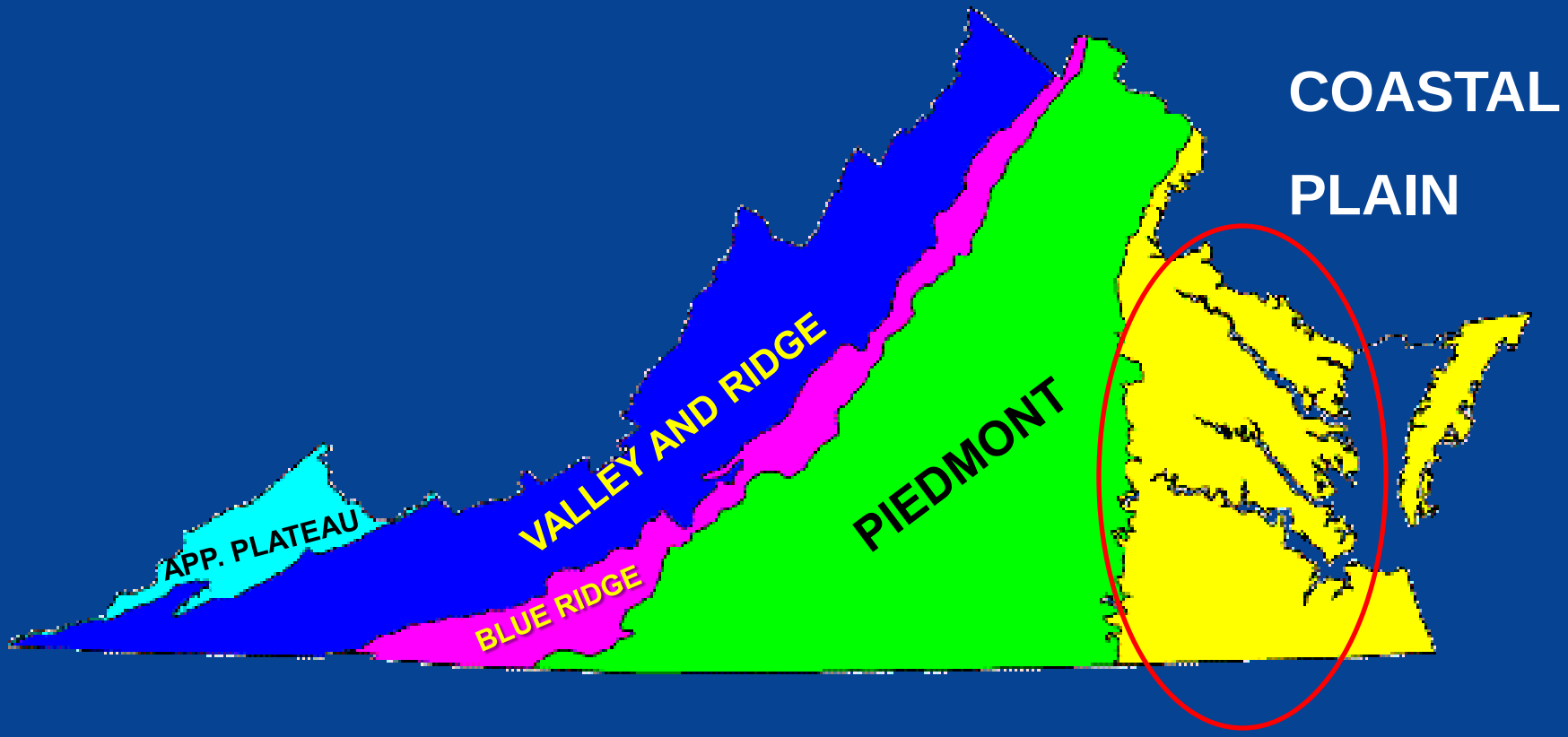
Virginia Coastal Plain Groundwater Issues
EVGMA Advisory Committee

