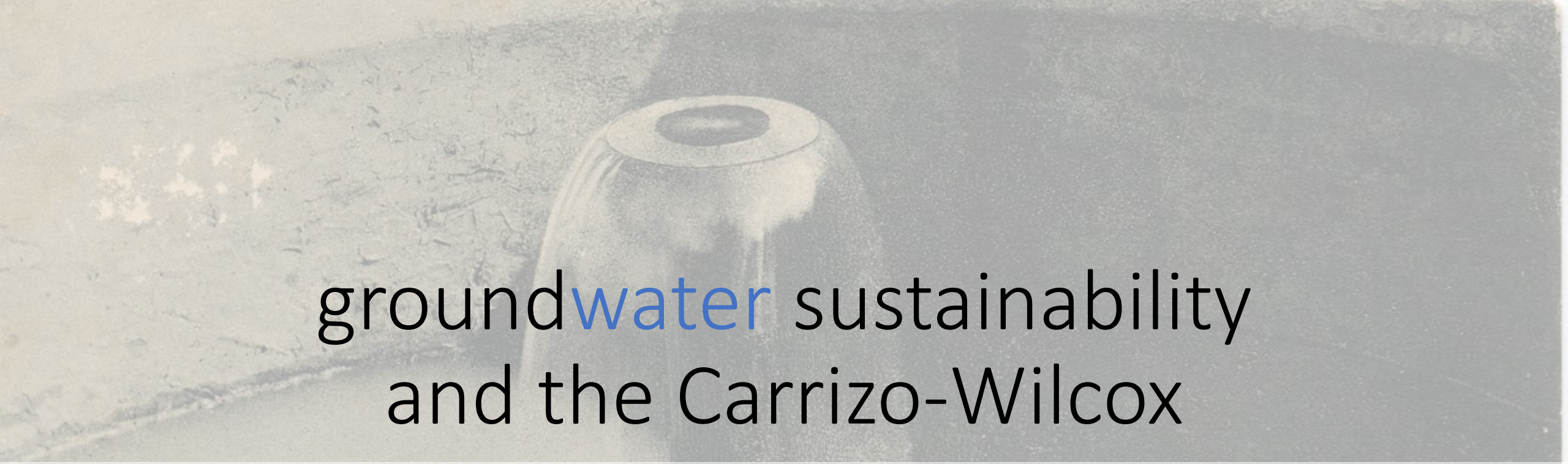


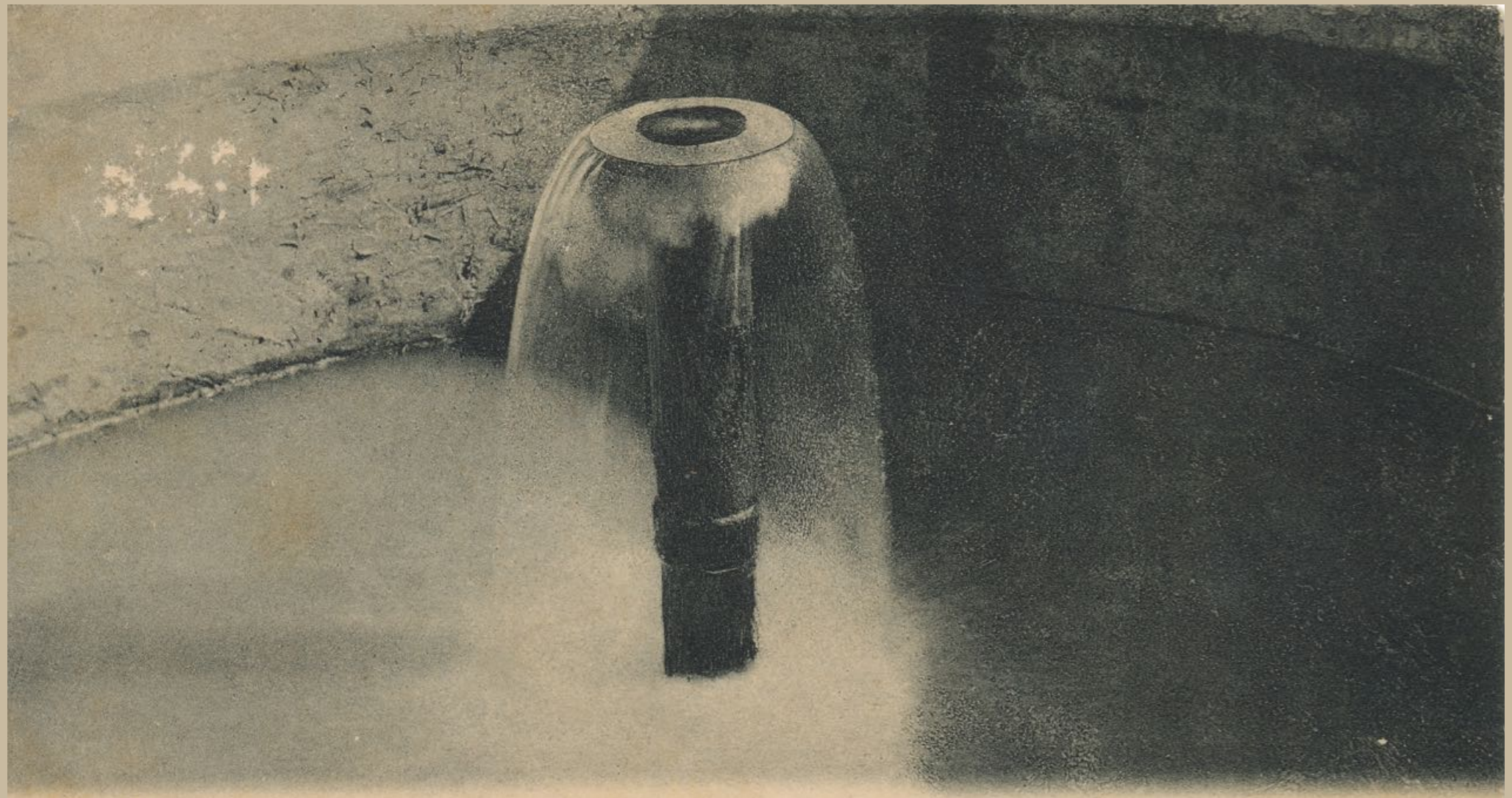
groundwater sustainability and the Carrizo-Wilcox

