LABORATORY ELECTRICAL RESISTIVITY IMAGING OF MACROPORE FLOW

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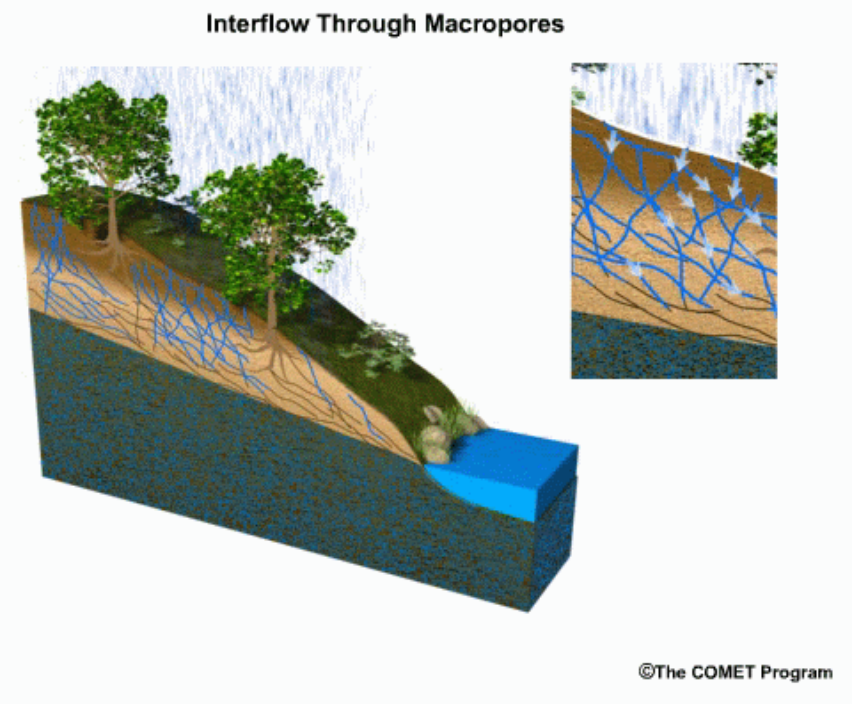
Introduction

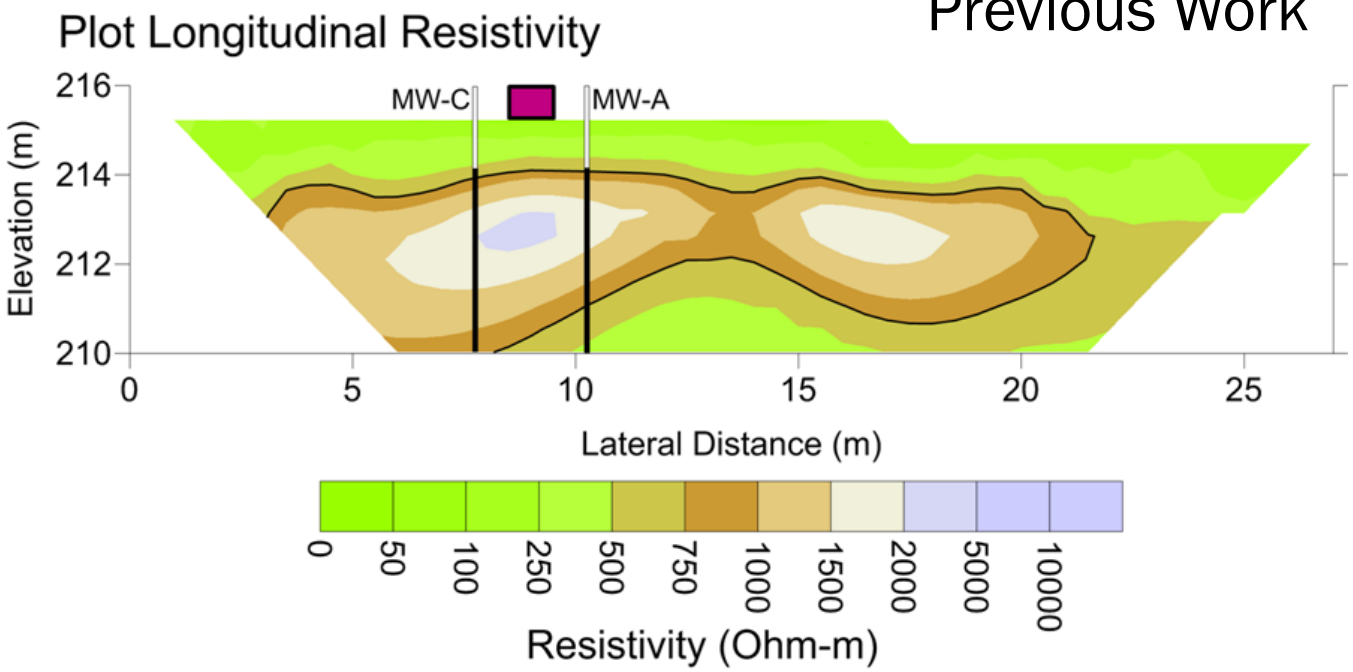
- Runoff prevention is essential for streams and rivers adjacent to major farms
- It’s unclear how temporal resistivity will detect flow with macropores
- Hypothesis: macropores will significantly affect flow and ERI will detect it.
- A 150 cm x 40 cm x 40 cm plexiglass tank on a wooden base was used in a controlled setting

