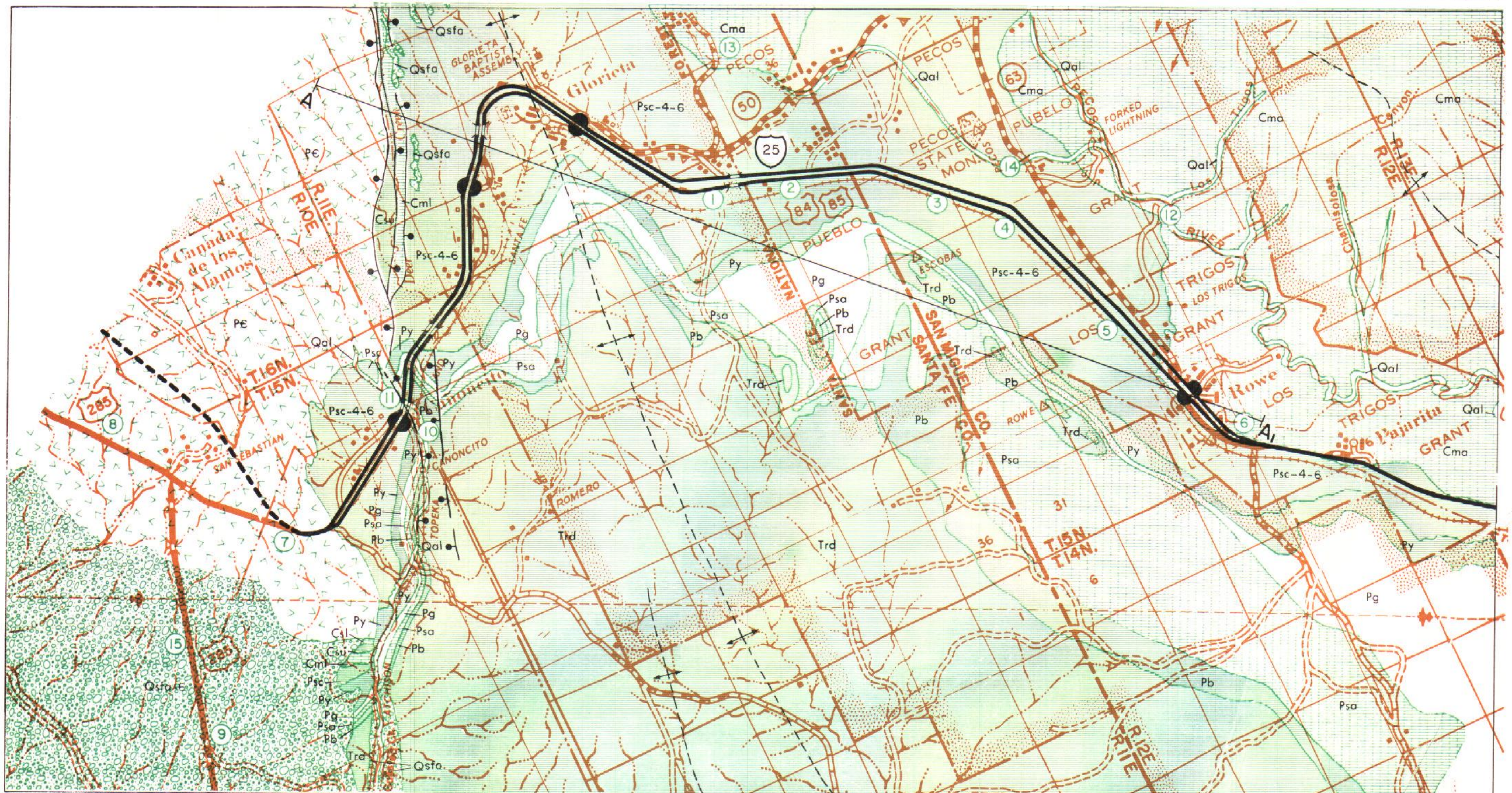
Panhandle Geological Society (1959), Guidebook: Northeastern New Mexico.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-17

SOILS AND GEOLOGY MAP 25-17



GEOLOGY MAPPED 1964

LEGEND—

SEDIMENTARY ROCKS

Qal	Alluvium		QUATERNARY
Qsfa	Ancha formation		QUATERNARY
Trd	Dockum group		TRIASSIC
Pb	Bernal formation		PERMIAN
Psa	San Andres limestone		PERMIAN
Pg	Glorieta sandstone		PERMIAN
Py	Yeso formation		PERMIAN
Psc	Sangre de Cristo formation		PERMIAN
Cma	Arkosic limestone member	Madera limestone, Magdalena group	CARBONIFEROUS
Cml	Lower gray limestone member	Madera limestone, Magdalena group	CARBONIFEROUS
Csu	Upper clastic member	Sandia formation, Magdalena group	CARBONIFEROUS
Csl	Lower limestone member	Sandia formation, Magdalena group	CARBONIFEROUS

IGNEOUS ROCKS

P€	Granite, gneiss, schist, and greenstone	PRECAMBRIAN

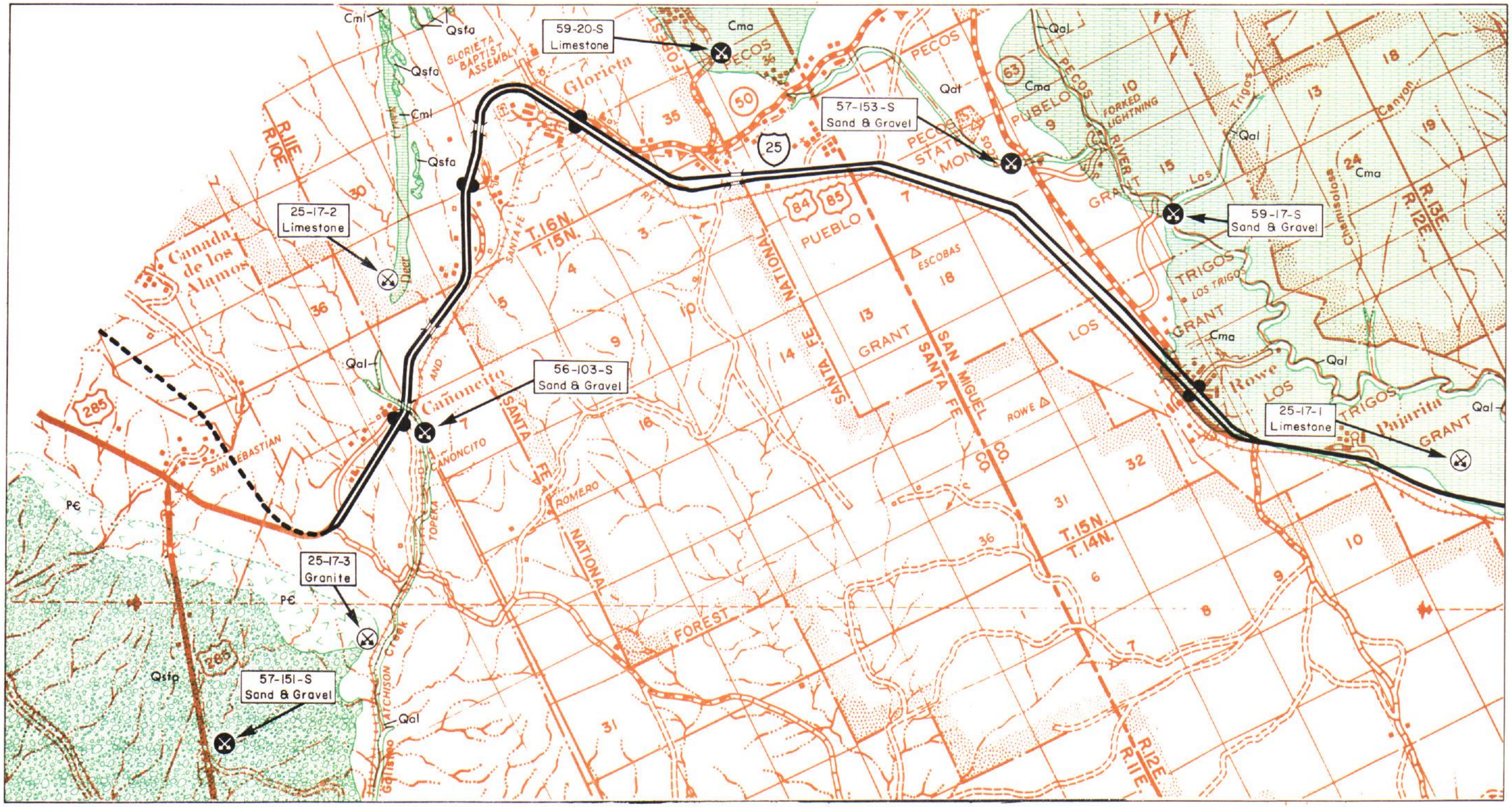
0
STATUTE MILES

Soils Summary:

Table 25-17-1

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Psc	1	A	0.0	6.5	A-4	Silt
"		B	6.5	13.5	A-4	Siltstone
"	2	A	0.0	7.5	A-4	Silt
"		B	7.5	10.0	A-2-4	Sandstone
"	3	A	0.0	1.5	A-4	Silt
"		B	1.5	13.0	A-2-4	Sandstone
"		C	13.0	21.5	A-4	Siltstone
"	4	A	0.0	11.5	A-4	Silt
"	5	A	0.0	4.0	A-4	"
"		B	4.0	8.0	A-6	Clay
"	6	A	0.0	12.0	A-4	Silt
P€	7	A	0.0	0.5	A-6	Clay
"		B	0.5	---	Bedrock	Granite
"	8	A	0.0	2.0	A-6	Clay
"		B	2.0	5.0	A-4	Silt
"		C	5.0	---	Bedrock	Greenschist
Qsfa	9	A	0.0	2.5	A-2-4	Silty sand
"		B	2.5	6.0	A-1-a	Sand & gravel
"		C	6.0	8.0	A-4	Silt
"		D	8.0	15.0	A-1-a	Sand & gravel
"		E	15.0	---	Unclassified	" " "
Qal	10	A	0.0	2.5	A-4	Silt
"		B	2.5	7.6	A-1-a	Sand & gravel
"		C	7.6	12.0	A-1-a	" " "
"	11	A	0.0	1.0	A-1-a	" " "
"		B	1.0	4.0	A-1-a	" " "
"		C	4.0	8.0	Unclassified	" " "
"		D	8.0	---	"	Gravel
"	12	A	0.0	0.5	A-4	Silt
"		B	0.5	5.5	A-1-a	Sand & gravel
"		C	5.5	7.5	A-1-a	" " "
Cma	13	A	0.0	9.0	Solid rock	Limestone
"		B	9.0	---	" "	Sandstone
Qal	14	A	0.0	7.3	A-1-a	Sand and gravel
"		B	7.3	---	Unclassified	" " "
Qsfa	15	A	0.0	1.0	A-6	Clay
"		B	1.0	3.0	A-4	Silt
"		C	3.0	5.0	A-1-b	Sand & gravel
"		D	5.0	---	Unclassified	" " "

CONSTRUCTION MATERIALS MAP 25-17



-LEGEND-

TESTED PIT OR QUARRY

PROSPECT PIT OR QUARRY

Qal	Sand, silt and gravel
Qsfa	Sand, silt and gravel
Cma	Arkosic limestone
Cml	Limestone
P€	Granite

STATUTE MILES

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-17-2

Pit or Prospect No.		25-17-1	25-17-2	25-17-3 (Prospect)	56-103-S	57-151-S	57-153-S
	Section	Not sectionalized	31	Not sectionalized.	Not sectionalized	Not sectionalized	5 & 8
	Twnshp.	Los Trigos Grant	T 16 N	Bishop John Lamy Grant	Bishop John Lamy Grant	Bishop John Lamy Grant	T 15 N
Location	& Range		R 11 E				R 12 E
	County	San Miguel	San Miguel	Santa Fe	Santa Fe	Santa Fe	San Miguel
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Forest Land	Private	Private	Private	Private
Geologic Age		Carboniferous	Carboniferous	Precambrian	Quaternary	Quaternary	Quaternary
Formation		Madera (upper arkosic member)	Madera (lower limestone member)	Granite	Alluvium	Ancha formation	Alluvium
Type of Pit		Quarry	Quarry	Gravel & quarry	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Limestone	Limestone	Granite	Various	Various	Various
Quality of Material		Good	Good	Good	Fair	-	Fair
Thickness of Material		30 feet	30 feet	-	5.9 feet	8.5 feet	0 to 6 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		?	?	Unexplored	-	-	-
Uniformity		Good	Good	"	Fair	-	Fair
Impurities		Shale lenses	Shale partings	"	Silt lenses	Silt & clay	Silt
Type of Mat'l. Underlying Formation		Sandstone	Sandstone & shale	"	Clay and shale	Granite sand & gravel	Clay & Silt
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Wet
Vegetation		Pinon & juniper	Pinon & cedar	Juniper	Juniper, cactus, grass	Grass, juniper	None
Local Terrain		Edge of canyon	Mountainous	Hillside	Creek bed	Plain	Stream bed
Depth of Overburden		Trace	Trace to 3 feet	-	2.6 feet	3.7 feet	-
P.I. (Overburden)		10 to 15	?	-	N.P.	12	-
Est. Reserve Quantity		Unlimited	Unlimited	-	See remarks	-	150,000 cu. yds.
Approx. Haul to Nearest Point		0.75 mile	0.5 mile	1.5 miles	1.6 miles	4.5 miles	3650 feet
L.A. Wear		16.8	24.8	30.8	36.4	50.0	37.6
Maximum Size		-	-	8"	10"	6"	12"
% Retained on 2" Sieve		-	-	90 estimated	-	12	-
	Crushed to	1"	1"	1"	3"	-	-
	2"	-	-	-	87	88	83
Pit	1"	100	100	100	70	71	65
Average	3/4"	81	95	94	63	66	60
% Passing	1/2"	46	60	56	54	59	55
	#4	17	20	19	38	43	45
	#10	9	10	11	27	30	36
	#200	2	2	10	2	4	5
P.I.		N.P.	N.P.	N.P.	N.P.	N.P.	N.P.
Lab. Numbers		64-755	64-368	63-4489	56-17350-17375	57-21555-21556	57-2261-2277

Remarks:

25-17-3 (Prospect) - This granite lies as talus on the side of a granite hill.

56-103-S - Can probably be extended to the southwest for maintenance use since there is not very much material left in this locality. However, there is sand and gravel all along Galisteo Creek.

57-151-S - There are other similar deposits in the area. They stand out as low hills in the Ancha formation (Qsfa).

57-153-S - Pit can be extended northward.

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-17-2

Pit or Prospect No.		59-17-S	59-20-S
	Section	W 1/2 sec. 22	25 & 36
	Twnshp.	T 15 N	T 16 N
Location	& Range	R 12 E	R 11 E
	County	San Miquel	Santa Fe
	State	New Mexico	New Mexico
Owner		Private	Private
Geologic Age		Quaternary	Pennsylvanian
Formation		Alluvium	Madera (upper arkosic member)
Type of Pit		Sand & gravel	Quarry
Kind of Material		Various	Limestone
Quality of Material		Excellent	Good
Thickness of Material		0 to 6.2 feet	9 feet
Thickness of Cap (Caliche)		-	-
Blasting Qualities		-	Good
Uniformity		Good	Good
Impurities		Some silt	?
Type of Mat'l. Underlying Formation		Sand & gravel	Arkose
Moisture Condition		Wet	Dry
Vegetation		Willows, cottonwoods, grass	Pine & grass
Local Terrain		Stream bed	Mountainous
Depth of Overburden		1.6 feet	-
P.I. (Overburden)		N.P.	-
Est. Reserve Quantity		300,000+ cu. yds.	150,000 cu. yds.
Approx. Haul to Nearest Point		1.6 miles	2.4 miles
L.A. Wear		35.2	26.8
Maximum Size		8"	-
% Retained on 2" Sieve		-	-
	Crushed to	-	2"
	2"	68	100
Pit	1"	57	42
Average	3/4"	51	27
% Passing	1/2"	46	19
	#4	36	9
	#10	30	5
	#200	4	1
P.I.		N.P.	N.P.
Lab. Numbers		59-2723-2772	59-2951-2958

Remarks:

59-17-S - This pit has been extended, but it can probably be extended further providing the owners are willing.

59-20-S - This pit can be extended to the northeast approximately 0.25 mile.

SOILS AND GEOLOGY

Introduction:

This strip begins approximately four miles southeast of Rowe and ends near the village of Bernal. The Pecos River and its tributaries form the main drainage system of the mapped area. The river separates the strip into two slightly differing physiographic regions. South of the river are high plateaus with many salients and re-entrants that mark the southern boundary of the Sangre de Cristo Mountains. North of the river are rugged, irregular mountains with predominately south dipping sedimentary rocks.

General Geology:

This strip is within the southeastern spur of the Sangre de Cristo Mountains which resembles a modified synclinoruim. The modifications are anticlinal upwarps that have been accented and deformed by moderate to intense thrust faulting. The Barillas Ridge is an example of an anticlinal upwarp.

Precambrian granite and associated metamorphic rocks are exposed as a narrow band along the crest of Barillas Ridge and form the crests of the highest peaks in the area.

Flat lying Permian sediments form Glorieta Mesa which rises several hundred feet above the valley floor south of Interstate Route 25.

During the Precambrian era, the area was part of a sedimentary basin in which great thichnesses of sediments and some volcanics were deposited. Subsequent to this deposition the area was folded, intruded by granite and metamorphosed into a structurally competent region.

A lack of pre-Mississippian rocks indicates that the area was a positive unit during early Poleozoic time.

During the Pennsylvainian period, the Rowe-Mora basin, Pedernal uplift, Las Vegas basin and the Sierra Grande uplift were developed, apparently due to east-west compressive components.

Transgressive and regressive sea conditions of the Permian deposited sandstones, siltstones, shales and the lower gray limestone member of the Madera formation.

In the Mesozoic era, periodic downwarping permitted approximately 5,000 feet of sediments to accumulate. In late Cretaceous or early Tertiary time, the folding and mountain building of the Laramide orogeny formed the mountains of today. Middle and late Tertiary upward movements uplifted the whole area to its present position.

The Pecos river began downcutting in late Tertiary or early Quaternary time along southeast trending fault zones and weak bedding planes of the Paleozoic sediments. Old river deposited gravel terraces are found 100 to 200 feet above the present day river.

The areal distribution of formations is shown on Soils and Geology Map 25-18. Their succession and character are given under the section termed "Stratigraphy."

Soils:

Alluvium (Qal): Sand, silt, clay, and gravel are found in the Pecos River and in the arroyos in a very limited areal extent. North of U.S. 85 the Pecos River soils are predominantly sand and gravel. Near U.S. 85 the river broadens and the top 2 to 6 feet of the soil is silt (A-4). Below this is a variable thichness of sand and gravel (A-l-a).

Terrace deposits (Qt): These deposits are composed of 2 to 12 feet of sand and gravel (A-l-a) and coarse-grained sand (A-l-b), with a cover that varies from clay (A-6) to clayey gravel (A-2-6 and A-2-7). These materials are a mixed variety of metamorphic, igneous, and sedimentary rocks derived from the Sangre de Cristo Mountains to the north.

Residual Soils:

Glorieta sandstone (Pg): The soils on this formation are primarily silty sand (A-2-4) and sand (A-3). They vary from 1 to 3 feet in thickness.

Yeso formation (Py): This formation is practically barren of soils; however, local areas have a silt (A-4) cover as thick as 7 feet.

Sangre de Cristo formation (Psc): Since the majority of this formation is made up of shales the soils are predominantly clay (A-6 and A-7). Where the underlying materials are siltstones and sandstones the residual soils vary from silt (A-4) to clayey gravel (A-2-6). The thickness varies from 0 to 15 feet.

Madera formation (Cma): The soils developed on this formation are silty clay (A-6) and silt (A-4). They are from 0 to 4 feet thick.

Madera formation (Cml): The soils developed on this formation are silt (A-4), silty clay (A-6), and clay (A-7). They vary from 0 to 3 feet in thickness.

Table 25-18-1 shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-18.

Stratigraphy:

Quaternary:	Alluvium (Qal) - rounded to sub-rounded gravel, sand and silt. Thickness: variable.
	Terrace deposits (Qt) - sand, gravel and clay. Thickness: 0 to 12 feet.
Permian:	San Andres formation (Psa) - dark gray, earthy, gypsiferous limestone. Thickness: 40 feet maximum.

Stratigraphy: continued...

Glorieta sandstone (Pg) - gray to tan-brown, fine-grained quartz sandstone.
Thickness: 125 to 300 feet.

Yeso formation (Py) - orange siltstone, sandstone and thin gypsum beds.
Thickness: 500 feet.

Sangre de Cristo formation (Psc) - alternating beds of arkose, siltstone, sandstone and shale; brown, red, and variegated purples.
Thickness: 2,500 feet.

Carboniferous: Madera formation (Cma) - upper arkosic member - arkosic sandstone, red to purple shale and medium-gray to dark-gray limestone.
Thickness: 1,000 feet.

Madera formation (Cml) - lower gray limestone member -dark to medium-gray, cherty, crystalline limestone interbedded with carbonaceous shale.
Thickness: 900 feet.

Sandia formation (Csu) - gray to brown sandstone, siltstone, shale and limestone.
Thickness: 350 feet.

Precambrian: (P€) - pinkish red granite and associated metamorphic rocks.

Construction Materials:

Quaternary: Alluvium (Qal): The floor of the Pecos River has an excellent grade of sand and gravel throughout most of this strip. The material lies in a narrow band along the main channel of the river. Since the river flows continually, working this material involves large amounts of water.

The river floor is practically inaccessible throughout most of the strip. It is easily reached where it broadens at U.S. 85; however, the sand and gravel has a sufficient amount of silty soil cover to be farmed and the land has been divided into numerous long narrow tracts. Each of these tracts usually has different owners.

The most suitable area to develop a pit seems to be at site 25-18-1. Here the deposit is from 300 to 500 feet wide for a distance of about 3/4 of a mile.

Terrace deposits (Qt): These deposits lie from 100 to 200 feet above the valley floor on each side of the Pecos River. They are small in areal extent and most of them are a relatively thin deposit. Pits 62-48-S and 62-52-S are representative of some of the thicker deposits.

Carboniferous: Madera formation (Cma) - Upper arkosic member: This formation dips steeply away from the Sangre de Cristo Mountains and most of the limestone beds pass under the overlying beds of arkose and shale near the Pecos River. There are numerous limestone outcrops along the southwestern escarpment of the Pecos River Canyon. They are small in areal extent and most of them disappear under the upper arkosic sandstone within a hundred feet of the escarpment.

The most desirable locations for limestone quarry operations southwest of the river seem to be adjacent to the larger tributaries that feed the Pecos River. Here the scour of the intermittent streams has exposed the lower limestone beds. Pit 25-18-5 is an example of such an exposure.

Northeast of the Pecos River erosion has stripped most of the overlying beds away and there are many exposures of limestone that are suitable for quarries. Pits 62-55-S, 25-18-2, 62-53-S, 25-18-3, and 63-28-S are excellent examples of this limestone.

Madera formation (Cml) - lower limestone member: The limestone of this member is very similar in outcrop to the upper arkosic member. Some of the exposures have numerous interbeds of carbonaceous shale. This member has several different beds of limestone that vary from 12 to about 50 feet in thickness. Some of the individual beds are badly impregnated with shale lenses; however, there are numerous exposures of pure crystaline limestone. Pit 25-18-4 is an example of this material.

Distribution of tested and prospective pit sites is shown on Construction Materials Inventory Map 25-18. Test data and other related information are shown in Material Pit Summary Table 25-18-2.

Selected References:

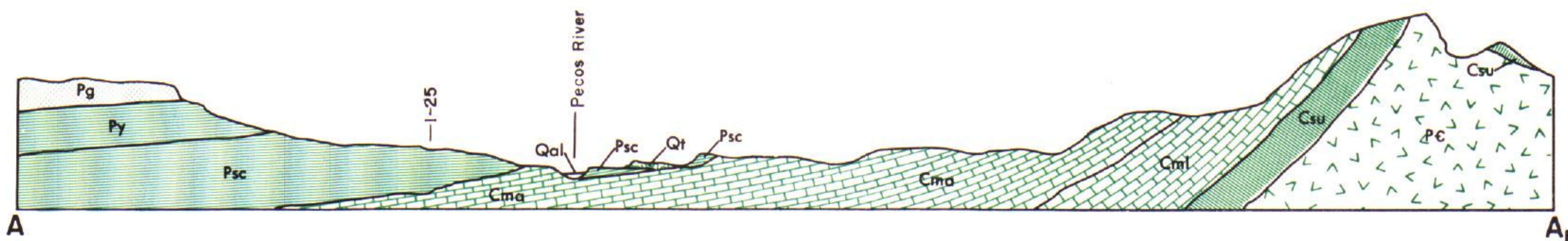
New Mexico Geological Society, 1955, Guidebook of the Southeastern Sangre de Cristo Mountains, 7th Field Conference, 146 p.

Northrop, S. A., et. al., 1946, Oil and Gas Investigations, U.S.G.S. Preliminary Map 54.

Read, C. B., et. al., 1944, Stratigraphic Sections of Permian and Pennsylvanian Rocks in North-Central New Mexico, U.S.G.S. Map 21.

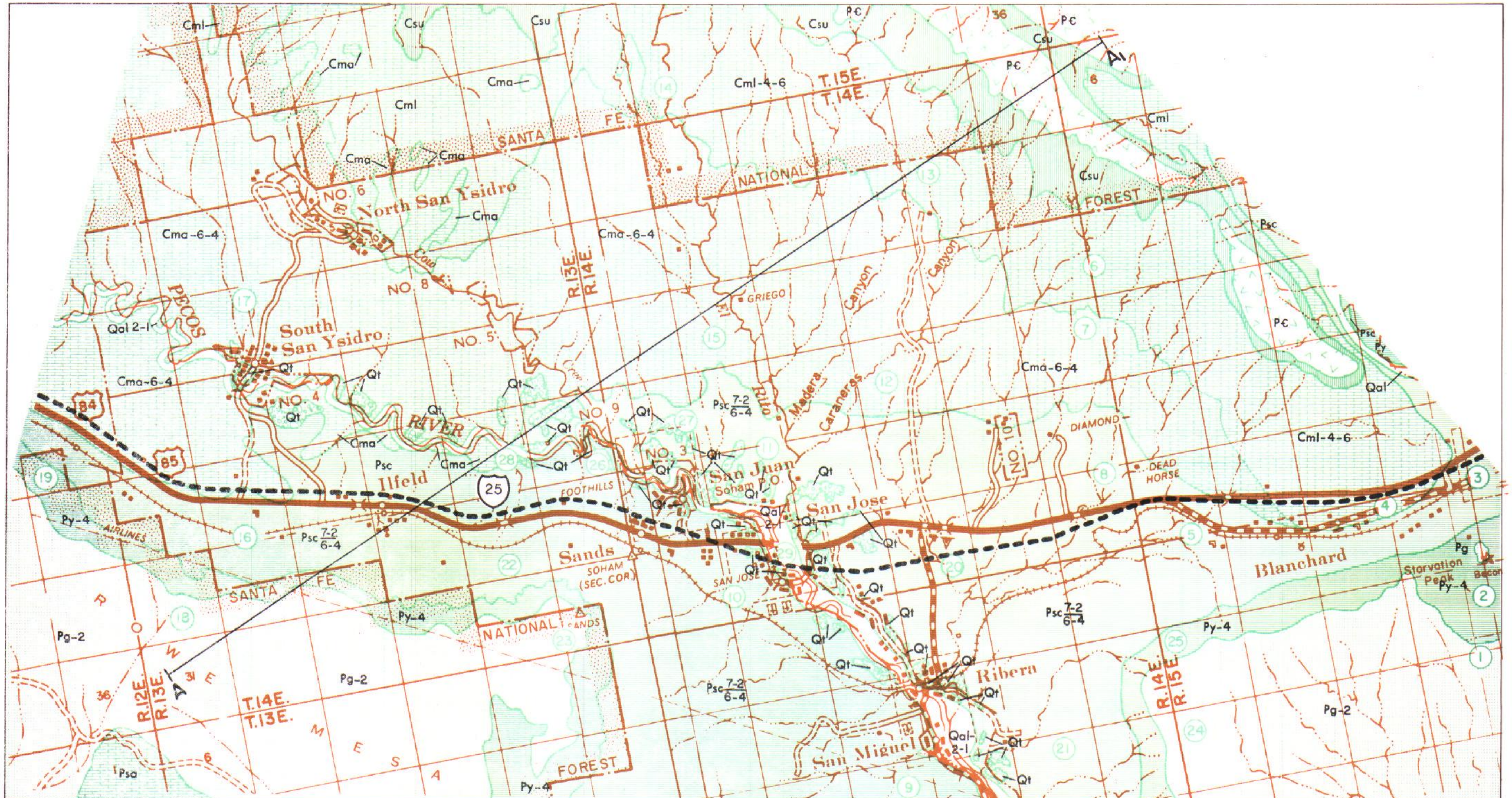
Griggs and Hendrickson, 1951, Geology and Ground-Water Resources of San Miguel County, New Mexico, N.M. I.M.T. Ground-Water Report 2, 116 p.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-18

SOILS AND GEOLOGY MAP 25-18



—LEGEND—

GEOLOGY MAPPED 1964

SEDIMENTARY ROCKS

QUATERNARY
- Qal — Alluvium
- Qt — Terrace deposits

- Psa — San Andres limestone

PERMIAN
- Pg — Glorieta sandstone
- Py — Yeso formation
- Psc — Sangre de Cristo formation

CARBONIFEROUS
- Cma — Madera formation upper arkosic member
- Cml — Madera formation Lower limestone member
- Csu — Sandia formation upper arkosic member