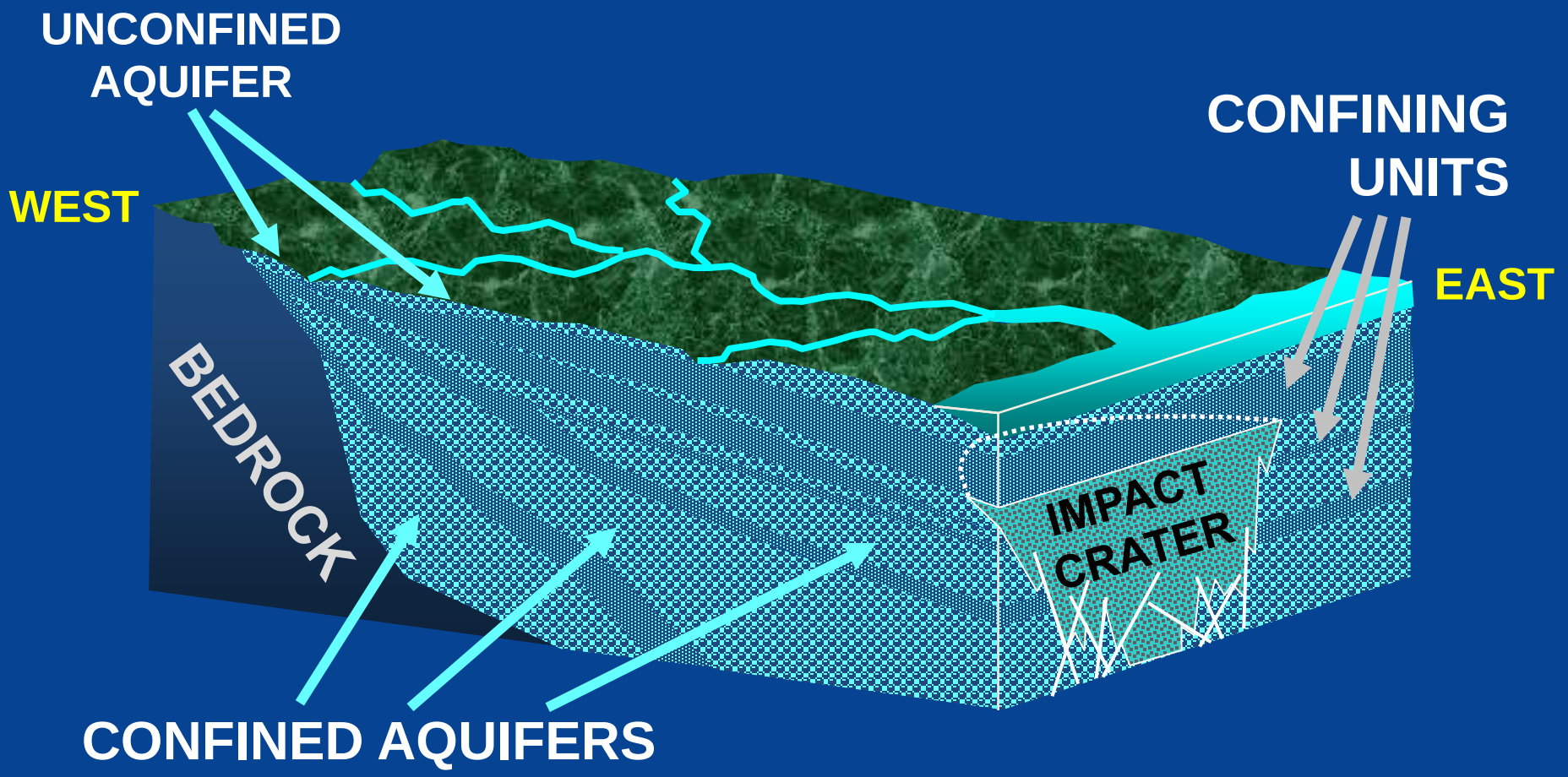
August 18, 2015

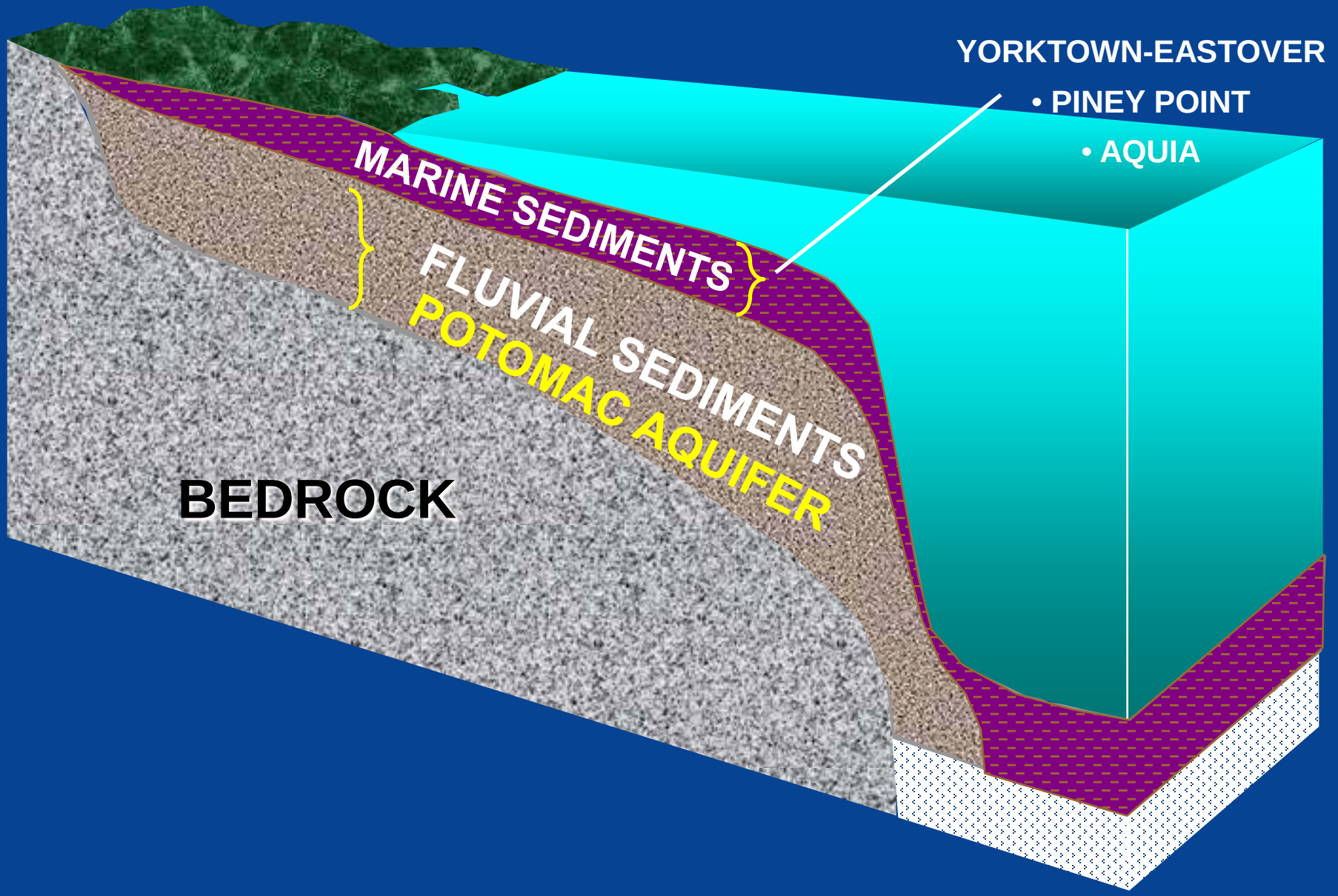
Geology 101

Virginia Physiographic Provinces

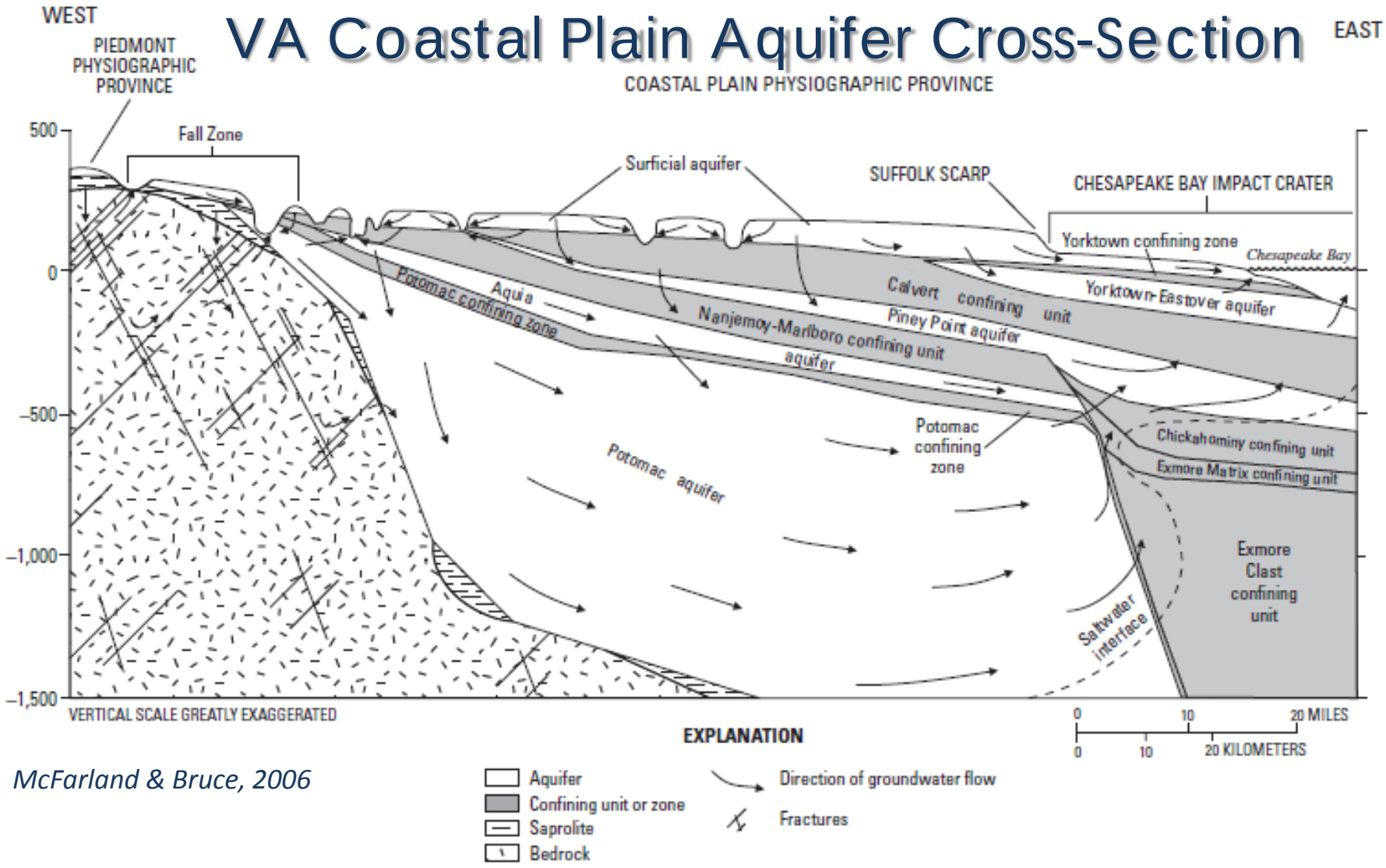


Coastal Plain Aquifer System




YORKTOWN-EASTOVER
• PINEY POINT
• AQUIA
MARINE SEDIMENTS
FLUVIAL SEDIMENTS
POTOMAC AQUIFER
BEDROCK

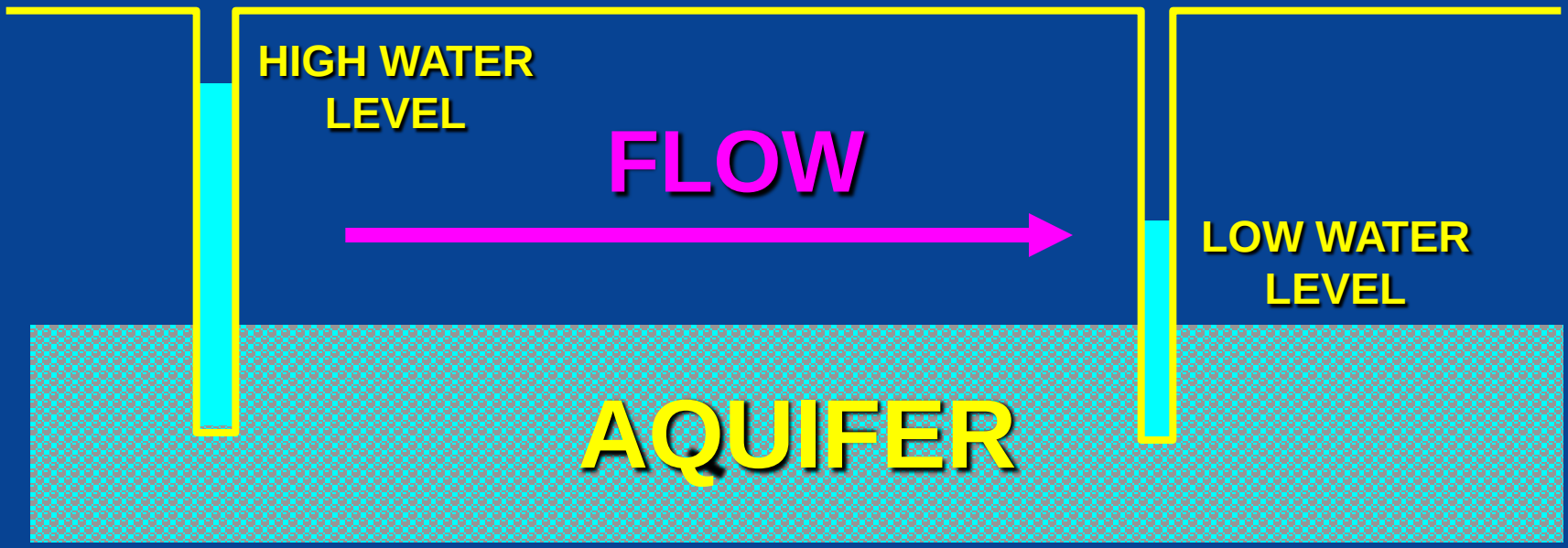
VA Coastal Plain Aquifer Cross-Section



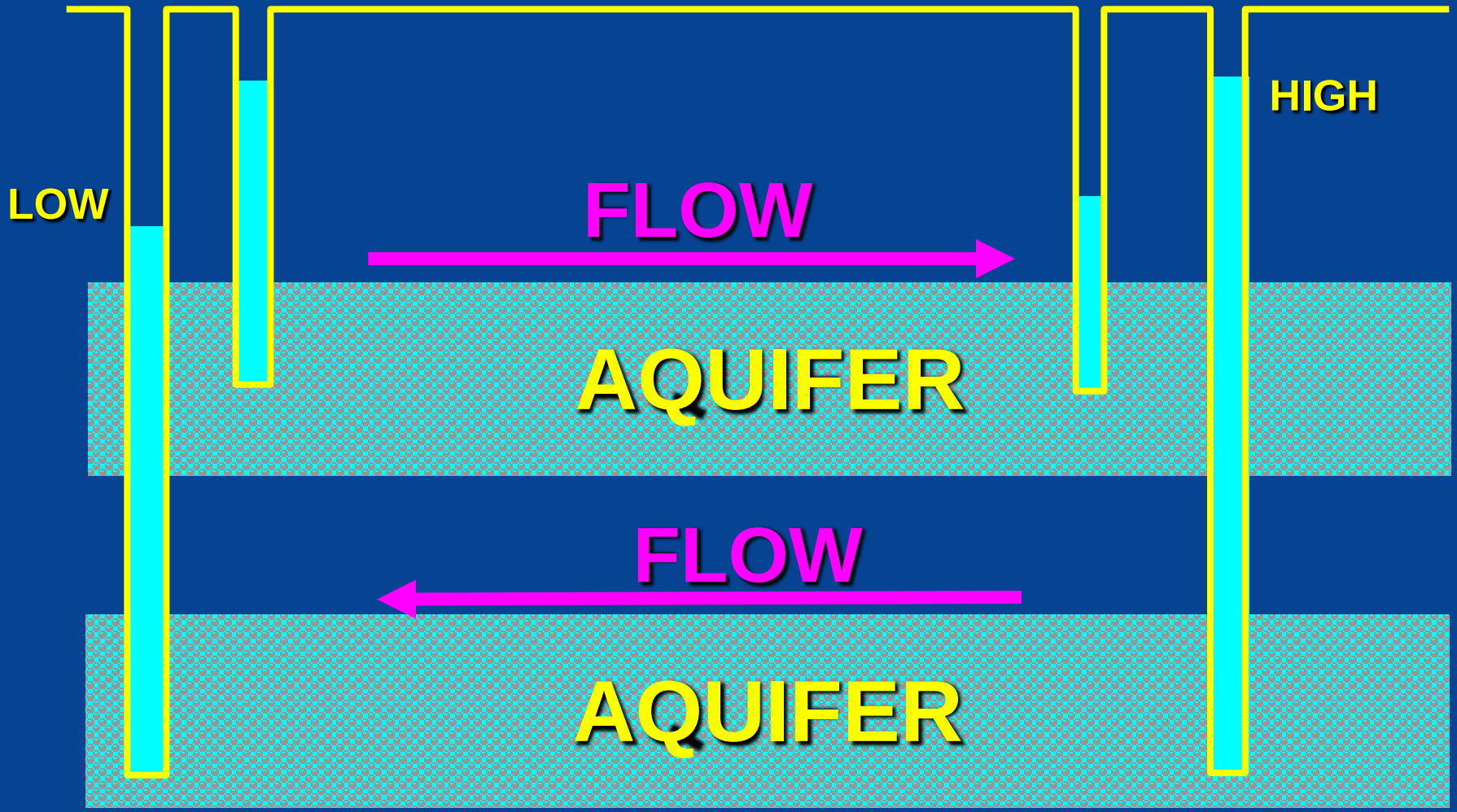
McFarland & Bruce, 2006

Groundwater Terms and Concepts

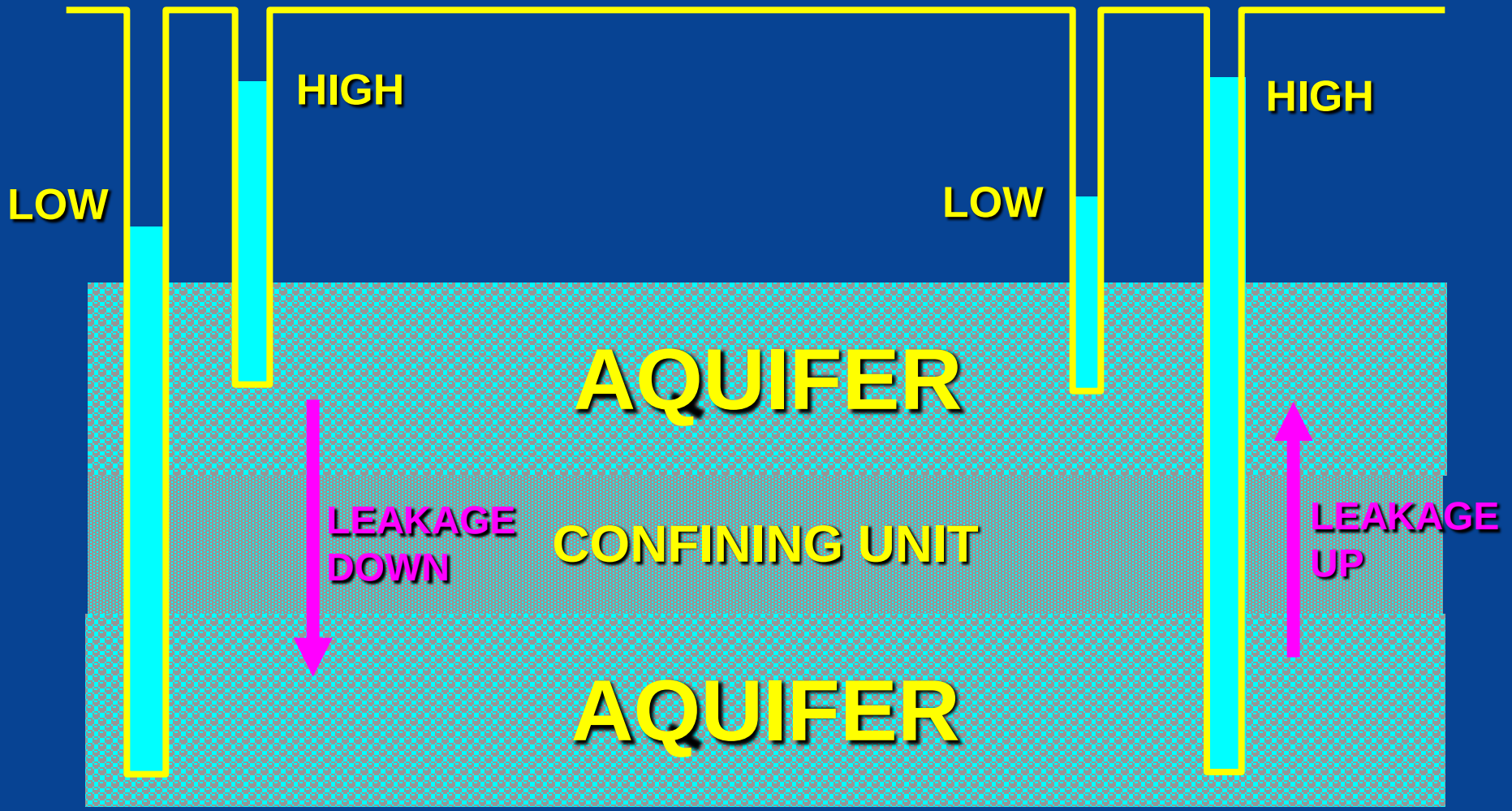
Well Water Levels Indicate Direction of Flow

