

CALCULATING AND ANALYZING STREAM FLOW

OBJECTIVES

- Understand the relationship between urbanization and stream flow in the San Antonio River Basin
- Learn about peak flows and how to calculate them using examples from local rivers and streams

TOPICS

- Stream flow
- Flooding
- Impervious surface
- Runoff

TEKS ALIGNMENT

Grade 7 Science:

1A, 2A, 2C, 2D, 2E,
3B, 3C, 4A, 8A, 8C

BACKGROUND MATERIAL

Every river has a certain amount of water in it, even during periods when it is not raining, which is called the base flow. In rivers such as the San Antonio, whose headwaters are springs, base flow is the water that enters the river from sources beneath the ground.

If rain falls faster than it can infiltrate into the soil, the result is surface runoff. One of the biggest problems with surface runoff is that land uses that prevent water from infiltrating into the soil can lead to increased flooding. The amount of water that runs off can be increased if much of the watershed is covered by an impervious surface (surface that does not allow water to infiltrate), thus also increasing flooding. An example of a type of area high in impervious surface is urban areas, where streets and houses are designed to move water off of the land quickly and to the closest river or stream.

One way to study the impact of impervious surface is by studying the flows of streams and rivers with watersheds having different amounts of impervious cover. Specifically, scientists focus on the spike in water level rise after a rain event, known as the peak flow. Stream flow levels are recorded at stations throughout the San Antonio River Basin, shown in the map on Teacher Sheet 1, and data can be obtained through the USGS website (see Procedures section for more information).

KEY TERMS

Base Flow is the water that is in a river during dry periods; the source of base flow is usually groundwater

Urban refers to a city or town

Urbanization is the process of creating and enlarging cities and towns

PROCEDURES

- A. Before class, explain the concept of "cubic feet per second" to the students. "Cubic feet" is the measure of volume and one cubic foot equals 7.48 gallons. One cubic foot per second would equal one cubic foot passing a single point in one second.
- B. Obtain flow data for the locations described below using the following instructions:
1. Go to tx.usgs.gov
 2. Retrieve "NWIS historical water data"
 3. Select "surface water"
 4. Under "statistics," select "annual." And then select "county," etc
- C. Conduct a study of stream flow in the San Antonio River Basin
1. Have the students determine what the highest recorded stream flow was at various stations in the San Antonio River Basin and have them convert the cfs readings to gallons per minute
 2. Have the students analyze stream flow for the San Antonio River at Elmendorf near San Antonio with stream flow farther downstream on the San Antonio River near Falls City in Karnes County and at Goliad in Goliad County (both rural counties). The students can create graphs showing peak stream flow of the river at Loop 410 vs. peak stream flow at the two locations further downstream.
 3. Have them compare peak stream flow at upstream vs. downstream locations for the same year and see if they can determine patterns between stream flow and urbanization. They should notice that peak stream flows are substantially higher at Elmendorf near San Antonio than they are in the rural locations. Ask the students to explain why stream flows are so high at Elmendorf near San Antonio after looking at an aerial photograph or a map of this area. Ask them what they think the drainage basin for the river looks like in San Antonio and what it looks like in Karnes and Goliad counties

MATERIALS

- Flow data from the USGS; make sure to obtain data from different points in the watershed that differ in impervious surface cover, and find flow during a storm event
- Aerial photographs of areas around streams for which you have flow data. If you cannot find more specific ones, use the maps from Teacher Sheet 2

4. Then have the students compare stream flows at Falls City with those at Goliad. They will find that stream flows at Goliad are mostly higher than they are at Falls City. Ask the students why they think this might be so. Point out the difference in drainage basin size between the two downstream locations.
- D. Lead a discussion based on the results of the students' study

