HISTORICAL CHANNEL CHANGES
ALONG THE LOWER SAN PEDRO RIVER,
SOUTHEASTERN ARIZONA

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Arizona State Land Department

This report is preliminary and has not been edited or
reviewed for conformity with Arizona Geological Survey
standards
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INTRODUCTION

The San Pedro River is divided into upper and lower reaches based on environmental and geomorphic contrasts (Tuan, 1962; Heindl, 1952a,b). The upper reach extends from the headwaters to “The Narrows,” a bedrock constriction near Benson. The lower reach extends from The Narrows to the San Pedro River’s confluence with the Gila River (Figure 1). A previous study of the historical geomorphology of the San Pedro River conducted by the Arizona Geological Survey for the Arizona State Land Department (Huckleberry, 1996) summarized the available published information regarding the nature and timing of channel changes along the upper and lower San Pedro River. Whereas there is an abundance of published information regarding the character and timing of channel changes along the upper San Pedro River, there is very little published information available regarding channel changes along the lower San Pedro River.

Major channel changes and arroyo formation occurred on the upper San Pedro River during the late 1800's and early 1900's. Much of the published literature inferred that the upper San Pedro became entrenched as a result of the flood events that occurred during the 1890's. In addition, many inferred that the timing and general character of channel changes were similar on the upper and lower San Pedro River. The Arizona Geological Survey recently received feedback from residents of the lower San Pedro River whose family records and historical photographs suggested that the lower San Pedro River had a history of channel change significantly different from that of the upper San Pedro River. In particular, they believed that greater channel changes resulted from the 1926 flood event than from the 1890's flood events.

This report summarizes a new investigation of historical channel changes along the lower San Pedro River that supplements Huckleberry’s 1996 report and explores the possible differences between the channel-change histories of the lower and upper reaches. It contributes to the baseline information that may be used by the Arizona Stream Navigability Commission in its determination of the potential navigability of the San Pedro River at the time of Statehood (1912). The primary objective of the research presented in this report is to establish a chronology of changes in channel characteristics along the lower San Pedro River, rather than to determine the causes of channel changes. For a review of the causes of channel change and arroyo formation on the San Pedro River and
Figure 1. Lower San Pedro River Basin (adapted from Huckleberry, 1996, and Heindl, 1952.)
other rivers in southeastern Arizona, refer to such publications as Antevs (1952), Hastings and Turner (1965), Cooke and Reeves (1976), Betancourt and Turner (1990), and Hereford and Betancourt (in press).

The next section provides a description of the sources of information available for this report. The third and fourth sections provide discussions of the changes in channel width and location, and of the timing of entrenchment of the reaches of the lower San Pedro River near Redington and Mammoth/Dudleyville, the reaches for which there was historical information available. The fifth section of this report compiles all available archival and physical evidence that describes streamflow and channel characteristics into chronological listings for the Redington and Mammoth/Dudleyville reaches. The final section summarizes the most notable channel changes to occur along the lower San Pedro River.

**SOURCES OF INFORMATION**

This research focused on the collection of information relating to channel changes along the entire length of the lower San Pedro River between 1890 and 1926, a period that encompasses not only the date of Statehood, but also the time of most dramatic change along the San Pedro River. Several sources of information were investigated: published and unpublished references; historical maps; aerial and ground photographs; and, oral histories collected from people who have lived along the lower San Pedro River.

The search for historical information had four phases. The first phase was a thorough review and update of the published references compiled by Huckleberry (1996). Digital reference databases maintained by several different universities were searched using The University of Arizona's computerized card-catalog system known as "SABIO." In addition, the card catalogs compiled by The University of Arizona's Special Collections and the Arizona Historical Society's Tucson library were searched manually.

The second phase consisted of sending letters to approximately one hundred individuals and families that owned land along the lower San Pedro River. The letters inquired about knowledge of family records such as photographs, historical maps, manuscripts, diaries, or any other information or memories that related to channel characteristics between 1890 and 1926. The names and addresses for the mass mailing were retrieved from the Land Ownership Geographical Information System, which was
compiled as part of the 1993 Arizona Stream Navigability Study\(^1\) and was archived by the Arizona State Land Department.

The third phase involved contacting over forty public and private agencies. The goals of this phase were to locate unpublished reports and project work, and to identify long-time residents of the lower San Pedro River Valley who might have memories or family records that described the channel at the turn of the century. The final phase of the search for historical information was contacting, by telephone or in person, current and former residents of the lower San Pedro Valley. A list of agencies and individuals that provided information, and summaries of the oral interviews and response letters, is provided in Appendix C. Information provided by these contacts that is relevant to the thesis of this report is interwoven throughout the following sections.

The vast majority of the data gathered related to two specific reaches of the San Pedro River: a ten-mile reach near Redington, and a twenty-five-mile reach between Mammoth and the Gila-San Pedro confluence. Information that relates to the history of arroyo formation in these two reaches is presented in the next section. Information about changes in channel width and location is presented in the fourth section of this report. The fifth section of this report provides detailed chronological listings of historical channel and streamflow descriptions for the Redington and Mammoth reaches of the lower San Pedro River.

Many of the oral histories described flow characteristics rather than channel characteristics. Much of the information in general related to changes that occurred after both Statehood and the 1926 flood event. Although such information did not fall within the scope of this investigation, it was included in the chronological listings if the authors thought it could be useful in the Arizona Navigable Stream Adjudication Commission's determination of the potential navigability of the San Pedro River.

Places mentioned in the following text are shown in Figure 1 or Plates 1, 2, and 3. Because the locations of many places are described using the Bureau of Land Management's system of land division, an explanation of this system is provided in Appendix A. Appendix B contains one historical photograph and nine recent ground

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photographs that illustrate conditions along the Redington and Mammoth reaches of the river, and Appendix C contains the list of contacts and oral history summaries.

LATERAL CHANNEL CHANGES ALONG THE LOWER SAN PEDRO RIVER

The dominant channel-change mechanism in each reach of a river depends on channel morphology, channel sediment, bank resistance, and flood magnitude. Where the channel is entrenched into an arroyo, a combination of fluvial processes and bank retreat mechanisms leads to arroyo change (Parker, 1995). The different types of lateral and vertical changes a river channel may experience are described in Table 1.

Major channel changes along the San Pedro River have occurred primarily as a result of large flood events (Hastings, 1959; Hastings and Turner, 1965; Cooke and Reeves, 1976; Hereford and Betancourt, in press). Newspaper accounts indicated that large floods occurred on the San Pedro River in 1881, 1886, 1887, 1890, 1891, 1893, 1894, 1896, 1900, 1901, 1904, 1905, and 1926 (Hereford and Betancourt, in press). Figure 2 provides the annual peak discharge measurements recorded by the U.S. Geological Survey gages at Charleston (located at the northernmost part of the upper San Pedro River) and near Redington, that began in 1916 and 1926, respectively. The gage record at Redington indicated that large floods occurred in 1926, 1940, 1947, 1951, 1977 (Water Year), 1983 (Water Year 1984), and 1993. The Charleston and Redington discharge records and the newspaper accounts indicated that the largest flood of record occurred in September of 1926.

This section of the report focuses on historical changes in the channel width and location of the San Pedro River, near Redington and Mammoth/Dudleyville, that resulted from the large floods of the late 1800's and early 1900's. To ascertain such lateral channel changes, the channel location and boundaries discerned from historical survey maps, and from historical and recent aerial photographs, were compiled onto 1:24,000-scale base maps. Table 2 describes the maps and photographs that were available for this study.

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2 Asterix (*) indicates a year in which newspaper accounts noted flood(s) specifically on the lower San Pedro River.

3 A water year is defined as October 1st of the previous calendar year to September 30th of the current calendar year.
Table 1. Channel change mechanisms.  
(Source: Wood et al, 1996. Adapted from Parker, 1995.)

<table>
<thead>
<tr>
<th>MECHANISM</th>
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<tr>
<td>Meander migration:</td>
<td>Lateral shifts of centerline position associated with the inception of meanders and their subsequent downstream translation, lateral extension, or rotation of meander axis.</td>
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<tr>
<td>Avulsion:</td>
<td>An abrupt shift in channel position that occurs when overbank flow incises new channels as other channels aggrade and are abandoned.</td>
</tr>
<tr>
<td>Meander cutoff:</td>
<td>An abrupt shift in channel position that occurs at meanders and may or may not involve concurrent aggradation of the abandoned channel segment. Meander cutoff and avulsion tend to occur where channels are shallowly incised, the floodplain is active, and aggradation rates generally are high.</td>
</tr>
<tr>
<td>Channel widening:</td>
<td>Results primarily from high flows that erode weakly cohesive banks. It is different from arroyo widening because arroyo boundaries may delineate not only a channel but also a floodplain at the bottom of the arroyo. It is a product of corrosion by fluvial erosion during rising flow, or mass wasting of banks following the flow peak.</td>
</tr>
<tr>
<td>Vertical change:</td>
<td>Results from changes in stream power, sediment concentration, or resistance that occur as a result of variation in flood magnitude, sediment availability, channel morphology, or local channel gradient. “Degradation and aggradation occur over years to decades and may reflect climatic changes, adjustments to channel widening or narrowing, sediment storage and episodic transport, and natural or artificial changes in channel-hydraulic properties... Degradation and aggradation can alternate in time and space.” [Parker, 1995, p. 24]</td>
</tr>
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Figure 2. Annual peak discharges recorded at the Charleston and Redington gages.
### Table 2. Historical maps and aerial photographs available for this study.

