NEW MEXICO OF MINES AND MINERAL RESOURCES

OPEN-FILE REPORT 253

PALEONTOLOGY AND THE ARIZONA INTERCONNECTION PROJECT

Donald L. Wolberg
New Mexico Bureau of Mines and
Mineral Resources
Socorro, New Mexico 87801

Objectives

This report attempts to provide an overview of the potential for fossils to be found in an area that encompasses a large part of southwestern New Mexico and extreme southeastern Arizona. Portions of this "study area" are proposed for the routing of a transmission line. Additionally, this report attempts to provide insight regarding possible effects activities related to the construction of the transmission line will have on fossils that may occur in the region, what should or shouldn't be done about perceived "impacts" to fossils, and an interpretation of the statutory and regulatory authority of Federal agencies that manage public lands.

The Study Area

Within the area of southwestern New Mexico and southeastern Arizona, a diversity of rock units is exposed that spans, with gaps, the Precambrian to Recent. Rock types present include igneous, metamorphic, volcanic, and a wide range of sedimentary strata that include marine carbonates, shales and sandstones; continental rocks, stream deposits and lacustrine sediments. These units vary widely in age. The region has had a complex tectonic history. Broad areas are covered by volcanic and volcanoclastics. Late Tertiary and Quaternary sedimentary strata predominate throughout the region. Except for limited areas, the paleontology of the region is poorly understood and not well documented. Restricted studies involving Paleozoic invertebrate studies have been published and a wealth of unpublished data related to the Quaternary of the San Agustine Plains remains unpublished but is considered confidential. Similar circumstances exist for Tertiary localities.

Personnel

This paleontological overview was completed by Donald L. Wolberg. Wolberg received a B.A. in Geology from New York University and a Ph.D. in Geology from the University of Minnesota. He serves as Paleontologist with the New Mexico Bureau of Mines and Mineral Resources and as Adjunct Associate Professor, Geosciences Department, New Mexico Institute of Mining and Technology. He has conducted fieldwork in New York, New Jersey, North Dakota, South Dakota, Montana, Colorado, Minnesota, Wisconsin, New Mexico, and Greece. He is a member of the Society of Vertebrate Paleontology, the Paleontological Society, the Paleontological Research Institute, the Association of Southwestern Naturalists, the International Society of Cryptozoology, Sigma Xi, the Association of Geoscientists for International Development. He is currently a Technical Editor for the Journal of Paleontology; a member of the Society of Vertebrate Paleontology Government Liaison Committee; has served on the New Mexico Coal Surface Mining Commission; serves on a State-BLM-Industry committee developing a cooperative program related to mining and Paleontology on BLM lands in New Mexico, and participated in the development of the State-Industry paleontological mitigation program for coal surface mining in New Mexico. He has published various papers dealing with cichlid ethology, australopithecine osteodontokeratic "tools", Paleocene mammals, Cretaceous sharks, Cretaceous dinosaurs and mammals, a Pleistocene horse, a Holocene zooarcheology fauna from Greece,and other topics. He is interested in statutes and regulations applied to fossil collecting and paleontology and the usefulness and development of salvage and mitigation programs.

Interpretations of Federal Legislation and Regulations and Fossils

Various Federal statutes and regulations have been or can be interpreted as applying to fossil collecting and the science of paleontology. These regulatory efforts can have a major effect on who can collect fossils, where such activities can occur, how collection is to proceed and even why fossils should or shouldn't be collected. The effect of these regulatory initiatives is profound given the fact that there are more than 60 Federal agencies that manage public lands and because of the sheer bulk of land regulated. For example, the U.S. Bureau of Land Management is concerned with more than 400 million acres of public lands; the U.S. Forest Service with more than 180 million acres; the U.S. Bureau of Indian Affairs with more than 50 million acres; the U.S. Fish and Wildlife Service with approximately 30 million acres; the U.S. National Park Service with approximately 25 million acres; and the U.S. Bureau of Reclamation, more than 7 million acres. The primary statutory and regulatory authority related to fossil collecting and paleontology is outlined below. This statutory authority, all or in part, has been utilized or proposed by various Federal agencies.

1. The Antiquities Act of 1906 (P.L. 59-209; 34 Stat. 225; 16 U.S.C. 432, 433)

Historically, this statute served as the major authority for the preservation and protection of antiquities on all Federal land. It provided for permitting, regulated the extent and intensity of activities, disposition of material collected, and established penalties. Unfortunately, the Antiquities Act of 1906 had nothing to do with fossils and paleontology and was clearly directed towards archeology. This fact, of course, did not prevent the application of the Act to paleontology. Annually, paleontologists would apply for collecting permits eventually processed by the Heritage and Conservation Division of the National Parks Service. In 1977, a Department of Interior Solicitor's opinion pointed out that the application of the 1906 Antiquities Act to paleontological permitting probably could not withstand a court test except if the fossils occurred in an archeological context.

Despite the opinion noted above, the U.S. Bureau of Land Management, in some states, still requires such a permit authorized by the 1906 Act, as dones the U.S. Bureau of Indian Affairs. BLM elsewhere, however, regulates paleontology under different authority. With the passage of the Archaeological Resources Protection Act of 1979, a peculiar situation arose. ARPA displaced the 1906 Act as the primary statutory authority regulating archeology on public lands and the regulation of paleontology was thus the only thing left to manage under the 1906 Act. Strangely, ARPA does include paleontological materials when they occur in an archeological context. Professional paleontologists, especially vertebrate paleontologists, have long been concerned with the use of the 1906 Antiquities Act for permitting and regulatory authority by Federal agencies, either individually or through the Society of Vertebrate Paleontolcgy.

2. Federal Land Policy and Management Act of 1976 (P.L. 94-579; 90 Stat. 2743; 43 U.S.C. 1701).

FLPMA has provided the statutory authority for BLM involvement in matters of scientific concern and much else; primary authority in FLPMA lies in Sections 103(a) and 103(c), where "Areas of Critical Environmental Concern" are discussed, and the management of "scientific and historic values." Additional authority can be interpreted from Section 102(a), parts 2, 7, 8, 9, 11, and 12. Of course, paleontology is not specifically noted anywhere in FLPMA but is interpreted through the term: scientific values. Title II of FLPMA, especially Sections 202, 302, and 307 can. in part, be interpreted to apply to paleontology. However, such applications can and have been questioned. Collecting permits on BLM lands are currently issued under this Act.

3. Petrified Wood (Minerals Materials Act of 1947 and as amended in 30 U.S.C. 601, 603, and 6110-615; 43 CFR Subpart 3622).

Petrified wood is treated differently from other fossil materials and its collection for non-commercial purposes is regulated by the authority cited above. An individual may collect 25 pounds plus one piece of petrified wood per day without charge and 250 pounds in one calendar year. Specimens larger than 250 pourds require application and permit.

4. <u>National Environment Policy Act of 1969</u> (P.L. 91-190; 83 Stat. 852; 42 U.S.C. 4321.

NEPA has had a significant impact on paleontology and fossil collecting albeit indirectly. Although Section 101(b)(4) of NEPA states that the Federal government is to, "...preserve important, cultural, and natural aspects of our national heritage," it is largely the need for <u>Environmental Impact Statements</u> that has affected paleontology. Paleontological sections are commonly included in such impact statements. Insofar as can be determined the inclusion of paleontological sections in impact statements followed from the inclusion of archeological sections and a progressively broader interpretation of the scope of the EIS.

5. <u>Surface Mining Control and Reclamation Act of 1977</u> (30 U.S.C. Sec. 1201 et seq.).

SMCRA requires the filing of a map which includes all manmade features and known archeological sites. The Act also sets criteria to determine which lands are unsuitable for mining including as a criterion damage to scientific values. The unsuitability criterion has been applied to paleontologic "values" in at least one instance. However,the regulatory authority found that the mitigation program proposed by the mining company was sufficient to deny the unsuitability petition.

6. <u>Executive Order 3104</u>, Department of the Interior, September 28, 1984.

This order "decentralized" the permitting process. It delegated the authority to issue archeological and paleontological permits to various DOI land managing agencies. The authority used was both the 1906 Antiquities Act and ARPA.

7. U.S. Department of Agriculture, Forest Service (Federal Register, Vol. 51, No. 165, August 26, 1986, p. 30355-30356.

This recently proposed change in rulemaking basically reverses previous Forest Service policy regarding paleontology. It finds that collecting fossils on National Forest lands is a "....legitimate scientific and educational pursuit and there is no evidence of widespread conflicts or problems that would require a blanket prohibition..." The rulemaking change would require permits for the collection of vertebrate fossils and commercial activities.

8. <u>Cooperation of Smithsonian Institution with State Institutions for Continuing Paleontologic Investigations</u> (20 U.S.C. Sec. 78)

This Act provided for cooperation of the Smithsonian Institution with any "...State, educational institution, or scientific organization in theUnited States for continuing paleontological investigations, and the excavation and preservation of fossil remains, in areas which will be flooded by the construction of dams or otherwise made unavilable because of such construction..."

Summary

It can be seen from the foregoing listing of statutory and regulatory authority that requirements affecting fossil collecting and paleontology is rather confused and overly complex. In general, the authority to permit is separate from the authority to require mitigation and salvage. Difficulties have arisen from the confusion of paleontology and archeology. In general, vertebrate fossils have commanded greater regulatory attention than invertebrates, although policies vary among Federal agencies. Except for the Act treating petrified wood, the Smithsonian Act, and the proposed Forest Service rulemaking, paleontology is not specifically treated.

Overview and Perspective

Paleontology is the study of fossils, the actual remains or traces of organisms preserved in the rocks and sediments of the Earth. Fossils document the evolution and history of life, provide a means for measuring time, record ancient environments and geographical relationships, and allow rock units in one area to be correlated, matched, to units in another area. Fossils are of value to industry and science and the study of fossils has an important cultural and educational component. Fossil collecting for profit forms a modest industry and provides specimens to museums, univrsities and the general public; fossil collecting is also a recreational activity for many people.

In general, fossils are not rare and countless numbers of specimens are available. Although in a narrow sense, fossils are not a "renewable resource"--the total number of Devonian fossils, for example, is finite and cannot increase--in a practical sense fossils are renewable in that rock exposures producing fossils constantly erode and yield more fossils. Some kinds of fossils are known from an abundance of specimens, Cretaceous oysters such as the various species of Exogyra, for example, while other fossils are known from very few specimens and some fossil species are known from only single specimens which may not even be a complete organism.

The degree to which an organism is complete does not always correspond to the amount of information conveyed by that specimen. A complete fossil pollen grain or oyster shell may convey less information than a single mammal tooth. Thus determinations of "significance" are difficult to formulate in any meaningful sense.

Methods

Fossils are almost always found in sedimentary rocks and unconsolidated sediments. Some fossils are found in volcanic or metamorphic rocks, but these are very much the exception. Thus, looking for fossils in anything other than sedimentary rocks is a poor expenditure of time, energy, and other resources although such a discovery may provide very important scientific information. For example, the discovery of marine, shelled organisms, brachiopods, and fragmentary remains of crinoids (sea lillies) in metamorphosed rocks of the Manhattan Schist in eastern North America, led to a profound rethinking of the age of these and associated rock units.

In general, paleontologists do not randomly look at all sedimentary rocks or unconsolidated sediments for fossils; paleontologists specialize. They may concentrate their efforts on a particular group of organisms, a particular period of time or set of rock strata, a particular depositional environment, or the history of a sigle kind or few kinds of organisms through time. Specialization is fundamental given the enormous amount of data potentially available.

Given these caveats, the following approach was employed to develop a data base to help determine where fossils were likely to occur along the proposed routing of the transmission line. Rather good topographic coverage of the routing exists; poor to good geologic coverage exists. Although some mapping has been completed at a scale of 1:24,000, a good deal of available mapping is included within thirty minute quadrangles and some in $1^{o} \times 2^{o}$ quadrangles. Except when equal scale geologic coverage on a topographic base was found, topographic coverage was superimposed on available geologic coverage, with or without topographic control.

Each topographic map available for the proposed routing was considered separately and the geology interpreted from the available geologic maps, associated descriptive text, or in some instances published and unpublished reports or data. In some cases, this data is in a prepublication stage and confidentiality is of some significance. Brief descriptions of the geologic units present in each topographic quadrangle were written and compiled. Included in these descriptions are the presence of centerlines for particular link segments or corridors and their relationships to the geology. The presence of sedimentary units was taken as an indication of likely fossil remains; the presence of volcanic, plutonic or metamorphic rocks indicates the lack of fossils. From available data, the depositional origin and age of the sedimentary units were noted and included in the description of each quadrangle. The results of this exercise led to the next step, an assessment of the paleontological potential of each quadrangle.

Paleontologic Inventory

Unlike archeological materials, fossils are not intrusive into sediments, but instead are components of sediments. The numbers of individual fossil specimens available for collection are dependent upon the areal extent of the rock unit in which the fossils occur and in a practical sense are inexhaustible. The diversity of fossil organisms present in rocks will vary depending on a wide range of factors generally related to the depositional environment of the rocks involved, but may be very great indeed, encompassing many different taxa. So great can this diversity be that complete (representative) collection and listing of different taxa would be all but impossible.

There are several reasons for this difficulty in completing an "inventory" that has any real scientific meaning. First, fossil collection is dependent upon sampling objectives and methods. A fossil palynoflora can be obtained via coring or by obtaining sediment samples from exposures. Processing these samples requires special laboratory facilities and preparation techniques. Interpreting the samples requires a palynologist. Evaluating marine invertebrates requires different objectives and techniques and any of many different specialists to determine what was collected in the first place. A specialist versed in Lower Paleozoic brachiopods will ordinarily not be able to do much with Jurassic ammonites. The same sort of restrictions apply to vertebrate paleontology. Thus, a scientifically meaningful inventory of a region would require a team of specialists versed in different groups of organisms, or different time periods represented by the rocks present.

Second, at any point in time, only a very small portion of a rock unit is available for study in any area or region. Most of the unit is not exposed, is subsurface, obscured by soils and vegetation, or covered by other rocks. This fact also creates a sampling problem in that any set of exposures available (and their fossil content) will constantly change over time and continually alter the sample population. Thus, trying to assess the fossil content of an area really has no meaning in a technical sense.

Third, in addition to the specialized knowledge of widely varying groups of organisms required, a practical problem arises. The collection, preparation and study of fossils requires time, laboratory facilities and staff not usually readily available except at certain institutions and agencies. Most research paleontologists are intensively involved in studies that require prioritizing of their available time, and that are problem oriented. From their perspective, the conduct of wide-ranging inventories are useful scientifically if they are part of regional reconnaissance especially in areas where fossil data is scarce. In these circumstances, it is likely that scientifically useful fossil material will be found, even if that material is not immediately studied.

Finally, it can be argued that fossils are not a resource to be inventoried for land management purposes in the sense that timber, mineral deposits or threatened and endangered species are inventoried. Although there is no doubt that regulatory authority can be interpreted to include fossils in management plans, the only appropriate management (or protection) of fcssils rests in their collection, study and repositing in a suitable institution.

Inventory and This Report

Locating fossils occurrences can be done in two ways. First, the available literature can be surveyed and compiled and when available, specific locality information recorded. The publication of specific locality information has always been done with varying degrees of exactness. In general, invertebrate localities in current literature are cited using standard notation that references topographic map coordinates. These may be presented in useful quarter- or even quarter-quarter Section, Township, Range form. Unfortunately, many citations are only in Section, Township, Range form, creating difficulty in relocating the sites. Vertebrate localities are frequently cited by institutional locality numbers or codes in an effort to ensure confidentiality of locality data and are only available with the respective institution's approval. Older literature varies greatly in the recordation of locality data and reflects different reporting standards or a lack of adequate topographic coverage. In all of these instances noted above, citation of locality data without field checking to determine the accuracy of the data and to determine whether the locality still exists, is necessary.

Second, fossils are found by looking for them. In order for a scientifically meaningful statement to be made about collections from localities previously collected, especially if the collections were made a long time ago, they should be reviewed by finding out if the collections still exist, if additional collections at the localities in question have been made, and what is the current interpretation of the fossils; are the taxonomic designations still valid. These questions can be answered by correspondence with the appropriate institution housing the collections or when necessary by borrowing the collections.