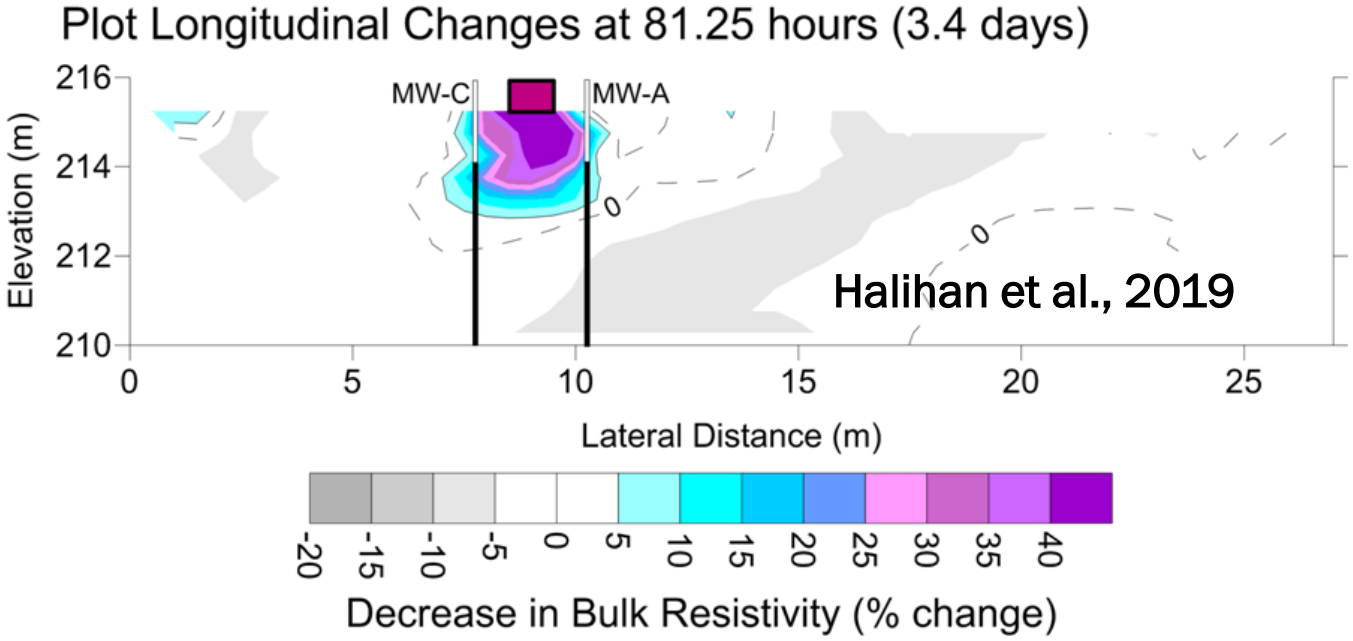
Macropore Definition

- Macropore definition not trivial as it involves a couple parameters ((Beven and Germann 1982))
- Channeling of fluid through the pores in comparison to the surrounding strata makes it a macropore (Weiler and Naef 2003)
- **Size is irrelevant**, a macropore can range from 75 µm in a clay layer to 50 mm holes caused by burrowing (Seladji, Cosenza et al. 2010).