<table>
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<th>DATE</th>
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<th>COMMENTS</th>
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<tr>
<td>1877</td>
<td>Survey of Gila &amp; Salt River Meridian (Mammoth/Dudleyville reach)</td>
<td>John L. Harris, Government Land Office</td>
<td>See Plate 2 and Plate 3. Maps were available for all Townships except T.8S. R.16E.</td>
</tr>
<tr>
<td>1902</td>
<td>Map of the Desert Land Entry No. 3248, Embracing W1/2 SE1/4 Sec 10, and W1/2 NE1/4 Sec 15, T11S R18E, Gila and Salt River Meridian, Arizona</td>
<td>N/A [Filed by Charles Bayless]</td>
<td>Scale: 1 inch = 1000 feet</td>
</tr>
<tr>
<td>1913</td>
<td>30' Winkelman Topographical Quadrangle</td>
<td>U.S. Geological Survey</td>
<td>Surveyed in 1910-11. Scale: 1:125,000</td>
</tr>
<tr>
<td>1921</td>
<td>Gila River Determination, Pima and Cochise Counties, Arizona: Map of surveys showing irrigated lands under ditches taking water from Gila River or tributaries, District No. 3</td>
<td>State Water Commissioner</td>
<td>This boundaries of the river channel on this map did not compare well with maps of earlier or later surveys. For example, when the river boundaries and ditch locations from the 1921 map were overlaid onto the 1981 base map, the river and Bayless Ditch were located high on the side of a present-day hill. Scale: 1 inch = 1000 feet</td>
</tr>
<tr>
<td>1926</td>
<td>Untitled.</td>
<td>N/A</td>
<td>Area of Bayless and Berkalew Company holdings. Scale: 1 inch = 1000 feet</td>
</tr>
<tr>
<td>1926</td>
<td>Untitled. [RR-East]</td>
<td>N/A</td>
<td>This is a survey of the channel area conducted by a railroad company (Smallhouse, 1997, oral commun.). It is a detailed map of all drainage features along only the eastern bank of the river. The location of the channel boundaries in this map closely matches the location of the river on the maps surveyed in 1902 and 1907. Scale: ~3 inches = 1 mile</td>
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</table>
Table 2. Historical maps and aerial photographs available for this study, continued.

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<th>SURVEYOR</th>
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<tr>
<td>Post-1926 Flood</td>
<td>Untitled. [RR-West]</td>
<td>N/A</td>
<td>This is identical in design to the above map, except that it is a survey of the drainage features west of the San Pedro’s channel, and the location of the channel boundaries in this map resemble the boundaries depicted in the 1934 aerial photographs, indicating that it was probably surveyed after the flood of 1926. Scale: ~3 inches = 1 mile</td>
</tr>
<tr>
<td>1934</td>
<td>Aerial photographs of the San Pedro Valley.</td>
<td>Soil Conservation Service</td>
<td>See Plate 1, Plate 2, and Plate 3. This is the first systematic aerial photography performed for the lower San Pedro River. Scale: 1:62,500.</td>
</tr>
<tr>
<td>1945</td>
<td>15’ Redington Topographical Quadrangle</td>
<td>U.S. Geological Survey</td>
<td>The survey was conducted in 1942-43. Scale: 1:62,500</td>
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<td>1948</td>
<td>7.5’ Mammoth Topographical Quadrangle</td>
<td>U.S. Geological Survey</td>
<td>Scale: 1:24,000</td>
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<td>1949</td>
<td>7.5’ Winkelman and Saddle Mountain (now Dudleyville) Topographical Quadrangles</td>
<td>U.S. Geological Survey</td>
<td>Scale: 1:24,000</td>
</tr>
<tr>
<td>1950</td>
<td>7.5’ Lookout Mountain Topographical Quadrangle</td>
<td>U.S. Geological Survey</td>
<td>Scale: 1:24,000</td>
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<tr>
<td>1972</td>
<td>7.5’ Dudleyville, Lookout Mountain, and Mammoth Topographical quadrangles</td>
<td>U.S. Geological Survey</td>
<td>See Plate 2 and Plate 3. Scale: 1:24,000</td>
</tr>
<tr>
<td>1981</td>
<td>7.5’ Redington Topographical Quadrangle</td>
<td>U.S. Geological Survey</td>
<td>See Plate 1. Scale: 1:24,000</td>
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<td>1994</td>
<td>Aerial photographs of Pinal County.</td>
<td>Pinal County Department of Planning</td>
<td>See Plate 2 and Plate 3. Scale: 1 inch = 600 feet</td>
</tr>
<tr>
<td>1995</td>
<td>Aerial photographs of Pima County.</td>
<td>Pima County Maps and Records</td>
<td>See Plate 1. Scale: 1 inch = 600 feet</td>
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<tr>
<td>1997</td>
<td>Aerial photographs of the Nature Conservancy’s holdings along the San Pedro River in Pinal County.</td>
<td>Nature Conservancy – Dudleyville</td>
<td>Scale: 1 inch = 400 feet</td>
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The next two parts of this section describe the changes in channel width and location that have occurred in the past century.

The timing of arroyo formation is not discussed until the fourth section of this report. However, because it is widely accepted that the channel of the lower San Pedro River has been entrenched at least since the 1926 flood event, and because periods of channel widening were often associated with periods of vertical change, it is impossible to completely segregate the discussion of channel widening and channel entrenchment. Therefore, the term “arroyo” and other key phrases used throughout this report are defined below.

**Channel:** A long, narrow, trough-like depression occupied and shaped by a stream.

**Active channel:** The San Pedro River, like many streams in the Southwest, is intermittent; that is, it has reaches that flow only during wet weather or during part of the year, and reaches that flow year-round. In addition, the streamflow experiences great variability from one season to the next, and from one year to the next. Hence, this report uses the phrase “active channel” to describe the area of the sandy channel bottom that was cleared of vegetation by recent flows (“recent” relative to the time a map was surveyed or aerial photograph taken), rather than the area of the sandy channel bottom covered by streamflow, or the area delineated by defined channel banks or arroyo walls.

**Floodplain:** A belt of low, flat ground present on one or both sides of a stream channel, subject to inundation by floods and underlain by stream-laid sediment deposits.

**Arroyo:** In the convention established by Bryan (1922) and refined by Antevs (1952), the term "arroyo" is used when there is a single channel incised in unconsolidated material consisting of clay, silt, sand and some gravel, with banks more than two feet high. The boundaries of an arroyo are defined by its steep banks. Once an arroyo widens to the point that it becomes relatively stable, the former floodplain becomes a terrace, and the arroyo floor becomes a floodplain (Meyer, 1989). Hence, the steep banks of an arroyo may delineate an active channel and a floodplain at the bottom of the arroyo.

Note: Several of the historical maps and written accounts did not define their use of the word “channel.” That is, their use of the word “channel” may refer to the area of the channel bottom covered by water, the area delineated by defined channel banks or arroyo banks, or the area defined by the sandy channel bottom cleared of vegetation. In such cases, this report uses “channel” in the same context as it was used in the historical reference.
Lateral Channel Changes in the Redington Area

A compilation map of channel changes created for the San Pedro River near Redington is shown in Plate 1. Channel locations from the 1879 General Land Office (GLO) survey, the 1907 Bayless and Berkalew Company (BBC) survey, and the 1934 and 1995 aerial photographs, were transferred to the U.S. Geological Survey’s 1981 Redington topographic quadrangle using a zoom-transfer projector. The 1879 GLO survey maps showed the channel location rather than the channel boundaries. In addition, the position of the channel was surveyed only where it crossed cadastral lines; channel locations between the cadastral lines were interpolated (Huckleberry, 1996).

The 1907 BBC survey mapped distinct channel boundaries; however, it is not known whether this survey defined the channel boundaries by the extent of a sandy channel bottom, by the edges of streamflow, or by the presence of defined channel banks. However, the channel boundaries drawn on the July 1902 Desert Land Entry map, the February 1926 Bayless and Berkalew map, the 1921 State Water Commission map, and the Rail Road-East Bank map, all recorded comparable channel widths. Such similarity in channel widths indicates that the channel was defined by the presence of distinct banks or by the area of the channel bottom that was cleared of vegetation.

The channel boundaries discerned from the 1934 and 1995 aerial photographs were defined by the extent of the active channel, rather than by the location of defined channel banks. The precise location of the channel banks was not visible in several of the aerial photographs, either because the photographs were shot at an angle that did not show the relief of the channel banks, or because the channel banks were obscured by vegetation. However, field observations in 1997 indicated that the extent of the sandy channel bottom typically coincided with the location of the steep channel banks that defined the width of the arroyo that had formed by this time along the Redington reach of the San Pedro River.

Although only the channel location was depicted by the 1879 maps of the lower San Pedro River, measurements of channel width were surveyed normal to cadastral lines and recorded in the notes of the surveyor, John L. Harris. Following the procedure of Burkham (1972), Huckleberry (1996) compiled and averaged the channel width measurements surveyed by Harris for each Township. The channel had a mean width of 35 feet in T.11S. R.18E., and 26 feet in T.12S. R.18E.
Between 1879 and 1907, three relatively short segments of the river experienced greater-than-1000-foot shifts in the their locations: a half-mile segment downstream of The Narrows (T.12S. R.18E. Sec.13; refer to Plate 1). Otherwise, the location of the San Pedro River channel changed very little between 1879 and 1907. However, the channel widened considerably during that period. The San Pedro River channel had a width of approximately 400 feet in T.11S. R.18E., and approximately 200 feet in T.12S. R.18E. The channel was as narrow as 150 feet at the R.18E./R.19E. Range line in T.12S., and as wide as 900 feet at the T.11S./T.12.S Township line in R.18E.