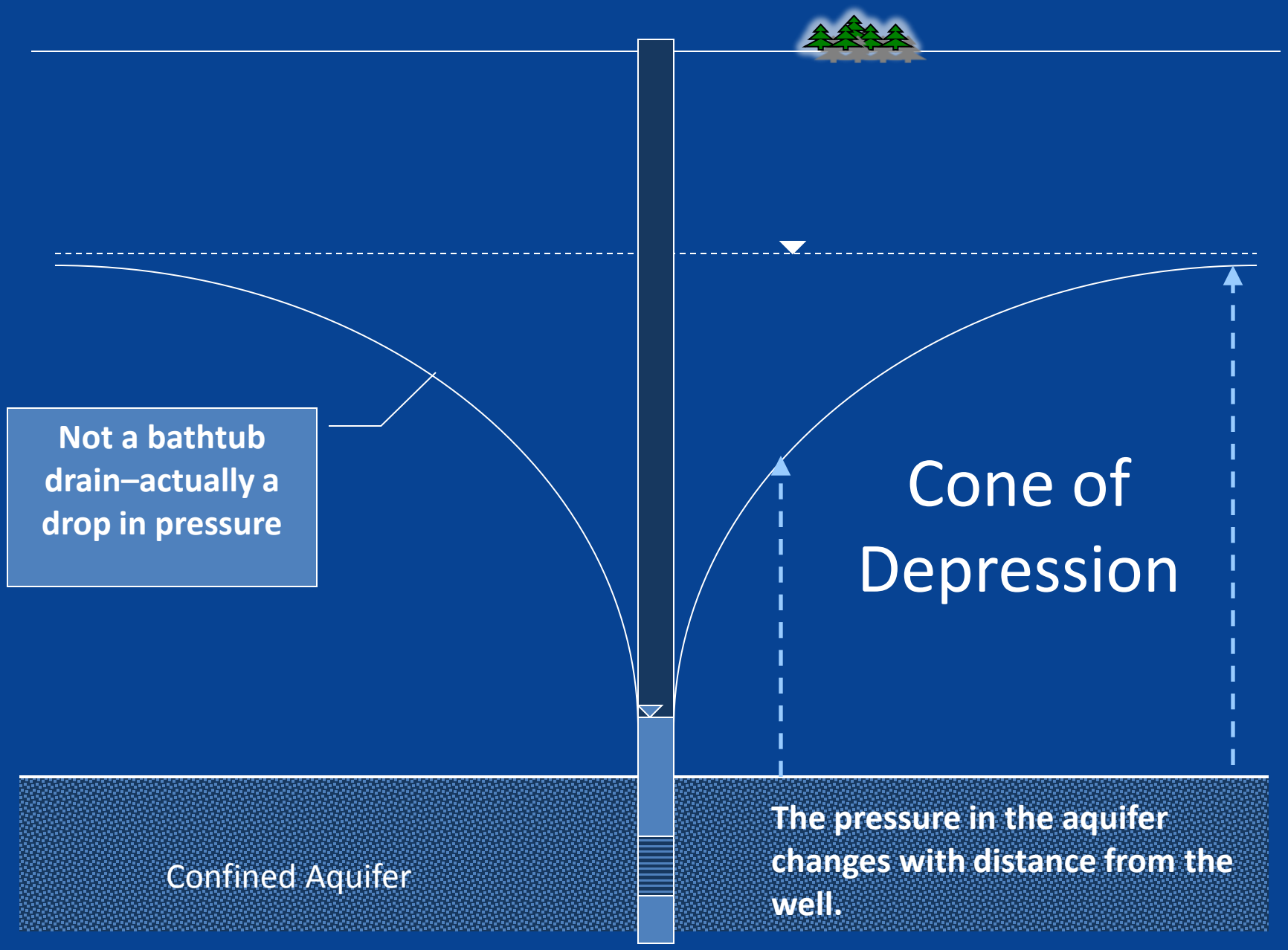


Well Water Levels Indicate Direction of Flow

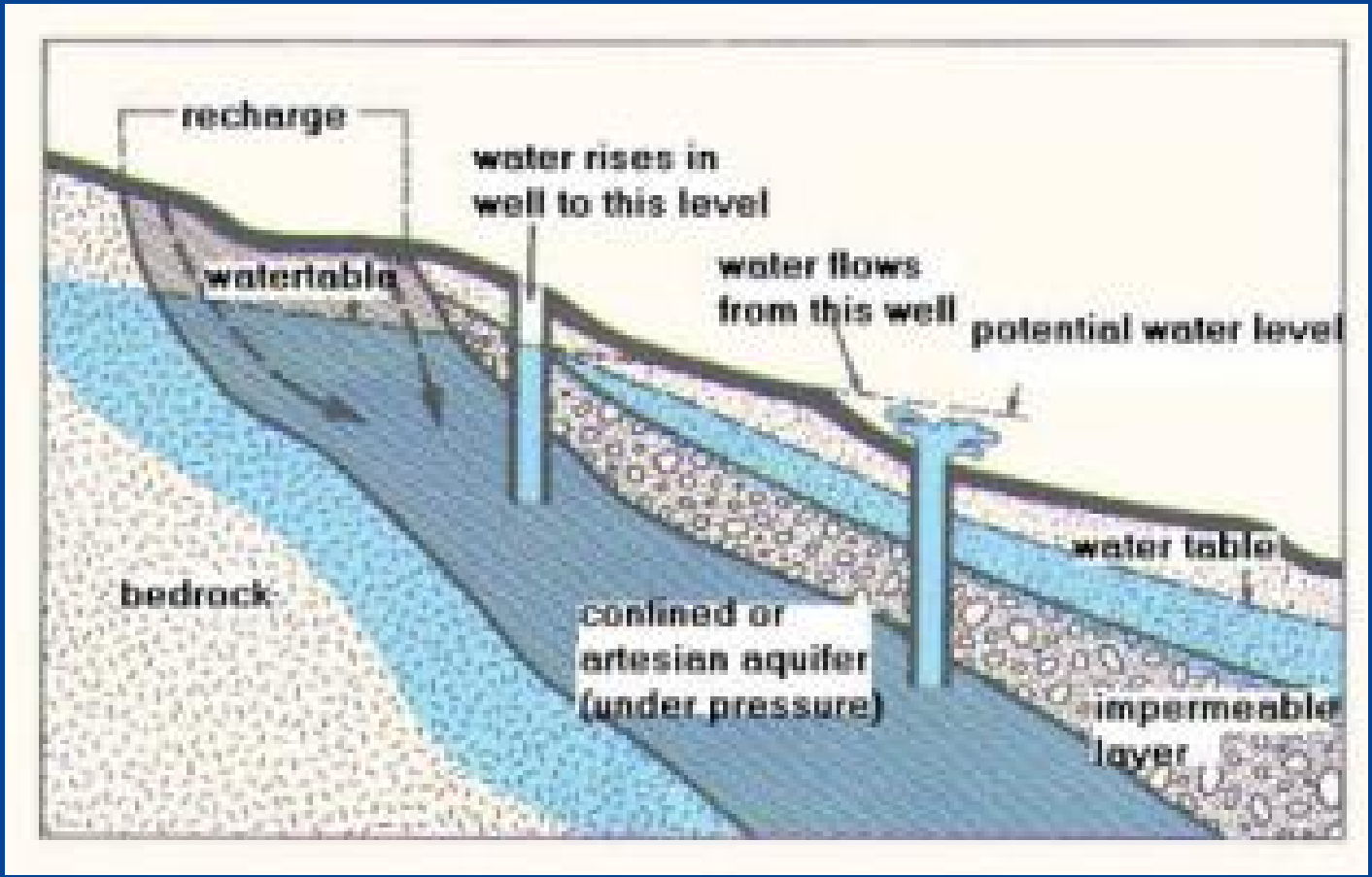


Well Water Levels Indicate Direction of Flow




Not a bathtub drain–actually a drop in pressure
Cone of Depression
Confined Aquifer
The pressure in the aquifer changes with distance from the well.