IGNEOUS ROCKS

PRECAMBRIAN
- P€ — Granite and metamorphic rocks

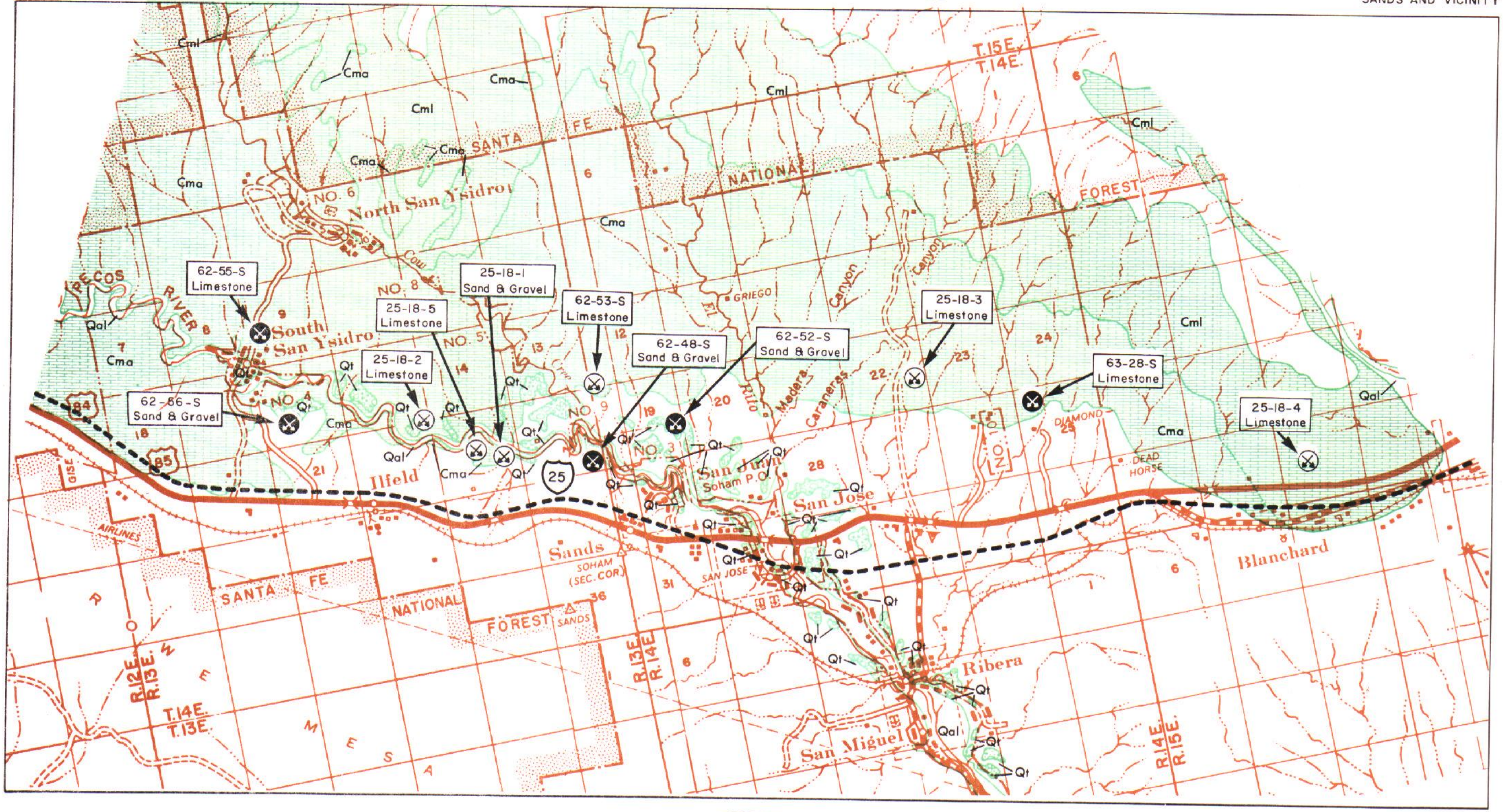
0
STATUTE MILES

Soils Summary:

Table 25-18-1

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Pg	1	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	-	Bedrock	Sandstone
Py	2	A	0.0	5.0	A-4	Silt
Psc	3	A	0.0	5.0	A-6	Clay
"		B	5.0	10.0	A-4	Silt
Cml	4	A	0.0	1.0	A-6	Silty clay
"		B	1.0	-	Bedrock	Limestone
Psc	5	A	0.0	4.0	A-2-6	Clayey gravel
"		B	4.0	10.0	A-6	Clay
Cml	6	A	0.0	2.0	A-4	Silt
"		B	2.0	-	Bedrock	Limestone
Cma	7	A	0.0	1.0	A-4	Silt
"		B	1.0	-	Bedrock	Arkosic sandstone
Psc	8	A	0.0	4.0	A-7	Clay
"		B	4.0	10	A-6	Clay
"	9	A	0.0	3.0	A-2-4	Silty sand
"		B	3.0	7.0	A-6	Clay
"	10	A	0.0	3.0	A-7	Clay
"		B	3.0	10.0	A-4	Clayey silt
"	11	A	0.0	4.0	A-6	Sandy clay
"		B	4.0	15.0	A-6	Clay
Cma	12	A	0.0	4.0	A-6	Silty clay
"		B	4.0	-	Bedrock	Arkosic sandstone
Cml	13	A	0.0	3.0	A-7	Clay
"		B	3.0	-	Bedrock	Limestone
"	14	A	0.0	3.0	A-4	Silt
"		B	3.0	-	Bedrock	Limestone
Cma	15	A	0.0	1.0	A-6	Silty clay
"		B	1.0	-	Bedrock	Sandstone
Psc	16	A	0.0	3.0	A-6	Clay
"		B	3.0	10.0	A-7	Clay
Cma	17	A	0.0	3.0	A-4	Clayey silt
Pg	18	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	-	Bedrock	Sandstone
Py	19	A	0.0	7.0	A-4	Silt
"		B	7.0	-	Bedrock	Siltstone
Psc	20	A	0.0	4.0	A-7	Clay
"		B	4.0	10.0	A-6	Clay
Psc	21	A	0.0	3.0	A-2-6	Clayey sand
"		B	3.0	7.0	A-7	Clay
"	22	A	0.0	4.0	A-6	Silty clay
"		B	4.0	10.0	A-6	Clay
Pg	23	A	0.0	0.5	A-2-4	Silty sand
"		B	0.5	-	Bedrock	Sandstone
"	24	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	-	Bedrock	Sandstone
Py	25	A	0.0	4.0	A-4	Silt
"		B	4.0	-	Bedrock	Siltstone
Qt	26	A	0.0	5.5	A-7	Clay
"		B	5.5	11.5	A-2-4	Silty sand and gravel
"		C	11.5	-	Bedrock	Shale
"	27	A	0.0	1.5	A-6	Clay
"		B	1.5	3.5	A-2-6	Clayey gravel
"		C	3.5	11.5	A-1-a	Sand and gravel
Qal	28	A	0.0	1.5	A-4	Silt
"		B	1.5	6.0	A-1-a	Sand and gravel
"	29	A	0.0	2.0	A-4	Silt
"		B	2.0	6.0	A-1-a	Sand and gravel

CONSTRUCTION MATERIALS MAP 25-18



—LEGEND—

TESTED PIT OR QUARRY

PROSPECT PIT OR QUARRY

Qal — Sand and gravel

Qt — Sand and gravel

Cma — Upper Madera limestone

Cml — Lower Madera limestone

N

STATUTE MILES

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-18-2

Pit or Prospect No.		25-18-1 (Prospect)	25-18-2 (Prospect)	25-18-3 (Prospect)	25-18-4 (Prospect)	25-18-5
Location	Section	23	NE 1/4 22	E 1/2 22	N 1/2 32 & 33	23
	Twnshp.	T 14 N	T 14 N	T 14 N	T 14 N	T 14 N
	& Range	R 13 E	R 13 E	R 14 E	R 15 E	R 13 E
	County	San Miguel	San Miguel	San Miguel	San Miguel	San Miguel
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Private	Private
Geologic Age		Quaternary	Carboniferous	Carboniferous	Carboniferous	Carboniferous
Formation		Alluvium	Madera (upper arkosic member)	Madera (upper arkosic member)	Madera (lower limestone member)	Madera (upper arkosic member)
Type of Pit		Sand & gravel	Quarry	Quarry	Quarry	Quarry
Kind of Material		Mixed aggregate	Limestone	Limestone	Limestone	Limestone
Quality of Material		Excellent	Excellent	Excellent	Excellent	?
Thickness of Material		6 to 20 feet	20 feet	16 feet	20 feet	12 to 15 feet
Thickness of Cap (Caliche)		-	-	-	-	-
Blasting Qualities		-	?	?	?	?
Uniformity		Good	Good	Good	Good	?
Impurities		None	Minor shale lenses	?	Shale stringers	?
Type of Mat'l. Underlying Formation		?	Sandstone	Shale (?)	Shale (?)	Shale & sandstone
Moisture Condition		Wet	Dry	Dry	Dry	Dry
Vegetation		Willow & cottonwood trees	Cedar, pinon & juniper	Pinon trees	Cedar, pinon & juniper	Cedar, pinon & juniper
Local Terrain		River canyon	Hilly	Hilly	Hilly	Hilly
Depth of Overburden		0 to 2 feet	Trace	0.0 to 3.0 feet	1.0 foot ave.	Trace to 3 feet
P.I. (Overburden)		N.P.	-	10.1	10.0 to 15.0	?
Est. Reserve Quantity		200,000 cu. yds.	Unlimited	Unlimited	Unlimited	?
Approx. Haul to Nearest Point		1.0 mile	2.0 miles	3.0 miles	0.3 mile	0.75 mile
L.A. Wear		26.0	25.2	21.6	24.0	?
Maximum Size		10"	-	-	-	-
% Retained on 2" Sieve		25	-	-	-	-
	Crushed to	-	1"	1"	1"	Not explored
Pit Average % Passing	2"	72	-	-	-	" "
	1"	53	100	100	100	" "
	3/4"	44	92	88	88	" "
	1/2"	36	60	51	48	" "
	#4	24	22	19	20	" "
	#10	17	12	10	11	" "
	#200	5	3	2	3	" "
P.I.		N.P.	N.P.	N.P.	N.P.	" "
Lab. Numbers		64-758-759	64-760	63-5575	63-5574	" "

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-18-2

Pit or Prospect No.		62-48-S	62-52-S	62-53-S	62-55-S	62-56-S	63-28-S
Location	Section	SE 1/4 24	SE 1/2 19	NW 1/4 19 & SW 1/4 18	SE 1/4 8 & SW 1/4 9	16	NW 1/4 25
	Twnshp.	T 14 N	T 14 N	T 14 N	T 14 N	T 14 N	T 14 N
	& Range	R 13 E	R 14 E	R 14 E	R 13 E	R 13 E	R 14 E
	County	San Miguel	San Miguel	San Miguel	San Miguel	San Miguel	San Miguel
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Private	State	Private
Geologic Age		Quaternary	Quaternary	Carboniferous	Carboniferous	Quaternary	Carboniferous
Formation		Terrace deposit	Terrace deposit	Madera (upper arkosic member)	Madera (upper arkosic member)	Terrace deposit	Madera (upper arkosic member)
Type of Pit		Sand & gravel	Sand & gravel	Quarry	Quarry	Sand & gravel	Quarry
Kind of Material		Mixed aggregate	Mixed aggregate	Limestone	Limestone	Mixed aggregate	Limestone
Quality of Material		Good	Good	Excellent	Good	Fair	Excellent
Thickness of Material		4 to 12 feet	6.5 feet	16 feet	20 feet	7 feet	12+ feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	Excellent	Good	-	Good
Uniformity		Fair	Fair	Good	Good	Good	Good
Impurities		Silt & clay lenses	Silt lenses	Minor clay seams	Shale lenses (minor)	Clay lenses	Shale minor
Type of Mat'l. Underlying Formation		Shale	Shale	?	Shale	Shale	Shale
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Pinon & juniper trees	Pinon & juniper trees	Pinon trees & grasses	Pinon & juniper trees	Pinon trees & grasses	Scattered pinon
Local Terrain		Hilly	Hilly	Hilly	Hilly	Hilly	Hilly
Depth of Overburden		3 to 4 feet	2.5 feet	1.5 feet	1.0 foot	3 to 4 feet	6 inches
P.I. (Overburden)		15 to 20	10 to 15	10 to 15	18	19	10 to 19
Est. Reserve Quantity		150,000 cu. yds.	350,000 cu. yds.	Unlimited	Unlimited	?	500,000 cu. yds.
Approx. Haul to Nearest Point		0.9 mile	2.5 miles	2.0 miles	3.0 miles	1.5 miles	1.5 miles
L.A. Wear		27.6	27.6	24.4	22.8	28.4	28.8
Maximum Size		6"	6"	-	-	6"	-
% Retained on 2" Sieve		20 to 30	40 to 60	-	-	20 to 30	-
	Crushed to	-	-	2"	2"	-	2"
Pit Average % Passing	2"	77	59	100	100	74	100
	1"	53	48	91	71	48	87
	3/4"	44	44	62	43	41	69
	1/2"	35	39	41	27	34	45
	#4	22	28	19	12	23	22
	#10	17	19	11	7	18	13
	#200	4	4	3	2	2	4
P.I.		N.P.	N.P.	N.P.	N.P.	N.P.	N.P.
Lab. Numbers		62-15232, 15262	62-15866, 15939	62-16435, 16448	62-16482	62-16668, 16695	63-16645, 16658

SOILS AND GEOLOGY

Introduction:

This strip begins at Bernal and ends about one mile northeast of Las Vegas, New Mexico. Parts of three large structural units are in this strip. The western and southwestern part of the strip lies within the Rowe-Mora basin; the central part of the strip is an extension of the ancient Pedernal uplift; and the northeastern corner lies within the Las Vegas embayment, a part of the Great Plains Province.

General Geology:

This strip is within a zone of structural transition which has developed two distinct geomorphic features. A mountainous topography characterizes the Rowe-Mora basin and the Pedernal uplift. This physiography is contrasted by the flat to moderately rolling plains of the Las Vegas embayment.

North to northeast trending anticlinal structures are striking features in the mountainous region. These structures are a result of large scale thrusting of the formations from the west to the east. They are asymmetrical with gently sloping western limbs. The eastern limbs are moderate to steeply dipping. Examples of overturned beds are well exposed near Montezuma in Gallinas Canyon.

These anticlinal structures seem to coalese near Hermit's Peak, northwest of Las Vegas. They develop into a pronounced thrust fault belt which has formed the spectacular mountains west of Sapello and Mora.

The plains area on the east is characterized by Mesozoic sediments that extend several hundred miles to the east. These sediments are marked locally by basalt flows, igneous necks and dikes.

Several thousand feet of Precambrian metamorphic rocks are exposed northwest of Las Vegas along the canyon walls of the Gallinas River.

The oldest Paleozoic rocks exposed in this area are of Carboniferous age. This region, apparently, was a highland during the early part of the Paleozoic era. The Carboniferous sediments are from 1,000 to 3,000 feet thick near the hog-back at Las Vegas; however, they thicken to the west to 15,000 feet in the deepest part of the Rowe-Mora basin.

At the close of the Paleozoic era, the area was uplifted, but, throughout the Mesozoic era it was periodically depressed and received about 5,000 feet of sediments. At the end of the Mesozoic era folding and thrusting of the Laramide orogeny produced the mountains of today. The area was further uplifted and eroded during the Cenezoic era. Erosion and deposition of the Quaternary period have produced the present physiography.

During the Pleistocene and Recent epochs a veneer of gravels, clays and silts apparently blanketed much of this area. Erosion has stripped most of this material away except for a few high level terrace deposits (Qoa) near the Gallinas River and a flat topped mesa east of Las Vegas. North of Las Vegas on strip 25-20 this older alluvium seems to be of glacial origin. The deposits near the river seem to be much younger and they may have been deposited by a close relative of the Gallinas River.

The areal distribution of formations is shown on Soils and Geology Map 25-19. Their succession and character are given under the section termed "Stratigraphy."

Soils:

Alluvium (Qal): The alluvial soils are very limited in areal extent. They occur in the bottoms of the larger drainageways of this strip: Gallinas River, Tecolote Creek, and Bernal Creek.

The Gallinas River broadens slightly near Las Vegas and there has been sufficient ponding or flooding of its back-water areas to develop a silt and clay cover over some of the old channel materials. Clay (A-7) and silt (A-4) overlie a silty sand and gravel (A-2-4). The clay and silt are from 0 to 10 feet thick and the maximum thickness of the silty sand and gravel is unknown, but it is at least 12 feet in local areas.

Below Las Vegas the river becomes very narrow and flows through a relatively deep canyon. Practically all of the materials have been scoured out of this canyon; however, there are a few sand and gravel bars throughout its length.

The material in Tecolote Creek is a coarse-grained sand (A-1-b). There are a few local silty areas but the sandy materials predominate.

The material in Bernal Creek is a silty, coarse-grained sand (A-2-4). Bernal Creek also has local silty areas.

Older alluvium (Qoa): These soils are also very limited in areal extent. A typical profile will show 2 to 3 feet of topsoil and caliche coated gravel over 3 to 20 feet of silty gravel (A-2-4) and sandy gravel (A-1-a).

Residual soils: Near McAllister Lake on the Dakota sandstone the soil cover is partly derived from sheet-wash erosion which crosses the Graneros shale to the north; therefore, the soil texture is not as one would expect, it varies from silt (A-4) to clay (A-6). Many of the sandstone formations of this strip have a residual silty cover. This suggests that perhaps the overlying shale members have left a considerable amount of residue behind as they were eroded away.

The Chinle and Bernal formations form strike valleys along the hog-back west of Las Vegas and the soils overlying these formations have received a considerable amount of junk from the adjacent formations. Therefore, the soils on these formations could very well be described as colluvial rather than residual.

A list of some of the formations of this strip and the classifications of their soil cover follows:

Geological Formation	AASHO Soil Classification	Estimated Thickness of Soil Cover
Carlisle shale	A-6	0.0 to 6.0 feet
Greenhorn limestone	A-7	0.0 to 6.0 feet
Graneros shale	A-7	0.0 to 6.0 feet

A list of some of the formations of this strip and the classifications of their soil cover, continued...

Geological Formation *	AASHO Soil Classification	Estimated Thickness of Soil Cover
Dakota sandstone	A-4 and A-6	0.0 to 15.0 feet
Morrison	A-4	Trace
Chinle	A-4	0.0 to 15 feet
Bernal	A-4 and A-7	0.0 to 15 feet
San Andres limestone	A-4	0.0 to 3.0 feet
Yeso	A-6 over A-4	2.0 to 10.0 feet
Sangre de Cristo	A-6 and A-4	10.0 to 20.0 feet

Table 25-19-I shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-19.

Stratigraphy:

Quaternary: Alluvium (Qal) - unconsolidated clay, silt sand and gravel.
Thickness: 0 to 20 feet.

Older Alluvium (Qoa) - sand and gravel with some clays, silts, and caliche.
Thickness: 0 to 20 feet.

Unconformity--

Tertiary: Intrusive (Ti) - dark-green to black hornblende monzonite.

Unconformity--

Cretaceous: Carlile shale (Kc) - dark-gray shale with calcareous concretions.
Thickness 75 to 100 feet.

Greenhorn limestone (kgh) - medium bedded dark-gray limestone with interbedded shale.
Thickness: 50 feet.

Graneros shale (Kgr) - black to medium-gray, fissle, bentonitic shale.
Thickness: 250 feet.

Dakota sandstone (Kd) - medium-grained, tan sandstone with interbedded shales.
Thickness: 200 feet.

Unconformity--

Jurassic: Morrison formation (Jm) - red, brown, and olive sandstone, siltstone and shale.
Thickness: 500 feet.

Todilto limestone and Wingate sandstone (Jtw) - the Todilto unit is dark gray, thinly laminated limestone.
Thickness: 10 feet. - The Wingate unit is light gray, massively - bedded sandstone. Thickness: 85 feet. Total thickness: 105 feet.

Unconformity--

Triassic: Chinle formation (Trc) - maroon, red, gray, and greenish shale, siltstone and sandstone.
Thickness: 950 feet.

Santa Rosa sandstone (Trs) - gray to brown sandstone with interbedded shale and siltstone.
Thickness: 300 feet.

Unconformity--

Permian: Bernal formation and San Andres limestone (Pbs) - the Bernal formation is red-brown to orange, fine-grained sandstone and siltstone. Thickness: 80 to 150 feet. - The San Andres unit is dark gray, fetid, gypsiferous limestone.
Thickness: 10 to 20 feet. Total thickness: 100 to 170 feet.

Glorieta sandstone (Pg) - gray to tan, massive, clean, sandstone.
Thickness: 210 feet.

Yeso formation (Py) - medium-bedded, orange-brown to red siltstone and sandstone and dolomitic limestone.
Thickness: 500 feet.

Sangre de Cristo formation (Psc) - course-grained, conglomeratic, arkosic, sandstone, with interbedded red to gray shale.
Thickness: 600 to 1,000 feet.

Carboniferous: Madera formation (Cma) (upper arkosic member, etc.) includes erosional remnants of the Sangre de Cristo formation; the upper Madera formation, arkosic sandstone, limestone and shale; and local exposures of the lower Madera formation.
Thickness: 1,000 feet.

Magdalena group (Cm) - includes the lower Madera formation, dark-gray, crystalline limestone and shale; and the Sandia formation, gray to tan sandstone, siltstone, and limestone.
Thickness: 1,500 feet.

Unconformity--

Precambrian: Undifferentiated (P€) - granite, schist, gneiss, amphibolite, and metasediments.

Construction Materials:

Quaternary: Alluvium (Qal): The Gallinas River, Tecolote Creek, and Bernal Creek all have

Construction Materials continued...

materials suitable for highway construction.

Gravel pits may be located in the Gallinas River near Las Vegas and near the village of San Agustin. San Agustin is from 8 to 9 miles southeast of Romeroville. At Las Vegas all of the areas sampled showed plastic materials. Near San Agustin the materials are much cleaner but there is a greater percentage of sandstone gravel.

Pits 25-19-7 and 25-19-8 are representative of the materials near Las Vegas. Pit 25-19-14 is representative of the materials near San Agustin.

The Tecolote Creek is floored with a good grade of sandy gravel. This material has been used for concrete aggregate and surfacing aggregate in the past. Pits 25-19-5 and 25-19-12 are good examples of this material.

Sand and gravel bars occur locally in Bernal Creek. They vary in size and in most places the stream has completely scoured the materials to bedrock. Pit 25-19-10 is a good example of this material.

Permian:

San Andres limestone (Pbs): This material crops out locally around Bernal Hill, and more extensively to the southeast of Bernal Hill and on the east cut bank of Bernal Creek.

Along Bernal Creek the exposures show the material to be extremely gypsiferous and cavernous. Probably the best locations for exploring this material are immediately northwest of Bernal Hill and from one to two miles southeast of Bernal Hill.

Glorieta sandstone (Pg): This material is not included on the Construction Materials Map, nor is it proposed as a construction material. However, it probably deserves an honorable mention since it is an unusually hard sandstone.

A sample taken from the road cut near Bernal Creek, after crushing to one inch showed the following: L.A. Wear - 55.6, P.I. - non-plastic, 25 percent passing the number 4 sieve, and 2 percent passing the number 200 sieve.

Quaternary:

Older Alluvium (Qoa): These deposits are the most extensively used materials in the vicinity of Las Vegas.

Near the Gallinas River and about 3.5 miles east of Las Vegas the deposits are fairly uniform in particle size, particle shape, and the amount of impurities. These deposits contain a variety of metamorphic, igneous and sedimentary rocks derived from the peaks of the Sangre de Cristo Mountains. Pit 61-38-S is representative of these deposits.

Near Kearneys Gap the older alluvium is made up of limestone and sandstone gravels. Pit 25-19-16 is an example of these materials.

Carboniferous:

Madera formation (Cma): The material proposed for use is in the upper part of this formation. There are numerous limestone outcrops but many of them will not make usable quarries because of their limited areal extent and their cover of sandstone and shale. North of Ojitos Frios the limestone exposures are quite large. Pit 25-19-4 is a good example of this material.

Magdalena group (Cm): The material proposed for use is in the lower Madera formation. The limestone of this member is very similar in outcrop to that of the upper member. Some of the exposures have numerous interbeds of carbonaceous shale. Pit 25-19-6 is a good exposure of pure crystalline limestone.

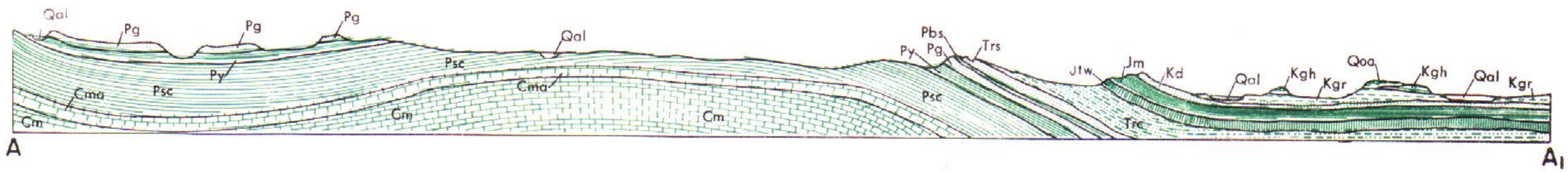
Distribution of tested and prospective pit sites is shown on Construction Materials Inventory Map 25-19. Test data and other related information are shown in Material Pit Summary Table 25-19-2.

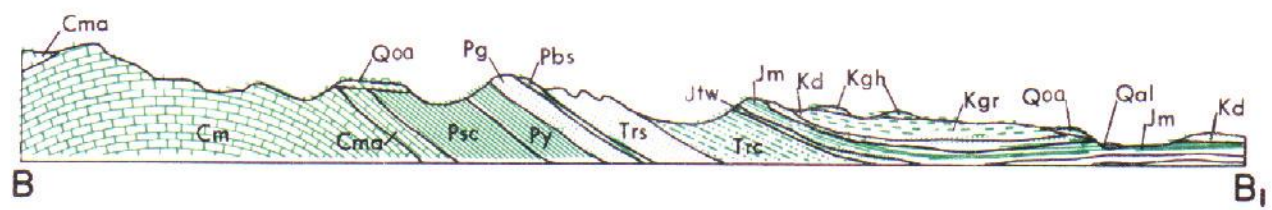
Selected References:

New Mexico Geological Society, 1956, Guidebook of the Southeastern Sangre de Cristo Mountains, 7th Field Conference, 146 p.

Northrop, et. al., 1946, Oil and Gas Investigations, U.S.G.S. Preliminary Map 54.

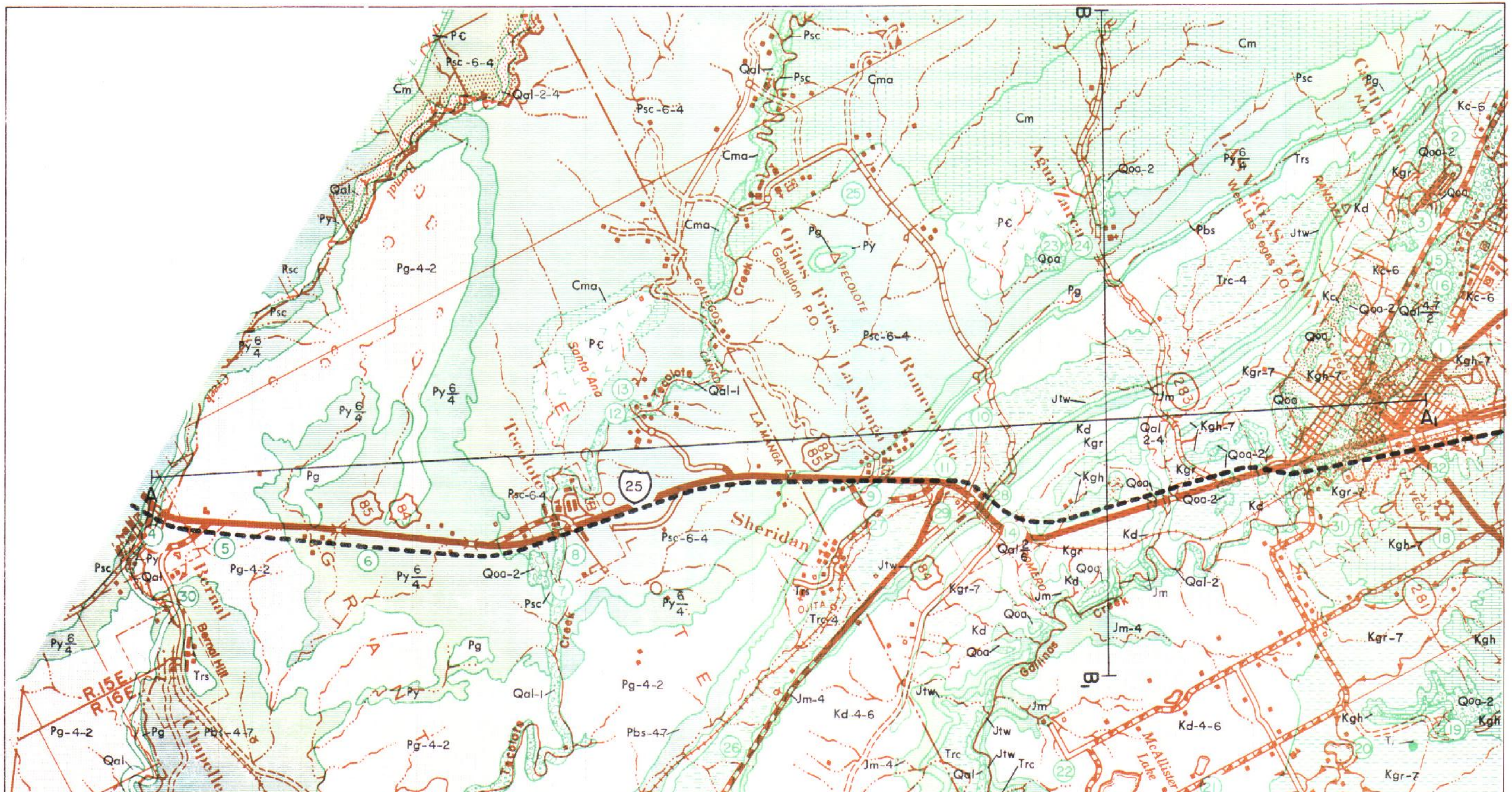
GENERALIZED CROSS-SECTIONS





Note: For explanation of symbols see Soils and Geology map 25-19

SOILS AND GEOLOGY MAP 25-19



— LEGEND —

GEOLOGY MAPPED 1964

SEDIMENTARY ROCKS

Qal	Alluvium	QUATERNARY
Qoa	Older alluvium	QUATERNARY
Kc	Carlile shale	CRETACEOUS
Kgh	Greenhorn limestone	CRETACEOUS
Kgr	Graneros shale	CRETACEOUS
Kd	Dakota sandstone	CRETACEOUS
Jm	Morrison formation	JURASSIC
Jtw	Todilto limestone Wingate sandstone	JURASSIC
Trc	Chinle formation	TRIASSIC
Trs	Santa Rosa sandstone	TRIASSIC
Pbs	Bernal formation San Andres limestone	PERMIAN
Pg	Glorieta sandstone	PERMIAN
Py	Yeso formation	PERMIAN
Psc	Sangre de Cristo formation	PERMIAN
Cma	Madera formation upper arkosic member	CARBONIFEROUS
Cm	Magdalena group	CARBONIFEROUS