Fossils are found by paleontological reconnaissance. A defined area is travelled and expsures of rock units and sediments are inspected. When appropriate, fossils that are found are collected. Only those rocks that are likely to have fossils are looked at--sedimentary material.

In terms of this report, the literature has been searched and found to be poor; the region is poorly documented in terms of published paleontological work. Unpublished sources are available to us but are confidential. A substantial body of data is available for the San Agustine Plains, as are modest collections, all housed at the New Mexico Bureau of Mines and Mineral Resources but is unpublished. Additional collections probably still exist elsewhere but time and funding are unavailable for their examination. Concerted paleontological reconnaissance of the region has not been conducted for purposes of this report. Instead, in the time available, a data base has been developed that indicates where fossils are likely to occur along, on, or in the area of the proposed transmission line routing. By the same token, this analysis indicates where fossils are not likely to occur. This data base is found in the descriptive narrative for each map. Table 1 extracts portions of this data for the centerlines and mileposts and keys each appropriate map. The relationships of corridors to likely fossil-bearing strata are noted in the map description.

Significance and Impacts

By convention and because of historic development, not all fossils are considered to be of equal "value" by land managing agencies. Microfossils (pollen, spores, foraminifera, ostracods, etc.) are generally, but not always, ignored. Petrified wood by statute and regulation can be collected except under special circumstances. Invertebrates, such as clams and snails, are of less "value" or "significance" than fossil horses, camels or dinosaurs. The significance of fossil leaves seems to vary from agency to agency. This sort of prioritizing of fossils for managment purposes has little if anything to do with science.

However, accepting this current prioritization of significance determinations, this report treats the occurrence or likely occurrence of vertebrate fossils as being "more significant" than the occurrence of other fossils. It cannot be too often stated that fossils will occur in the appropriate sedimentary rocks and these are identified in this report. The preponderance of fossil-bearing rocks in the area are Tertiary and Quaternary and they are likely to contain vertebrate fossils; this fact is noted in the report. It is also likely that freshwater and terrestrial invertebrates also occur. Other than Teritary and Quaternary fossil-bearing units are also noted when they occur.

Based on available data and data from the same or equivalent rock units outside the study area, published or unpublished collections available, and personal experience, rock units were evaluated. For purposes of this report, vertebrate fossils are treated as being <u>significant</u>. Factored into the process is the likelihood of finding adequate exposures, or if adequate exposures are likely to be lacking or restricted, would the presence of vertebrate, or other fossils, be of importance because of the potential for valuable scientific information being present.

Project associated activities within this context of significance can be considered to have low, moderate, or high impacts to fossils. Obviously, in the case of a transmission line hanging overhead between poles or towers, fossils are unaffected by the presence of the line. The construction of towers and associated access roads, temporary or permanent, however, can be an impact on whatever fossils may be present. Thus, if vertebrate fossils are likely to be present, based on known or extrapolated data, and the nature of available rock exposure is sufficient to expect to be able to find fossils, and actual construction activities will occur in the area, the impact level is at least moderate. If vertebrate fossils do not or most likely will not occur, there is no impact. If large concentrations or densities of localities of vertebrate fossils are known or likely, the impact level is high. If vertebrate or other fossils can contribute significant data, but localities or outcrops are limited, impacts can still be high. This method of interpretation is reflected in Table 1 and is recognized as having a <u>subjective</u> component in its formulation.

The above evaluation is rather standard but must be understood within the context of the transmission line project. Most of the reasoning breaks down when comparisons of real rather than ideal impacts are made for various kinds of development projects. Thus, for example, the real impacts to fossils caused by the construction of a transmission line are minimal when compared to the impacts of developing and operating a surface mine if fossils are present. Even in the case of a surface mining operation, the impact to fossils can be considered minimal if the locus of the operation is compared to the total extent of the rock units which remain unmined. Even if the impact to fossils of the construction of a transmission line is compared to a more comparable sort of project, the construction of a highway, the impacts to paleontology are still minimal. In many ways the highway comparison is useful. Highway projects generally require rather extensive land disturbance and modification. Grades are established, gravel resources quarried, drainages bridged or culverts installed, and the roadway surfaced. By this comparison, construction activities related to transmission line siting of towers or routing are minimal indeed in relation to fossils. This comparison is indicated in Table 1, and as is evident from the table, most comparative impacts are recorded as low.

Mitigation

Beginning with the assumption that a survey has located fossils, the mitigation of perceived impacts to fossils centers on the premise that the fossils are threatened by some action or activity, and that the fossils have or don't have some intrinsic potential value. If, for any of various reasons, the fossils have no defineable significance or value, no mitigative measures need be proposed. If the fossils are judged to have value, two mitigative actions are possible. First, the "impacting" activity can be diverted or moved elsewhere or if this is not possible, the fossils can be removed, salvaged. In virtually all instances, the only adequate "protection" for a fossil once it is exposed is collection. If an exposed fossil is of scientific interest or has educational value, it should be collected. Left to the erosional processes that exposed the fossil, destruction of the specimen is certain. The Mitigation column in Table 1 reflects the reasoning used in the discussion above. It is suggested that following reconnaissance ("prospecting") for significant fossils, in the preponderance of cases this means vertebrate fossils, any significant fossils found should be collected.

Once again, this is a rather standard approach. However, it is not meant to be considered as an invariable program. Several circumstances may exist that would modify the actions suggested. For example, fossil quality may be too poor to make collection worthwhile. Access may not be sufficient to make collection practical. Better material may be available elsewhere along the route or in areas adjacent to the route. No real transmission line construction activity will impact the material.

Of some importance is an analysis of what sorts of mitigative actions should reasonably be required for transmission line projects. A reasonable argument can be made that given the extent of fossil-bearing rocks and sediments, and the potentially enormous number of fossils probably contianed therein, no significant impact is likely to occur. An argument can be made that if concern for these fossil "resources" genuinely reflects their potential value to science or some other useful societal purpose, it is the professional responsibility of the scientific community to collect them and insure their preservation. After all, the material would never have come to the attention of science if the project had not been brought forward. At the opposite extreme the argument could be made that the presence of scientifically interesting fossil material is sufficient to justify rerouting of the proposed project and/or intensive studies to locate, evaluate and salvage all fossil material along the entire route of the proposed project. Neither of these extremes is considered reasonable.

The following is proposed as a suitable and reasonable program to deal with fossils along the proposed transmission line route. First, and most importantly, no actions should be undertaken until routing, siting of towers, placement of service roads and access roads, and siting of all ancillary facilities has been finalized. Secondly, the primary focus of mitigation efforts should be areas of greatest disturbance and areas likely to have fossils. These are considered to be areas likely to have fossils that are affected by concerted activities that include tower placement and associated activities or other areas where there will be more than incidental activities associated with completion of the transmission line or where fossils of demonstrable significance are present. Thirdly, it is proposed that such programs be conducted under the direction of suitable paleontological supervision namely a paleontologist associated with a recognized museum, educational institution, or public agency with a demonstrated interest in the fossils and with the assurance that the fossils collected will be maintained for research and education. Fourthly, it is proposed that mitigation-related activities concentrate on areas with reasonable access available. Lastly, if mitigation and salvage is conducted, it is proposed that only those activities related to the actual search for fossils and their recovery on a time and materials basis be funded. No funding should be provided for preparation, curation, storage, or publication. This will ensure that any fossils collected are considered to have worth scientifically or educationally. In any considered mitigation or salvage effort, the legitimate concerns of scientists actively working in an area will be considered to have priority.

Mitigation efforts to locate and salvage fossil materials should take place before construction activities occur. In the event that fossils are discovered during actual construction, an appropriate paleontologist should be consulted and if the material is of value, as determined by the paleontologist, the fossils should be salvaged. It is not very likely that, except in the most unusual circumstances, untrained personnel will notice fossils, hence the emphasis on pre-activity mitigation.

Mitigation Impacts

Mitigation impacts include the following. If planned siting of major transmission line components are altered to avoid fossil localities, additional cost and/or delay may result. The avoided localities will continue to erode and the specimens will be lost if not collected. If the localities are collected, minimal land disturbance such as excavations may result. These will have to be filled; such impacts are minimal compared to construction associated activities. The collection of fossils should not adversely affect the environment and within this context, Table 1 shows no mitigation impacts resulting from fossil collection.

MAP ASSESSMENT

MAP 1 - GOAT SPRINGS

The geology of the Goat Springs Quadrangle at 1:24,000 is encompassed as a portion of the thirty-minute geologic map of the Cañon Largo Quadrangle (Willard and Weber, 1958). Cretaceous Mancos Shale and Mesaverde sedimentary rocks occupy the northern and eastern portions of the quadrangle. Tertiary Baca strata occupy the western part of the quadrangle. Quaternary volcanics are present in the east-central portion of the quadrangle. Quaternary alluvial deposits are in the extreme southeastern corner of the quadrangle.

The centerline of Link 1, mileages 5-12, and a corridor to the north, transect the quadrangle W-E. Both cross Cretaceous and Tertiary deposits. Although not likely to be abundant fossils will occur, including vertebrates. Significant occurrences are possible.

MAP 2 - BLAINES LAKE

The geology of the Blaines Lake 1:24,000 quadrangle is encompassed by a portion of the thirty-minute geologic map of Cañon Largo (Willard and Weber, 1958). Rocks in the Blaines Lake Quadrangle include Cretaceous Mesaverde rocks, Tertiary Baca-like strata, Tertiary volcanoclastics and Quaternary volcanics and alluvial deposits.

The centerline of Link 1, mileages 5-12, and a corridor to the north transect the quadrangle W-E. The centerline and corridor cross the rock units noted above. Mesaverde, Tertiary, and Quaternary sediments are known to be fossiliferous although rot abundantly so. The opportunity for significant discoveries exists.

MAP 3 - TEJANA MESA

The geology of the Tejana Mesa 1:24,000 quadrangle is included as part of the thirty-minute geologic map of Cañon Largo (Willard and Weber, 1958). The geology of the Tejana Mesa Quadrangle is dominated by volcanoclastic sediments present in a broad NE-SW band; parallel trending Tertiary Baca-like deposits, Quaternary alluvial deposits, and in the extreme northeastern part of the map area, Cretaceous Mesaverde deposits. Quaternary basalts are present in the northeast and southwest.

The centerline of Link 1, mileages 13-19, and a northern corridor are present, trending E-W through the quadrangle. Centerline and corridor transact Tertiary volcanoclastic sediments and Quaternary alluvial deposits. Vertebrate fossils would not be unexpected.

MAP 4 - ARMSTRONG CANYON

The geology of the Armstrong Canyon 1:24,000 quadrangle is encompassed by a portion of the Cañon Largo thirty-minute geologic map (Willard and Weber, 1958). The geology of the Armstrong Canyon Quadrangle is dominated by Tertiary volcanoclastic sediments and Quaternary alluvial deposits trending N-S in the eastern part of the quadrangle. Baca-like deposits occur in the north and Quaternary volcanics in the extreme northwest.

The centerline of Link 1, mileages 20-26, transects the extreme southern portion of the quadrangle, trending E-W. A corridor to the north parallels the centerline. Both the centerline and corridor cross wide expanses of the Tertiary volcanoclastics and Quaternary alluvium. Given the area covered by these deposits, it is probable that vertebrates occur.

MAP 5 - QUEMADO

The geology of the 1:24,000 Quemado Quadrangle is included in the geologic map of the thirty-minute Piñonville Quadrangle (Willard, 1957). As shown on the Piñonville map, the geology of the Quemado Quadrangle consists of Tertiary nonvolcanic clastics in the immediate vicinity of Quemado; volanoclastics through much of the southwest, north, and eastern parts of the quadrangle, and Quaternary sediment gravels along NM 60.

The centerline of Link 1, mileages 27-32.1, Link 2 and Link 3, mileages 1-2, transects the Quemado Quadrangle at the base line between T. 1 N. and T. 1 S. A corridor parallels this line to the north. Both corridor and baseline cross Tertiary volcanoclastics and Quaternary pediment gravels and alluvial deposits. Although not expected to be abundantly represented, vertebrate fossils in these deposits would not be unexpected.

MAP 6 - OMEGA QUADRANGLE

The geology of the Omega 1:24,000 quadrangle is included as a portion of the geologic map of the Piñonville thirty-minute quadrangle (Willard, 1957). The Omega Quadrangle is virtually completely covered by Quaternary pediment gravels and alluvial deposits.

Link 3 just crosses the Omega Quadrangle at its southwestern corner; a northern corridor transects the quadrangle north of the centerline following a NW-SE trend. Only Quaternary pediment gravels and alluvial deposits are crossed. Vertebrate fossils would not be unexpected.

MAP 7 - COW SPRINGS

The geology of the Cow Springs Quadrangle is included in the coverage of the thirty-minute Cañon Largo geologic map (Willard and Weber, 1958). The Cow Springs Quadrangle is dominated by Quaternary basaltic flows and alluvial deposits. Tertiary volcanoclastics occur along and near Highway 60 while Tertiary sediments, similar if not identical to the Baca Formation, intrude the quadrangle in the northwest and northeast.

The centerlines of Link 5, mileages 1-3, Link 4, mileages 2-8, and Link 6, mileages 1-4, trend N-S and SE through the quadrangle. A corridor transects the quadrangle in the northeast.

The centerline, links, and corridor cross sedimentary units of volcanoclastics, Baca-like strata, and alluvial deposits. Vertebrate fossils can be expected in these deposits, and have the potential for being scientifically significant.

MAP 8 - RED HILL

The geology of the 1:24,000 Red Hill Quadrangle is encompassed by part of the thirty-minute geologic map of the Cañon Largo Quadrangle (Willard and Weber, 1958). The geology of the Red Hill Quadrangle is dominated by Quaternary volcanics and alluvial deposits. Older Tertiary volcanoclastics are present in the southwestern portion of the quadrangle and Baca-like sediments are present as isolated outcrops in the north.

The centerline of Link 6, mileage 4.5-5.5, is present in the extreme southwestern corner of the quadrangle. A corridor transacts the quadrangle's southwestern quarter trending NW-SE. The corridor crosses areas with alluvial deposits and Tertiary volcanoclastics. It is likely that vertebrates occur in these sediments. The centerline, however, crosses exclusively volcanic terrane.

MAP 9 - PONDEROSA TANK

The geology of the 1:24,000 Ponderosa Tank Quadrangle is covered by the thirty-minute Cañon Largo geologic map (Willard and Weber, 1958). The geology of the Ponderosa Tank Quadrangle is dominated by Tertiary volcanoclastics in the south, Quaternary alluvium in the middle of the quadrangle, and Quaternary volcanics in the north. Alluvial deposits and older Tertiary volcanoclastics also are present in the north.

A corridor transects the quadrangle trending E-W in the northern quarter of the quadrangle. This corridor crosses all rock units present in the quadrangle. Vertebrate fossils would not be unexpected in the Tertiary volcanoclastics or Quaternary alluvial deposits.

MAP 10 - LARGO MESA

The geology of the Largo Mesa 1:24,000 quadrangle forms a portion of the thirty-minute Cañon Largo geologic map (Willard and Weber, 1958). The quadrangle is dominated by Tertiary volcanoclastic sediments. In the north, alluvial deposits in and about NM 32. Minor volcanics occur in the south as do alluvial deposits.

A corridor transects the northern quarter of the quadrangle trending E-W. This corridor only crosses terrane occupied by Tertiary volcanoclastic sediments and Quaternary alluvial deposits. The large expanses of these deposits in the quadrangle make it highly probable that vertebrate fossils occur.

MAP 11 - ESCONDIDO MOUNTAIN

The geology of the 1:24,000 Escondido Mountain Quadrangle is included as a portion of the geologic map of the thirty-minute Piñonville Quadrangle (Willard, 1957). The central portions of the Escondido Mountain Quadrangle are dominated by Tertiary basalts. These are surrounded by Tertiary volcanoclastics which cover most of the quadrangle except in the extreme northeastern region, where Quaternary pediment gravels and alluvial deposits are present.