Potentiometric Surface

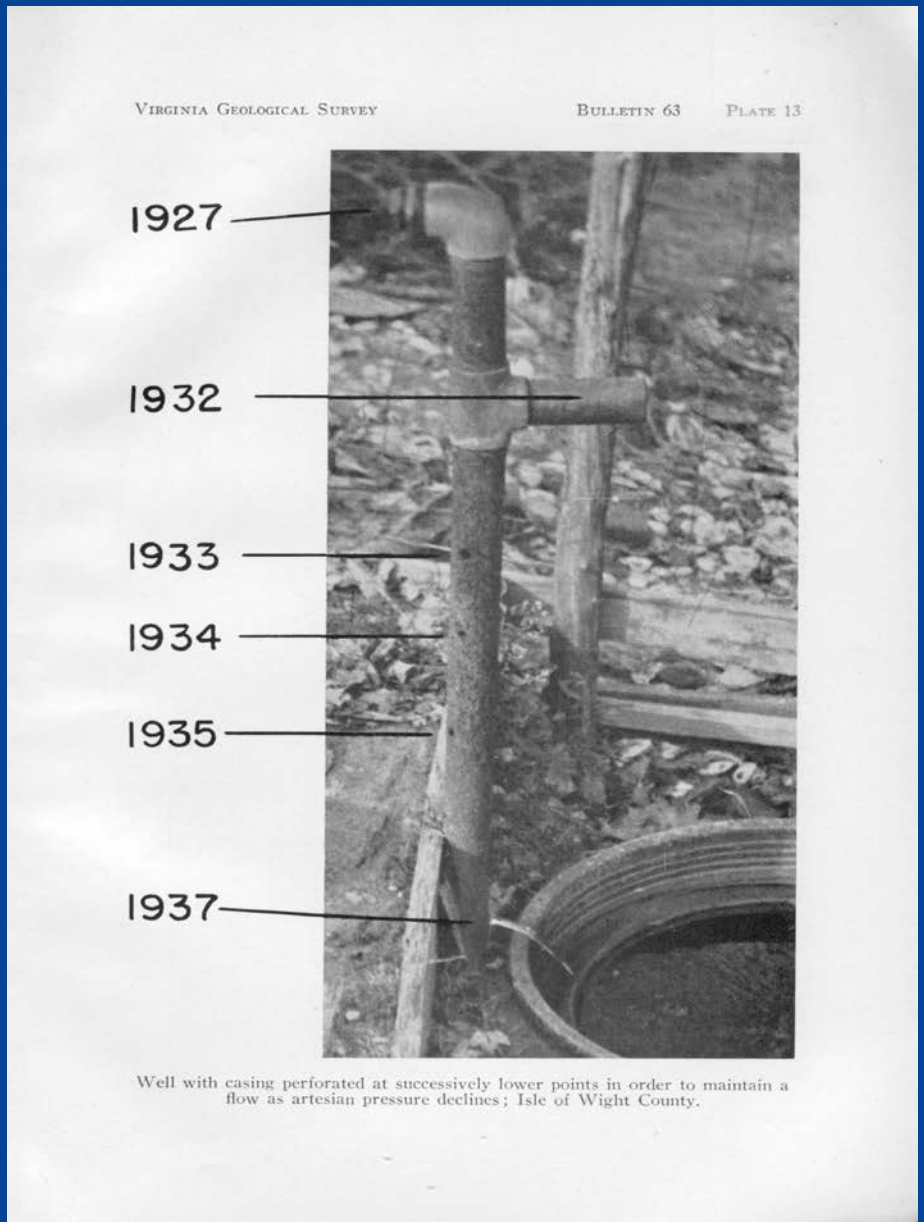


Management Issues

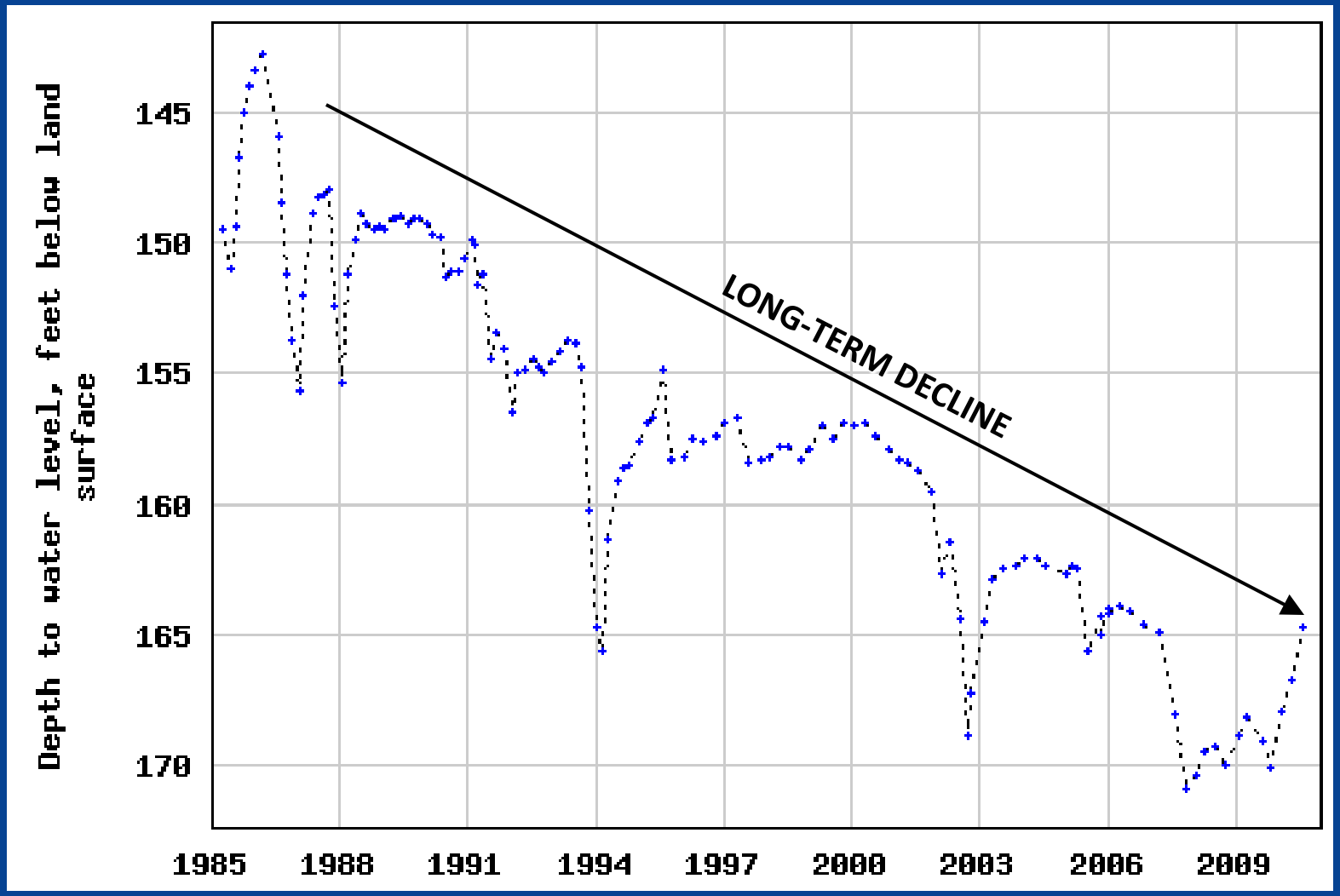
- Declining water levels
- Reversal of the hydraulic gradient (groundwater flow) leads to salt water intrusion
- Subsidence and loss of storage

Groundwater Level Declines

Artesian Characteristics Lost Over Time

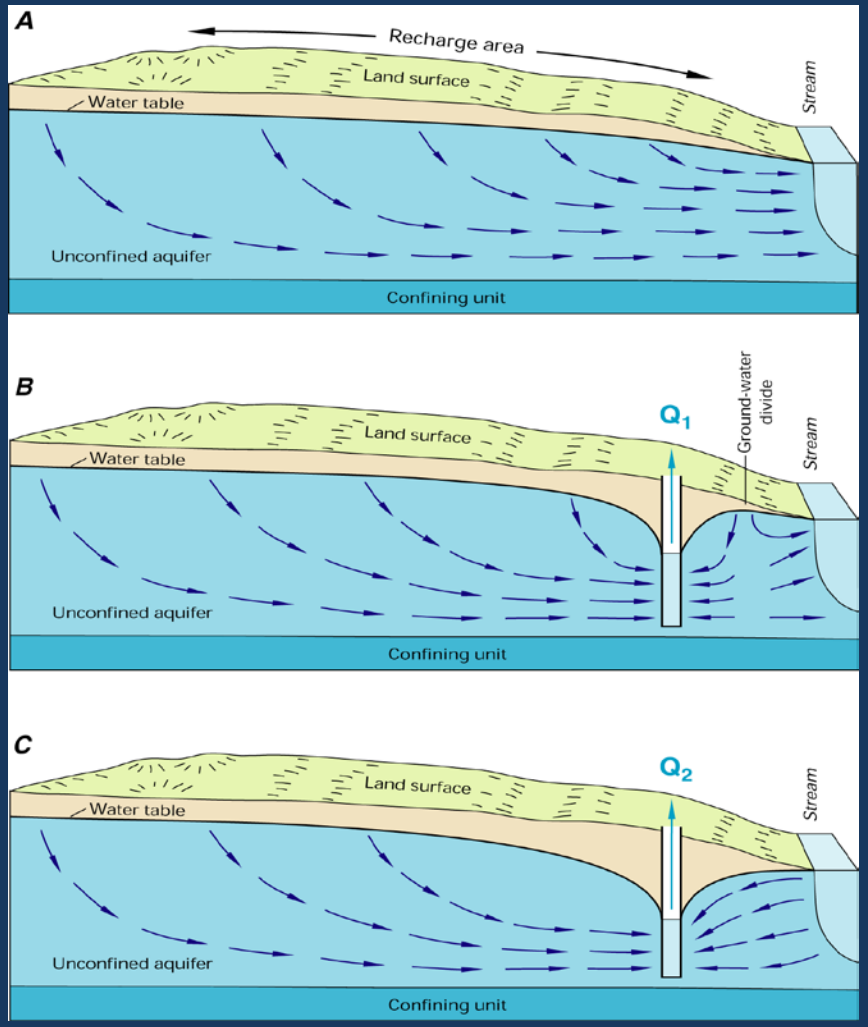


Long Term Water Level Decline

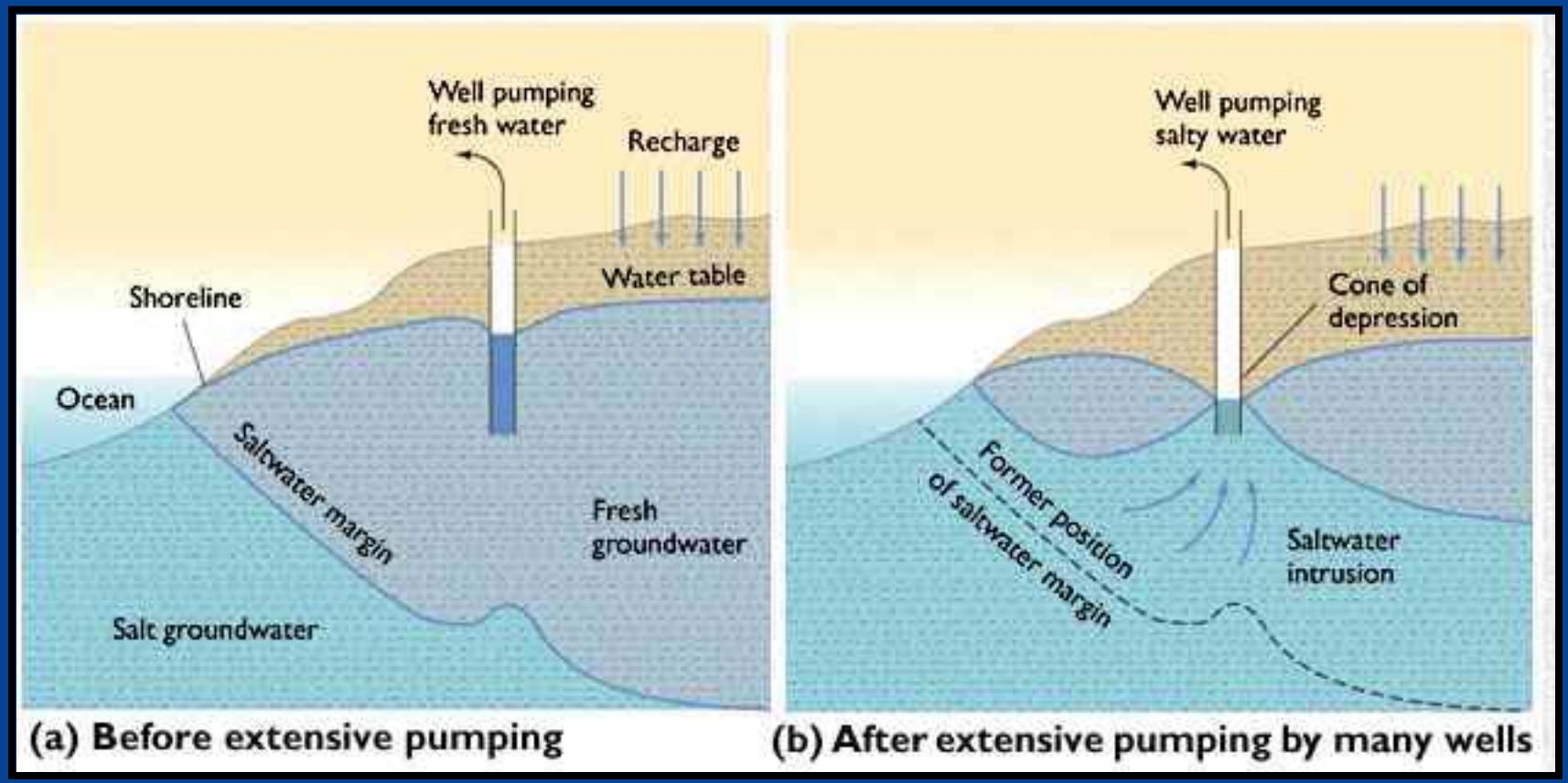


Reversal of Hydraulic Gradient and Saltwater Intrusion

Groundwater Pumping and Reversal of Hydraulic Gradient



Salt Water Intrusion - Upconing



Pumping draws the salt water upwards into the well.