OUS ROCKS

Ti	Intrusive	TERTIARY
Pє	Undifferentiated	PRECAMBRIAN

STATUTE MILES

SOILS AND GEOLOGY

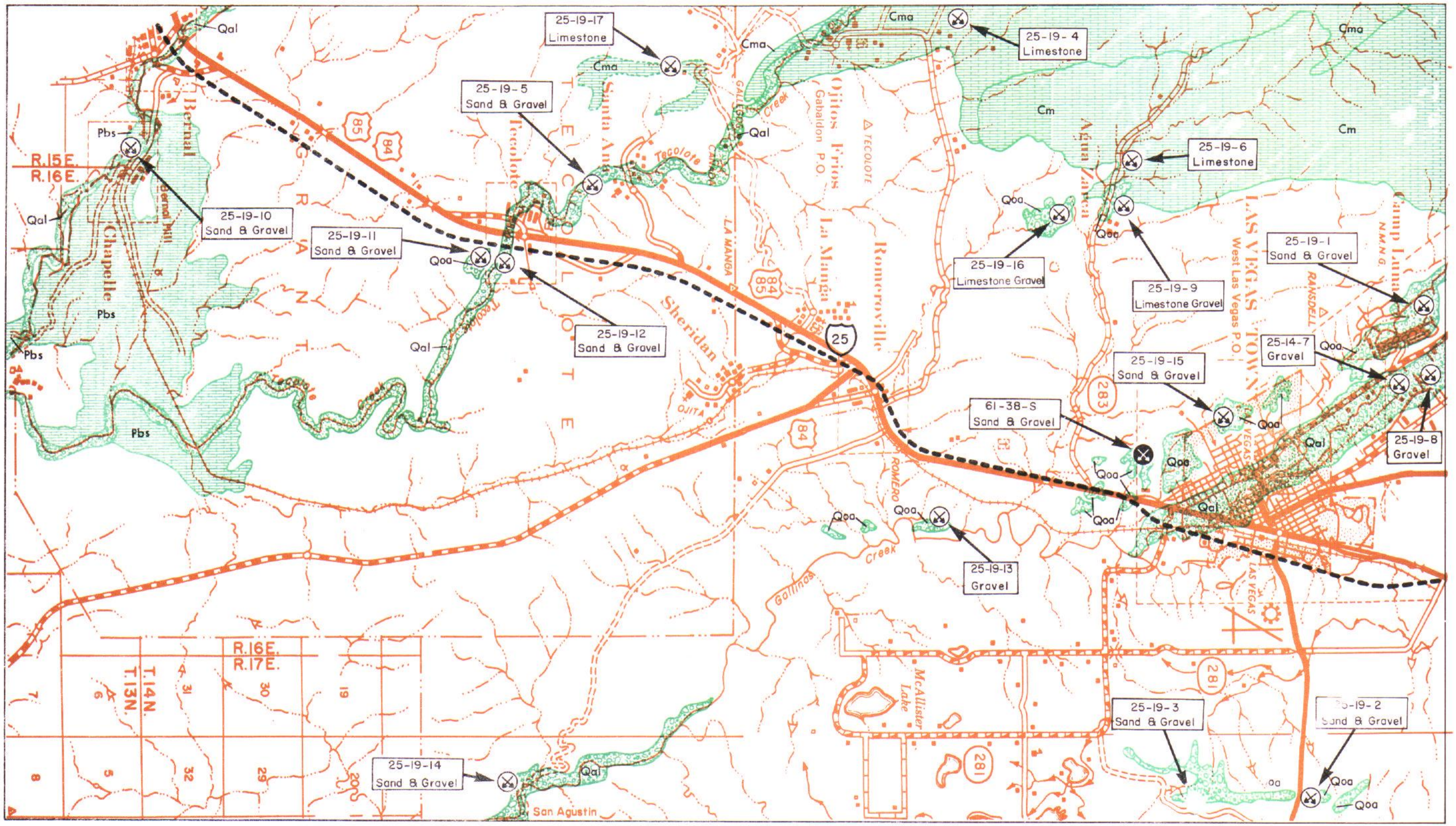
Soils Summary:

Table 25-19-1

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Kc	1	A	0.0	6.0	A-6	Clay
"		B	6.0	8.0	A-4	Silt
"		C	8.0	10.0	A-6	Shale
Qoa	2	A	0.0	0.8	A-2-4	Silty gravel
"		B	0.8	10.0	A-2-4	" "
"		C	10.0	-	A-6	Clay
"	3	A	0.0	1.0	A-2-4	Silty gravel
"		B	1.0	4.0	A-2-4	" "
"		C	4.0	25.0	A-6	Clay
Py	4	A	0.0	2.0	A-6	"
"		B	2.0	7.0	A-4	Silt
"		C	7.0	10.0	A-4	"
Pg	5	A	0.0	1.5	A-4	"
"		B	1.5	3.5	A-4	"
"		C	3.5	5.0	A-6	Clay
Py	6	A	0.0	1.5	A-6	"
"		B	1.5	3.5	A-4	Silt
"		C	3.5	-	A-4	Siltstone
Qal	7	A	0.0	5.0	A-1-b	Coarse sand
Psc	8	A	0.0	2.0	A-4	Silt
"		B	2.0	7.0	A-4	"
"		C	7.0	10.0	A-2-4	Silty gravel
"		D	10.0	-	A-2-4	" "
Pbs	9	A	0.0	1.0	A-4	Silt
"		B	1.0	3.0	A-7	Clay
Trc	10	A	0.0	5.0	A-2-4	Silty sand
"		B	5.0	8.0	A-2-4	" "
"	11	A	0.0	1.0	A-4	Silt
"		B	1.0	5.0	A-4	"
Qal	12	A	0.0	5.0	A-1-a	Sand & gravel
Psc	13	A	0.0	1.5	A-4	Silt
"		B	1.5	5.0	A-4	"
"		C	5.0	8.0	A-4	"
"		D	8.0	-	A-4	"
Qal	14	A	0.0	0.8	A-2-4	Silty sand
"		B	0.8	2.0	A-2-4	" "
Kgr		C	2.0	5.0	A-6	Clay
Qal	15	A	0.0	6.0	A-1-a	Gravel
"	16	A	0.0	2.5	A-4	Silt

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Qal	16	B	2.5	4.0	A-4	Silt
"		C	4.0	6.0	A-4	"
"	17	A	0.0	3.0	A-7	Clay
Kgh	18	A	0.0	1.5	A-7	"
"		B	1.5	5.0	A-7	"
Qoa	19	A	0.0	10.0	A-1-a	Sand & gravel
Kgr	20	A	0.0	1.0	A-7	Clay
"		B	1.0	5.0	A-7	Shale
Kd	21	A	0.0	5.0	A-6	Clay
"	22	A	0.0	3.5	A-4	Silt
Qoa	23	A	0.0	3.0	A-2-6	Clayey gravel
"		B	3.0	15.0	A-2-4	Silty gravel
"		C	15.0	17.0	A-7	Clay
Psc	24	A	0.0	1.0	A-6	"
"	25	A	0.0	3.0	A-6	"
"		B	3.0	10.0	A-6	"
"		C	10.0	13.0	A-2-6	Clayey gravel
"		D	13.0	-	Bedrock	Sandstone
Trc	26	A	0.0	2.0	A-4	Silt
"		B	2.0	5.0	A-4	Siltstone
"	27	A	0.0	10.0	A-4	Silt
"		B	10.0	-	-	Shale
Jm	28	A	0.0	3.0	A-4	"
Trc	29	A	0.0	3.0	A-4	"
Pbs	30	A	0.0	3.0	A-4	Silt
Kgr	31	A	0.0	3.0	A-4	Shale
"	32	A	0.0	3.0	A-7	"

CONSTRUCTION MATERIALS MAP 25-19



TESTED PIT OR QUARRY

PROSPECT PIT OR QUARRY

Qal Sand and gravel

Qoa Sand and gravel

Pbs Limestone

Cma Limestone

Cm Limestone

STATUTE MILES

Material Pit Summary:

Table 25-19-2

Pit or Prospect No.		61-38-S	25-19-1 (Prospect)	25-19-2 (Prospect)	25-19-3 (Prospect)	25-19-4 (Prospect)	25-19-5 (Prospect)
Location	Section	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized
	Twnshp. & Range	Las Vegas Grant	Las Vegas Grant	Las Vegas Grant	Las Vegas Grant	Las Vegas Grant	Tecolote Grant
	County	San Miguel	San Miguel	San Miguel	San Miguel	San Miguel	San Miguel
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Private	Private	Private
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Carboniferous	Quaternary
Formation		Older alluvium	Older alluvium	Older alluvium	Older alluvium	Madera (upper arkosic member)	Alluvium
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Quarry	Fine aggregate
Kind of Material		Mixed aggregate	Mixed aggregate	Mixed aggregate	Mixed aggregate	Limestone	Mixed aggregate
Quality of Material		Good	Good	Good	Good	Good	Good
Thickness of Material		15 feet	3 to 12 feet	10 feet	20 feet	12+ feet	15 feet est.
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	-	-	?	-
Uniformity		Good	Fair	Good	Good	Good	Good
Impurities		Silt lenses	Silt lenses	Silt lenses	Silt lenses	?	Silt pockets
Type of Mat'l. Underlying Formation		Shale	Shale	Shale	Shale	Sandstone & shale	Sandstone & shale
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Wet periodically
Vegetation		-	-	Grass	Grass	Pine, pinon & cedar trees	Scattered willow & cottonwood
Local Terrain		Hilly	Hilly	Mesa	Mesa	Hilly	Stream Valley
Depth of Overburden		6 feet	0 to 5 feet	0 to 3 feet	0 to 3 feet	Trace	-
P.I. (Overburden)		3 to 11	3 to 11	3 to 11	3 to 11	-	-
Est. Reserve Quantity		?	500,000 cu. yds.	200,000 to 300,000 cu. yds.	200,000 to 300,000 cu. yds.	Unlimited	Unlimited
Approx. Haul to Nearest Point		1 mile	5 miles	3.5 miles	3.5 miles	5.5 miles	1.5 miles
L.A. Wear		42	42	36.0	37.6	28.4	40.8
Maximum Size		36"	24"	24"	24"	-	6"
% Retained on 2" Sieve		20 to 25	40	23	25	-	Less than 10
	Crushed to	-	-	-	-	1"	-
Pit Average % Passing	2"	75	60	51	47	-	81
	1"	52	49	36	24	100	69
	3/4"	44	44	32	20	81	67
	1/2"	36	39	26	16	43	64
	#4	23	35	23	14	16	59
	#10	18	29	19	11	8	56
	#200	3	23	15	9	1	6
P.I.		N.P.	3	11	6	N.P.	N.P.
Lab. Numbers		61-17153-17167	62-5930-5932	62-6038	62-5926	64-1140	-

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-19-2

Pit or Prospect No.	25-19-6 (Prospect)	25-19-7 (Prospect)	25-19-8 (Prospect)	25-19-9 (Prospect)	25-19-10 (Prospect)	25-19-11 (Prospect)
Location — Section	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized
Location — Twnshp. & Range	Las Vegas Grant	Las Vegas Grant	Las Vegas Grant	Las Vegas Grant	Tecolote Grant	Las Vegas Grant
Location — County	San Miquel	San Miquel	San Miquel	San Miguel	San Miquel	San Miquel
Location — State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner	Private	Private	Private	Private	Private	Private
Geologic Age	Carboniferous	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation	Madera (lower limestone member)	Alluvium	Alluvium	Older alluvium	Alluvium	Older alluvium
Type of Pit	Quarry	Sand & gravel	Sand & gravel	Gravel	Sand & gravel	Sand & gravel
Kind of Material	Limestone	Mixed aggregate	Mixed aggregate	Limestone	Mixed aggregate	Mixed aggregate
Quality of Material	Good	Fair	Poor	Fair	Fair	Fair
Thickness of Material	?	3 to 12 feet	?	7 to 10 feet	2 to 6 feet	3 to 6 feet
Thickness of Cap (Caliche)	-	-	-	-	-	-
Blasting Qualities	?	-	-	-	-	-
Uniformity	Good	Fair	?	Poor	Fair	Fair
Impurities	Shale lenses (minor)	Silt & clay pockets	Silt & clay	Silt & clay	Shale	Silt & clay
Type of Mat'l. Underlying Formation	Shale	Shale (?)	Shale (?)	Limestone	Limestone	Shale & sandstone
Moisture Condition	Dry	Wet	Wet	Dry	Wet	Dry
Vegetation	Scrub oak, pinon & pine	Willows & river brush	Grass	Scrub Oak, pine, and pinon	None	-
Local Terrain	Mountainous	Stream valley	River valley	Mountainous	Stream valley	Stream terrace
Depth of Overburden	0 to 5 feet	0 to 5 feet	3 to 4 feet	3.5 feet	-	1 to 3 feet
P.I. (Overburden)	9	6 to 17	6 to 17.	17	-	-
Est. Reserve Quantity	Unlimited	?	?	500,000 cu. yds.	?	Less than 10,000 cu. yds.
Approx. Haul to Nearest Point	5 miles	4 miles	5 miles	6 miles	2 miles	0.5 mile
L.A. Wear	22.4	33	46	21.2	-	32.4
Maximum Size	-	36"	36"	10"	3"	12"
% Retained on 2" Sieve	-	8	30	15	1	?
Crushed to	1"	-	-	-	-	3/4"
Pit Average % Passing 2"	-	83	42	83	100	-
1"	100	67	32	61	95	-
3/4"	75	60	29	52	89	100
1/2"	41	53	27	43	86	88
#4	17	42	21	28	76	66
#10	9	35	17	20	59	53
#200	2	10	5	7	1	6
P.I.	N.P.	6	11	13	N.P.	N.P.
Lab. Numbers	64-1137-1139	62-5933	62-6036-6037	62-14902-14905	64-1455	52-5481-5508

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-19-2

Pit or Prospect No.		25-19-12 (Prospect)	25-19-13 (Prospect)	25-19-14 (Prospect)	25-19-15 (Prospect)	25-19-16 (Prospect)	25-19-17
Location	Section	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized
	Twnshp. & Range	Tecolote Grant	Las Vegas Grant	Las Vegas Grant	Las Vegas Grant	Las Vegas Grant	Tecolote Grant
	County	San Miguel	San Miguel	San Miguel	San Miguel	San Miguel	San Miguel
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Private	Private	Private
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary	Carboniferous
Formation		Alluvium	Older alluvium	Alluvium	Older alluvium	Older alluvium	Madera
Type of Pit		Sandy gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Quarry
Kind of Material		Mixed aggregate	Mixed aggregate	Mixed aggregate	Mixed aggregate	Limestone	Limestone
Quality of Material		Good	Fair	Good	Good	Fair	?
Thickness of Material		3 to 10 feet	6 feet avg.	0 to 12 feet	6 to 10 feet est.	12 to 15 feet est.	?
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	-	-	-	?
Uniformity		Good	Poor	Good	?	Good	?
Impurities		Silt	Silt & clay	Silt	Silt	Silt	?
Type of Mat'l. Underlying Formation		?	Sandstone	?	Shale	?	Granite (?)
Moisture Condition		Dry	Dry	Wet	Dry	Dry	Dry
Vegetation		Scattered willow & cottonwood	-	River brush	Grass	Pine, pinon & cedar	Cedar & pinon
Local Terrain		Stream valley	River terrace	Stream valley	Terrace	Mountainous	Hilly
Depth of Overburden		None	1 foot	0 to 3 feet	0 to 3 feet.	1 to 3 feet	?
P.I. (Overburden)		-	14	N.P.	3 to 11	12	?
Est. Reserve Quantity		Unlimited	Unexplored	50 to 100,000 cu. yds.	?	500,000 cu. yds.	?
Approx. Haul to Nearest Point		0.5 mile	0.75 mile	11 miles	2.5 miles	6.0 miles	2.5 miles
L.A. Wear		41	42	40	42	24.4	Unexplored
Maximum Size		12"	12"	18"	36"	8"	"
% Retained on 2" Sieve		15 to 20	10 to 15	23	20 to 25	Less than 10	"
	Crushed to	-	-	-	-	-	"
Pit Average % Passing	2"	81	84	67	75	92	"
	1"	69	63	58	52	76	"
	3/4"	67	57	54	44	70	"
	1/2"	64	50	51	36	60	"
	#4	59	35	44	23	40	"
	#10	56	26	35	18	27	"
	#200	6	6	4	3	5	"
P.I.		N.P.	N.P.	N.P.	N.P.	10.5	"
Lab. Numbers		62-5927	62-14896-14901	64-1456-1457	-	62-14906-14911	

Remarks:

25-19-17 - Limestone outcrop is limited and there is a considerable amount of chert float in the area. There are no weathered faces of limestone in the area.

SOILS AND GEOLOGY

Introduction:

This strip begins at the northern edge of the city of Las Vegas and ends about one half mile south of Watrous near the San Miguel-Mora County Line. It is within the Las Vegas basin, a small sub-division of the Great Plains Province.

There are two main drainageways in the strip. The Sapello River heads in the Sangre de Cristo Mountains and joins the Mora River at Watrous and eventually enters the Canadian River east of Watrous. The Gallinas Creek also heads in the Sangre de Cristo Mountains but it eventually flows into the Pecos River about 21 miles northwest of Santa Rosa. Gallinas Creek becomes Gallinas River below Las Vegas.

General Geology:

This strip lies in a zone of transition from the rugged topography of the Sangre de Cristo Mountains to the monotonous rolling prairies of the Great Plains. It is situated within the Las Vegas-Raton structural basin, a large assymetrical syncline that plunges northward. The steeply dipping western limb of the syncline is broken and overturned in places by the thrust faults that characterize the eastern front of the mountains. The eastern limb of the syncline culminates at the crest of the Sierra Grande arch which lies to the northeast of the mapped area.

The rocks in this area range from Quaternary through Cretaceous. The Greenhorn limestone covers about one half of the strip. Cretaceous shales and the Dakota sandstone cover most of the remaining half.

During the Pleistocene and Recent epochs a veneer of clays, silts, sands and gravels, older alluvium (Qoa), apparently blanketed the plains area east of the hogback. Erosion has stripped most of this material away except for a few high-level deposits that are scattered throughout the strip.

North of the Sapello River this older alluvium seems to be of glacial origin. Many of the larger boulders (up to 24 inches in diameter) have striations which indicate glacial activity.

A heterogeneous mixture of clay, silt, sand and gravel lies on the floor of Gallinas Creek and the Sapello River.

Two small intrusive bodies appear in this strip. They are believed to be a diabase or some related basic igneous rock.

The areal distribution of formations is shown on Soils and Geology Map 25-20. Their succession and Character are given under the section termed "Stratigraphy."

Soils:

Alluvium (Qal): These soils occur on the floors of the Sapello River and the Gallinas Creek. Sand and gravel lie in discontinuous bars among deposits of silt and clay.

Older alluvium (Qoa): The soils of these deposits vary extremely throughout the strip. Near the Gallinas Creek, east of Las Vegas along S.R. 65, and near the Sapello River these deposits are primarily gravel, the soil types vary from clayey gravel (A-2-6) to sand and gravel (A-1-a). The gravelly soils are usually covered by a 3 to 6 foot layer of clay (A-7) or silt (A-4).

The deposits that lie south of the Sapello River, beyond the terraced edge of the older alluvium are interbedded silts, clays, and sands.

To the east of U.S. 85 in the northeast part of the strip the older alluvium is caliche with a silty soil cover.

Residual soils: The soils overlying the Greenhorn limestone, the Carlisle shale, and the Graneros shale are clay (A-7). They vary in depth from 0 to 15 feet. The Dakota sandstone has a silt (A-4) cover from 0 to 4 feet thick.

Table 25-20-1 shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-20.

Stratigraphy:

Quaternary: Alluvium (Qal) - clay, silt, sand and gravel.
Thickness: 0 to 20 feet.

Older alluvium (Qoa) - clay, silt, sand and gravel, and caliche.
Thickness: 0 to 20 feet.

Unconformity--

Tertiary: Intrusives (QTi) - dark-gray to greenish-black igneous dykes.

Unconformity--

Cretaceous: Carlisle shale (Kc) - dark-gray shale with interbeds of sandstone siltstone and mudstone.
Thickness: 200 to 300 feet.

Greenhorn limestone (Kgh) - dark-gray to black limestone with interbedded shale.
Thickness: 50 feet.

Graneros shale (Kgr) - dark to- medium-gray shale with thin beds of argillaceous limestone.
Thickness: 250 feet.

Dakota sandstone (Kd) - white to- light-gray sandstone. Weathers buff to tan.

Stratigraphy continued...

Dakota sandstone continued...
Interbedded bluish-gray shale.

Construction Materials:

Quaternary: Alluvium (Qal) - There are local areas in the Sapello River and the Gallinas Creek that may be suitable for highway aggregate; although, most of the deposits do have P.I. Pits 58-90-S, 58-91-S, and 25-20-S are located in these deposits.

Older alluvium (Qoa) - The pits along the Sapello River, near Lake Isabel, and immediately north of Las Vegas seem to have the most desirable materials in these deposits. These deposits also have a high percentage of clay but they have been used for highway construction in the past. Pits 57-63-S, 59-33-S, 62-54-S and 25-20-4 are in these deposits.

There is a relatively large deposit of caliche on top of the Greenhorn limestone at Coley Triangulation Station. Further exploration may reveal a vast quantity of suitable highway material in this caliche.

Cretaceous: Dakota sandstone (Kd) - Since good highway materials are relatively scarce in this area it might be worth-while to explore the possibilities of using this sandstone. The exposures are very extensive in the north part of this strip. A sample taken from the old railroad quarry at Watrous showed a L.A. Wear of 55.6. Even though this does not meet present materials specifications, further research may develop some use for this rock.

Carboniferous: Magdalena group (Cm) - The material proposed for use is limestone in the Madera formation. There are numerous limestone outcrops in the area mapped west of the hogback, but many of them will not make usable quarries because of their limited areal extent and their cover of sandstone and shale. Most of the material west of the hogback is very difficult to reach. The two most accessable areas are at Montezuma and Mascarenas. At pits 25-20-1 and 25-20-2 there are good exposures of pure crystalline limestone.

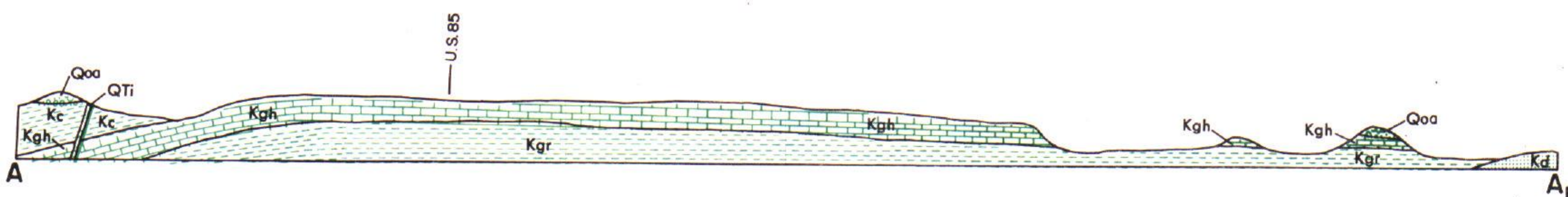
Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-20. Test data and other related information are shown in Material Pit Summary Table 25-20-2.

Selected References:

Bachman, G. O., and Dane, Carle H., 1962, Preliminary Geologic Map of the Northeastern Part of New Mexico, U.S.G.S. Map I-358.

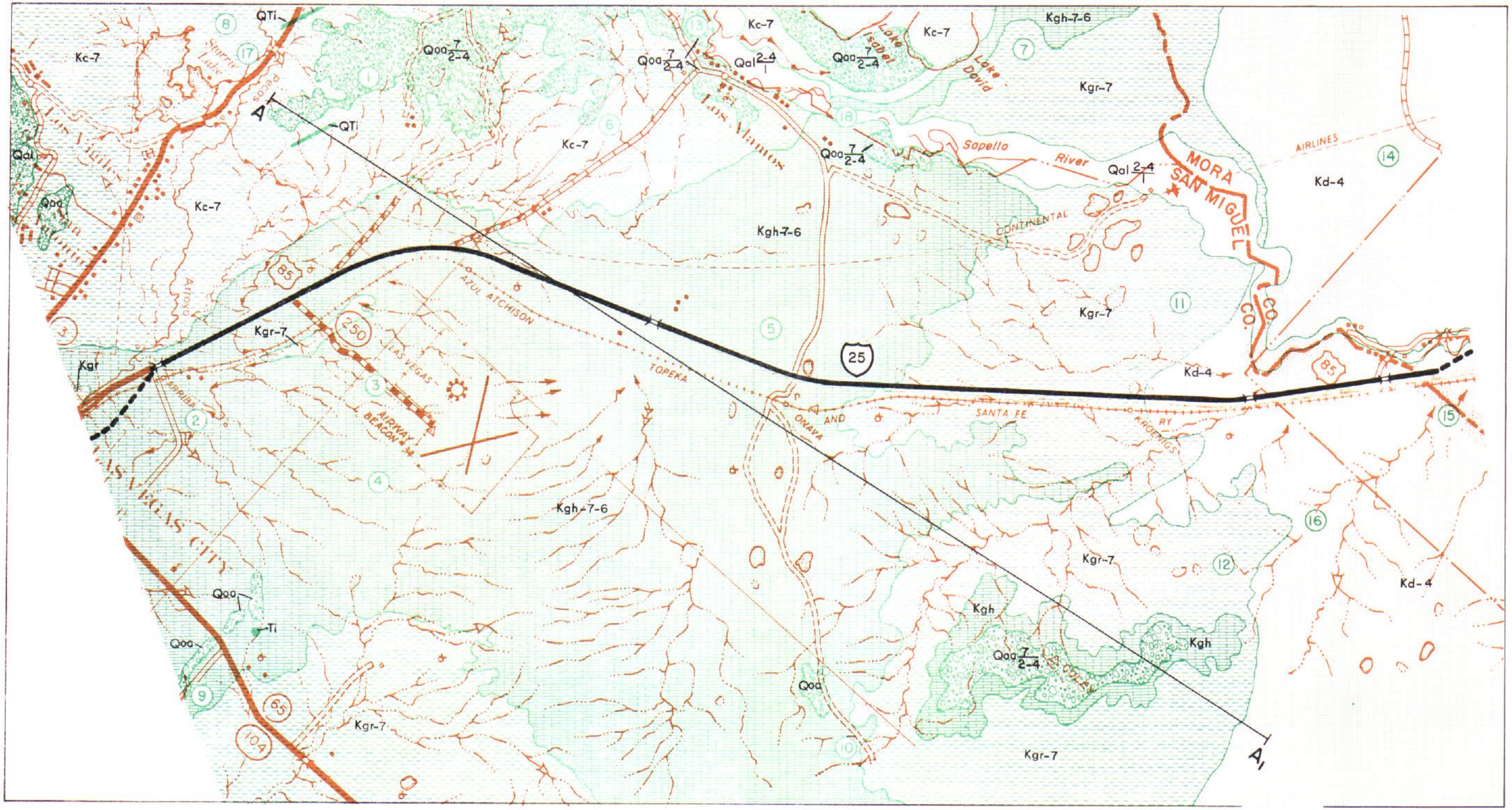
Griggs, R. L., and Hendrickson, G. E., 1951, Geology and Ground-Water Resources of San Miguel County, New Mexico, N.M. Bur. of Mines and Mineral Resources, Ground Water Report 2.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-20

SOILS AND GEOLOGY MAP 25-20



-LEGEND-

GEOLOGY MAPPED 1964

SEDIMENTARY ROCKS

Qal	Alluvium	QUATERNARY
Qoa	Older alluvium	QUATERNARY
Kc	Carlile shale	CRETACEOUS
Kgh	Greenhorn limestone	CRETACEOUS
Kgr	Graneros shale	CRETACEOUS
Kd	Dakota sandstone	CRETACEOUS

IGNEOUS ROCKS

QTi	Intrusive	TERTIARY QUATERNARY
Ti	Intrusive	TERTIARY

STATUTE MILES

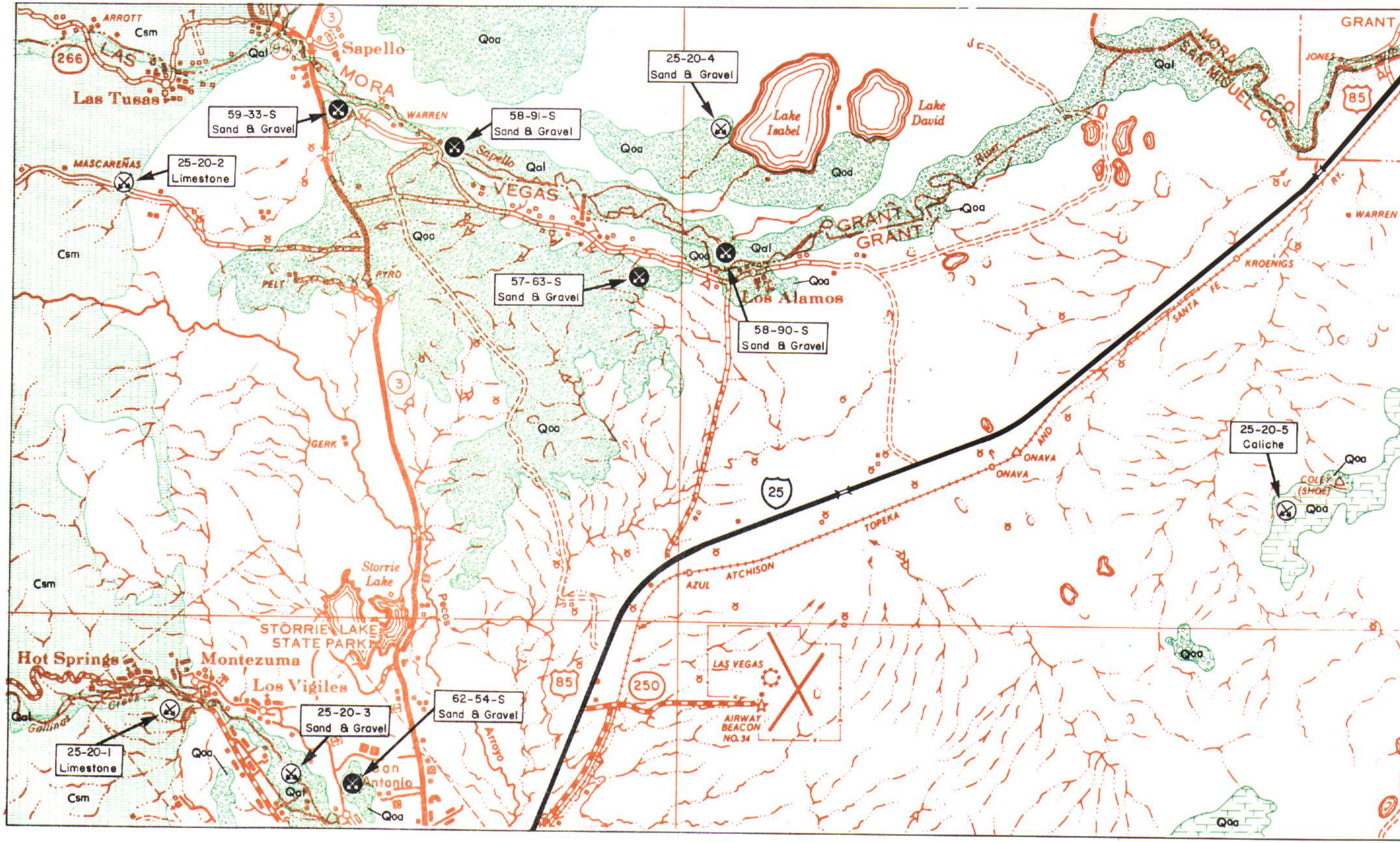
SOILS AND GEOLOGY

Soils Summary:

Table 25-20-1

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Qoa	1	A	0.0	4.0	A-7	Clay
"		B	4.0	20.0	A-2-4	Silty gravel
Kc		C	20.0	30.0	A-4	Shale
Kgh	2	A	0.0	5.0	A-6	Clay
"	3	A	0.0	4.0	A-6	Clay
"		B	4.0	10.0	Bedrock	Limestone
"	4	A	0.0	4.0	A-7	Clay
"		B	4.0	10.0	Bedrock	Limestone
"	5	A	0.0	10.0	A-7	Clay
"		B	10.0	11.0	Bedrock	Limestone
Kc	6	A	0.0	2.0	A-7	Clay
"		B	2.0	10.0	Bedrock	Shale
Kgr	7	A	0.0	4.0	A-7	Clay
"		B	4.0	15.0	Bedrock	Shale
Kc	8	A	0.0	1.0	A-7	Clay
"		B	1.0	10.0	Bedrock	Shale
Kgh	9	A	0.0	4.0	A-7	Clay
"		B	4.0	10.0	Bedrock	Limestone
"	10	A	0.0	3.0	A-7	Clay
"		B	3.0	10.0	Bedrock	Limestone
Kgr	11	A	0.0	4.0	A-7	Clay
"		B	4.0	10.0	Bedrock	Limestone
"	12	A	0.0	5.0	A-6	Clay
"		B	5.0	10.0	Bedrock	Shale
Qoa	13	A	0.0	2.0	A-4	Silt
		B	2.0	10.0	A-2-6	Clayey gravel
Kd	14	A	0.0	3.0	A-4	Silt
"		B	3.0	10.0	Bedrock	Sandstone
"	15	A	0.0	3.0	A-4	Silt
"		B	3.0	10.0	Bedrock	Sandstone
"	16	A	0.0	4.0	A-4	Silt
"		B	4.0	10.0	Bedrock	Sandstone
Kc	17	A	0.0	20.0	A-4	Black fissle shale & silty shale
"		B	20.0	30.0	Bedrock	Shale
Qal	18	A	0.0	1.2	A-4	Silt
"		B	1.2	6.0	A-1-a	Sand & gravel

CONSTRUCTION MATERIALS MAP 25-20



-LEGEND-

TESTED PIT OR QUARRY

PROSPECT PIT OR QUARRY

Qal — Sand and gravel

Qoa — Sand, gravel and caliche

Csm — Madera limestone

STATUTE MILES

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-20-2

Pit or Prospect No.	57-63-S	58-90-S	58-91-S	59-33-S	62-54-S	25-20-1 (Prospect)	25-20-2 (Prospect)
Location: Section	Not sectionalized	Not Sectionalized	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized
Location: Twnshp. & Range	Las Vegas Grant	Las Vegas Grant	Mora & Las Vegas Grant	Las Vegas Grant	Las Vegas Grant	Las Vegas Grant	Las Vegas Grant
Location: County	San Miguel	San Miguel	San Miguel	San Miguel	San Miguel	San Miguel	San Miguel
Location: State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner	Private	Private	Private	Private	Private	Private	Private
Geologic Age	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary	Carboniferous	Carboniferous
Formation	Older Alluvium	Alluvium	Alluvium	Older alluvium	Older Alluvium	Madera	Madera
Type of Pit	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Quarry	Quarry
Kind of Material	Mixed aggregate	Mixed aggregate	Mixed aggregate	Mixed aggregate	Mixed aggregate	Limestone	Limestone
Quality of Material	Fair	Good	Fair	Fair	Fair	Good	Excellent
Thickness of Material	12 feet	2 to 5 feet	4 to 5 feet	6 feet	15+ feet	100 feet	10+ feet
Thickness of Cap (Caliche)	-	-	-	-	-	-	-
Blasting Qualities	-	-	-	-	-	Good	-
Uniformity	Fair	Fair	Fair	Fair	Fair	Good	Good
Impurities	Silt & clay	Clay lenses noted	Clay seams	Silt & clay	Clay	Shale interbeds	None noted
Type of Mat'l. Underlying Formation	Shale	Shale	Shale	Shale	Shale	Shale	Shale
Moisture Condition	Dry	Dry	Dry	Dry	Dry	Dry	Dry
Vegetation	Range grass	Prairie grasses	Prairie grasses	Range grass	Sparse	Juniper, pinon & pine	Pine, pinon & cedar
Local Terrain	Rolling hills	Stream valley	Flat to rolling	Rolling hills	Flat-top terrace	Mountainous	Mountainous
Depth of Overburden	3 feet	0 to 2 feet	1 to 2 feet	2.5 feet	4 feet	-	-
P.I. (Overburden)	8	6	6 to 7	18	12	-	-
Est. Reserve Quantity	200,000 cu. yds	?	?	See remarks	500,000 cu. yds.	Unlimited	Unlimited
Approx. Haul to Nearest Point	5 miles	4.0 miles	4.0 miles	9 miles	2.5 miles	6 miles	10 miles
L.A. Wear	44	42	52.4	30	33.6	30	23
Maximum Size	12"	12"	12"	24"	4"	-	-
% Retained on 2" Sieve	35	20	42	63	37	-	-
Crushed to	-	-	-	-	-	1"	1"
Pit Average % Passing 2"	65	80	58	37	63	-	-
1"	50	58	50	27	49	100	100
3/4"	43	50	47	25	43	92	92
1/2"	36	45	43	22	39	58	55
#4	28	36	36	19	30	22	20
#10	21	27	31	16	22	12	10
#200	6	3	12	5	6	2	2
P.I.	8	6	14	5	11	N.P.	N.P.
Lab. Numbers	57-10824-10827	58-17711-17731	63-7770-7771	59-4740-4762	62-16450-16469	62-6035	63-11646

Remarks:

59-33-S - This pit is presently being worked by state maintenance crews. (Feb., 1964)

25-20-1 (Prospect) - This pit is located on a hill south of Montezuma and west of the Peterson reservoir.

25-20-2 (Prospect) - This site lies about 4 miles west of S.R. 3 along the Las Dispensas Road. The Las Dispensas road leads away from S.R. 3 about 3 miles south of Sapello. Limestone crops out in several areas in the wooded mountainous region.

AGGREGATE RESOURCES AND SOILS STUDY
NEW MEXICO INTERSTATE ROUTE 25
LAS VEGAS-MORA COUNTY LINE

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-20-2

Pit or Prospect No.		25-20-3 (Prospect)	25-20-4 (Prospect)	25-20-5 (Prospect)
Location	Section	Not sectionalized	Not sectionalized	Not sectionalized
	Twnshp. & Range	Las Vegas Grant	Mora Grant	Las Vegas Grant
	County	San Miguel	San Miguel	San Miguel
	State	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private
Geologic Age		Quaternary	Quaternary	Quaternary
Formation		Alluvium	Older alluvium	Older alluvium
Type of Pit		Sand & gravel	Sand & gravel	Quarry
Kind of Material		Mixed aggregate	Mixed aggregate	Caliche
Quality of Material		Fair	Fair	?
Thickness of Material		12 feet	?	3 to 6 feet
Thickness of Cap (Caliche)		-	-	-
Blasting Qualities		-	-	-
Uniformity		Fair	?	?
Impurities		Silt & clay lenses	Silt & clay	?
Type of Mat'l. Underlying Formation		Shale	Shale	Limestone & shale
Moisture Condition		Dry	Dry	Dry
Vegetation		Grass	Range grass	Range grass
Local Terrain		Stream valley	Plain	Hilly
Depth of Overburden		0 to 3 feet	3 to 6 feet	?
P.I. (Overburden)		9 to 11	13.6	?
Est. Reserve Quantity		?	?	?
Approx. Haul to Nearest Point		5 miles	7 miles	3 miles
L.A. Wear		46.	42.8	Unexplored
Maximum Size		36"	12"	"
% Retained on 2" Sieve		30	15 to 20	"
Pit Average % Passing	Crushed to	-	-	"
	2"	42	75	"
	1"	32	61	"
	3/4"	29	50	"
	1/2"	27	44	"
	#4	21	29	"
	#10	17	10	"
	#200	5	5	"
P.I.		11	7.5	"
Lab. Numbers		62-6036-6037	64-761-762	

Remarks:

25-20-3 (Prospect) - Pit is in the following described property: Point of beginning - Southwest corner Montezuma College Farm, thence N. 51° 31' E for 1,362 feet to center of Gallinas River, thence S. along River 2,330 feet, thence S. 53° 38' W. for 1,351 feet, thence N. along A.T.S.F. Railroad N. 37° 15' W. for 2,330 feet to point of beginning.

SOILS AND GEOLOGY

Introduction:

This strip begins south of Watrous near the San Miguel-Mora County Line and ends about 3 miles south of Wagon Mound. It lies in the Las Vegas-Raton basin in the Great Plains Province. The Las Vegas-Raton basin is bounded on the west by a hogback of steeply dipping sedimentary rocks which marks the eastern boundary of the southeastern Sangre de Cristo Mountains. The eastern boundary of the basin culminates at the crest of the Sierra Grande arch.

This area is characterized by rolling prairie-lands, typical of the Great Plains. It is broken by an extensive flow of basalt near the middle of the strip. A part of Turkey Mountain lies in the northwest part of the strip.

The Mora River is the main drainage of the area. It heads in the Sangre de Cristo Mountains and flows generally east and joins the Canadian River east of Watrous.

General Geology:

The rocks exposed in this strip range from Triassic through Quaternary in age, a period of over 230 million years. Many of the rocks which once lay in this area have been removed by Recent erosion.

The oldest formation exposed in the strip is the Chinle sandstone and shale. The Chinle formation was deposited during the Triassic period on land, by streams and in shallow lakes, when this part of the state was an extensive plain.

This area remained a featureless rolling plain during most of the Jurassic period. A shallow sea advanced over the land in late Jurassic time and the Todilto limestone and gypsum were deposited. Dune sands that formed on the advancing shores of this sea consolidated into the Wingate sandstone (referred to by some as the Ocate sandstone.) Later, as the sea withdrew, the salty basin was covered by the varicolored sands and clays of the Morrison formation.

The Todilto limestone, Wingate sandstone, and the lower Morrison formation are included in the San Rafael group on the Soils and Geology Map. The upper part of the Morrison formation is mapped as a single unit.

Cretaceous time was one of great contrast in this area. The seas advanced and withdrew many times. Black, limy muds were deposited beyond the littoral zone in the deeper part of the Cretaceous sea. Stream sands and coal beds lie landward from the beach sands which are interbedded with the limy materials toward the deeper part of the sea. The Dakota sandstone is the lowest of these rocks. It was laid down as strand deposits of the advancing sea. The limy materials have subsequently become the Graneros shale, the Greenhorn limestone, the Carlisle shale, the Fort Hays limestone, and the Pierre shale.

The Dakota sandstone is the most extensive outcropping unit in this strip. Most of the upper units (Fort Hays limestone, Pierre shale, and Carlisle shale) have been removed from this strip by erosion.

Toward the end of the Cretaceous the Laramide "Revolution" began and this area emerged from the sea. A mountain range arose in the vicinity of the present Sangre de Cristo Range and erosional sands and gravels were dumped in the Raton Basin area. The formations of this particular period of deposition have been removed from this strip by erosion.

During the Cenezoic Era the Sangre de Cristo Range was formed, and this area became a basin of deposition. All of the deposits of early Cenezoic time have been stripped from this area by erosion. Near Raton some of the early Tertiary deposits remain today.

Turkey Mountain is a dome-shaped laccolithic structure which lies in an area of relatively undeformed rocks. The age of this intrusion is problematical; however, it is believed to be associated with the Laramide upheaval.

During late Tertiary or early Quaternary time a volcano erupted southeast of Turkey Mountain and deposited an extensive flow of basalt. This may be a result of the emition of molten rock through fractures which formed during the emplacement of the Turkey Mountain laccolith.

A blanket of debris from the Sangre de Cristo Mountains probably covered most of this area during the Pleistocene epoch. Remnants of pediment deposits occur locally over the strip. West of the strip these deposits are much more extensive and some of the boulders amoung the deposits show evidence of glacial activity.

Recent erosion and removal of older sediments developed the present pattern of drainage and topography of today.

The areal distribution of formations is shown on Soils and Geology Map 25-21. Their succession and character are given under the section termed "Stratigraphy."

Soils:

Alluvium (Qal): Alluvial soils occur in and along the present day streams. In the present channel of the Mora River the soils are sand and gravel (A-1-a). Along the flood banks of this channel are slack-water deposits of silty-sand which overlie the sand and gravel. Most of these materials are derived from the Sangre de Cristo Mountains, but they do include a few sandstone particles from the Dakota sandstone.

Wolf Creek seems to have been a much larger stream in the past than it is today. The stream was apparently choked up with well-rounded, well-washed sands and gravels as it reached its profile of equilibrium. It subsequently became silted over and a fairly thick cover of grass covered the low area. The present run-off is beginning to develop pot-holes and narrow, discontinuous, elongated channels in the early deposits. At hole 18 there is a 5 foot cover of clay (A-6) over an undetermined thickness of silty gravel (A-2-4). Similar conditions exist at hole 15 in the north part of the strip.

Pediment deposits (Qp): These are very isolated deposits of silt, sand and gravel that have become

Soils continued...

indurated near the top by calcium carbonate (caliche). At hole 14 there is from 2 to 3 feet of caliche and clay (A-6) overlying about 6 feet of coarse-grained sand and gravel.

Residual soils: The soils overlying the basalt and the Dakota sandstone are predominantly silt (A-4). They vary from 2 to about 6 feet in thickness and in some places they have become indurated by calcium carbonate.

The Greenhorn limestone has a cover of clay (A-6 and A-7) which varies from 4 to 10 feet in thickness.

The soil cover on the Graneros shale varies from silt (A-4) to clay (A-6 and A-7). This formation has thin beds of bentonitic shale which adds to the high plasticity of the residual cover. These soils will also vary from 4 to about 10 feet in thickness.

Table 25-25-1 shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-21.

Stratigraphy:

Quaternary: Alluvium (Qal) - non-uniform discontinuous deposits of clay, silt, sand and gravel.
Thickness: 0 to 20 feet.

Pediment deposits (Qp) - clay, silt, sand, and gravel which may be partly consolidated with calcium carbonate (caliche).
Thickness: 0 to 10 feet.

Unconformity---

Quaternary-Tertiary: Basalt (QTb) - dense to vesicular, black to gray olivine basalt.

Unconformity---

Cretaceous: Greenhorn limestone (Kgh) - alternately bedded, dark-gray to black, finely-crystalline limestone and dark-gray shale.
Thickness: 15 to 35 feet.

Graneros shale (Kgr) - dark-gray to black, fissile shale with thin interbeds of orange-brown bentonitic clay.

Dakota sandstone (Kd) - white to light-gray to tan, fine-grained, crossbedded sandstone with a middle member of bluish-gray shale.

Unconformity---

Jurassic: Morrison formation (Jm) - light-gray sandstone and mottled dark red shale overlain by grayish-green shale.

San Rafael group (Jsr) - This group has three units: The upper unit (Wanakah formation, equivalent to lower Morrison) is interbedded, buff to pale-red sandstone and green to brownish-red siltstone; the middle unit is the thinly-laminated, gray Todilto limestone; the lower unit is the buff colored, massive Wingate sandstone.
Thickness: 90 feet. approx.

Note: The above formations have been mapped as a group because of their limited outcrop in Turkey Mountain.

Unconformity---

Triassic: Chinle formation (Trc) - maroon to red, fine-grained siltstone, sandstone, and shale with some arenaceous limestone.
Thickness: 200 to 300 feet.

Construction Materials:

Quaternary: Alluvium (Qal) - The Mora River is the main source of supply for good aggregate in this strip. Pit 55-34-S is an example of this material. There seems to be an almost unlimited supply of good sand and gravel in and near the main channel of the river. This gravel seems to be under the flood plain adjacent to the present stream. Small farms will restrict the development of materials on the flood plain; but, there are several areas of waste land near the river that will be suitable for pit sites.

Dog Creek and the creek at Pit 25-21-4 are favorable areas for aggregate. As explained in the soils report these creeks seem to have been choked up with gravel as they attained their profile of equilibrium, then they became broad flat grassy bottomed swales, now the present drainage is beginning to cut through the early deposits of gravel. Further exploration may reveal large supplies of good aggregate in these creeks.

Pediment deposits (Qp) - There are a few isolated pediment deposits in this strip with small quantities of gravel. Most of them will have plastic fines. Pit 25-21-2 (an old maintenance pit) seems to be the most desirable of these deposits; however, the quantity is quite limited. Further exploration may reveal usable quantities of materials in the other pediment deposits of this strip.

Quaternary-Tertiary: Basalt (QTb) - Basaltic cinders have been used for road construction on U.S. 85 in this strip. Pits were developed in the cinder cones that form the vents for the basalt flows in the north part of the strip. These cinders make a very poor aggregate because of their instability; therefore, they are not shown as a construction material for this strip.

Construction Materials continued...

Since suitable materials are relatively scarce in this area it is suggested that the basalt flow in the center of the strip be thoroughly investigated. There is a good exposure of very dense rock at Pit 25-21-1. Further exploration may reveal a vast quantity of suitable quarry rock in this flow.

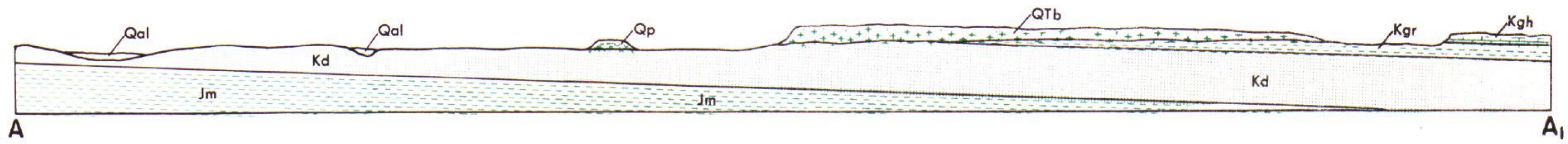
Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-21. Test data and other related information are shown in Material Pit Summary Table 25-21-2.

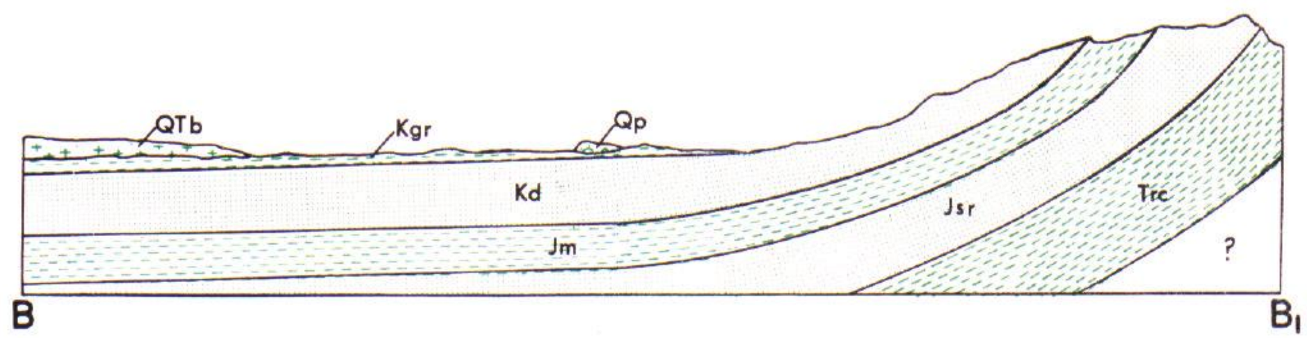
Selected References:

New Mexico Geological Society, 1956, Guidebook of the Southeastern Sangre de Cristo Mountains, 7th Field Conference.

U.S.G.S., 1962, Preliminary Geology Map of the Northeastern Part of New Mexico, Map I-348.

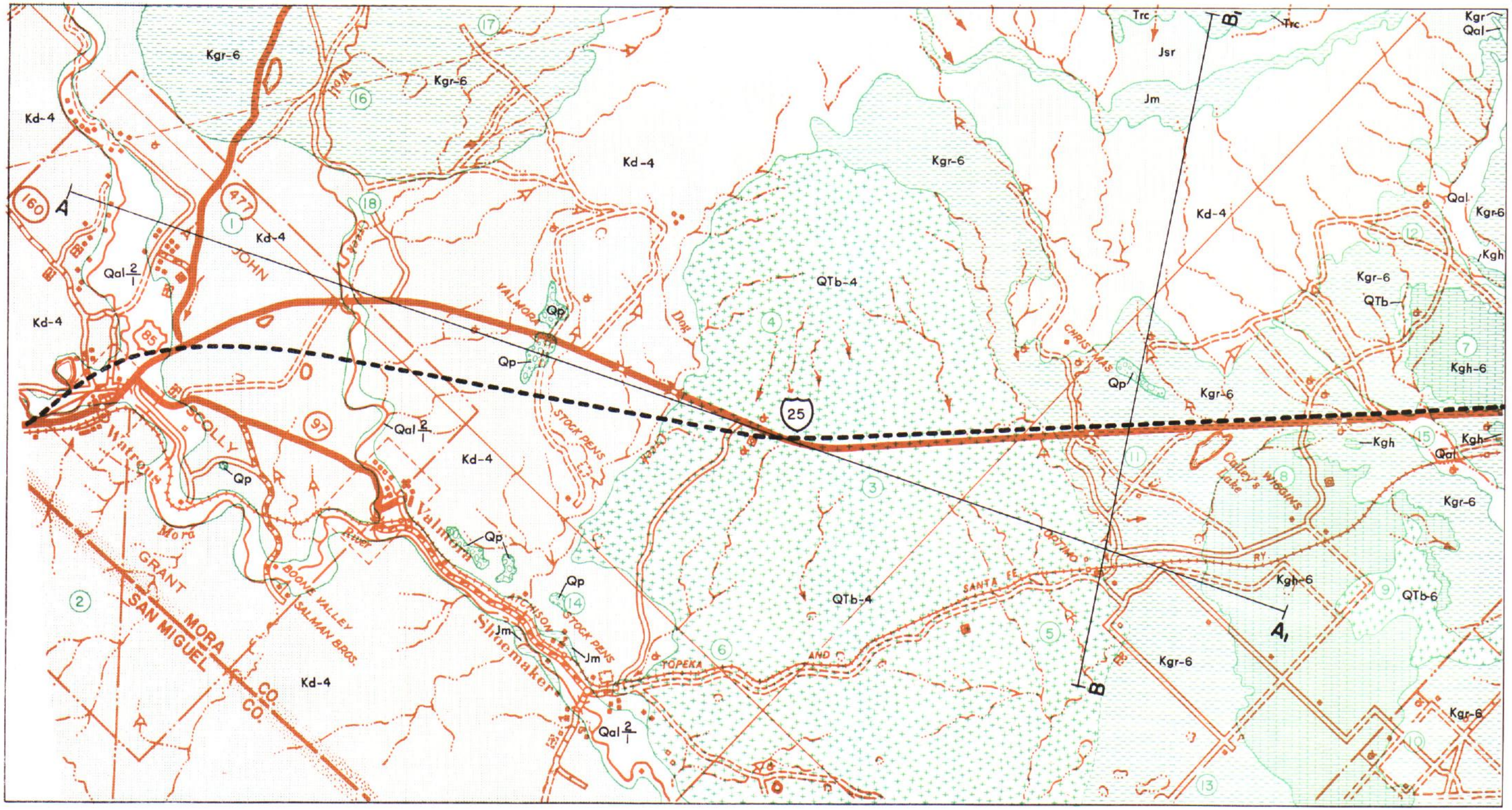
GENERALIZED CROSS-SECTIONS





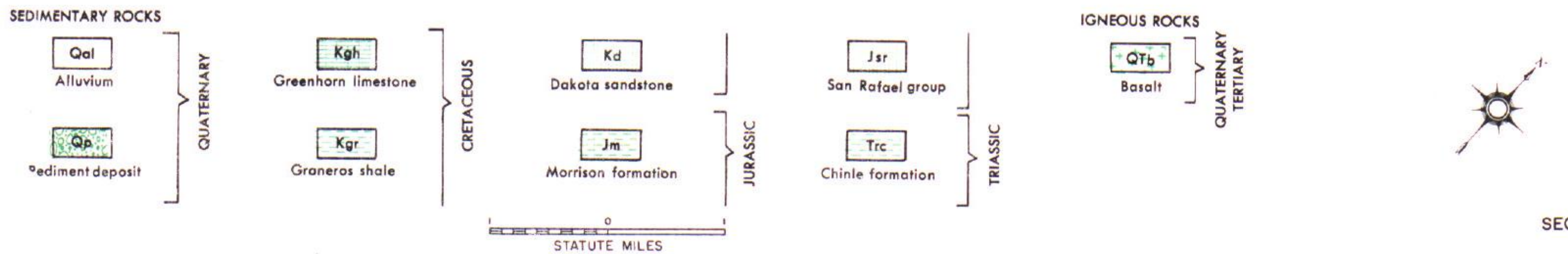
Note: For explanation of symbols see Soils and Geology map 25-21

SOILS AND GEOLOGY MAP 25-21



-LEGEND-

GEOLOGY MAPPED 1964



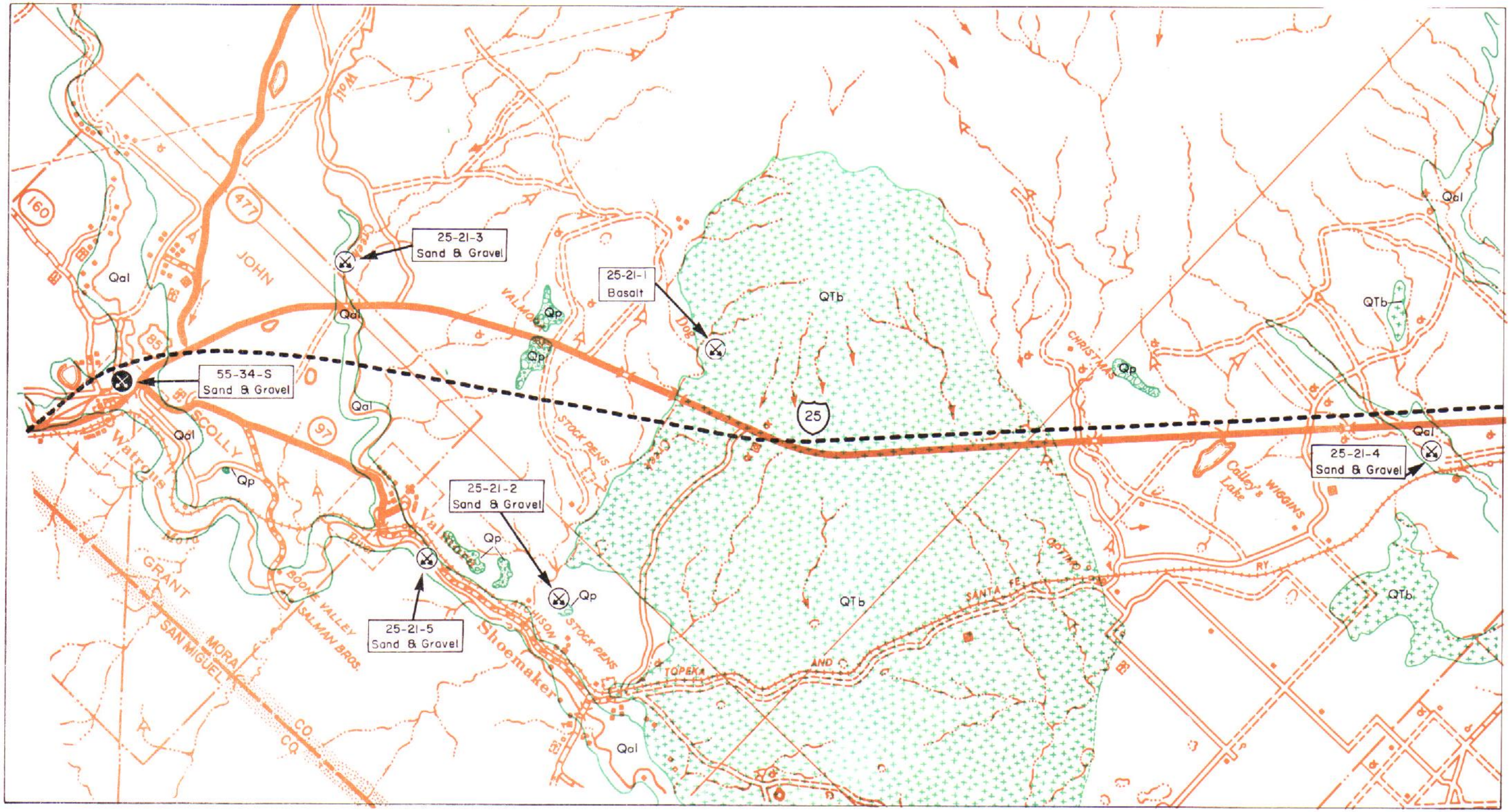
SOILS AND GEOLOGY

Soils Summary:

Table 25-21-1

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Kd	1	A	0.0	1.0	A-4	Silt
"		B	1.0	10.0	Bedrock	Sandstone
"	2	A	0.0	0.5	A-4	Silt
"		B	0.5	12.0	Bedrock	Sandstone
Qb	3	A	0.0	3.0	A-4	Silt
"		B	3.0	10.0	Bedrock	Basalt
"	4	A	0.0	1.0	A-4	Silt
"		B	1.0	10.0	Bedrock	Basalt
"	5	A	0.0	0.5	A-4	Silt
"		B	0.5	5.0	Bedrock	Basalt
"	6	A	0.0	1.5	A-4	Silt
"		B	1.5	7.0	Bedrock	Basalt
Kgh	7	A	0.0	4.0	A-6	Clay
"		B	4.0	10.0	Bedrock	Limestone
"	8	A	0.0	5.0	A-6	Clay
"		B	5.0	10.0	Bedrock	Limestone
QTb	9	A	0.0	15.0	A-6	Clay
"		B	15.0	20.0	Bedrock	Basalt
Kgh	10	A	0.0	6.0	A-7	Clay
"		B	6.0	10.0	Bedrock	Limestone
Kgr	11	A	0.0	3.0	A-6	Silty clay
"		B	3.0	6.0	Bedrock	Shale
"	12	A	0.0	4.0	A-7	Clay
"		B	4.0	7.0	Bedrock	Shale
"	13	A	0.0	5.0	A-7	Clay
"		B	5.0	10.0	Bedrock	Shale
Qp	14	A	0.0	3.5	A-6	Clay
"		B	3.5	10.0	A-1-a	Sand & gravel
Qal	15	A	0.0	4.0	A-4	Silt
"		B	4.0	8.0	A-2-4	Silty gravel
Kgr	16	A	0.0	4.0	A-6	Clay
"		B	4.0	10.0	Bedrock	Shale
"	17	A	0.0	3.0	A-6	Silty clay
"		B	3.0	10.0	Bedrock	Shale
Qal	18	A	0.0	5.0	A-6	Clay
"		B	5.0	12.0	A-2-4	Silty gravel
"	19	A	0.0	1.0	A-2-4	Silty sand
"		B	1.0	10.0	A-1-a	Sand & gravel

CONSTRUCTION MATERIALS MAP 25-21



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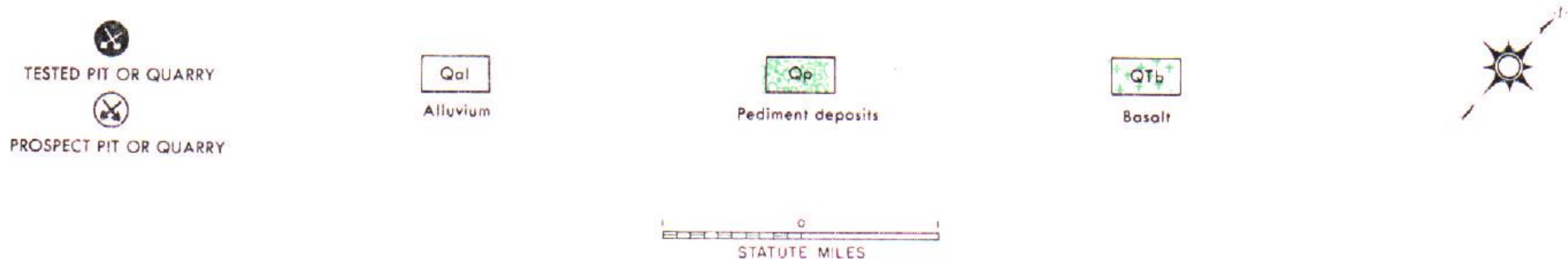


CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-21-2

Pit or Prospect No.		25-21-1	25-21-2	25-21-3	25-21-4	25-21-5	55-34-S
	Section	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized
Location	Twnshp. & Range	John Scolly Grant	John Scolly Grant	Grant Land	Grant Land	Grant Land	John Scolly Grant
	County	Mora	Mora	Mora	Mora	Mora	Mora
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Private	Private	Private
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Basalt	Pediment deposits	Alluvium	Alluvium	Alluvium	Alluvium
Type of Pit		Quarry	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Basalt	Mixed aggregate	Mixed aggregate	Mixed aggregate	Mixed aggregate	Mixed aggregate
Quality of Material		Good	Good	Good	Fair	Good	Good
Thickness of Material		10+ feet.	4 to 5 feet	10 feet	5+ feet	5+ feet	10+ feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		?	-	-	-	-	-
Uniformity		Good	Fair	Fair	?	Good	Good
Impurities		None	Clay seams	Clay lenses	Clay lenses	None	None
Type of Mat'l. Underlying Formation		Shale & sandstone	Sandstone (Dakota)	Sandstone	Shale	?	?
Moisture Condition		Dry	Dry	Dry	Dry	Wet	Water, 7 to 10 feet
Vegetation		Grass	Grass	Grass	Grass	Cottonwood & river brush	Cottonwood, willow & river brush
Local Terrain		Flat to rolling	Flat to rolling	Flat to slightly rolling	Flat to rolling	River bottom	River bottom
Depth of Overburden		0.5 to 1.0 feet	1.0 to 2.0 feet	5.0 feet	3.5 feet	None	0 to 2 feet
P.I. (Overburden)		9	12	12	9	-	N.P.
Est. Reserve Quantity		Unlimited	20,000 cu. yds.	?	?	?	?
Approx. Haul to Nearest Point		0.5 mile	2.5 miles	2.0 miles	1.0 mile	4.0 mile	0.1 mile
L.A. Wear		20.8	33.6	42	53	46.4	45.2
Maximum Size		-	1.0 foot	12 inches	12 inches	4 to 6 inches	4 inches
% Retained on 2" Sieve		-	16	20 to 30	20 to 30	20 to 30	15 to 20
	Crushed to	1"	-	-	-	-	3/4
	2"	-	84	54	61	65	-
Pit	1"	100	64	30	45	42	-
Average	3/4"	91	55	27	41	35	100
% Passing	1/2"	53	46	24	38	28	79
	#4	24	32	18	30	20	47
	#10	15	24	15	24	17	37
	#200	4	5	4	12	1	6
P.I.		N.P.	13	10	8	N.P.	N.P.
Lab. Numbers		63-10581	63-10255-10256	62-10912-10913	63-10908-10909	63-10251	55-3619-3645

Remarks:

55-34-S - Pit can be extended upstream on the Mora River.