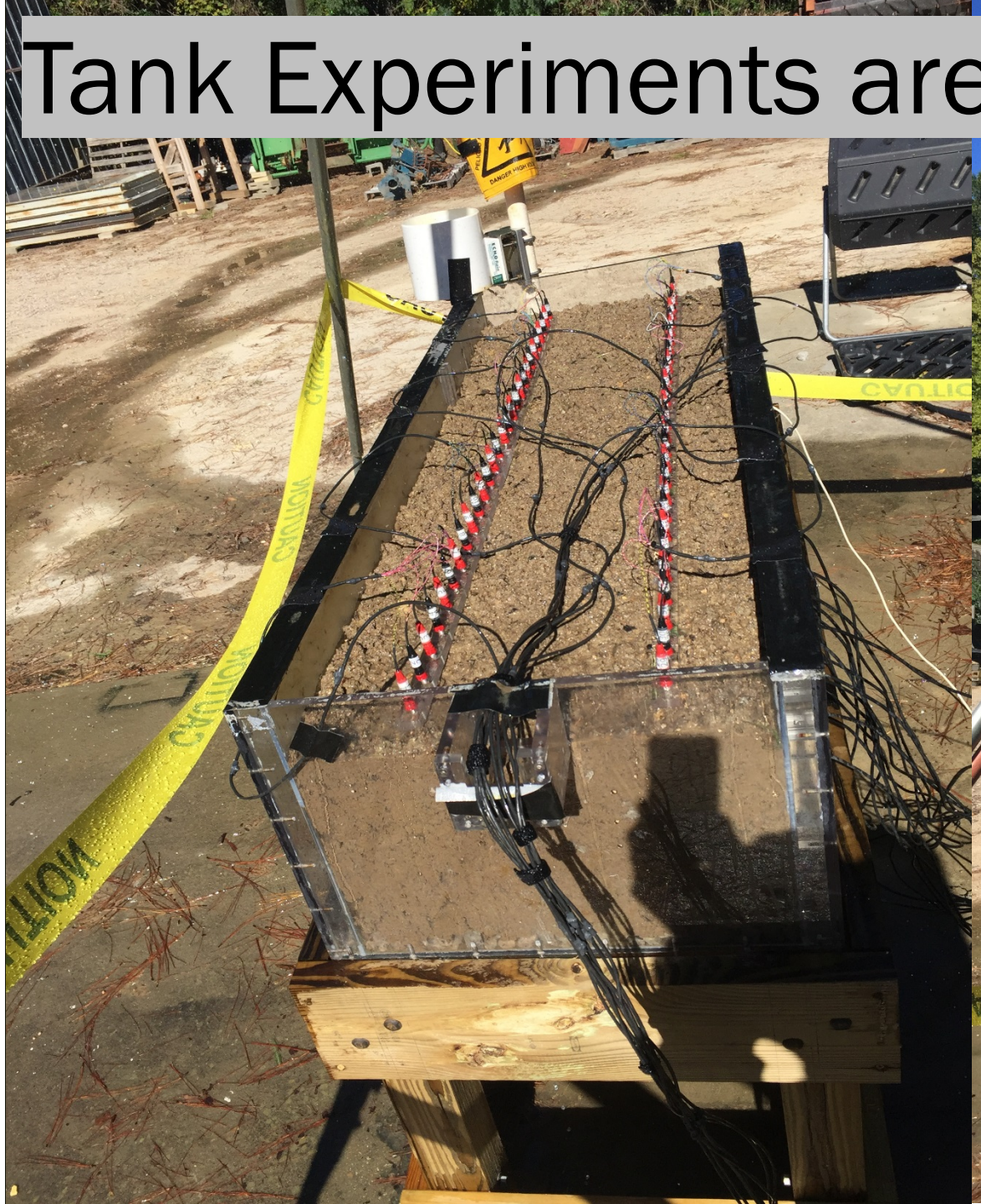
Previous Work



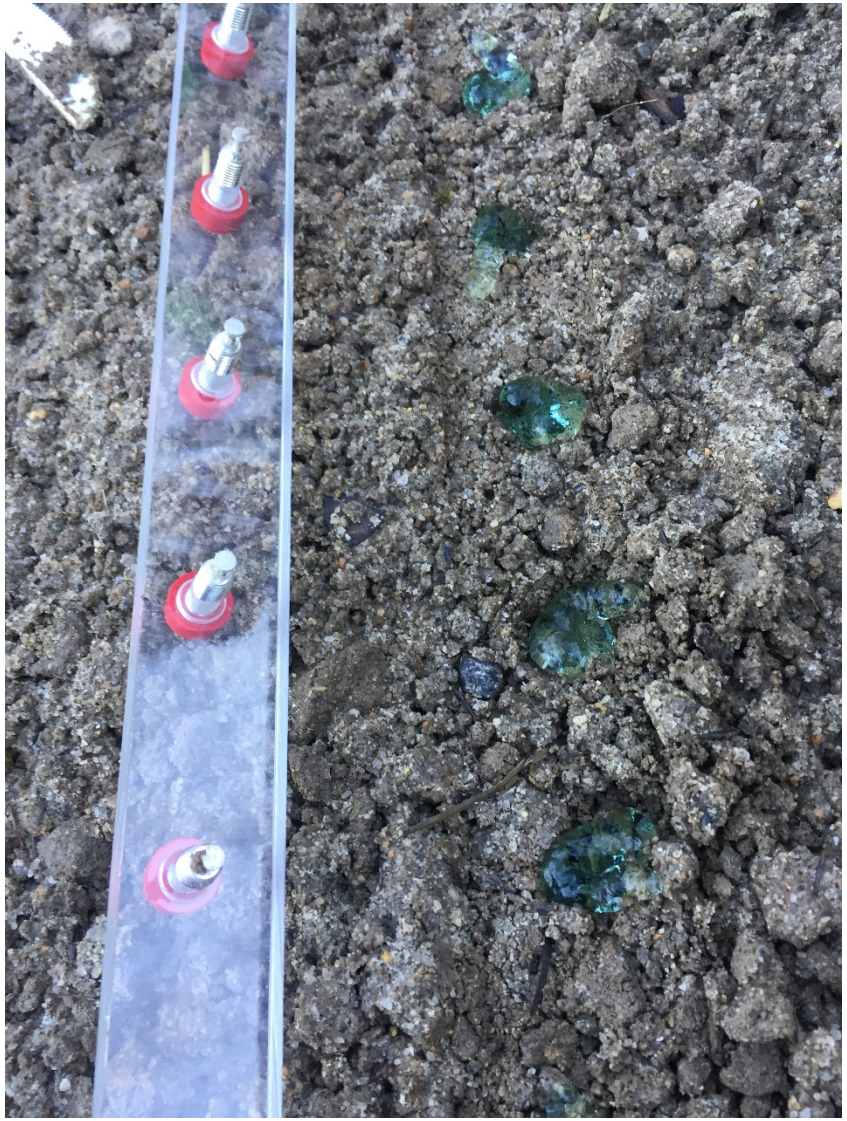


Halihan et al., 2019

Tank Experiments aren’t Easy

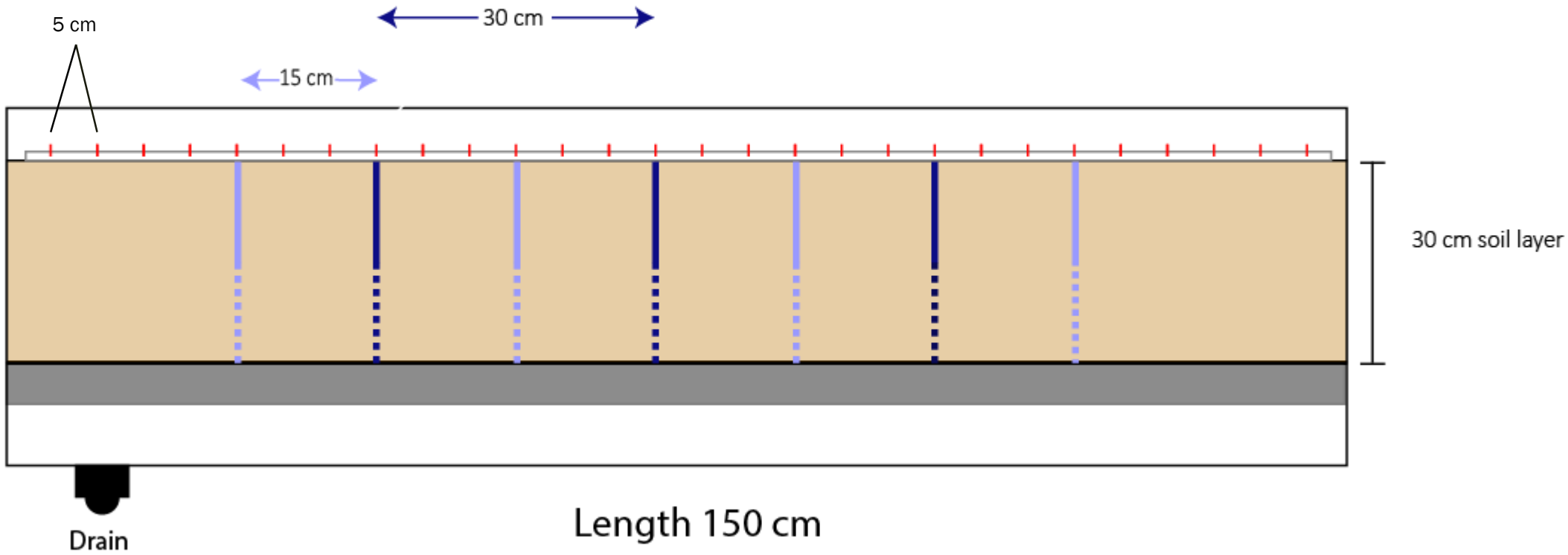