Salinity Within the Aquifer System

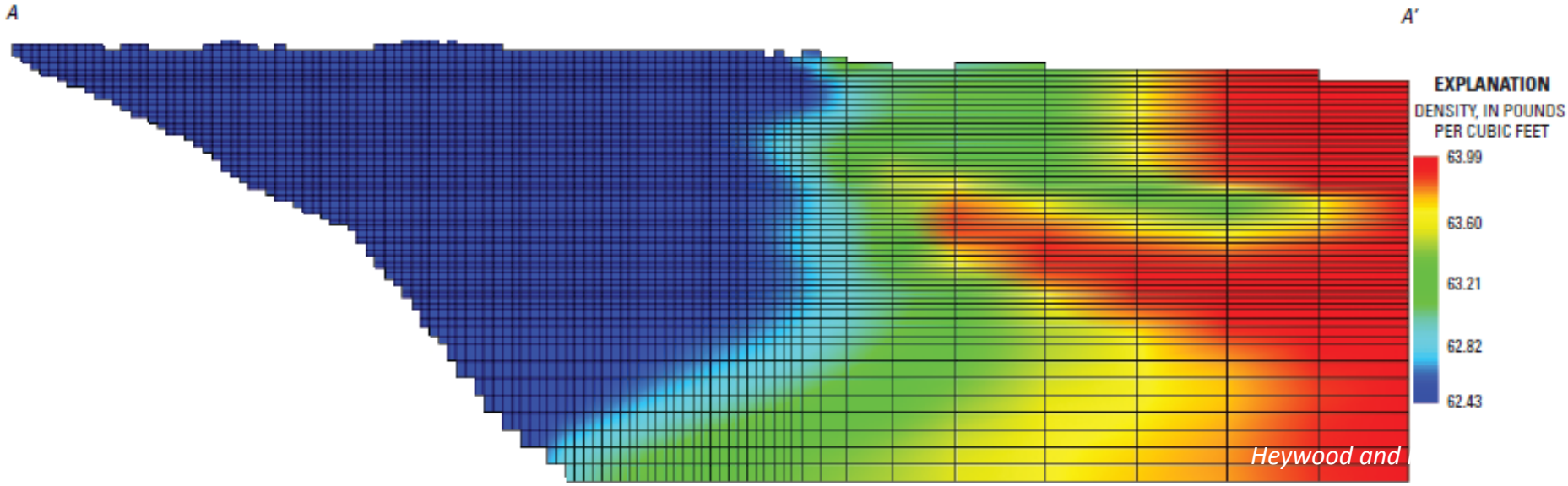
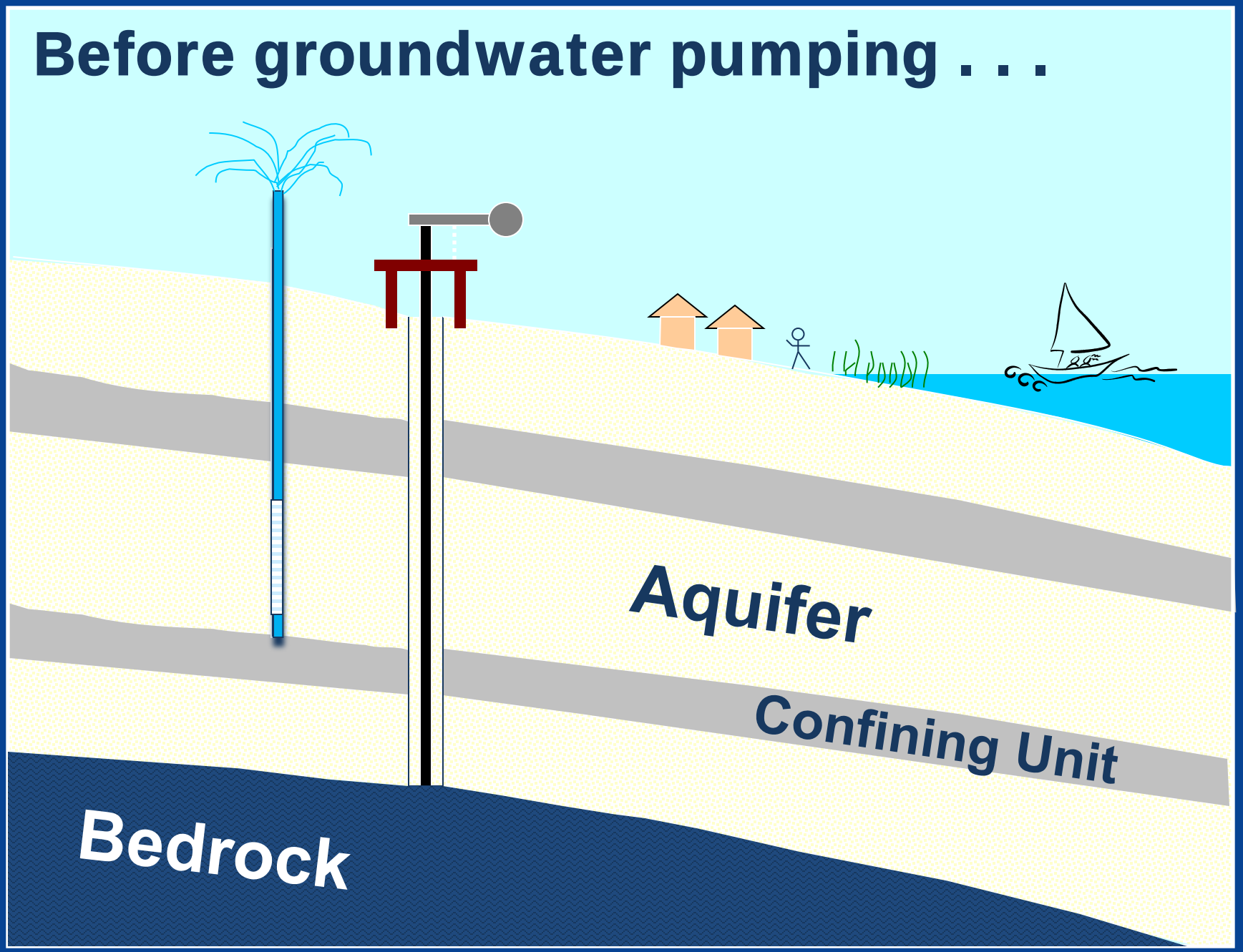


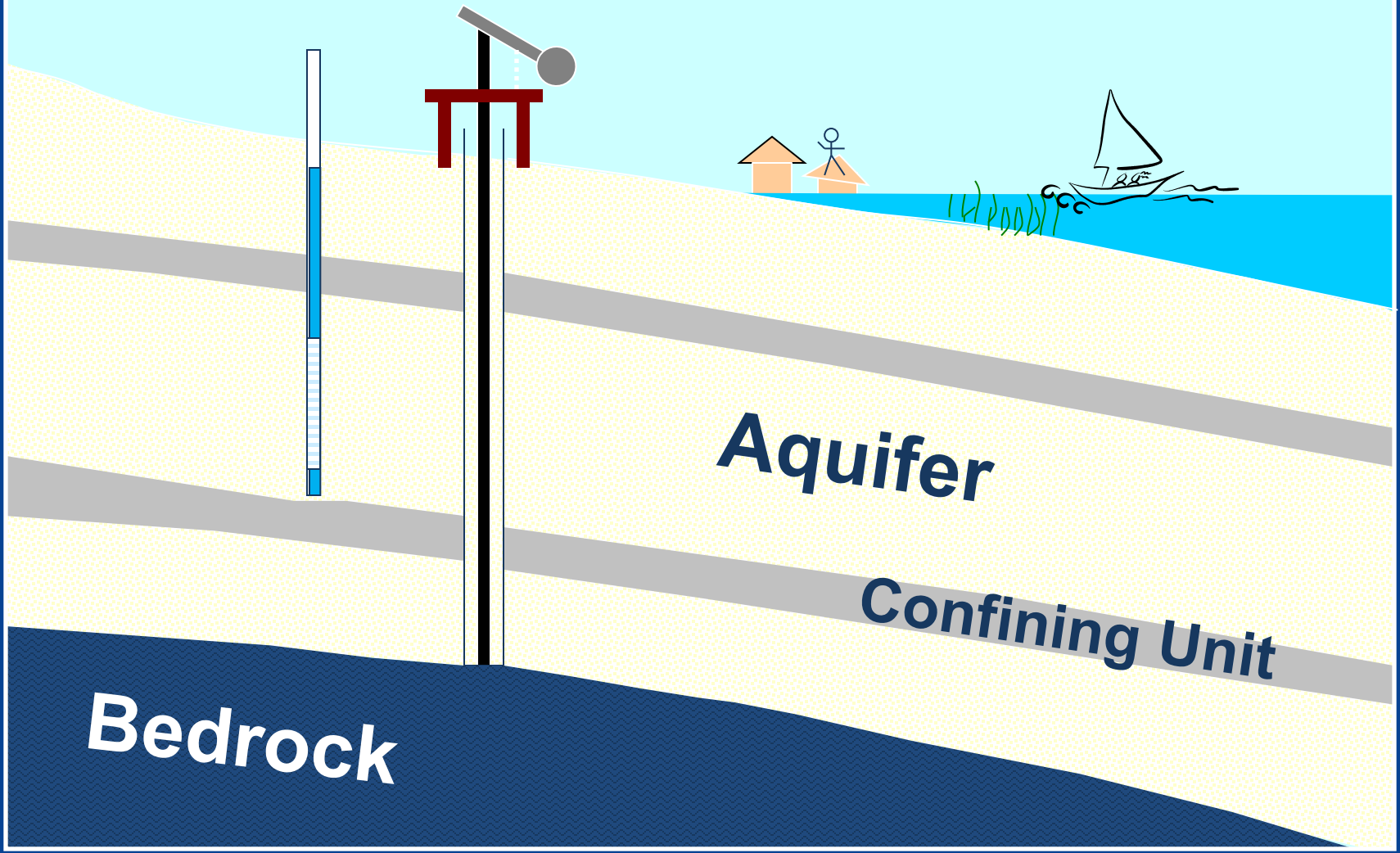
Figure A3. Simulated water density near the saltwater transition zone of the Virginia Coastal Plain. (Location of cross section shown in figure A2.)

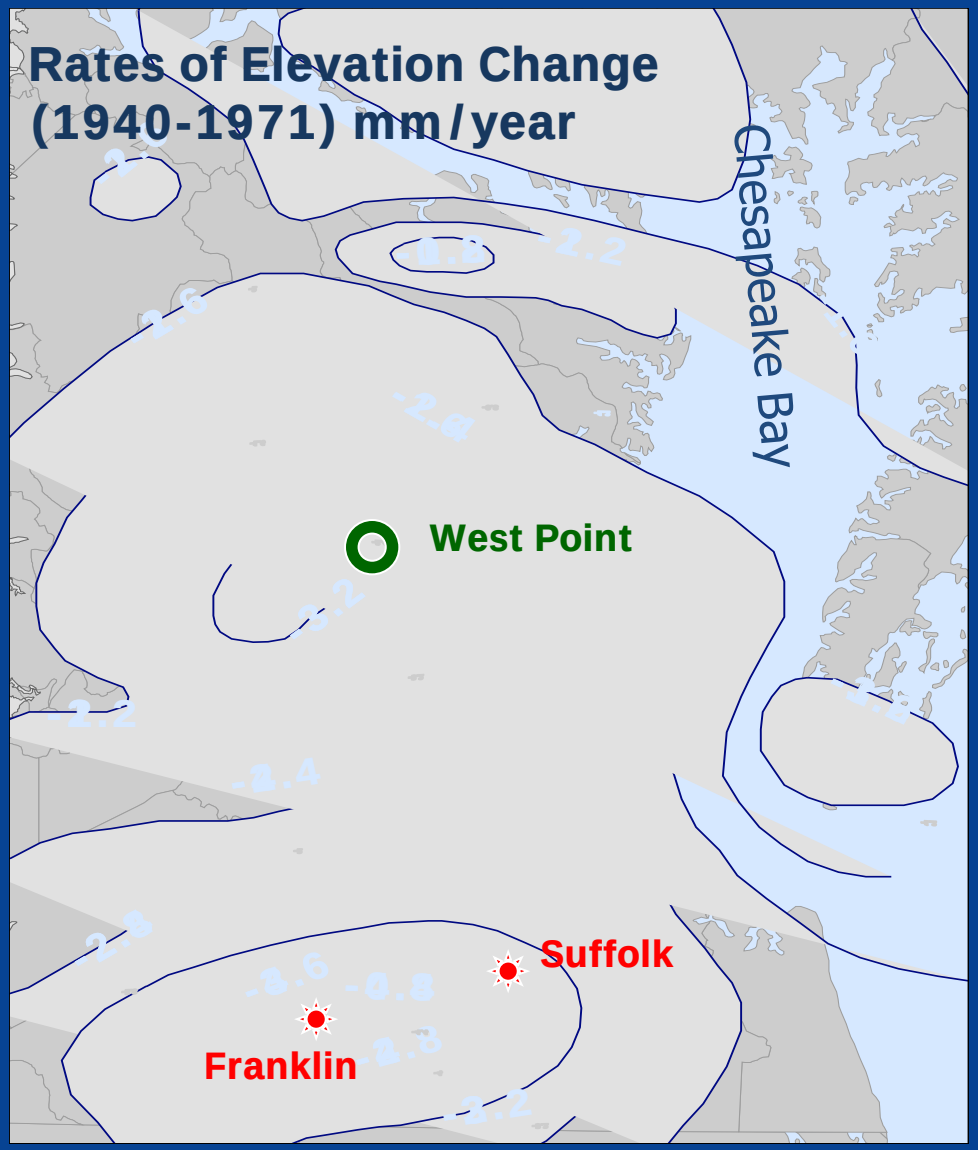
Land Subsidence and Loss of Storage

Before groundwater pumping . . .



