LANDFORMS
TEMPE QUADRANGLE, MARICOPA COUNTY, ARIZONA

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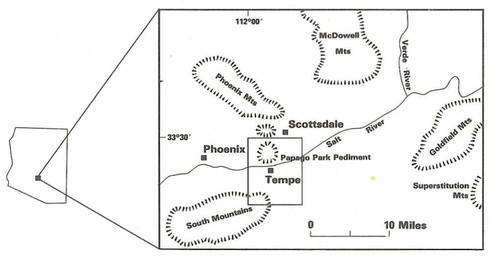
1986

Prepared in cooperation with the cities of
Tempe, Scottsdale, and Phoenix, and the
Arizona State Land Department



INTRODUCTORY STATEMENT

The Tempe Quadrangle is in the Sonoran Desert Section of the Basin and Range Physiographic Province. The alternating basins and ranges were produced during a period of block faulting which occurred in Mid-Tertiary time, approximately 12 to 17 million years ago. The relatively upthrown blocks form the ranges, while the downdropped blocks form the basins. Erosion of the bedrock highlands of these ranges has contributed great thicknesses of debris, forming alluvial fans at the base of the highlands. As the basins fill with alluvium, the distal ends of these alluvial fans coalesce into a nearly flat, extensive basin floor. Many small, isolated knobs of bedrock, such as Tempe Butte, Bell Butte, and Twin Buttes, represent the tops of hills and ranges that are being buried by the infilling alluvium.

Mountains in arid regions are commonly bordered by a realitively smooth, eroded bedrock surface called a pediment. A break in slope separates the broad, concave upward pediment surface from the steep mountain front. The Papago Park Pediment is a partly buried, gullied pediment. The original upland mass has been reduced to a number of isolated, residual bedrock hills called inselbergs. The Papago Park Pediment is small, only 7.5 mi (19.5 km). It is thought to be about 3 to 5 million years old. This age is based on the relatively extensive development of caliche in the colluvium which overlies the pediment. As the surrounding basins filled with alluvium, the debris could no longer be transported away from the pediment, and accumulated on the bedrock surfaces, where it became cemented by caliche. As the bordering Salt River has lowered its base level, streams draining the pediment have cut into this calichified colluvium, locally exposing bedrock in the floors and sides of the gullies.

The pediment is distinguished from an alluvial fan: a pediment is a surface of erosion, but an alluvial fan is a surface of deposition. Alluvial fans are not well developed within this quadrangle due to the absence of large mountains. The distal portions of alluvial fans from surrounding mountain ranges converge to form the continous surface of the basin floor. Dry washes draining the fans of Camelback Mountain and the McDowell Mountains are tributaries to Indian Bend Wash, a shifting, ephemeral stream which is a tributary to the Salt River.

The Salt River has contributed to the basin-fill deposits by transporting alluvium from the Superstition-Goldfield-Mazatzal Mountains in the east. As the river locally meanders across the valley, it has eroded laterally forming an extensive floodplain. Four paired alluvial terraces border the modern channel, and represent older floodplain levels. These floodplain remnants were left behind as the river cut down through alluvium which it had deposited at an earlier time. Three terrace levels can be distinguished within the Tempe Quadrangle. Each terrace reflects a period of downcutting due to uplift of the mountains in the east, which causes a rejuvenation of the river. The terraces converge near Tempe, where the older terraces disappear under the basin floor.