Between 1907 and 1934, a 1.5-mile segment of the river in T.12S. R.18E. had shifted to approximately 1300 feet west of its 1907 location, probably as a result of the 1926 flood event. Except for the movement of channel meanders (e.g., in T.11S. R.18E. Section 15), no other changes in channel location occurred during the period from 1907 to 1934. Although the channel widened very little during this period upstream of Redington, it widened dramatically downstream of Redington. Huckleberry (1996) determined that the 1934 channel had a mean width of 236 feet in T.12S. R.18E. (upstream of Redington), and 837 feet in T.11S. R.18E. (downstream of Redington).

The 1995 aerial photographs showed that the channel location upstream of Redington (T.12S. R.18E.) had not changed since 1934, and that channel width had changed very little since 1934. However, the channel located downstream of Redington (T.11S. R.18E.) had widened dramatically since 1934. Several of the reaches had widths in excess of 1200 feet (e.g., in Sections 10, 11, 15, 26, and 34).

Lateral Channel Changes Between Mammoth and the Gila Confluence

The compilation maps of the reach between Mammoth and the San Pedro-Gila River confluence are illustrated by Plate 2 (the Mammoth area) and Plate 3 (the Dudleyville area). Channel locations from the 1877 General Land Office (GLO) survey, the U.S. Geological Survey's 1911 Winkelman topographical quadrangle, and the 1934 and 1994 aerial photographs, were transferred to the U.S. Geological Survey's 1972 topographic quadrangles of that reach using a zoom-transfer projector. The 1877 GLO survey maps showed the channel location rather than the channel boundaries, and the position of the

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4 Refer to the chronology of channel descriptions for the Redington reach in the fifth section of this report for more details about this segment of the river.
channel was surveyed only where it crossed cadastral lines (Huckleberry, 1996). The 1911 Winkelman quadrangle appeared to depict the channel boundaries as the extent of the sandy channel bottom.

The channel boundaries discerned from the 1934 and 1994 aerial photographs were defined by the extent of active channel, rather than by the location of defined channel banks. The precise location of the channel banks was not visible in several of the aerial photographs, either because the photographs were shot at an angle that did not show the relief of the channel banks, or because the channel banks were obscured by vegetation. In contrast to the Redington reach, field observations in 1997 of the Mammoth-Dudleyville reach indicated that the boundaries of the active channel typically did not coincide with the location of the steep banks of the arroyo that had formed by this time. In many segments of this reach, the arroyo walls delineated both an active channel and a floodplain at the bottom of the arroyo.

Although only the channel location was depicted by the 1877 maps of the lower San Pedro River, measurements of channel width were surveyed normal to cadastral lines and recorded in the notes of the surveyor, John L. Harris. The channel had a mean width of 35 feet in T.5S. R.15E., 36 feet in T.6S. R.16E., 38 feet in T.7S. R.16E., 35 feet in T.8S. R.16E., and 40 feet in T.8S. R.17E.

The U.S. Geological Survey's 1911 survey indicated that several segments of the river experienced notable shifts in location since the 1877 survey. For example, a one-mile segment of the channel located east of and upstream from the historic location of Dudleyville (T.5S. R.15E. Sec.25, Plate 3) had shifted approximately 1000 feet east of the location of the 1877 channel. A shift of similar magnitude occurred upstream of Malpais Hill (T.6SS. R.16E. Sections 17 and 20, Plate 3) and downstream from Mammoth (T.8S. R.17E. Sec.18, and T.7S. R.16E. Sec.22 and 35, Plate 2). The 1911 survey also indicated that the San Pedro River channel had widened considerably along the Mammoth/Dudleyville reach since 1877. The 1911 channel had a width of approximately 1700 feet at its confluence with the Gila River, 700 feet in T.5S. R.15E., 850 feet in T.6S. R.16E. (with a dramatically wide reach of 2300 feet in Section 26), 800 feet in T.7S. R.16E., and 600 feet in T.8S. R.16E. and T.8S. R.17E. The channel continued to widen between 1911 and 1934. In 1934, the active channel had a mean width of 1600 feet in T.5S. R.15E., 1280 feet in T.6S. R.16E., 930 feet in T.7S. R.16E., 1120 feet in T.8S. R.16E., and 925 feet in T.8S. R.17E (Huckleberry, 1996). The active channel mapped
from the 1934 photographs may indicate the location of the channel banks because of the relatively recent large flows that occurred in 1931 and 1932, may have kept vegetation from becoming re-established in the channel after the 1926 flood of record.

The comparison of the 1934 and 1995 active-channel boundaries of the Mammoth/Dudleyville reach indicated that the 1995 active channel was more narrow and sinuous than the 1934 channel. As noted above, field observations in 1997 indicated that, in many segments of this reach, the arroyo that had formed by this time had stabilized to the degree that the arroyo walls delineated both an active channel and a densely-vegetated floodplain at the bottom of the arroyo. However, Plate 2 and Plate 3 also show several segments of that reach where the 1995 active channel meandered beyond the boundaries of the 1934 active channel.

ARROYO FORMATION AND CHANGE ALONG THE LOWER SAN PEDRO RIVER

Many earth scientists have observed and sought to explain the almost synchronous arroyo formation experienced by the San Pedro River and other major watercourses of southern Arizona around the turn-of-the-century (Bryan, 1925; Antevs, 1952 and 1955; Hastings and Turner, 1965; Melton, 1965; Cooke and Reeves, 1976; Betancourt and Turner, 1990; and, Hereford and Betancourt, in press). However, Hereford and Betancourt (in press) noted that neither the archival nor physical evidence of arroyo formation along the San Pedro River has received more than cursory attention. In addition, Huckleberry (1996) determined that, while there is an abundance of published information regarding the character and timing of channel changes along the upper San Pedro River, there is very little published information available regarding channel changes along the lower San Pedro River.

This section of the report describes the compilation and evaluation of archival and physical evidence, both published and unpublished, that better define the timing and character of arroyo initiation along the lower San Pedro River. The next part of this section provides a brief summary of a commonly-quoted view of historical channel entrenchment along the San Pedro River. Then final two parts present published and unpublished information that specifically relates to the channel entrenchment histories of the Redington and Mammoth/Dudleyville reaches of the river.
Three often-cited statements made by Bryan (1925), Charles H. Bayless (1901), and Hastings and Turner (1965), for many years have shaped the commonly-held views on the timing and character of channel entrenchment along the San Pedro River:

“The trench on the San Pedro River was cut progressively headward between 1883, when an arroyo formed at the mouth of the river, and 1892, when the headwater fall cut through the boundaries of the Boquillas Grant 200 km upstream.” (Bryan, 1925, p. 342)

“Where the San Pedro River of southeastern Arizona formerly wound its sluggish course northward through a marshy, largely unchanneled valley, in August, 1890, it began carving a steep-walled trench through which it thereafter emptied rapidly and torrentially into the Gila. Where it formerly ran more or less consistently throughout the year, after 1890 its flow became intermittent, leaving the new channel dry over much of its length for most of the time…” (Hastings and Turner, 1965, p.3)

“About twelve years [1888] ago the San Pedro Valley consisted of a narrow strip of subirrigated and very fertile lands. Beaver dams checked the flow of water and prevented the cutting of a channel. Trappers exterminated the beavers, and less grass on the hillsides permitted greater erosion, so that within four or five years a channel varying in depth from 3 to 20 feet was cut almost the whole length of the river. Every year freshets are carrying away new portions of the bottom lands. At present this valley is a sandy waste from bluff to bluff, while the few fields remaining are protected from the river at large and continuous expense. Thus, in addition to curtailing the area of good land, the deep channel has drained the bottoms, leaving the native grass no chance to recover from the effects of close pasturing. It also makes it more difficult to get irrigating water onto the surface of the land.” (C.H. Bayless, as cited in Griffith, 1901, p. 111)

In December of 1900, Charles H. Bayless received a circular from D.A. Griffiths, who was the chief botanist in charge of grass and forage plant investigations for the Arizona Experiment Station in Tucson (Griffiths, 1901; Santiago, 1994; Bahre, 1991). Griffiths had sent a circular to a select group of ranchers in southern Arizona in order to obtain accurate knowledge of range conditions before the livestock boom of the 1880’s. The above quote is Charles H. Bayless' response to the questions, “Can you describe any specific instances of the destructive action of water gulllying out the river valleys? Can you state how and at what time such gullying started in any particular instance, and the extent to which the washing progressed in a given time?” To better understand the intensity and thoroughness of Bayless' response, it may help to know a bit of his history. Charles H. Bayless, born on November 23, 1863, in Highland, Kansas, was a well-respected resident of southern Arizona. He first came to Arizona in 1879 when he took off a year from his studies in Kansas to travel with his father and uncle out West and to spend several months clerking at a store in Tombstone (Santiago, 1994). He returned to Kansas in 1880 and resumed his studies at Highland University, where he received a B.A. in 1884. Bayless then became a partner of the Bayless and Berkalew Company (the properties of which were located in the San Pedro River Valley near Redington) with his father, William Bayless, and Jehiel W. Berkalew, in 1884. He spent a few months over the winter of 1884-85 helping his father acquire more cattle for
Although Bryan's 1925 claim has continued to be a popular citation, more recent research has cast doubt on his assertions (Hastings, 1959; Cooke and Reeves, 1976; and, Hereford and Betancourt, in press). Cooke and Reeves (1976) claim that the assertions about the timing of arroyo cutting made in Bryan's often-quoted 1925 paper are almost wholly incorrect:

"The dates are not substantiated, and the notion of headward erosion seems to be derived more from the contemporary geomorphological 'conventional wisdom' related to drainage rejuvenation than from historical data. All available sources point towards a more complex history." (Cooke and Reeves, 1976, p. 42)

Hereford and Betancourt (in press) explained that Bryan's sources did not support his statement that arroyo development progressed from the mouth into the upper San Pedro in less than ten years. Hereford and Betancourt also noted that, over the short term, bedrock outcrops located at The Narrows and at Charleston⁶ should have restricted propagation of headcuts or coalescence of discontinuous arroyos from one subbasin to another.