Robert E. Mace, Ph.D., P.G.
The Meadows Center for Water & the Environment
Department of Geography and Environmental Studies
Texas State University

presented to the

Groundwater Conservation Districts of Groundwater Management Area 12
Milano, Texas; April 21, 2022

Artesian Well at Caldwell, Texas.
Water Flowing from a 6 in. pipe. Flow estimated at Half Million Gallons Daily.

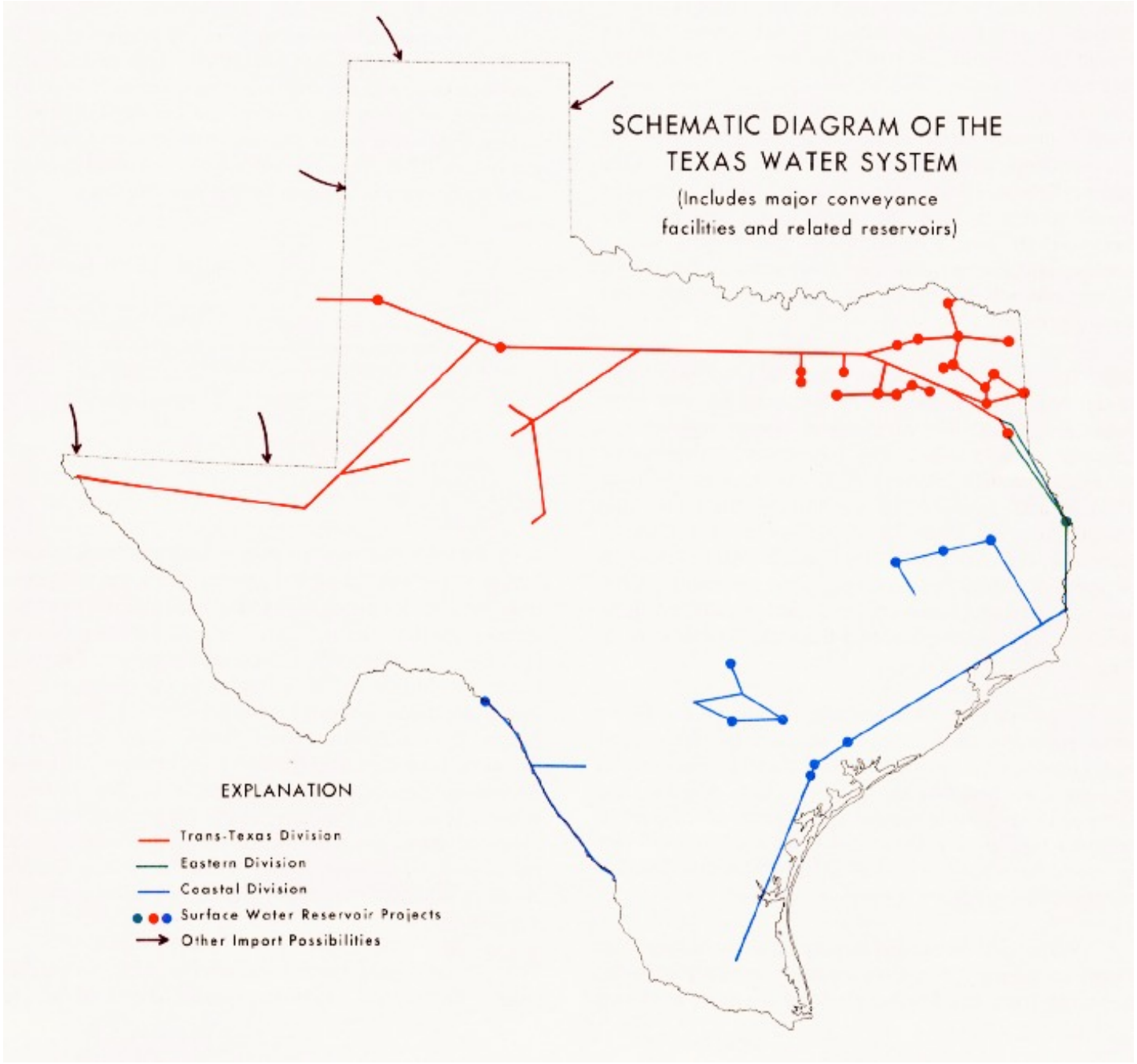


Artesian Well at Caldwell, Texas.

Water Flowing from a 6 in. pipe. Flow estimated at Half Million Gallons Daily.

~350 gallons per minute

- **Owens Valley**
  - Charles H. Lee (1915) introduced the term "safe yield" to groundwater
  - "…the limit to the quantity of water which can be withdrawn regularly and permanently without dangerous depletion of the storage reserve."



