Is Just Good Enough Conductivity Still Good Enough When it Gets Dirty?

Ray Ellis: Regional Technology Manager, Liberty Energy

Resources

- SPE 199751, *Shale Frac Designs Move to Just-Good-Enough Economics*
  - *Howard Melcher, Mike Mayerhofer, Karn Agarwal, Ely Lolon, Oladapo Oduba, Jessica Murphy, Ray Ellis, Kirk Fiscus, Leen Weijers – Liberty Oilfield Services, Robert Shelley – RF Shelley LLC*
- Stimlab Proppant Consortium ongoing research
  - *Barry Hlidek, Lisa O'Connell, Bob Duenckel*

Where and What

- Proppant Trends/Big Data Review
- Minimum required conductivity
  - Eagle Ford Play
  - Permian Basin
- Turbidity effects

Where We Were

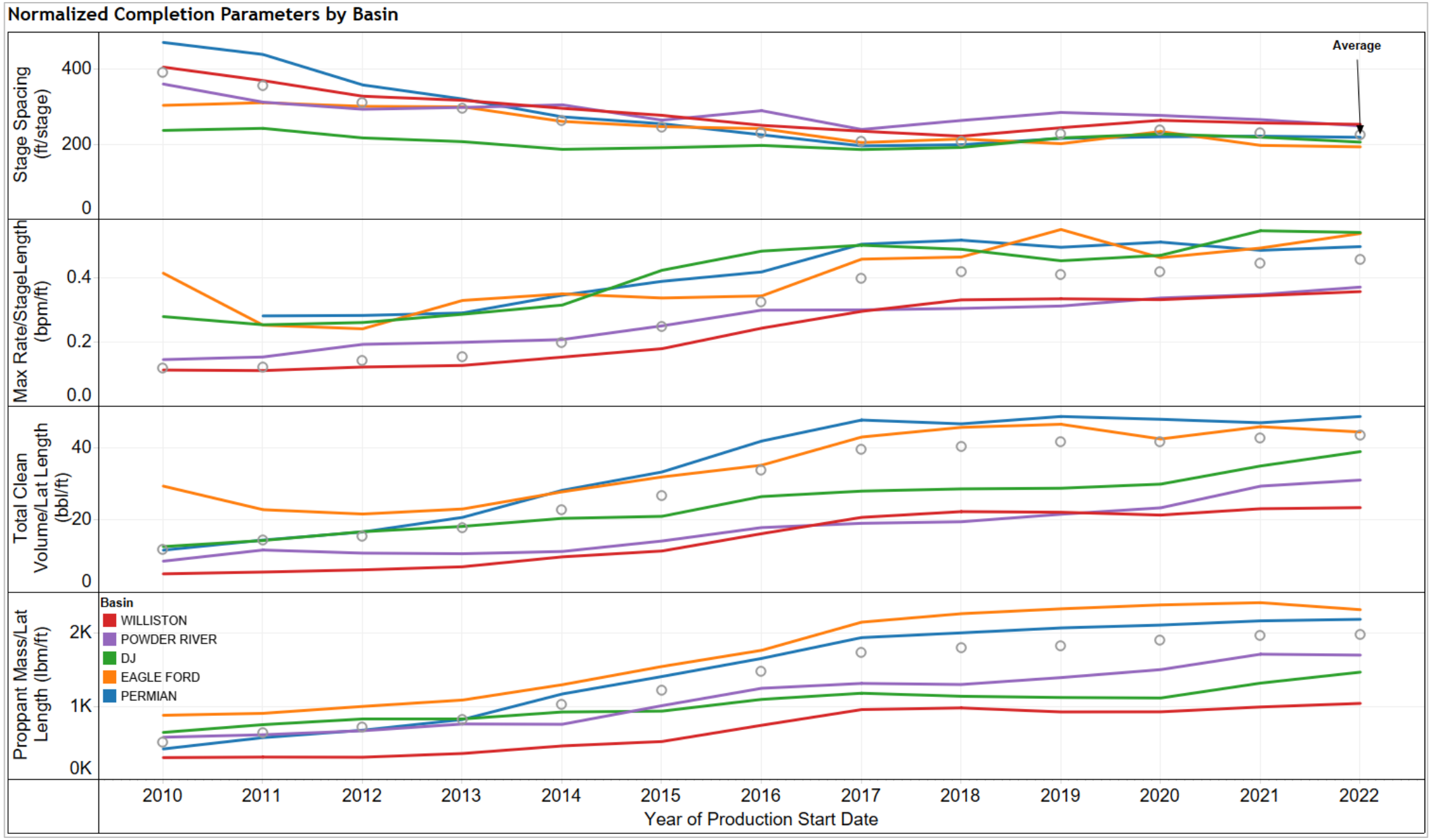
Where We Are

Closer to Home

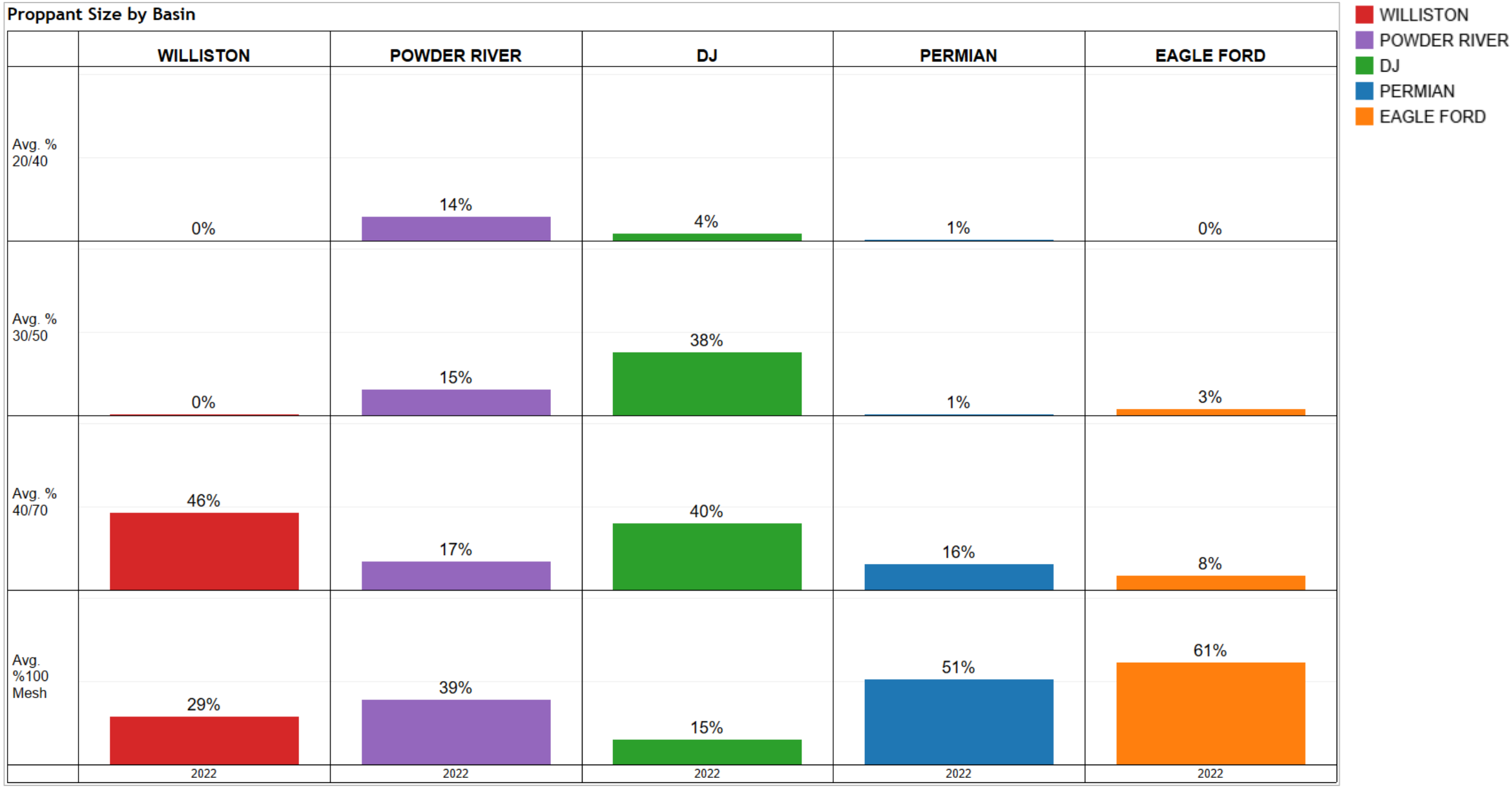
Northern White

Texas Dune

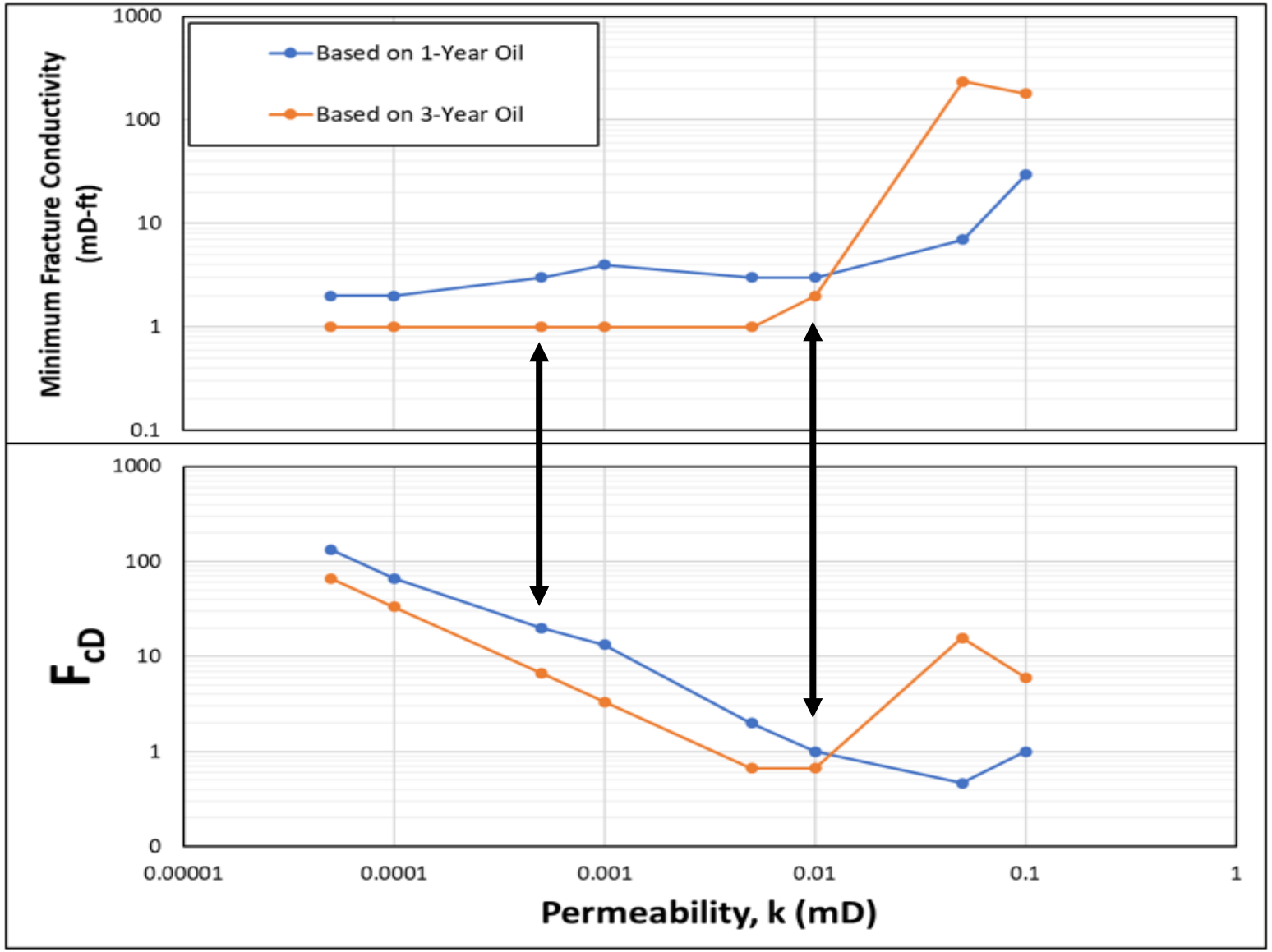
Where are we Heading?



Honey, I Shrunk the Sand!

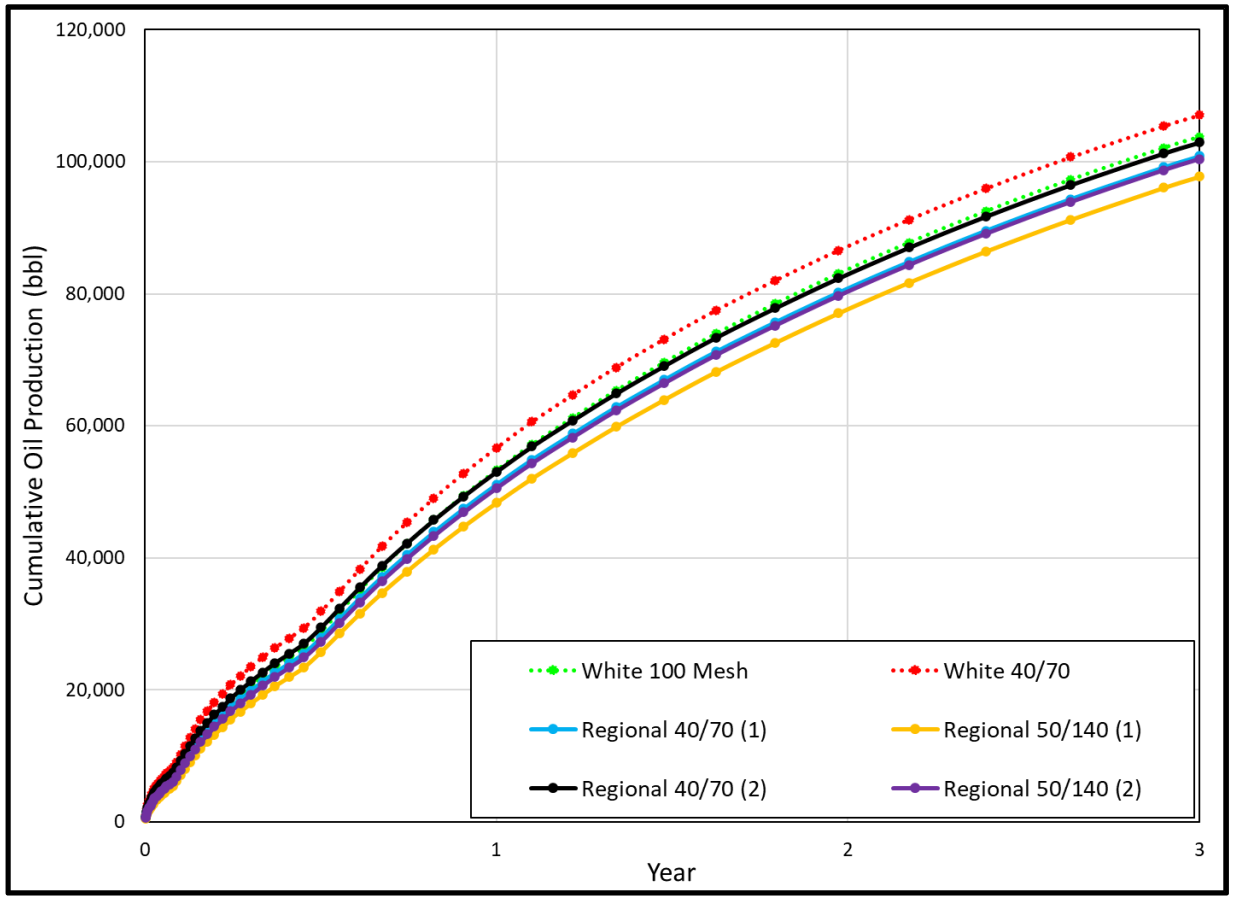


How Low Can We Go?