While not incorrect, the statements made by Hastings and Turner (1965) and Bayless (1901) are, perhaps, overly simplistic. Hereford and Betancourt (in press) and, in subsequent chapters of their book, Hastings and Turner (1965), provided evidence that painted a more complicated picture of the character of the San Pedro River than implied by the introductory paragraph of Hastings and Turner's 1965 publication, and Bayless' 1901 statement. Hastings and Turner's review of historical references dating to the mid-1800's found that the upper San Pedro River and parts of the lower San Pedro were characterized by a perennial stream flowing through a grass-choked valley with cienegas⁷ and pools. However, they also found evidence that the river was intermittent in some reaches, especially in the lower San Pedro River Valley, and that some reaches were entrenched, both in the upper and lower San Pedro River Valley.

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⁶ Charleston is located about 35 miles upstream of The Narrows in the upper San Pedro River Valley.

⁷ "Cienega" is a term applied by Spanish explorers to the distinctive, treeless, riparian marshes of the Southwest.
Regarding the timing of channel entrenchment along the San Pedro River, Hastings and Turner (1965) cited two 1890 newspaper accounts that described channel-bank erosion near Dudleyville\(^8\) and Mammoth\(^9\) that resulted from the 1890 flood event, and one account of the flood-caused destruction that occurred between Tres Alamos (located just south of The Narrows) and the confluence with the Gila River.\(^{10}\) They made no mention of channel-bank erosion due to the 1890 flood event along any other reach of the river.

Hereford and Betancourt (in press) more thoroughly compiled and evaluated archival records for all reaches of the San Pedro River, and field mapped the floodplain surfaces and cutbank stratigraphy of a reach in the upper San Pedro. Their goals were to better define general floodplain conditions before arroyo-cutting and to establish timelines for major floods and cutting episodes. They ascertained that alternating marshes, mesquite thickets, and short entrenched channels appeared to have persisted in the middle and lower San Pedro until the 1880's, and probably as late as the early 1900's in the upper reaches of the San Pedro River Valley. In addition, they noted that, although 1881, 1882, and 1883 had unusually wet summers, and large floods occurred in 1886, 1887, 1890, and 1891, arroyo initiation probably did not occur along the southern reach of the upper San Pedro River until 1896, and the northern reach of the upper San Pedro River did not become entrenched until the 1910's.

Although Hereford and Betancourt's manuscript provided the most thorough review of archival and physical evidence of any reference to date, it highlighted the sparcity of information available for the lower San Pedro River Valley. The rest of this section provides evidence that better defines the timing and character of channel entrenchment in the lower San Pedro River. There are two parts: one part that describes channel

\(^8\) "At Riverside, the road is fordable for the first time in two weeks, but raining again on the San Pedro. If the San Pedro continues to rise the next thing we'll see is Dudleyville floating down the Gila. Has caved within 15 ft of Cook's place. He piled brush to divert, but now it has washed out. Mr. Bates house in danger, several of his outhouses gone. The Riverside-Globe road impassable for two weeks; is being rebuilt on Kane Springs Canyon stretch." (Arizona Daily Star, September 6, 1890, as cited in Hereford and Betancourt, in press)

\(^9\) "Recent floods at Mammoth washed the soil out in places 30 ft deep along the river bottom. Exposed area at bottom brought out in many places evidence of ancient civilizations...." (Arizona Daily Star, October 2, 1890, as cited in Hereford and Betancourt, in press)

\(^10\) "Of the country down the San Pedro, from Tres Alamos to the Gila [Captain Van Alstine] ...says, "all of it is gone, destroyed, torn up, 'vamosed' down with high water." He never saw such a destruction in all his life. ... The San Pedro never was as high as it was this time, and will not probably be for the next ten years. The losses sustained by the people will reach into the thousands." (Arizona Daily Star, August 14, 1890, as cited in Hastings and Turner, 1965, p.42)
entrenchment in the Redington reach; and, one part that describes the Mammoth/Dudleyville reach.

Channel Entrenchment in the Redington Reach of the San Pedro River

Four types of information were found that described the nature and timing of arroyo initiation along the Redington reach of the lower San Pedro River: historical maps with the location of acequias noted; oral histories; historical ground photographs; and, previously-published accounts of channel entrenchment. Each type of information is first described individually below, and then discussed together in the final part of this section.

Location of Acequias

The location of historical acequias, or gravity-flow ditches, can provide information about the local channel characteristics in two ways.\(^\text{11}\) Gravity-flow ditches, as their name implies, rely on the slope of the land to transport water from the source (a river or spring) to the fields that need irrigation. Hence, if the intake of a given acequia, that has the river as its source, is located immediately upstream of the fields for which it supplies water, it can be inferred that the channel is not entrenched (Huckleberry, 1996). In addition, the upstream movement of acequia intakes (also called "ditch heads") over time implies that changes have occurred in the slope of the channel, probably due to arroyo initiation and deepening.

The locations of ditch heads discerned from the historical maps and oral histories for the Redington area are listed in Table 3 and plotted on Plate 1.

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\(^{11}\) Jack Smallhouse, grand-nephew of C.H. Bayless, brought it to the attention of the authors that comparing the location of acequia intakes over time could help to determine possible changes in the depth of the channel (Smallhouse, 1997, oral commun.). He contributed a number of historical maps to this project that were not found in any other private or public map collection. He also contributed several oral histories passed on to him by his neighbors and family members. Much of the information presented in this section would have been unknown, but for Smallhouse’s generosity with his time and family records.
### Table 3. Historical locations of ditch heads along the Redington reach.

<table>
<thead>
<tr>
<th>NAME OF DITCH</th>
<th>DITCH-HEAD LOCATION</th>
<th>YEAR</th>
<th>SOURCE OF INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bayless Ditch:</td>
<td>T.12S. R.19E. Sec. 19 BBB</td>
<td>1879</td>
<td>GLO Survey</td>
</tr>
<tr>
<td></td>
<td>T.12S. R.19E. Sec. 19 BAD</td>
<td>1907</td>
<td>Bayless &amp; Berk. Map</td>
</tr>
<tr>
<td></td>
<td>T.12S. R.19E. Sec. 19 BAD</td>
<td>Before 1926</td>
<td>RR-East Map</td>
</tr>
<tr>
<td>Los Angeles Ditch:</td>
<td>T.12S. R.19E. Sec. 30 ABA</td>
<td>1907</td>
<td>Bayless &amp; Berk. Map</td>
</tr>
<tr>
<td>Markham Ditch:</td>
<td>T.11S. R.18E. Sec. 26 CBD</td>
<td>1902</td>
<td>Desert Land Entry Map</td>
</tr>
<tr>
<td></td>
<td>T.11S. R.18E. Sec. 27 DDA</td>
<td>1907</td>
<td>Bayless &amp; Berk. Map</td>
</tr>
<tr>
<td>Bollen Ditch:</td>
<td>T.11S. R.18E. Sec. 23 BAB/BBA</td>
<td>1879</td>
<td>GLO Survey</td>
</tr>
<tr>
<td></td>
<td>T.11S. R.18E. Sec. 14 CCA</td>
<td>1902</td>
<td>Desert Land Entry Map</td>
</tr>
<tr>
<td></td>
<td>T.11S. R.18E. Sec. 23 BBA</td>
<td>1907</td>
<td>Bayless &amp; Berk. Map</td>
</tr>
<tr>
<td></td>
<td>T.11S. R.18E. Sec. 23 CD</td>
<td>After 1926</td>
<td>Smallhouse (1997, oral c.)</td>
</tr>
<tr>
<td>Unnamed Ditch - 1:</td>
<td>T.12S. R.18E. Sec. 11 ABA</td>
<td>1879</td>
<td>GLO Survey</td>
</tr>
<tr>
<td></td>
<td>T.12S. R.18E. Sec. 2 DCC</td>
<td>Before 1926</td>
<td>RR-East Map</td>
</tr>
<tr>
<td>Unnamed Ditch - 2:</td>
<td>T.12S. R.18E. Sec. 2 BBC</td>
<td>1879</td>
<td>GLO Survey</td>
</tr>
</tbody>
</table>

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12 Several of the historical maps used different names for the same ditches. The names listed above were the most commonly used for each of the different ditches.

13 Refer to Appendix A for a description of the system of land subdivision used to describe the location of the ditch heads.

14 Several of the historical maps listed in Table 2 showed the location of ditches. However, only the ditch heads located on large-scale maps with reliable surveys were listed above and plotted on Plate 1.

15 The modern intake for the Bayless Ditch is located about one mile upstream of the historic intakes, south of the reach shown on this map (Smallhouse, 1997, oral commun.).

16 The Bollen ditch had its intake at approximately this location until it was abandoned during the 1940’s, when an irrigation well was drilled.

17 The intake for this ditch was not located near the river. It may have had a spring as a source.
The 1879 survey map showed that the intake for the Bayless Ditch was located near the fields that it irrigated, implying that the channel was not entrenched in that segment of the Redington reach. The locations of the other acequias (Bollen Ditch, and two unnamed ditches) were either not as near the fields they irrigated, or were noted in areas that had no field delineated on the maps. However, Cooke and Reeves (1976) noted that it is unlikely that ditches would have been constructed where the main river was entrenched.