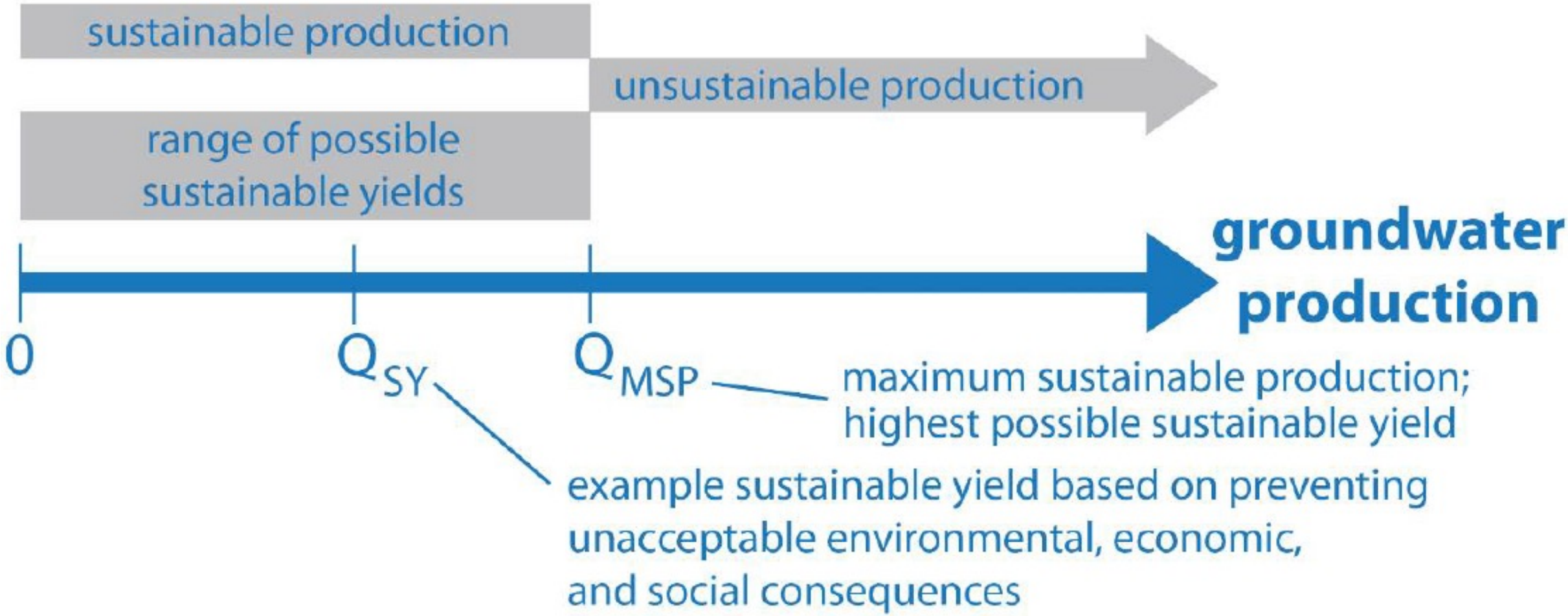
Texas Water Development Board
1968 State Water Plan

one of the plan's guiding principles was for groundwater resources to "…be developed and used on a safe-yield basis"

groundwater availability

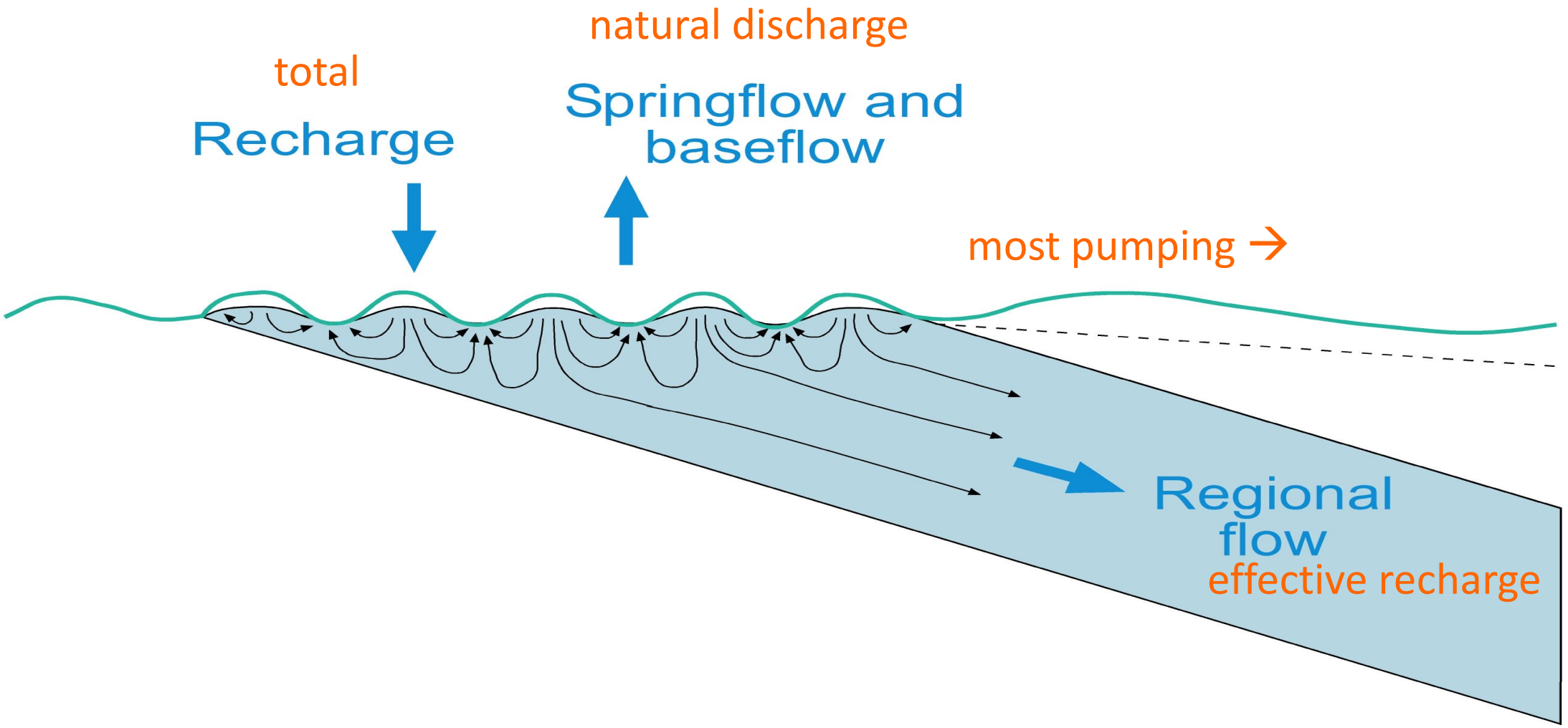
definitions:

- groundwater sustainability is the "development and use of ground water in a manner that can be maintained for an indefinite time without causing unacceptable environmental, economic, or social consequences." (Alley and others 1999) (policy informed by science)
- sustainable yield is the amount that can be produced to achieve groundwater sustainability (science defined by policy)
- sustainable production is any production that can be done indefinitely
  - sustainable yield is a special case
- time: needs to be indefinite but adaptive
- safe yield = sustainable yield
- choosing to manage sustainably (or not) is a policy decision


sustainable production
unsustainable production
range of possible
sustainable yields
groundwater
production
0
Q_{SY}
Q_{MSP}
maximum sustainable production;
highest possible sustainable yield
example sustainable yield based on preventing
unacceptable environmental, economic,
and social consequences

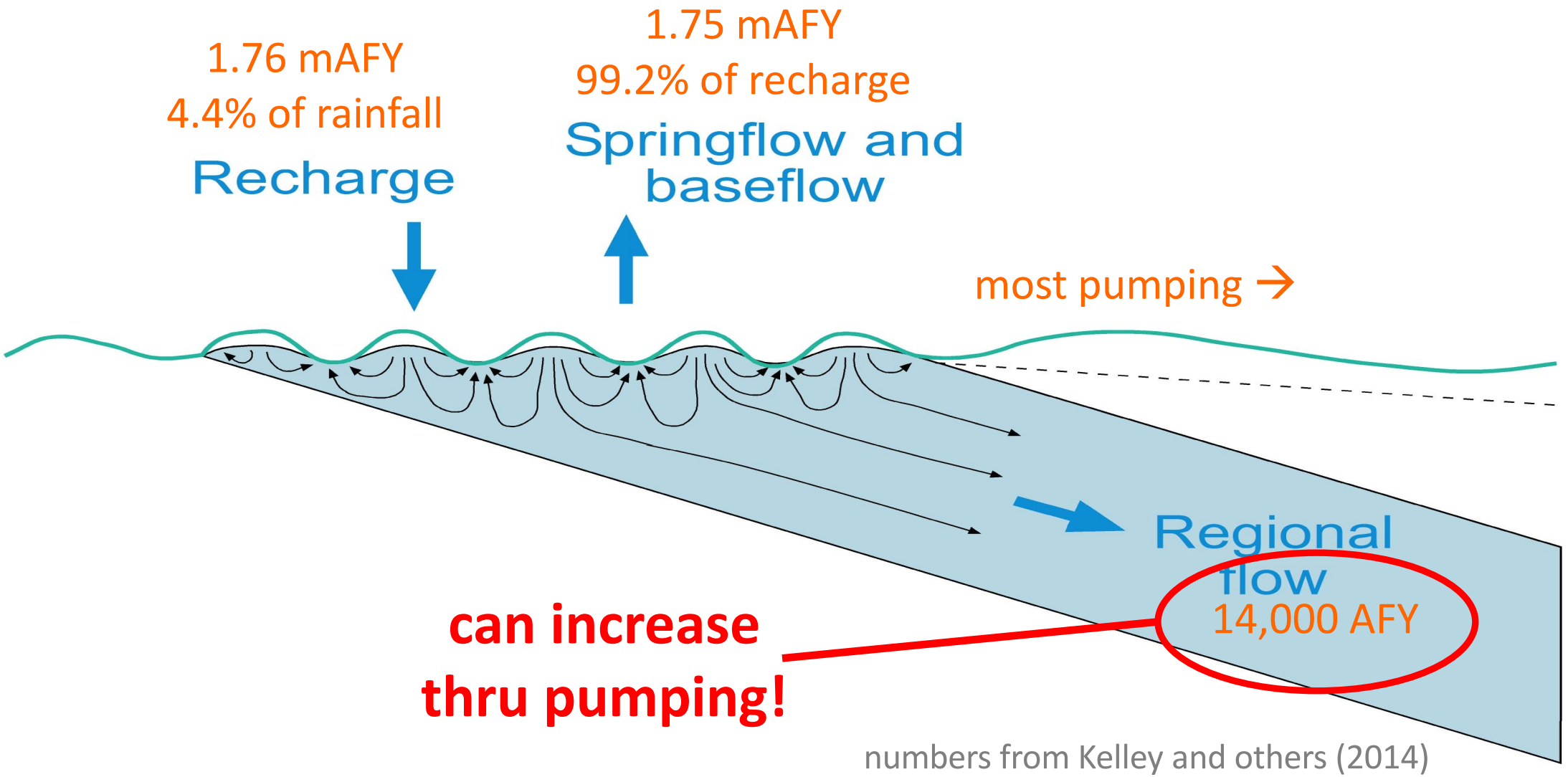
Mace (2021)

