The North Coast Limestone Aquifer of Puerto Rico

by Caitlin Brown

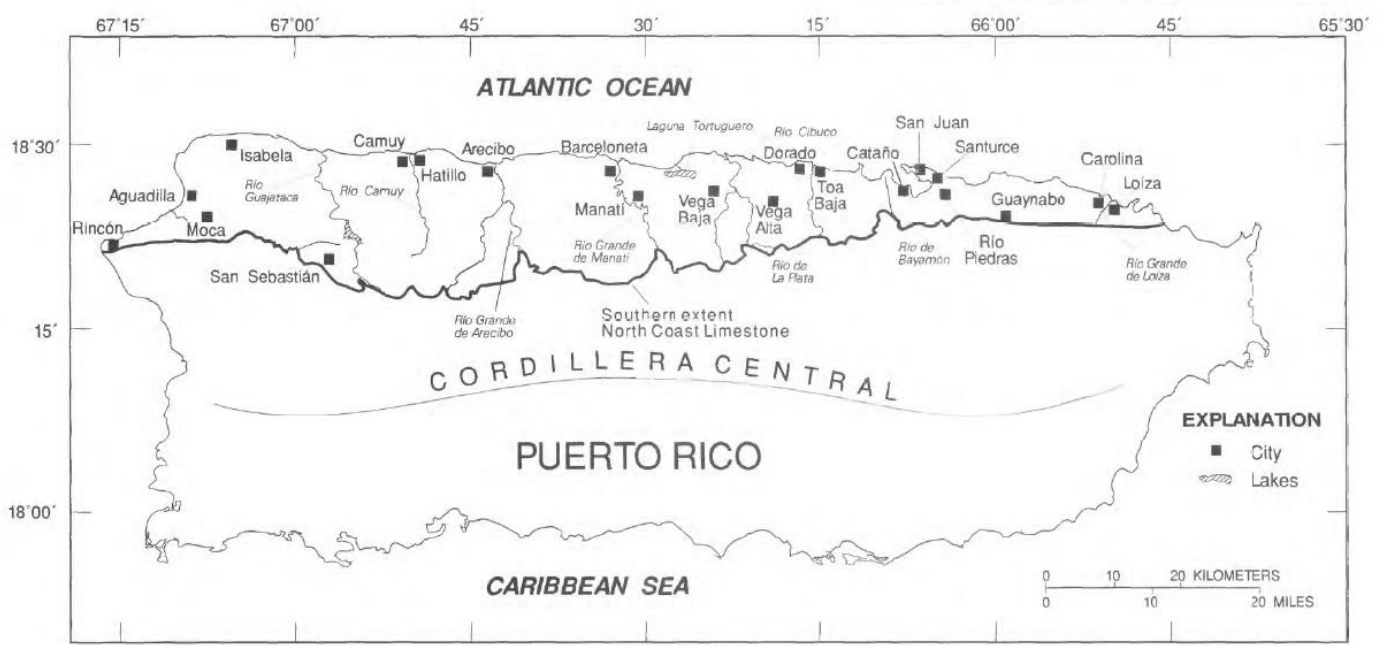


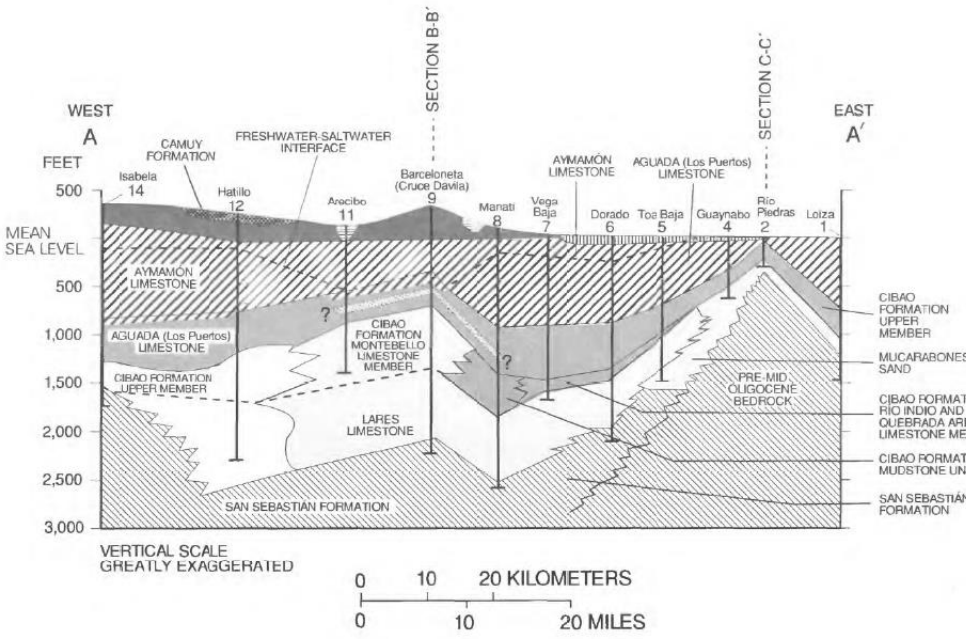
Figure 1. Areal extent of the North Coast Limestone of Puerto Rico.

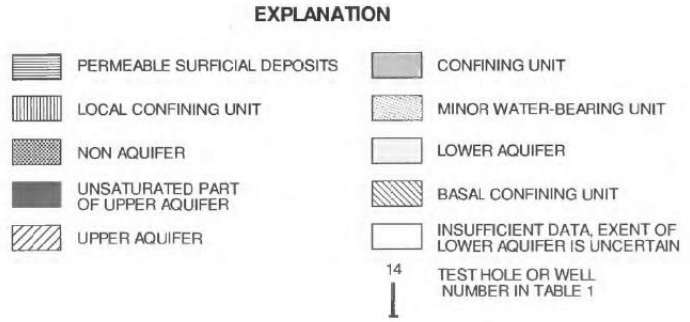
Background

- Takes up the northern third of the island
- Storage has overall increased due to severe hurricanes
- Citizens relied on mostly surface water and groundwater was introduced as a water source in the 19th century
- Makes up 35% of total groundwater withdrawals
- The southernmost aquifer is smaller and is utilized most

Previous Literature

- Studied from 1983 to 1988 through the U.S. Geological Survey
- Covers ~700 mi^2
- Consists of 3 major hydrogeologic units
  - Upper aquifer
  - Intervening confining unit
  - Lower Aquifer