The centerline of Link 2, mileages 1-6, crosses the northeastern portion of the quadrangle through an area of volcanoclastics and

Quaternary deposits. A corridor to the west crosses volcanoclastics and basalt flows.

The Tertiary volcanoclastics and Quaternary deposits would be expected to contain vertebrate fossils. However, an abundance of fossil material would be surprising.

MAP 12 - MANGAS

The geology of the Mangas 1:24,000 quadrangle is included as a portion of the thirty-minute geologic map of the Piñonville Quadrangle (Willard, 1957). Quaternary pediment gravels and alluvial deposits dominate the quadrangle; Tertiary volcanoclastics occur in the southeastern and southwestern portions of the quadrangle.

Centerlines of Links 2 and 3 and associated corridors pass through the quadrangle and cover almost the entire area. It is highly probable that vertebrate fossils occur within the quadrangle.

MAP 13 - ALEGRES MOUNTAIN

The geology of the Alegres Mountain 1:24,000 quadrangle is included as part of the thirty-minute geologic map of the Piñonville Quadrangle (Willard, 1957). Volcanic rocks of Tertiary age dominate the southern part of the quadrangle while Tertiary volcanoclastics and Quaternary pediment gravels dominate the geology of the northern part of the quadrangle.

A corridor transects the quadrangle in a NW-SE direction at the western margin. This corridor crosses mostly volcanoclastics and pediment gravels. Although not expected to be abundantly present, vertebrate fossils in either of these sequences may occur and would be scientifically significant.

MAP 14 - JONES CANYON

The Jones Canyon 1:24,000 quadrangle is mapped geologically as part of the Willard and Weber (1958) Cañon Largo thirty-minute quadrangle. Quaternary basalts dominate the quadrangle. An E-W band of Tertiary volcanoclastics and other sediments is present in the south. Quaternary alluvium is present.

The centerline of Link 5, mileages 3-11, transects the quadrangle in a N-S direction and is flanked by corridors. The Tertiary volcanoclastics are not viewed as a major source of fossil material. The Quaternary alluvial deposits contain vertebrate fossils, but are not considered especially significant.

MAP 15 - BLACK PEAK

The geology of the Black Peak 1:24,000 sheet is included in the geologic map of the Cañon Largo thirty-minute quadrangle (Willard and Weber, 1958). The Black Peak Quadrangle is dominated by Tertiary volcanic and volcanoclastic rocks in the south, and Quaternary volcanic basalts and alluvial deposits to the north.

The centerline of Link 6, mileages 6-15 and an associated corridor to the west transect the quadrangle with a NW-SE trend. Centerline and corridor cross volcanoclastic and alluvial deposits. The Tertiary volcanoclastics are poorly understood paleontologically. Although an abundance of significant fossil material is not expected, fossil data of any sort would be scientifically valuable.

MAP 16 - GALLO MOUNTAINS WEST

The geology of the Gallo Mountains West 1:24,000 quadrangle is encompassed by a portion of the Cañon Largo thirty-minute geologic map (Willard and Weber, 1958).

The geology of the Gallo Mountains West Quadrangle is dominated by Tertiary volcanics and volcanoclastic rocks. The Gila Conglomerate is present in the south and Quaternary alluvium in the extreme northeast.

The centerline of Link 6 just enters the quadrangle in the southwestern corner. An eastern corridor also crosses the quadrangle. The centerline crosses Quaternary alluvial deposits, Gila conglomerate, and Tertiary volcanoclastics. The corridor also crosses terrane with these units. There is a reasonable likelihood that these routes pass through areas with vertebrate fossils.

MAP 17 - GALLO MOUNTAIN EAST

The geology of the Gallo Mountain East Quadrangle, 1:24,000, is included in the thirty-minute Cañon Largo geologic map (Willard and Weber, 1958). Rocks in the quadrangle consist of Tertiary volcanoclastics and volcanics, and Quaternary alluvial deposits in the south and extreme northwest.

A corridor enters the quadrangle in the southwestern corner and trends NW-SE. This corridor transects Tertiary volcanoclastics. Although it is not expected that these sediments contain an abundance of fossils, fossil data would be scientificlaly significant.

MAP 18 - SLAUGHTER MESA

The geology of the Slaughter Mesa 1:24,000 quadrangle is included in the thirty-minute geologic map of the Piñonville Quadrangle (Willard, 1957). Tertiary basalt flows dominate the quadrangle. Quaternary pediment gravels are present in the Slaughter Mesa area and Tertiary volcanoclastics occur in the extreme northwestern and southwestern corners of the quadrangle.

A corridor runs N-S along the eastern extent of the quadrangle through basaltic terrane. No fossils are expected.

MAP 19 - MANGAS MOUNTAIN

The geology of the Mangas Mountain 1:24,000 quadrangle is included in a portion of the geologic map of the thirty-minute Piñonville Quadrangle (Willard, 1957). Quaternary basalt flows and Tertiary rhyolite tuffs dominate the quadrangle. Quaternary pediment gravels occur along the extreme northern boundary of the quadrangle.

The centerline of Link 2, mileages 10-19, transects the quadrangle N-S along the western edge. Two N-S corridors cross volcanic terrane except in the north, where they intersect the pediment gravels. Although the likelihood is not high, any fossils present in the quadrangle would be associated with these gravels.

MAP 20 - WALLACE MESA

The geology of the Wallace Mesa 1:24,000 quadrangle is included in the thirty-minute geologic map of the Piñonville Quadrangle (Willard, 1957). Tertiary rhyolite tuffs and Tertiary basalts dominate this quadrangle. Latitic beds of the Spears and Quaternary pediment gravels are prominent in the eastern half of the quadrangle.

The centerline of Link 3, mileages 15-23, crosses the quadrangle at its western margin in a NW-SE direction. To the east, an associated corridor parallels the centerline. The centerline crosses volcanic terrane while the corridor crosses the sedimentary gravel pediments and latite facies. If present, fossils would be associated with the corridor and would be unexpected along the centerline.

MAP 21 - UNDERWOOD LAKE QUADRANGLE

The geology of the 1:24,000 Underwood Lake Quadrangle is encompassed in the thirty-minute geologic map of the Reserve Quadrangle (Weber and Willard, 1959). Rock units in the quadrangle consist of Tertiary sediments and volcanic deposits and Quaternary alluvial deposits. The older Tertiary sedimentary strata occupy a large expanse of the central N-S portion of the quadrangle; Quaternary alluvial deposits occupy much of the northeastern portions of the quadrangle.

The centerline of Link 38, mileages 1-9, crosses the quadrangle in a generally N-S direction, meeting Link 7 in Section 33, T. 3 S., R. 20 W. at the northern edge of the quadrangle. A corridor parallels the Link 38 centerline. The centerline and corridors cross terrane dominated by the older Tertiary sedimentary strata and Quaternary alluvium.

It is likely that fossil vertebrates occur in these strata. Fossil information from the older Tertiary deposits would have significant scientific value.

MAP 22 - CENTERFIRE BOG QUADRANGLE

The geology of the Centerfire Bog 1:24,000 Quadrangle is included in the thirty-minute Reserve Quadrangle geologic map (Weber and Willard, 1959). The Centerfire Bog Quadrangle is dominated by volcanic and volcanoclastic rocks. Older Tertiary sediments and Quaternary alluvial deposits are well represented in the northeastern part of the quadrangle.

The centerline for Link 7, mileages 4-11, transects the extreme northern part of the quadrangle in an east-west direction. The centerline crosses deposits which may contain significant vertebrate fossils. An east-west corridor parallels the centerline but crosses largely volcanic terrane. The same is true for a N-S corridor at the extreme portion of the quadrangle.

MAP 23 - QUEENS HEAD, NEW MEXICO

The geology of the 1:24,000 Queens Head Quadrangle is included in Weber and Willard (1959). The quadrangle is dominated by Tertiary volcanics which overlie older Tertiary volcanoclastics and other sediments. The Gila Conglomerate and Quaternary alluvial deposits occupy significant portions of the quadrangle. Quaternary basalt flows have limited extent in the southern portion of the quadrangle.

The centerline of Link 8, mileage 1-6, crosses the quadrangle in an E-W direction very near the northern border. The centerline crosses older Tertiary volcanoclastics, Quaternary alluvium, and Gila Conglomerate. Fossils in the older Tertiary deposits, whether complete or not, would be of significance. There is a good probability of the presence of vertebrate fossils in the Gila Conglomerate. Vertebrates would not be unexpected in the alluvial deposits as well.

MAP 24 - ARAGON, NEW MEXICO

The geology of the Aragon 1:24,000 quadrangle is included in the geologic map of the thirty-minute Reserve Quadrangle (Weber and Willard, 1959). The rocks of the Aragon Quadrangle largely consist of volcanoclastic deposits of Tertiary age overlain by Tertiary and possibly Quaternary volcanics. The upper Tertiary-Pleistocene Gila Conglomerate is present in the south-central portion of the quadrangle. Quaternary alluvial deposits occur in the northeastern part of the quadrangle.

The Tertiary volcanoclastic rocks probably contain vertebrate fossils; these occurrences would be of some scientific significance. The Gila Conglomerate is paleontologically sensitive with a high probability of containing vertebrate fossils.

The centerline of Link 8, mileages 7-15, crosses the Tertiary volcanoclastics and Quaternary alluvium. The same is true of a northern corridor, while the southern corridor is largely restricted to volcanic terrane.

MAP 25 - TULAROSA CANYON

The geology of the Tularosa Canyon Quadrangle (1:24,000) is included in the geologic maps related to the thirty-minute Pelona Quadrangle (Stearns, 1962; Willard and Stearns, 1971). The northeastern, central, and southwestern portions of the quadrangle are dominated by Tertiary volcanic rocks. Quaternary sediments occur in the southeast and northwest; the southeastern Quaternary sediments are associated with the San Agustine Plains.

The centerlines of Link 8, mileages 16-18, Link 9, mileages 1-6, Link 11, mileages 1-6, and portions of Links 10, 11, and 13 occur in the quadrangle. A corridor occupies large portions of the northern part of the quadrangle. Portions of Link 10, Link 9, and Link 8 cross Quaternary sediments likely to contain fossils. The northern corridor similarly encounters Quaternary deposits in the west.

MAP 26 - BELL PEAK

The geology of the 1:24,000 Bell Peak Quadrangle is included in the geologic maps of the northern half of the thirty-minute Pelona Quadrangle (Stearns, 1962) and the entire Pelona Quadrangle (Willard and Stearns, 1971). The Bell Peak Quadrangle is dominated by volcanic rocks in the northwest and east, and Quaternary deposits associated with ancient Lake San Agustine through the central and southern parts of the quadrangle.

The centerlines of Link 2, mileages 19-25, Link 12, mileages 1-3, and minor portions of Links 9, 11, and 13 cross the quadrangle. Corridors are present to the east. Those segments that cross Quaternary deposits associated with the San Agustine Plains have a high "sensitivity" profile for fossil materials. Localities are known to be present within portions of these corridors. The centerline is much less likely to impact fossils, especially in the central and northern parts of its length.

MAP 27 - HORSE MOUNTAIN WEST

The geology of the Horse Mountain Quadrangle (1:24,000) is included in the geologic maps covering the northern half of the Pelona thirty-minute Quadrangle (Stearns, 1962) and the entire Pelona Quadrangle (1971). The Horse Mountain West Quadrangle is dominated by Quaternary deposits associated with the San Agustine Plains. Tertiary volcanic deposits occur in the northwestern parts of the quadrangle.

The centerline of Link 3, mileages 23-32, transects the quadrangle N-S as does a corridor to the east. A portion of a corridor to the west just enters the quadrangle. The centerline and eastern corridor transect portions of the quadrangle known to contain fossil invertebrates and vertebrates. That portion of the western corridor that just intrudes the quadrangle largely crosses volcanic dominated terrane with little expectation of significant fossils.

MAP 28 - LUNA QUADRANGLE

The geology of the Luna 1:24,000 quadrangle is included in Weber and Willard (1959) and their coverage of the thirty-minute Reserve Quadrangle. Sedimentary strata of the Gila Conglomerate and Quaternary alluvial deposits trend NE-SW through the quadrangle. These deposits are flanked by Tertiary and Quaternary volcanic rocks. The Gila Conglomerate is of late Tertiary or early Quaternary age.

The centerline of Link 38, mileages 9-18 crosses the quadrangle in a generally N-S direction on the eastern side of the quadrangle. The centerline crosses Quaternary alluvial deposits and the Gila Conglomerate along its northern extent. The largest portion of the centerline crosses volcanic rocks. A western corridor parallels the centerline and crosses the center of the quadrangle. This corridor crosses areas with Quaternary alluvial deposits and the Gila Conglomerate, largely concentrated in the center of the quadrangle in and about Luna, New Mexico. Most of the corridor crosses terrane dominated by volcanic rocks. The Gila Conglomerate is paleontologically sensitive. Vertebrate fossils would not be unusual in the Quaternary deposits.

MAP 29 - DILLON MOUNTAIN QUADRANGLE

The geology of the Dillon Mountain 1:24,000 quadrangle is included in the thirty-minute geologic map of the Reserve Quadrangle (Weber and Willard, 1959). The Dillon Mountain Quadrangle is dominated by volcanic rocks with limited exposures of Quaternary alluvial deposits in the northwestern portion of the quadrangle and upper Tertiary-lower Quaternary Gila Conglomerate in the southeast.

A corridor transects the quadrangle in a generally N-S direction at the western edge. Quaternary alluvial deposits and Gila Conglomerate are exposed in the Centerfire Creek area. These units probably contain vertebrate fossils.

MAP 30 - JOHN KERR PEAK

The geology of the John Kerr Peak 1:24,000 quadrangle is included in the thirty-minute geologic map of the Pelona Quadrangle (Willard and Stearns, 1971) and also discussed in Stearns (1962). Potentially fossil-bearing sediments in the John Kerr Peak Quadrangle are not a significant proportion of the geology except in the northeastern and southeastern corners. Here, Quaternary alluvial and other sediments associated with the San Agustine Plains are present. The quadrangle is dominated by Tertiary and possibly Quaternary (Stearns, 1962) volcanic rocks.

The centerline of Link 16 just enters the quadrangle at its extreme northeastern corner and does cross potentially significant Quaternary deposits. A corridor transects the northern portions of the quadrangle trending generally in a NW-SE direction but is largely restricted to volcanic rocks.

MAPE 31 - RAEL SPRINGS

The geology of the 1:24,000 Rael Springs Quadrangle is included in the geologic map of the north half of the thirty-minute Pelona Quadrangle (Stearns, 1962) and the geologic map of the Pelona Quadrangle (thirty-minute) completed by Willard and Stearns (1971). The northwestern and north central portions of the quadrangle are dominated by Tertiary basalts, rhyolites, and andesites. The remainder of the quadrangle is dominated by alluvial and littoral deposits of the San Agustine Plains.

The centerline of Link 16, mileages 1-10, Link 13, mileages 1-3, Link 12, mileages 3-4, and Link 14, mileages 1-5 transect the northern and western margins of the quadrangle. A corridor lies south and east of these links. The northern portion of Link 16 crosses volcanic terrane; the southern portion, mileages 5-10, fronts the edge between volcanic and littoral, alluvial deposits. Much the same is true for the Link 13-12-14 segment where Links 13 and 12 either cross volcanic rocks or front the edge of the volcanics and lake sediments; most of Link 14 transects lake sediments. The corridor largely crosses sedimentary deposits.

San Agustine sedimentary deposits are paleontologically "sensitive". They record the history of the region from the late Pleistocene to the Holocene. Within the areas covered by the proposed links and corridors of the Rael Spring Quadrangle, fossil invertebrate and vertebrate localities are known. These include at least one Mammuthus locality and reported sites with Equus.

MAP 32 - FULLERTON

The geology of the Fullerton Quadrangle (1:24,000) is included in the geologic maps of the northern half of the thirty-minute Pelona Quadrangle (Stearns, 1962) and the Pelona Quadrangle (Willard and Stearns, 1971). Volcanic deposits dominate the southern portion of the quadrangle and consist of basalts, andesites, and rhyolites. Most of the quadrangle is covered by Quaternary deposits associated with the San Agustine Plains.