SOILS AND GEOLOGY

Introduction:

This strip lies in the Great Plains province of northern New Mexico. It begins approximately four miles south of Wagon Mound, Mora County, and ends one mile south of the Mora-Colfax County line.

The area specifically investigated is a plains area in which low relief is broken in many places by basalt mesas and volcanic plugs or vents. The rocks of the plains area range in age from Triassic through Quaternary, but the greater part of the area is immediately underlain by upper Cretaceous formations ranging from the Dakota sandstone through the Pierre shale. The bulk of this sequence is shale, but the thin, presistent, scarp forming Greenhorn limestone crops out in the southern region of the mapped area, and the scarp forming Fort Hays limestone member of the Niobrara formation, crops out in the northern region. Some of the events of the Laramide deformation are recorded in the rocks of these formations.

Locally, Laramide deformation began with epeirogenic movements west of the Las Vegas basin. The result of this deformation can be noted in the gentle north and east dip of the sedimentary beds. The inclination of these strata was caused by the general tectonic activity probably of late Cretaceous or early Tertiary age. The result of this activity is further evident in Turkey Mountain which is an isolated dome-shaped uplift 10 miles west of Wagon Mound.

Waters with an easterly dendritic drainage, empting into the Canadian River, are derived from the many intermittent creeks in this region. The creeks are fed by springs that flow from beneath the basalt mesas, in various places, and by run-off waters.

General Geology:

There is little evidence in the area of this strip or in the surrounding region concerning geologic events of the early Triassic period. The upper Triassic Dockum group was laid down across the site of the Pennsylvanian and Permian Rowe-Mora basin. Strata of the Dockum group completely buried the few monadnocks of Precambrian rocks that stood above the Sangre de Cristo formation. By late Triassic or early Jurassic period, epeirogenic movements gently tilted the region and as a result of these movements the upper part of the Dockum group locally was removed by erosion.

The region then gradully subsided, and a shallow sea transgressed it. Sediments of the Morrison formation were laid down during the remainder of the Jurassic period on broad deltas, on flood plains, and in lakes.

At the end of Jurassic and during early Cretaceous time the region lay near base level, but some erosion seems to have preceded the next incursion of the sea. Early in the late Cretaceous period the region subsided and was covered by a broad shallow sea. The Dakota sediments accumulated as strand deposits of the advancing sea. Several hundred feet of fine sand, silt, mud and limey material were deposited beyond the littoral zone in the deeper part of the late Cretaceous sea. These sediments have since been consolidated into the Graneros shale, the Greenhorn limestone, the Carlile shale, the Fort Hays limestone, and the Pierre shale.

Near the end of Pierre deposition, evidence of early epeirogenic movements of the Laramide Revolution is suggested by the fine sand in the transition zone of the Pierre shale. Finally the sea withdrew to the east, and the continental sediments (mud, silt, and carbonaceous material) were deposited on deltas, on flood plains, and in swamps.

The oldest part of this basin-fill is overlain by basic flows of igneous rock (basalt). These basalt flows which now form extensive basalt capped mesas, were controlled by an essentially modern topography. The flows are believed to be either late Tertiary or early Quaternary in age.

Considerable portions of the area mapped are covered by landslide and talus debris. Slopes beneath most of the basalt mesas, are partially or wholly obscured by landslides.

The frequency and occurence of the landslides in this locality depend upon the erodibility and plasticity of the underlying rocks. They occur most commonly where Cretaceous shale is overlain by lava flows; less commonly where limestone or siltstone underlie the flows.

A somewhat continuous dike, of probable late Cretaceous or early Tertiary age, strikes east-west across the northern part of the strip. The dike may be associated with the basalt intrusions along tension joints that resulted during the Laramide Revolution. It is from 15 to 40 feet wide, and several miles long. The dike, being more resistant to erosion than the intruded formations, stands as a relatively straight, somewhat vertical wall 0 to 25 feet above the surrounding country.

A laccolith, probably of late Cretaceous or early Tertiary age, apparently underlies Turkey Mountain in the southwest corner of this strip. A laccolith beneath the mountain would best explain the sharp domal structure which lies in an area of relatively undeformed rocks. Further evidence of a laccolith is the local exposures of medium-grained porphyry in the interior of Turkey Mountain.

The sedimentary rocks exposed in this strip range in age from late Triassic to Quaternary. The igneous rocks are of late Tertiary to Quaternary ages.

The following resume describes the rocks, oldest to the youngest, found cropping out in the area:

Rocks assigned to the Dockum group of late Triassic age are the oldest rocks exposed in the mapped area. The total thickness of the Dockum group is probably several hundred feet but only the upper few hundred feet of rocks, belonging to the Chinle formation, are exposed.

Strata of the San Rafael group of Jurassic age unconformably overlie the Dockum group. These strata consist of the Wingate sandstone, the Todilto limestone, and the Wanakah formation which generally forms a vertical or slightly rounded cliff at its exposure. The very distinctive, thinly laminated Todilto limestone overlies the Wingate sandstone. Although the Todilto is absent in many places it does appear in the Turkey mountains. Here it is about 10 to 15 feet thick. Sandstone and siltstone of the Wanakah formation (equivalent to lower Morrison), overlie the Todilto formation.

The Morrison formation of Jurassic age apparently lies conformably on the San Rafael group and within the area discussed, it consists of two subdivisions. Approximately the lower half is a shaley sandstone and the upper half of the formation is mainly shale with subordinate thin sandstone beds.

Cretaceous rocks that have been included in the Dakota sandstone unconformably overlie the Morrison formation. The Dakota sandstone consists predominately of sandstone with some thin interbedded shale. The lower part of the Dakota, ranging from 70 to 100 feet thick, forms a vertical or steep ledge around the edge of the Las Vegas Plateau and along the Canadian River and its more prominent tributary canyons.

The Graneros shale of Cretaceous age lies conformably on the Dakota sandstone. This formation decreases in thickness northward and consists mainly of fissile shale with two thin limestone beds near the top of the formation and some thin sandstone beds at the base.

The Greenhorn limestone of Cretaceous age overlies the Graneros shale conformably and consists of an alternating sequence of limestone and shale beds. The limestone beds, 2 inches to 2 feet thick, are very finely crystalline. The intervening shale beds are calcareous, and range from a few inches to a few feet in thickness.

The Greenhorn limestone of Cretaceous age grades upward into the Carlile shale, a sequence of thinly bedded shale which is somewhat calcareous.

The Fort Hays limestone of Cretaceous age conformably overlies the Carlile shale, ranges from 0 to 6 feet thick, and consists of alternating beds of fine grained limestone and calcareous shale. The Fort Hays limestone thickens northward and is as much as 25 feet thick in Colfax County.

The Fort Hays limestone grades into the Cretaceous age Pierre shale. Above the transition zone, which is about 50 feet thick, the Pierre shale is largely dark-gray to black fissile shale. The thickness of the Pierre shale ranges from zero to several hundred feet and thickens considerably to the north.

A dike of probable late Cretaceous or early Tertiary age intruded the Cretaceous sediments. This intrusive rock is a fine-grained, grayish-green phonolite with large phenocrysts of potash feldspar and less conspicuous phenocrysts of green pyroxene. The dike is from 15 to 40 feet wide, several miles long, and it stands 0 to 25 feet above the surrounding country.

Basic flows of late Tertiary and early Quaternary age cap extensive areas in the strip. The basalt flows are on several erosional surfaces and may represent several periods of eruption from centers near Wagon Mound.

Pediment gravels of probable Quaternary age are noted in several places within the mapped area. These surficial deposits, consisting of cobbles, gravel, sand and silt, are as much as 30 feet thick.

Landslide and talus debris of Quaternary age surround the basalt mesas. The debris ranges in size from silt to huge blocks 20 feet or more across.

Fine-grained Quaternary alluvium occurs along creeks and in topographically depressed areas, whereas alluvium composed of silt, sand, and gravel occurs along the major stream courses.

The areal distribution of formations is shown on Soils and Geology Map 25-22. Their succession and character are given under the section termed "Stratigraphy."

Soils:

The soils of this strip are: Alluvium (Qal); landslide and talus debris (Qls); pediment deposits (Qp); and residual.

Alluvium (Qal): Alluvial deposits occur as narrow bands along present day streams and creeks, and as sheet-like alluvium that seems to have been deposited in a poorly drained area.

The intermittent creeks south-southwest of Wagon Mound are predominantly silty gravel (A-2-4), usually with a cover of silt (A-4) upon them. The material in this area seems to be derived from older river channels and bars.

The alluvial deposits in Ocate Creek and its tributaries are primarily clay (A-6) although some sand and gravel is evident in localized areas along the creek.

Sheet-like, alluvial clay (A-6) covers a broad shallow depressed area in and about Dry Salt Lake.

Landslide and talus debris (Qls): Colluvial soils (silts) have formed about the accumulation of rock debris or talus at the base of the steep basalt rock escarpments.

Pediment deposits (Qp): Pediment deposit remnants are most conspicuous near the northern and eastern perimeters of the mapped area. These pediment deposits are believed to be remnants of surfaces formed in past erosion cycles, and because subsequent erosion has taken place, they stand above the lower plains.

A probable pediment deposit has also been mapped in the southern portion of this strip. This deposit seems to be material derived from old river channels and bars, which is presently being reworked and deposited as alluvium in an adjacent intermittent stream.

At soils sample site 28, and to the east of this site, the deposit consists of clay, silt, sand, and gravel, which is locally cemented with calcium carbonate and caliche.

The materials of the pediment deposits range in size from clay to small boulders, although much of this material is sand and gravel. The thickness of the pediment deposits ranges from 0 to about 20 feet. Soil cover on the pediment deposits consists of a veneer of silt (A-4) or clays (A-6 or A-7).

Observations made of residual soils overlying sediments of Cretaceous age are:

Pierre shale (Kp) - silty soil (A-4).
Thickness: 0 to 6 feet.

Fort Hays limestone (Kfh) - silty soil.
Thickness: 0 to 2 feet.

Carlile shale (Kc) - clayey soil.
Thickness: 0 to 4 feet.

Greenhorn limestone (Kgh) - silty soil (A-4).
Thickness: 0 to 2 feet.

Graneros shale (Kgr) - silty soil (A-4).
Thickness: 0 to 4 feet.

Dakota sandstone (Kd) - silty soil (A-4).
Thickness: 0 to 2 feet.

Table 25-22-I shows the log and classification of soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-22.

Stratigraphy:

Quaternary:	Alluvium (Qal) - unconsolidated gravel sand, silt, and clay along intermittent streams and in low areas. Thickness: 0 to 15 feet.
	Landslide or talus debris (Qls) - unconsolidated basalt debris from fine to boulder size at the base and slopes surrounding basalt mesas.
	Pediment deposits (Qp) - isolated veneers of sand and gravel. Thickness: 0 to 30 feet.
Quaternary-Tertiary	Basalt (QTb) - gray to black, dense to vesicular basalt. The more dense rock contains a high percentage of olivine phenocrysts. Thickness: 50 to 200 feet.
	Intrusive (QTiv) - plugs or vents of black, dense olivine basalt surrounded by associated cinders.

Unconformity---

Tertiary:	Intrusive (Ti) - dike of grayish-green phonolite.

Unconformity---

Cretaceous:	Pierre shale (kp) - dark-gray to black fissile shale. Thickness: 0 to 200+ feet.
	Fort Hays limestone (Kfh) - alternating beds of thin gray limestone and very thin beds of light-gray shale. Thickness: 0 to 6 feet.
	Carlile shale (Kc) - dark-gray thinly bedded shale. Thickness: 75 to 100 feet.
	Greenhorn limestone (Kgh) - alternating sequence of limestone, and shale. Thickness: 15 to 35 feet.
	Graneros shale (Kgr) - a dark-gray to black, fissile shale. Thickness: 150 to 200 feet.
	Dakota sandstone (Kd) - light-gray cliff-forming sandstone. Thickness: 200 to 250 feet.

Unconformity---

Jurassic:	Morrison formation (jm) - Lower half is light gray sandstone and the upper half is mainly grayish shale with subordinate thin sandstone beds. Thickness: 100 feet. approx.
	San Rafael group (Jsr) - This group consists of three units: The upper unit (Wanakah formation equivalent to lower Morrison) consists of interbedded buff to pale-red sandstone and green to brownish-red siltstone; the middle unit consists of the thinly laminated Todilto limestone; the Wingate sandstone, a buff colored, massive, persistent formation is the lower unit. Thickness: 90 feet. approx.

Unconformity---

Triassic:	Chinle formation (Trc) - maroon to pastel red shale, mudstone, and fine-grained silty sandstone. Thickness: 200 to 300 feet.

Construction Materials:

Quaternary:	Alluvium (Qal) - A heterogeneous mixture of clay, silt, sand and gravel is found in the creek adjacent to Pit 59-75-S. Local exposures of sand and gravel seem to be derived from reworked pediment deposits.
	To the east of Pit 59-75-S the present stream has cut through local sand and gravel deposits. These sand and gravel deposits are braided among deposits of silt and clay.
	West of Pit 59-75-S for approximately 2 miles most of the more desirable material seems to lie within the main channel of the present stream.
	Pediment deposits (Qp) - Pediment deposits are scattered throughout the strip. The most extensive deposits lie to the north. In most places the deposits are very thin, but locally they are as much as 30 feet thick. In some places they have become indurated with calcium carbonate to form a conglomerate or caliche.
	Pits 54-61-S and 25-22-4 are examples of the gravelly materials and Pit 25-22-2 is an example of the caliche.
	At Pit 25-22-2 the caliche is from 2 to 3 feet below the surface, but farther east the caliche is almost at the surface. Further exploration may reveal large quantities of these materials.
Quaternary-Tertiary:	Basalt (Qb) - The most desirable basaltic materials are in the volcanic plugs or vents or near these source areas where the flows are quite thick.
	The basalt in the plugs is more dense than it is in the flows and it generally has columnar jointing which facilitates the quarry operation. There may be large quantities of cinders along the lower slopes of the plugs. Pit 59-76-S is an example of the material in a basaltic plug.

Construction Materials continued...

The flow rock is generally more vesicular than the plugs or vents, but where the material is thick and massive good material may also be obtained. Pit 25-22-1 is an example of the flow rock.

Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-22. Test data and other related information are shown in Material Pit Summary Table 25-22-2.

Selected References:

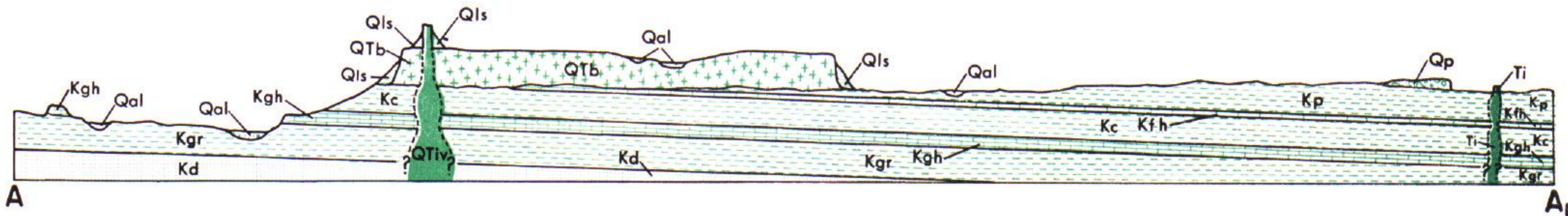
Guidebook, (1955), Northeastern New Mexico, Oklahoma Panhandle Southeastern Colorado, Panhandle Geological Society, Amarillo, Texas.

Guidebook, (1956), Southeastern Sangre de Cristo Mountains, New Mexico, New Mexico Geological Society, 7th Field Conference.

Guidebook, (1959), Northeastern New Mexico, Panhandle Geological Society, Amarillo, Texas.

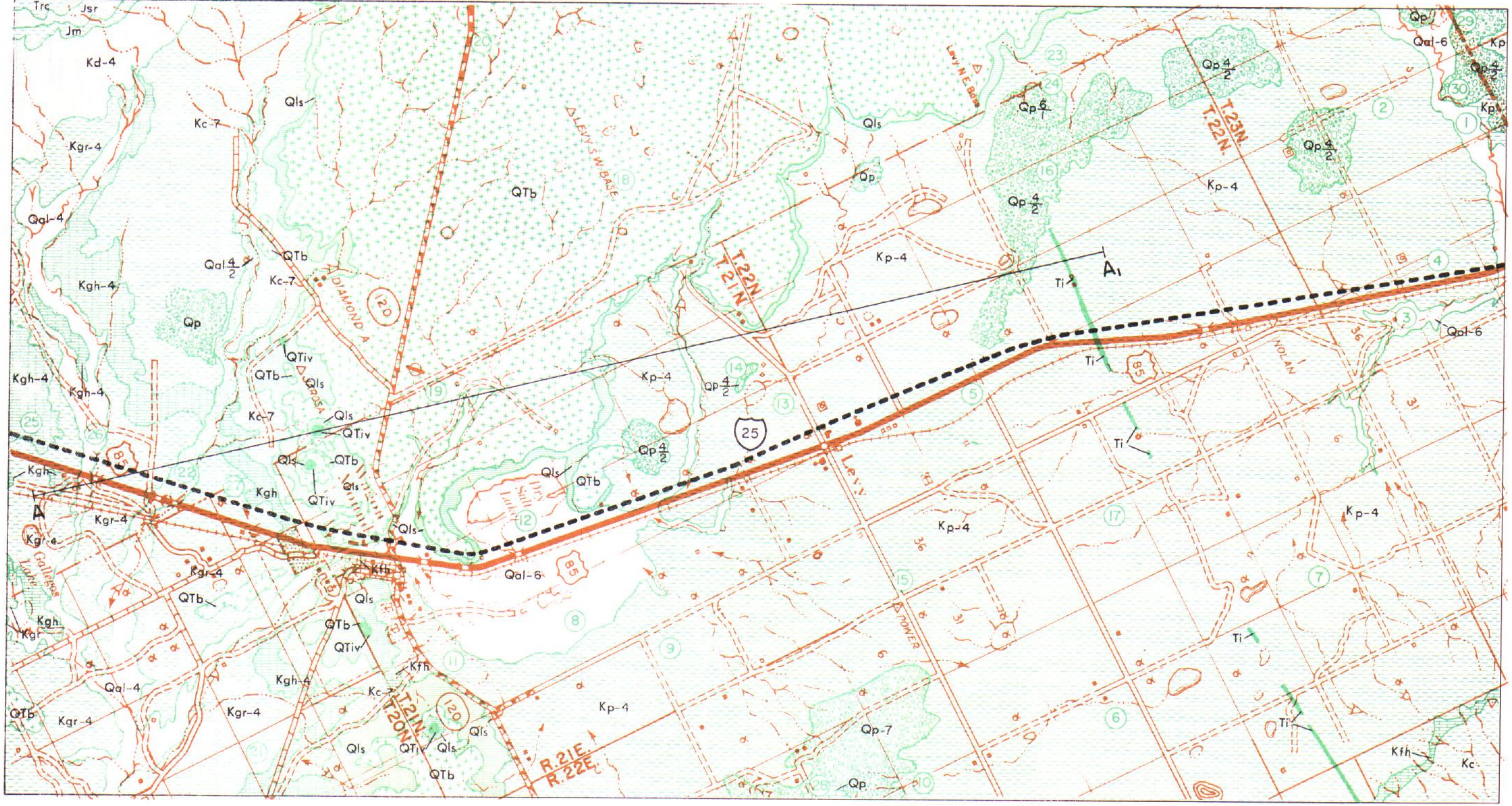
Bachman, G. O., and Dane, C. H., (1962), Preliminary Geologic Map of Northeastern Part of New Mexico, Map I-358, U.S. Geological Survey.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-22

SOILS AND GEOLOGY MAP 25-22



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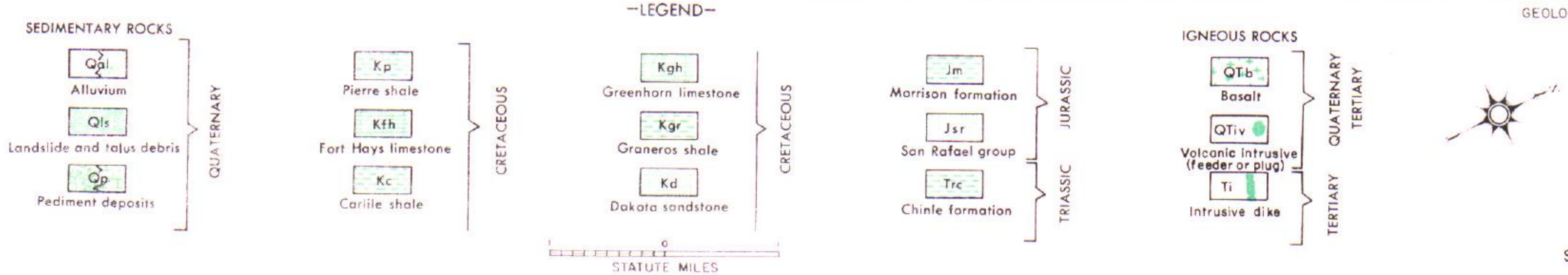
GEOLOGY MAPPED 1964

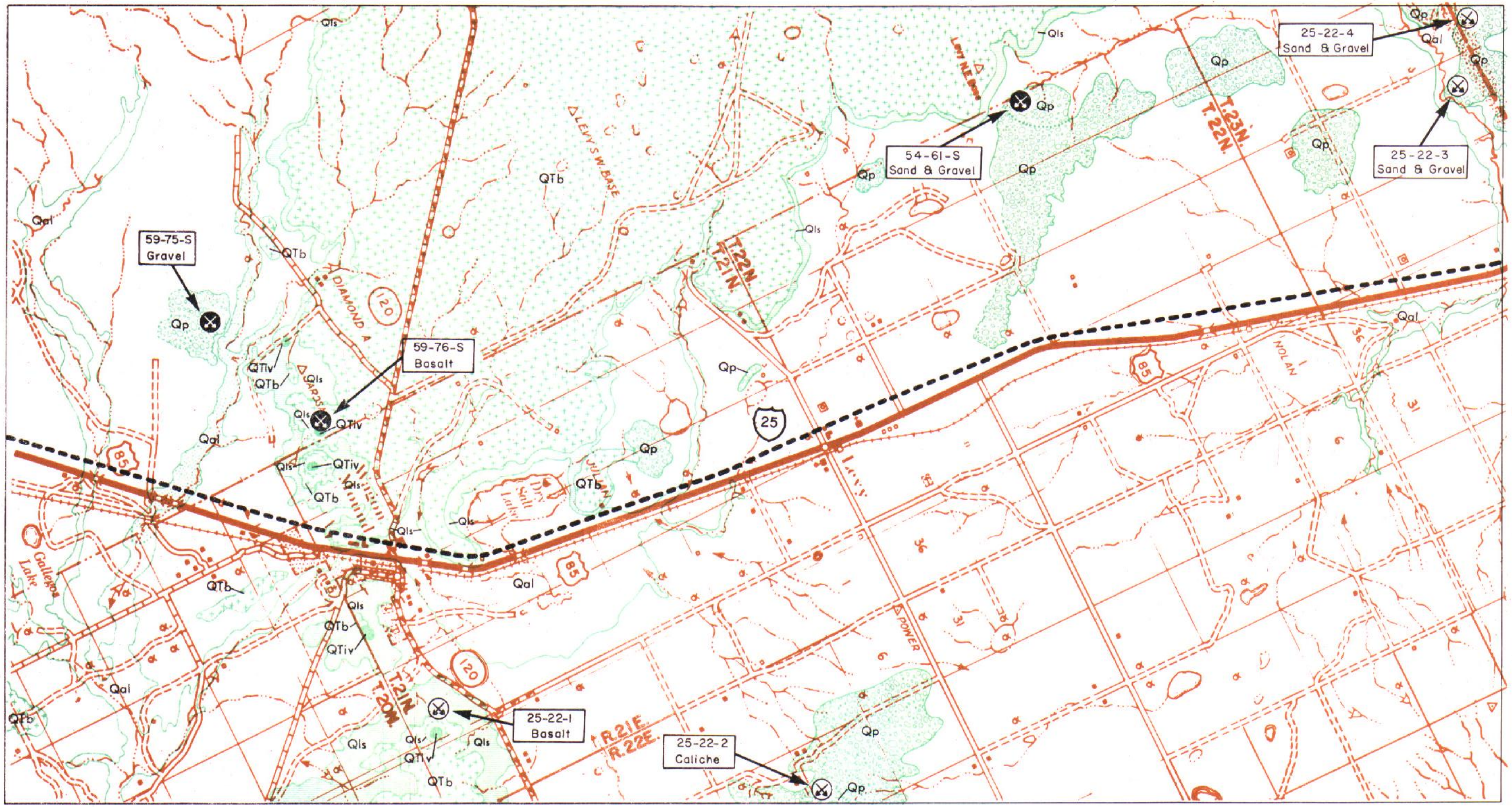


Soils Summary:

Table 25-22-1

Age and Formation	Hole No.	Lift	Depth in Feet From	Depth in Feet To	AASHO Classification	Material Type
Qal	1	A	0.0	8.0	A-6	Clay
Kp	2	A	0.0	1.0	A-4	Silt
"		B	1.0	4.0	A-6	Clay
Qal	3	A	0.0	4.0	A-6	"
Kp	4	A	0.0	5.0	A-4	Silt
"	5	A	0.0	5.0	A-4	"
"	6	A	0.0	5.0	A-4	"
"	7	A	0.0	4.0	A-4	"
Qal	8	A	0.0	4.0	A-6	Clay
Kp	9	A	0.0	5.0	A-4	Silt
"	10	A	0.0	5.0	A-4	"
"	11	A	0.0	3.0	A-6	Clay
Qal	12	A	0.0	5.0	A-7	"
Kp	13	A	0.0	5.0	A-6	"
Qp	14	A	0.0	0.6	A-4	Silt
"		B	0.6	2.0	A-2-4	Silty sand & gravel
Kp	15	A	0.0	3.0	A-4	Silt
Qp	16	A	0.0	0.6	A-4	"
"		B	0.6	4.0	A-6	Clay
"		C	4.0	7.0	Bedrock	Conglomerate
"		D	7.0	11.0	A-2-4	Silty sand & gravel
"		E	11.0	15.0	A-2-4	" " " "
Kp	17	A	0.0	5.0	A-4	Silt
QTb	18	A	0.0	3.0	A-4	"
"	19	A	0.0	5.0	A-6	Clay
"	20	A	0.0	1.0	A-4	Silt
Kgr	21	A	0.0	5.0	A-4	"
Qal	22	A	0.0	7.0	A-4	"
"		B	7.0	11.0	A-2-4	Silty sand & gravel
Kp	23	A	0.0	4.0	A-7	Clay
Qp	24	A	0.0	3.0	A-6	"
		B	3.0	9.0	A-1-a	Sand & gravel
Kgh	25	A	0.0	1.0	A-4	Silt
"		B	1.0	2.0	Bedrock	Limestone
"		C	2.0	3.5	A-4	Silt
"		D	3.5	4.5	Bedrock	Limestone
"		E	4.5	5.5	A-4	Silt
"		F	5.5	-	Bedrock	Limestone
Qal	26	A	1.0	7.0	A-4	Silt
Kgr	27	A	1.0	4.0	A-4	Silt
Qp	28	A	1.0	3.0	A-7	Clay
"		B	3.0	-	Cap rock	Caliche
"	29	A	0.0	2.0	A-4	Silt
		B	2.0	6.0	A-1-b	Sand & gravel
"	30	A	0.0	3.0	A-4	Silt
Qp		B	3.0	7.0	A-1-a	Sand & gravel

CONSTRUCTION MATERIALS MAP 25-22



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TESTED PIT OR QUARRY

PROSPECT PIT OR QUARRY

Qal — Sand, silt and gravel

Qls — Landslide and talus debris

Qp — Pediment deposits sand, gravel and caliche

QTb — Basalt

QTiv — Volcanic intrusive (feeder or plug)

STATUTE MILES

AGGREGATE RESOURCES AND SOILS STUDY
NEW MEXICO INTERSTATE ROUTE 25
WAGON MOUND AND VICINITY

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-22-2

Pit or Prospect No.		59-75-S	54-61-S	59-76-S	25-22-1	25-22-2	25-22-3	25-22-4
Location	Section	Not sectionalized	SW 1/4 Sec. 8 & NW 1/4 Sec. 17	Not sectionalized	SE 1/4 Sec. 35	SE 1/4 Sec. 8	NW 1/4 Sec. 22	S 1/2 Sec. 16
	Twnshp.	Mora Grant	T 22 N	Mora Grant. See remarks	T 21 N	T 21 N	T 23 N	T 23 N
	& Range		R 21 E		R 21 E	R 22 E	R 21 E	R 21 E
	County	Mora	Mora	Mora	Mora	Mora	Mora	Colfax
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Private	Private	Private	Private
Geologic Age		Quaternary	Quaternary	Quaternary-Tertiary	Quaternary-Tertiary	Quaternary	Quaternary	Quaternary
Formation		Pediment deposit	Pediment deposit	Basalt	Basalt	Caliche	Pediment deposit	Pediment deposit
Type of Pit		Sand & gravel	Sand, gravel & conglomerate	Quarry	Quarry	Quarry	Sand & gravel	Sand & gravel
Kind of Material		Various	Various	Basalt	Basalt	Caliche	Various	Various
Quality of Material		Fair	Fair	Good	Good	?	Good	Fair
Thickness of Material		12 to 15 feet	3 to 30 feet	50+ feet	200+ feet	?	4 to 10 feet	3 to 10 feet
Thickness of Cap (Caliche)		-	-	-	-	?	-	-
Blasting Qualities		-	-	Good	?	?	-	-
Uniformity		Fair	Fair	Good	Good	?	Fair	Fair
Impurities		Silt	?	None	None	?	Silt & clay	Silt & clay
Type of Mat'l. Underlying Formation		Silty soil	Conglomerate or shale	?	?	Shale	Shale	Shale
Moisture Condition		Dry	Dry	Dry	Dry	Dry	Dry	Dry
Vegetation		Range grass	Range grass	Range grass	None	Range grass	Range grass	Range grass
Local Terrain		Rolling hills	Rolling hills	Mountainous	Mountainous	Rolling hills	Rolling hills	Rolling hills
Depth of Overburden		2 to 4 feet	6 inches	None	None	1 to 3 feet	2 feet	3 feet
P.I. (Overburden)		17	10	-	-	13.6	9	N.P.
Est. Reserve Quantity		60,000+ cu. yds.	80,000+ cu. yds.	300,000+ cu. yds.	Unlimited	?	?	?
Approx. Haul to Nearest Point		2 miles	3.7 miles	2.5 miles	2.0 miles to I-25	7.5 miles	2 miles	2.5 miles
L.A. Wear		52.4	36.4	13.2	15.2	?	38.4	37.2
Maximum Size		6"	6"	-	-	-	6"	12"
% Retained on 2" Sieve		53	?	-	-	Unexplored	14	Less than 1
Pit Average % Passing	Crushed to	As received	3/4"	1"	1"	"	-	-
	2"	47	-	-	-	"	86	100
	1"	36	-	100	100	"	80	94
	3/4"	33	100	75	83	"	78	90
	1/2"	31	76	43	48	"	75	84
	#4	25	44	18	19	"	64	55
	#10	21	32	10	10	"	53	28
	#200	4	5	2	2	"	5	11
P.I.		40	N.P.	N.P.	N.P.	"	N.P.	60
Lab. Numbers		59-9800-9820	54-11097-11131	59-9708-9713	64-371		64-372-373	64-369-370

Remarks:

59-75-S - Pit is located 14,580 feet South of station 895+32 on Project S-1429(7).