GUIDING QUESTIONS

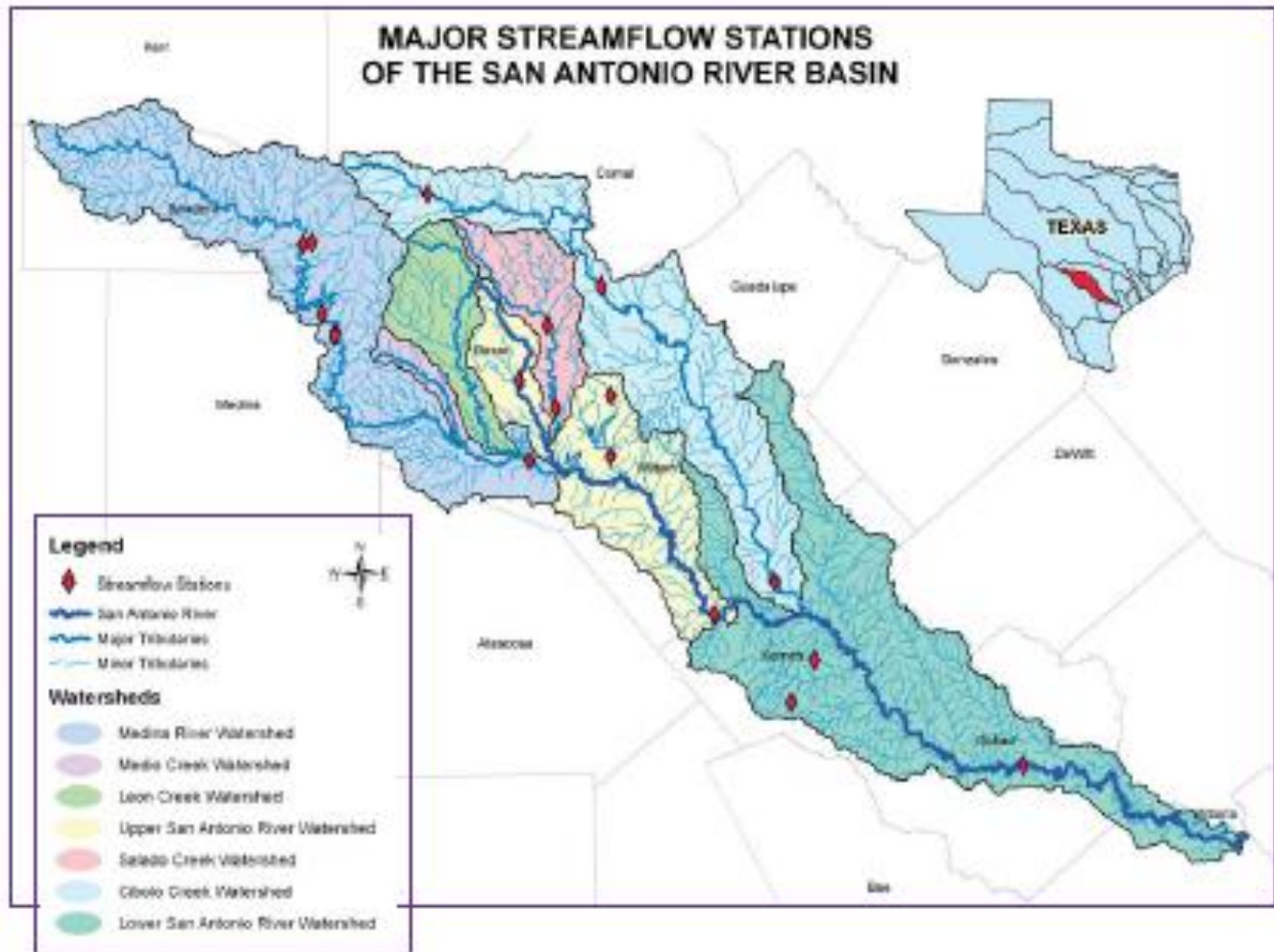
- How does water get into the ground?
- What can happen to water once it does enter the ground?
- From where does the extra water come that causes a flood?
- What are some types of impervious cover?
- Do you think that San Antonio would have more or less impervious cover than Wilson, Karnes or Goliad counties?
- How were the peak flows different between areas near San Antonio and the rural counties?
- How were the peak flows different between areas upstream vs. downstream on the San Antonio River?

EVALUATION

Have the students write a short report on the impact of urbanization on impervious surface cover, and consequently the effect on peak flows. Encourage them to create graphs using Excel or another graphing program that directly compare peak flows at sites in San Antonio vs. sites downstream. Have the students describe the differences between the stream flow in the areas that they studied and have them explain why they thought they may have gotten those results.