Previous Literature

Aymamon Limestone

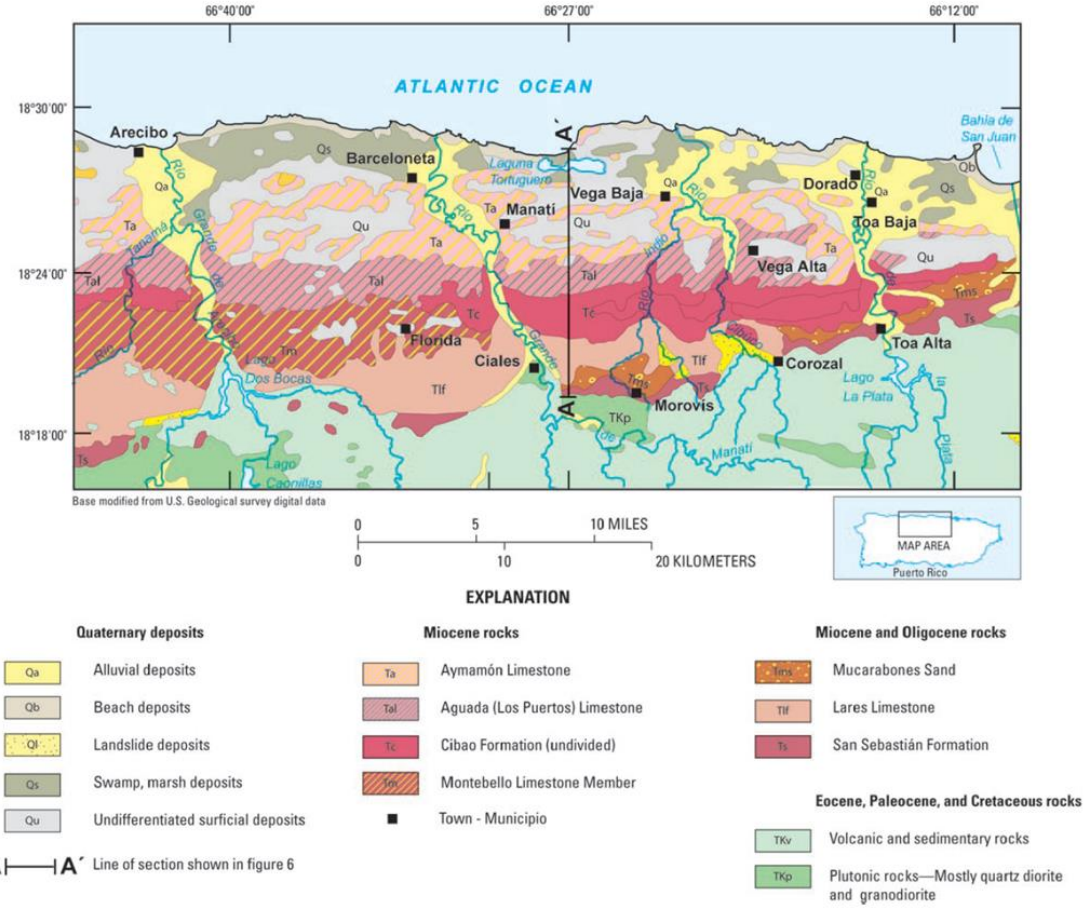
- hydrogeologic conductivity values range from 57 to 570 ft/day.
- Transmissivity has a large range - 200 to 280,000 ft^2/day
    - Highest values (over 100,000 ft^2/day) are between the Arecibo and La Plata Rivers

Lares Limestone

- Hydraulic conductivity is greater from Arecibo to Manati.
- consists of fine-grained soils, low transmissivity

Montebello Limestone Member

- Transmissivity of 370 to 680 ft^2/day.
- A high transmissivity indicates that the aquifer is not confined and drains quickly into the ocean, and rivers.

