Technical Study Summaries: Lower San Antonio River

Geomorphic Data

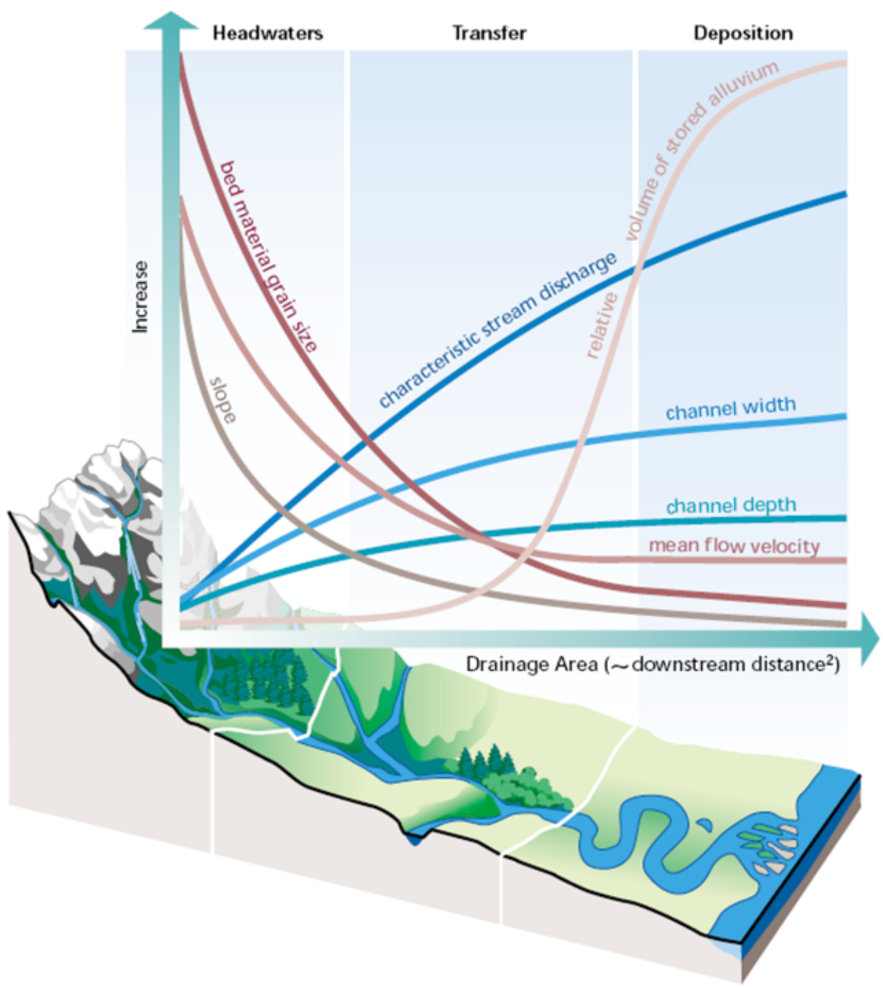
Active physical processes and characteristics are an important influence on the Lower San Antonio River system. Studies of these processes and characteristics (termed fluvial geomorphology) contribute to our understanding of the system and the flows required to maintain a sound ecological environment.

Stream corridor restoration: principles, processes, and practices (1998)
By Federal Interagency Stream Restoration Working Group

Interest in restoring stream ecosystems has driven recent advances in understanding the physical processes at work in healthy rivers and streams. It is now recognized that the relative importance of different physical processes varies along the length of a river. One particular instream flow recommendation is typically not sufficient to ensure the health of the entire length of a stream. Somewhat different flows may be required to ensure the health of different portions of the river.

As shown in the figure below, river basins can be divided into three general zones (headwaters, transfer, and deposition) based on dominant physical processes. Physical characteristics (such as channel slope, width and depth; bed material; and average discharge and velocity) vary from the upper watershed area to the mouth of a river. For most rivers, variable conditions such as climate and underlying geology interact to create a more complex situation than the idealized pattern of Figure 1.

Full report: http://www.nrcs.usda.gov/technical/stream_restoration



Headwaters Zone: Main source of water and sediment for a river system. Water and sediment are generally moving from the watershed to the channel.