The centerline of Link 15, mileages 1-8, Link 14, mileages 5-7, Link 3, mileages 32-33, crosses the center of the quadrangle in a NW-SE direction. Two corridors parallel the centerline to the east and west. Centerlines and corridors transect areas likely to contain invertebrate and vertebrate fossils in deposits associated with Lake San Agustine. Localities are known to occur along ancient shorelines of the lake.

MAP 33 - SHAW MOUNTAIN

The geology of the 1:24,000 Shaw Mountain Quadrangle is included in the thirty-minute scale geologic maps of the northern Pelona Quadrangle (Stearns, 1962) and the Pelona Quadrangle (Willard and Stearns, 1971). The southern half of the quadrangle is dominated by Tertiary volcanic rocks which trend NE-SW along the edge of the San Agustine Plains. The Plains are composed of Quaternary deposits associated with the ancient lake that occupied the Plains.

The centerline of Link 15, mileages 8-15, crosses the quadrangle in a general E-W direction. A corridor parallels the centerline to the north. The centerline crosses volcanic rocks along most if not all of its length. The corridor, however, crosses a long extent of shoreline deposits associated with Lake San Agustine. Vertebrate localities are known to occur within this corridcr.

MAP 34 - LUERA MOUNTAIN WEST

The geology of the Luera Mountain West Quadrangle (1:24,000) is included in the geologic map of the thirty-minute Luera Spring Quadrangle (Willard, 1957). The northwestern and north central portions of the Luera Mountain West Quadrangle is dominated by deposits associated with the San Agustine Plains. The remainder of the quadrangle is dominated by volcanic deposits.

The centerline of Link 15, mileages 15-19, crosses the southwestern portion of the quadrangle. A corridor crosses to the north in an east-west direction. The centerline and corridor cross volcanic terrane and little, if any, paleontologic material would be expected.

MAP 35 - LUERA MOUNTAIN EAST

The geology of the Luera Mountain East (1:24,000) Quadrangle is included in the geologic map of the Luera Spring thirty-minute Quadrangle (Willard, 1957). The western and southern portions of the quadrangle are dominated by Tertiary volcanic rocks. The northeastern, south central, and central portions of the quadrangle are dominated by Quaternary deposits associated with the San Agustine Plains.

A corridor transects the southern portion of the quadrangle in an E-W direction. Quaternary deposits lie in the eastern portion of this quadrangle. These deposits may contain invertebrate and vertebrate fossils.

MAP 36 - OAK PEAK

The geology of the Oak Peak Quadrangle (1:24,000) is included in the geologic map of the thirty-minute Luera Spring Quadrangle (Willard, 1957). The northeastern and southwestern portions of the quadrangle are dominated by Tertiary volcanic rocks. The Gila Conglomerate occupies a broad central and south central area. Sediments associated with the San Agustine Plains occur in the northwestern portion of the quadrangle.

A corridor crosses the south central and southwestern porticns of the quadrangle. The central portion of the corridor route traverses Gila Conglomerate-Santa Fe sediments that may contain vertebrate fossils.

MAP 37 - BULL BASIN

Weber and Willard (1959) include the geology of the Bull Basin 1:24,000 Quadrangle in their thirty-minute geologic map of the Reserve Quadrangle. The western two-thirds of the Bull Basin Quadrangle is dominated by volcanic and volcanoclastic rocks of

Tertiary age. The late Tertiary-early Quaternary Gila Conglomerate is present in the southeastern one-third of the quadrangle.

The centerline of Link 38, mileages 18-19, 22-27, crosses the Bull Basin Quadrangle in the southeast and the northeast. A corridor parallels the centerline to the west. The centerline crosses extensive deposits of Gila Conglomerate. The western corridor largely crosses volcanic rocks.

It is probable that the Gila Conglomerate contains vertebrate fossils.

MAP 38 - RESERVE QUADRANGLE

The geology of the 1:24,000 Reserve Quadrangle is included in the geologic map of the thirty-minute Reserve Quadrangle (Weber and Willard, 1959). Geologic units present in the quadrangle include Tertiary volcanics and volcanoclastics, upper Tertiary or lower Quaternary sedimentary strata of the Gila Conglomerate, and Quaternary alluvial deposits. The Gila Conglomerate and the Quaternary alluvial deposits probably contain vertebrate fossils.

A small portion of the centerline of Link 38, mileages 19-21, crosses the extreme northwestern portion of the quadrangle, through deposits of the Gila Conglomerate. A corridor to the east largely crosses Gila Conglomerate to the north and volcanic deposits to the south.

MAP 39 - COLLINS PARK

The geology of the Collins Park 1:24,000 quadrangle is included in the geologic map of the Pelona thirty-minute Quadrangle (Willard and Stearns, 1971). Quaternary alluvial deposits occupy the southwestern portion of the quadrangle along and about Bursum Road. The remainder of the quadrangle is dominated by Tertiary basalts and basaltic andesites and latite flows.

A corridor transects the northwestern portion of the quadrangle through volcanic terrane and does not cross any likely fossiliferous deposits.

MAP 40 - SALVATION PEAK

The geology of the Salvation Peak Quadrangle 1:24,000 sheet is included in the geologic map of the thirty-minute Pelona Quadrangle (Willard and Stearns, 1971). Most of the Salvation Peak Quadrangle is covered by Tertiary volcanic rocks including rhyolites, latites, basalts, and andesites. Quaternary sedimentary deposits associated with the San Agustine Plains dominate the northeastern part of the quadrangle.

The centerline of Link 16, mileages 10-19 transects the center of the Salvation Peak Quadrangle in a generally N-S direction. Corridors parallel the centerline to the east and the west. The deposits of the San Agustine Plain are paleontologically "sensitive". Similarly, the deposits within the canyon occupied by Bursum Canyon Road are paleontologically "sensitive". Vertebrate and invertebrate fossils are not unexpected within these areas or deposits.

MAP 41 - RAIL CANYON

The geology of the Rail Canyon Quadrangle (1:24,000) is included in the geologic map of the thirty-minute Pelona Quadrangle (Willard and Stearns, 1971). The dominant geology of the quadrangle is volcanic except for the northwestern portion. Volcanic rocks include basalts, latites, rhyolites, and andesites of Tertiary age. Quaternary rocks associated with the San Agustine Plains occur in the northwest.

Two corridors enter the quadrangle, one in the extreme northeastern part of the quadrangle, the other crosses the quadrangle in the extreme southern portion of the quadrangle in an East-West direction. Both corridors are restricted to volcanic terranes. No paleontological material of significance would be expected.

MAP 42 - PELONA MOUNTAIN

The geology of the 1:24,000 Pelona Mountain quadrangle is included in the geologic map of the Pelona thirty-minute Quadrangle (Willard and Stearns, 1971). Except for a south-central, relatively narrow band of sedimentary deposits of the Gila Conglomerate, virtually the entire quadrangle is composed of volcanic deposits, mainly basalts and basaltic andesites.

Two corridors transect the quadrangle, essentially east-west in trend. The northern corridor crosses only volcanic rocks. The southern corridor crosses the narrow band of Gila Conglomerate, a late Tertiary-early Quaternary unit, and the only unit likely to contain fossils. However, limited exposures and extent of this unit make it unlikely that significant concentrations of fossil material occurs in the corridors.

MAP 43 - MOJONERA CANYON

The geology of the Mojonera Canyon Quadrangle (1:24,000) is included in the geologic map of the Luera Spring thirty-minute Quadrangle (Willard, 1957). Sedimentary deposits of the Gila Conglomerate-Santa Fe Group occupy the northwestern corner, central, and most of the southeastern portions of the quadrangle. Volcanic rocks comprise the remainder of the quadrangle.

The centerline for Link 15, mileages 20-22, crosses the northeastern corner of the quadrangle, largely through volcanic terrane with little likelihood for finding significant fossils. The centerline for Link 17, mileages 3-6, crosses the southeastern corner of the quadrangle through deposits of the Gila Conglomerate-Santa Fe Group. Both corridors between the centerline links, cross areas largely covered by Gila-Santa Fe deposits. Thus, it is likely that the southern link and both corridors cross areas with vertebrate fossils.

MAP 44 - PADDYS HOLE

The geology of the Paddys Hole Quadrangle (1:24,000) is included in geologic map of the Luera Spring thirty-minute Quadrangle (Willard, 1957). The eastern and central portions of the quadrangle are dominated by Tertiary volcanic deposits. The southwestern, west central, and portions of the northwestern areas are characterized by well developed deposits of the Gila Conglomerate-Santa Fe Group.

The centerline of Link 15, mileages 23-30, crosses the quadrangle east-west, largely if not exclusively through volcanic terrane. South of this, a corridor crosses east-west, largely through deposits of the Gila Conglomerate-Santa Group and likely to contain vertebrate fossils. To the south, the centerline of Link 17, mileages 7-14, transects the quadrangle in an east-west direction. A corridor lies to the north of this centerline. Both centerline of Link 17 and the associated corridor cross Gila-Santa Fe sediments in the west and volcanics in the east.

MAP 45 - DUSTY

The geology of the Dusty Quadrangle (1:24,000) is included in the geologic map of the thirty-minute Luera Quadrangle (Willard, 1957). Except for the western edge of the quadrangle, the entire area is dominated by deposits of the Gila Conglomerate-Santa Fe Group. Tertiary volcanics occur along the western edge of the quadrangle.

The centerlines of several links enter the quadrangle: Link 15, mileages 30-34 in the extreme northwest; Link 17, mileages 14-18 in the extreme southwest; Link 21, mileages 1-4 in the extreme southeast; Link 20, mileages 1-4, and Link 26 for 1 mile. A corridor transects the northeastern corner of the quadrangle. Western portions of Link 15 and Link 17 cross volcanic rocks not likely to contain fossils. The longest link segments and the corridor cross sedimentary deposits that are likely to contain vertebrate fossils.

MAP 46 - WELTY HILL

The geology of the Welty Hill Quadrangle (1:24,000) is included in the geologic map of the Luera Spring thirty-minute Quadrangle (Willard, 1957). The eastern portion of this quadrangle is dominated by Tertiary volcanic rocks; the western portions by the Gila Conglomerate-Santa Fe Group sedimentary deposits.

Link 26, mileages 2-6, transects the southwestern corner of the quadrangle as do corridors to the southwest and northeast. Link and corridors cross the sedimentary deposits. These deposits are likely to contain vertebrate fossils.

MAP 47 - SALIZ PASS

The geology of the Saliz Pass 1:24,000 Quadrangle is included in the thirty-minute geologic map of the Reserve Quadrangle (Weber and Willard, 1959). The southern half of the Saliz Pass Quadrangle is dominated by deposits of the Gila Conglomerate, an upper Tertiary-lower Quaternary unit. Most of the northern half of the quadrangle is dominated by Tertiary volcanics and volcanoclastics.

The centerline of Links 38, 39, and 40 and associated corridors cross the quadrangle. All cross the Gila Conglomerate in the south and volcanics in the north or east. The Gila Conglomerate has a likelihood of containing vertebrate fossils.

MAP 48 - O BLOCK CANYON

The geology of the O Block Canyon 1:24,000 quadrangle is treated by Weber and Willard (1959) as part of their geologic map of the thirty-minute Reserve Quadrangle. Most of the quadrangle consists of volcanic and volcanoclastic rocks of Tertiary age. Deposits of Gila Conglomerate are found in the northeastern portion of the quadrangle.

A corridor passes through the extreme western portion of the quadrangle. This corridor includes areas almost exclusively volcanic.

MAP 49 - O BAR O CANYON WEST

The geology of the O Bar O Canyon West (1:24,000) is included in the geologic map of the Pelona thirty-minute Quadrangle (Willard and Stearns, 1971). Volcanic deposits, rhyolite flows, basalts, and basaltic andesite dominates the geology of the quadrangle. A broad Quaternary alluvial valley between volcanics forms the route for NM 78. In the southwestern and east central corners of the quadrangle fingers of Gila Conglomerate, late Tertiary or early Pleistocene intrude into the quadrangle.

The centerline of Link 16, mileages 19-22, crosses the extreme northeastern corner of the quadrangle with a corridor to the west. Both centerline and corridor cross volcanic terrane with minimal prospects for fossiliferous deposits.

MAP 50 - O BAR O CANYON EAST

The geology of O Bar O Canyon East (1:24,000) is included in the geologic map of the Pelona thirty-minute Quadrangle (Willard and Stearns, 1971). The northern and central portions of the quadrangle are dominated by Tertiary rhyolites, basalts, and basaltic andesites. Widely spread deposits of the late Tertiary-early Pleistocene Gila Congomerate occupy the southern and southeastern portions of the quadrangle. A minor intrusion of Quaternary alluvium is present in the southwestern portion of the quadrangle, and in the northwest.

The Gila Conglomerate and the Quaternary alluvium are paleontologically "sensitive". However, the centerline of Link 16, mileages 22-29, transects the quadrangle in an east-west direction well to the north, through volcanic-dominated terrane. It is unlikely that vertebrate fossils would be encountered along this route. A corridor that parallels the centerline to the north just intrudes into the quadrangle, again crossing volcanic terrane. A southern corridor crosses deposits of Gila Conglomerate in the eastern quarter of the quadrangle and may encounter vertebrate fossils.

MAP 51 - INDIAN PEAKS WEST

The geology of the (1:24,000) Indian Peaks West Quadrangle is included in the geologic map of the Pelona thirty-minute Quadrangle (Willard and Stearns, 1971). Tertiary volcanic rocks occur in the northeastern and northwestern parts of the quadrangle and is likely to contain vertebrate fossils.

The centerline of Link 16, mileages 29-36, transects the northern part of the quadrangle in a general east-west direction. This centerline transects volcanic rocks in the eastern half of its extent and sedimentary deposits of the Gila Conglomerate in the west. A northern corridor just enters the quadrangle and largely crosses volcanic terrane. A southern corridor crosses volcanic terrane in the east and the Gila Conglomerate in the central and west central portions of the quadrangle, and volcanic rocks in the extreme west. The expanse of Gila Conglomerate suggests the likely presence of vertebrate fossils.

MAP 52 - INDIAN PEAKS EAST

The geology of the Indian Peaks East Quadrangle (1:24,000) is included in the geologic map of the Luera Spring thirty-minute Quadrangle (Willard, 1957). Tertiary volcanic rocks dominate the southwestern, south central, and northwestern portions of the quadrangle. Most of the north and northeastern, central, and southwestern areas are dominated by sediments of the Gila Conglomerate and Santa Fe Group. These are late Tertiary to early Quaternary in age.

The centerline of Link 16 joins the centerline of Link 17, mileages 1-3, and Link 18, mileages 1-6. A corridor is present to the south. The eastern parts of Link 18 and the corridor cross the Gila Conglomerate-Santa Fe deposits. These deposits may contain vertebrate fossils.

MAP 53 - WAHOO PEAK

The Wahoo Peak Quadrangle (1:24,000) and its geology is included in the geologic map of the thirty-minute Luera Spring Quadrangle (Willard, 1957). Most of the Wahoo Peak Quadrangle is covered by Tertiary volcanic deposits. Sedimentary deposits are limited to the northwestern and west central portions of the quadrangle.

The centerline of Link 18, mileages 6-15, cross the center of the quadrangle in a generally NW-SE direction. Parallel corridors to the NE and SW transect the quadrangle as well. The Link, centerline, and corridors cross Gila Conglomerate-Santa Fe exposures in the west. The exposures may yield vertebrate fossils.

MAP 54 - WAHOO RANCH

The geology of the Wahoo Ranch Quadrangle (1:24,000) is included in the geologic map of the Luera Spring thirty-minute Quadrangle (Willard, 1957). As mapped by Willard, virtually the entire quadrangle is covered by Gila Conglomerate-Santa Fe Group deposits.

The centerlines of Link 22, mileages 1-5, Link 21, mileages 1-7.5, and Link 24, mileages 1-5, cross the quadrangle in the northeast corner, and along the north-south edge. Link 18, mileages 15-19, crosses the southwestern corner of the quadrangle. Two corridors occupy the central portions of the quadrangle.