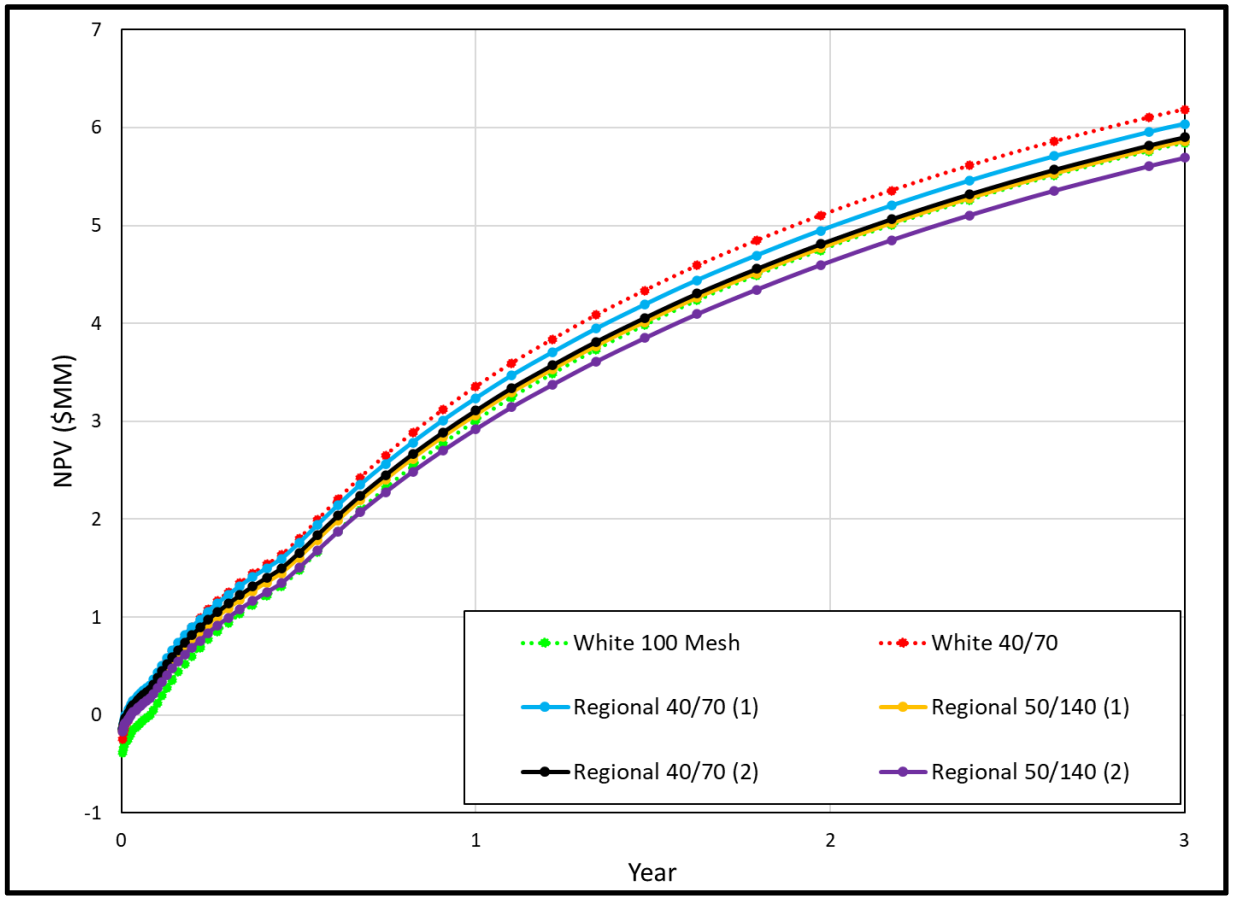


Is Regional Sand a Better Value? Maybe Not
Eagle Ford - Results

Cumulative Oil Production

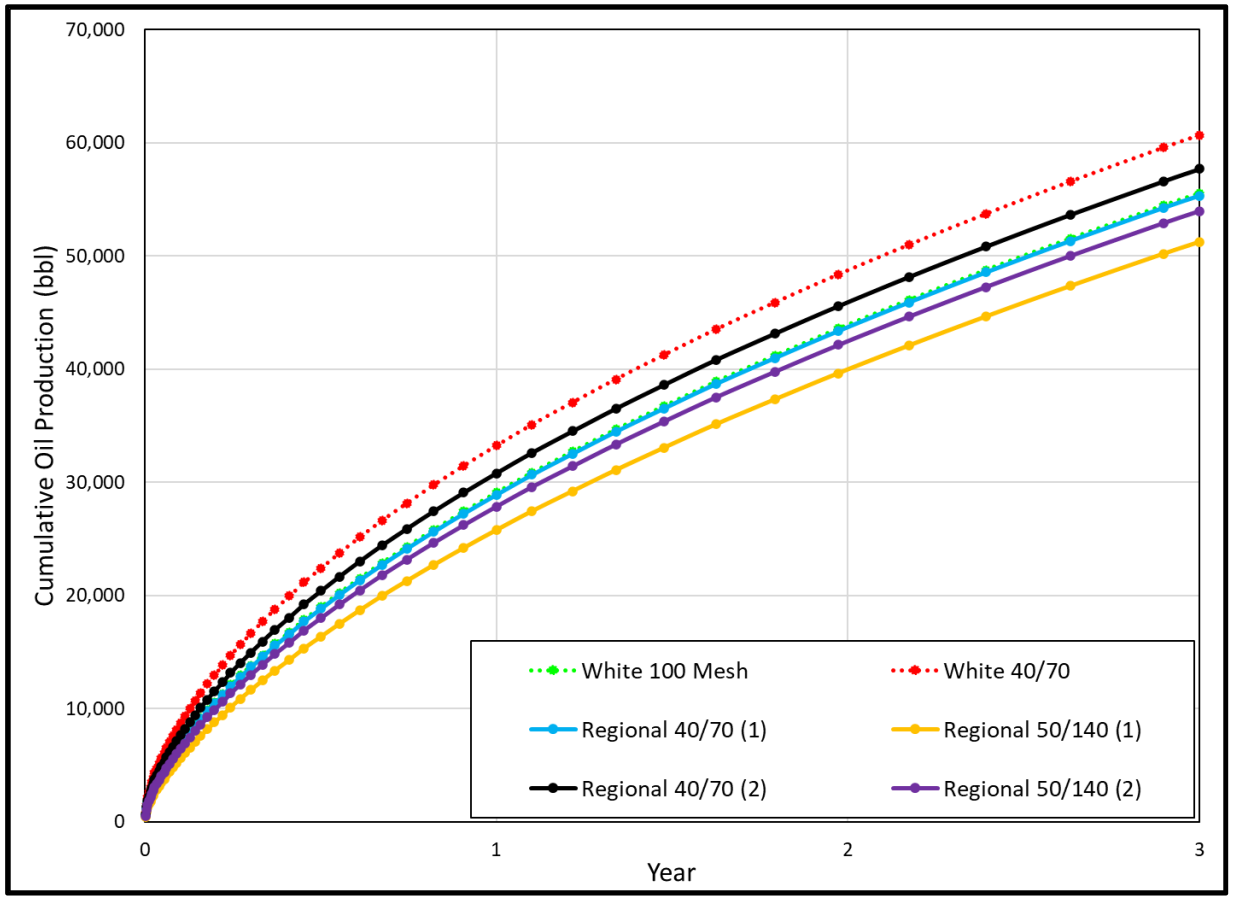


Net Present Value

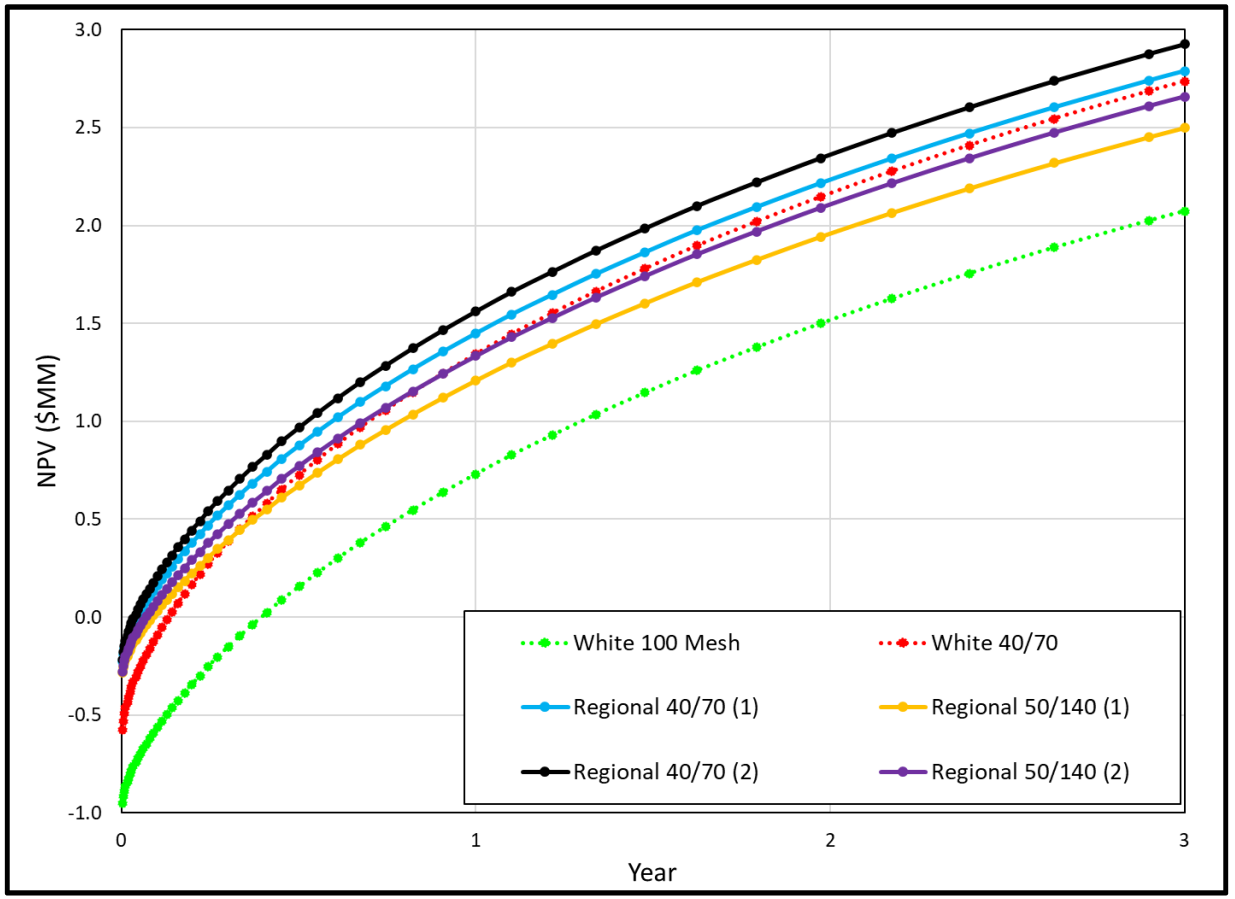


Or Maybe So!
Permian, Lower Spraberry - Results