Transfer Zone: Principle region of sediment transport in a river system. Channel and valley become larger, more developed.

Deposition Zone: Region of sediment dispersal and deposition. River has a well developed valley over which the channel is free to meander. At its mouth, the river may divide into multiple channels as it flows across a delta of built up sediment into the receiving water body (ocean or larger river).

Figure 1. General zones of a river based on dominant physical processes (adapted from FISRWG, 1998).

Geomorphic classification of the Lower San Antonio River, Texas (2008)
By F.L. Engel and J.C. Curran

A detailed geomorphic classification of the Lower San Antonio River provides a useful tool to understand differences in physical processes and habitats along the river. In this study, the river was segmented into 25 reaches based on channel and valley characteristics, as shown in the figure below. A description of each reach was provided, including characteristic channel and floodplain features such as point bars, large woody debris dams, cobble riffles, oxbow lakes, and backwater swamps. When investigating the river, some of these reaches may be combined, depending on the processes or features of interest.

Full report: http://www.twdb.state.tx.us/RWPG/rpgm_rpts/0604830637_LowerSanAntonioRiver.pdf

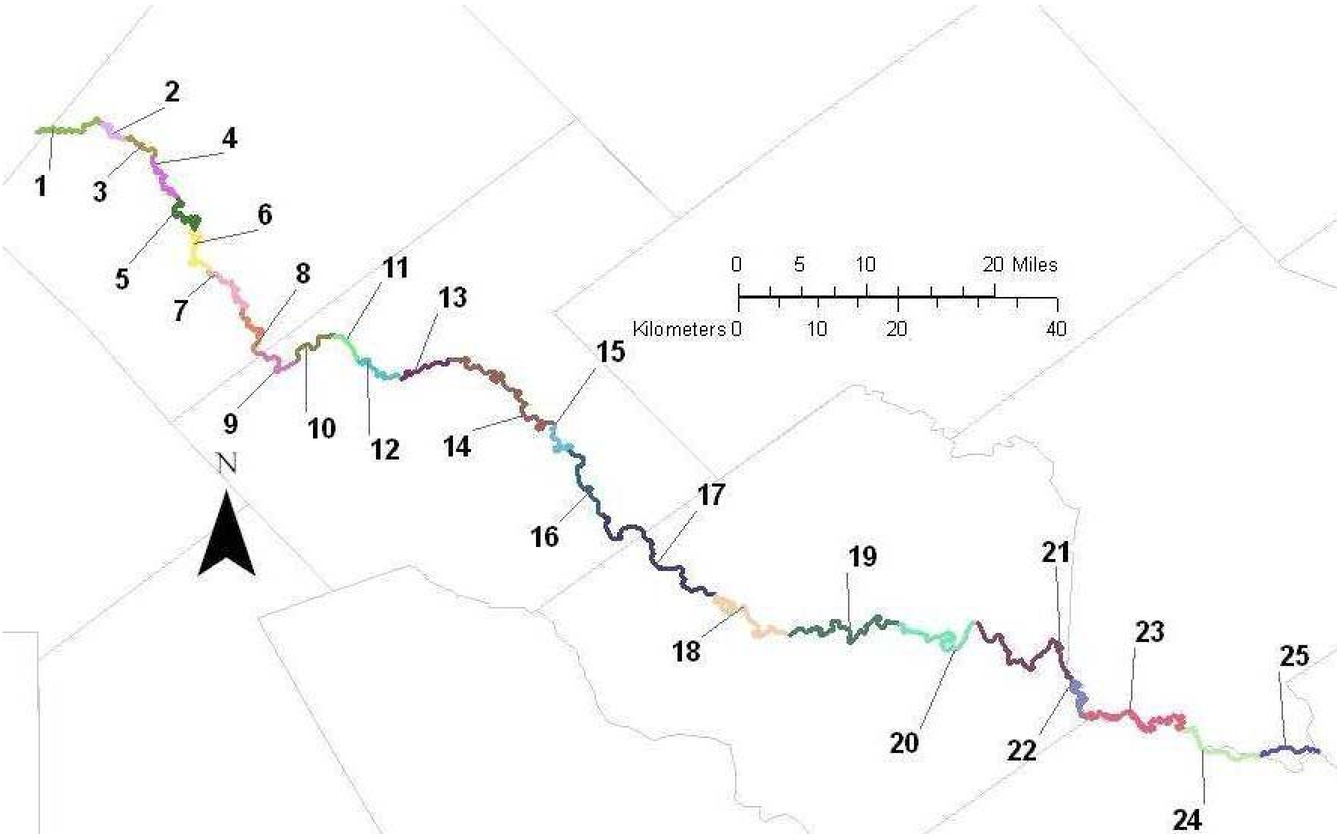


Figure 2. Geomorphic classification of the Lower San Antonio River (from Engle and Curran, 2008).

Stream channel response to floods, with examples from central Texas (1977)
By V. R. Baker

Floods are more important for the Lower San Antonio River than for other rivers because central Texas is prone to flash floods. Under these conditions, river channels are often responding to, or recovering from, the most recent extreme flood event. This contrasts with humid, low-relief terrains with deep soils (the majority of regions where studies of geomorphic processes have been conducted), where most of the work shaping the channel of a river is carried out by moderate flows that occur on average every year or two. In such systems, channels recover from changes caused by extreme floods relatively quickly