The Gila Conglomerate-Santa Fe Group sedimentary deposits contain vertebrate fossils of late Tertiary-early Quaternary age. Given the expanse of deposits, it is likely that fossils will be encountered.

MAP 55 - MONTOYA BUTTE

The geology of the Montoya Butte Quadrangle (1:24,000) is included in the geologic map of the Luera Spring thirty-minute Quadrangle (Willard, 1957). Tertiary volcanics are present in the northeastern corner of the quadrangle, the southwestern third of the quadrangle, and isolated areas in the central region and the southeast. Broad expanses of the late Tertiary-early Quaternary sediments occur in a NW-SE trending belt.

The centerline of Link 26, mileages 6-12, transects the northeastern corner of the quadrangle with two corridors to the southwest that merge in the northwestern corner, and a corridor in the extreme northeastern corner. The northeastern corridor transects volcanic rocks. The centerline crosses sedimentary deposits of the Gila Conglomerate-Santa Fe Group and these are likely to contain vertebrate fossils. The northernmost of the southwestern corridors crosses mostly sedimentary deposits while the remaining corridor crosses volcanic rocks in the southern half and sediments in the north.

MAPS 56, VICKS PEAK; 59, IRON MOUNTAIN; 60, JARALOSA MOUNTAIN; 61, MONTICELLO; 64, WINSTON; 65, CHISE; 66, PRIEST TANK; 69, THUMB TANK PEAK; 70, WILLIAMSBURG, NW; 70A, CUCHILLO; 73, SALADONE TANK; 74, WILLIAMSBURG

The geology of these 1:24,000 quadrangles is treated as a unit and taken from the State Geologic Map (Dane and Bachman, 1965) and other unpublished sources. These quadrangles form a N-S block and to the south and east parallels the Rio Grande; in the eastern portion of this block, drainages are E-SE across ancestral Rio Grande facies of the late Tertiary-Pleistocene Santa Fe Group and Quaternary alluvium and bolson deposits. These sediments are known to contain vertebrate fossils. To the west, Tertiary volcanics and volcanoclastics predominate although Santa Fe deposits occur. Isolated upper Cretaceous-lower Tertiary intrusives are present in the extreme southwestern portion of the block. Upper Paleozoic marine rocks and isolated Cretaceous units occur in the central portion of the block. These are fossiliferous. Tertiary volcanics and volcanoclastics predominate in the west and lower Paleozoic marine rocks that are fossiliferous may occur in the southwestern portion of the block.

The centerline of Link 30, mileages 3-7, and a corridor to the east crosses the western portion of Map 74 - Williamsburg. Both intersect exposures of the Santa Fe Group and Pleistocene alluvium known to contain vertebrate fossils.

The centerlines of Link 31, mileages 1-7, Link 30, mileages 7-9, and Link 30, mileages 1-3, cross the eastern portion of Map 73, Saladone Tank. A corridor to the west trends N-S. Centerlines and corridor intersect strata of the Santa Fe Group and Pleistocene alluvium known to contain vertebrate fossils.

A corridor trends N-S through the western portion of Map 70a. Cuchillo. It crosses Quaternary alluvium through most of its course and Santa Fe units to the north. These deposits are likely to contain vertebrate fossils.

The centerline of Link 29, mileages 1-4, and Link 28, mileages 3-7.3, run N-S through Map 70, Williamsburg. Link 27, mileages 23-29.4, joins these and trends NW-SE. A corridor is present to the west. The centerlines cross Santa Fe and Quaternary alluvial deposits; the corridor crosses Santa Fe and volcanic deposits. The sedimentary deposits are likely to contain vertebrate fossils.

A corridor crosses the northeastern corner of Map 69, Thumb Tank Peak, largely through volcanic units and is not likely to intersect fossil-bearing deposits.

The centerlines of Link 26, mileages 27-31.5, Link 28, mileages 1-3, and Link 25, mileages 13-19, run N-S and NW-SE through Map 66, Priest Tank Quadrangle. A corridor occupies the southwestern portion of the quadrangle. The links and corridor intersect potentially vertebrate fossil-bearing deposits of the Santa Fe Group and Quaternary alluvial units.

The centerline of Link 27, mileages 10-21, crosses the center of Map 65, Chise, with corridors to the east and west. Most of these routes are through volcanic deposits. Paleozoic marine sediments may be crossed by the centerline, however. The Paleozoic units are fossiliferous.

A corridor crosses the extreme northeastern corner of Map 64, Winston, and intersects Quaternary alluvial deposits which may contain vertebrate fossils.

The centerlines of Link 27, mileages 1-9, Link 18, Link 23, mileages 1-3, and Link 24 merge in the eastern portion of Map 59, Iron Mountain, with a corridor to the west. Corridors intersect Tertiary volcanics and Paleozoic marine rocks. The corridor intersects Quaternary alluvial deposits. The marine units contain invertebrate fossils and fossil vertebrates are likely to occur in the alluvial deposits.

The centerline of Link 25, mileages 1-8, crosses the southwestern corner of Map 60, Jaralosa Mountain. A corridor trends NW-SE to the east. The centerline crosses volcanics and volcanoclastics, and possibly marine Paleozoic rocks. The corridor crosses volcanics. The marine rocks are likely to contain invertebrate fossils.

The centerline of Link 26, mileages 17-26, crosses N-S through Map 61, Monticello. A corridor crosses the northeastern portion of the quadrangle and another corridor is present to the west. The northeastern corridor crosses volcanic terrane. The southwestern corridor crossed deposits of the Santa Fe Group likely to contain vertebrate fossils. The centerline seems to cross predominantly volcanic rocks.

The centerline of Link 26, mileages 12-17, crosses the southwestern corner of Map 56, Vicks Peak. A corridor is present to the east, trending NW-SE. The centerline crosses predominantly deposits of the Santa Fe Group, likely to contain vertebrate fossils. The corridor crosses volcanic terrane, except in the northwest, where it intersects Santa Fe deposits.

MAP 57 - ALMA, NEW MEXICO

The geology of the Alma, New Mexico 1:24,000 quadrangle is treated in Weber and Willard (1959) geology of the Mogollon thirty-minute Quadrangle. The rock units present in the Alma quadrangle are few and consist of upper Tertiary volcanics and volcanoclastics, the upper Tertiary-lower Quaternary Gila Conglomerate, and Quaternary alluvial deposits. The Gila Conglomerate has broad extent and is likely to contain vertebrate fossils.

The centerline of Link 41, mileages 5-14, transects these units as do the flanking corridors.

MAP 62 - GLENWOOD, NEW MEXICO

The Glenwood, New Mexico 1:24,000 quadrangle is included in the thirty-minute geologic map of Weber and Willard (1959). Rock units included in the Glenwood Quadrangle consist of Tertiary volcanics and volcanoclastics, upper Tertiary-lower Quaternary sediments of the Gila Conglomerate and Quaternary alluvium. Vertebrate fossils are not unexpected in the Gila Conglomerate or Quaternary alluvium.

The centerlines of Link 46, mileage 14-16, Link 41, Link 42, mileage 1-3, Link 43, mileage 1-5.3, Link 44, mileage 1-4.95, and Link 45, mileage 1-2, cross NW-SE together with associated corridors. All rock units in the quadrangle are crossed and although volcanics dominate, exposures of vertebrate-bearing sediments also are crossed.

MAP 63 - HOLT MOUNTAIN, NEW MEXICO

The Holt Mountain 1:24,000 quadrangle is included in the coverage of the thirty-minute geologic map of the Mogollon Quadrangle (Weber and Willard, 1959). Rock units in the quadrangle are limited and consist of Tertiary volcanics and volcanoclastics and upper Tertiary-lower Quaternary sediments of the Gila Conglomerate. The Gila Conglomerate is likely to contain vertebrate fossils.

A corridor transects the southwestern corner of the quadrangle, largely through the Gila Conglomerate. As noted above, this sedimentary unit is paleontologically sensitive.

MAP 67 - WILSON MOUNTAIN, NEW MEXICO

The geology of the Wilson Mountain, 1:24,000 quadrangle is incorporated into the thirty-minute geologic map of the Mogollon Quadrangle (Weber and Willard, 1959). Rock units in the quadrangle consist of Tertiary volcanics and volcanoclastics and upper Tertiary-lower Quaternary sediments of the Gila Conglomerate.

A major corridor transects the quadrangle on its east side in a NW-SE direction largely crossing volcanics in the north and Gila Conglomerate in the south. Another corridor crosses the quadrangle at its northwestern corner, trending NE-SW and joins the eastern corridor. This western corridor crosses only volcanic rocks.

The Gila Conglomerate is paleontologically sensitive and is likely to contain vertebrate fossils.

MAP 68 - MOON RANCH, NEW MEXICO

The Moon Ranch Quadrangle at 1:24,000 scale covers an area included in the thirty-minute geologic map of the Mogollon Quadrangle (Weber and Willard, 1959). Rocks in the quadrangle consist of Tertiary volcanics and volcanoclastics and upper Tertiary-lower Quaternary sediments of the Gila Conglomerate.

The centerline of Link 45, mileages 2-11, and an associated corridor to the east largely crosses volcanic rocks, while the corridor crosses the Gila Conglomerate almost exclusively. The Gila Conglomerate is a paleontologically sensitive unit likely to contain fossil vertebrates.

MAP 71 - MULE CREEK, NEW MEXICO

The geology of the Mule Creek 1:24,000 quadrangle is included on the thirty-minute sheet showing the geology of the Mogollon Quadrangle (Weber and Willard, 1959). Rocks of the Mule Creek Quadrangle include Tertiary volcanics and upper Tertiary-lower Quaternary sedimentary rocks of the Gila Conglomerate.

A corridor transects the eastern margin of the corridor in a generally N-S direction. This corridor crosses terrane dominated by the Gila Conglomerate in the south and upper Tertiary volcanics in the north in the region of Mule Mountain.

The Gila Conglomerate is paleontologically sensitive and likely to contain vertebrate fossils.

MAP 72 - BEAR MOUNTAIN QUADRANGLE

The geology of the 1:24,000 Bear Mountain Quadrangle is encompassed within the geologic map of the thirty-minute Mogollon Quadrangle (Weber and Willard, 1959). The southeastern portion of the Bear Mountain Quadrangle is dominated by Tertiary volcanics. The southwestern and northwestern portions of the quadrangle are dominated by Gila Conglomerate deposits.

Centerlines of Link 48, mileages 1-8, trending NW-SE, and Link 47, mileages 1-8, generally trending NE-SW join at Link 45 in Section 5, T. 24 S., R. 19 W. Link 48 largely crosses terrane dominated by volcanic rocks. Link 47 crosses terrane dominated by Gila Conglomerate deposits. An eastern corridor crosses expanses of both volcanics and Gila Conglomerate. A southern corridor bracketed by Links 47 and 48 encompasses only volcanic rocks.

The Gila Conglomerate is paleontologically sensitive and is likely to contain vertebrate fossils.

MAP 72A - BUCKHORN, NEW MEXICO

The geology of the Buckhorn, New Mexico 1:24,000 quadrangle is encompassed on the thirty-minute geologic map of the Mogollon Quadrangle (Weber and Willard, 1959). The preponderance of the Buckhorn Quadrangle is covered by the Gila Conglomerate, an upper Tertiary-lower Quaternary sedimentary unit. Alluvial deposits occur along the Duck Creek drainage. The southwestern corner of the quadrangle contains upper Tertiary volcanics.

The centerline of Link 48, mileages 8-12, crosses the largely volcanic southwestern corner of the quadrangle. An eastern corridor, also trending NW-SE, lies entirely within alluvial and Gila Conglomerate deposits.

The Gila Conglomerate is considered to be paleontologically sensitive and likely to contain vertebrate fossils.

MAP 75 - STEEPLE ROCK, NEW MEXICO

The geology of the Steeple Rock 1:62,500 Quadrangle is included in the geologic map of the Virden thirty-minute Quadrangle published by Elston (1960). Rocks exposed in the Steeple Rock Quadrangle include Cretaceous volcanics and sedimentary rocks of the Virden Formation, lower Tertiary volcanics, upper Tertiary volcanics and volcanoclastics, upper Tertiary sediments, and Quaternary sediments.

The centerline of Link 47, mileages 9-26, crosses the quadrangle north-south, slightly east of the N-S midline and two flanking corridors. Paleontologically sensitive rock units that are crossed by the centerline and corridors include the Virden Formation, the Gila Conglomerate, and Plio-Pleistocene terrace gravels. The Virden Formation is a very poorly understood, very thick continental unit. The Gila Conglomerate and terrace deposits have a high probability of containing vertebrate fossils.

MAP 77 - SKUTE STONE ARROYO

The geology of the Skute Stone Arroyo Quadrangle (1:24,000) is included in the geology of the Las Cruces $1^{o}x2^{o}$ sheet (Seager and others, 1982). The Skute Stone Arroyo Quadrangle is characterized by the presence of extensive Plio-Pleistocene, Pleistocene, and Holocene sediments. Excellent exposures of these are produced by well developed east-west drainages.

The centerline of N-S trending Link 32, mileages 1-9, transects the eastern portion of quadrangle. Links 31 and 30 join 32 at its northern extremity. A corridor crosses the southeastern corner of the quadrangle and another corridor crosses most of the quadrangle west of the centerline. Centerline and corridors cross wide expanses of sedimentary deposits that are likely to contain vertebrate fossils.

MAP 76 - CLIFF, NEW MEXICO

The geology of the Cliff, New Mexico 1:62,500 quadrangle is included as part of the Virden thirty-minute geologic map (Elston, 1960). Rock units occurring in this quadrangle include Precambrian metamorphic and igneous rocks, Cretaceous marine sandstones and shales, lower and upper Tertiary volcanics and volcanoclastic units, and Quaternary terrace gravels and alluvium.

The centerline corridor of Link 48, mileages 13-28, and two associated corridors occupy the NW-SE half of the quadrangle and transects virtually all rock units noted above. The Cretaceous marine units are fossiliferous but contain an almost exclusively invertebrate fauna not considered unusual. The upper Tertiary and Quaternary units have a high probability of containing vertebrate fossils.

MAP 76A - DORSEY RANCH

The geology of the Dorsey Ranch Quadrangle (1:24,000) is included in the geologic map of the Silver City $1^o x 2^o$ sheet (Drewes and others, 1985). The Gila Conglomerate (upper Miocene-Pleistocene) occurs in the northwestern and southeastern portions of the quadrangle. Volcanic and volcanoclastics occupy intervening areas.

A corridor crosses the southwestern corner of the quadrangle through Gila Conglomerate sediments. The Gila Conglomerate contains vertebrate fossils. The ruggedness of the terrain in this region and lack of access would make collecting rather difficult, however.

MAP 78 - CABALLO

The geology of the Caballo Quadrangle (1:24,000) is included in the geologic map of the Las Cruces $1^o x 2^o$ sheet (Seager and others, 1982). Caballo Reservoir occupies the east central portion of the quadrangle and is bounded on either side by extensive Plio-Pleistocene, upper Pleistocene, and Holocene sedimentary deposits.

A corridor crosses the western northwestern and west central portions of the quadrangle. This corridor transects areas with extensive sedimentary deposits likely to contain vertebrate fossils.

MAP 79 - CIRCLE MESA

The geology of the Circle Mesa Quadrangle (1:24,000) is included in the geologic map of the Silver City $1^{o}x2^{o}$ sheet (Drewes ard others, 1985). The upper Miocene to Pleistocene Gila Conglomerate is the dominant stratigraphic unit in the quadrangle and occupies the central regions in a broad northwestern-southeastern band. Tertiary volcanics occur in the extreme southwestern corner and northeastern corner. Cambrian-Silurian sedimentary rocks occur in the east central region as well as isolated Cretaceous exposures.