. . . and after groundwater pumping





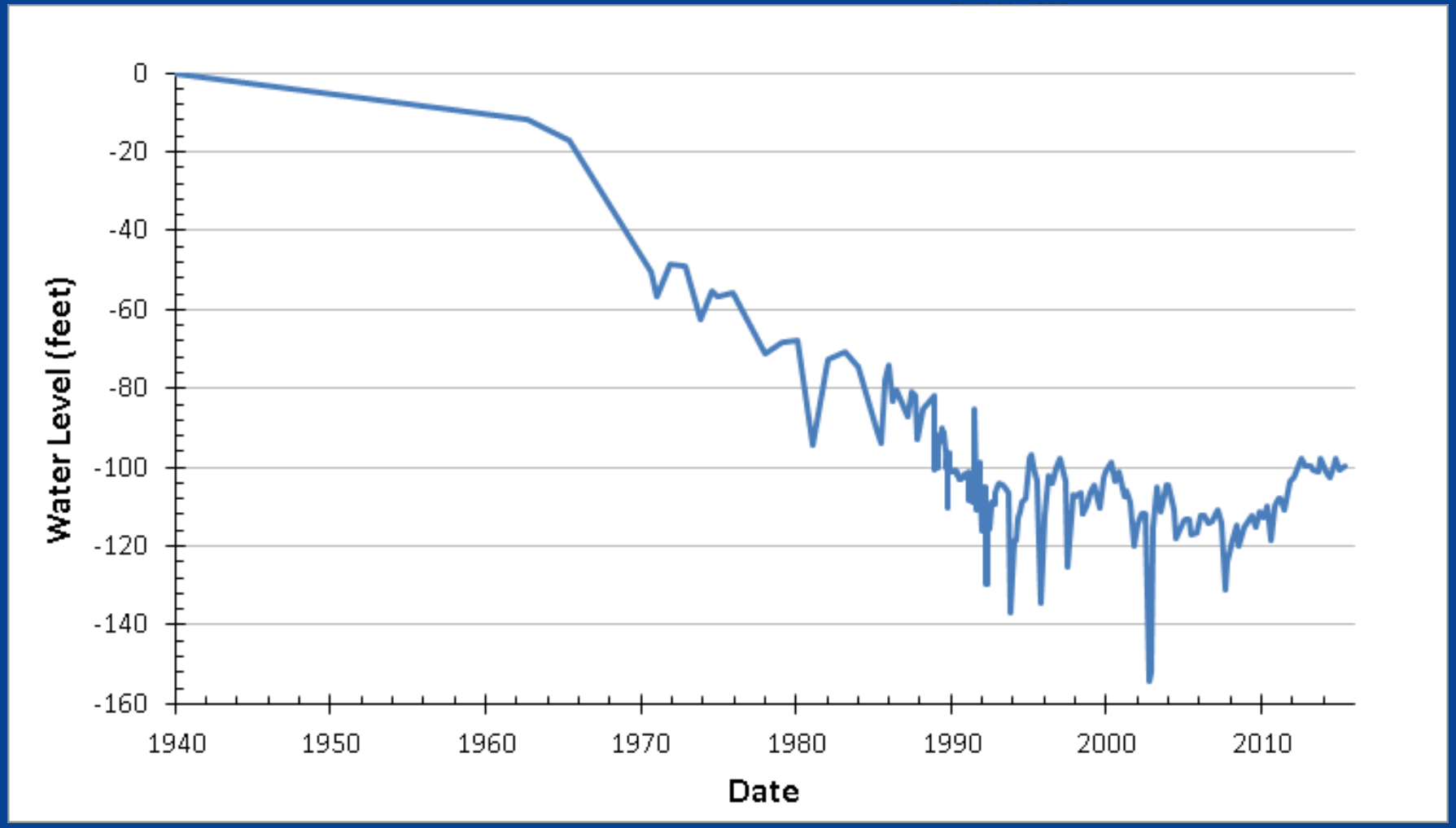
Measurement of Compaction and Subsidence

Franklin Extensometer
Oct. 1979 – Dec. 1995
Depth = 255.1 m

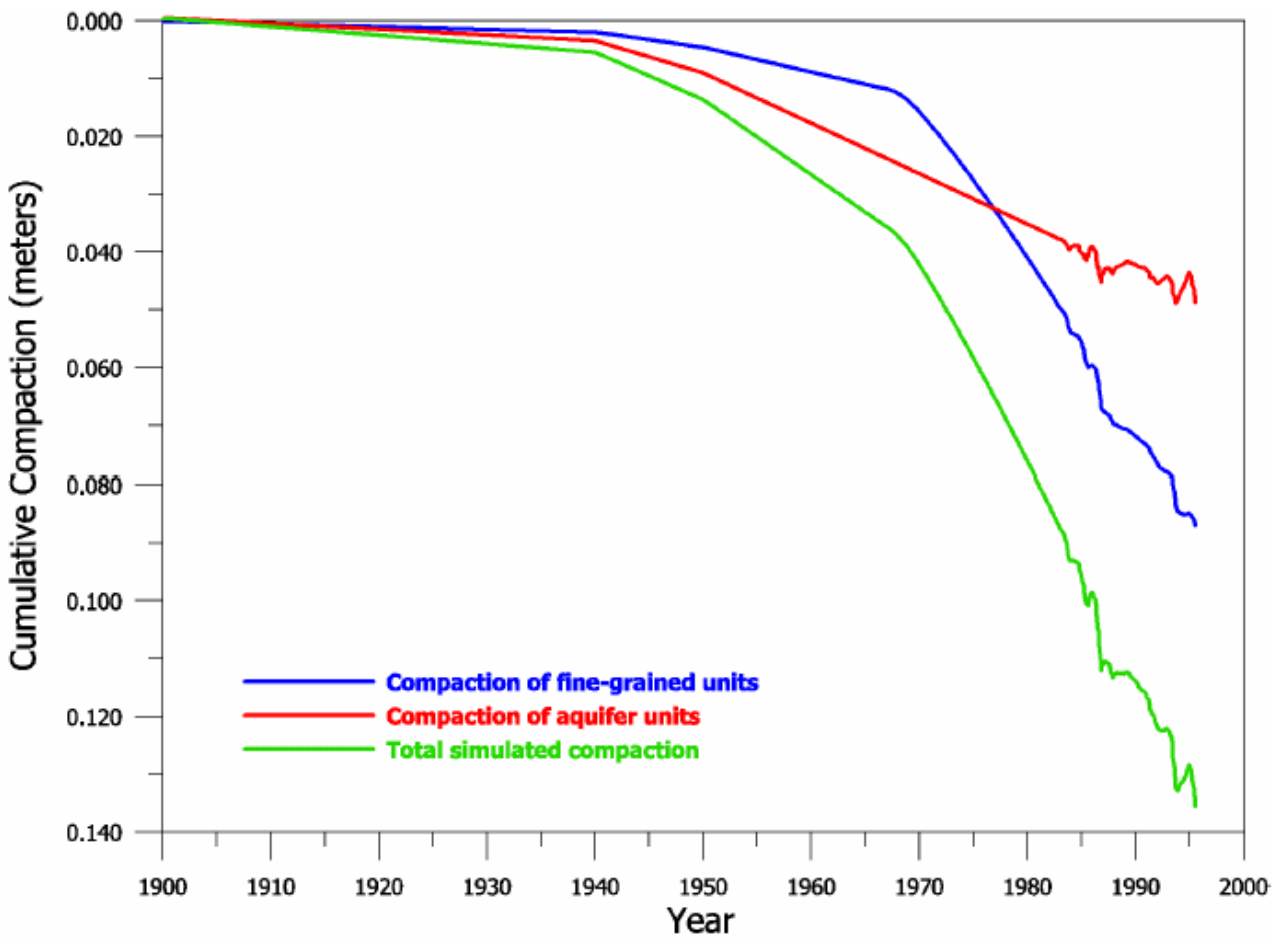
Suffolk Extensometer
June 1982 – Dec. 1995
Depth = 484.0 m