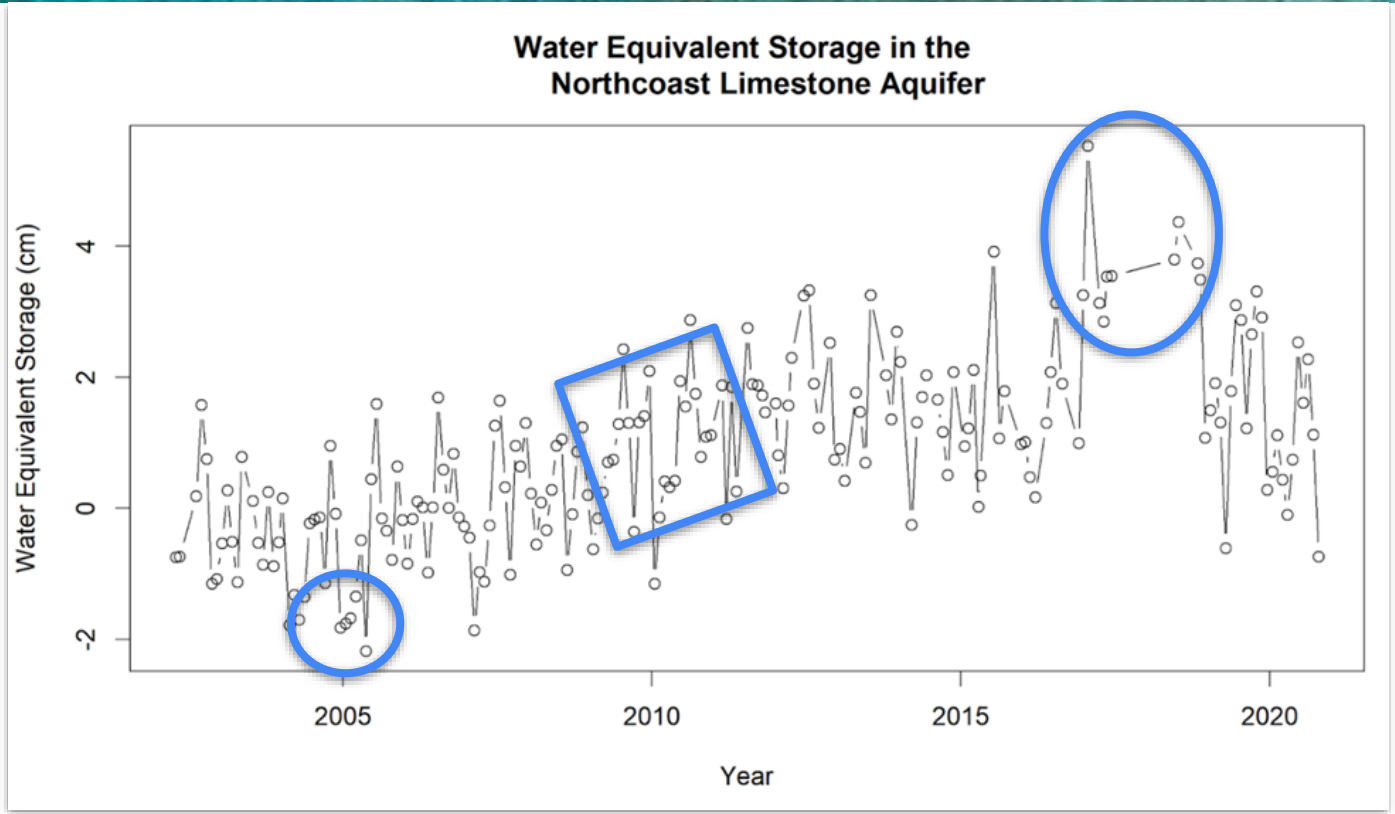


Overall Water Use

Freshwater Sources

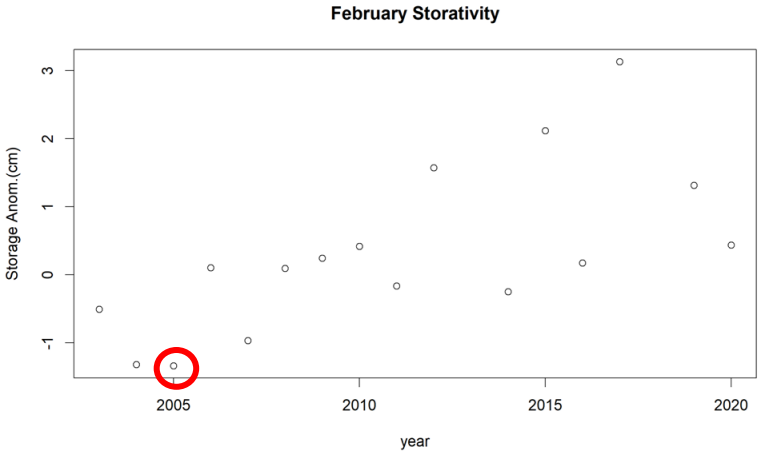
- Groundwater provided 20 percent of the total freshwater withdrawals
  - The north uses mostly surface water
  - North Coast Limestone Aquifer supplies 35 percent of all groundwater
  - The southern area extracts its groundwater from the South Coastal Plain aquifer
  - makes up 50 percent of total groundwater withdrawals.