The centerline of Link 48, mileages 29-38, transect the central part of the quadrangle in a NW-SE direction. Parallel corridors occur to the northeast and southwest. The centerline crosses deposits of the Gila Conglomerate. The northern corridor intersects Cambro-Silurian and possibly Cretaceous exposures. The southern corridor intersects the Gila Conglomerate and volcanics. The Gila Conglomerate is likely to contain vertebrate fossils; the Cretaceous and Cambro-Silurian rocks are likely to contain marine invertebrate fossils.

MAP 80 - SILVER CITY QUADRANGLE

The geology of the Silver City Quadrangle has been mapped by Cunningham (1974) at a scale of 1:24,000. The geologic column of the Silver City Quadrangle includes Precambrian igneous and metamorphics, Cambro-Ordovician sandstones and dolomites, upper Ordovician carbonates and cherts, Devonian shales, Mississippian and Pennsylvanian limestones, upper Cretaeous sandstones and some carbonates, Tertiary volcanics, igneous intrusives and volcanoclastics, and Pliocene-Quaternary alluvial and fresh water limestones of limited extent. The sedimentary rock units are fossiliferous. Paleozoic and Cretaceous strata are dominated by invertebrate faunas. Pliocene deposits have yielded vertebrate fossils reported by Cunningham (1974) and residents of the area reported additional fossils from Pliocene and Pleistocene deposits.

The centerline of Link 48 and a northern corridor cross the southwestern portion of the quadrangle. Both cross strata with a reasonable expectation of containing fossils, invertebrates, and vertebrates in the northern corridor and vertebrates along the centerline. Field inspection of impacted routes is suggested.

MAP 81 - CLARK SPRING CANYON

The geology of the Clark Spring Canyon Quadrangle (1:24,000) is included in the geologic map of the Las Cruces $1^{o}x2^{o}$ sheet (Seager and others, 1982). The Clark Spring Quadrangle is dominated by Pio-Pleistocene fanglomerates and gravels broken by east-trending drainages with Pleistocene-Holocene sediments.

The centerline of Link 32, mileages 10-18, transects the western portion of the quadrangle trending NE-SW. A corridor just crosses the northwestern corner of the quadrangle; another corridor is present east of the centerline and crosses the center of the quadrangle. Centerline and corridors cross extensive deposits of Plio-Pleistocene and Pleistocene-Holocene sediments. These sediments are likely to contain fossil vertebrates.

MAP 83 - CANADOR PEAK QUADRANGLE

The geology of the Canador Peak 1:62,500 Quadrangle has been mapped by Elston (1960) as part of the Virden thirty-minute quadrangle. Rock units present in the Canador Peak Quadrangle include Precambrian igneous rocks, Cretaceous marine shales, isolated occurrences of Cretaceous volcanics, Cretaceous continental rocks, lower Tertiary volcanics and volcanoclastics, and upper Tertiary and Quaternary sediments.

The centerline of Link 35, mileages 27-44, passes generally N-S through the quadrangle, slightly east of the N-S midpoint and is flanked by two corridors. As in the case of Map 75 - Steeple Rock, New Mexico, the routes through this quadrangle traverse paleontologically sensitive deposits. It is highly probable that the Colorado Shale, the Virden Formation, the Gila Conglomerte, and Quaternary terrace gravels, alluvium and bolson deposits are fossiliferous. With the exception of the Colorado Shale, which contains a marine invertebrate fauna, the sedimentary deposits traversed will contain a vertebrate fauna.

MAP 84 - WIND MOUNTAIN

The geology of the Wind Mountain Quadrangle (1:24,000) is included in the geologic map of the Silver City $1^{o}x2^{o}$ sheet (Drewes and others, 1985). Precambrian igneous and metamorphic rocks dominate the western and southwestern portions of the quadrangle. The upper Miocene-Pleistocene Gila Conglomerate is present along the Mangas Creek drainage in the central portion of the quadrangle. Cretaceous rocks occur in the northeast along with isolated Tertiary volcanics.

A corridor crosses the northeastern corner of the quadrangle and intersects Cretaceous sedimentary rocks, Tertiary volcanics, and deposits of the Gila Conglomerate. The Cretaceous rocks are likely to contain marine invertebrate fossils. The Gila Conglomerate is likely to contain vertebrate fossils.

MAP 85 - TYRONE QUADRANGLE

The geology of the Tyrone Quadrangle was mapped by Hedlund (1978) at 1:24,000 scale. Kolessar 91970) discussed the geology and geologic history of the Tyrone Mining District. Precambrian basement rocks are overlain by upper Cretaceous strata of the Beartooth Quartzite and Colorado Formation. These units have limited exposure in the west central portion of the map area.

Cretaceous rocks are overlain by a series of uppermost Cretaceous and lower Tertiary volcanic and volcanoclastic rocks and these in turn are overlain by upper Tertiary and Quaternary sedimentary strata.

The centerline for Link 48, mileages 39-50, transects the quadrangle NW-SE roughly splitting the quadrangle diagonally. Geologically the centerline transects terrane dominated by sheetflood fan deposits of Pleistocene age derived in part from the underlying Gila Conglomerate. Holocene alluvium occupies major drainages. The extensive distribution of Pleistocene deposits suggests a high probability of fossil vertebrate material along the centerline.

The southern corridor crosses a more varied sequence of geologic units largely composed of volcanic and volcanoclastic rocks with comparatively less expanse of Pleistocene deposits. This corridor should have a lesser degree of paleontological sensitivity.

The northern corridor closely resembles the centerline geologically.

MAP 86 - HURLEY WEST

The geology of the Hurley West Quadrangle (1:24,000) is included in the geologic map of the Silver City $1^{o}x2^{o}$ sheet (Drewes and others, 1985). The southwestern and central portions of the quadrangle are dominated by deposits of the Gila Conglomerate and isolated deposits of Pliocene-Holocene alluvial sediments. Pliocene-Holocene deposits dominate the eastern portions of the quadrangle. In the northwest, Cretaceous marine rocks and isolated remnants of Pennsylvanian-Permian strata occur together with Tertiary volcanics.

A corridor crosses the southwestern corner of the quadrangle. It intersects the Gila Conglomerate and Pliocene-Holocene alluvial deposits. These are likely to contain vertebrate fossils.

MAP 87 - LAKE VALLEY QUADRANGLE

The geology of the Lake Valley Quadrangle was published by Jicha (1954) as a report and map at 1:58,000 scale. Proposed corridors transect the quadrangle. The geology of the quadrangle is characterized by a sequence of marine Paleozoic strata which are fossiliferous but with limited exposure, overlain unconformably by lower and upper Cretaceous fossiliferous marine rocks concentrated in the southwestern portion of the quadrangle. Tertiary volcanics and volcanoclastics dominate the quadrangle while the eastern portion of the quadrangle is dominated by Quaternary terrace and pediment sands and gravels and Holocene alluvium.

Three centerlines, Link 33, mileages 1-9, Link 34, mileages 3-8, and Link 35, mileages 7-9, cross these last noted Quaternary units.a The same is true of a western corridor. Vertebrate fossils are not unusual in terrace deposits. It is suggested that field inspection of impacted deposits be carried out.

MAP 88 - NUTT

The geology of the Nutt 1:62,500 Quadrangle is mapped and discussed in Clemons (1979). The south central portion of the quadrangle is dominated by Tertiary volcanic and volcanoclastic deposits. Quaternary deposits including valley slope alluvium and some fluvial deposits occupy most of the quadrangle.

The centerline for Link 32, mileages 19-28, portions of Link 33, Link 34, and Link 35, mileages 1-7, transect the western portion of the quadrangle trending slightly NE-SW. A corridor to the east parallels the links. The centerline and corridor cross Quaternary dominated terrane. These Quaternary deposits, Pleistocene to Holocene in age, may contain vertebrate fossils. The same deposits north of this area contains a Pleistocene vertebrate fauna.

MAP 90 - WHITE SIGNAL

The geology of the White Signal Quadrangle (1:24,000) is included in the geologic map of the Silver City $1^{o}x2^{o}$ sheet (Drewes and others, 1985). The Gila Conglomerate of upper Miocene-Pleistocene age dominates the northeastern part of the quadrangle. Pliocene-Holocene alluvial deposits dominate the central and southeastern parts of the quadrangle. Volcanics dominate the western portions of the quadrangle.

A corridor crosses the northeastern corner of the quadrangle intersecting deposits of the Gila Conglomerate. These deposits are likely to contain vertebrate fossils.

MAP 91 - WHITEWATER

The geology of the Whitewater Quadrangle (1:24,000) is included in the geologic map of the Silver City $1^{o}x2^{o}$ sheet (Drewes and others, 1985). The northeastern corner and isolated patches in the southwestern and south central portions of the quadrangle contain Pliocene-Holocene alluvial deposits. The remainder of the quadrangle is dominated by deposits of the Gila Conglomerate.

The centerline of Link 48, mileages 50-58, crosses the northern part of the quadrangle with corridors to the north and south. The northern corridor crosses mostly Piocene-Holocene alluvial deposits. The centerline crosses areas dominated by the Gila Conglomerate. The southern corridor crosses areas with alluvial deposits and the Gila Conglomerate. These sedimentary units are likely to contain vertebrate fossils.

MAP 92 - FAYWOOD STATION

The geology of the Faywood Station Quadrangle (1:24,000) is included in the geologic map of the Silver City $1^{O}x2^{O}$ sheet (Drewes and others, 1985). Holocene alluvial deposits dominate the southeastern and south central portions of the quadrangle. Older alluvial deposits of Pleistocene-Holocene age occupy almost all of the remainder of the quadrangle.

The centerline of Link 48, mileages 59-66, trends NE-SW across the southwestern third of the quadrangle with corridors to the northeast and southwest. The northwestern portions of these cross Pleistocene-Holocene sediments that are likely to contain vertebrate fossils.

MAP 93 - DWYER, NEW MEXICO

Map 93 is only of minor concern because a small portion of a corridor passes through the extreme southwestern portion of the Dwyer 1:62,500 sheet. Elston (1957) described the geology of the Dwyer Quadrangle and his published map indicates that the proposed corridor segment crosses Holocene bolson and alluvium. Likely paleontologic materials of significance are not expected.

MAP 95 - SUMMIT

The geology of the Summit Quadrangle (1:24,000) is included in the geologic map of the Silver City $1^{o}x2^{o}$ sheet (Drewes and others, 1985). The east-central portion of the quadrangle is covered by eolian deposits of late Pleistocene to Holocene age. Playa and lacustrine deposits occur in the central and southeastern parts of the quadrangle. Pliocene to Holocene fan, pediment and alluvial deposits occur in the western portions of the quadrangle. Isolated volcanics and volcanoclastics occur in the extreme northwest.

The centerline of Link 46, mileages 63-70 crosses the northern portion of the quadrangle, within a portion of a corridor to the north and a corridor to the south, through the south central part of the quadrangle.

The centerline and corridors cross these sedimentary units. The southern corridor intersects lacustrine deposits. The northern corridor intersects volcanic rocks at its western extremity. The sedimentary rocks are likely to contain vertebrate fossils.

MAP 96 - NINEMILE HILL

The geology of the Ninemile Hill Quadrangle is included in the geologic map of the Silver City $1^{o}x2^{o}$ sheet (Drewes and others, 1985). Isolated volcanics occur in the south; igneous intrusives occur in the east central areas, as "Ninemile Hill". Pleistocene and Holocene eolian deposits occur about Ninemile Hill and across the eastern portions of the quadrangle. Lacustrine deposits occur in the south and southwest. Pliocene to Holocene deposits occur in the central and south central regions.

The centerline of Link 46, mileages 71-73, joins that of Link 49, mileages 1-5, both running east-west. Link 47 joins Links 46-49. The southern portions of corridors to the east and west of the link T-junction enter the quadrangle. Links and corridors intersect sediments that may contain vertebrate fossils.

MAP 97 - CULVERSON RANCH

The geology of the Culberson Ranch Quadrangle (1:24,000) is included in the geologic map of the Silver City $1^{o}x2^{o}$ sheet (Drewes and others, 1985). The Gila Conglomerate of late Tertiary to early Pleistocene age is present in the northern, northeastern, and eastern portions of the quadrangle. Recent sediments are present in the southwest and Pliocene-Holocene sediments occupy the center of the quadrangle in a broad northeast-southwest band.

The centerline of Link 49, mileages 5-13, crosses the center of the quadrangle, trending northwest-southeast. Corridors occur to the northeast and southwest. Fossil vertebrates are likely to occur in these deposits.

MAP 98 - GOLD HILL QUADRANGLE

The geology of the Gold Hill Quadrangle was mapped by Hedlund (1978). Precambrian metamorphic and igneous rocks dominate the southwestern, central, and northeastern portions of the quadrangle. The Cambro-Ordovician Bliss Sandstone has limited exposures. Lower Tertiary intrusives as light-colored rhyolite dikes. Quaternary talus, sheetflood fan, and terrace gravels are present. The terrace gravels have a very restricted distribution (e.g., Sections 34, 35, T. 21 S., R. 17 W., and Section 14, T. 21 S., R. 17 W. Quaternary deposits are concentrated in the western portion of the map.

The Bliss Sandstone contains invertebrate fossils. The Bliss is better developed elsewhere, however. The Quaternary terrace gravels are worth field-checking if impacted by construction activities.

The centerline of Link 49, mileages 13-19, transects the southwestern part of the Gold Hill quadrangle, parallels a pipeline and crosses Quaternary sheetflood fan deposits and allvium. The northern corridor shown crosses more complex terrane, including the restricted terrace gravel deposits. This corridor is paleontologically more sensitive than the centerline. The southern corridor minimally impacts the quadrangle and crosses terrane much like that crossed by the centerline.

MAP 99 - ANTELOPE HILL

The geology of the Antelope Hill Quadrangle (1:24,000) is included in the geologic map of the Silver City $1^{o}x2^{o}$ sheet (Drewes and others, 1985). Volcanic rocks of Tertiary age occur in the southern part of the quadrangle. Oligocene volcanics comprise Antelope Hill. Isolated stringers of Gila Conglomerate trend NW-SE along drainages. Pliocene-Holocene deposits dominate the quadrangle.

The centerline of Link 48, mileages 67-68, crosses the northeastern corner of the quadrangle, trending NW-SE. A corridor parallels the centerline to the southwest. Corridor and centerline intersect Pliocene-Holocene alluvial deposits and possibly Gila Conglomerate as well. These deposits may contain vertebrate fossils.

MAP 100 - SPALDING

The geology of the Spalding Quadrangle (1:24,000) is included in the geologic map of the Las Cruces $1^{o}x2^{o}$ sheet (Seager and others, 1982). The Spalding Quadrangle has extensive exposures of late Pleistocene axial river, terrace and fan deposits. These are associated with the Mimbres-San Vincente drainages.

The centerline of Link 48, mileages 69-79 transects the quadrangle in a NW-SE direction with corridors to the northeast and southwest. The centerline and corridors intersect sediments that are likely to contain vertebrate fossils.

MAP 101 - GOAT RIDGE

The geology of the Goat Ridge Quadrangle (1:24,000) is included in the geologic map of the Las Cruces $1^{o}x2^{o}$ sheet (Seager and others, 1982). The geology of the Goat Ridge Quadrangle is characterized by lower Tertiary clastic sediments, Tertiary volcanics, isolated Cretaceous volcnics and extensive Plio-Pleistocene clastics and Pleistocene terrace deposits.

A corridor crosses the southwestern corner of the quadrangle. This corridor intersects mostly Pleistocene deposits, and possibly Plio-Pleistocene sediments. These deposits are likely to contain fossil vertebrates.

MAP 102 - MASSACRE PEAK QUADRANGLE

The geology of the Massacre Peak Quadrangle has been mapped in detail by Clemons (1982). The geologic units range in age frorm Precambrian to Holocene and include Paleozoic marine sandstone, carbonates, and shales as well as Permian continental rocks of the Abo Formation. Triassic and Jurassic rocks are absent, but lower and upper Cretaceous marine rocks of the Sarten Sandstone and Colorado Formation, respectively, are present. Lower Tertiary volcanics and volcanoclastic rocks occur. Upper Tertiary and Quaternary units occur as piedmont-slope facies, fan gravels and fanglomerates, and colluvium-alluvium.

