The Geology of the Safford-San Carlos Area, Graham and Gila Counties, East-Central Arizona

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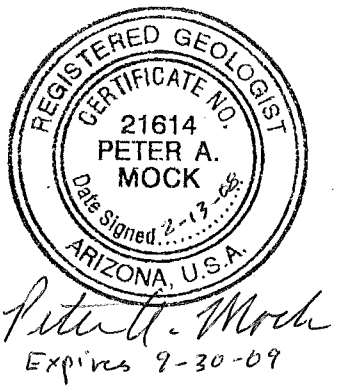

EXECUTIVE SUMMARY

In flowing from its origins in the mountains of west-central New Mexico down to the broad sedimentary basins of central Arizona's Salt River Valley, the Gila River and its enclosing fluvial deposits are tightly enclosed by strongly-consolidated, low-permeability rock. An exception is the broad and deep expanse of sedimentary deposits crossed by the Gila River in the Safford-San Carlos area of east-central Arizona. An interconnected chain or complex of geologic structural subbasins in this area is filled with thousands of feet of weakly- to moderately-consolidated sedimentary deposits. These sedimentary deposits have the potential for storing and transmitting much more water than the strongly-consolidated rock of surrounding mountain ranges. This chain of structural subbasins will collectively be called the Safford-San Carlos Area Subbasin Complex in this report.

Previous geologic studies conducted within the Safford-San Carlos Area (the study area) have had a variety of objectives and have addressed areas larger or smaller than the study area. Different terms have been applied to geologic units in different parts of the study area. Previous studies have primarily addressed surficial geology. The present study is a comprehensive, three dimensional geologic synthesis for the study area integrated from the previous studies and new analyses of the available data focused on geologic characteristics controlling the flow of water.

The first of two primary types of geologic units identified in the study area comprises the strongly-consolidated rocks of the exposed mountain ranges, which also extend beneath the valley floor between the exposed mountain ranges and form a "Basement Complex." The Basement Complex forms a container for overlying, primarily sedimentary rock units. Because they are assumed for this study to have much reduced capacity to store and transmit water relative to overlying units, the components and arrangements of Basement Complex units are not individually addressed in this study. In general, Precambrian and Tertiary granitic-gneissic rocks typical of the Pinaleno and Santa Teresa Mountains dominate the southern side of the study area and Tertiary volcanic rocks typical of the Gila Mountains dominate the northern side of the study area. All of the Basement Complex rocks are combined in this study under a designation of Sequence 0 (zero).

The second primary type of geologic units in the study area comprises primarily sedimentary deposits of Tertiary to Holocene age. These "Basin Fill Complex" units are dominated on a volumetric basis by relatively fine-grained sediments (silts to clays) that were deposited in alluvial fan, playa (salt flat), palustrine (shallow, intermittent

lake/swamp/marsh) and lacustrine (deep, relatively permanent lake) depositional systems of Tertiary age.

During Pleistocene time, hundreds of feet of the Basin Fill Complex deposits were eroded and carried out of the study area. The results of these erosion processes were the deep arroyos and broad terraces that step up and away from the Gila River. The remnants of relatively thin alluvial fan and fluvial deposits of Pleistocene age mantle the multiple terraced exposures of Tertiary deposits. Incised into the Tertiary deposits are relatively thin (~100 feet in depth) troughs filled with relatively coarse-grained sediments (predominantly sands to boulders) of Holocene age by the fluvial (river) depositional systems of the Gila River and its major tributaries. Thin deposits of relatively coarse-grained sediments of Holocene age spread by alluvial fan depositional systems mantle the Pleistocene Alluvial fans near their mountain sources. A limited area of Quaternary volcanic flows is found in the far northwestern edge of the study area near the (new – since the 1920s) town of San Carlos.

Based on review of the available relevant previous geologic studies and inspection of the available relevant geologic data, the geologic materials of the Basin Fill Complex can be organized as sequences (stacks) of consistent arrangements of sedimentary depositional systems, in ascending order:

- Sequence 1 – Lower Basin Fill - Miocene alluvial fan and playa depositional systems
- Sequence 2 – Upper Basin Fill - Pliocene alluvial fan, alluvial fan delta, palustrine and lacustrine depositional systems,
- Sequence 3 – Pleistocene remnant alluvial fan and fluvial depositional systems
- Sequence 4 – Holocene alluvial fan and fluvial depositional systems.

Sequences 1 and 2 were deposited during the later part of the Tertiary Period and primarily represent aggradation (sediment accumulation) processes. Sequences 3 and 4 were deposited during the Quaternary Period and primarily represent degradation (sediment erosion) processes.

In this study, the elevations of the contact between the top of the Basement Complex and the base of the Basin Fill Complex in the study area were interpreted from depth-to-bedrock calculations, which were derived from interpretations of surficial gravity and seismic reflection surveys. The contacts between each of the sequences in the Basin Fill Complex were interpreted from the available surficial geologic mapping, soil surveys, seismic interpretations, and a new, independent evaluation of more than 70 measured sections of exposed outcrops, and more than 5,000 drillers' or geologists' logs. The composite database was interpreted to extend the interpretations of sequence contacts from the available well logs to a total of over 24,000 points which interpret the contacts between Sequences 1 through 4 and thereby provide for two-dimensional plotting and three-dimensional viewing of the interpreted sequence contacts.

This study provides context and terminology for further geologic analyses of the area as a whole as well as for geologic analyses of constituent smaller geologic volumes.