The lowest terrace, the Lehi, is only 5 ft (1.5 m) above the dry river bed near Tempe, and rises to 18 ft (6 m) above the river 24 miles (40 km) upstream. A higher terrace, the Blue Point, is not recognized in this quadrangle. The most prominent terrace is the Mesa, on which most of the cities of Mesa and Tempe are built. It is 10 to 15 ft (3 to 4.5 m) above the dry river bed at Tempe, 218 ft (67 m) above the river at Stewart Mountain Dam, and more than 290 ft (90 m) above the river near Roosevelt Dam. The highest and oldest terrace, the Sawik, is the most fragmentary. It is about 45 ft (15 m) above the dry river bed at Scottsdale and the Salt River Indian Reservation, where it has been buried under alluvial fan deposits from Camelback Mountain and the McDowell Mountains. Although the river has shifted back and forth across the valley, and its level is now lower, the grain-size distribution, the roundness, and the sphericity of the cobbles indicate that conditions under which the older gravels were deposited are very similar to the modern conditions of deposition. Comparison of the rock types of terrace deposits with those of the modern channel show that the source has not changed throughout the history of the Salt River. The downstream convergence of the terraces suggests a continual regional uplift of the mountains to the east and north, with the relative subsidence of the basin.

The older Mesa and Sawik Terrace deposits show various stages of caliche development, and could be up to 2 million years old. Similar terraces on the Gila River downstream near Arlington are covered by lava flows 2 to 3 million years old.

On November 4, 1977, Péwé (unpublished data) found a fossil tortoise (late Pleistocene ?) at a depth of 6 ft (2 m) under overbank silt on the Lehi Terrace 1/4 mile (1015 m) southeast of Lehi, Arizona (2 1/2 miles [4.2 km] east of Tempe Quadrangle). Teeth of a Pleistocene horse were found in the Lehi Terrace deposit east of Sky Harbor Airport, south of Washington Street, north of the Salt River (Nations and Lindsay, 1976). The teeth were identified to be from *Equus occidentalis* and their condition suggests the specimens had not been transported with the river gravels nor reworked from older deposits. Presence of these teeth supports a late Pleistocene age (Rancholabrean Land Mammal Age) for the Lehi Terrace deposit.

As the river abandons a former level, the terrace gradually becomes covered by encroaching alluvium from the surrounding highlands. This alluvial blanket is thicker to the east, where the mountains are higher and closer to the river. South Mountains is close enough to the river to have caused partial burial of even the youngest terrace.

Different landforms are the result of different geologic conditions. Parameters used to differentiate landforms include topographic expression, slope, caliche development, drainage and incision. Identification of a particular landform allows a prediction of the relative flood hazard, the permeability, the available material resources, and the excavation conditions.