Abstract of report: http://www.gsajournals.org/perlserv/?request=get-abstract&doi=10.1130%2F0016-7606%281977%2988%3C1057%3ASRTFWE%3E2.0.CO%3B2

Channel change on the San Antonio River (2008)
By T Cawthon and J.C. Curran

The channel of the Lower San Antonio River has widened over a 68-year period, primarily due to floods, according to an analysis of historical aerial photos.

This study examined channel change in the form of migration, widening, erosion, and deposition by analyzing aerial photos of the river from Wilson to Victoria counties taken from 1938 to 2004.

The 1946 flood had the greatest impact on the channel in the upper portion of the river (above central Karnes County) while the 1967 flood caused the greatest amount on change in the lower portion. Conditions prior to the 1946 flood (oversteepened banks saturated by an extended period of rainfall) probably contributed to the severity of changes due to this event. The effectiveness of large floods is reduced in the lower portion of the study area, where the valley becomes wider and the channel is less confined.

Full report: http://www.twdb.state.tx.us/RWPG/rpgm_rpts/0604830638_channelchange.pdf

Negative impacts of overbank flows estimated for different sizes of floods (Ongoing)
By National Weather Service

The negative impacts of overbanks flows are summarized at most streamflow gages maintained by the US Geological Service. These estimates are based on observations and damage reports from previous flooding incidents. The magnitude of floods is described by the surface elevation of the water, not the discharge value. However, because of the stage discharge relationship developed at each USGS gage, the value for surface elevation of the water or “stage” can be converted into an approximate discharge value. This allows comparison to the magnitude of overbank flows that may be part of an instream flow recommendation. An example from USGS gage #08188500, San Antonio River at Goliad, is provided in the table below.

For flood impact data: http://ahps.srh.noaa.gov/ahps2/hydrograph.php?wfo=crp&gage=glit2

Table 1. Flood impacts of various stages at USGS gage #08188500, San Antonio River at Goliad.

