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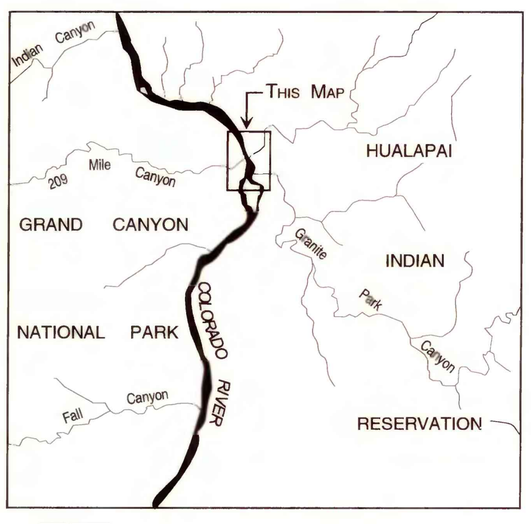
PREPARED IN COOPERATION
WITH U.S. BUREAU OF RECLAMATION,
GLEN CANYON ENVIRONMENTAL STUDIES

OPEN-FILE REPORT 96-298



Location of the map area, western Grand Canyon, Arizona

Compiled by Photogrammetry Section, Branch of Astrogeology, Flagstaff, Arizona
Base from aerial photography of 13 October 1992, approximate scale 1:4,800
Ground control by Glen Canyon Environmental Studies survey department
Water flow at approximately 226 m^3/s

SCALE 1:2,000
0 100 200 meters
CONTOUR INTERVAL 1 METER

NORTH

EXPLANATION

Drainage-basin perimeter

Nickpoint in catchment with sand deposits that may contain archeologic remains

River-based stream

Terrace-based stream

Description of Drainage Basin Characteristics

Approximately 10 archeologic sites in the Granite Park area (Fairley and others, 1994) are buried beneath pre-dam alluvial terraces located 5 to 17 m above the Colorado River. The sites are particularly susceptible to erosion in this area, because small tributary streams that drain the loosely consolidated sandy terraces have recently been rejuvenated in response to post-dam river conditions and rainfall (Hereford and others, 1993).

Before regulation of the Colorado River, small streams probably drained to a higher local temporary baselevel represented by the pre-dam terraces. Under pre-dam conditions, sand and silt deposited in the mouths of small tributary channels during annual floods would infill previously eroded headcuts, thus preventing them from migrating up-channel. Because regulated flows have lowered the level at which river sand-bars are deposited, small streams are regrading to a lower effective baselevel. With local intense rainfall as the driving force, channels are presently extending headward and widening, as they adjust to the new post-dam "baselevel" (Hereford and others, 1993).

Stream rejuvenation is indicated by nickpoints or places of local channel steepening; nickpoints are plotted on the map along with the perimeters of drainage basins. Nickpoints are shown only in areas that could contain archeologic remains buried in the substrate. The type of stream, basin area, channel length, and channel relief are listed in Table 1. This information should be useful in the preservation, remediation, or future monitoring of archeologic features.

Two types of streams drain alluvial terraces and adjacent debris fans and bedrock of the Colorado River. River-based streams drain to the river, while the mouths of terrace-based streams reach a late pre-dam level. River-based streams are indirectly affected by operation of Glen Canyon Dam and will continue to downcut until equilibrium with the post-dam flow regime is reached. This case is demonstrated in basin 9 (Table 1), where several nickpoints indicate active headward erosion. Terrace-based streams are currently somewhat stable; however, they will undergo the most rapid and catastrophic changes in the future as they attain a new, lower "baselevel" (Hereford and others, 1993). Terrace-based streams should be targeted for monitoring while archeologic sites are still buried and stabilization efforts would be cost-effective.

Runoff from local intense rainstorms can lead to further development of the upper reaches of small tributary channel systems. Channel entrenchment and headward erosion become accelerated when upper hillslope tributary systems integrate with gullies draining the lower Colorado River terraces. Examples of this type of stream integration are found in basins 1, 4, and 9. Because basins 1 and 4 have large catchment areas and long, steep channels (Table 1), they have the potential to downcut across the lower terraces and eventually reach the river. These two basins should be prioritized for erosion monitoring and channel remediation.

Catchments 3, 5, 6, 7, and 8 have the potential to further integrate into hillslope systems. Headward channel cutting in these catchments may soon lead to stream capture in nearby basins. The net result would be an expansion in basin area and channel length, thus accelerating bank erosion and channel incision. These basins could rapidly form networks similar to 1 and 4.

The least active of the channels is 2. The baselevel is still maintained at the pre-dam level and the basin is fairly isolated from nearby large basins. Also, its small catchment area, short channel length, and low gradient suggest stability in the short term (Table 1).

The nine basins should be monitored for exposure and erosion of archeologic sites. Stabilization efforts should be focused in long, steep, terrace-based streams with large catchment areas. Furthermore, the location of sites in the drainage network should determine the size and number of control structures for stabilization.

References

Fairley, H.C., Bungart, P.W., Coder, C.M., Huffman, Jim, Samples, T.L., and Balsom, J.R., 1994, The Grand Canyon river corridor survey project: archaeological survey along the Colorado River between Glen Canyon Dam and Separation Canyon: Report prepared for Grand Canyon National Park Service, Cooperative Agreement No. 9AA-40-07920, 276 p.

Hereford, Richard, Fairley, H.C., Thompson, K.S., and Balsom, J.R., 1993, Surficial geology, geomorphology, and erosion of archeologic sites along the Colorado River, eastern Grand Canyon, Grand Canyon National Park, Arizona: U.S. Geological Survey Open-File Report 93-517, 45 p., 4 plates.

Glossary

Alluvial terrace - a river-formed bench with a relatively level surface consisting of unconsolidated stream deposits of sand, clay, or gravel.

Baselevel - the level below which a stream cannot erode its bed.

Nickpoints - places of locally steep channel gradient indicating active stream erosion.

Regulated flows - discharge regimen of the Colorado River as controlled by Glen Canyon Dam releases.

Stream rejuvenation - the action of stimulating a stream to renewed erosive activity by baselevel lowering.

Stream capture - the natural diversion of the headwaters of a stream into the channel of another stream flowing at a lower level with greater erosional activity.

Table 1. Geomorphic characteristics of terrace- and river-based catchments that may contain archeologic remains

Area number	Drainage-basin area, m^2 (ac)	Main channel length, m (ft)	Main channel relief, m (ft)
Terrace-based streams			
1	26,445 (6.53)	250 (820)	25 (82)
2	430 (0.11)	50 (160)	4 (13)
4	31,000 (7.66)	330 (1080)	24 (79)
7	7,920 (1.96)	190 (620)	29 (95)
River-based streams			
3 [1]	4,180 (1.03)	155 (508)	9 (29)
5 [1]	320 (0.08)	20 (66)	1 (3)
6 [1]	455 (0.11)	30 (98)	2 (7)
8	3,755 (0.93)	110 (361)	33 (108)
9	11,730 (2.90)	360 (1,181)	32 (105)

[1] Considered river based since stream drains to a major Colorado River tributary

TOPOGRAPHIC MAP SHOWING DRAINAGE BASINS ASSOCIATED WITH PRE-DAM TERRACES IN THE GRANITE PARK AREA, GRAND CANYON, ARIZONA

by

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