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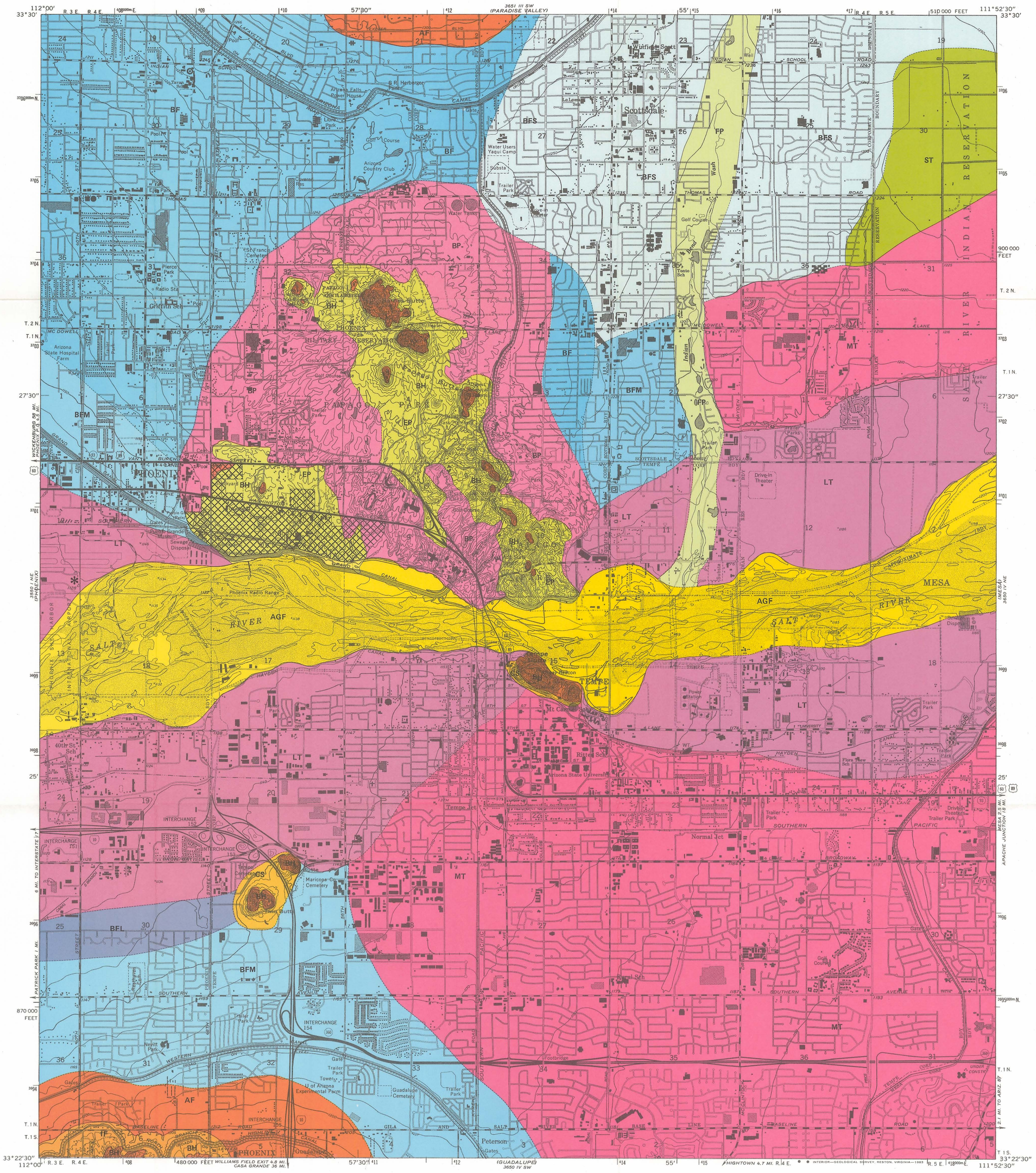
This map involves a general evaluation on a broad scale and does not preclude the necessity of site investigation.

SYMBOLS

✱ Vertebrate fossil locality



BASE MAP FROM U.S. GEOLOGICAL SURVEY
TOPOGRAPHIC MAP, 1:24,000 SERIES
TEMPE QUADRANGLE (1952, PHOTOREVISED 1967)
Additional revisions compiled by the Geological Survey from aerial photographs taken 1978 and other sources. This information not field checked. Map edited 1982.

UTM GRID AND 1982 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24000

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

EXPLANATION

AGF — Active geologic floodplain of the Salt River — Undulatory topography of alternating bars and channels with relief of approximately 15 ft (4.6 m), sloping east to west (2 to 5%). No caliche development. Boundary is scarp of Lehi Terrace. Flooding is common in years of extreme rainfall. Floodplain capable of containing a flow of approximately 150,000 cubic feet per second. This floodplain does not consider artificial channels, obstructions, and regulatory devices. (See Flooding (GI-2-E) for delineation of floodplain according to regulated and unregulated flows of various frequencies.

FP — Floodplain of Indian Bend Wash — Nearly level floodplain (0 to 2% slope) extending north to south across the basin floor, joining the Salt River. Boundaries delineate the 100 year floodplain. Indian Bend Wash is incised less than 20 ft (6.1 m). Caliche strongly developed except where floodplain crosses Lehi Terrace. Flooding common during major storms.

LT — Lehi Terrace — Paired alluvial terraces representing a former level of the Salt River floodplain before a change in stream regimen caused the river to cut down through its own deposits. The terrace is approximately 5 ft (1.5 m) above the present river channel, and was flooded by exceptional flows prior to the construction of reservoirs upstream. The back scarp between this and the older Mesa Terrace marks the limit of flooding. The terrace remnants range from 0.5 to 2.0 miles (610 to 3,220 m) in width, and are bounded by a front and back scarp (except locally where scarp has been buried by basin-fill deposits or modified by erosion). The terrace surface has little to no relief, sloping very gently (less than 1%) downstream. Indian Bend Wash has incised a channel across the terrace to a depth of 20 ft (6.1 m). Incipient caliche coatings on rounded river gravels of terrace deposits.