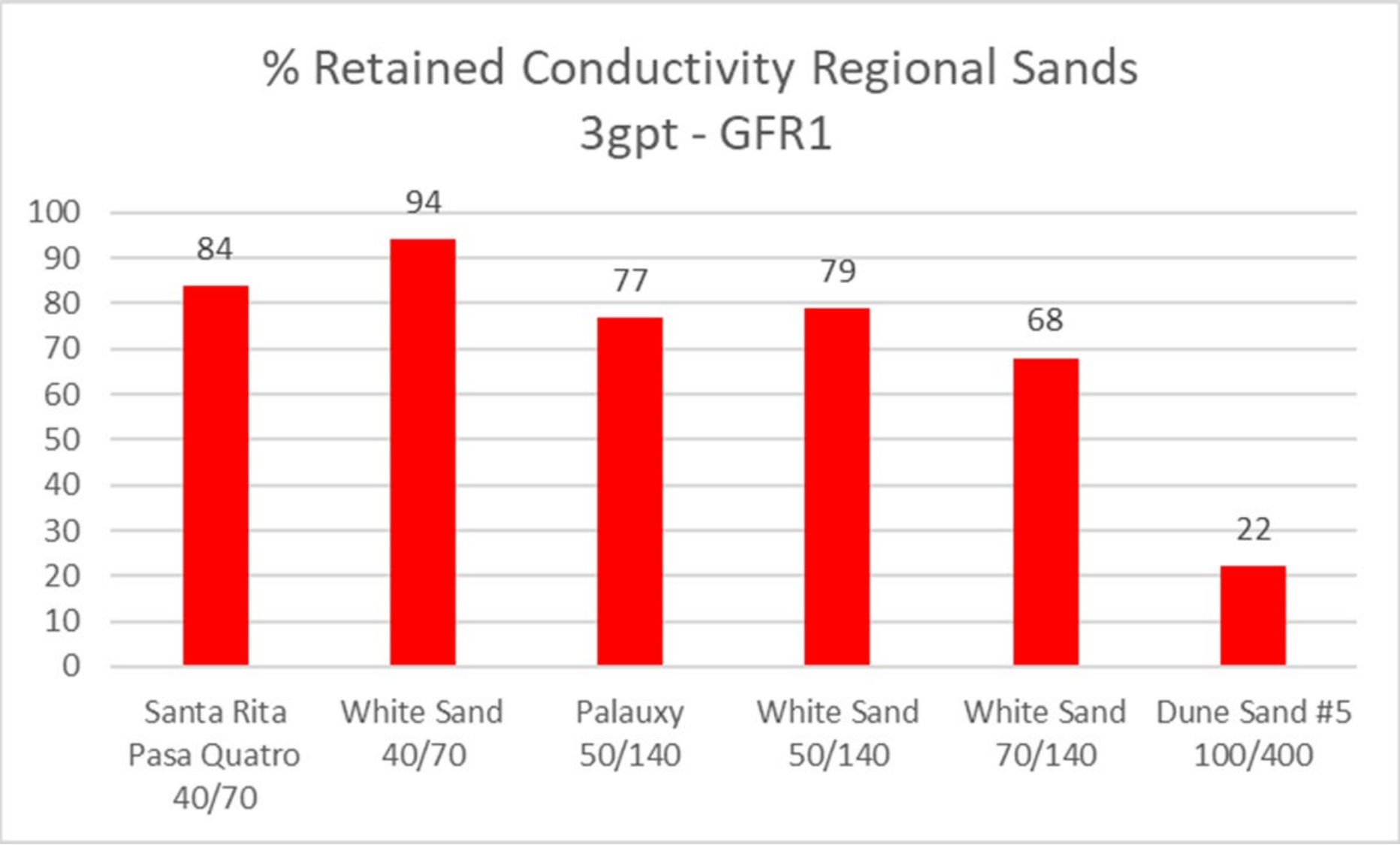
Cumulative Oil Production



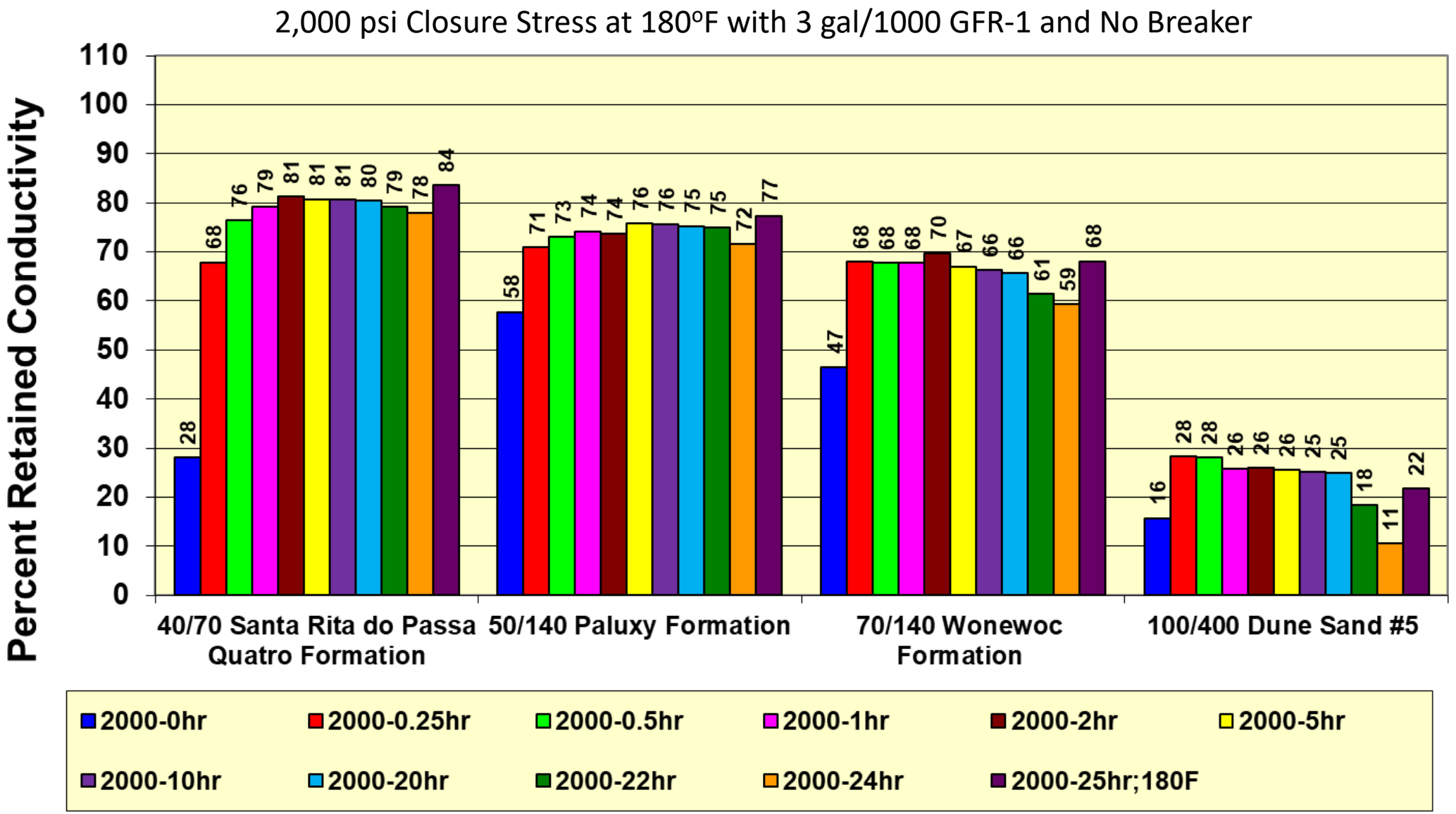
Net Present Value



Now Let’s Add Some Friction Reducer

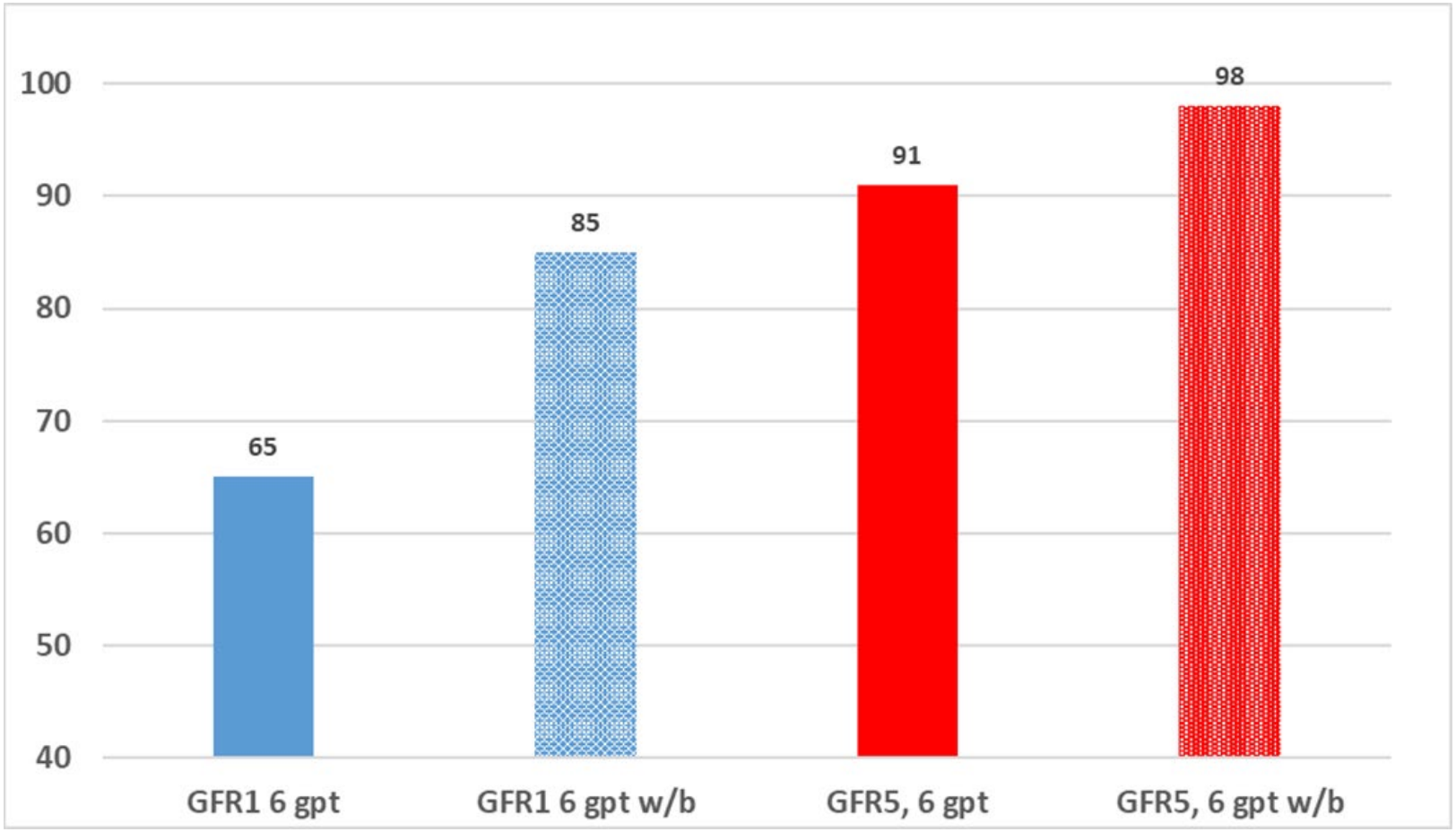


Certainly, Time and Temperature Will Make it Better



Breaker, The Universal Cure, Right?