confined aquifer



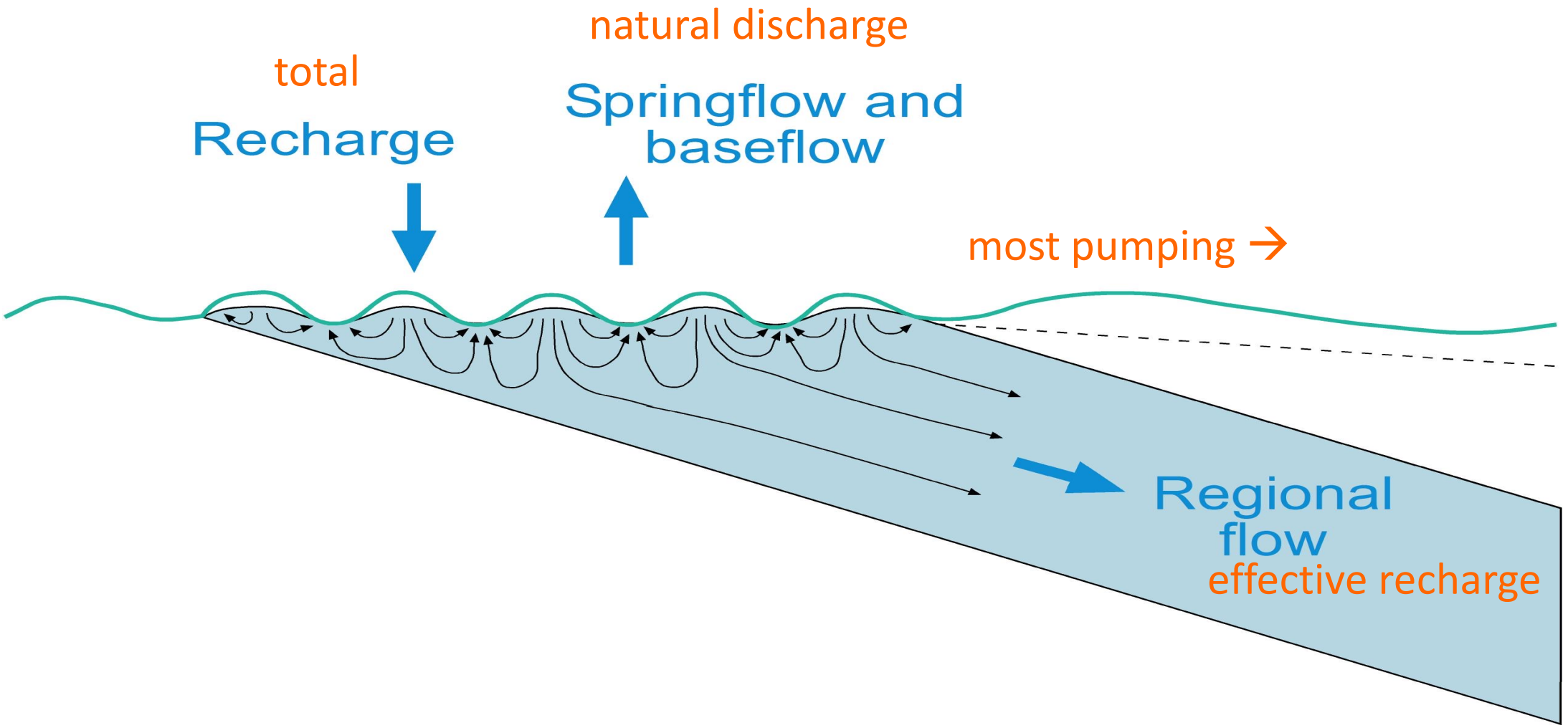
Trinity Aquifer

north of the Colorado



numbers from Kelley and others (2014)

Carrizo-Wilcox aquifer?



FIVE GALLONS IN A TEN GALLON HAT: GROUNDWATER SUSTAINABILITY IN TEXAS

November 2021 | Report: 2021-08

THE MEADOWS CENTER
FOR WATER AND THE ENVIRONMENT
TEXAS STATE UNIVERSITY

AUTHOR:

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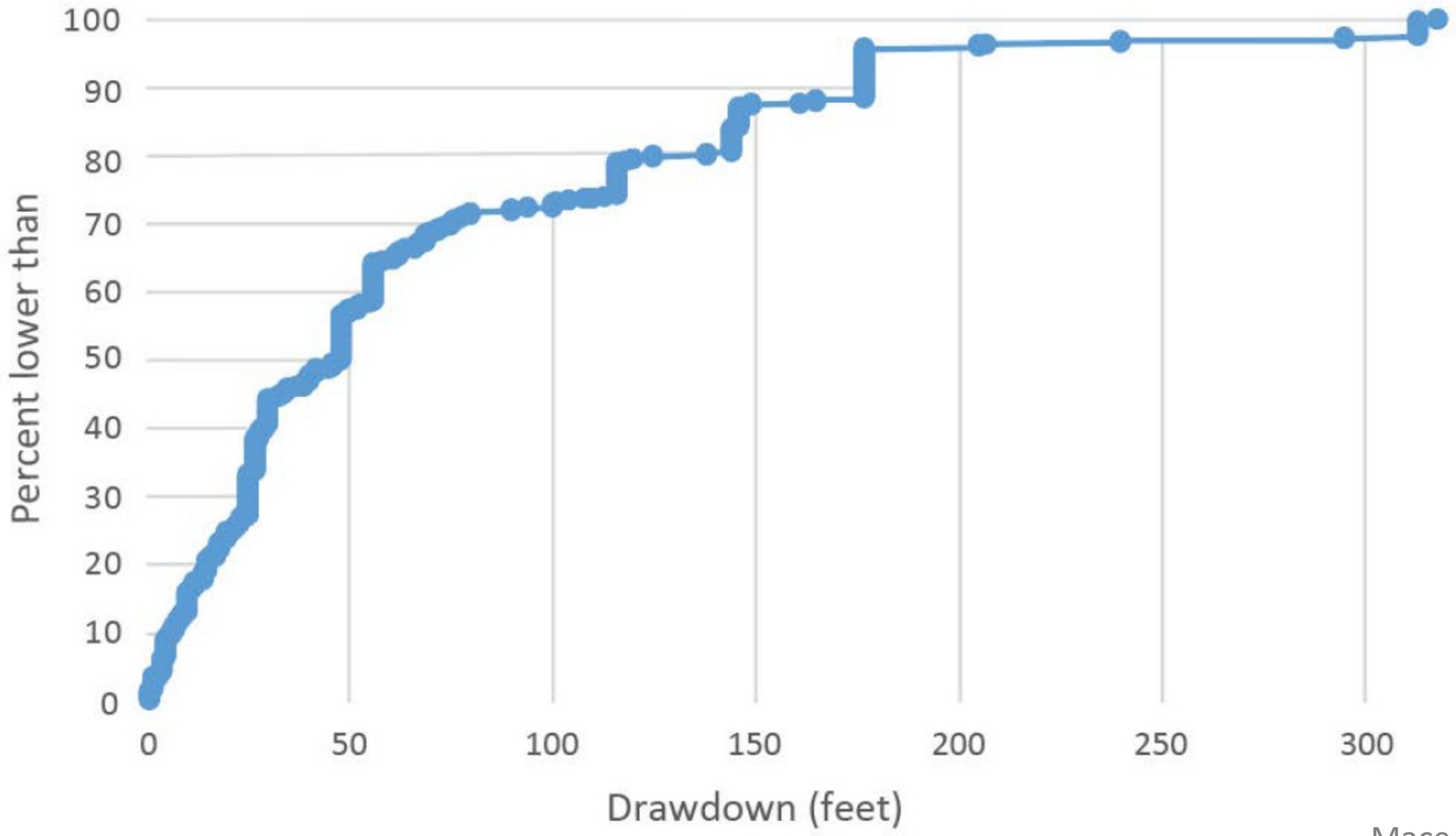
Texas State University