Methodology - Electrodes

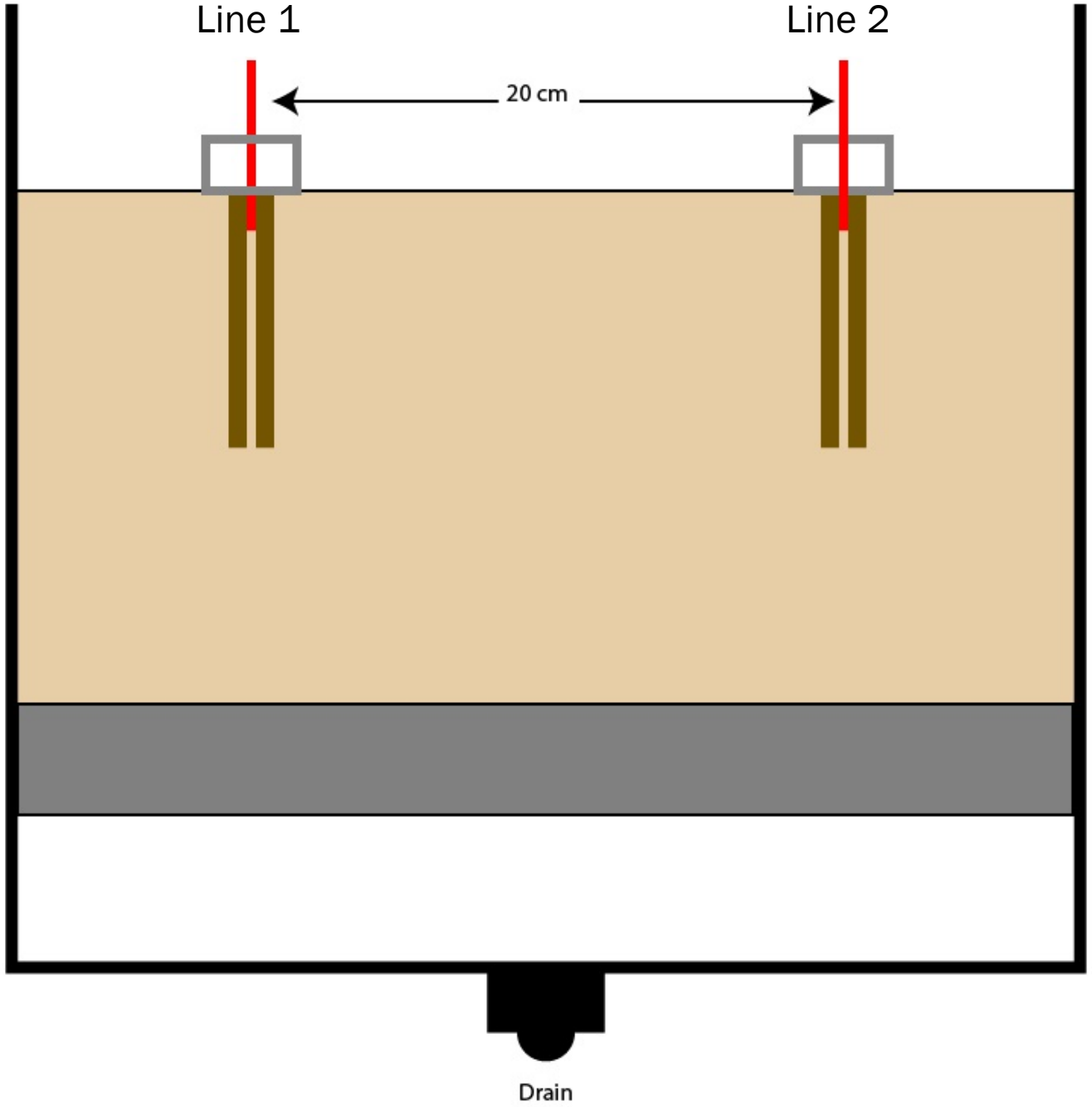


Methodology

- Line 1 has three macropores spaced 30 cm apart
- Line 2 has seven macropores spaced 15 cm apart