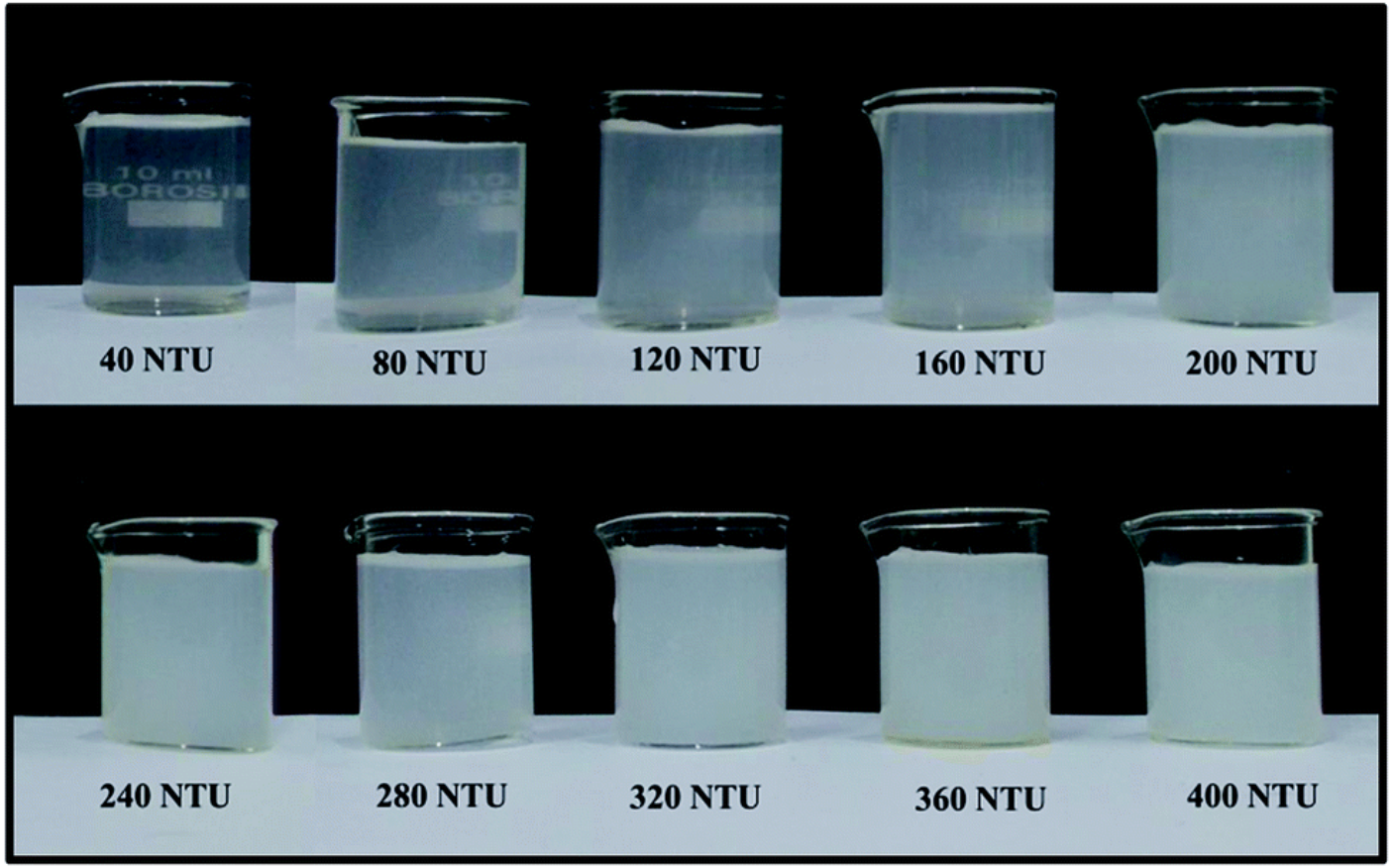
API Conductivity Cell Clean-up
70/140, 180°F



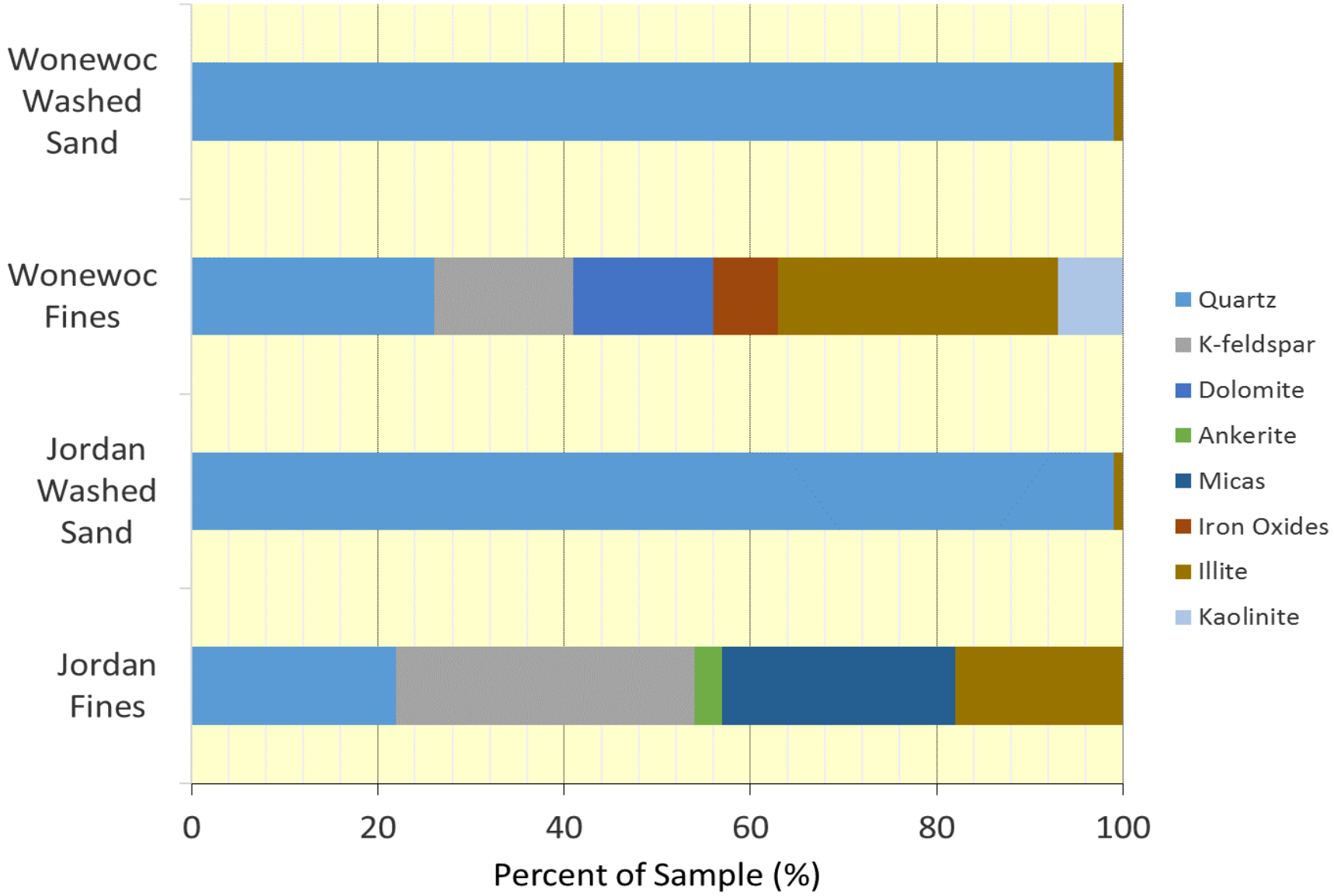
Breaker- 2 ppt AP

Bring On the Dirt

- API STD19C defines turbidity as the following:
  - “Turbidity tests measure an optical property of a suspension that results from the scattering and absorption of light by the particulate matter suspended in the wetting fluid”
  - Essentially-The opacity of the total suspended solids in a suspension after 5 minutes of settling time
  - Particle Settling Rate is driven by:
    - Size
    - Density
    - Mineralogy
    - Shape
  - Max Allowed – 250 NTU
  - Common values today…
    - To Infinity and Beyond!