0 25 Miles

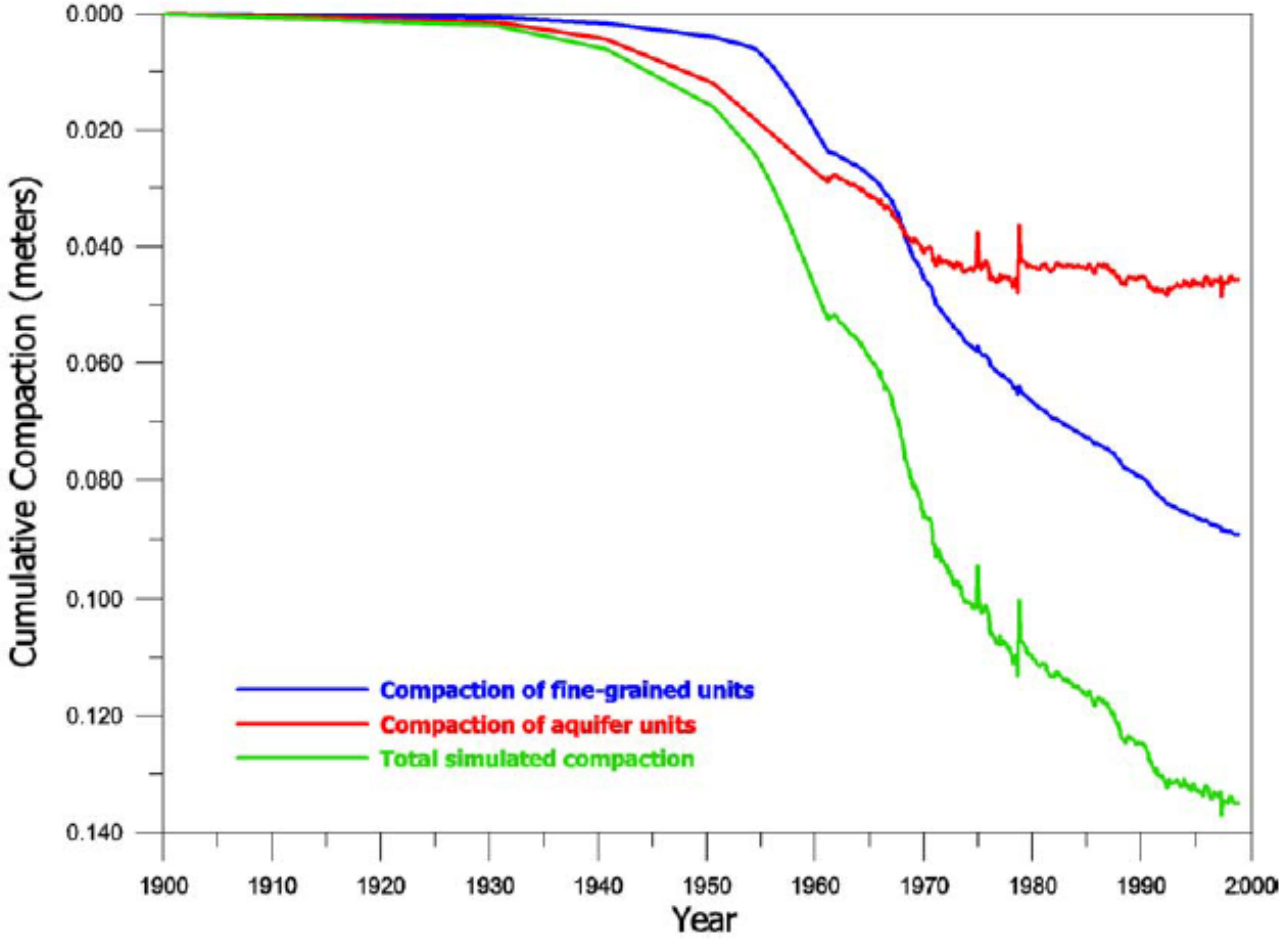
Potomac Aquifer Declines at Suffolk



Simulated Compaction at Suffolk



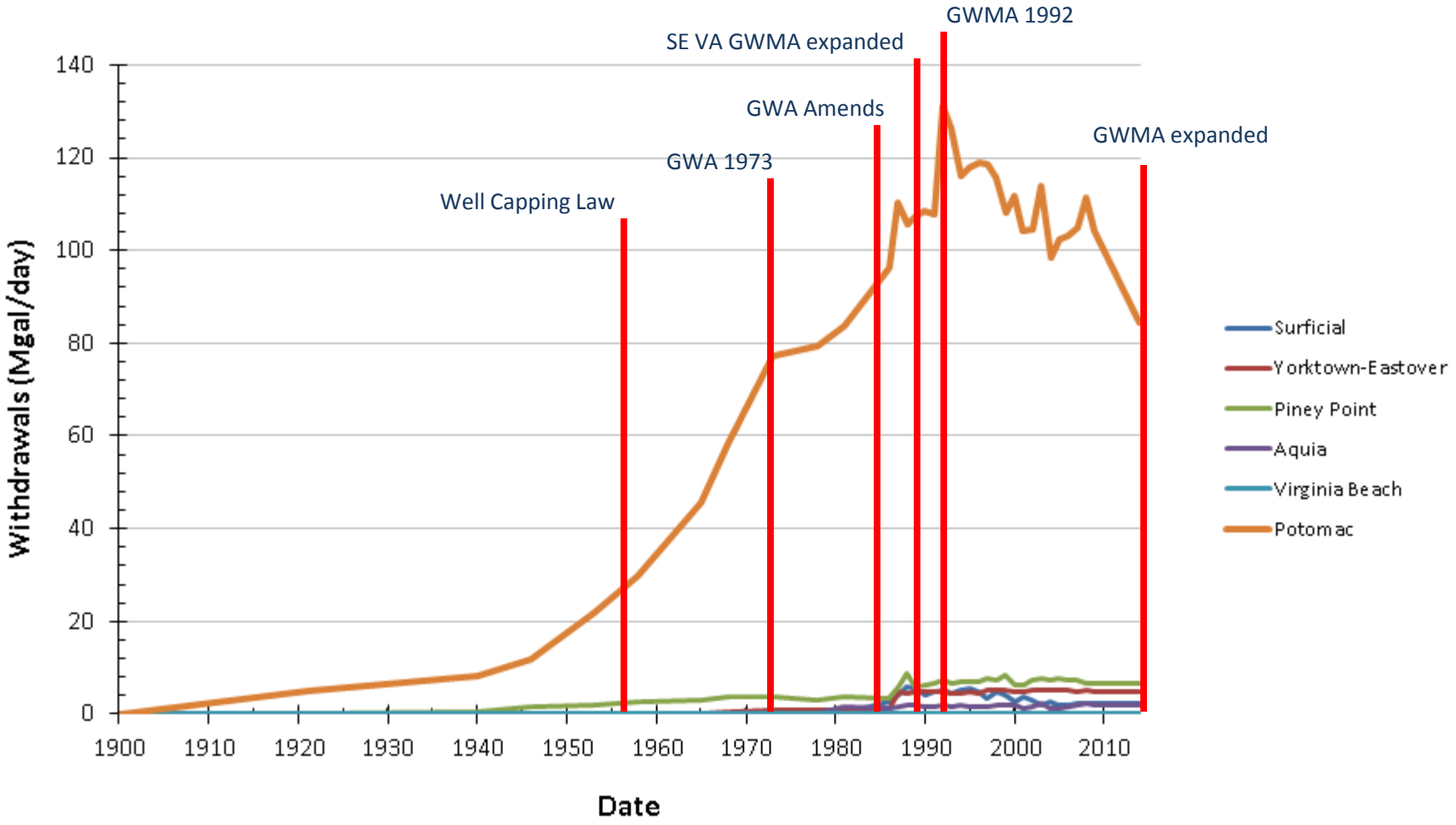
Simulated Compaction at Franklin

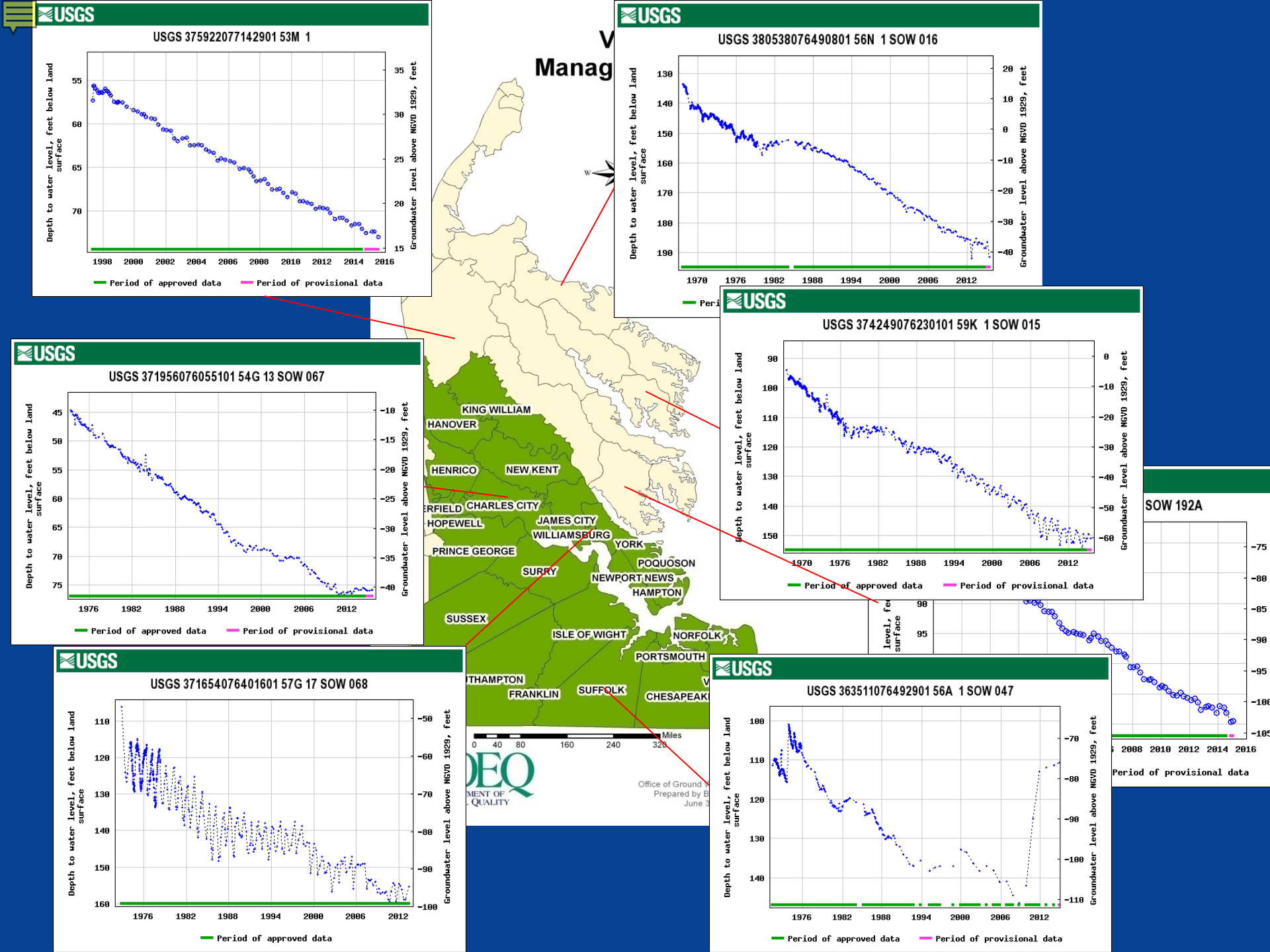


Groundwater Management in Virginia

- Regional studies (late 1970s –early 1980s)
- Hydrologic Framework I (1988)
- Coastal Plain Groundwater Flow Model I (1990)
- Coastal Plain Groundwater Flow Model II (1998)
- Chesapeake Bay Impact Crater (1999)
- Land Subsidence Study I (2002)
- Hydrologic Framework II (2006)
- Coastal Plain Groundwater Flow Model III (2009)
- Eastern Shore Model I (2009)
- Groundwater Quality Trend Study (2010)
- Program Peer Review (2011)
- Potomac Aquifer Study (2013)
- Land Subsidence Study II (2013)
- Piney Point Aquifer Study (2014, publication pending)
- Saltwater Monitoring Network Study (2015, publication pending)

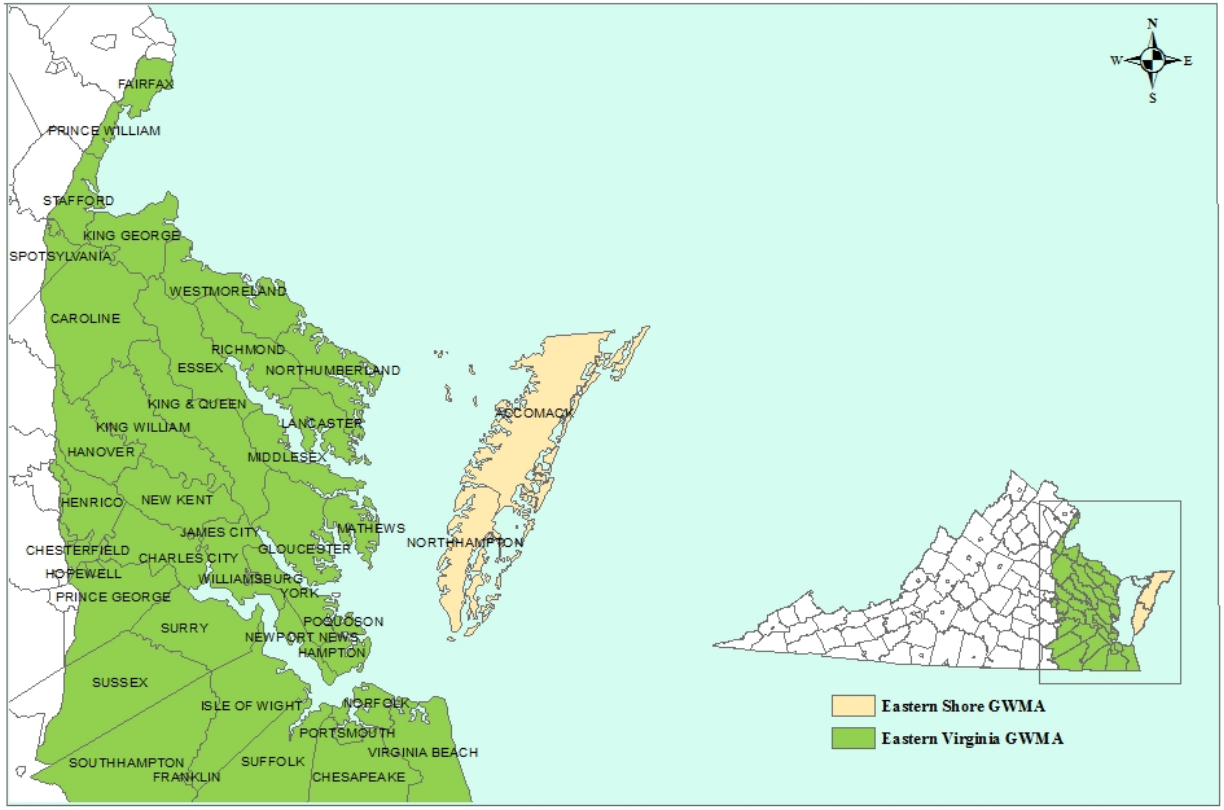
Actual Withdrawals by Aquifer




USGS
USGS 375922077142901 53M 1
Depth to water level, feet below land surface
Groundwater level above NGVD 1929, feet
Period of approved data
Period of provisional data
USGS
USGS 380538076490801 56N 1 SOW 016
Depth to water level, feet below land surface
Groundwater level above NGVD 1929, feet
USGS
USGS 374249076230101 59K 1 SOW 015
Depth to water level, feet below land surface
Groundwater level above NGVD 1929, feet
Period of approved data
Period of provisional data
USGS
USGS 371956076055101 54G 13 SOW 067
Depth to water level, feet below land surface
Groundwater level above NGVD 1929, feet
Period of approved data
Period of provisional data
SOW 192A
Period of provisional data
USGS
USGS 371654076401601 57G 17 SOW 068
Depth to water level, feet below land surface
Groundwater level above NGVD 1929, feet
Period of approved data
USGS
USGS 363511076492901 56A 1 SOW 047
Depth to water level, feet below land surface
Groundwater level above NGVD 1929, feet
Period of approved data
Period of provisional data
KING WILLIAM
HANOVER
HENRICO
NEW KENT
CHARLES CITY
JAMES CITY
HOPEWELL
WILLIAMSBURG
YORK
PRINCE GEORGE
POQUOSON
SURRY
NEWPORT NEWS
HAMPTON
SUSSEX
ISLE OF WIGHT
NORFOLK
PORTSMOUTH
FRANKLIN
SUFFOLK
CHESAPEAKE
Miles
0 40 80 160 240 320
Office of Ground
Prepared by B
June 3