- The investigated portion of the tank is the 30 cm of top soil. Underneath the soil lies 3 cm of crushed limestone and a void to aid drainage.

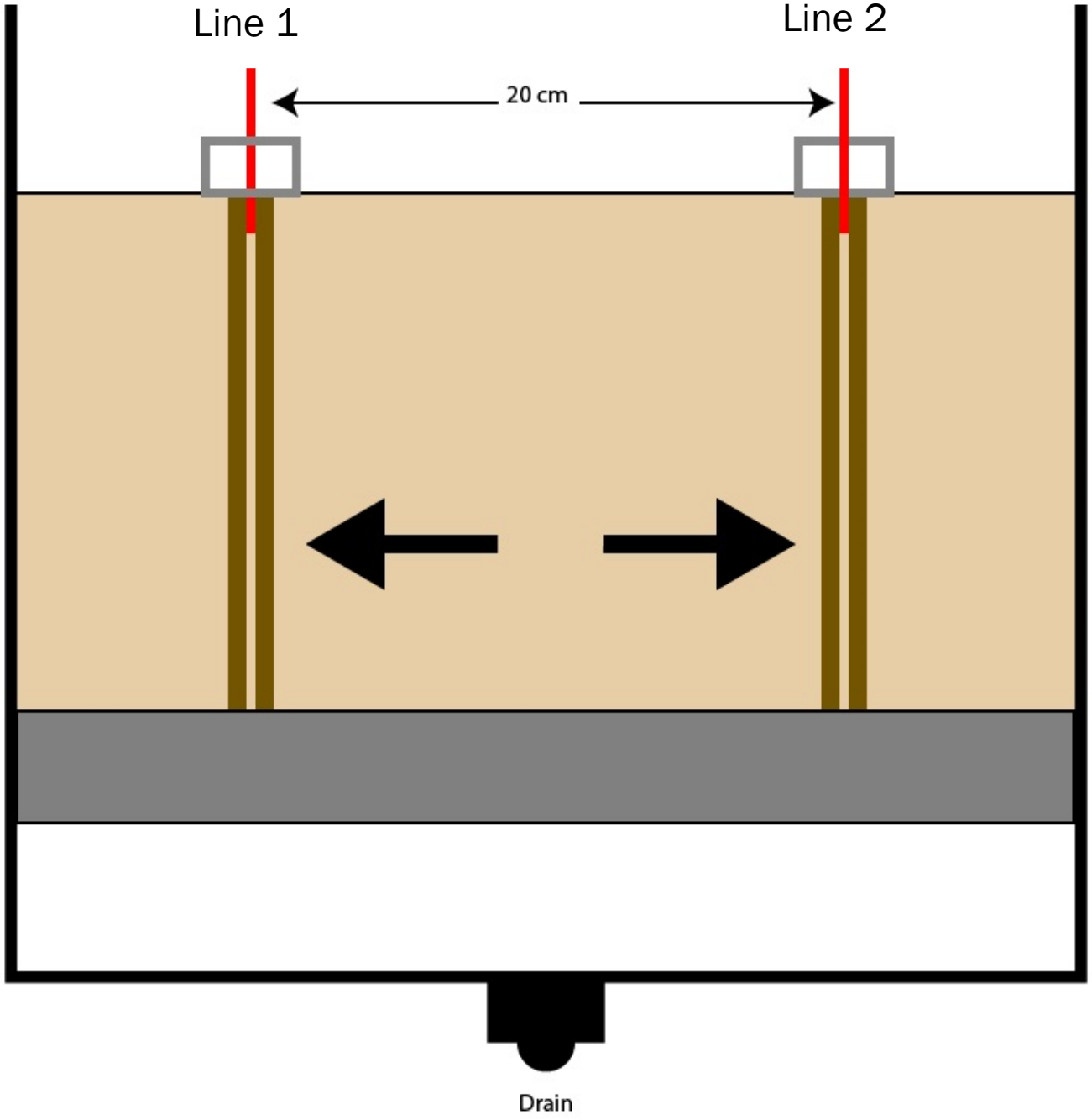


How were the macropores created?