The records of ditch-head movement for the Bollen and Bayless ditches are the most useful for inferring channel changes because they bracket the entire period of interest: before and after the 1880-90’s floods; and, before and after the 1926 flood. The intake location for the Bollen ditch remained almost unchanged between 1879 and 1907. However, it shifted almost a mile upstream after the 1926 flood event.

In contrast, the 1907 and Before-1926 intakes of the Bayless Ditch were located more than a half of a mile upstream of the 1879 intake. However, the contrast between the pre-1926 flood intake locations and post-1926 flood intake location is even more dramatic. The modern location of the Bayless Ditch intake is almost a mile upstream of the 1907 intake location.

The segments of the Bayless and Los Angeles ditches located at the Redington Narrows provided another type of information about the rate of channel entrenchment in that reach. The canal for the Los Angeles Ditch, located on the western bank of the channel, was carved through the cemented conglomerate that forms the constriction known as the Redington Narrows before the flood of 1926, and was later reinforced with cement during the 1940’s (Smallhouse, 1997, oral commun.). The U.S. Geological Survey’s Twenty-First Annual Report (1901) indicated the presence of the Los Angeles Ditch as early as 1899, and the Bayless and Berkalew Company map showed the location of its intake in 1907 upstream of the Redington Narrows. Photograph #1 in Appendix B shows the canal as a horizontal line of white cement perpendicular to the gaging station. The photograph also shows a grass-covered surface to the right of the cemented conglomerate

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18 The geographical feature known as the Redington Narrows is not labeled on Plate 1. However, it can be easily identified by the constriction of the river channel approximately 1500 feet east of the Cochise-Pima County line; also, it coincides with the location of the Redington gage, labeled “Gaging Station” on the base map.
that is even with the canal, indicating that this surface existed prior to the pre-1926. The canal and pre-1926 surface are 17 feet above the surface of the modern-day channel floor.

Photograph #2 shows a tunnel that was dug in 1927 for the Bayless Ditch through the cemented conglomerate of the eastern bank of the Redington Narrows. To the left of the tunnel is the modern canal on the floor of the present-day channel, about two feet lower than the base of the 1927 tunnel. The difference in elevation between the pre-1926 Los Angeles Ditch and the 1927 Bayless Ditch indicate a vertical change in the channel bottom of about 15 feet, probably as a result of the 1926 flood event. The two-foot difference between the bases of the 1927 and 1997 canals indicate that very little net vertical change has occurred in this segment of the channel during the last seventy years.

Oral Histories

Cayetano Ronquillo told Jack Smallhouse that he and his family crossed the San Pedro River in several locations using simple foot bridges before the 1926 flood event, and that the 1926 event changed the course of the river and incised it (Smallhouse, 1997, oral commun.). He showed Jack Smallhouse where they used a cable foot bridge tied from a tree. Photograph #4 in Appendix B, taken in June of 1997, shows the remains of the cable still tied to a tree at the edge of an abandoned channel. Though the channel is barely noticeable in this photograph, it was discernible in the field as a very gentle dip in the ground to the west of the current location of the present-day channel (T.12S. R.18E. Sec.3, “Photo 4” on Plate 1). Ronquillo showed Smallhouse a second place where there had been a foot bridge across a narrow channel, in T.12S. R.18E. Sec. 27.

Barbara Clark, of the Cascabel area, recounted histories of the area told to her by long-time residents such as Carey Smith and Emma Bennett. According to Smith and Bennett, the 1926 flood caused the entrenchment of the channel in the Cascabel area. Clark also was able to indicate in the field the location of an abandoned channel that she believed to be a former channel of the San Pedro River, although she did not know when it had been abandoned. The abandoned reach that she indicated closely resembled the abandoned channels present in the Redington area in width and depth.

19 Cascabel is located upstream (south) of the Redington reach, between The Narrows and the Redington Narrows.
Conrad Gamez, who was born in 1928 in the Cascabel area, noted that there have not been any large floods in the Cascabel/Redington area for a long time, and therefore the sand was building up in the channel bed (Gamez, oral commun., 1997).

**Historical Photographs**

The Arizona Historical Society’s archives contained several photographs taken in 1903 along the San Pedro River during one of Bayless and Berkalew Company’s cattle drives. The photograph entitled, “A round-up in old Arizona, taken on the Bayless and Berkalew Ranch, San Pedro River, fall of 1903” [AHS #21329], gave the best view of the river. Refer to Photograph #5 in Appendix B to see a copy of the original 1903 photograph, and Photograph #6 to see the same view in June of 1997.

The 1903 photograph showed a very narrow, shallow channel with flow. The floodplain immediately adjacent to it was very flat with little vegetation (perhaps because of the cattle, perhaps because of recent flood events). There were no signs of steep arroyo walls in this photograph. However, steep channel banks were not discernible in the 1997 photograph, either, not because there were no steep banks, but because the photographer was standing on one bank to take the picture, and the other bank was hidden from site by the vegetation in the distance and by the angle of the view.

**Previously-Published Accounts**

Charles H. Bayless’ account (cited in Griffiths’ 1901 publication) claimed that by 1900, the valley was a “sandy waste from bluff to bluff” and a channel varying in depth from 3 to 20 feet was cut almost the whole length of the river. He also noted that it was more difficult to get irrigating water onto the surface of the land. Because he managed ranches near Redington, it probably would be sensible to infer that he had particular experience with channel change along the Redington reach of the river.

The U.S. Geological Survey’s Twenty-First Annual Report was the first published account to note the presence of a sandy channel bed and intermittent reaches:

“The period of greatest precipitation is in the months of July and August, when floods of considerable size come down San Pedro River. During the rest of the year the stream is small, winding back and forth in its sandy bed... In the lower portions of its course the river is in places dry, owing to the diversions made by a large number of small canals” (USGS, 1901, p.352)
However, no mention was made in this report of the presence of entrenched reaches or of which reaches were dry.

Cooke and Reeves (1976) cited Melton (1965) and Jones (1968) when they noted that marked downcutting north of The Narrows appeared to have occurred in two periods: prior to 1895, when a continuous sand-bed was formed; and, 1926-27, when major floods resulted in notable incision. Entrenchment was reported to have happened as late as 1926-27 between The Narrows and Hot Springs Canyon near Cascabel (Melton, 1965, oral communication with a rancher, Charles Gillespie, as cited in Cooke and Reeves, 1976).

Discussion

The historical photographs and maps, and the accounts by the U.S. Geological Survey, Bayless, and Cooke and Reeves, all indicated that a wide channel with a sandy bed had been established along the Redington reach, and, indeed, along most - if not all - of the San Pedro River in the late 1800's to early 1900's. However, the different types of evidence imply a more complicated history of channel entrenchment along the Redington and Cascabel reaches of the San Pedro River.

Bayless' account indicated that the entire San Pedro River became entrenched prior to 1900. An alternate scenario would be one in which only particular segments of the reach became notably incised. Oral histories and previously published accounts indicated that the channel in the Cascabel area did not become entrenched until 1926. The analysis of the movement of the Bollen Ditch intakes indicated that that segment of the Redington reach did not become incised until the 1926 flood event, or, if it became incised prior to 1926, the entrenchment was not deep enough to affect the location of the intakes. The analysis of the Bayless Ditch intakes at the Redington Narrows indicated that that segment of the Redington Reach probably did become incised somewhat prior to the 1926 flood event. However, comparison of (1) the elevations of the pre-1926 Los Angeles Ditch and the 1927 Bayless Ditch, and (2) the pre- and post-1926 locations of the Bayless Ditch intakes, indicates that even more dramatic incision resulted from the 1926 flood event.

The oral histories that described the use of foot bridges over a narrow San Pedro River prior to the 1926 flood event, the abandoned channels near Redington, and the photograph of the 1903 channel provided inconclusive, or even contradictory, information about channel entrenchment. They seemed to imply that the channel prior to the 1926 flood event was still very narrow. However, the historical maps and several other accounts
indicated that the channel was very wide and had a sandy base. Perhaps the accounts of the narrow channel were describing an active channel defined by the low-discharge perennial flow. Such an active channel may have been inset into a wide, sandy channel bottom that may or may not have had arroyo walls.

Channel Entrenchment in the Mammoth/Dudleyville Reach of the San Pedro River

There was much less information available for the Mammoth/Dudleyville reach of the lower San Pedro River than for the Redington reach. However, the evidence available describes a more straightforward history of widening and entrenchment.

John L. Harris' 1877 cadastral survey of the Mammoth and Dudleyville areas indicated several acequias (gravity-flow ditches) along the channel, implying non-entrenchment. [Refer to Plate 2 and Plate 3 for the locations of the ditch heads.] Cooke and Reeves (1976) noted that it is unlikely that ditches would have been constructed where the main river was entrenched. Ditches located away from the main channel probably indicated other sources of water, such as springs. Unfortunately, there was no other historical information available that described the location of ditch intakes at the turn of the century.\(^{20,21}\)

Hereford and Betancourt (in press) noted that, although there were several large floods in 1886 and 1887, the first mention of extensive channel widening and channel entrenchment were described in newspaper accounts of the damage resulting from the flood events of August and September 1890:

\(^{20}\) Every attempt was made to locate State Water Commission maps for the Mammoth and Dudleyville areas, and to locate water rights information that may have described the location of ditches, but to no avail. Appendix C provides the names of various agencies and mining companies that may have information archived, but the researcher who pursues such avenues must be willing to spend weeks or months tracking down the right contacts and exploring long-ago-filed archives.