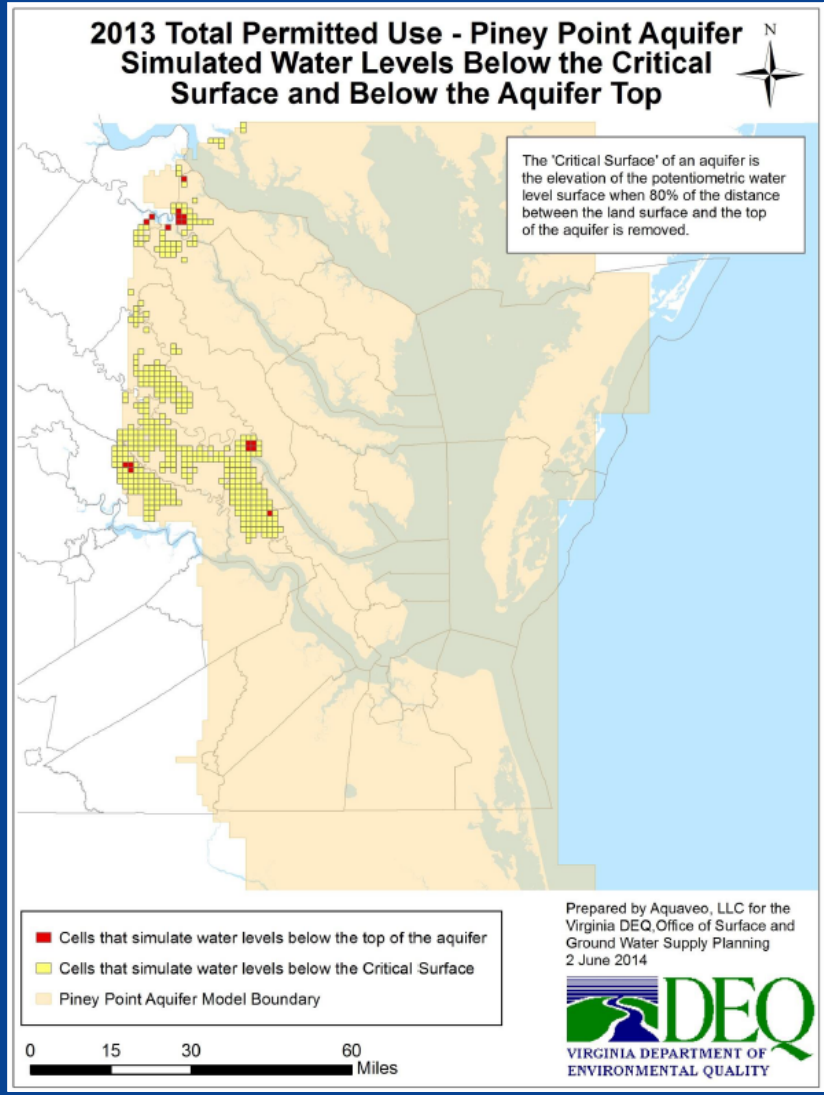
GW Management Areas

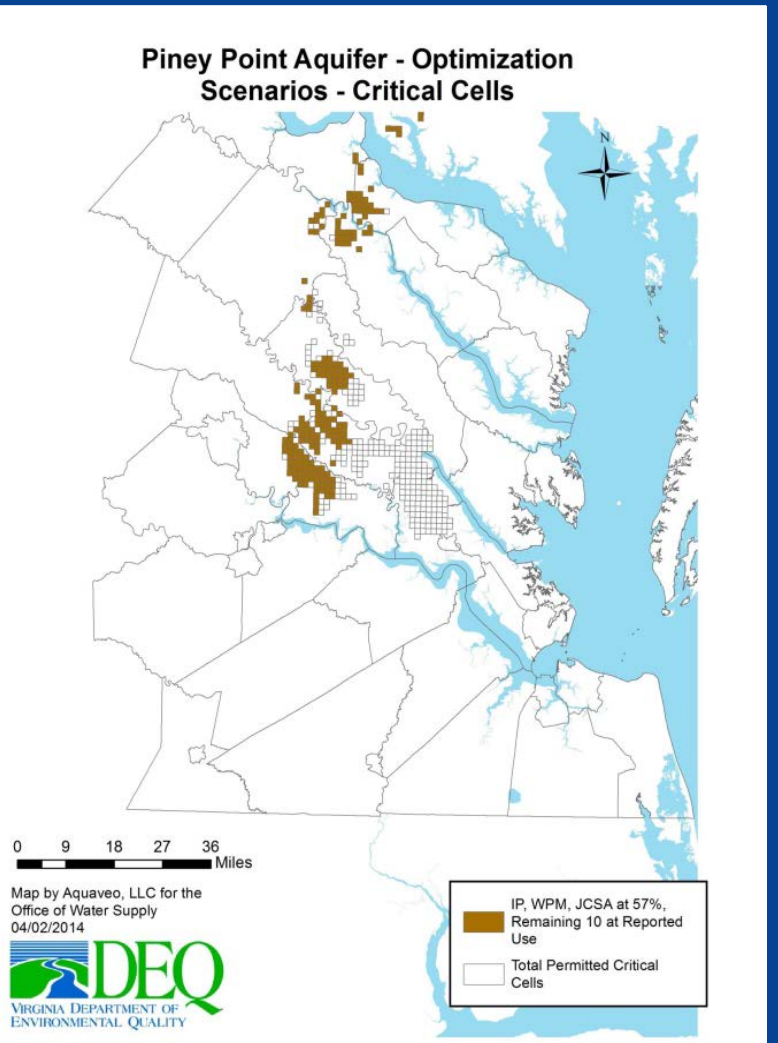
COMMONWEALTH OF VIRGINIA
GROUNDWATER MANAGEMENT AREAS (GWMA)

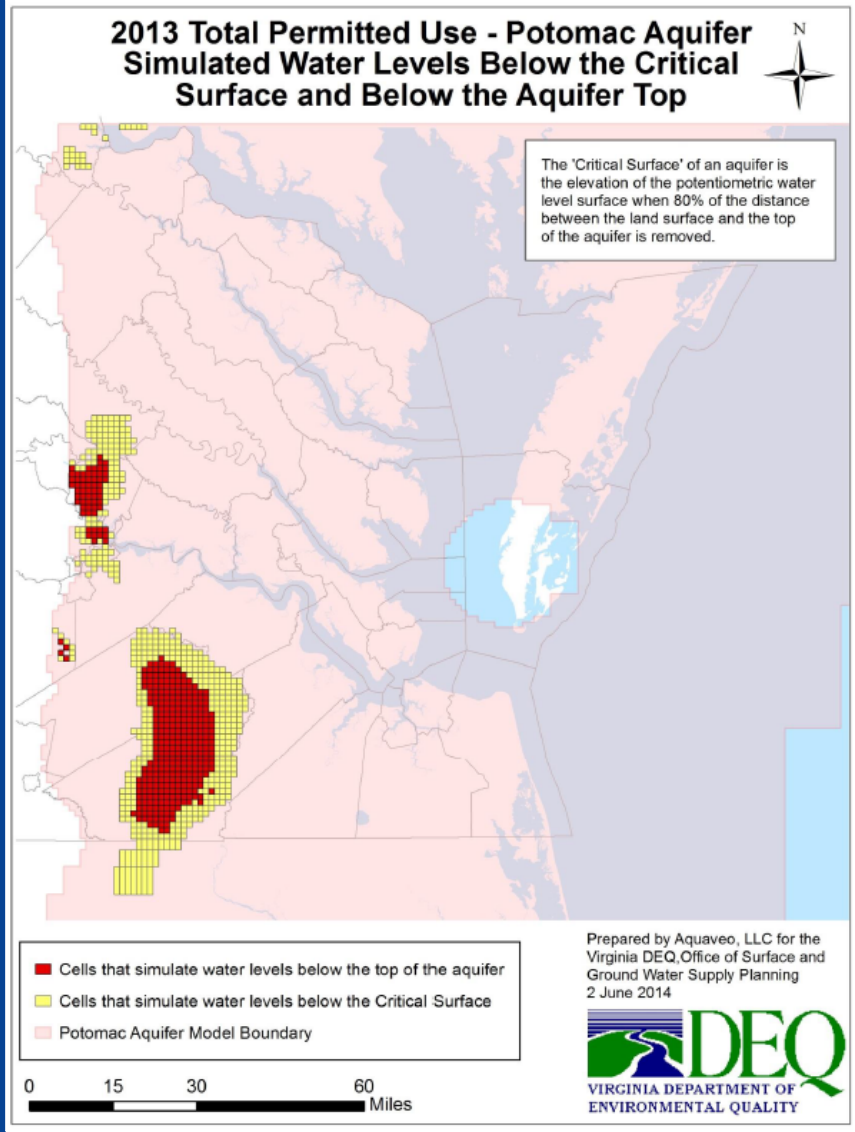


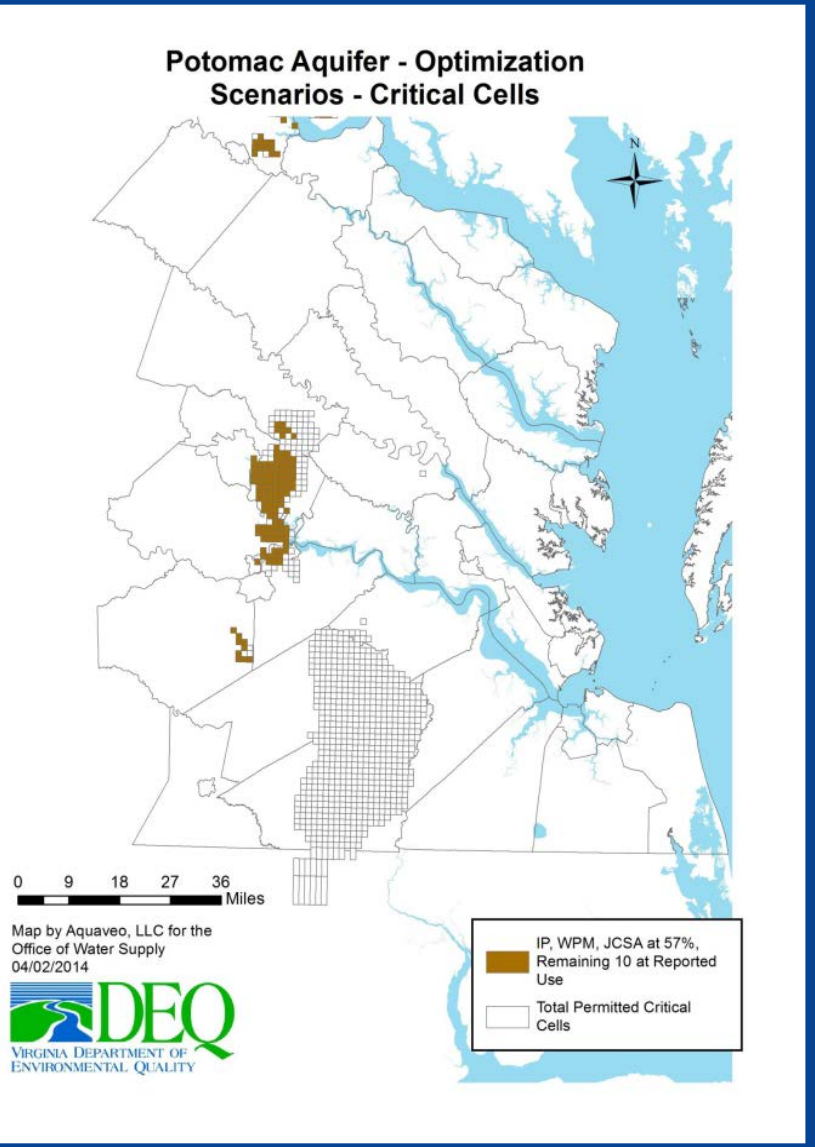
Effective: January 1, 2014
Prepared By: Virginia Department of Environmental Quality
Groundwater Withdrawal Permitting Program

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY


2013 Total Permitted Use - Piney Point Aquifer
Simulated Water Levels Below the Critical
Surface and Below the Aquifer Top
N
The 'Critical Surface' of an aquifer is the elevation of the potentiometric water level surface when 80% of the distance between the land surface and the top of the aquifer is removed.
Cells that simulate water levels below the top of the aquifer
Cells that simulate water levels below the Critical Surface
Piney Point Aquifer Model Boundary
0 15 30 60
Miles
Prepared by Aquaveo, LLC for the Virginia DEQ,Office of Surface and Ground Water Supply Planning
2 June 2014
DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY


Piney Point Aquifer - Optimization
Scenarios - Critical Cells
N
0 9 18 27 36
Miles
Map by Aquaveo, LLC for the
Office of Water Supply
04/02/2014
DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY
IP, WPM, JCSA at 57%, Remaining 10 at Reported Use
Total Permitted Critical Cells


2013 Total Permitted Use - Potomac Aquifer
Simulated Water Levels Below the Critical
Surface and Below the Aquifer Top
N
The 'Critical Surface' of an aquifer is the elevation of the potentiometric water level surface when 80% of the distance between the land surface and the top of the aquifer is removed.
Cells that simulate water levels below the top of the aquifer
Cells that simulate water levels below the Critical Surface
Potomac Aquifer Model Boundary
0 15 30 60
Miles
Prepared by Aquaveo, LLC for the Virginia DEQ,Office of Surface and Ground Water Supply Planning
2 June 2014
DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY


Potomac Aquifer - Optimization
Scenarios - Critical Cells
N
0 9 18 27 36
Miles
Map by Aquaveo, LLC for the Office of Water Supply
04/02/2014
DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY
IP, WPM, JCSA at 57%, Remaining 10 at Reported Use
Total Permitted Critical Cells

Questions?