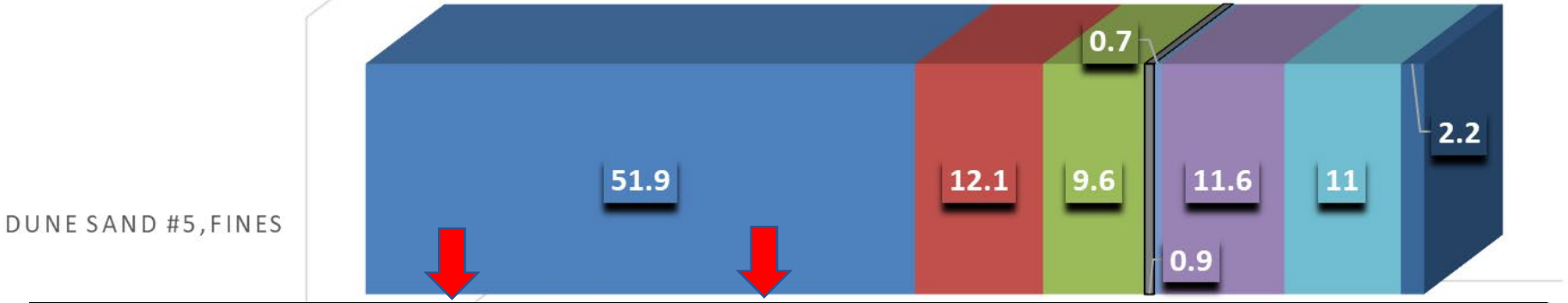


What's In the Dirt?

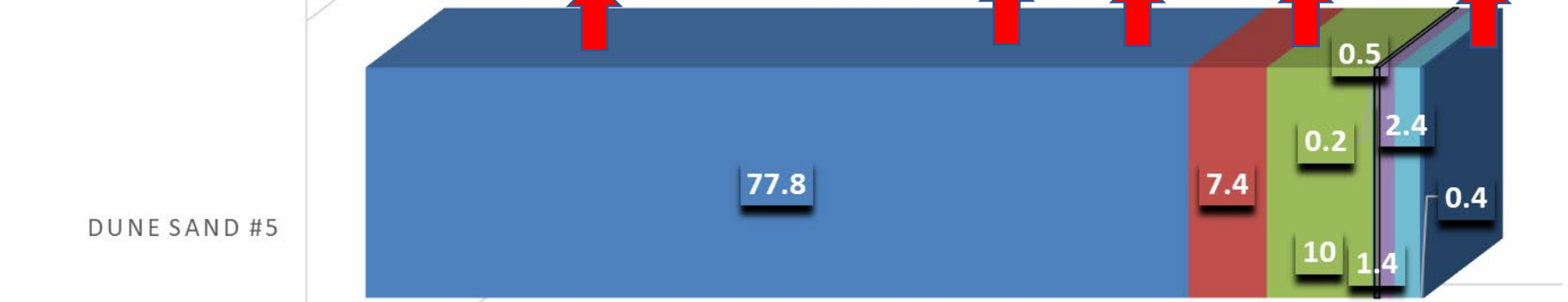


Everything's Big in Texas

200 Mesh Texas Dune Sand, Winkler County, Texas

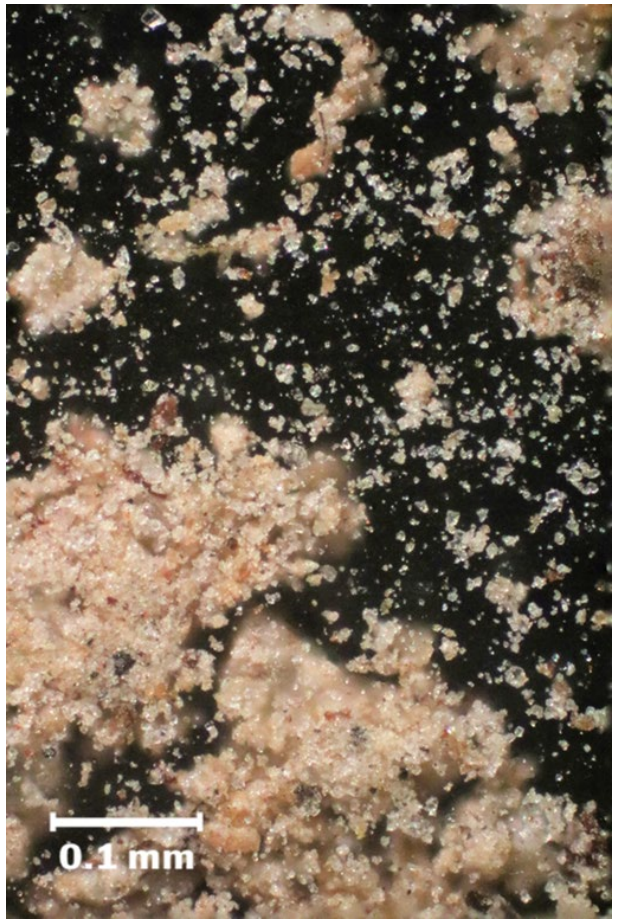


	Quartz	Plagioclase	K-feldspar	Pyrite	Halite	Illite/Mica	Illite/ Smectite	Kaolinite
Dune Sand, Winkler County, TX 200 Mesh, Turbidity Fines	51.9	12.1	9.6	0.9	0.7	11.6	11	2.2



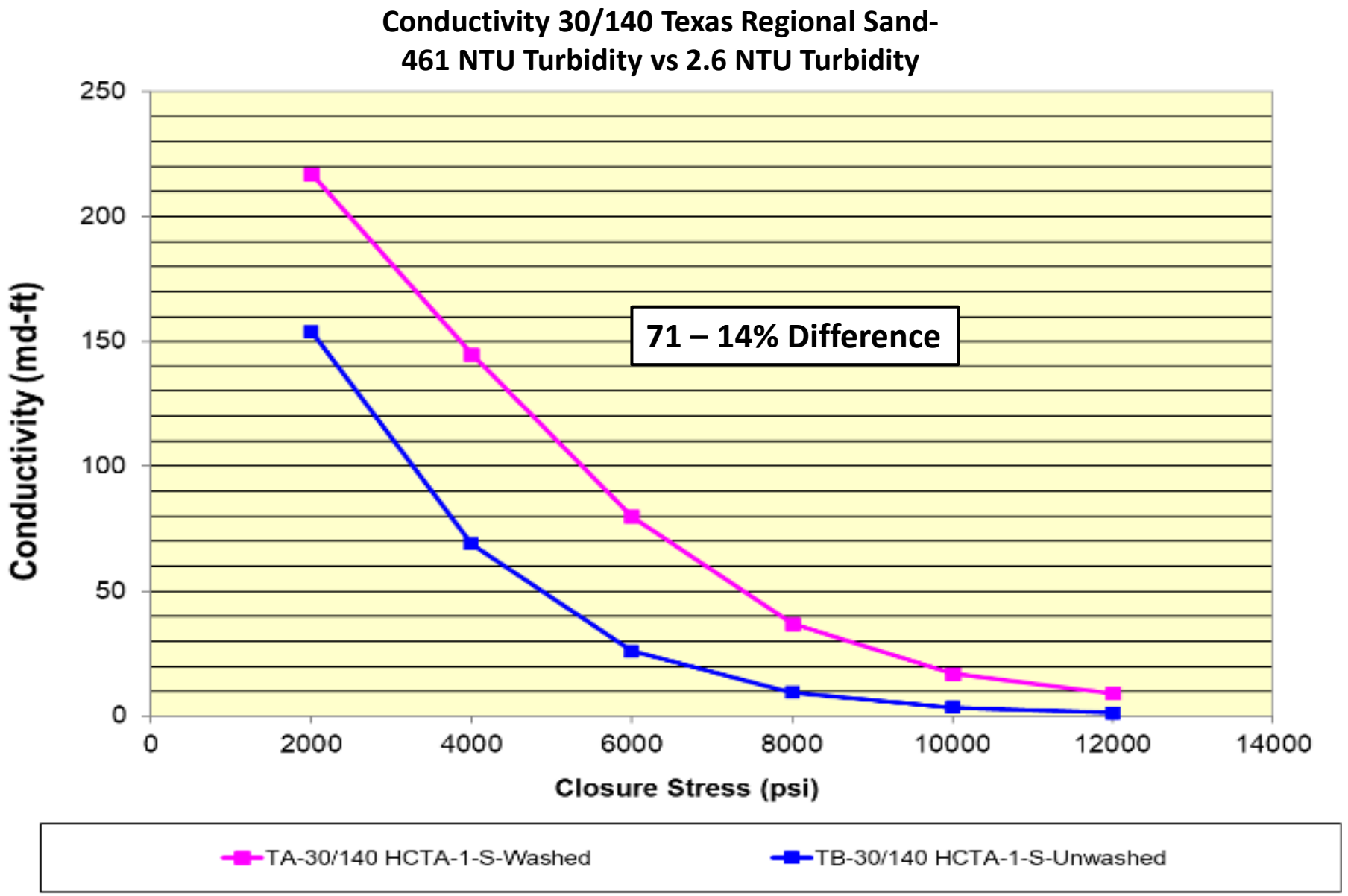
	Quartz	Plagioclase	K-feldspar	Calcite	Pyrite	Illite/Mica	Illite/Smectite	Kaolinite
Dune Sand, Winkler County, TX 200 Mesh	77.8	7.4	10	0.2	0.5	1.4	2.4	0.4