\(^{21}\) Ralph Garcia and John Smith, long-time residents of the Dudleyville area, remembered that there had been several ditches along the river that had been in use until the 1940's, when irrigation wells with electric pumps replaced the ditches as sources of irrigation water. Huckle's 1991 publication that described the life of Jo Curtis Flieger confirmed Garcia and Smith's memories. Jo Curtis and Gussie Flieger bought the farm located at Cook's Lake in 1940. Not long after, Jo Curtis Flieger became annoyed by the amount of effort required by the ditch that brought irrigation water from the river, drilled a well, and used a pump to get water onto his fields (as told to Huckle, 1991). Unfortunately, field checks in June of 1997 indicated that most of the ditches had been eroded by bank collapse along the main channel; hence, intake locations were not discernible.
"At Riverside, the road is fordable for the first time in two weeks, but raining again on the San Pedro. If the San Pedro continues to rise the next thing we'll see is Dudleyville floating down the Gila. Has caved within 15 ft of Cook's place. He piled brush to divert, but now it has washed out. Mr. Bates house in danger, several of his outhouses gone. The Riverside-Globe road impassable for two weeks; is being rebuilt on Kane Springs Canyon stretch." (Arizona Daily Star, September 6, 1890, as cited in Hereford and Betancourt, in press)

"Recent floods at Mammoth washed the soil out in places 30 ft deep along the river bottom. Exposed area at bottom brought out in many places evidence of ancient civilizations...." (Arizona Daily Star, October 2, 1890, as cited in Hereford and Betancourt, in press).

The 1911 Winkelman Topographic Quadrangle indicated that the entire length of the Mammoth/Dudleyville reach had been widened significantly between 1877 and 1911. The widening of newly-formed arroyos and the extension of headcuts continued until 1926 in the Mammoth and Dudleyville areas as a result of subsequent flood events. (Refer to the chronological listing of newspaper accounts in the next section.) However, the 1926 flood event seemed to produce the most dramatic channel changes since the floods of 1890, as evidenced by this account:

"Every highway and railroad bridge on the San Pedro River from the International boundary line to where it flows into the Gila River below Mammoth were either destroyed or rendered useless last Monday evening and Tuesday morning when the San Pedro River, swollen by a three day rain, went on the most destructive rampage in its entire history... Mammoth highway bridge totally destroyed." (Tombstone Weekly Epitaph, September 30, 1926, as cited in Hereford and Betancourt, in press)

In addition, large parts of the Clark Ranch (~2 miles south of Mammoth) were removed by channel-bank erosion caused by the 1926 flood flow (Charles Clark Sr., 1997, oral commun. via Charles Clark Jr.). Landholders reported that some of their diversion canals were abandoned after the 1926 flood event because the river had incised well below the intake level (Jones, 1968).

Hereford and Betancourt (in press) and Charles Clark Jr. (1997, oral commun.) noted that the channel downstream of Mammoth has been aggrading in recent years. However, large flood events have continued to cause the widening of the steep-walled channel in many locations. For example, Ralph Garcia (1997, oral commun.) reported that the 1993 flood event resulted in dramatic undercutting of the arroyo walls in T.6S. R.16E. Sections 8 and 17, and, indeed, Plate 3 shows that the 1995 active channel extends well beyond the 1934 channel in these areas. This indicates that, although no modern flow
event had exceeded the magnitude of the 1926 flood event (refer to Figure 2), and the 1995 active channel was more narrow than the 1934 channel, widening of the arroyo had occurred since 1926.

LOWER SAN PEDRO RIVER CHRONOLOGIES

The data collected from the published and unpublished references, historical maps, and oral histories were synthesized into two chronologies. The first chronology describes the historical streamflow and channel characteristics of the Redington reach, and the second chronology describes the reach between Mammoth and the Gila-San Pedro confluence. The chronologies have three components: the date of the description; the description itself; and the source of the descriptive information.

When possible, the exact year, month, and day were provided in the “Date” column of the chronology. Often an exact year was not provided in the oral histories. In such cases, the approximate date provided by the interviewee is annotated with a tilde (“~”) symbol. In addition, some of the historical maps were not dated at all. However, information from undated maps was included in the chronological listing if the date of the map could be constrained to a particular range of years.

For the sake of clarity and brevity, much of the information gathered from published sources is presented in the “Description” column as direct quotes. The source of the information is provided in parentheses following the description.

Redington Reach:

Date: Description (Source):

1879 John L. Harris performed the first cadastral survey of the Redington area in 1879. Based on Harris’ survey notes, the channel had a mean width of 35 feet in T.11S. R.18E., and 26 feet in T.12S. R.18E. (Huckleberry, 1996). His survey plat maps showed acequias, or gravity-fed irrigation ditches, in T.11S. R.18E. and T.12S. R.18E., implying nonentrenchment of the river channel in those areas. [Refer to Plate 1 for the location of the ditch heads.] Harris’ observations of flow in the channel, and the presence of cottonwoods and irrigation ditches, indicate intermittent to perennial flow in this reach (Fonseca, unpublished manuscript).

~1884-88 “About twelve years ago the San Pedro Valley consisted of a narrow strip of subirrigated and very fertile lands. Beaver dams checked the flow of
water and prevented the cutting of a channel. Trappers exterminated the beavers, and less grass on the hillsides permitted greater erosion, so that within four or five years a channel varying in depth from 3 to 20 feet was cut almost the whole length of the river. Every year freshets are carrying away new portions of the bottom lands. At present this valley is a sandy waste from bluff to bluff, while the few fields remaining are protected from the river at large and continuous expense. Thus, in addition to curtailing the area of good land, the deep channel has drained the bottoms, leaving the native grass no chance to recover from the effects of close pasturing. It also makes it more difficult to get irrigating water onto the surface of the land.” (C.H. Bayless, as cited in Griffith, 1901)

~1890 “My mother told me that the river was narrow when they first came to Redington. They used just a little board to cross the river. My father had his fields there; everything was cultivated - even the sides of the hills - all the way from Benson to Winkelman. But the river got wider and wider, and it swept away my father’s fields and the house we lived in. Can you imagine - they told me that Winkelman is on the banks of the river now!” (Paulina Moreno Montoya, b. 1905, as cited in Martin, 1992)

1883-92 “The trench on the San Pedro River was cut progressively headward between the years 1883, when the arroyo first formed at the mouth of the river, and 1892, when the head water fall cut through the boundaries of the Boquillas Grant 125 miles upstream.” (Bryan, K., 1925, p. 342)

1899 “The period of greatest precipitation is in the months of July and August, when floods of considerable size come down San Pedro River. During the rest of the year the stream is small, winding back and forth in its sandy bed... In the lower portions of its course the river is in places dry, owing to the diversions made by a large number of small canals” (USGS, 1901, p.352). [No mention was made in this report of the presence of entrenchment or of which reaches were dry.]

1903 A ground photograph taken along the river during a Bayless and Berkalew cattle drive shows a very narrow, shallow channel with flow. The floodplain immediately adjacent to it is very flat with little vegetation. There

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22 The date of this entry is a very uncertain estimate. Paulina Moreno Montoya was born in Redington in 1905 and was the seventh of eight children. Her mother, Vicente Soto de Moreno, came to the Tanque Verde area near Tucson from Mexico when she was nine years old because of a war (probably the war against French occupation, according to Martin (1992)). Vicente Soto de Moreno’s date of birth was not mentioned in Martin (1992).

23 Cooke and Reeves (1976) claim that the assertions about the timing of arroyo cutting made in Bryan’s often-quoted 1925 paper are almost wholly incorrect. Refer to the fourth section of this report for a more detailed discussion.

24 “A round-up in old Arizona, taken on the Bayless and Berkalew Ranch, San Pedro River, fall of 1903.” Arizona Historical Society Photograph #21329; refer to Photograph #5 in Appendix B to see a copy of the original 1903 photograph, and Photograph #6 to see the same view in June of 1997.
is no sign of any steep arroyo walls in this photograph.

1907

The 1907 map of the Bayless and Berkalew property indicated that the San Pedro River channel had a mean width of approximately 400 feet in T.11S. R.18E., and 200 feet in T.12S. R.18E. However, the channel was as narrow as 150 feet at the R.18E./R.19E. range line in T.12S., and as wide as 900 feet at the T.11S./T.12.S township line in R.18E. This maps also showed acequias in T.11S. R.18E. and T.12S. R.18E., implying nonentrenchment of the river channel [Refer to Plate 1 and the fourth section of this report for a more detailed review of this map and the significance of the acequias.]

~1925

Cayetano Ronquillo showed Jack Small house many years ago where he and his family crossed the San Pedro River near Redington using a cable foot bridge tied from a tree, before the river changed its course and became entrenched. In June of 1997, Smallhouse showed one of the authors of this report the remains of the cable still tied to a tree at the edge of an abandoned channel. The channel was subtle, but discernible as a very gentle dip in the ground to the west of the current location of the present-day channel (T.12S. R.18E. Sec.3, “Photo 4” on Plate 1). Refer to Photograph #4 in Appendix B. Ronquillo showed Small house a second place where there had been a foot bridge across a narrow channel, located in T.12S. R.18E. Sec. 27.

1926

The September 28, 1926, flood event resulted in deep entrenchment of the San Pedro River channel in the Redington and Cascabel areas (based on oral histories gathered by J. Smallhouse and B. Clark from local residents such as Cayetano Ronquillo, Carey Smith, and Emma Bennett). [Refer to the fifth section of this report for a more detailed description of the entrenchment history of the lower San Pedro River.]