54-61-S - Pit located 3.7 miles (west) right of station 271+04 on Project FI 001-6(401).

59-76-S - Pit is located 4560 feet south of station 900+01.2 of Project S-1429(7). Face of Basalt plug (vent) has sub-hexagonal columnar jointing.

25-22-1 - Face of basalt flow and plug (vent) has sub-hexagonal columnar jointing. Talus boulders to 20 feet--70% crusher size.

SOILS AND GEOLOGY

Introduction:

This strip begins one mile south of the Mora-Colfax County Line and ends one mile north of French Corners in Colfax County. There are prominent topographic features in this strip. The plain has been dissected by streams and arroyos and is underlain by soft Cretaceous shales which occasionally contain limestone beds.

The Cimarron River and other small intermittent creeks that are tributary to the Canadian River drain the area.

General Geology:

This strip lies on a plain of little topographic relief. Except for sparse Quaternary pediment gravels and alluvium along the major drainages, the plain is underlain by soft upper Cretaceous shales in which ridges of limestone crop out.

"Early in late Cretaceous period, the region now occupied by the Rocky Mountains subsided, and a broad epeiric sea transgressed it. Sand and mud accumulated on the margins of the sea as beach and littoral deposits and later were indurated into the Dakota sandstone. Mud, silt, fine sand, and limy material were then laid down and have since been consolidated into the Graneros shale, the Niobrara formation, and the Pierre shale. The thinness of the beds suggests that these strata were deposited below the level of wave action and current agitation. While the upper part of the Pierre shale was deposited, epeirogenic movements that preceded the Laramide Revolution began. These resulted in a slow and intermittent uplift, which is reflected in the fine sand and clay at the top of the Pierre shale." (Panhandle Geological Society, 1955).

The Upper Cretaceous Greenhorn limestone is the oldest formation exposed in this strip. It consists of alternating beds of limestone and shale. The Carlile shale conformably overlies the Greenhorn limestone and it is mainly composed of dark-gray fissile shale and occasionally contains limestone beds.

The Fort Hays limestone member of the Niobrara formation conformably overlies the Carlile shale. It is composed of gray limestone separated by calcareous beds of shale. The beds are about one foot thick. The Fort Hays limestone crops out in a ridge of low relief and may be easily seen except in the southern part of the strip. It is used as a marker bed and is mapped as a single unit. The upper member of the Niobrara formation is the Smoky Hill marl member. This member is not a true marl in Colfax County; it is mainly a calcareous shale. It conformably overlies the Fort Hays limestone member.

The Pierre shale conformably overlies the Smoky Hill marl member of the Niobrara formation. It is black and fissils and contains calcareous concretions at several horizons. The contact between the Pierre shale and the Smoky Hill marl member is generally covered; therefore, they are mapped as a single unit on the strip map.

At places pediment gravels overlie the upper Cretaceous beds. They are usually not over 20 feet thick and most often they are only a few feet thick.

Alluvium composed of silt, sand, and gravel occurs only along the major drainages.

The areal distribution of formations is shown on Soils and Geology Map 25-23. Their succession and character are given under the section termed "Stratigraphy."

Soils:

Alluvium (Qal): The alluvium is composed of silt, sand, and gravel along the Canadian River and its main tributaries. The sample taken at hole 11 was sand and gravel (A-1-2). The Canadian River channel contains a large amount of coal mixed in with the sand and gravel. The Cimarron River channel contains deposits of sand and gravel and little coal.

Pediment deposits (Qp): There are scattered remnants of pediment gravel throughout the area. They are usually a few feet thick; however a few deposits may be as much as 20 feet thick. The soil covering the pediment gravel may be from a few inches to about 3 feet thick and is clay (A-6) with gravel. Beneath the cover the gravel is silty sand and gravel (A-2-4).

Pierre shale and Smoky Hill marl member of the Niobrara formation (Knp): These shales cover the greater part of the mapped area. The residual soil cover is variable in thickness, but usually ranges from 0.0 to 3 feet. It is predominantly clay (A-6). Where the more sandy beds of the formations are exposed the soil cover is silt (A-4).

Carlile shale (Kc): The Carlile shale cover is similar to that of the Pierre shale. It is mainly clay and only a few feet thick.

Table 25-23-1 shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of soils and their related formations is shown on Soils and Geology Map 25-23.

Stratigraphy:

Quaternary: Alluvium (Qal) - silt, sand and gravel.
Thickness: 0 to 20 feet. approx.

Pediment deposits (Qp) - clay, silt, sand and gravel.
Thickness: 0 to 20 feet.

Unconformity--

Cretaceous: Pierre shale and the Smoky Hill marl member of the Niobrara formation (Knp) - The Pierre shale is a black fissile shale with calcareous concretions at several horizons, and an upper 50 feet of sandy shale.
Thickness: 1,650 feet.

The Smoky Hill marl member of the Niobrara formation has an upper zone (about 600 feet) of gray, calcareous slightly sandy shale. Below this is a highly calcareous shale containing thin beds of shaly limestone. Between the upper and lower zone lies about 100 feet of gray, calcareous, highly arenaceous shale about 100 feet thick.
Thickness: 900 feet.

Fort Hays limestone member of the Niobrara formation (Kfh) - limestone beds separated by beds of dark-gray, calcareous shale. The limestone is light-gray, finely-crystalline, and sublithographic.
Thickness: 15 to 25 feet.

Carlisle shale (Kc) - light and dark-gray shales with some limestone beds.
Thickness: 25 to 100 feet.

Greenhorn limestone (Kgh) - thin limestone beds separated by thin beds of shale. The limestone beds are gray to black but the weathered surfaces are light-gray. The shale beds are calcareous and dark-gray to black.
Thickness: 35 feet.

Construction Material:

Quaternary:

Alluvium (Qal): The alluvium in the Canadian River channel may be suitable for highway construction; however, it contains a great deal of coal. The alluvium in the Cimarron River is more suitable for highway aggregate. Pit 55-9-S had an average of about 4.0 feet of non-plastic sand and gravel. There was almost no overburden. Further exploration in the Cimarron River may reveal additional material suitable for highway aggregate.

Basalt gravel (Qbg): A fan of basalt gravel lies south of the re-entrant in Gonzalitos Mesa. This fan appears to be water-laid and the material in the fan may be suitable for highway construction. There are also landslide debris and talus basalt deposits surrounding the mesa. Many of the blocks are several feet in diameter. These debris deposits need further exploration in order to determine quality, quantity, and maximum size.

Basalt (Qb): The basalt capping Gonzalitos Mesa is vesicular on both upper and lower surfaces. However, where the flow is thick the central part appears to be dense, good material and may be suitable for quarry rock.

Pediment deposits (Qp): There are small patches of pediment gravel in the area west of the strip; however, few of them are more than a few feet thick. The more favorable looking deposits that are within economic hauling distance should be explored. Pit 25-23-1 is an example of these deposits.

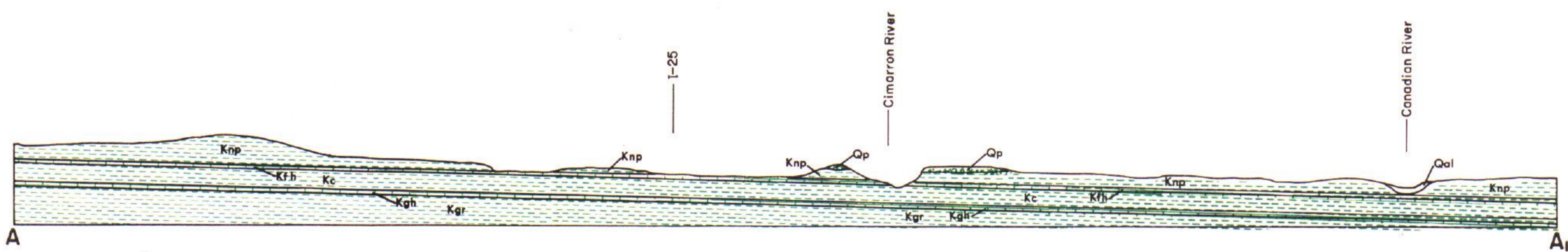
Distribution of tested and prospective pit sites for construction material is shown in Construction Materials Inventory Map 25-23. Test data and other related information are shown in Material Pit Summary Table 25-23-2.

Selected References:

Griggs, Roy L., 1948, Geology and Ground-Water Resources of the Eastern Part of Colfax County, New Mexico, Ground-Water Report 1, State Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology, Socorro, New Mexico.

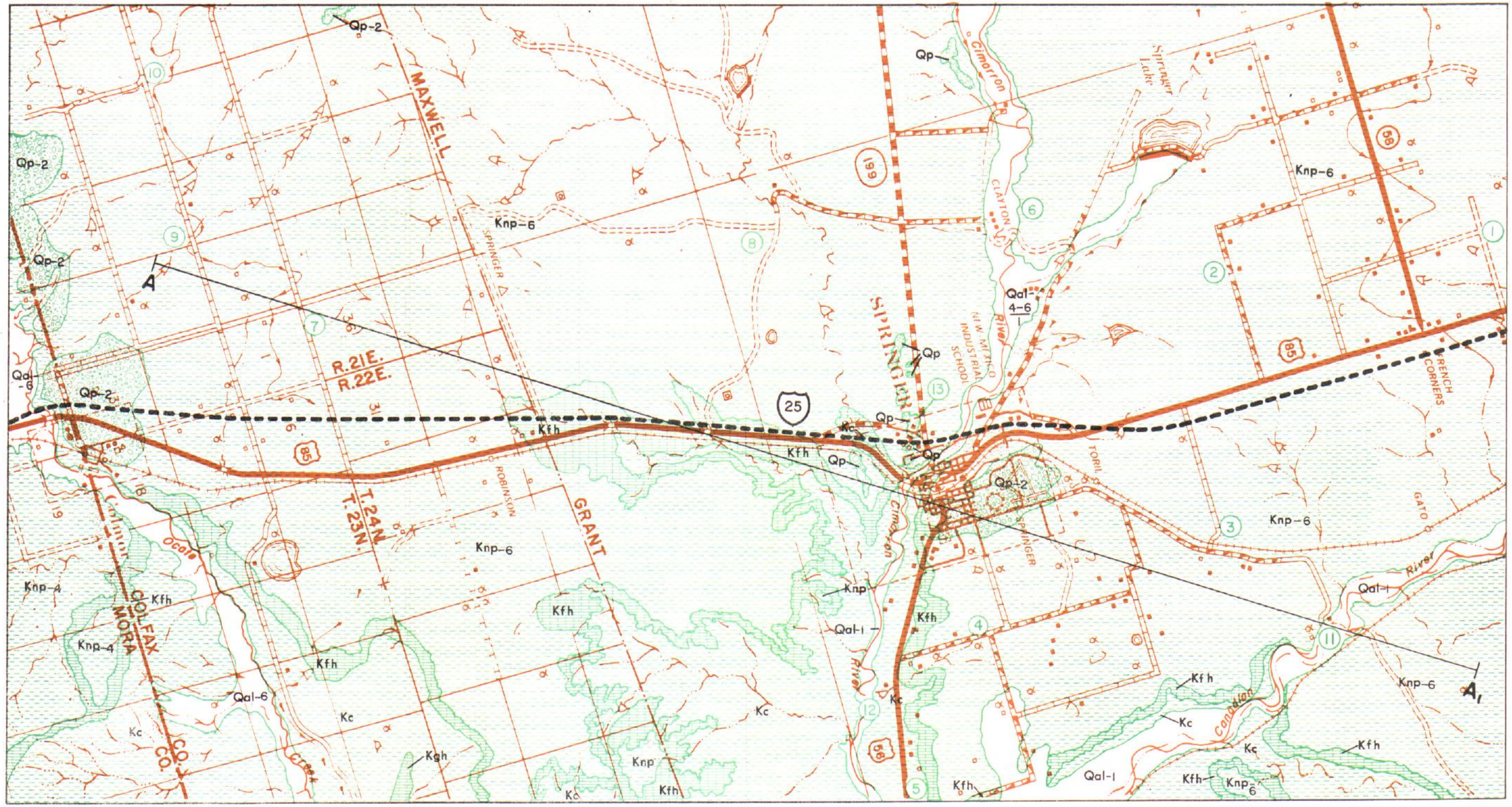
Guidebook, 1959, Northeastern New Mexico, Panhandle Geological Society, Amarillo, Texas.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-23

SOILS AND GEOLOGY MAP 25-23



GEOLOGY MAPPED 1964

—LEGEND—

SEDIMENTARY ROCKS

Qal	Alluvium		QUATERNARY
Qp	Pediment deposits		QUATERNARY
Knp	Pierre shale and Smoky Hill marl member	Niobrara formation	CRETACEOUS
Kfh	Fort Hays limestone member	Niobrara formation	CRETACEOUS
Kc	Carlile shale		CRETACEOUS
Kgh	Greenhorn limestone		CRETACEOUS
Kgr	Graneros shale		CRETACEOUS

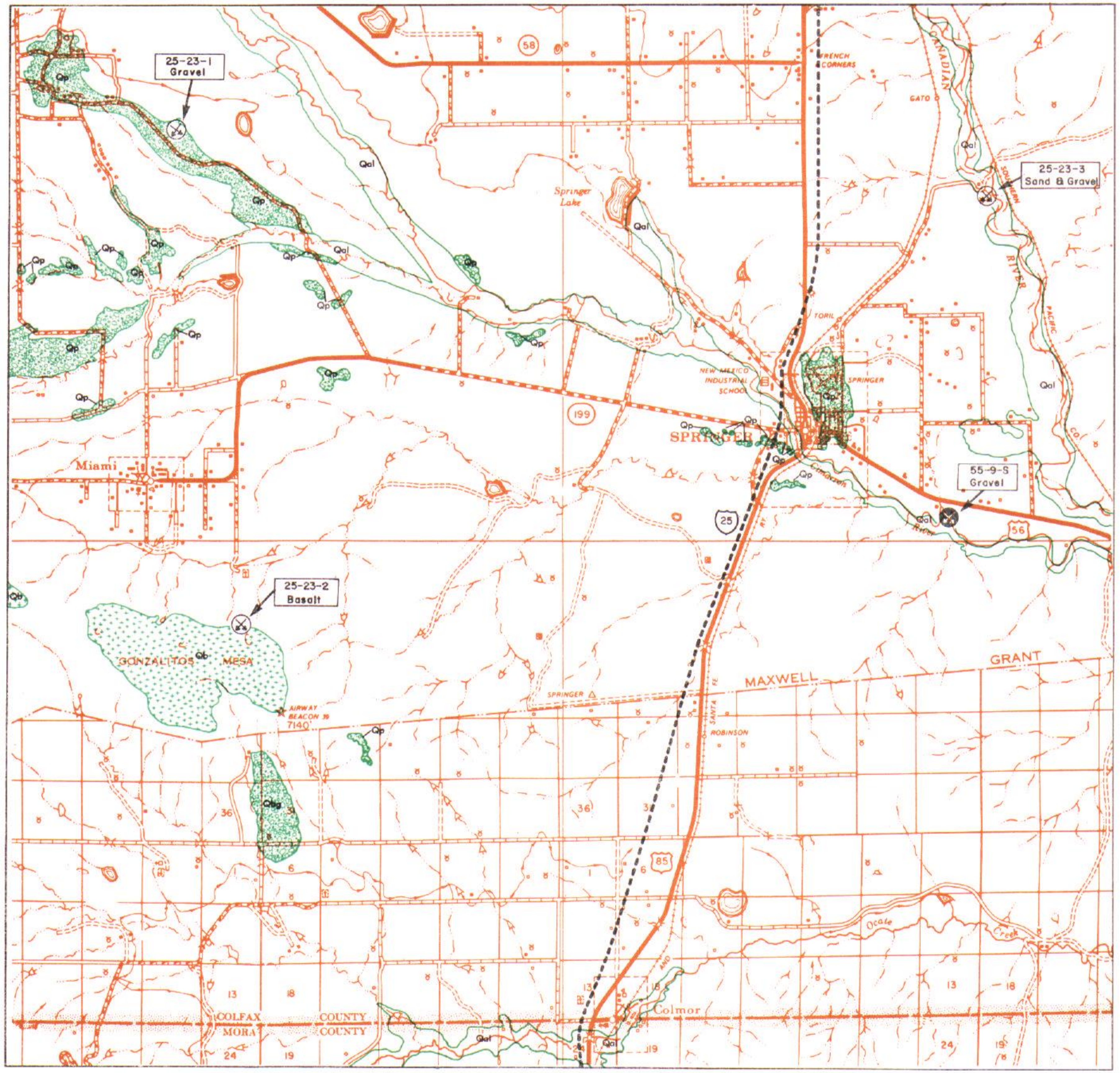
0
STATUTE MILES

Soils Summary:

Table 25-23-1

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Knp	1	A	0.0	1.0	A-6	Clay
"	2	A	0.0	2.0	A-6	"
"		B	2.0	-	A-7	"
"	3	A	0.0	3.0	A-4	Silt
"	4	A	0.0	2.0	A-4	"
Kc	5	A	0.0	3.0	A-6	Clay
Knp	6	A	0.0	2.5	A-4	Silt
"		B	2.5	6.0	A-4	"
"	7	A	0.0	1.4	A-6	Clay
"		B	1.4	3.4	A-6	"
"	8	A	0.0	1.4	A-6	"
"		B	1.4	3.0	A-6	"
"	9	A	0.0	2.0	A-6	"
"	10	A	0.0	0.6	A-4	Silt
"		B	0.6	2.6	A-6	Clay
Qal	11	A	0.0	2.0	A-1-a	Sand & gravel
"	12	A	0.0	5.2	A-1-b	" " "
Qp	13	A	0.0	1.5	A-4	Silt
"		B	1.5	6.5	A-1-a	Gravel
Knp		C	6.5	30.0	A-4	Shale

CONSTRUCTION MATERIALS MAP 25-23



-LEGEND-

Qal — Sand, silt and gravel

Qp — Pediment deposits

Qbg — Basalt gravel

Qb — Basalt

TESTED PIT OR QUARRY

PROSPECT PIT OR QUARRY

STATUTE MILES

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-23-2

Pit or Prospect No.		55-9-S	25-23-1 (Prospect)	25-23-2 (Prospect)	25-23-3 (Prospect)
Location	Section	Not sectionalized	Not sectionalized	Not sectionalized	Not sectionalized
	Twnshp. & Range	Maxwell Grant	Maxwell Grant	Maxwell Grant	Maxwell Grant
	County	Colfax	Colfax	Colfax	Colfax
	State	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Private
Geologic Age		Quaternary	Quaternary	Quaternary-Tertiary	Quaternary
Formation		Alluvium	Pediment deposit	Basalt	Alluvium
Type of Pit		Sand & gravel	Sand & gravel	Quarry	Sand & gravel
Kind of Material		Mixed aggregate	Mixed aggregate	Basalt	Sand & gravel
Quality of Material		Good	Fair	Good	Good
Thickness of Material		5.2 feet	10 to 20 feet	20 to 50 feet	?
Thickness of Cap (Caliche)		-	-	-	-
Blasting Qualities		-	-	?	-
Uniformity		Good	Fair	Good	Good
Impurities		Silt	Silt & clay	?	Coal
Type of Mat'l. Underlying Formation		Shale	Silt & shale	Pediment gravel	?
Moisture Condition		Wet	Dry	Dry	Wet
Vegetation		None	Grass	Juniper	None
Local Terrain		River channel	Plain	Mesa	Canadian River channel
Depth of Overburden		-	0 to 2.5 feet	-	None
P.I. (Overburden)		-	12	-	-
Est. Reserve Quantity		?	500,000+ cu. yds.	Unlimited	Unlimited
Approx. Haul to Nearest Point		3.5 miles	12.5 miles	14 miles	3.5 miles
L.A. Wear		27	28	23	-
Maximum Size		6"	12"	-	?
% Retained on 2" Sieve		Less than 10	15 to 20	-	5 to 10
	Crushed to	3/4"	-	1"	-
Pit Average % Passing	2"	-	83	-	90
	1"	-	64	100	81
	3/4"	100	54	87	75
	1/2"	85	45	49	66
	#4	52	32	19	45
	#10	40	25	10	30
	#200	6	9	3	8
P.I.		N.P.	8	N.P.	N.P.
Lab. Numbers		55-1370-1382	63-9441-9442	63-9443	62-16035

Remarks:

25-23-3 (Prospect) - This pit may be extended up and down the Canadian River Channel.

SOILS AND GEOLOGY

Introduction:

This strip begins one mile north of French Corners and ends a mile north of Hoxie Junction, Colfax County, New Mexico. It lies in the Great Plains province of northeastern New Mexico. The plain is underlain by soft Cretaceous shales. There is little relief in the strip except in the northeast corner of the map where basalt capped Eagle Tail Mountain rises above the plain.

Intermittent watercourses such as the Vermejo River, Crow Creek, and Curtis Creek drain into the Canadian River. Numerous lakes have been formed by damming and are used for irrigation.

General Geology:

This strip lies in a plain of little topographic relief. It is underlain by soft upper Cretaceous shales of the Smoky Hill marl member of the Niobrara formation and the overlying Pierre shale. These formations have been mapped as a single unit (Knp) because the contact between them is conformable and generally covered. The mud, silt, fine sand, and limy deposits of the Smoky Hill marl member were laid down in a broad epeiric sea in the late Cretaceous period. The Pierre shale is predominantly dark-gray to black, somewhat gypsiferous, and noncalcareous. It is yellow-brown where weathered.

At places pediment gravel deposits (Qp) lie on the upper Cretaceous beds. They are composed of various types of rock and are angular to sub-angular. The only extensive deposits are east of Maxwell.

Terrace gravel deposits (Qt) occur along Vermejo Creek. They are mainly reworked pediment gravel and are discontinuous.

Eagle Tail Mountain is surrounded by landslide debris (Ql). It is an old pediment surface capped by basalt (Qb). There are also several intrusive basaltic dikes (Qi) in the strip.

The Construction Materials Inventory Map covers a much larger area than the Soils and Geology Map. There are monzonitic sills and dikes shown on the Construction Materials Inventory Map that are not exposed or do not occur in the area of the Soils and Geology Map.

The areal distribution of formations is shown on Soils and Geology Map 25-24. Their succession and character are given under the section termed "Stratigraphy."

Soils:

The Pierre shale and Smoky Hill marl member of the Niobrara formation cover most of the strip. The soil cover is clay (A-6) and is usually only a few feet thick.

Alluvium (Qal): The alluvial soils cover the floors of the drainageways of this strip. The creeks have discontinuous deposits of silty sand and silt. The Vermejo River and the Canadian River have sand and gravel along their main channels. Silt covers the flood banks of each river.

Aeolian deposits (Qa): There is a very small sand dune (A-3) south of Maxwell. It is probably derived from the floor of the Canadian River.

Terrace deposits (Qt): These soils are primarily a well-washed river sand and gravel with a residual cover of clay and silt.

Pediment deposits (Qp): These deposits have a very limited areal extent in this strip. They have a residual cover of clay (A-6) which lies over from 1 to 3 feet of silty and clayey gravel.

Table 25-24-I shows the log and classification of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-24.

Stratigraphy:

Quaternary:	Alluvium (Qal) - silt, sand, and gravel. Thickness: 0 to 20 feet. approx.
	Aeolian sand (Qa) - fine grained windblown sand. Thickness: 20 feet.
	Landslide debris (Qls) - accumulations of basaltic debris below the basalt capped Eagle Tail Mesa.
	Terrace gravel deposits (Qt) - discontinuous deposits of sand, silt, clay and gravel. Thickness: 0 to 20 feet,
	Pediment deposits (Qp) - clay, silt, sand and gravel. Thickness: 0 to 20 feet. approx.
	Basaltic dikes and sills (Qi) - thin dikes and sills.
	Basalt (Qb) - medium- to dark-gray, fine-grained, olivine basalt. Thickness: 100 to 500 feet.
Tertiary:	Monzonite (Tm) - fine- to medium-grained monzonitic porphries of various colors. Most of them are light- to medium-gray which contain phenocrysts. Note: This material appears on the Construction Materials Map only.

Unconformity--

Cretaceous:	Pierre shale and the Smoky Hill marl member of the Niobrara formation (Knp) - The Pierre shale is a black fissile shale in which calcareous concretions occur at several horizons. These argillaceous limestone concretions usually weather to

Stratigraphy continued...

a yellowish-gray. The upper 50 feet of the Pierre shale is sandy. Thickness: 1,650 feet.

The Smoky Hill marl member of the Niobrara formation has an upper zone of 600 feet of gray, calcareous, slightly sandy shale. Below this zone lies a highly calcareous shale containing thin beds of shaly limestone. Between the upper and lower zones is about 100 feet of gray, calcareous, highly arenaceous shale. Thickness: 900 feet.

Construction Materials:

Quaternary:

Alluvium (Qal) - Materials suitable for construction may be developed in the Canadian River and the Vermejo River.

The sand and gravel in the Vermejo River is in small discontinuous bars and it has a considerable amount of silt.

In the Canadian River the materials are quite fine-grained and they have a high percentage of coal and shale. Pit 25-24-4 is in this material.

Aeolian sand (Qa) - A small wind-blown deposit of fine-grained sand occurs east of the Canadian River about 2 miles south of Maxwell. The dunes are about 20 feet high, the sand is non-plastic and may be suitable as a fine aggregate for some phases of highway construction.

Terrace deposits (Qt) - The most extensive terrace gravels fringe the Vermejo River. They appear to be reworked pediment gravels. Pits 57-68-S and 25-24-3 are good examples of these deposits.

Pediment deposits (Qp) - Pediment gravels are scattered throughout the strip. The most extensive deposits are to the east of U.S. 85 south of Eagle Tail Mountain. Some of these deposits seem to be as much as 20 feet thick. Pit 25-24-1 is representative of this material. Further exploration may reveal adequate supplies for highway construction.

Basalt (Qb) - Since construction materials are relatively scarce in this area it is suggested that the basalt at Eagle Tail Mountain be explored. Most of the outcrops show a vesicular basalt overlying a dense basalt. The vesicular material materials seem to increase in depth away from the eroded bluffs.

Tertiary:

Monzonite (Tm) - There is an extensive outcrop of monzonite from 12 to 15 miles northeast of Maxwell that will make an excellent quarry rock. Pit 25-24-2 is representative of this rock.

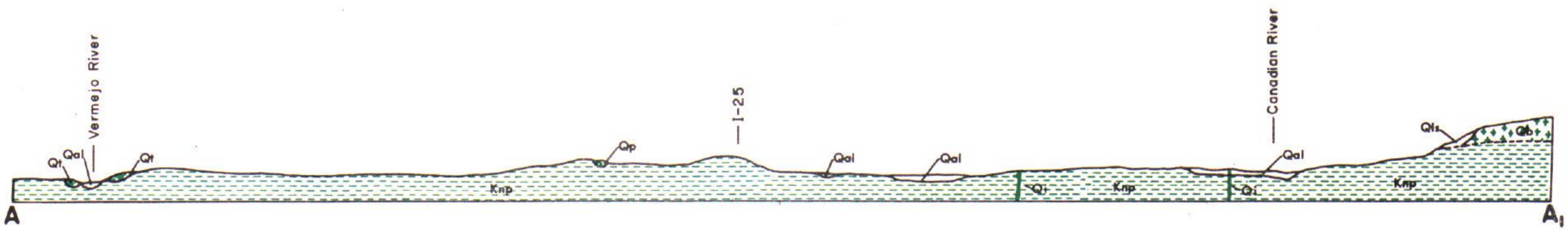
Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventroy Map 25-24. Test data and other related information are shown in Material Pit Summary Table 25-1-2.