All of the Paleozoic and Cretaceous units present in this quadrangle are fossiliferous. At some localities marine fossils of Paleozoic age are abundant (see Laudon and Bowsher, 1949). The NMBM&MR has documented Cretaceous localities in Section 13, T. 21 S., R. 9 W., and Section 18, T. 21 S., R. 8 W. These localities have yielded marine invertebrate faunas.

We have not documented vertebrate localities within the quadrangle. However, such localities probably occur within Upper Tertiary and Quaternary units; occurrences are likely to be sporadic.

The centerline of Link 33 passes through Sections 23, 14, 11, 2, and 1 of T. 22 S., R. 8 W. in the extreme southeastern portion of the quadrangle. The centerline transects mostly volcanic and volcanoclastic units not likely to be fossiliferous. Alluvial deposits, in part late Pleistocene or early Holocene are crossed as well. Only these might contain vertebrate material.

The western corridor transects a more varied geologic landscape, but again one dominated by Tertiary volcanics and volcanoclastics with some late Tertiary units (Mimbres Formation) and Quaternary units that might contain vertebrate fossils. However, localities should be isolated.

MAP 103 - FLORIDA

The geology of the Florida Quadrangle (1:24,000) is included in the geologic map of the Las Cruces $1^{O}x2^{O}$ sheet (Seager and others, 1982). The quadrangle is dominated by Late Pleistocene fan and terrace deposits and upper Tertiary to lower Pleistocene piedmont deposits.

The centerlines of Link 33, mileages 10-15, Link 34, mileages 11-18, Link 35, mileages 9-18, transect the quadrangle northeast-southwest. A corridor crosses the southwestern corner of the quadrangle and another corridor just crosses the northwestern corner. Exposures are better developed in the western portion of the quadrangle but corridors and centerlines cross deposits that are likely to contain fossil vertebrates.

MAP 103A - GOOD SIGHT PEAK

The geology of the Good Sight Peak Quadrangle (1:24,000) is included within Clemons (1979) at a scale of 1:48,000. The north central and southeastern portions of the quadrangle are dominated by Tertiary volcanic and volcanoclastic deposits. The remaining portions of the quadrangle are dominated by Quaternary sediments, especially to the west and northeast.

A corridor transects the northwestern corner of the quadrangle in a NE-SW direction. This corridor crosses volcanic rocks to the northeast and Quaternary sediments, especially to the west and northeast.

A corridor transects the northwestern corner of the quadrangle in a NE-SW direction. This corridor crosses volcanic rocks to the northeast and Quaternary sediments in the southwest. The Quaternary deposits may contain vertebrate fossils.

MAP 104 - LISBON

The geology of the Lisbon Quadrangle (1:24,000) is included in the map of the geology of the Silver City $1^{o}x2^{o}$ sheet (Drewes and others, 1985). The northeastern corner of the quadrangle has deposits of the Gila Conglomerate. Holocene lacustrine and alluvial deposits occur in the southwestern corner of the quadrangle. The central regions are dominated by a broad NW-SE band of Pliocene-Holocene fan and pediment deposits.

The centerline of Link 49, mileages 19-21, transects the extreme northwestern corner of the quadrangle with a centerline to the south. Both cross the Gila Conglomerate and Plio-Holocene sediments that may contain vertebrate fossils.

MAP 105 - NINETYSIX RANCH QUADRANGLE

The geology of the Ninetysix Ranch Quadrangle has been published as U.S.G.S. Map MF-1034 (Hedlund, 1978b). Bedrock in the quadrangle consists of a sequence of Precambrian metamorphic and igneous rocks. These are intruded by rhyolite dikes thought to be of Paleocene or Eocene age. Pleistocene and Holocene sheetflood fan deposits occupy the bulk of the quadrangle. Alluvial deposits of Holocene age occupy the many drainages.

The corridor centerline runs NW-SE just north of a pipeline. The centerline cuts across varied geologic units as does the northern corridor. By contrast, the southern corridor crosses a geologic landscape noteworthy for its sameness, exclusively sheetflood fan deposits and Holocene alluvium occupying NE-SW drainages. Neither the northern or southern corridors (nor for that matter, the centerline) seems to be paleontologically sensitive.

MAP 106 - SOLDIERS FAREWELL HILL QUADRANGLE

The Soldiers Farewell Hill Quadrangle has been published as U.S.G.S. Map MF-1033 (Hedlund, 1978a). Bedrock in the quadrangle consists of a sequence of Precambrian igneous and metamorphic rocks found in limited exposures in the western and northwestern portions of the map area. An isolated exposure of a coarse-grained sandstoe and conglomerate is mapped in the center of Section 11, T. 23 S., R. 14 W. as questionably Beartooth

Quartzite, questionably Upper Cretaceous, and up to 15 m thick. The north central and northwestern portions of the quadrangle are characterized by a sequence of Tertiary volcanic and volcanoclastic rocks, chiefly andesites, rhyolites, basalts, and ash flow tuff. Relief of the exposures of these units is gentle to steep.

The preponderance of the quadrangle is covered by Quaternary sheetflood fan and alluvial deposits. These deposits cover the southern, central, and northeastern portions of the quadrangle.

The centerline lies just north of a pipeline at mileage 29.5 (approximately) to 37 of Link 49. Stratigraphic units crossed by the centerline are exclusively Holocene or Upper Pleistocene and, in the extreme west of the map area, isolated occurrences of Precambrian units. Significant fossil localities along this segment would be unexpected. This conclusion is applicable to the southern corridor, while the corridor north of the centerline crosses a more varied geologic landscape including the only possibly Cretaceous exposures, and Tertiary sedimentary units intercalated with volcanics. This route would be more paleontologically sensitive than the centerline and southern corridor.

MAPS 108 AND 107 - GRANDMOTHER MOUNTAIN EAST AND GRANDMOTHER MOUNTAIN WEST

The geology of these quadrangles in part was mapped by Thorman and Drewes (1979) at a scle of 1:24,000. Bedrock is typified by volcanic sequences with intercalated volcanoclastics overlying a lowermost unit of siltstones, sandstones, and conglomerates thought to be Upper Cretaceous or Paleocene. This unit, termed "lower sedimentary rocks" by Thorman and Drewes has very limited exposure in the Grandmother Mountain area in the southern portion of the Grandmother Mountain West Quadrangle.

A "middle sedimentary" unit is questionably referred to the Oligocene and consists of volcanoclastics. This unit is restricted to the flanks of Little Grandmother Mountain. An "upper sedimentary" unit, thought to be Miocene or Pliocene in age, outcrops in the middle of the Grandmother Mountain East Quadrangle. Pleistocene and Holocene alluvial deposits veneer most of the area of both quadrangles.

The most significant rock unit (but also the most restricted in occurrence) is the Cretaceous or Paleocene "loser sedimentary" sequence. Fossils, if present in these rocks, could add significant information. The "middle" and "upper" sedimentary units are not terribly promising as fossil-bearing rocks.

The centerline of the corridors in Link 49, mileages 37-44, passes to the south of Grandmother Mountain across a landscape dominated by Pleistocene and Holocene alluvium. The northern corridor shown on Map 107, however, transects Grandmother Mountain and the deposits of the "lower sedimentary unit." If these units are to be impacted by construction activities they should be field-checked.

The centerline of Link 49, mileages 45-51, transects the southern portions of the Granmother Mountain East Quadrangle and parallels a pipeline. This is south of the coverage of Thorman and Drewes but should cross Pleistocene and Hoocene alluvial deposits with likely minimal paleontological significance.

The northern corridor shown includes the eastern extent of Grandmother Mountian, including exposures of the "lower sedimentary rocks." These are potentially significant and if impacted should be field-checked.

MAPS 109 - WILLIAMS RANCH; 110 - DEMING WEST; 111 - DEMING EAST

These maps involve very uniform geology consisting of Quaternary alluvial deposits and other sediments of Pleistocene-Holocene age. Vertebrate fossils are known to occur in the region included in the maps.

MAP 112 - SAN SIMON, ARIZONA-NEW MEXICO

The San Simon Quadrangle (1:62,500) was not included in the map set; instead San Simon Ranch, New Mexico (1:24,000) was sent. In any event, the geology of the San Simon Quadrangle is included in the geologic map of the Silver City $1^{o}x2^{o}$ sheet (Drewes and others, 1985). Volcanics of Tertiary age dominate the quadrangle in a broad extent from the northwestern corner to the southeastern corner. Pliocene-Holocene alluvial deposits occur in the southwest and east-central areas. Pliocene-Holocene fan and pediment deposits are present in the extreme northeast and southwestern regions. Only the very extreme northeastern portion of the quadrangle is intersected by the project, but this area may contain vertebrate fossils.

MAP 113 - DUNCAN, ARIZONA-NEW MEXICO

The geology of the Duncan Quadrangle (1:62,500) is included in the geologic map of the Silver city $1^{\circ}x2^{\circ}$ sheet (Drewes and others, 1985). The northeastern, east-central, and southeastern portions of the quadrangle are dominated by Upper Miocene-Pleistocene alluvial, lacustrine, playa, fan, and pediment deposits of the Gila Conglomerate and Holocene channel and floodplain deposits. The western portion of the quadrangle is dominated by Miocene and Oligocene basalts, basaltic andesites, dacites, and volcanoclastics.

The centerline of Link 46, mileages 45-62, crosses the eastern portion of the quadrangle trending NW-SE with associated corridors to the east and west. The centerline and corridors intersect sedimentary deposits likely to contain vertebrate and other fossils.

MAP 114 - YORK VALLEY, ARIZONA-NEW MEXICO

The geology of the York Valley Quadrangle (1:62,500) is included in the geologic map of the Silver City $1^{\circ}x2^{\circ}$ sheet (Drewes and others, 1985). The northeastern, east central, and southwestern portions of the quadrangle are dominated by Oligocene and Miocene volcanic rocks. The central two-thirds or more of the quadrangle, trending NW-SE from the northwestern corner to the southeastern corner of the quadrangle is dominated by Upper Miocene-Pleistocene sediments of the Gila Conglomerate and Holocene alluvial deposits.

The centerline of Link 46, mileages 27-44, trends N-S through the center of the quadrangle. Corridors are present to the east and west. Centerline and corridors cross sedimentary deposits, virtually to the exclusion of other rocks. These deposits are likely to contain vertebrate fossils.

REFERENCES

Clemons, R. E. 1979. Geology of Good Sight Mountains and Uvas Valley, Southwest New Mexico. New Mexico Bureau of Mines and Mineral Resources Circular 169, 32 p.

Clemons, R. E. 1982. Geology of Massacre Peak Quadrangle, Luna County, New Mexico. New Mexico Bureau of Mines and Mineral Resources, Geologic Map 52.

Cunningham, J. E. 1974. Geologic map and sections of Silver City Quadrangle, New Mexico. New Mexico Bureau of Mines and Mineral Resources, Geologic Map 30.

Dane, C. H. and G. O. Bachman. 1965. Geologic Map of New Mexico (1:500,000). U.S. Geological Survey and State Bureau of Mines and Mineral Resources.

Drewes, H., B. B. Houser, D. C. Hedlund, D. H. Richter, C. H. Thorman and T. L. Finnel. 1985. Geologic map of the Silver City 1°x2° Quadrangle, New Mexico and Arizona. U.S. Geological Survey, Miscellaneous Investigations Series, Map I-1310-C.

Elston, W. E. 1957. Geology and Mineral Resources of Dwyer Quadrangle, Grant, Luna, and Sierra Counties, New Mexico. State Bureau of Mines and Mineral Resources, Bulletin 38, 86 p.

Elston, W. E. 1960. Reconnaissance geologic map of Virden Thirty-Minute Quadrangle. State Bureau of Mines and Mineral Resources, Geologic Map 15.

Hedlund, D. C. 1978. Geologic map of the Soldiers Farewell Hill Quadrangle, Grant County, New Mexico. U.S. Geological Survey, Map MF-1033. Scale 1:24,000.

Hedlund, D. C. 1978. Geologic map of the Ninetysix Ranch

Quadrangle, Grant County New Mexico. U.S. Geological Survey, Map MF-1034. Scale 1:24,000.

Hedlund, D. C. 1978. Geologic map of the Gold Hill Quadrangle, Hidalgo and Grant Counties, New Mexico. U.S. Geologic Survey, Map MF-1035.

Hedlund, D. C. 1978. Geologic map of the Tyrone Quadrangle, Grant County, New Mexico. U.S. Geologic Survey, Map MF-1037.

Jicha, Henry L. Jr. 1954. Geology and Mineral Deposits of Lake Valley Quadrangle, Grant, Luna, and Sierra Counties, New Mexico. New Mexico Bureau of Mines and Mineral Resources, Bulletin 37, 93 p.

Kolessar, J. Geology and copper deposits of the Tyrone District, p. 127-132. In, New Mexico Geological Society Guidebook, 21st Field Conference, Tyrone-Big Hatchet Mountains-Florida Mountains Region.

Laudon, L. R. and A. L. Bowsher. 1949. Mississippian formations of southwestern New Mexico. Geological Society of America, Bulletin, 60: 1-87.

Seager, W. R., R. E. Clemons, J. W. Hawley and R. E. Kelley. 1982. Geology of northwest part of Las Cruces 1°x2° sheet, New Mexico. New Mexico Bureau of Mines and Mineral Resources, Geologic Map 58.

Stearns, C. E. 1962. Geology of the North Half of the Pelona Quadrangle, Catron County, New Mexico. State Bureau of Mines and Mineral Resources, Bulletin 78, 46 p.

Thorman, C. H. and H. Drewes. 1979. Geologic map of parts of the

Grandmother Mountain East and Grandmother West Quadrangles, Luna County, New Mexico. U.S. Geological Survey, Map MF-1088.

Weber, R. H. and M. E. Willard. 1959. Reconnaissance geologic map of Mogollon Thirty-Minute Quadrangle. State Bureau of Mines and Mineral Resources, Geologic Map 10.

Weber, R. H. and M. E. Willard. 1959. Reconnaissance geologic map of Reserve Thirty-Minute Quadrangle. State Bureau of Mines and Mineral Resources, Geologic Map 12.

Willard, M. E. 1957. Reconnaissance geologic map of Luera Spring Thirty-Minute Quadrangle. State Bureau of Mines and Mineral Resources, Geologic Map 2.

Willard, M. E. 1957. Reconnaissance geologic map of Piñonville Thirty-Minute Quadrangle. State Bureau of Mines and Mineral Resources, Geologic Map 3.

Willard, M. E. and R. H. Weber. 1958. Reconnaissance geologic map of Cañon Largo thirty-minute quadrangle. State Bureau of Mines and Mineral Resources, Geologic Map 6.

Willard, M. E. and C. E. Stearns. 1971. Reconnaissance geologic map of the Pelona Thirty-Minute Quadrangle. New Mexico State Bureau of Mines and Mineral Resources. Geologic Map 23.