Stage [feet above gage datum]	Flood Impact
40.0	MAJOR FLOODING OCCURS. NEARLY ALL OF GOLIAD STATE PARK FLOODS...EXCEPT THE HEADQUARTERS AREA AND MISSION...CAUSING MAJOR DAMAGE TO THE PARK. MANY SECONDARY AND PRIMARY ROADS AND LOW BRIDGES FLOOD. THE FLOW IS WITHIN A FEW FEET OF THE LOWEST RESIDENCES IN THE SOUTH EDGE OF GOLIAD AND HIGHWAY 183. HUNDREDS OF LIVESTOCK ARE CUT OFF...AND CAN POTENTIALLY DROWN IN THE FLOOD PLAIN BELOW FALLS CITY TO THE GUADALUPE RIVER CONFLUENCE
35.0	MAJOR LOWLAND FLOODING OCCURS. ROADS...MANY CAMP SITES...RV AND TEMPORARY SHELTER SITES IN GOLIAD STATE PARK FLOOD. HUNDREDS OF LIVESTOCK DOWNSTREAM IN THE FLOOD PLAIN ARE CUT OFF AND POTENTIALLY DROWN
33.0	MODERATE FLOODING OCCURS. ROADS...MANY CAMP SITES...RV AND TEMPORARY SHELTER SITES IN GOLIAD STATE PARK FLOOD. HUNDREDS OF LIVESTOCK DOWNSTREAM IN THE FLOOD PLAIN ARE CUT OFF AND POTENTIALLY DROWN
32.0	ROADS AND SEVERAL CAMP SITES THROUGH GOLIAD STATE PARK FLOOD. MODERATE LOWLAND FLOODING ABOVE GOLIAD TO THE GUADALUPE RIVER CONFLUENCE...CUTS LIVESTOCK OFF AND POTENTIALLY DROWNS THEM
30.0	MODERATE LOWLAND FLOODING OCCURS...COVERING MUCH OF CAMPING AREA AT GOLIAD STATE PARK
25.0	MINOR LOWLAND FLOODING OCCURS...WITH WATER IN THE LOWEST AREAS OF GOLIAD STATE PARK. LIVESTOCK BELOW GOLIAD TO THE GUADALUPE RIVER CONFLUENCE ARE CUT OFF AND POTENTIALLY DROWN
22.0	BANKFULL CONDITIONS OCCUR. THE LOWEST CAMP SITES IN GOLIAD STATE PARK FLOOD. LIVESTOCK BELOW GOLIAD TO THE GUADALUPE RIVER CONFLUENCE ARE CUT OFF AND POTENTIALLY DROWN
15.0	NUISANCE FLOODING OCCURS. LIVESTOCK ARE CUT OFF IN THE FLOOD PLAIN DOWNSTREAM BELOW GOLIAD TO THE GUADALUPE RIVER CONFLUENCE

Indicators: Lower San Antonio River
Geomorphology

Geomorphology Objectives

- Determine and balance the geomorphic effects of different flows, including:
  - channel migration
  - positive and negative effects of overbank flows
  - woody-debris dynamics

Geomorphic Indicators

Category	Indicator	Explanation
Channel migration	Rate of lateral channel migration	Rate of lateral movement of channel across valley. Some migration of the channel is crucial to support diverse riparian habitats and a healthy ecosystem.
	Rate of channel avulsion	Rate of creation of channel cut-offs. Cut-offs, in the form of oxbow lakes, back water areas, and abandoned channels, provide distinct and important habitats.
	Rate of bank erosion	The rate at which flows erode the sides of channels. This will vary by bank material and condition of the banks (vegetated, saturated, etc.).
Overbank flows	Total area inundated	The amount of out of channel area inundated by an overbank flow of a particular magnitude.
	Habitat area inundated	The amount of habitat area of a particular type that is inundated by a particular magnitude of overbank flow.
	Stage (at USGS gage locations)	The National Weather Service provides flood impact summaries for most USGS streamflow gage sites, based on water surface elevation or “stage.” These summaries provide an estimate of negative impacts of overbank flows.
Woody-debris	Volume	The volume of woody debris in a section of river. A certain amount of woody debris is necessary to provide food and/or shelter for various organisms.
	Transport rate	The rate at which woody debris moves past a specific point along the river.
	Recruitment rate	The rate that woody debris enters a section of river. Wood may be supplied by upstream sections of the river, tributaries, tree fall from the banks, or washed into the river during flood events.
Channel shape characteristics	In-channel bars (area, configuration, sediment size)	Sediment bars are an important in-channel bed form. Flow across these features provides a diversity of hydraulic conditions. Bar formation, in combination with opposite-bank erosion, is the driving process behind channel migration. As bars age, they gradually create new areas of floodplain and riparian habitat.
	Meander pools (depth)	Meander pools are another important in-channel bed form. Deep pools provide diverse hydraulic conditions and cover for some species. They also provide refuge habitat for many species during low flow periods.