Selected References:

Griggs, Ray L., 1948, Geology and Ground-Water Resources of the Eastern Part of Colfax County, New Mexico, Ground-Water Report 1, State Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology, Socorro, New Mexico.

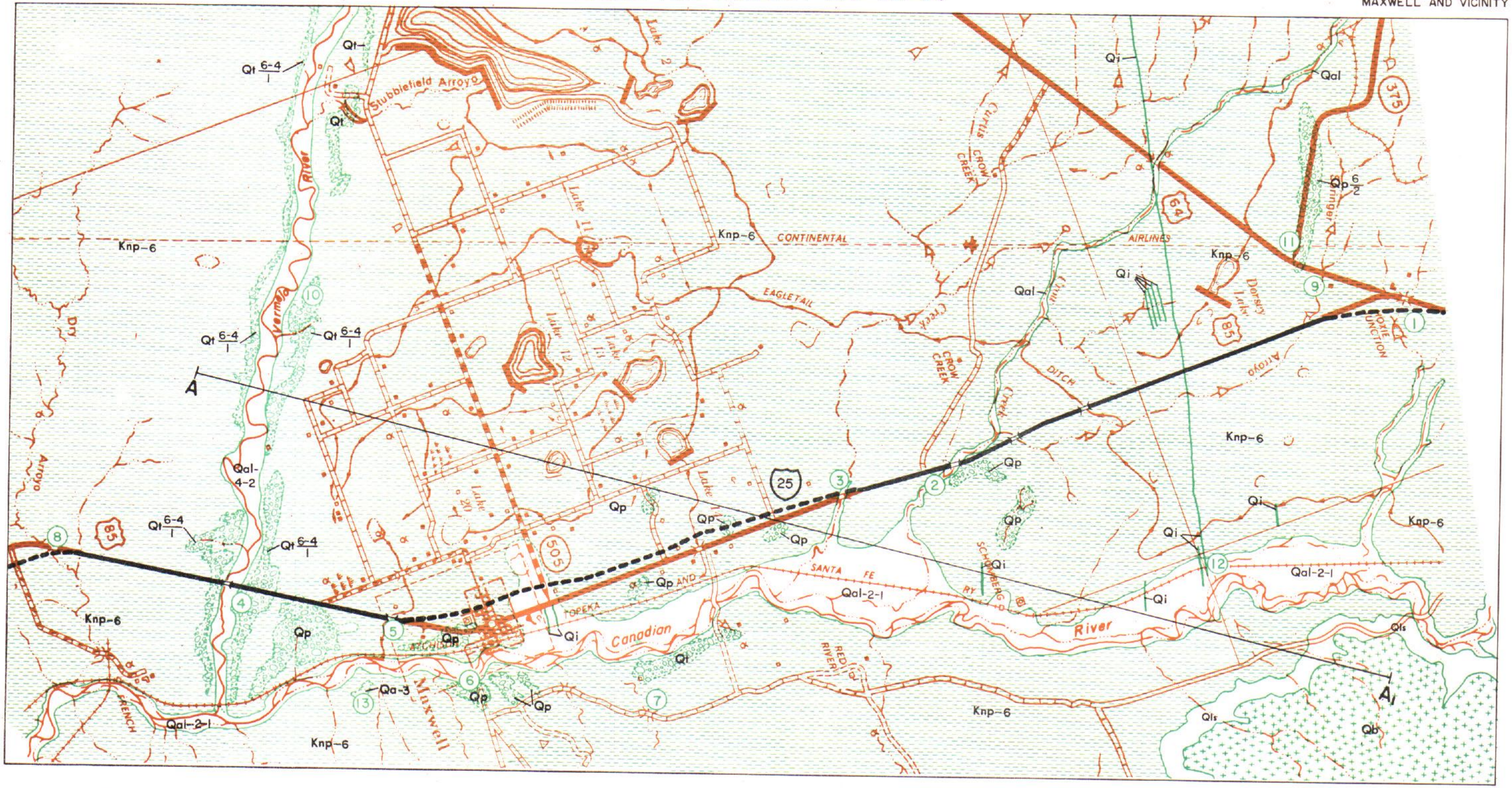
Guidebook, 1959, Northeastern New Mexico, Panhandle Geological Society, Amarillo, Texas.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-24

SOILS AND GEOLOGY MAP 25-24



GEOLOGY MAPPED 1964

—LEGEND—

SEDIMENTARY ROCKS

QUATERNARY: Qal Alluvium; Qa Aeolian deposit

QUATERNARY: Qls Landslide debris; Qt Terrace deposit

Qp Pediment deposits

CRETACEOUS: Knp Pierre shale and Smoky Hill marl member of the Niobrara formation

IGNEOUS ROCKS

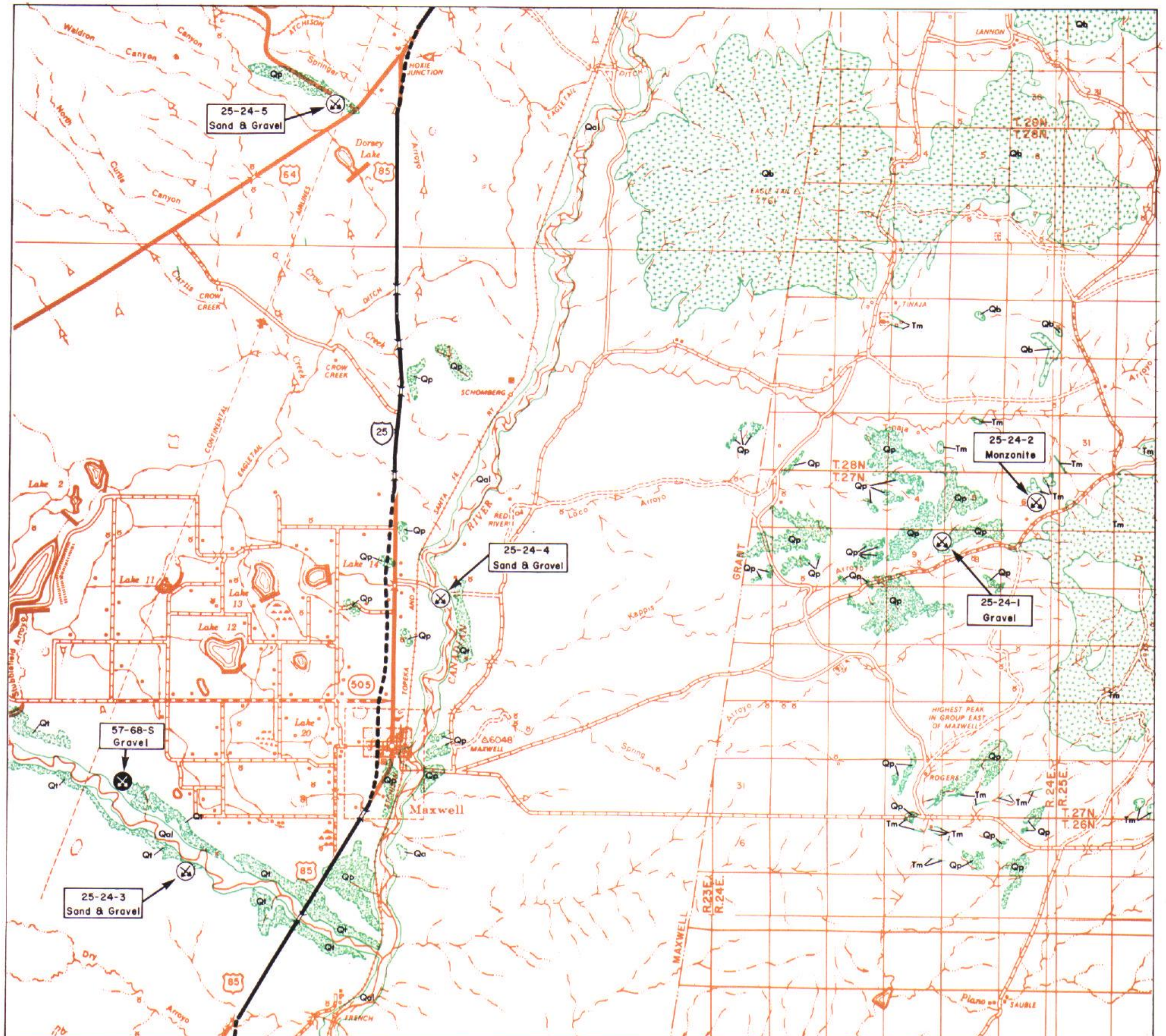
QUATERNARY: Qi Intrusives; Qb Basalt

STATUTE MILES

Soils Summary:

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Knp	1	A	0.0	3.0	A-7	Clay
Qal	2	A	0.0	6.0	A-6	"
"		B	6.0	10.0	A-2-4	Silty sand
Knp	3	A	0.0	2.0	A-7	Clay
"		B	2.0	10.0	A-6	Shale
"		C	10.0	-	A-6	"
"	4	A	0.0	3.0	A-4	Silt
"		B	3.0	4.0	A-4	Sandy silt
"		C	4.0	10.0	A-6	Shale
"	5	A	0.0	3.0	A-6	Clay
"		B	3.0	12.0	A-4	Siltstone
"	6	A	0.0	10.0	A-6	Clay
"		B	10.0	-	A-6	Shale
"	7	A	0.0	5.0	A-4	Silt
"		B	5.0	-	Bedrock	Shale
"	8	A	0.0	4.0	A-6	Clay
"	9	A	0.0	2.0	A-4	Silt
Qt	10	A	0.0	1.0	A-4	"
"		B	1.0	12.0	A-1-a	Sand & gravel
Qp	11	A	0.0	1.0	A-6	Clay
"		B	1.0	6.0	A-2-4	Silty sand & gravel
Qi	12	A	Talus		A-1-a	Basalt
Qa	13	A	0.0	10.0	A-3	Fine sand

CONSTRUCTION MATERIALS MAP 25-24



—LEGEND—

Qal — Sand, silt, clay and gravel
Qa — Aeolian sand
Qt — Terrace gravels
Qp — Pediment gravel
Qb — Basalt
Tm — Monzonite
TESTED PIT OR QUARRY
PROSPECT PIT OR QUARRY

STATUTE MILES

N

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-24-2

Pit or Prospect No.		57-68-S	25-24-1 (Prospect)	25-24-2 (Prospect)	25-24-3 (Prospect)	25-24-4 (Prospect)	25-24-5 (Prospect)
Location	Section	W 1/2 Sec. 32	10 & 11	1	Not sectionalized	Not sectionalized	Not sectionalized
	Twnshp.	T 27 N	T 27 N	T 27 N			
	& Range	R 22 E	R 24 E	R 24 E	Grant Land	Grant Land	Grant Land
	County	Colfax	Colfax	Colfax	Colfax	Colfax	Colfax
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Private	Private	Private
Geologic Age		Quaternary	Quaternary	Tertiary	Quaternary	Quaternary	Quaternary
Formation		Terrace deposit	Pediment gravel	Monzonite	Terrace deposit	Alluvium	Pediment deposit
Type of Pit		Sand & gravel	Gravel	Quarry	Sand & gravel	Sand & Gravel	Sand & gravel
Kind of Material		Mixed aggregate	Mixed aggregate	Monzonite	Mixed aggregate	Mixed aggregate	Mostly sandstone
Quality of Material		Good	?	Excellent	Good	Fair	Poor
Thickness of Material		10 feet	Approx. 10 feet	?	10 to 15 feet	6 to 15 feet	6 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	?	-	-	-
Uniformity		Good	?	Good	Good	Fair	Poor
Impurities		None	Shale	None	None	Coal & shale	Clay & silt
Type of Mat'l. Underlying Formation		Sand & shale	Shale	?	Shale	Shale	Shale
Moisture Condition		Dry	Dry	Dry	Dry	Wet	Dry
Vegetation		Grass	None	None	Grass	Tamarix, willow & cottonwood	Grass
Local Terrain		Terrace	Plain	Hill	Plain	River valley	Plain
Depth of Overburden		1.0 feet	0 to 1 foot	-	1 to 3 feet	None	1 to 3 feet
P.I. (Overburden)		7 to 9	11	-	18	-	13
Est. Reserve Quantity		See remarks	?	Unlimited	500,000 cu. yds.	Unlimited	?
Approx. Haul to Nearest Point		6 miles	13 miles	12 miles	2 miles	1 mile	1 mile
L.A. Wear		32	36	22	32 ?	34.8	?
Maximum Size		6"	18"	-	12"	6"	6"
% Retained on 2" Sieve		9	30	-	25 to 30	9	10 to 15
	Crushed to	-	1"	1"	-	-	-
Pit Average % Passing	2"	91	-	-	83	91	73
	1"	79	100	100	67	86	64
	3/4"	72	90	84	60	81	58
	1/2"	59	65	45	52	76	49
	#4	33	40	18	34	62	30
	#10	20	30	10	24	50	20
	#200	4	12	3	4	6	6
P.I.		N.P.	7	N.P.	N.P.	N.P.	9
Lab. Numbers		57-10626-10653	63-10247-10248	63-10249	64-2518-2519	64-2522	62-16039-16040

Remarks:

57-68-S - Terrace gravels extend along both banks of the Vermejo River. These gravels may be developed with further exploration.

AGGREGATE RESOURCES AND SOILS STUDY
NEW MEXICO INTERSTATE ROUTE 25
RATON AND VICINITY

SOILS AND GEOLOGY

Introduction:

This strip begins about a mile north of Hoxie Junction and ends at the New Mexico-Colorado border. It lies in the northern part of Colfax County, New Mexico which is in the Great Plains province. The plain is underlain by soft Cretaceous shales. In the northern and northeastern part of the strip there are mesas which stand several hundred feet high. The Canadian River is the main drainage in the strip and it is fed by several smaller drainages.

General Geology:

This strip lies in the Raton basin, an early Tertiary structural feature that trends north south. Here it is a plain underlain by the soft upper Cretaceous shales of the Smoky Hill marl member of the Niobrara formation and the overlying Pierre shale. These formations have been mapped as a single unit (Knp) because the contact between them is conformable and generally covered. This unit is covered by soil, alluvium, landslide debris and pediment gravel in many places. The mud, silt, fine sand, and limy deposits of the Smoky Hill marl member were laid down in a broad epeiric sea in the late Cretaceous period. The Pierre shale is predominantly dark-gray to black, somewhat gypsiferous, and noncalcareous. It is yellow brown where weathered; but in a fresh cut (at the railroad overpass) it is dark-gray to black. The fine sand and clay in the upper part of the Pierre shale reflect the beginning of uplift that preceded the Laramide Revolution.

"As the uplift continued the sea gradually withdrew, and the Trinidad sandstone accumulated as a regressive littoral deposit. Strata of the Vermejo formation were laid down in swamps and on flood plains that developed on the emergent Trinidad sandstone. Mountain building began to the west of the mapped area during the deposition of the upper sediments of the Vermejo formation. As the mountains gradually rose they were eroded and contributed sediments to a subsiding basin that lay to the east. The coal, shale, siltstone, sandstone, and conglomerate of the Raton formation, of late Cretaceous and Paleocene age, accumulated as a flood plain, piedmont, and paludal suite in the basin. The mountains were rejuvenated during the deposition of the upper sediments of the Raton formation." (Wood, Northrop, and Griggs, 1953, Oil and Gas Investigations, Map OM 141, sheet 2).

The Trinidad sandstone, the Vermejo formation, and the Raton formation are well exposed in the escarpment of Raton Mesa. The Raton formation caps Raton Mesa which lies in the northwestern part of the strip. The Raton and Vermejo formations have been mapped as a single unit. A basalt flow covers the Raton formation on Bartlett Mesa.

Pediment deposits occur in the strip, but they are not very extensive. They consist of gravel, sand, and clay deposited during Quaternary time. Wood, Northrop, and Griggs (1953) state that the younger deposits are within 50 feet of the adjacent stream bottoms.

Many sills and dikes have intruded the Pierre shale. They are basaltic and are probably associated with the series of Quaternary basaltic flows which cap the mesas in the area. Landslide debris has accumulated on the slopes of these mesas.

Alluvium or valley fill occurs along the major drainages. It consists of clay, sand, silt, and gravel. The alluvium seldom extends more than a few hundred feet away from the river or creek channels. Their thicknesses may reach 20 to 30 feet.

The areal distribution of formations is shown on Soils and Geology Map 25-25. Their succession and character are given under the section termed "Stratigraphy."

Soils:

This strip is covered mainly by residual soils.

Alluvium or valley fill (Qal): The alluvial deposits are sand, silt, and gravel. Samples taken of the valley fill are silt (A-4). There are extensive gravel deposits in the vicinity of the confluence of the Canadian River and the Dillon Canyon drainage. The valley fill maybe from 20 to 30 feet thick.

Pediment deposits (Qp): These pediment deposits are composed predominantly of sedimentary rocks; however, they do contain igneous rocks. They are usually not more than 12" in maximum diameter. They are poorly sorted and most particles are angular and flat. They may have impure beds or lenses of clay and silt. Some of the pediment gravels cap the entire hill, but, at other places, they are only a fringe or apron surrounding hills or along ridges. There may be conglomerate layer, a few inches to a few feet thick, underlying the pediment gravel. At other places it lies on shale.

The residual soils on the basalt (Qb) and the Raton formation (TK) were not sampled and classified.

Pierre formation and the Smoky Hill marl member of the Niobrara formation (Knp): These residual soils range from silt (A-4) to clay (A-6). At some places the surface is overlain by a very thin cover of wind-blown sand.

Table 25-25-I shows the log and classificiation of the soil samples taken along this portion of Interstate Route 25. The areal distribution of the soils and their related formations is shown on Soils and Geology Map 25-25.

Stratigraphy:

Quaternary:

Alluvium or valley fill (Qal) - sand, silt, and gravel in the major drainages.
Thickness: 20 to 30 feet.

Landslide debris (Qls) - debris mainly adjacent to the lava capped mesas.

Pediment deposits (Qp) - sand, silt, and gravel on hills and along ridges.
Thickness: 0 to 20+ feet.

Dacite-Andesite dikes and sills (Qd) - thick sills and dikes of intermediate composition. It is white to light-gray and weathers to a pinkish red.
Note: Construction Materials Map only.

Stratigraphy continued...

Basalt dikes and sills (Qi) - thin dikes and sills associated with the basalt of Raton Mesa.

Basalt (Qb) - medium- to dark-gray, fine-grained, olivine basalt.
Thickness: 100 to 500 feet.

Tertiary:

Raton formation and Vermejo formation (TK) - These formations are mapped as a single unit. The Raton formation consists of interbedded shale, siltstone, graywacke, arkosic and feldspathic sandstone, quartzose sandstone, conglomerate, and coal with ironstone concretions occuring in the shale and siltstone intervals (Wood, Northrop, and Griggs, 1953). The sandstone is brown to buff and the shale is yellow to black.
Thickness: 0 to 1,800 feet.

Unconformity--

Cretaceous:

The Vermejo formation consists of interbedded layers of coal, shale, siltstone, and sandstone. The shale is dark and the sandstone is light-gray and friable.
Thickness: 0 to 420 feet.

Trinidad sandstone (Kt) - light-gray to buff, fine to medium-grained, well-sorted, and slightly arkosic, thick-bedded and cross-laminated sandstone.
Thickness: 100 to 150 feet.

Pierre shale and the Smoky Hill marl member of the Niobrara formation (Knp) - dark-gray to black, somewhat gypsiferous, noncalcareous shale that weathers to yellow-brown. The Pierre shale contains concretions of argillaceous and fossiliferous limestone and iron carbonate.
Thickness: 1,600 to 1,700 feet.

The Smoky Hill marl member of the Niobrara formation consists of calcareous beds of alternating silty shale and sandy shale. It usually weathers to a gray or buff. The lower part contains a few shaly limestone beds.
Thickness: 900 to 1,000 feet.

Construction Materials:

Quaternary:

Alluvium (Qal) - "The alluvium ranges in thickness from a feather edge to more Than 40 feet. It may exceed 50 feet in thickness along the main streams. It also varies in character, some coarse gravel occurs in nearly all of it, but finer sizes, including clay also occur." (Griggs, 1948, p. 66).

Gravel deposits lie mainly in the Canadian River channel; however, there are also discontinuous bars of gravel in the upper reaches of Chicorico Creek that should be explored for construction materials, and good materials have been located in Cottonwood Canyon. Most of the gravel deposits have coal and shale impurities. Coal occurs in the alluvium especially at and down stream from the confluence of the Canadian River and Coal Canyon drainage.

The Canadian River channel has been worked out except for small quantities down stream from Cottonwood Canyon. An almost unlimited supply of good gravel lies in the Canadian channel upstream from Cottonwood Canyon. To the south of U.S. 85 the channel gravels, of the Canadian River, become much more fine-grained and have high percentages of coal and shale.

Landslide debris and talus (Qls) - Near the New Mexico-Colorado border there are some huge talus piles along the escarpment of the lava flow east of U.S. 85. This material is predominantly basalt and should make suitable highway aggregate.

Dacite - Andesite dikes and sills (Qd) - About 2 miles south of U.S. 64 in the eastern part of the strip is a relatively large mass of dacite and andesite. This rock rises above the surface as a dike on the west and extends into a huge massive flow to the east. An almost unlimited supply of excellent quarry rock may obtained from this area. Pits 62-28-S and 62-29-S are located in this material.

Pediment deposits (Qp) - Pediment gravel lies in scattered patches throughout this strip. In some places it is as much as 20 feet thick, but usually it is not over 5 feet thick. Some of the deposits will cap an entire hill, whereas others lie as a fringe or apron surrounding the hills or along ridges. In some places conglomerate (a few feet thick) underlies the pediment deposits.

The most extensive deposits lie west of the Canadian River from 6 to 8 miles south of Raton. These deposits seem to mingle with well-washed stream deposits near the eastern edge along the high river terrace. Pit 25-25-3 is representative of this material. Pits 57-74-S, 57-73-S, and 25-25-1 are representative of deposits derived from the escarpment north of Raton.

Basalt (Qb) - There is an unlimited supply of basalt in this strip which may be suitable for highway construction. Bartlett Mesa, Horse Mesa, and Johnson Mesa seem to have the most ideal rock for highway construction.

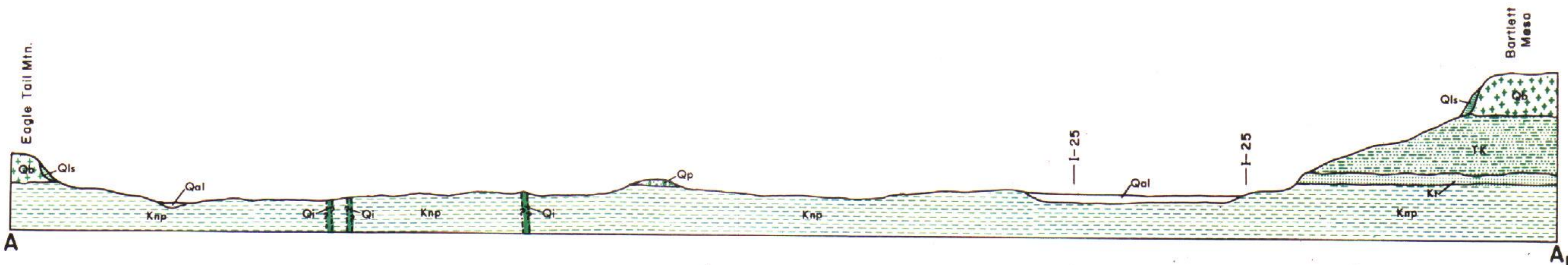
Distribution of tested and prospective pit sites for construction materials is shown on Construction Materials Inventory Map 25-25. Test data and other related information are shown in Material Pit Summary Table 25-25-2.

Selected References:

Griggs, Roy L., 1948, Geology and Ground-Water Resources of the Eastern Part of Colfax County, New Mexico, New Mexico Bureau of Mines and Mineral Resources.

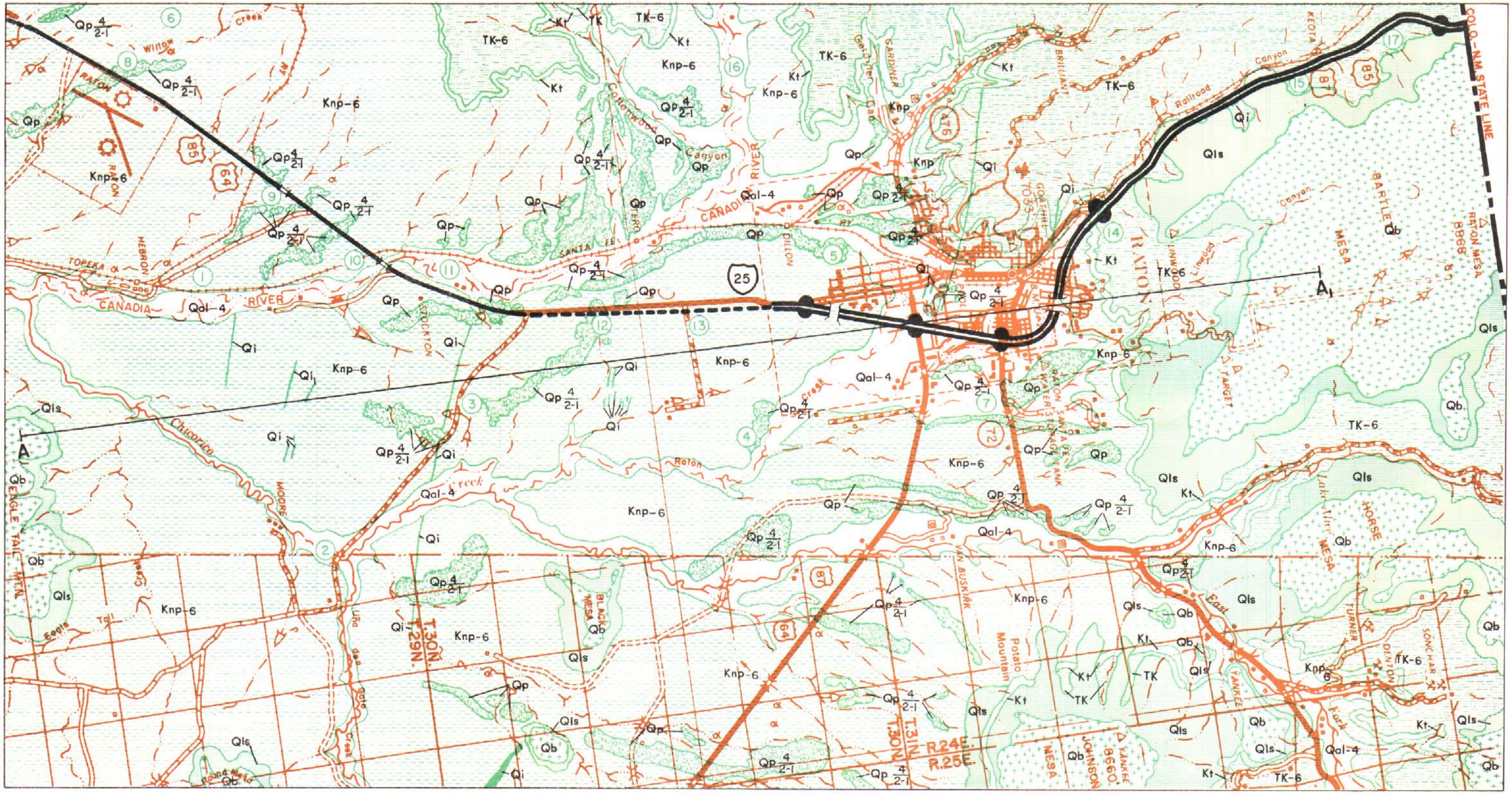
Wood, G. H., Jr., Northrop, S. A., and Griggs, R. L., 1953, Geology and Stratigraphy of Kochler and Mount Laughlin Quadrangles and Parts of Abbott and Springer Quadrangles, Eastern Colfax County, New Mexico, Oil and Gas Investigations, Map OM 141(in 2 sheets) Sheet 2, U.S.G.S.