MEMBER **THE TEXAS STATE UNIVERSITY SYSTEM**

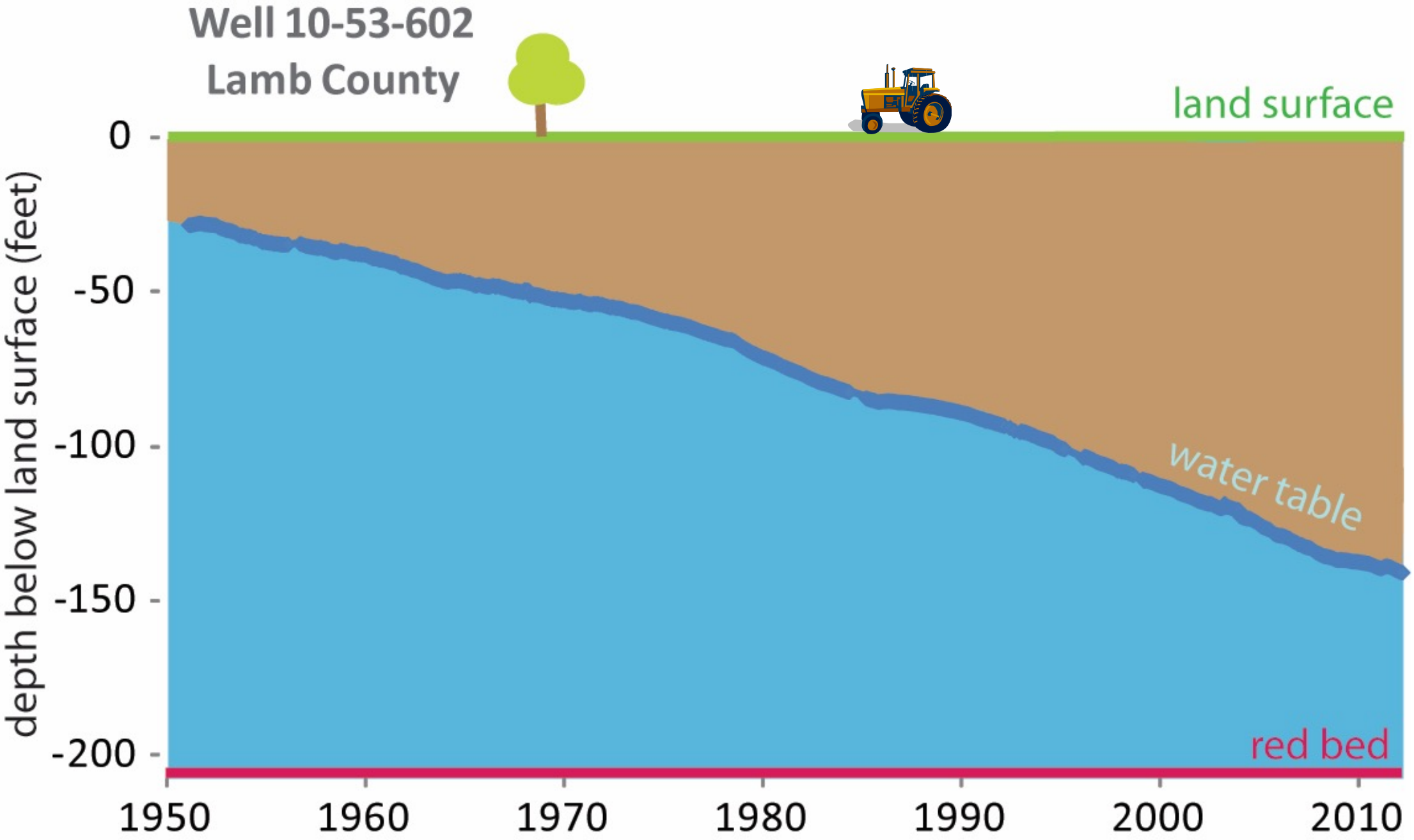
drawdowns for desired future conditions



Mace (2021)

sustainability of Texas aquifers

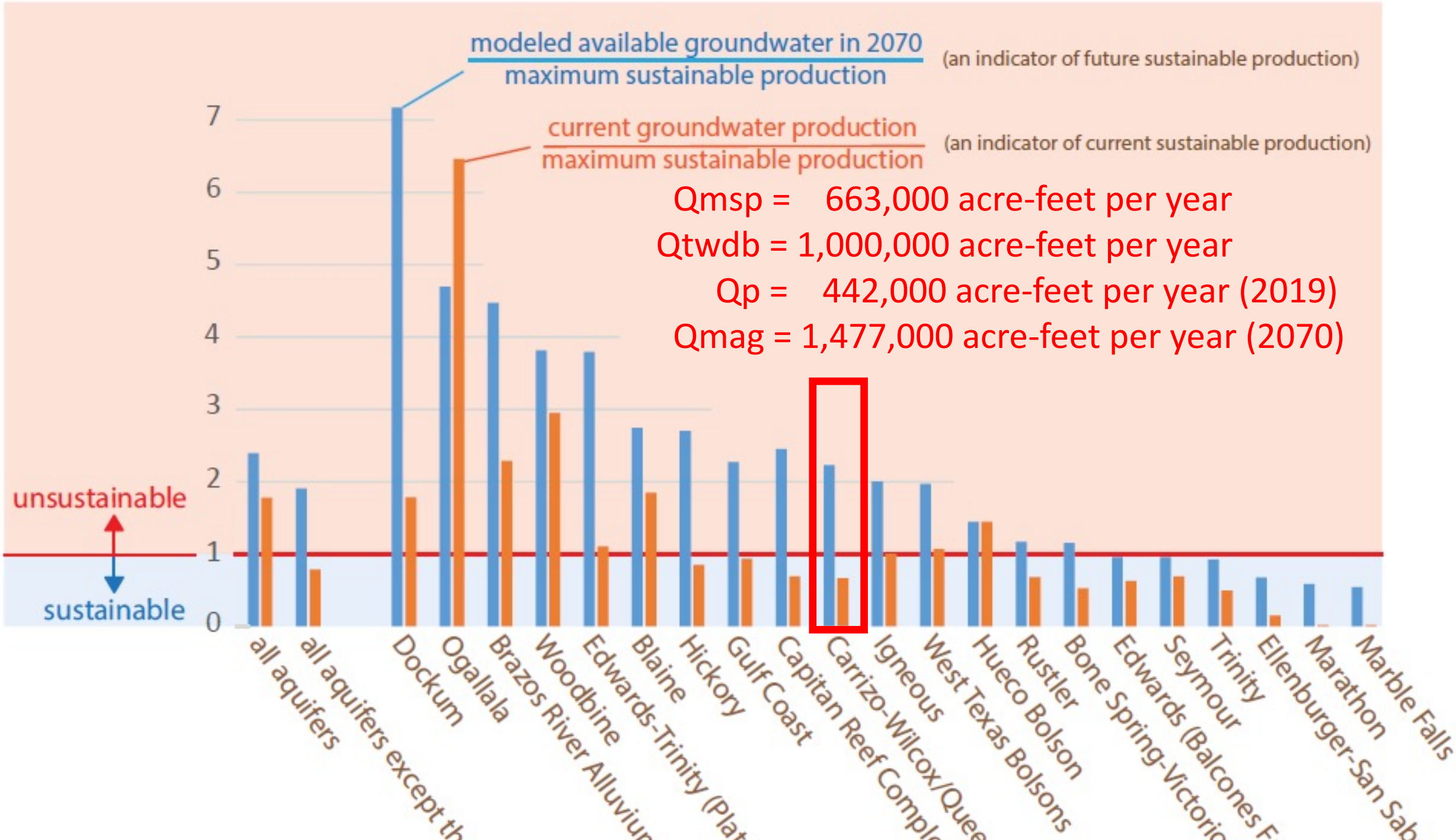
- “max” sustainable production of Texas aquifers:
  - ~4.0 million acre-feet per year
- current production:
  - ~7.1 million acre-feet per year
  - producing 1.8 times “max” sustainable production
- groundwater availability:
  - 9.4 million acre-feet per year
  - availability = ~2.4 times “max” sustainable production



author's graphic

a world without the Ogallala…

- Ogallala provides 64% of all groundwater in Texas…
- “max” sustainable production of Texas aquifers (no Ogly-Ugly):
  - ~3.3 million acre-feet per year
- current production (no Ogly-Ugly):
  - ~2.6 million acre-feet per year
  - producing 0.8 times “max” sustainable production
- groundwater availability (no Ogly-Ugly):
  - 6.3 million acre-feet per year
  - availability = ~1.9 times “max” sustainable production