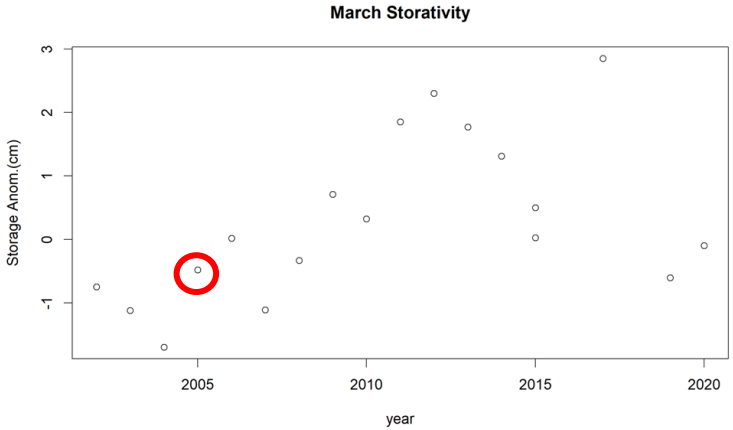
Grace Data


Water Equivalent Storage in the
Northcoast Limestone Aquifer
Water Equivalent Storage (cm)
-2
0
2
4
2005
2010
2015
2020
Year

Minimum in 2005

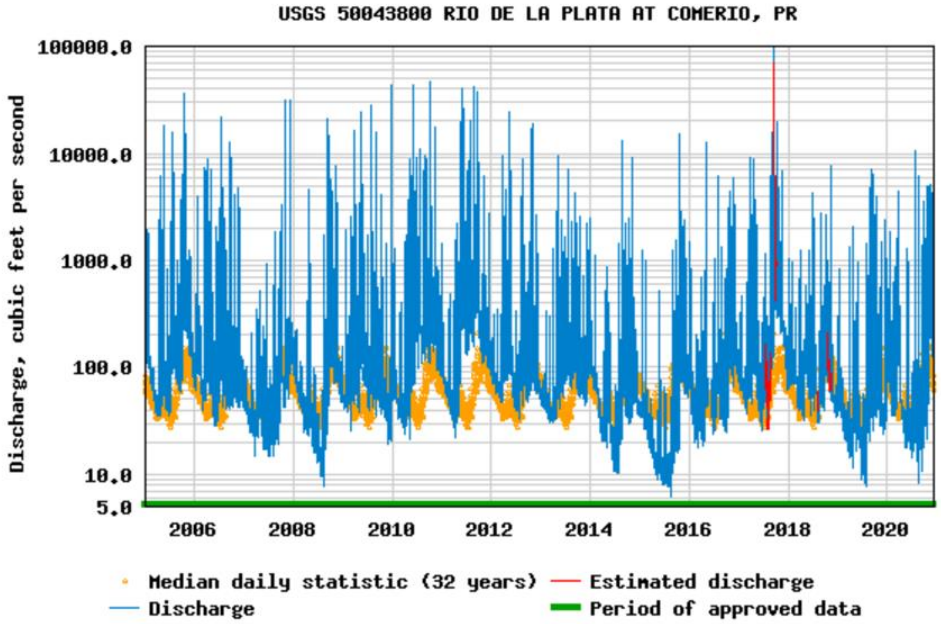
- vicennial minimum in early 2005
- low amount of precipitation beginning in December 2004 and continuing until March 2005
  - record low precipitation of 5.81mm in March 2005
  - typical monthly average of 175.58mm
  - Aquifer recharged by the end of March