~1926-27

“Entrenchment is reported to have been initiated north of Benson - between The Narrows and Hot Springs Canyon <near Cascabel, south of Redington> - as late as 1926-7 [Melton, 1965, quoting an oral communication with a rancher, Charles Gillespie].” (Cooke and Reeves, 1976, p.45)

1934

The Soil Conservation Service performed the first systematic aerial photography of the lower San Pedro River Valley in 1934. "The photography reveals a shallow, braided channel within an incised floodplain. The channel is dramatically wider than in the 19th century..., especially downstream from Redington... Because of the wider, entrenched reach below Redington, changes in channel position through time are greater along this segment than any other part of the river." (Huckleberry, 1996, p.15.) Huckleberry (1996) determined that the channel had a mean width of 837 feet in T.11S. R.18E., and 236 feet in T.12S. R.18E.
Plate 1 shows how a one-and-a-half-mile reach of the river in T.12S. R.18E. had shifted to about 1300 feet west of its 1907 location. The abandoned 1907 channel was distinctly visible in the 1934 photographs but not in the 1995 photographs. According to J. Smallhouse (1997, oral commun.), this abandoned segment of the 1907 channel was in the same location as the main channel prior to the 1926 flood event. When he was a boy during the 1940's, flows came into this abandoned channel on a regular basis because the main channel had not been so deeply incised as to prevent the flow of water into it. Since the main channel has become more deeply incised, the abandoned channel has acted as a secondary flow channel during large flood events such as the floods of 1977, 1983, and 1993. At the time of the 1997 field visit, this abandoned channel was about 30 feet wide and had gently sloping banks with a depth of about two feet. Smallhouse noted that it was deeper in 1997 than it had been in his youth because several flood flows have passed down it since then, and it has been used as an alternate farm road.

Conrad Gamez was born in 1928 and raised on a farm in Cascabel about 500 yards east of the San Pedro River. He remembered that, when he was about five or six years old, the water in the river was “about knee high, depending on the weather,” and that the river flowed year-round in some reaches. In other reaches, the water went subsurface. He remembered that where the river was narrow, there were very steep banks, but where the river was wide, the channel depth was more shallow. Neighbors would work together to make dikes from sand and brush to divert river water into canals to irrigate their fields next to the river. During the monsoon rains, the river water would overflow to the adjacent fields. Gamez did not remember seeing any canoes or rafts on the river, but then, “nobody had time for much recreation – times were rough.” He did not remember seeing any fish in the river.

The 1983 flood event destroyed the six-inch well located in the lower part of the Redington Narrows (J. Smallhouse, 1997, oral commun.).

Channel width, as seen in the 1995 aerial photographs, had changed very little upstream of Redington (T.12S. R.18E.) since 1934. [Refer to Plate 1.] However, the channel located downstream of Redington (T.11S. R.18E.) had widened dramatically since 1934. Several of the reaches had widths in excess of 1200 feet (e.g., in Sections 10, 11, 15, 26, and 34).
Mammoth to the Gila-San Pedro Confluence:

**Date:** 1870-73  
**Description (Source):** John J. Bourke, who served at Camp Grant from 1870 to 1873, described Camp Grant as being located at "the junction of the sand-bed of the Aravaypa [sic] with the sand-bed of the San Pedro, which complacently figured on the topographical charts of the time as creek and river respectively, but generally were dry as a lime-burner's lot excepting during the 'rainy season.'" (Bourke, 1891, as cited in "History of the San Pedro River" chapter of the 1993 Arizona Stream Navigability Study for the San Pedro River)

1877  
John L. Harris performed the first cadastral survey of the Mammoth and Dudleyville areas in 1877. His survey plat maps showed several acequias, or irrigation ditches, along the channel between Mammoth and Dudleyville. [Refer to Plates 2 and 3 for the location of the ditch heads.] Based on Harris' survey notes, the channel had a mean width of 35 feet in T.5S. R.15E., 36 feet in T.6S. R.16E., 38 feet in T.7S. R.16E., 35 feet in T.8S. R.16E., and 40 feet in T.8S. R.17E. (Huckleberry, 1996).

1886 Aug. 14  
"Reports from Dudleyville say an avalanche of water swept down the river Saturday (8/7) like a wave, 6 ft high.... People in Florence Sunday saw tailings from Mammoth mill floating in canal. Brought by freshet that passed Mammoth Friday." (Arizona Weekly Enterprise, as cited in Hereford and Betancourt, in press)

1886  
"Inconclusive evidence suggests that channeling took place upstream at Mammoth... in 1886." (Hastings, 1959, p.64)

1887 Aug. 15  
"From Mammoth dated August 15: Glorious rains last week and the San Pedro is on the rampage. The cattle are all smiles." (Arizona Weekly Enterprise, August 20, 1887, as cited in Hereford and Betancourt, in press)

1887 Sept. 14  
"A letter from Mammoth dated September 14: Our San Pedro has been on the rampage, with higher water than has ever been known before. Families living near the river in Neal's corral were forced to evacuate." (Arizona Weekly Enterprise, September 17, 1887, as cited in Hereford and Betancourt, in press)

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The book Arizona Place Names (Barnes, 1935), newspaper accounts, and historical survey maps indicated that Dudleyville was located about one mile south of the Gila River on the west bank of the San Pedro River in T. 5 S. R. 15 W. Sec. 25. Dudleyville was established by the family of Dudley Harrington in 1879, and a U.S. post office was established May 8, 1881 (Barnes, 1935). Between ~1949 and 1972, according to the USGS topographic maps of those dates, what is currently referred to as Dudleyville began to develop along the eastern side of the San Pedro river about five miles south of the Gila River. Field checks conducted in June of 1997 found few remains of the historic Dudleyville.
1890
Aug. 14
"Of the country down the San Pedro, from Tres Alamos to the Gila [Captain Van Alstine] . . . says, "all of it is gone, destroyed, torn up, 'vamosed' down with high water." He never saw such a destruction in all his life . . . The San Pedro never was as high as it was this time, and will not probably be for the next ten years. The losses sustained by the people will reach into the thousands." (Arizona Daily Star, as cited in Hastings and Turner, 1965, p.42)

1890
Aug. 15
"The river is still overflowing its banks, doing a great deal of damage. The ground about Mammoth has been flooded and many Mexicans have been compelled to vacate their houses. The river carried off a large stack of hay from Mr. John Brown's ranch, taking some fence also, and at Mr. Sellick's part of his orchard, including about 150 fruit trees, as well as part of his hay field. His house is also in danger and his family has vacated it. Mr. George Scott has had a large portion of his ranch washed away, and across the river from him the outbuildings of Theo. Gates have been taken down by the stream. The road is utterly impassable from Mammoth to Riverside, it being washed out, and in many places in holes ten ft deep." (Arizona Daily Star, as cited in Hereford and Betancourt, in press).

1890
Aug. 30
"At Dudleyville damage to the Swingle and Young Ditch is $300. George Cook has been trying to save Dudleyville by building dykes; but last flood washed away the dyke, leaving his house and store in had shape..." (Arizona Daily Star, as cited in Hereford and Betancourt, in press)

1890
Sept. 6
"At Riverside, the road is fordable for the first time in two weeks, but raining again on the San Pedro. If the San Pedro continues to rise the next thing we'll see is Dudleyville floating down the Gila. Has caved within 15 ft of Cook's place. He piled brush to divert, but now it has washed out. Mr. Bates house in danger, several of his outhouses gone. The Riverside-Globe road impassable for two weeks; is being rebuilt on Kane Springs Canyon stretch." (Arizona Daily Star, as cited in Hereford and Betancourt, in press)

1890
Oct. 2
"Recent floods at Mammoth washed the soil out in places 30 ft deep along the river bottom. Exposed area at bottom brought out in many places evidence of ancient civilizations...." (Arizona Daily Star, as cited in Hereford and Betancourt, in press)

1891
Mar. 5
"Captain Johnson, manager of the Mammoth gold mine, who is now in the city, says that the San Pedro was higher during the recent flood than the highest water mark [flood of February 23]." (Arizona Weekly Star, as cited in Hereford and Betancourt, in press)
Twenty canals that diverted water from the San Pedro River in the Mammoth and Dudleyville reaches were mapped by the USGS in 1899\(^{26}\) (USGS, 1901). "The period of greatest precipitation is in the months of July and August, when floods of considerable size come down San Pedro River. During the rest of the year the stream is small, winding back and forth in its sandy bed... In the lower portions of its course the river is in places dry, owing to the diversions made by a large number of small canals" (USGS, 1901, p.352). [No mention was made in this report of the presence of entrenchment or of which reaches were dry.]

"W.H. Clinton, who carries the mail from Riverside to Benson got through last Friday (8/2) for the first time since the floods commenced. He reports great destruction of property on the lower San Pedro between Mammoth and Riverside. He says at the ranches in the river bottoms have been injured more or less and Youtseys ranch is entirely destroyed, about half of Robles' ranch is gone and on Whetlock's ranch the river changed its channel, now being on the opposite side of the river where it used to be." (Florence Tribune, as cited in Hereford and Betancourt, in press)

"At Dudleyville the river bed became over a mile wide. Several times the store had to be moved to new and higher quarters because the building was removed by floods." (Arizona Blade and Florence Tribune, as cited in Hereford and Betancourt, in press)

"The high water in the San Pedro last week did considerable damage to the agricultural lands bordering the stream. A watermelon patch on Judge George Scott's farm at Dudleyville was entirely washed away. The river has been enroaching on his land since 1901..." (Arizona Blade and Florence Tribune, as cited in Hereford and Betancourt, in press)

"Greatest floods and rains since 1891 last week. P & E RR badly washed out between Florence and Winkelman. Parties coming in from the Dudleyville and Riverside country report greater damage to the farms along the Gila and lower San Pedro from the recent floods than was wrought by the great flood of 1891. The Cook, Sellick, Scott and Cunningham farms located on the east side of the San Pedro, near Dudleyville, suffered great damage, and it is reported that nearly every acre of Robert Branaman's farm on the south side of the Gila was washed away, also his dwelling house and stables." (Arizona Blade and Florence Tribune, as cited in Hereford and Betancourt, in press)

Based on the U.S. Geological Survey's 1911 Winkelman Quadrangle, the San Pedro River channel had a width of ~1700 feet at its confluence with the Gila River, ~700 feet in T.5S. R.15E., ~850 feet in T.6S. R.16E. (with a dramatically wide reach of 2300 feet in Section 26), ~800 feet in T.7S. R.16E., and ~600 feet in T.8S. R.16E. and T.8S. R.17E. (Refer to Plate 2

\(^{26}\) The names, locations, and significance of the canals are provided in the fifth section of this report that describes vertical channel changes.
"Every highway and railroad bridge on the San Pedro River from the International boundary line to where it flows into the Gila River below Mammoth were either destroyed or rendered useless last Monday evening and Tuesday morning when the San Pedro River, swollen by a three day rain, went on the most destructive rampage in its entire history... Mammoth highway bridge totally destroyed." (Tombstone Weekly Epitaph, as cited in Hereford and Betancourt, in press)

Large parts of the Clark Ranch (~2 miles south of Mammoth) were removed by channel-bank erosion caused by the 1926 flood flow (Charles Clark Sr., 1997, oral commun. via Charles Clark Jr.).