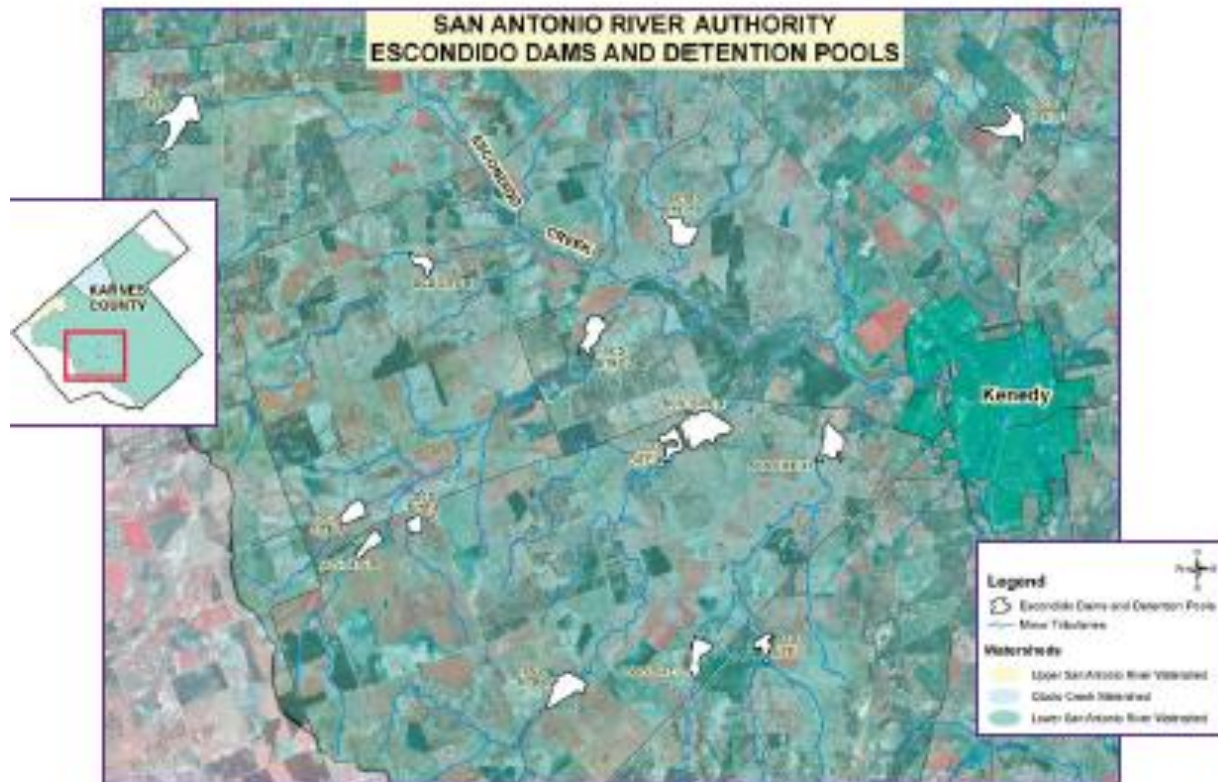
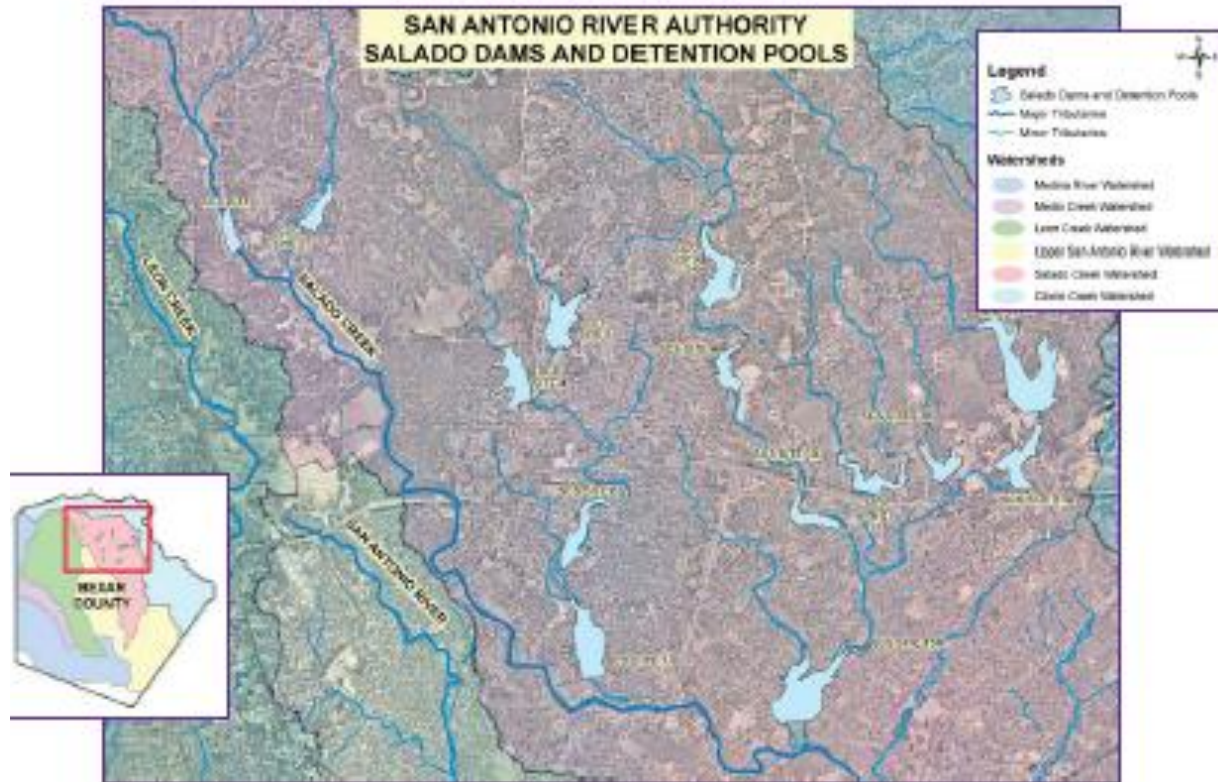
THE SAN ANTONIO RIVER AUTHORITY

TEACHER SHEET 1



THE SAN ANTONIO RIVER AUTHORITY

TEACHER SHEET 2



REFERENCES

- Black, P. E. 1996. Watershed Hydrology, Second Edition. Ann Arbor Press, Chelsea, MI. 449pp.
- Schlesinger, W. H. 1997. Biogeochemistry: An Analysis of Global Change, Second Edition. Academic Press, San Diego, CA. 588pp.
- U.S. Geological Survey. 1996. Groundwater Atlas of the United States: Oklahoma, Texas. U.S.G.S Publication HA 730-E.
- Wetzel, R. G. 1983. Limnology, Second Edition. Saunders College Publishing, Orlando, FL. 857pp.