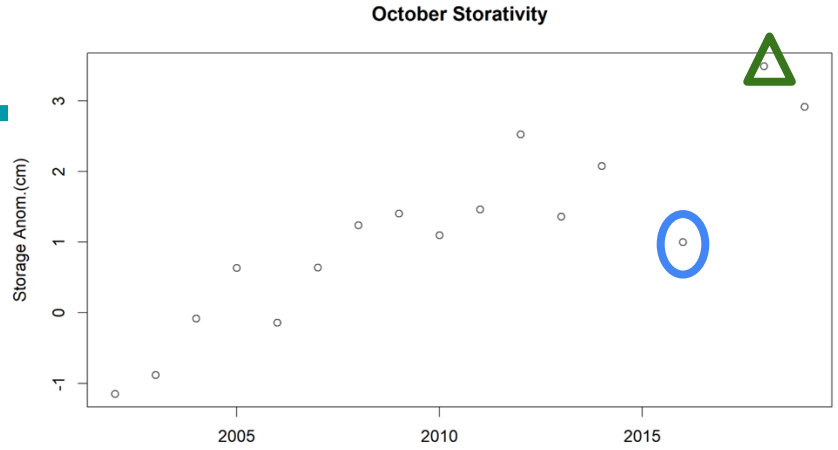
Overall Increase

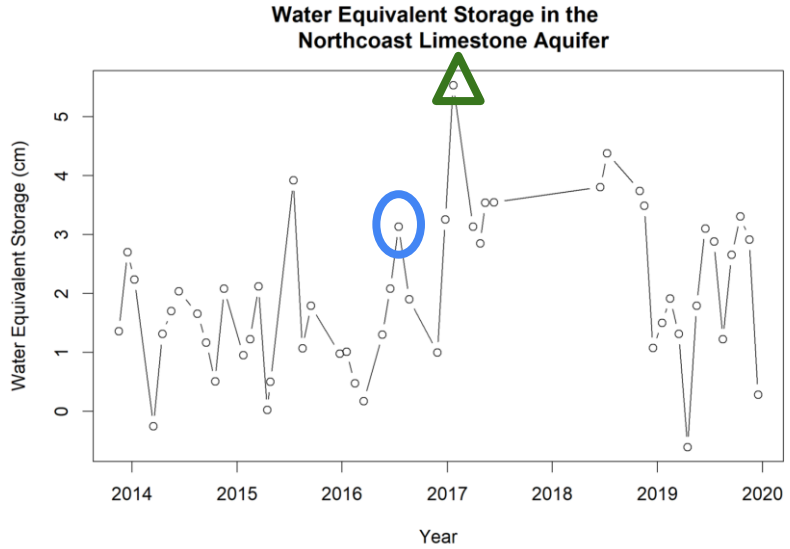
- Overall positive deviation from 2002 to 2020
- Stored more in 2010, continued until 2016 with an average change of +1.5cm
- Could be attributed to an increase in precipitation, possibly from more severe storms
    - The severity of tropical storms is increasing due to higher water temperatures from global warming



Hurricanes Matthew and Maria

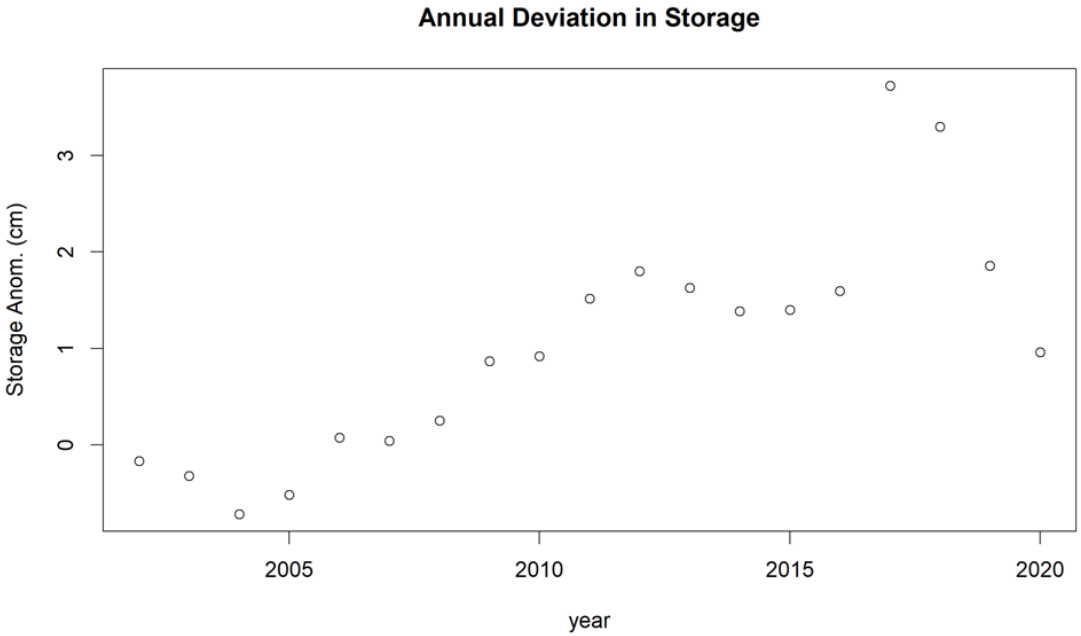
- In 2016 - Hurricane Matthew
- In 2017 - Hurricane Maria
  - River Discharge increase
  - Storage increased to 5 cm above normal
    - 3.5 cm above normal for Hurricane Matthew
  - Seasonality of the storage disappeared
- In 2019 - no severe storms
  - Storage returned to normal