Landholders reported that some of their diversion canals were abandoned after the 1926 flood event because the river had incised well below the intake level (Jones, 1968).

Charles Clark Sr. (born in 1920) remembered that the San Pedro River ~2 miles south of Mammoth had continuous flow until he was ten years old. He also remembered seeing "sucker" fish (which he also called "trash" fish), catfish, and beaver in the river until ~1930 (Charles Clark Sr., 1997, oral commun. via Charles Clark Sr.).


Between about 1943 and 1945, Houston Evans and his family lived on the Teag Ranch located next to the San Pedro River near Dudleyville. He remembered that at that time the river had clear water, ~2-3 feet deep, flowing year-round. He remembered that there were fish in the river, but they were too small to eat. He also remembered that there were raccoons and turtles in the river area. Evans never saw beaver along the San Pedro River, but he did find beaver ponds in the upper reaches of Aravaipa Creek. Evans and his childhood friends spent several of their weekends canoeing, fishing, and camping along the San Pedro River between Mammoth and Dudleyville. They would canoe on the San Pedro River from Mammoth to a lake located in the middle of the river, downstream of the Aravaipa confluence, where they had a raft. They would then spend the rest of their weekend fishing on the lake and camping. There were water

27 The lake that Evans described was probably Cooks Lake, and is shown in Photograph #7 (Appendix B) and on Plate 3. The 1949 U.S. Geological Survey topographical quadrangle showed a small, open body of water labeled Cooks Lake located on the northern edge of a marshy area in T.6S. R.16E. Sec.33. The 1972 U.S. Geological Survey topographical quadrangle indicated a large marshy area but no open water. In June of 1997, there was open water. Refer to Photograph #7 in Appendix B.
turtles, perch, small-mouth bass, and catfish in the lake and in a few of the deeper water holes along the river.

1983

The 1983 flood flow filled the old channel in the area of the hard-rock crossing near the Aravaipa confluence (M. Spiess, 1997, oral commun.). “The 1983 flood swept the channel clean!” (J. Smith, 1997, oral commun.)

1993

The 1993 flood waters overflowed the banks of the San Pedro River and came through the main gate of Charles Clark Jr.’s house, which is located one foot above Mammoth’s Main Street (Charles Clark Jr., 1997, oral commun.). The 1993 flood flows also resulted in extensive channel bank erosion, especially along the western bank, of the San Pedro River’s steep cut-banks near Dudleyville (R. Garcia and J. Smith, 1997, oral commun.; refer to the third section of this report and Plate 3 for more detailed descriptions of the channel widening in this area).

1995

The San Pedro River’s 1995 active channel, between Mammoth and the Gila confluence, is more narrow and sinuous than the 1934 channel. Refer to Plate 2, Plate 3, and the third and fourth sections of this report for a more detailed description of the channel characteristics.
SUMMARY

This report summarized a new investigation of historical channel changes along the lower San Pedro River. Information was gathered from published and unpublished references, historical maps, aerial and ground photographs, and oral histories collected from long-time residents of the lower San Pedro River Valley. The majority of the information related to the Redington and Mammoth/Dudleyville reaches of the river. All available descriptions of these reaches were compiled into chronologies and evaluated with the goal of better defining the timing of channel widening and arroyo initiation. The oral histories collected from long-time residents also provided information about streamflow characteristics. Although the gathering of such information was not a goal of this investigation, accounts that may be relevant to the issue of stream navigability, such as Houston Evans’ account of canoeing on the San Pedro River below Mammoth during the 1940’s, were included in the chronologies.

The historical photographs and maps, and the accounts by the U.S. Geological Survey (1901), Bayless (as cited in Griffiths, 1901), and Cooke and Reeves (1976), all indicated that by 1912 a wide channel with a sandy bed had been established along the Redington and Mammoth/Dudleyville reaches of the lower San Pedro River, and along most - if not all - of the lower and upper San Pedro River. However, the different types of evidence described a more complicated history of channel entrenchment along the lower San Pedro River.

The hypothesis that the down-cutting of the San Pedro River north of The Narrows occurred in two periods (Cooke and Reeves, 1976; Melton, 1965; and Jones, 1968) seems the most likely. The newspaper articles, the analysis of the historical movement of the Bayless Ditch intake, and Bayless’ account indicated that, at the very least, several segments of the San Pedro River channel became entrenched as a result of the 1890’s flood events (e.g., at the Redington Narrows and near Mammoth and Dudleyville). In contrast, accounts of the Cascabel area, and the analysis of the historical movement of the Bollen Ditch intake, indicated that some channel segments did not become entrenched until the 1926 flood event (e.g., in the Cascabel area and downstream of the town of Redington).

Newspaper accounts of the Mammoth/Dudleyville area, and Bayless’ account, indicated that the widening of newly-formed arroyos and the extension of headcuts continued after the floods of the 1890’s as a result of subsequent flood events. However,
several lines of evidence indicated that incision as dramatic, if not more dramatic, resulted from the 1926 flood event. The comparison of the elevations of the pre-1926 Los Angeles Ditch and the 1927 Bayless Ditch, the comparison of the pre- and post-1926 locations of the Bayless Ditch intakes, the newspaper accounts and oral histories – all indicated that the 1926 flood event widened and/or incised any segment of the Redington and Mammoth/Dudleyville reaches that had not yet been notably entrenched.

Hereford and Betancourt (in press) noted that channel widening had probably slowed if not stopped along the lower San Pedro, and that reaches below Mammoth were presently aggrading (Hereford and Betancourt, in press). In general, their statement is true. However, the large flood events of 1977, 1979, 1983, and 1993 resulted in notable erosion of the arroyo walls in both the Redington/Cascabel and Mammoth/Dudleyville reaches of the lower San Pedro river (B. Clark, J. Smallhouse, R. Garcia, 1997, oral commun.; Plates 1, 2, and 3).
REFERENCES


Many of the location descriptions provided in this report are based on the U.S. Bureau of Land Management’s system of land subdivision. Under this system, the State is divided into four quadrants by the Gila and Salt River meridian and base line. The quadrants are designated by capital letters A, B, C, and D in a clockwise direction beginning in the northeast quarter. Because the entire San Pedro River falls within the “D” quadrant, the quadrant designation will not be included in location descriptions. The first number indicates the township, the second the range, and the third the section in which the place of interest is located. The letters A, B, C, and D after the section number indicate the location within the section. The first letter denotes a particular 160-acre tract, the second the 40-acre tract, and the third the 10-acre tract. The letters are assigned in a counterclockwise direction beginning in the northeast quarter. If the location of a place is known within the 10-acre tract, three capital letters are provided in the location description.

T.13S. R.14E. Sec.26 DCB
Quadrant D, Township 13 South, section 26, quarter section d, quarter section c, quarter section b.

(Adapted from Tadayon (1995), U.S. Geological Survey Water-Resources Investigations Report 95-4062.)
APPENDIX B

GROUND PHOTOGRAPHS

Refer to Plate 1 and Plate 3 for the photograph locations.

Photograph 1. View of the west bank of the Redington Narrows (June 1997). The Redington Gaging Station is located in the middle of the photograph. The Los Angeles Ditch is the white line of concrete perpendicular to the gage, and is 17 feet above the bottom of the channel.

Photograph 2. View of the east bank of the Redington Narrows (June 1997). The tunnel was carved through cemented conglomerate for the Bayless Ditch in 1927. The modern Bayless ditch is located to the left of the tunnel. The bottom of the modern channel is about two feet lower than the base of the tunnel.
Photograph 3. Upstream view of the channel north of the Redington Narrows.

Photograph 4. View of an abandoned channel of the San Pedro River near Redington. It is discernible as a slight dip. In the center of the photograph, barely visible in the shadows, is the remains of a cable foot bridge still tied to the tree to the left.
Photograph 5. "A round-up in old Arizona, taken on the Bayless and Berkalew Ranch, San Pedro River, fall of 1903." [AHS #21329]

Photograph 6. Same view as the historical photograph, taken in June 1997.
Photograph 7. View looking north at Cooks Lake.

Photograph 8. Downstream (northern) view of a perennial reach located near the PZ Ranch, about two miles downstream from the Aravaipa-San Pedro confluence.
Photograph 9. Close-up view of a more-densely-vegetated perennial reach located near Dudleyville.

Photograph 10. View of the perennial reach's end of flow, located about one mile downstream from the location of Photograph #9.