TABLE 1 - "IMPACT" ANALYSIS

LINK	MAP	MILEAGE	"RESOURCE"	IMPACT LEVEL	COMPARATIVE IMPACT	MITIGATION	MITIGATION IMPACT
1	1	1-4	Cretaceous and Tertiary vertebrates very possible	moderate	moderate	prospect and collect if found	none
1	2	5-12	Cretaceous and Tertiary vertebrates very possible	moderate	moderate	prospect and collect if found	none
1	3	12-20	none	none	none	none	none
1	4	20-27	Tertiary vertebrates slightly possible	low	low	prospect and collect if found	none
1	5	27-32.1	Tertiary vertebrates slightly possible	low	low	prospect and collect if found	none
2	5	1	Tertiary vertebrates slightly possible	low	low	prospect and collect if found	none
2	11	1-6	possible Tertiary and Quaternary vertebrates	low to moderate	low	prospect and collect if found	none
2	12	7-10	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
2	19	10-19	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
2	26	19-26	probably none	none or low	none	none	none
3	5	1-2	Tertiary vertebrates slightly possible	low	low	prospect and collect if found	none
3	12	2-14	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
3	19	14	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
3	20	15-23	possible Quaternary vertebrates	low	low	prospect and collect if found	none
3	27	23-32	Quaternary vertebrates	high	high	prospect and collect if found	none
3	32	32-33	probable Quaternary vertebrates	high	high	none	none
4	1	1-2	Cretaceous and Tertiary vertebrates very possible	moderate	moderate	prospect and collect if found	none
4	7	2-8.3	Tertiary vertebrates possible	moderate	low	prospect and collect if found	none
5	7	1-3	Tertiary vertebrates possible	moderate	low	prospect and collect if found	none
5	14	3-11	possible Tertiary and Quaternary vertebrates	low-none	low	prospect and collect if found	none
6	7	1-4	Tertiary vertebrates possible	moderate	low	prospect and collect if found	none
6	15	5-15.5	possible Tertiary and Quaternary vertebrates	low	low	prospect and collect if found	none
6	16	15.5-16.5	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
6	23	17.1	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
7	21	1-4	possible Quaternary and Tertiary vertebrates	moderate	low	prospect and collect if found	none
7	22	4-11	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
7	23	11.5	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
8	23	1-7	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none

TABLE 1 - "IMPACT" ANALYSIS

LINK	MAP	MILEAGE	"RESOURCE"	IMPACT LEVEL	COMPARATIVE IMPACT	MITIGATION	MITIGATION IMPACT
8	24	7-16	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
8	25	16-18.8	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
9	25	1-6	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
10	25	1-6.1	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
11	25	1-2	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
12	26	1-3	Quaternary vertebrates	moderate	low	prospect and collect if found	none
12	31	3-4	probable Quaternary vertebrates	high	high	prospect and collect if found	none
13	31	1-3	probable Quaternary vertebrates	high	high	prospect and collect if found	none
14	31	1-5	probable Quaternary vertebrates	high	high	prospect and collect if found	none
14	32	5-7	probable Quaternary vertebrates	high	high	prospect and collect if found	none
15	32	1-8	probable Quaternary vertebrates	high	high	prospect and collect if found	none
15	33	8-15	probably none	none	none	none	none
15	34	15-19	probably none	none	none	none	none
15	43	20-22	none	none	none	none	none
15	44	23-30	none	none	none	none	none
15	45	30-34	none	none	none	none	none
16	30	1	low-none	low-none	none	none	none
16	31	2-5	probable Quaternary vertebrates	low-none	none	none	none
16	31	5-10	probable Quaternary vertebrates	high	high	prospect and collect if found	none
16	40	10-19	Quaternary invertebrates and vertebrates	high	high	prospect and collect if found	none
16	49	19-22	none	none	none	none	none
16	50	22-29	none	none	none	none	none
16	51	29-36	little-none	little-none	none	none	none
16	52	36-38.02	little-none	little-none	none	none	none
17	52	1-3	little-none	little-none	none	none	none
17	43	3-6	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
17	44	7-14	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
17	45	14-18	none	none	low	none	none
18	52	1-6	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
18	53	6-10	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
18	53	11-15	none	none	none	none	none

TABLE 1 - "IMPACT" ANALYSIS

LINK	MAP	MILEAGE	"RESOURCE"	IMPACT LEVEL	COMPARATIVE IMPACT	MITIGATION	MITIGATION IMPACT
18	59	19.6	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
20	45	1-4	possible Tertiary and Quaternary fossils	moderate	low	prospect and collect if found	none
21	45	1-4	possible Tertiary and Quaternary fossils	moderate	low	prospect and collect if found	none
21	54	4-7.5	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
22	54	1-5	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
23	59	1-3.45	Paleozoic invertebrates	low	none	none	none
24	54	1-6	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
24	59	7.8	Paleozoic invertebrates	low	none	none	none
25	59	1	Paleozoic invertebrates	low	none	none	none
25	60	1-9	Paleozoic invertebrates to none	low	none	none	none
25	66	13-19.45	possible Tertiary and Quaternary fossils	moderate	low	prospect and collect if found	none
26	45	1	possible Tertiary and Quaternary fossils	moderate	low	prospect and collect if found	none
26	46	2-6	possible Tertiary and Quaternary fossils	moderate	low	prospect and collect if found	none
26	55	6-12	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
26	56	12-17	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
26	61	17-26	possible Tertiary-Quaternary invertebrates	moderate	low	prospect and collect if found	none
26	66	26-31.48	possible Tertiary and Quaternary fossils	moderate	low	prospect and collect if found	none
27	59	1-9	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
27	64	9	possible Quaternary vertebrates	low-moderate	low	prospect and collect if found	none
27	65	10-21	possible Paleozoic fossils	low	none	optional	none
27	69	22	none	none	none	none	none
27	70	23-29.4	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
28	66	1-3	possible Tertiary and Quaternary fossils	moderate	low	prospect and collect if found	none
28	70	3-7.3	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
29	70	1-5	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
29	73	5-6	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
30	73	1-3	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
30	73	7-9	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
31	73	1-7	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none

TABLE 1 - "IMPACT" ANALYSIS

LINK	MAP	MILEAGE	"RESOURCE"	IMPACT LEVEL	COMPARATIVE IMPACT	MITIGATION	MITIGATION IMPACT
32	77	1-9	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
32	81	10-18	Tertiary and Quaternary vertebrates possible	moderate	low	prospect and collect if found	none
32	88	19-28	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
33	87	1-9	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
33	103	10-15	possible Tertiary-Quaternary vertebrates	moderate	low	prospect and collect if found	none
33	102	15-17	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
33	111	19-25	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
34	87	1-8	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
34	103	11-18	possible Tertiary-Quaternary vertebrates	moderate	low	prospect and collect if found	none
35	87	7-8	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
35	103	9-18	possible Tertiary-Quaternary vertebrates	moderate	low	prospect and collect if found	none
35	83	27-44	Tertiary and Quaternary vertebrates possible	moderate	low	prospect and collect if found	none
36	111	1-8	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
36	111a	0-1	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
38	21	1-9	possible Quaternary and Tertiary vertebrates	moderate	low	prospect and collect if found	none
38	28	9-18	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
38	37	18-19, 22-27	possible Quaternary and Tertiary vertebrates	moderate	low	prospect and collect if found	none
38	38	19-21	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
38	47	27-28.21	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
39	47	1-3	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
40	47	1-3.9	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
41	47	1-5	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
41	57	5-14	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
41	62	14-16	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
42	62	1-3.35	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
43	62	1-5.3	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
44	62	1-4.95	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none

TABLE 1 - "IMPACT" ANALYSIS

LINK	MAP	MILEAGE	"RESOURCE"	IMPACT LEVEL	COMPARATIVE IMPACT	MITIGATION	MITIGATION IMPACT
45	62	1-2	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
45	68	2-11	none	none	none	none	none
45	72	11.75	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
46	116	0-7	possible Tertiary-Quaternary vertebrates	low-moderate	low	prospect and collect if found	none
46	115	8-26	possible Tertiary-Quaternary vertebrates	low-moderate	low	prospect and collect if found	none
46	114	27-44	possible Tertiary-Quaternary vertebrates	moderate	low	prospect and collect if found	none
46	113	45-62	possible Tertiary-Quaternary vertebrates	moderate	low	prospect and collect if found	none
46	95	63-70	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
46	96	71-73	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
47	72	1-8	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
47	75	9-26	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
47	96	44-47	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
48	72	1-8	none	none	none	none	none
48	72a	8-12	none	none	none	none	none
48	76	13-26	Cretaceous, Tertiary and Quaternary fossils	moderate	moderate	prospect and collect if found	none
48	79	28-48	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
48	80	39-40	Cretaceous, Tertiary and Quaternary fossils	moderate	moderate	prospect and collect if found	none
48	85	39-50	Tertiary and Quaternary vertebrates possible	moderate	low	prospect and collect if found	none
48	91	50-58	possible Tertiary or Quaternary vertebrates	moderate	low	prospect and collect if found	none
48	92	59-66	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
48	99	67-68	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
48	100	69-70	possible Quaternary Quaternary vertebrates	moderate	low	prospect and collect if found	none
48	110	80-86	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
49	96	1-5	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
49	97	5-13	possible Tertiary and Quaternary vertebrates	moderate	low	prospect and collect if found	none
49	98	13-19	possible Tertiary and Quaternary vertebrates	low	none	prospect and collect if found	none
49	104	19-21	possible Tertiary-Quaternary vertebrates	moderate	low	prospect and collect if found	none
49	105	21-30	none-low	none-low	none	none	none
49	106	30-37	none-low	none-low	none	none	none

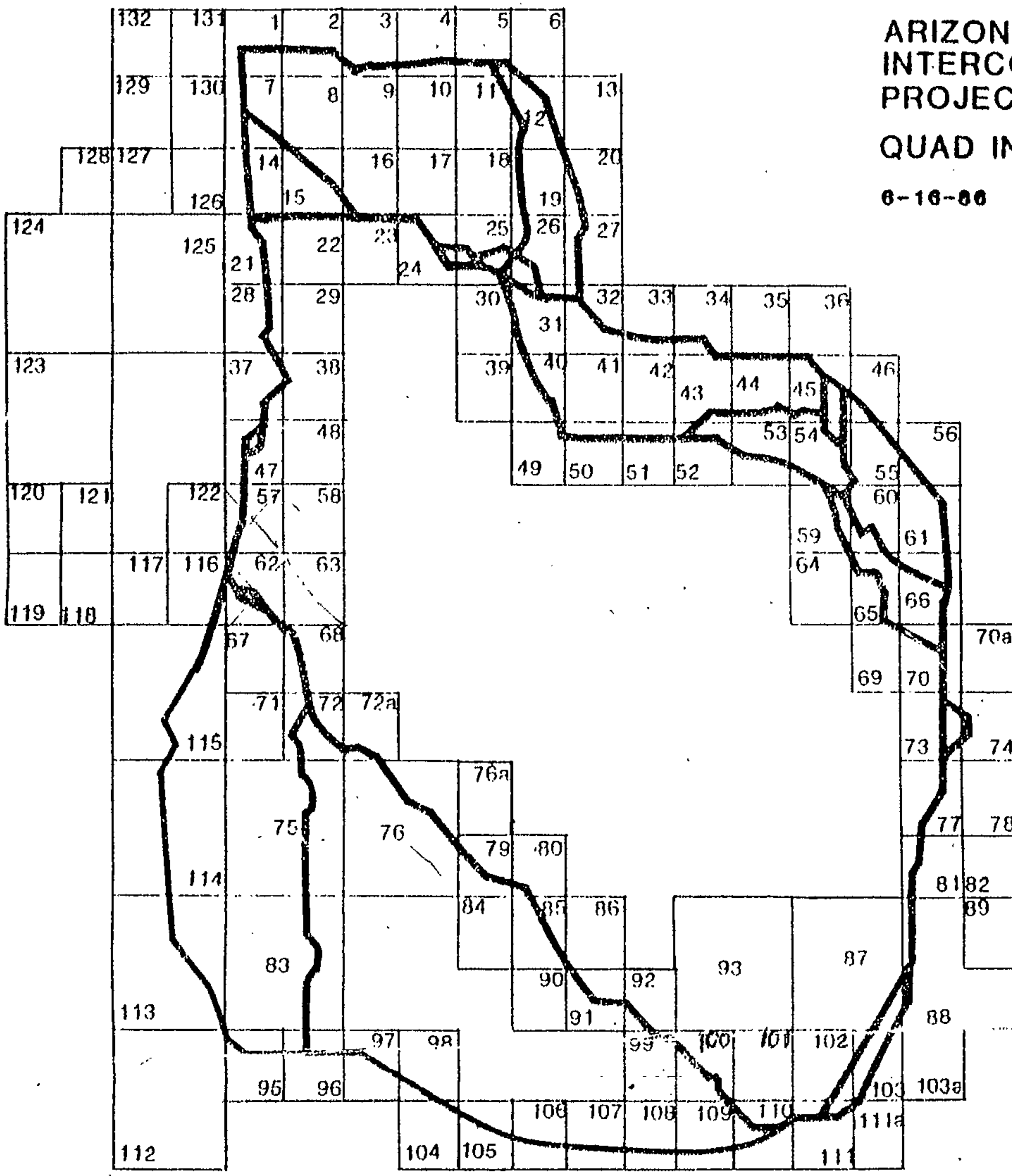
TABLE 1 - "IMPACT" ANALYSIS

LINK	MAP	MILEAGE	"RESOURCE"	IMPACT LEVEL	COMPARATIVE IMPACT	MITIGATION	MITIGATION IMPACT
49	107-108	37-51	low	none-low	none	none	none
49	109	52-59	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none
49	110	59-64	possible Quaternary vertebrates	moderate	low	prospect and collect if found	none

ARIZONA INTERCONNECTION PROJECT

QUAD INDEX

6-16-86



1. Goat Springs
2. Blaines Lake
3. Tejana Mesa S.W.
4. Armstrong Canyon
5. Quemado
6. Omega
7. Cow Springs
8. Red Hill
9. Ponderosa Tank
10. Largo Mesa
11. Escondido Mesa
12. Mangas
13. Alegres Mtn.
14. Jones Canyon
15. Black Peak
16. Gallo Mtn. W.
17. Gallo Mtn. E.
18. Slaughter Mesa
19. Mangas Mtn.
20. Wallace Mesa
21. Underwood Lake
22. Center Fire Bog
23. Queens Head
24. Aragon
25. Tularosa Canyon
26. Bell Peak
27. Horse Mtn.
28. Luna
29. Dillon Mtn.
30. John Kerr Peak
31. Rael Spring
32. Fullerton
33. Shaw Mtn.
34. Luera Mtn. W.
35. Luera Mtn. E.
36. Oak Peak
37. Bull Basin
38. Reserve
39. Collins Park
40. Salvation Peak
41. Rail Canyon
42. Pelona Mtn.
43. Mojonera Canyon
44. Paddy's Hole
45. Dusty
46. Welty Hill
47. Soliz Pass
48. O Block Canyon
49. O Bar O Canyon W.
50. O Bar O Canyon E.
51. Indian Peaks W.
52. Indian Peaks E.
53. Wahoo Peak
54. Wahoo Ranch
55. Montoya Butte
56. Vicks Peak
57. Alma
58. Mogollon
59. Iron Mtn.
60. Jaralosa Mtn.
61. Monticello
62. Glen Wood
63. Holt Mtn.
64. Winston
65. Chise
66. Priest Tank
67. Wilson Mtn.
68. Moon Ranch
69. Thumb Tank Peak
70. Williamsburg N.W.
70a. Cuchillo
71. Mulecreek
72. Bear Mtn.
72a. Buckhorn
73. Saladone Tank
74. Williamsburg
75. Steeple Rock
76. Cliff
76a. Dorsey Ranch
77. Skute Stone Arroyo
78. Caballo
79. Circle Mesa
80. Silver City
81. Clark Spring Canyon
82. Garfield
83. Canador Peak
84. Wind Mtn.
85. Tyrone
86. Hurley W.
87. Lake Valley
88. Nutt
89. Arroyo Cuervo
90. White Signal
91. Whitewater
92. Faywood Station
93. Dwyer
94. Nutt
95. Summit
96. Nine Mile Hill
97. Culberson Ranch
98. Gold Hill
99. Antelope Hill
100. Spalding
101. Goat Ridge
102. Massacre Peak
103. Florida
103a. Good Sight
104. Lisbon
105. Ninety Six Ranch
106. Soldiers Farewell
107. Grandmother Mtn. W.
108. Grandmother Mtn. E.
109. Williams Ranch
110. Deming W.
111. Deming E.
111a. Carne
112. San Simon
113. Duncan
114. York Valley
115. Big Lue Mtns.
116. Maple Peak
117. Fritz Canyon*
118. Pipe Stem Mtn.*
119. Bee Canyon*
120. Robinson Mesa*
121. Rose Peak*
122. Alma Mesa
123. Hannagan Meadow*
124. Big Lake*
125. Alpine
126. Loco Knoll
127. Nelson Reservoir*
128. Eagar*
129. Coyote Hills*
130. Nelson Reservoir N.E.
131. The Rincon
132. Voigt Ranch*

*Quads not needed.

INDEX MAP (FROM DAMES AND MOORE)