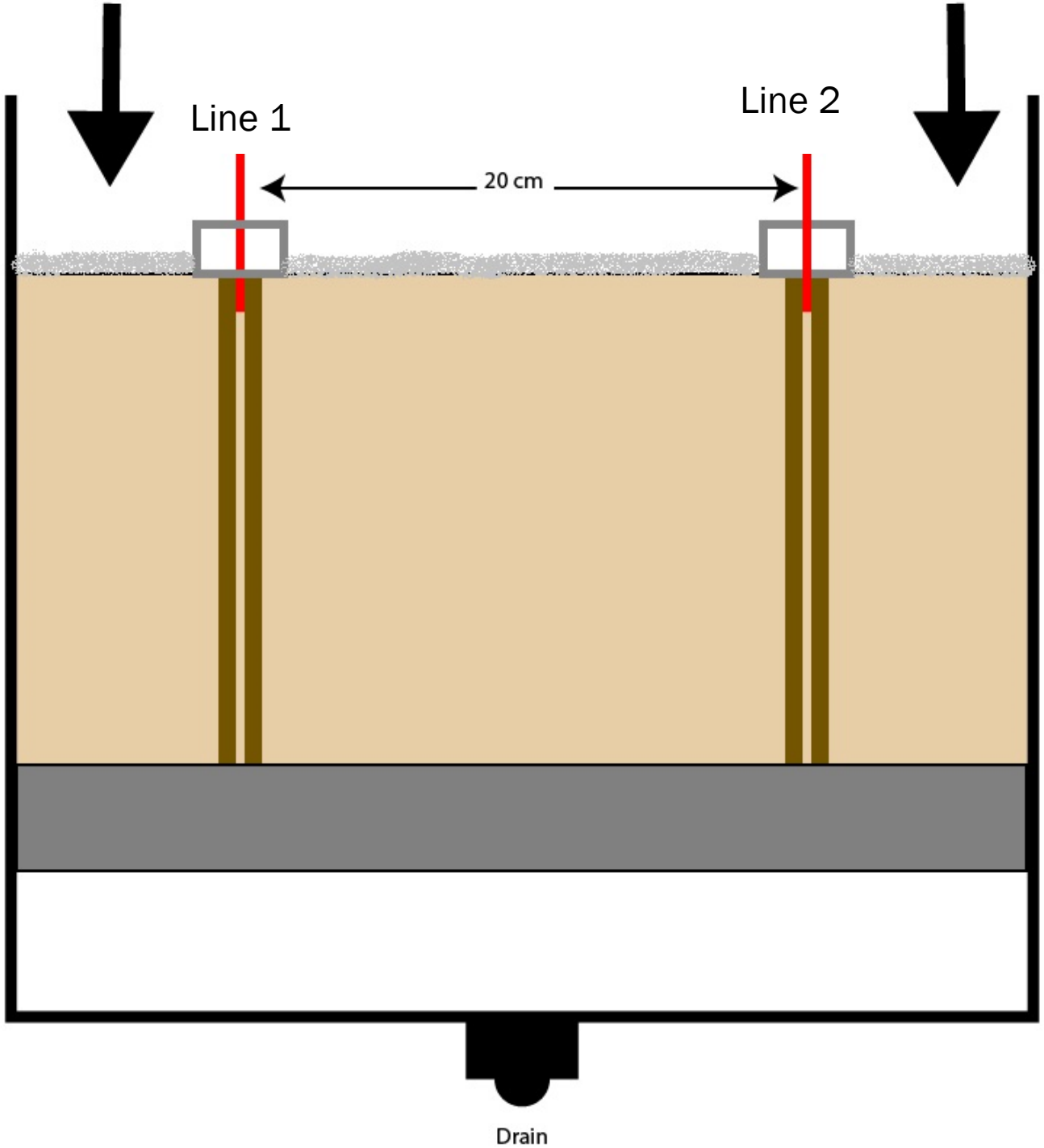
Tank Side View

Experiment 1
macropores ½ depth



Experiment 2

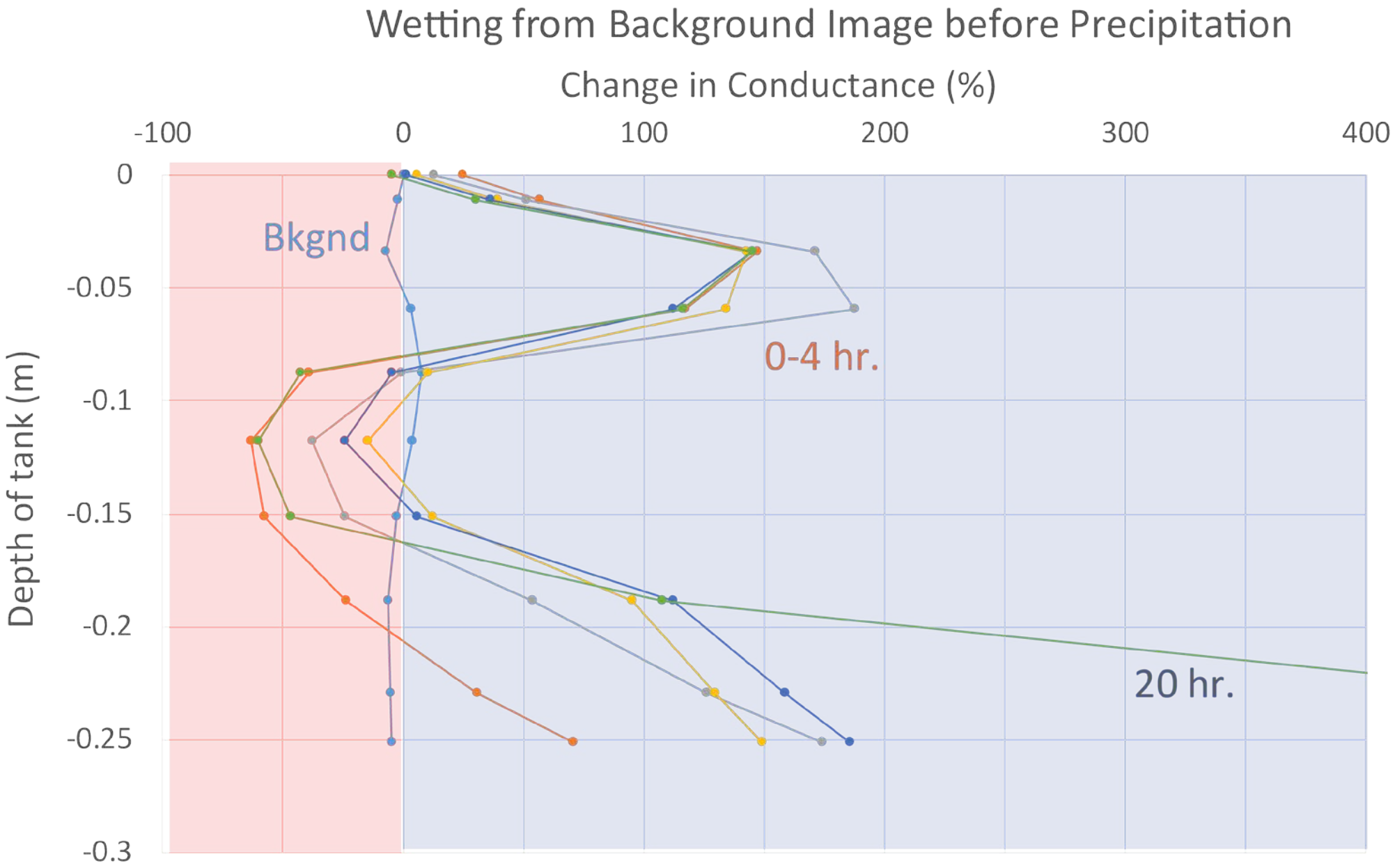
macropores full depth