GENERALIZED CROSS-SECTION



Note: For explanation of symbols see Soils and Geology map 25-25

SOILS AND GEOLOGY MAP 25-25



LEGEND

SEDIMENTARY ROCKS

QUATERNARY
- Qal — Alluvium or valley fill
- Qls — Landslide debris

TERTIARY
- Qp — Pediment gravel
- TK — Raton and Vermejo formations

CRETACEOUS
- Kt — Trinidad sandstone
- Knp — Pierre shale

IGNEOUS ROCKS

QUATERNARY
- Qi — Intrusive dikes and sills
- Qb — Basalt

GEOLOGY MAPPED 1964

STATUTE MILES

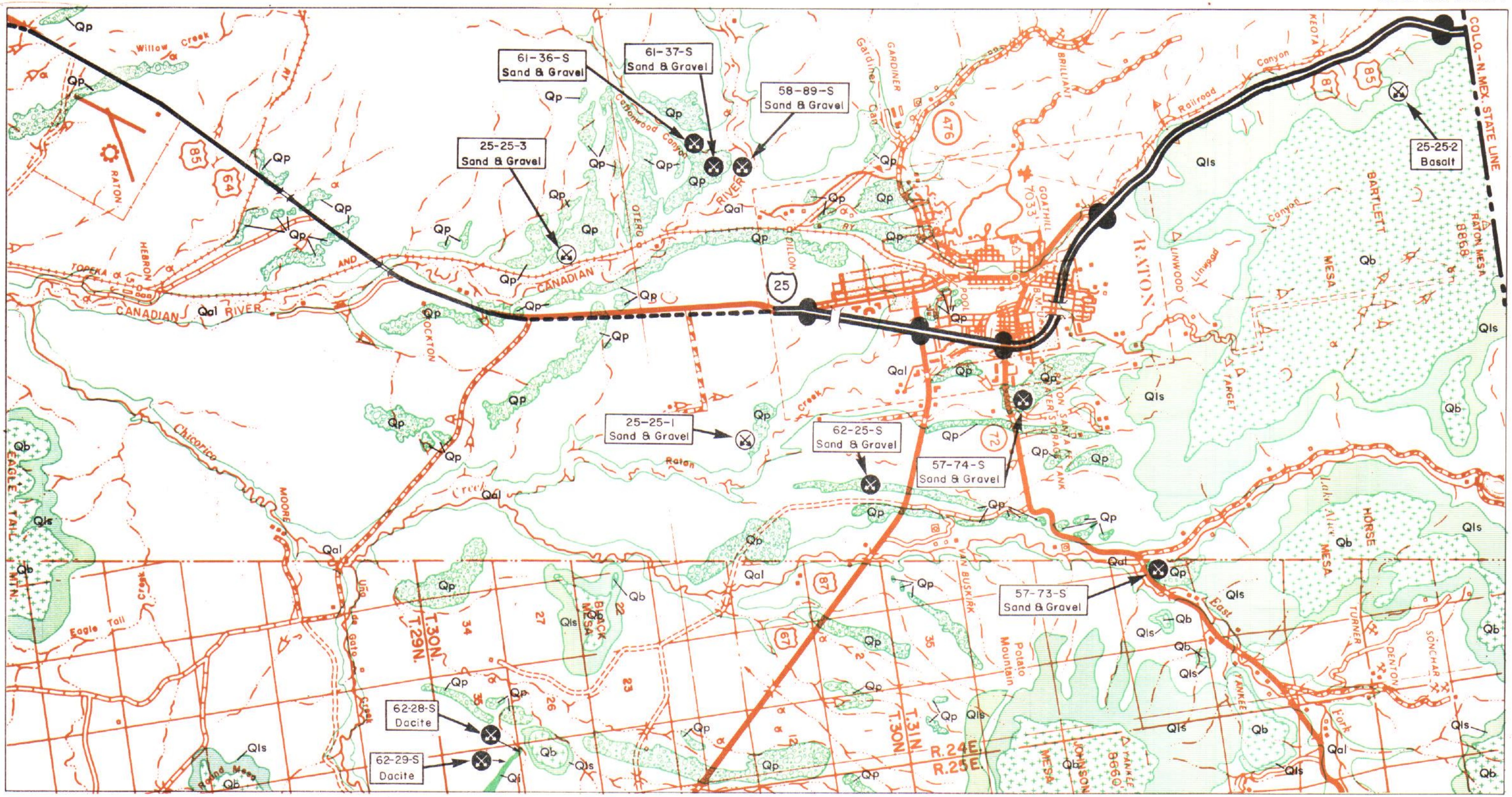
SOILS AND GEOLOGY

Soils Summary:

Table 25-25-1

Age and Formation	Hole No.	Lift	Depth in Feet From	To	AASHO Classification	Material Type
Knp	1	A	0.0	6.5	A-6	Clay
Qal	2	A	0.0	10.0	A-4	Silt
Knp		B	10.0	-	Bedrock	Shale
"	3	A	0.0	5.0	A-4	Silt
"		B	5.0	11.0	A-4	"
Qp	4	A	0.0	1.0	A-4	"
""		B	1.0	3.0	A-2-4	Silty sand & gravel
"		C	3.0	4.5	A-4	Silt
"		D	4.5	-	A-1-a	Gravel
"	5	A	0.0	3.0	A-4	Silt
"		B	3.0	13.0	A-2-4	Silty sand & gravel
Knp		C	13.0	-	A-4	Shale
"	6	A	0.0	6.0	A-6	Clay
Qal	7	A	0.0	20.0	A-4	Silt
Qp	8	A	0.0	4.0	A-4	"
"		B	4.0	8.0	A-1-a	Gravel
"		C	8.0	14.0	A-1-a	"
"		D	14.0	16.0	Solid rock	Conglomerate
Knp		E	16.0	-	A-4	Silt
"	9	A	0.0	9.5	A-6	Clay
"		B	9.5	-	Bedrock	shale
"	10	A	0.0	25.0	A-4	Silt
Qal	11	A	0.0	10.0	A-4	"
Qp	12	A	0.0	10.0	A-2-4	Silty sand & gravel
"		B	10.0	18.0	A-2-4	" " " "
"		C	18.0	28.0	A-2-4	" " " "
"		D	28.0	33.0	A-4	Silt
Knp		E	33.0	-	A-4	"
"	13	A	0.0	1.0	A-6	Clay
TK	14	A	0.0	3.0	A-6	"
"	15	A	0.0	3.0	A-7	"
Qal	16	A	0.0	3.0	A-4	Silt
"		B	3.0	7.0	A-1-a	Sand & gravel
"		C	7.0	9.0	A-1-a	" " "
"		D	9.0	-	-	Clay & gravel
TK	17	A	0.0	3.0	A-6	Shale

CONSTRUCTION MATERIALS MAP 25-25



-LEGEND-

TESTED PIT OR QUARRY

PROSPECT PIT OR QUARRY

Qal — Clay, silt, sand and gravel

Qls — Basalt landslide debris

Qp — Pediment deposit silt, sand and gravel

Qi — Dacite dike

Qb — Basalt

STATUTE MILES

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-25-2

Pit or Prospect No.		57-73-S (extended)	57-74-S	58-89-S	61-36-S	61-37-S	62-25-S
Location	Section	NW 1/4 Sec. 14	SW 1/4 Sec. 20	Not sectionalized	Not sectionalized	Not sectionalized	SW 1/4 Sec. 33
	Twnshp. & Range	T 31 N R 24 E	T 31 N R 24 E	Maxwell Grant	Maxwell Grant	Maxwell Grant	T 31 N R 24 E
	County	Colfax	Colfax	Colfax	Colfax	Colfax	Colfax
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	Private	Private	Private	Private	Private
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Alluvium	Pediment deposit	Alluvium	Alluvium	Pediment deposit	Pediment deposit
Type of Pit		Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel	Sand & gravel
Kind of Material		Sandstone & basalt	Various	Various	Various	Various	Various
Quality of Material		Good	Good	Fair	Good	Fair	Fair
Thickness of Material		7.5 feet avg.	8.0 feet	4.7 feet avg.	9 to 15 feet	6 to 12 feet	6.4 feet
Thickness of Cap (Caliche)		-	-	-	-	-	-
Blasting Qualities		-	-	-	-	-	-
Uniformity		Good	Good	Fair	Good	Fair	Fair
Impurities		Silt lenses	Silt	Shale & coal (minor)	Shale & coal (minor)	Shale & coal	Shale & silt
Type of Mat'l. Underlying Formation		Shale	Shale	Sand & gravel	Shale	Shale	Sand & gravel
Moisture Condition		Dry	Dry	Water at 6 feet	Wet (periodically)	Wet	Dry
Vegetation		Pinon & cedar	Trees & grass	Grass	Grass	Grass	Grass
Local Terrain		Stream valley	Ridge	River channel	Stream channel	River channel	Hill
Depth of Overburden		3.0 feet avg.	4.0 feet avg.	None	3 feet approx.	2 to 8 feet	4.9
P.I. (Overburden)		10 avg.	12 avg.	-	6 approx.	13	17
Est. Reserve Quantity		10,000 to 15,000 cu. yds.	10,000 cu. yds.	See remarks	500,000 cu. yds.	?	200.000 cu. yds.
Approx. Haul to Nearest Point		4.5 miles	1 mile	5 miles	2.7 miles	2.7 miles	1,800 feet
L.A. Wear		32	36.0	36	22	24.8	30
Maximum Size		12"	15"	8"	8"	8"	10"
% Retained on 2" Sieve		33	36	22	17	22	30
	Crushed to	-	-	-	-	-	-
	2"	75	75	90	69	78	72
Pit	1"	56	56	71	59	64	53
Average	3/4"	50	49	62	55	57	49
% Passing	1/2"	44	42	54	50	50	44
	#4	31	29	44	38	37	31
	#10	25	22	37	30	29	19
	#200	5	6	3	7	6	5
P.I.		N.P.	N.P.	N.P.	N.P.	N.P.	11
Lab. Numbers		57-11170-11187	57-11283-11299, 56-11300-11304, 17163-17175	58-17876-17882	61-16811-16857	61-16858-16884	62-3974-3976, 7051-7100

Remarks:

57-73-S (extended) - This pit is worked out except for minor quantities possibly 10 to 15 thousand cu. yds. may be salvaged.

58-89-S - For all practical purposes this area is worked out. Similar material may be found upstream from the confluence of the Canadian River and Cotton wood Canyon Creek.

CONSTRUCTION MATERIALS INVENTORY

Material Pit Summary:

Table 25-25-2

Pit or Prospect No.		62-28-S	62-29-S	25-25-1 (Prospect)	25-25-2 (Prospect)	25-25-3 (Prospect)
Location	Section	SW 1/4 Sec. 25	36	Not sectionalized	Not sectionalized	Not sectionalized
	Twnshp.	T 30 N	T 30 N	Maxwell Grant	Maxwell Grant	Maxwell Grant
	& Range	R 24 E	R 24 E			
	County	Colfax	Colfax	Colfax	Colfax	Colfax
	State	New Mexico	New Mexico	New Mexico	New Mexico	New Mexico
Owner		Private	State	Private	Private	Private
Geologic Age		Quaternary	Quaternary	Quaternary	Quaternary	Quaternary
Formation		Dacite	Dacite	Pediment gravel	Landslide debris	Pediment deposit
Type of Pit		Quarry	Quarry	Sand & gravel	Quarry	Sand & gravel
Kind of Material		Dacite & andesite	Dacite & andesite	Various	Basalt	Sandstone & igneous
Quality of Material		Excellent	Excellent	Poor	Unexplored	Good
Thickness of Material		40+ feet	20+ feet	18 feet approx.	"	15 to 20 feet
Thickness of Cap (Caliche)		-	-	-	-	-
Blasting Qualities		-	?	-	-	-
Uniformity		Good	Excellent	Poor	Unexplored	Good
Impurities		?	?	Silt & shale	"	Silt
Type of Mat'l. Underlying Formation		Andesite	Andesite	Shale	Sandstone & siltstone	Shale
Moisture Condition		Dry	Dry	Dry	Dry	Dry
Vegetation		None	-	Grass	Juniper	Pinon
Local Terrain		Dike	Mesa	Side of hill	Slope of mesa	Hilly
Depth of Overburden		None	None	0 to 4+ feet	None	1 to 3 feet
P.I. (Overburden)		-	-	9	-	11
Est. Reserve Quantity		Unlimited	Unlimited	?	?	500.000 cu. yds.
Approx. Haul to Nearest Point		9.5 miles	10 miles approx.	2 miles	1 mile	1 mile
L.A. Wear		20	20	30	Unexplored	28.4
Maximum Size		-	-	6"	"	36"
% Retained on 2" Sieve		-	-	26	"	12
	Crushed to	2"	2"	-	"	-
	2"	100	100	74	"	65
Pit	1"	77	73	53	"	57
Average	3/4"	44	42	44	"	51
% Passing	1/2"	28	28	36	"	45
	#4	12	13	21	"	32
	#10	7	7	14	"	25
	#200	2	2	4	"	4
P.I.		N.P.	N.P.	7	"	N.P.
Lab. Numbers		62-7688-7691. 8912	63-6243-6244, 6248	63-10891-10895		64-2520-2521

APPENDIX A

GEOLOGIC TIME CHART

ERAS	PERIODS (of time) or SYSTEMS (of rock)	EPOCHS (of time) or SERIES (of rock)	APPROXIMATE TIME IN YEARS SINCE BEGINNING OF EACH	PHYSICAL AND BIOLOGICAL FEATURES
CENOZOIC	QUATERNARY (Q)	Recent	50,000	Development of modern man.
		Pleistocene	1,000,000	Ice sheets over Europe and North America; appearance of early man.
	TERTIARY (T)	Pliocene	12,000,000	Development of modern plants and animals; formation of mountains in western America.
		Miocene	30,000,000	Highest development of larger mammals; formation of mountains, including the Alps, Andes, and Himalayas.
		Oligocene	40,000,000	Development of higher mammals.
		Eocene and Paleocene	60,000,000	Rise to dominance of mammals; appearance of ancestral horse and primates.
MESOZOIC	CRETACEOUS (K)		120,000,000	Extinction of dinosaurs; development of early mammals and flowering plants; deposit of chalk beds.
	JURASSIC (J)		155,000,000	Appearance of flying reptiles and birds; dominance of dinosaurs; appearance of primitive mammals; abundance of coniferous trees.
	TRIASSIC (Tr)		190,000,000	Appearance of dinosaurs; dominance of reptiles; appearance of cycadaceous trees.
PALEOZOIC	PERMIAN (P)		215,000,000	Development of reptiles; decline of huge plants of the Mississippian and Pennsylvanian.
	PENNSYLVANIAN (ℙ)		300,000,000	Age of coal; formation of coal beds from luxuriant plant life in warm, swampy forest; great fernlike trees; appearance of primitive conifers; abundance of insect life; first appearance of reptiles; development of amphibians.
	MISSISSIPPIAN (M)			
	DEVONIAN (D)		350,000,000	Age of fish; appearance of primitive amphibians; development of primitive plant life on dry continents.
	SILURIAN (S)		390,000,000	Appearance of scorpions, the first animals to live on land; extensive coral reefs.
	ORDOVICIAN (O)		480,000,000	Floods and recessions of shallow seas; deposits of limestone, lead, and zinc ores; abundance of marine invertebrate life; appearance of a few primitive fishlike vertebrates.
	CAMBRIAN (Є)		550,000,000	Shallow seas over much of the land; formation of sedimentary rocks; development of marine invertebrate life, including brachiopods, snails, sponges, and trilobites.
PRECAMBRIAN (PЄ)	PROTEROZOIC		1,200,000,000	Formation of mountains; deposits of iron ore; abundance of lime-secreting algae; appearance of sponges.
	ARCHEOZOIC		2,000,000,000	Great volcanic activity; formation of igneous rocks; some microscopic algae; probably some protozoa.

APPENDIX B

NOMENCLATURE CHART OF NEW MEXICO GEOLOGIC NAMES
AND
HIGHWAY DEPARTMENT EQUIVALENTS

SYSTEM	SERIES	NORTHEAST			HIGHWAY DEPARTMENT EQUIVALENTS	
QUATERNARY	Pleistocene & Recent	Alluvium			Alluvium	
		Bolson deposits			Bolson deposits	
		Caliche			Caliche	
		Extrusive igneous rocks			Extrusive igneous rocks	
		Intrusive igneous rocks			Intrusive igneous rocks	
		Landslides			Landslides	
		Pediment gravels			Pediment gravels	
		Spring deposits			Spring deposits	
		Terrace deposits			Terrace deposits	
TERTIARY	Pliocene	SANTA FE fm	OGALLALA fm		Santa Fe fm	Ogallala fm
	Mio-cene					
	Oligocene					
	Eo-cene	GALISTEO fm			Tertiary rocks undifferentiated	
		POISON CANYON fm			Poison Canyon fm	
	Paleo-cene	RATON fm			Raton fm	
CRETACEOUS	Upper	VERMEJO fm	RAIL CANYON ss mbr		Vermejo fm	
		TRINIDAD ss			Trinidad ss	
		MONTANA group	PIERRE shale		Pierre shale	
		COLORADO group: NIOBRARA fm	SMOKEY HILL marl (APISHAPA sh)		Niobrara fm	Apishapa sh
			FORT HAYS limestone (TIMPAS limestone)			Fort Hays limestone
		BENTON sh	CARLILE sh	Juana Lopez ss mbr	Benton sh	Carlile shale
			GREENHORN limestone			Greenhorn ls
			GRANEROS shale			Graneros shale
		DAKOTA sandstone			Dakota sandstone	
	Lower	PURGATOIRE fm	PAJARITO sh mbr		Purgatoire fm	
			MESA RICA ss mbr			
			TUCUMCARI sh mbr			
JURASSIC	Upper	MORRISON fm			Morrison fm	
		WANAKAH fm	WANAKAH marl			
			BILK CREEK ss			
		TODILTO limestone				
		*Ocate ss	EXETER (*Exter-) ss			
	Mid. / Low.	WINGATE ss	ENTRADA ss		Wingate sandstone	
		NARANJO fm (Sheep Pen Canyon ss)				
TRIASSIC	Upper	Sloan Canyon fm				
		DOCKUM group	REDONDO ss mbr		Dockum group	Chinle fm
			CHINLE fm			
			SANTA ROSA sandstone			Santa Rosa ss
	Low.					

SYSTEM	SERIES			
PERMIAN	Ochoa			
	Guadalupe	BERNAL fm		Bernal fm
		SAN ANDRES fm		San Andres fm
		GLORIETA ss		Glorieta ss
	Leonard	YESO fm	SAN YSIDRO mbr	Yeso fm
			MESETA BLANCA mbr	
	Wolfcamp	SANGRE de CRISTO fm		Sangre de Cristo fm
PENNSYLVANIAN	Virgil	MAGDALENA group	MADERA limestone	Magdalena group: Madera limestone
	Missouri			
	Des Moines			
	Atoka		SANDIA fm	Sandia fm
	Mor-row			
MISSISSIPPIAN	Chest.			
	Meram	ARROYO PENASCO fm	LEADVILLE ls	Mississippian rocks undif
	Osage			
	Kind			
DEVONIAN	Upper	OURAY ls		Devonian rocks undifferentiated
		ELBERT fm	McCraken sandstone mbr	
	Mid.			
SIL	Mid.			
ORDOVICIAN	Upper			
	Low.			
CAM	U.			

Names printed in caps are currently accepted for use by the U.S. Geological Survey.

Names printed in caps and lower case are those which the survey has not accepted or has no occasion to consider for use.

Names preceded by * have either been abandoned by their authors or rejected by the survey.

Names preceded by ✱ are recommended for suppression by the survey or the New Mexico Bureau of Mines and Mineral Resources.

NOMENCLATURE CHART OF NEW MEXICO GEOLOGIC NAMES AND HIGHWAY DEPARTMENT EQUIVALENTS

SYSTEM	SERIES	NORTHWEST	HIGHWAY DEPARTMENT EQUIVALENTS
QUATERNARY	Pleistocene & Recent	Alluvium	Alluvium
		Bolson deposits	Bolson deposits
		Extrusive igneous rocks	Extrusive igneous rocks
		Intrusive igneous rocks	Intrusive igneous rocks
		Landslides	Landslides
		Morainal deposits	Morainal deposits
		Pediment gravels	Pediment gravels
		Spring deposits	Spring deposits
		Terrace deposits	Terrace deposits
		Puye gravels; Tuerto gravels; ANCHA fm; FLORIDA gravels	
TERTIARY	Pliocene	SANTA FE fm (Abiquiu fm; Picurius tuff; BISHOPS LODGE mbr); TESUQUE fm; GILA congl	Santa Fe fm; Gila congl
	Miocene	CHUSKA ss	Chuska ss
	Oligocene	DATIL fm (La Jara Peak mbr; Hells Mesa mbr; Spears mbr)	Datil fm
		POTOSI volcanic series	Extrusive rocks undif.
	Eocene	BACA fm; GALISTEO fm	Tertiary rocks undifferentiated
		WASATCH (San Jose) fm	Wasatch fm
	Paleocene	TORREJON fm	Torrejon and Puerco fms
		PUERCO fm	
		NACIMIENTO fm; ANIMAS fm	Nacimiento fm; Animas fm
CRETACEOUS	Upper	OJO ALAMO ss	Ojo Alamo ss
		TOHATCHI fm	Tohatchi fm
		McDERMOTT fm	McDermott fm
		KIRTLAND sh; FARMINGTON ss mbr	Kirtland sh; Farmington ss mbr
		FRUITLAND fm	Fruitland fm
		PICTURED CLIFFS ss	Pictured Cliffs ss
		LEWIS sh	Lewis sh
		MESAVERDE group: CLIFF HOUSE ss (*Chacra ss): Baker Dome tongue; BEECHATUDA tongue; CHOLLA CANYON tongue; NORTH HOGBACK tongue; UTE CANYON tongue; LA VENTANA ss mbr	Mesaverde group: Cliff House ss
		MENEFEE fm: ALLISON barren mbr; CLEARY coal mbr	Menefee fm
		POINT LOOKOUT ss	Point Lookout ss
		HOSTA tongue; SATAN tongue (MANCOS shale)	
		CREVASSE CANYON fm (Chamiso fm): GIBSON coal mbr; BARTLETT barren mbr; DALTON ss; MULATTO tongue; DILCO coal mbr	Crevasse Canyon fm
		GALLUP ss: GALLEGO ss mbr; PESCADO tongue; D-CROSS tongue; *Tocito ss lentil	Gallup ss
		MANCOS sh: Sanastee mbr; Horsehead tongue; Atarque mbr; GREENHORN mbr; Twowells ss mbr; GRANEROS mbr; TRES HERMANOS mbr	Mancos sh
		DAKOTA ss	Dakota ss
	Lower		
JURASSIC	Upper	MORRISON fm: BRUSHY BASIN sh; WESTWATER CANYON ss (Prewitt mbr); RECAPTURE sh (Chavez mbr); SALT WASH ss mbr; ZUNI (Cow Springs) ss	Morrison fm
		SAN RAFAEL group: Navajo ss; BLUFF ss; SUMMERVILLE (Red Mesa fm); Thoreau fm	Navajo ss
		TODILTO fm	Todilto fm
	Mid.	ENTRADA fm	Wingate fm
	Low.	CARMEL fm	
TRIASSIC	Upper	GLEN CANYON group: WINGATE ss: LUKACHUKAI mbr; ROCK POINT mbr	
		CHINLE fm: OWL ROCK mbr; CORREO ss mbr; PETRIFIED FOREST mbr; Sonsela ss bed; POLEO ss lentil; SALITRAL sh mbr; AGUA ZARCA ss mbr	Chinle fm: Upper mbr; Middle mbr; Lower mbr
		SHINARUMP congl	Shinarump congl
	Low.	MOENKOPI fm	Moenkopi fm

SYSTEM	SERIES		
PERMIAN	Ochoa		
	Guadalupe		
	Leonard	*MANZANO group: SAN ANDRES fm; GLORIETA ss; DE CHELLY ss; *CHUPADERA fm; YESO fm: LOS VALLOS mbr; SAN YSIDRO mbr; ORGAN ROCK mbr; MESETA BLANCA mbr; CEDAR MESA mbr; CUTLER fm	Manzano group: Chupadera fm: San Andres fm; Glorieta ss; De Chelly ss; Yeso fm; Cutler fm
	Wolfcamp	ABO fm; HALGAITO mbr	Abo fm
		BURSUM fm	Bursum fm
PENNSYLVANIAN	Virgil	MAGDALENA group: MADERA ls: RED TANKS mbr	Magdalena group: Madera ls
	Missouri	ATRASADO mbr	
	Des Moines	GRAY MESA mbr	
	Atoka	SANDIA fm	Sandia fm
		Log Springs fm	
MISSISSIPPIAN	Chest.		
	Merm	ARROYO PENASCO fm	Mississippian rocks undif.
		Kelley ls	
	Osage		
	Kind	Caloso fm	Mississippian rocks undif.
DEVONIAN	Upper		
	Mid.		
SIL	Mid.		
ORDOVICIAN	Upper		
	Low.		
CAM	U.	IGNACIO quartzite	Ignacio quartzite

NOMENCLATURE CHART OF NEW MEXICO GEOLOGIC NAMES AND HIGHWAY DEPARTMENT EQUIVALENTS

SYSTEM	SERIES	SOUTHEAST	HIGHWAY DEPARTMENT EQUIVALENTS
QUATERNARY	Pleistocene & Recent	Alluvium	Alluvium
		Bolson deposits	Bolson deposits
		Caliche	Caliche
		Extrusive igneous rocks	Extrusive igneous rocks
		Intrusive igneous rocks	Intrusive igneous rocks
		Landslides	Landslides
		Pediment gravels	Pediment gravels
		Spring deposits	Spring deposits
		Terrace deposits	Terrace deposits
TERTIARY	Pliocene	SANTA FE fm; OGALLALA fm	Santa Fe fm; Ogallala fm
	Miocene		
	Oligocene		
	Eocene	Cub Mountain fm	Tertiary rocks undif
	Paleocene		
CRETACEOUS	Upper	MESAVERDE fm	Mesaverde fm
		MANCOS (EAGLE FORD) fm	Mancos shale
		DAKOTA ss	Dakota ss
	Lower	BUDA ls	Lower Cretaceous undifferentiated
		DEL RIO fm	
		GEORGETOWN fm	
		EDWARDS ls; FINLAY ls	
		COX fm	
JURASSIC	Upper		
	Mid.		
	Low.		
TRIASSIC	Upper	DOCKUM group	Dockum group
		SANTA ROSA sandstone	
	Low.	TECOVAS shale	Shinarump conglomerate
		PIERCE CANYON red beds	

SYSTEM	SERIES		
PERMIAN	Ochoa	DEWEY LAKE fm	Ochoa evaporites
		RUSTLER fm: MAGNETA dolomite mbr; CULEBRA dolomite mbr; Vaca Triste mbr	
		SALADO fm: McNutt zone; COWDEN anhydrite mbr; LA HUERTA silt mbr; FLECHER anhydrite mbr	
		CASTILE fm	
	Guadalupe	WHITEHORSE group: Ocotillo silt mbr; TANSILL fm; YATES ss; AZOTEA tongue; SEVEN RIVERS fm; QUEEN fm (Shattuck mbr; Yoakum dol mbr); GRAYBURG fm	Carlsbad group; Capitan ls; Delaware Mountain group
		THREE TWINS mbr; CARLSBAD group; CHALK BLUFF fm	Chalk Bluff fm; Goat Seep ls
		CAPITAN limestone: LAMAR ls; McCOMBS mbr; RADER mbr; PINERY mbr; HEGLER limestone	
		GOAT SEEP ls: MANZANITA ls mbr; SOUTH WELLS mbr; GETAWAY mbr	
		DELAWARE MOUNTAIN group: BELL CANYON fm; CHERRY CANYON fm; Sandstone tongue Cherry Canyon fm; BRUSHY CANYON fm	
		BERNAL fm	
		SAN ANDRES fm; Hondo ss mbr	San Andres fm
		GLORIETA ss	Glorieta ss
	Leonard	YESO fm: JOYITA ss mbr; CANAS gypsum; TORRES mbr; MESETA BLANCA mbr	Yeso fm; Bone Spring ls
		BONE SPRING ls: CUTOFF shaley mbr; VICTORIA PEAK gray mbr	
	Wolfcamp	ABO fm: LEE RANCH tongue; Danley Ranch tongue	Abo fm; Hueco
		DEER MOUNTAIN sh; Pendejo tongue; POWWOW congl; HUECO fm	
		BURSUM (Laborcita) fm	Bursum fm
PENNSYLVANIAN	Virgil	MAGDALENA group: Holder fm; Panther Seep fm	Magdalena group: Madera limestone
	Missouri	Beeman fm	
	Des Moines	Gobbler fm; Bug Scuffle ls mbr	
	Atoka	SANDIA fm	Sandia fm
	Morrow		
MISSISSIPPIAN	Chest.	HELMS fm	Mississippian rocks undif
	Mer.	Rancheria fm	
		Las Cruces fm	
	Osage	LAKE VALLEY fm: Dona Ana mbr; Arcente mbr; Tierra Blanca mbr; Nunn mbr; Alamogordo mbr; Andrecito mbr	Lake Valley fm
	Kind.	Caballero fm	Mississippian rocks undif
DEVONIAN	Upper	PERCHA (WOODFORD) fm	Percha fm
		Contadero fm	Devonian rocks undifferentiated
		Sly Gap fm	
	Mid.	Onate fm	
SIL.	Mid.	FUSSELMAN ls	Fusselman limestone
ORDOVICIAN	Upper	Valmont dolomite	Montoya group
		MONTOYA group: Aleman fm; Upham dolomite; Cable Canyon ss	
	Low.	EL PASO fm (ELLENBURGER group)	El Paso fm
CAM.	U.	Bliss sandstone	Bliss sandstone

NOMENCLATURE CHART OF NEW MEXICO GEOLOGIC NAMES AND HIGHWAY DEPARTMENT EQUIVALENTS

SYSTEM	SERIES	SOUTHWEST		HIGHWAY DEPARTMENT EQUIVALENTS	
QUATERNARY	Pleistocene & Recent	Alluvium		Alluvium	
		Bolson deposits		Bolson deposits	
		Caliche		Caliche	
		Extrusive igneous rocks		Extrusive igneous rocks	
		Intrusive igneous rocks		Intrusive igneous rocks	
		Landslides		Landslides	
		Pediment gravels		Pediment gravels	
		Spring deposits		Spring deposits	
		Terrace deposits		Terrace deposits	
		PALOMAS gravels			
TERTIARY	Pliocene	SANTA FE fm	GILA conglomerate	Santa Fe fm	Gila congl.
	Miocene				
	Oligocene	Bell Top fm; Thurman fm; Palm Park fm	DATIL fm	Tertiary rocks undifferentiated	Datil fm
	Eocene	BACA fm		Tertiary rocks undifferentiated	
	Paleocene	McRae fm	Hall Lake mbr; Jose Creek mbr	McRae fm	
CRETACEOUS	Upper	MESAVERDE fm	Ash Canyon mbr	Mesaverde fm	
		MANCOS sh	COLORADO sh	Mancos sh	Colorado sh
		DAKOTA ss		Dakota ss	
		BEARTOOTH quartzite		Beartooth quartzite	
		SARTEN ss		Sarten ss	
	Lower	Trinity gp	SKUNK RANCH conglomerate; PLAYAS PEAK fm; CORBETT ss; HOWELLS RIDGE fm; HIDALGO fm; RINGBONE sh; BROKEN JUG ls	Lower Cretaceous undifferentiated	
		Bisbee group	Johnny Bull ss; Still Ridge fm; Carbonate Hill ls; McGhee Peak fm		
JURASSIC	Upper				
	Mid.				
	Low.				
TRIASSIC	Upper	DOCKUM group		Dockum group	
	Low.				

SYSTEM	SERIES		HIGHWAY DEPARTMENT EQUIVALENTS
PERMIAN	Ochoa		
	Guadalupe		
	Leonard	*MANZANO group; *CHUPADERA fm: SAN ANDRES fm	San Andres fm
		GLORIETA sandstone	Glorieta sandstone
		YESO fm: CONCHA limestone; SCHERRER fm; EPITAPH dolomite; COLINA limestone	Yeso fm
	Wolfcamp	ABO (LOBO) fm; HUECO ls; *GYM ls; EARP fm	Abo fm; Hueco ls
		BURSUM fm; *Agua Torres fm; NACO group	Bursum fm
PENNSYLVANIAN	Virgil	MAGDALENA group; MADERA limestone; Bar-B fm; Syrena fm; Fresnal group: Bruton fm	Magdalena group: Madera limestone
		Keller group: Moya fm; Del Cuerto fm	
	Missouri	Hansonburg gp: Storey fm; Burrego fm	
		Veredas group: Council Springs ls; Adobe fm; Coane ls	
		Bolander group; Nakaye fm; HORQUILLA limestone	
	Des Moines	Bishops Cap fm; Bernio fm; Oswaldo fm; Armendaris group: Garcia fm; Whiskey Canyon ls; Elephant Butte fm; Warmington mbr	
	Atoka	SANDIA fm; La Tuna mbr; Red House fm; Mud Springs group: Cuchillo Negro fm; Fra Cristobal fm (*Hot Springs fm)	Sandia fm
	Morrow	Green Canyon gp: Apodaca fm; Arrey fm	
MISSISSIPPIAN	Chest	HELMS fm; PARADISE fm	Mississippian rocks undifferentiated
	Merm	Rancheria fm; Las Cruces fm	
	Osage	Kelley limestone	Lake Valley fm
		LAKE VALLEY fm: Dona Ana mbr; Arcente mbr; Tierra Blanca mbr; Nunn mbr; Alamogordo mbr; Andrecito mbr; ESCABROSA limestone	
	Kind	Caballero fm	Mississippian rocks undif.
DEVONIAN	Upper	PERCHA fm: Box mbr; Ready Pay mbr	Percha fm
		Contadero fm; Sly Gap fm	Devonian rocks undifferentiated
	Mid.	Onate fm; Canutillo fm	
SI	Mid.	FUSSELMAN limestone	Fusselman limestone
ORDOVICIAN	Upper	MONTOYA group: Cutter fm (Raven mbr; Par Value mbr); Aleman fm; Upham dolomite; Cable Canyon ss; Second Value mbr	Montoya group
	Low.	EL PASO group: Bat Cave fm; Sierrite limestone	El Paso group
CAM	U.	BLISS sandstone	Bliss sandstone
		BOLSA quartzite	Bolsa quartzite