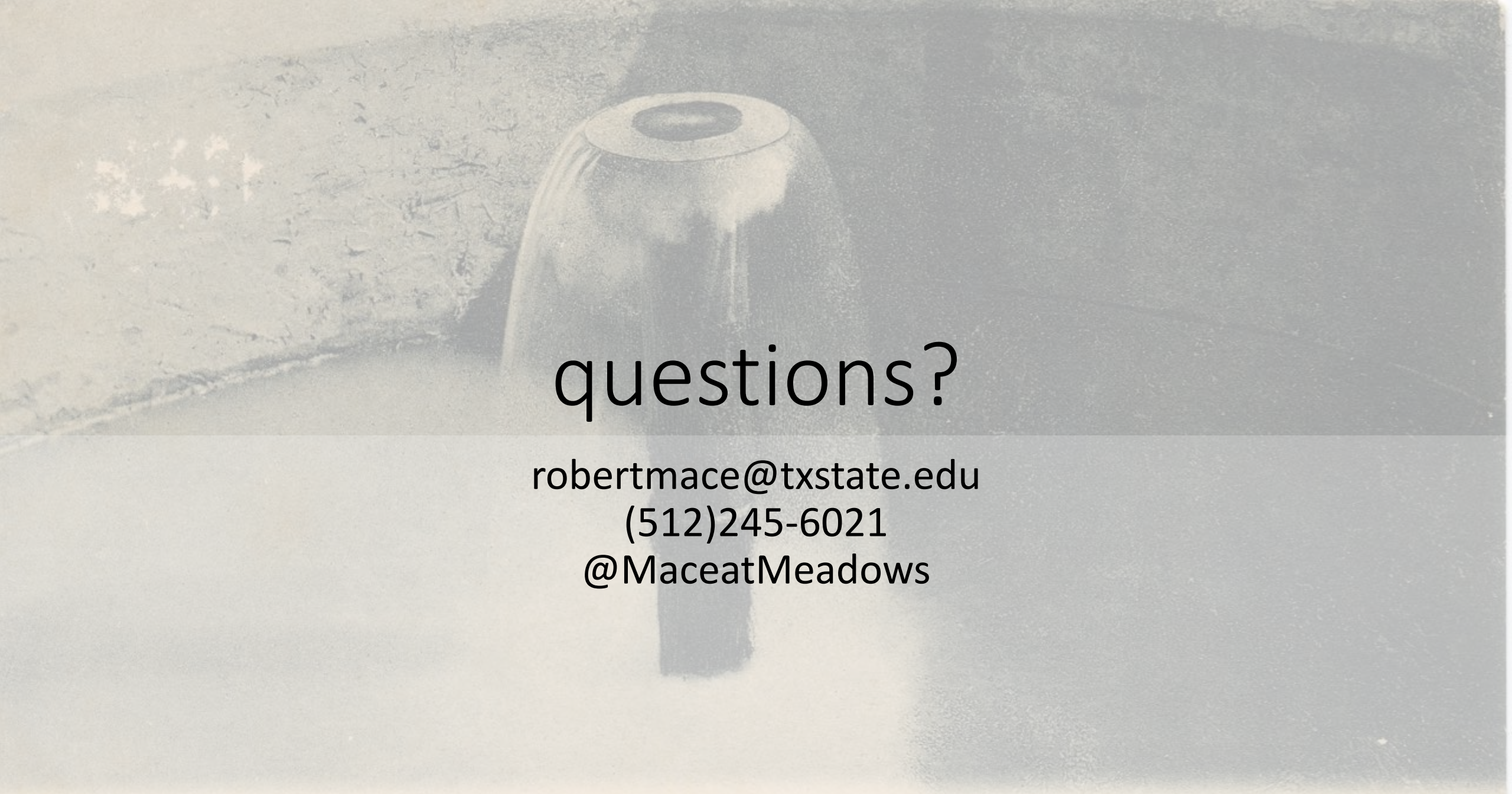

modeled available groundwater in 2070
maximum sustainable production
(an indicator of future sustainable production)
current groundwater production
maximum sustainable production
(an indicator of current sustainable production)
Qmsp = 663,000 acre-feet per year
Qtwdb = 1,000,000 acre-feet per year
Qp = 442,000 acre-feet per year (2019)
Qmag = 1,477,000 acre-feet per year (2070)
unsustainable
sustainable
0
1
2
3
4
5
6
7
all aquifers
all aquifers except th
Dockum
Ogallala
Brazos River Alluviu
Woodbine
Edwards-Trinity (Pla
Blaine
Hickory
Gulf Coast
Capitan Reef Comple
Carrizo-Wilcox/Quee
Igneous
West Texas Bolsons
Hueco Bolson
Rustler
Bone Spring-Victorio
Edwards (Balcones F
Seymour
Trinity
Ellenburger-San Sab
Marathon
Marble Falls

sustainability signaling

- groundwater availability (no Ogly-Ugly):
  - 6.3 million acre-feet per year
  - availability = ~1.9 times “max” sustainable production
- modeled available groundwater (no Ogly-Ugly)
  - decreases 2.2% between 2020 and 2070

“How did you go bankrupt?” Bill asked.
“Two ways,” Mike said. “Gradually, then suddenly.”

-Ernest Hemingway, *The Sun Also Rises*



questions?

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