Quartz Plagioclase K-feldspar Calcite Pyrite
Halite Illite/Mica Illite/Smectite Kaolinite

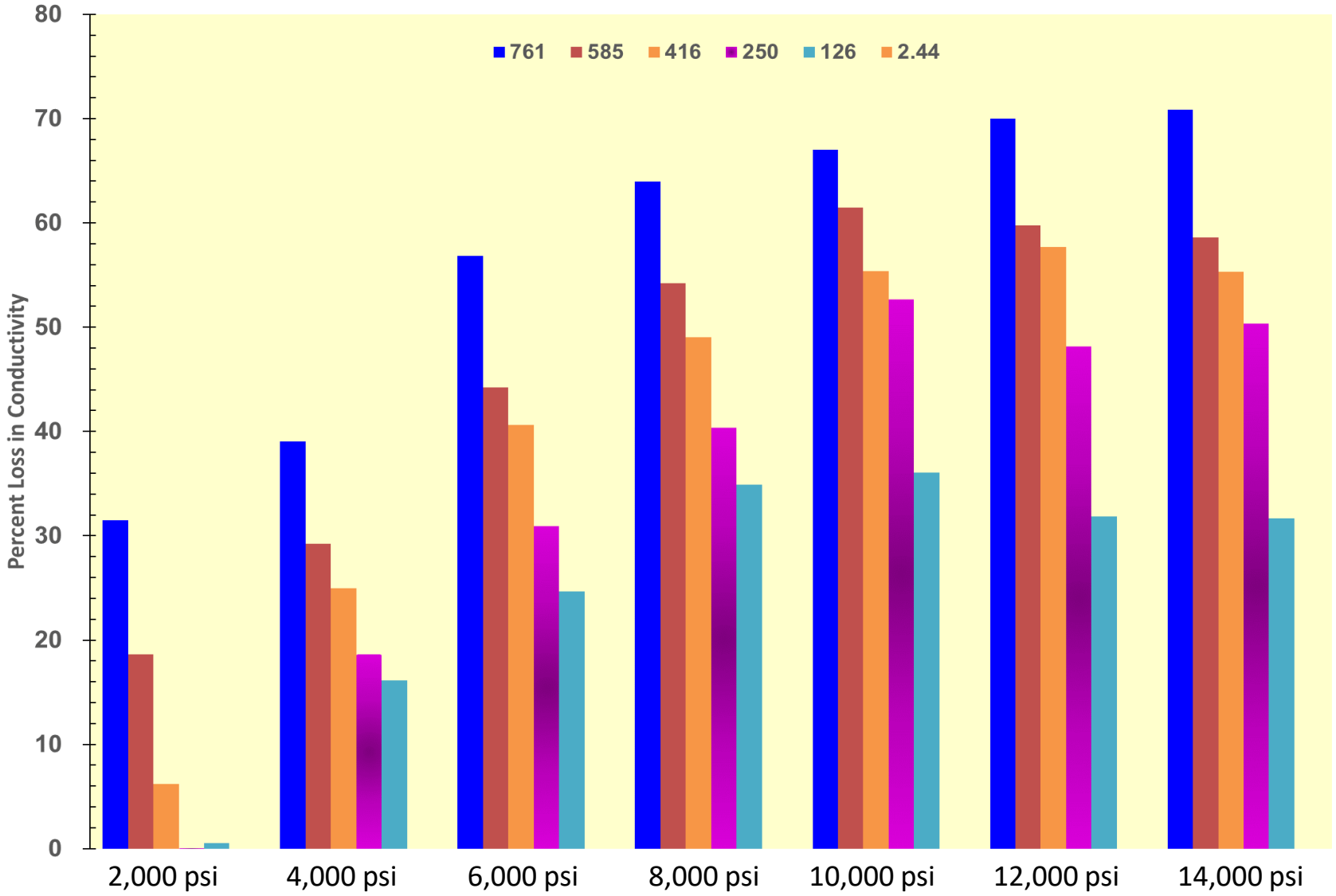


~450 Mesh
442 NTU

How Bad Could a Little Dirt Be?

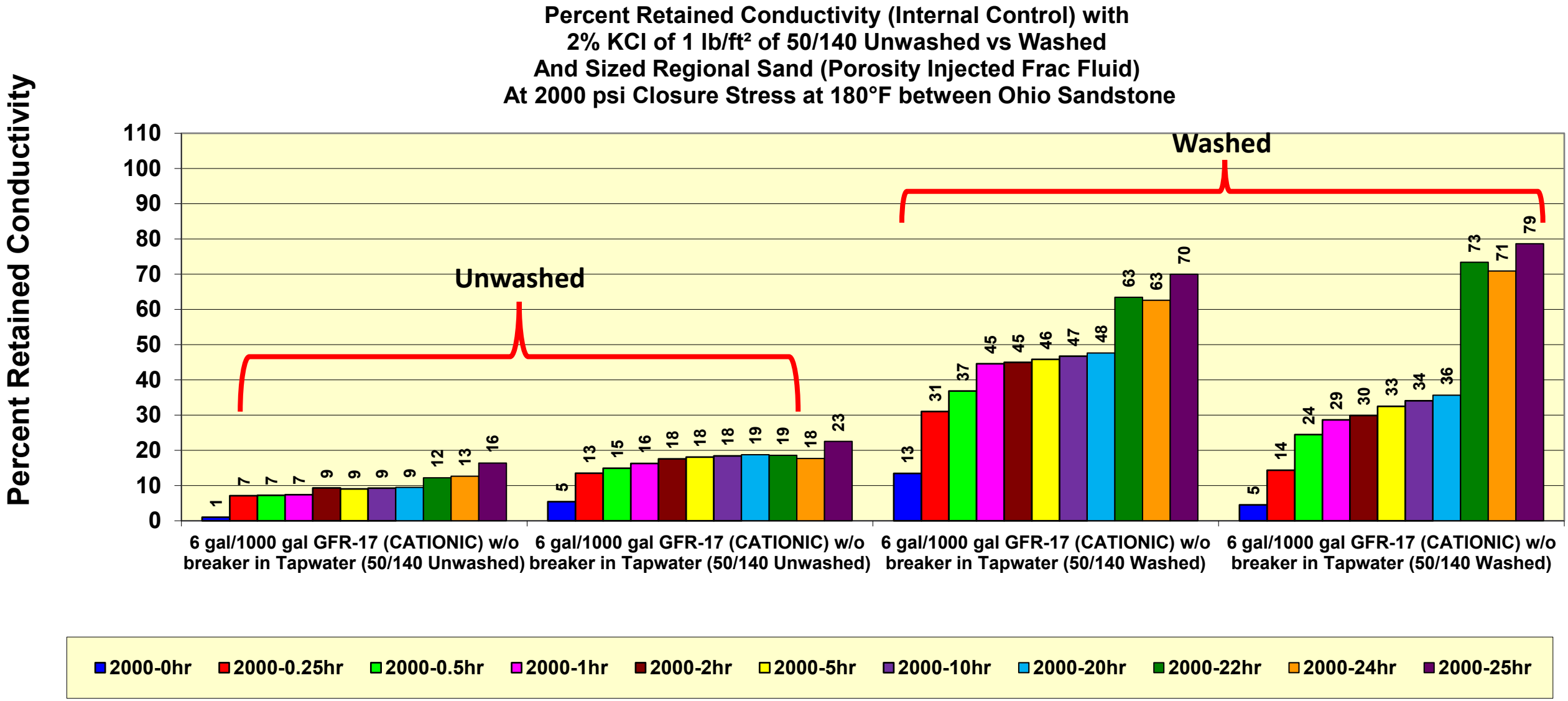


Maybe We Can Crush it Out of Existence



To Bathe, Or Not to Bathe…?