Future Approximations

- From 2005 the storage increased
  - More severe hurricanes
- After Hurricane Maria groundwater storage decreased but the potential for severe storms could spike it higher



Future Approximations

- Rising sea levels will erase the coastline and move the saltwater basin inland
- Lower the area for freshwater withdrawals
- More of a concern in the south
  - Aquifer is smaller
  - Groundwater is the primary water source

Questions?

Picture - Fast Facts about Puerto Rico, Magaly Rivera
https://welcome.topuertorico.org/fastfacts.shtml

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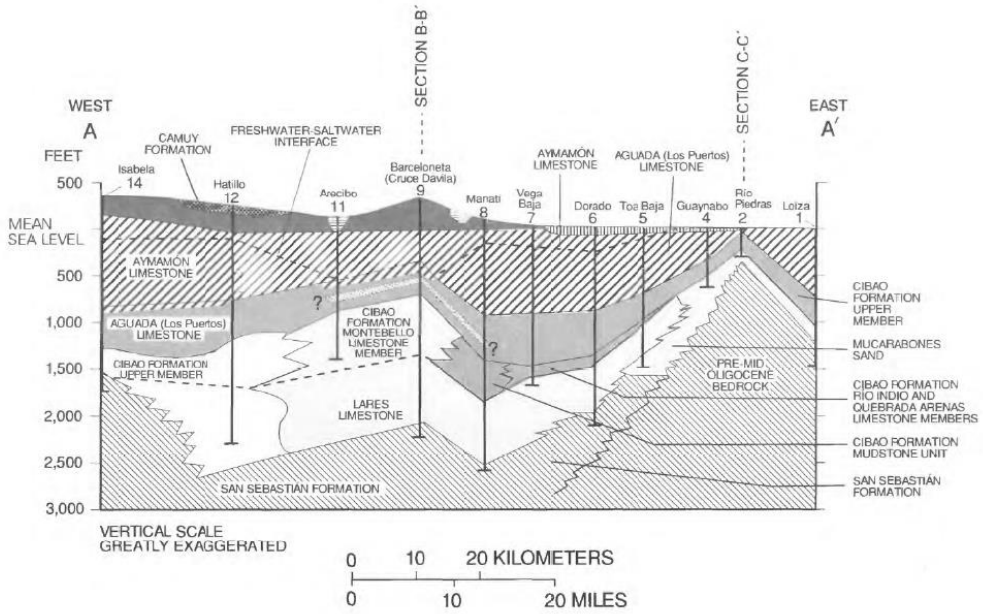

EXPLANATION

- PERMEABLE SURFICIAL DEPOSITS
- LOCAL CONFINING UNIT
- NON AQUIFER
- UNSATURATED PART OF UPPER AQUIFER
- UPPER AQUIFER
- CONFINING UNIT
- MINOR WATER-BEARING UNIT
- LOWER AQUIFER
- BASAL CONFINING UNIT
- INSUFFICIENT DATA, EXENT OF LOWER AQUIFER IS UNCERTAIN
- 14 TEST HOLE OR WELL NUMBER IN TABLE 1