MT — Mesa Terrace — Paired alluvial terrace remnants representing a former level of the Salt River floodplain. Gently sloping (0 to 2%), slightly undulating surface of low relief. Five to 10 ft (1.5 to 3 m) scarp forms boundary between this and the younger Lehi Terrace, except locally where concealed beneath a wedge-shaped blanket of sediment from South Mountains and Papago Park Pediment. Caliche strongly developed in the terrace deposits. Incised 10 ft (3m) by Granite Reef Wash, which floods during major storms. Natural drainage poor south of Salt River.

ST — Sawik Terrace — High alluvial terrace remnant of the Salt River. Gently sloping (0 to 2%), slightly undulating surface of low relief. Locally buried by the distal ends of alluvial fans from McDowell Mountains. This alluvial blanket, together with erosion, has blurred distinction of the scarp between this and the younger Mesa Terrace, leaving only a gentle break in relief. The terrace deposits are tightly cemented by caliche.

BF, BFL, BFM, BFS — Basin floor — Nearly level to very gently sloping (0 to 2%), nearly center of basin at the distal ends of alluvial fans. Individual fans no longer discernable, but coalesce to form a basin-fill deposit. Land surfaces generally flat with dry washes incised less than 5 ft (1.5 m), and relief between washes less than 3 ft (1 m).
BFL — Thin (less than 15 ft [4.6 m]) blanket of South Mountains alluvium over Lehi Terrace deposits.
BFM — Thickening wedge (up to 40 ft [12.2 m]) of alluvium from South Mountains and Papago Park pediment over Mesa Terrace deposits, obscuring scarp.
BFS — Distal ends of alluvial fans from McDowell Mountains or from Camelback Mountain and Papago Park Pediment over Sawik Terrace deposits.

AF — Active alluvial fan segments — Gently sloping surfaces (less than 5%). Undulatory relief, incised less than 5 ft (1.5 m) by minor drainage channels. Little to no caliche visible in stream cuts, possible at depth. Active alluvial fans form when modern mountain streams emerge from channels incised into older surfaces, and spread out depositing alluvium in fan-shaped wedge. Relief generally does not exceed 5 ft (1.5 m). Flooding common during major storms.

IF — Inactive alluvial fan segments — Gently sloping surfaces (seldom exceeding 5%). Land surface undulatory with less then 5 ft (1.5 m) relief, except near stream channels which may be incised up to 15 ft (4.6 m). Strongly developed caliche visible in stream cuts. Well drained, flooding generally confined to channels.

CS — Colluvial slopes — Accumulations of debris on steep slopes and the base of isolated bedrock highlands. Surfaces nearly flat with slopes generally exceeding 15%. Caliche strongly developed. Well drained, flooding slight.

BP, EP — Pediment — Low, eroded bedrock surfaces with slopes generally less than 10% (except steep, isolated bedrock knobs called inselbergs which rise above the pediment surface). Topography is undulating, channels incised up to 25 ft (7.1 m) deep. Caliche strongly developed in the overlying colluvium. Drainage well developed, flooding generally contained in incised channels. Hashed pattern indicates where colluvium and weathered bedrock have been artifically removed for commercial use.
BP — Buried pediment, bedrock surface covered by strongly calichified colluvial-alluvial debris, 2 to 50 ft (0.6 to 15 m) thick. Bedrock locally exposed in deep stream cuts.

BH — Bedrock highlands — Isolated bedrock knobs and inselbergs locally covered by a thin (less than 2 ft [0.6 m]) veneer of talus and colluvium. Slopes generally exceed 15%. Topography is rugged and steep with elevations up to 1745 ft (529 m) atop Barnes Butte, the highest point in the quadrangle. Well drained with flooding confined to steep mountain washes.