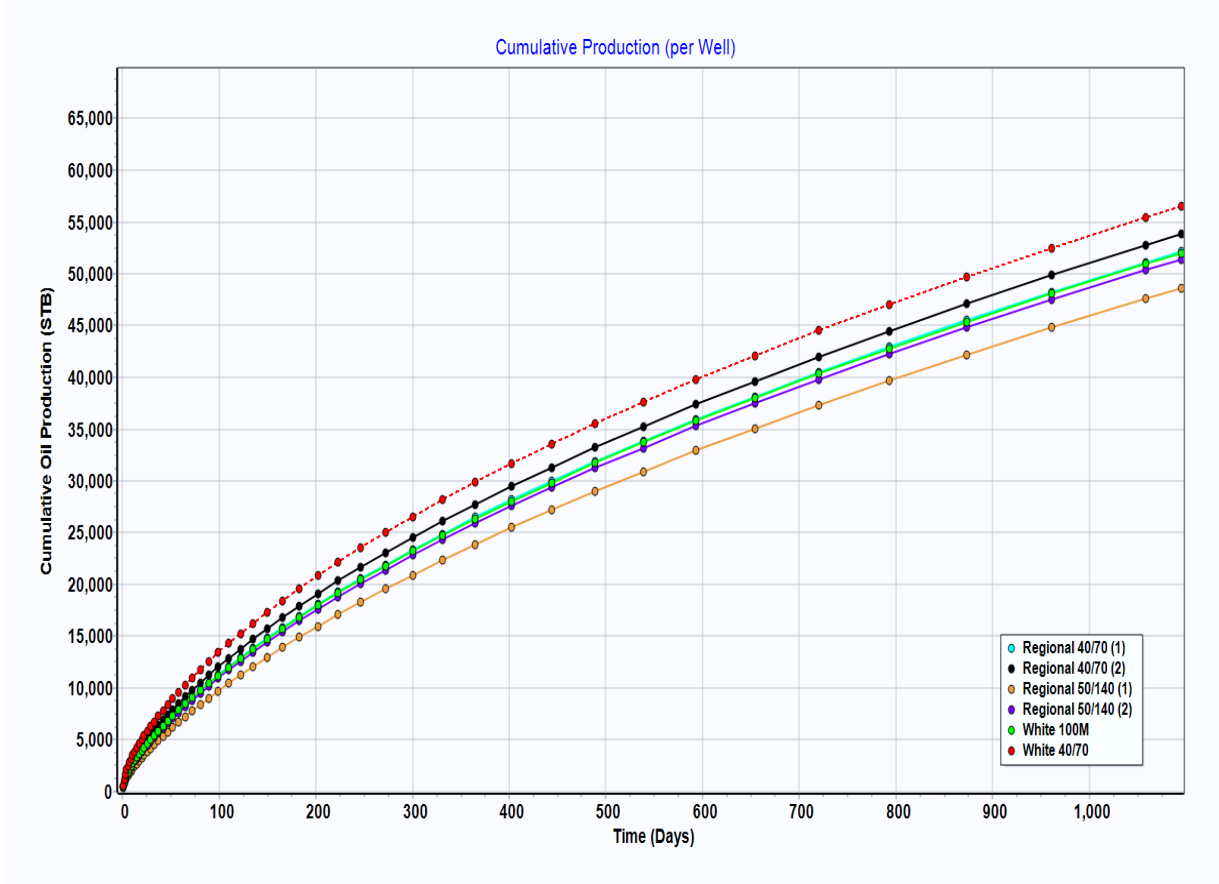
50/140 Alluvial, Howard County, TX



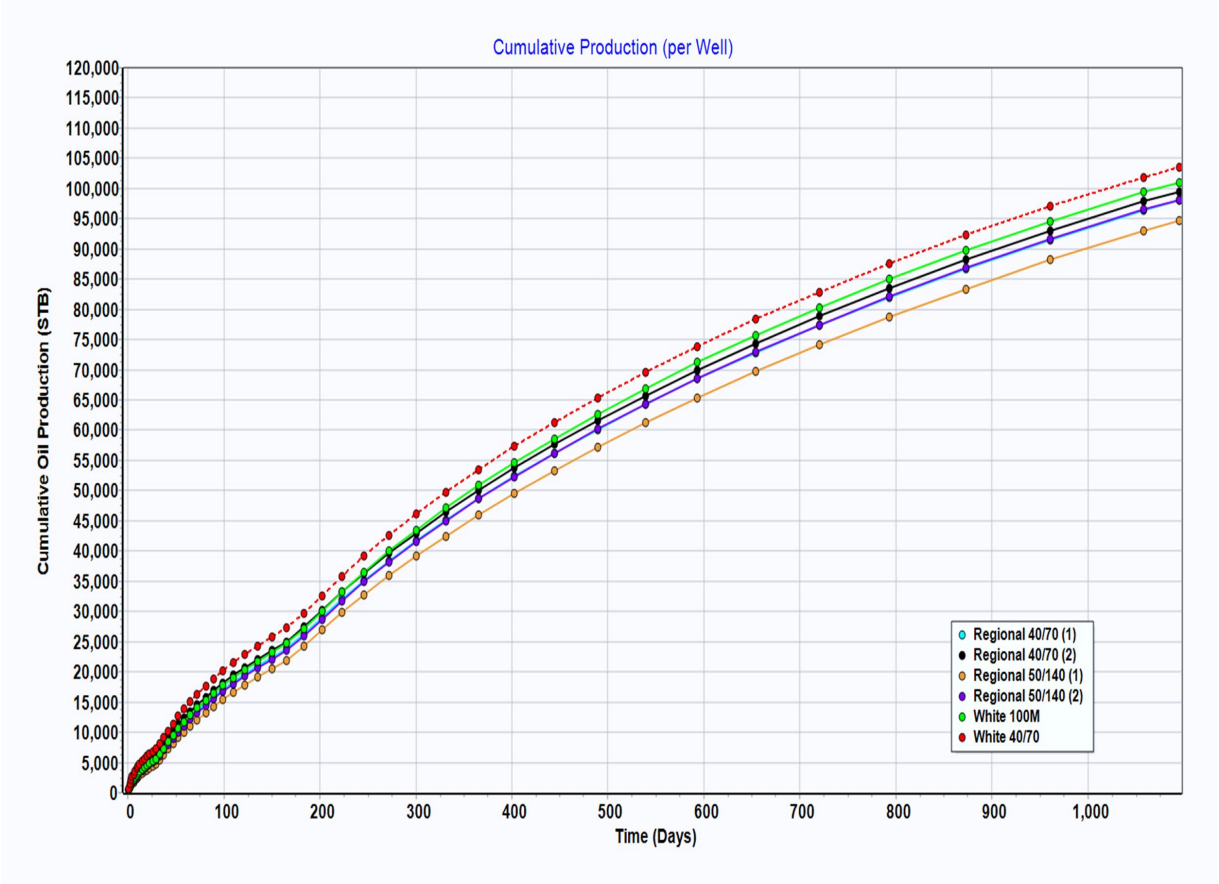
So…What Difference Does it Make?

Impact of 50% Damage on Model Production

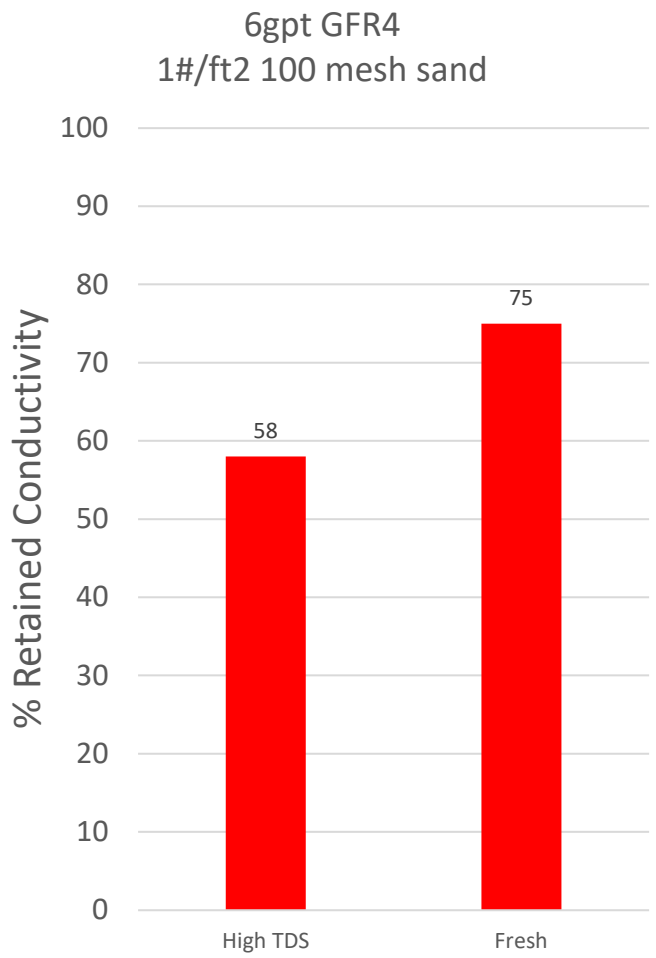
LWR Spraberry (10% Loss)



Eagle Ford (3% Loss)



My Sand is Clean…But…

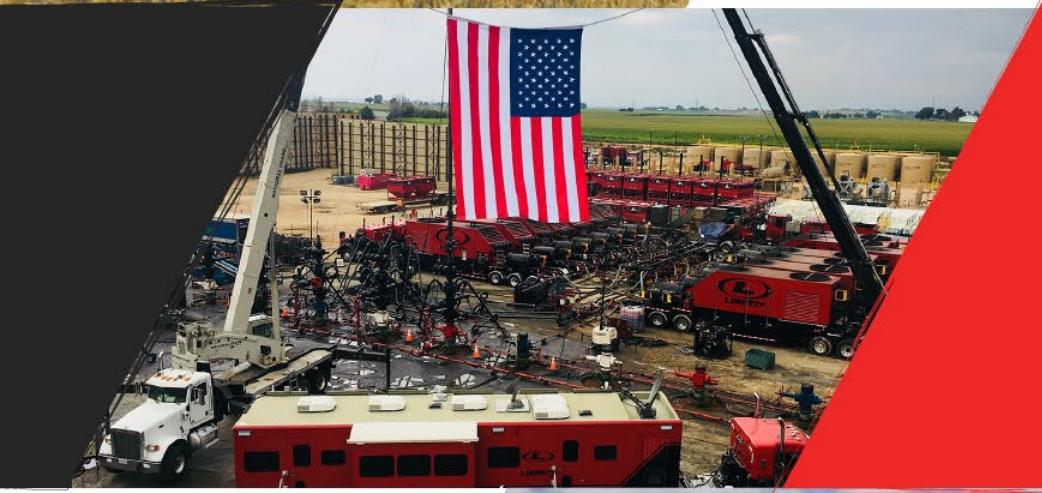


GFR4

Viscosity at 100 sec $^{-1}$ cp

High TDS – 10cp (190k TDS)

Fresh Water – 25cp



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