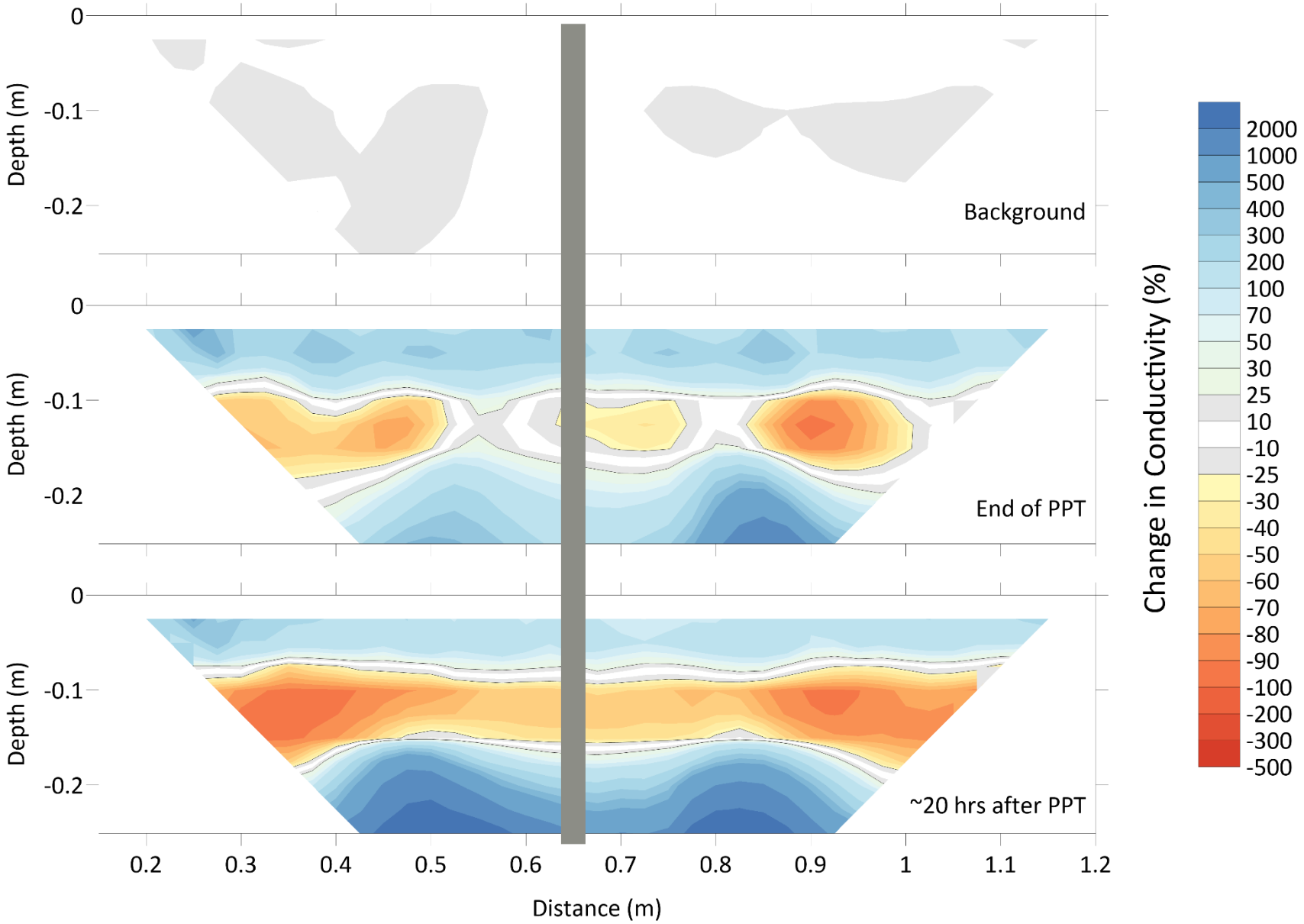
Experiment 3

800 mL of NaCl solution added to the top of the soil conc. = 1,000 ppm

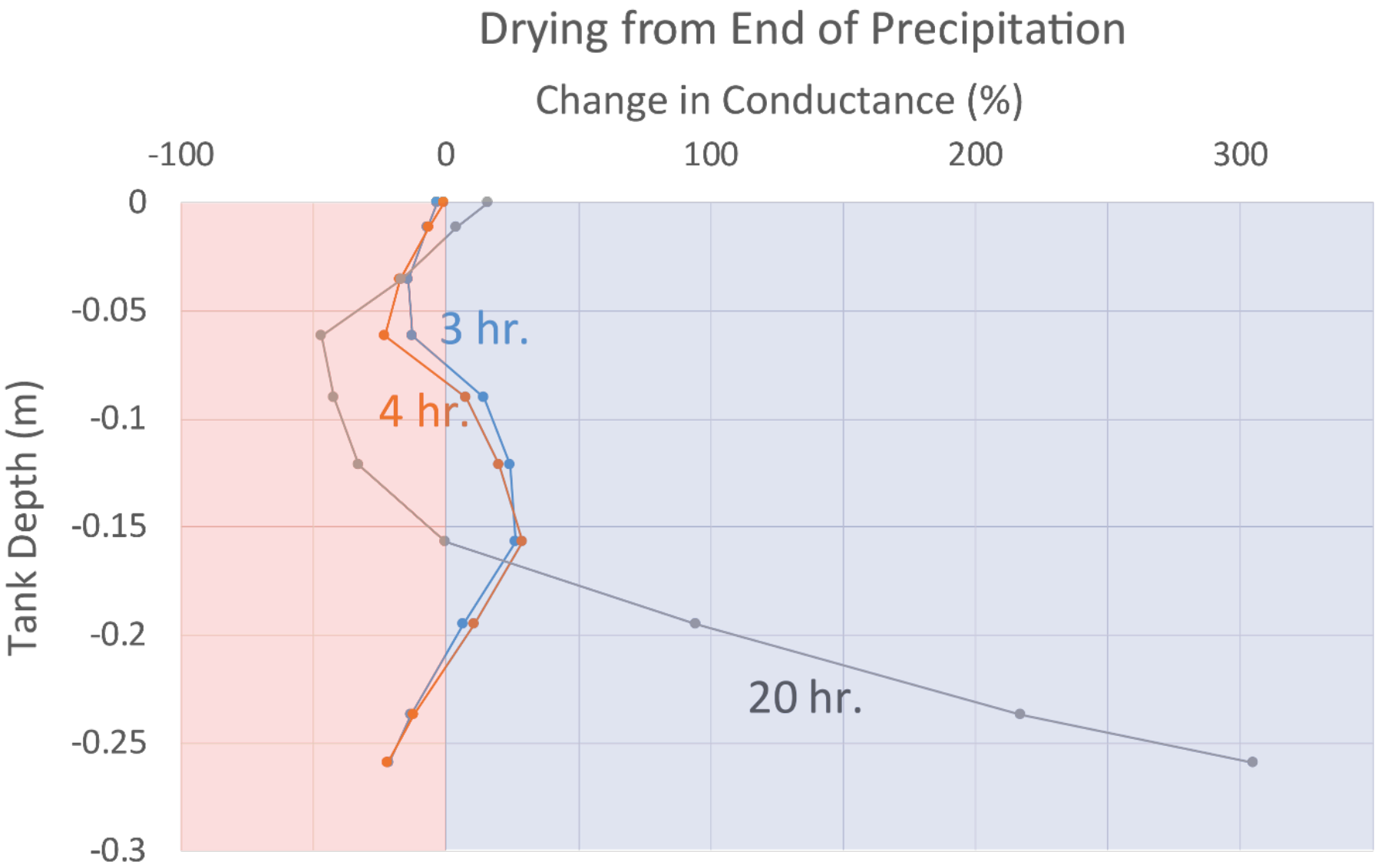
Results


Wetting from Background Image before Precipitation
Change in Conductance (%)
-100
0
100
200
300
400
Depth of tank (m)
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
Bkgnd
0-4 hr.
20 hr.

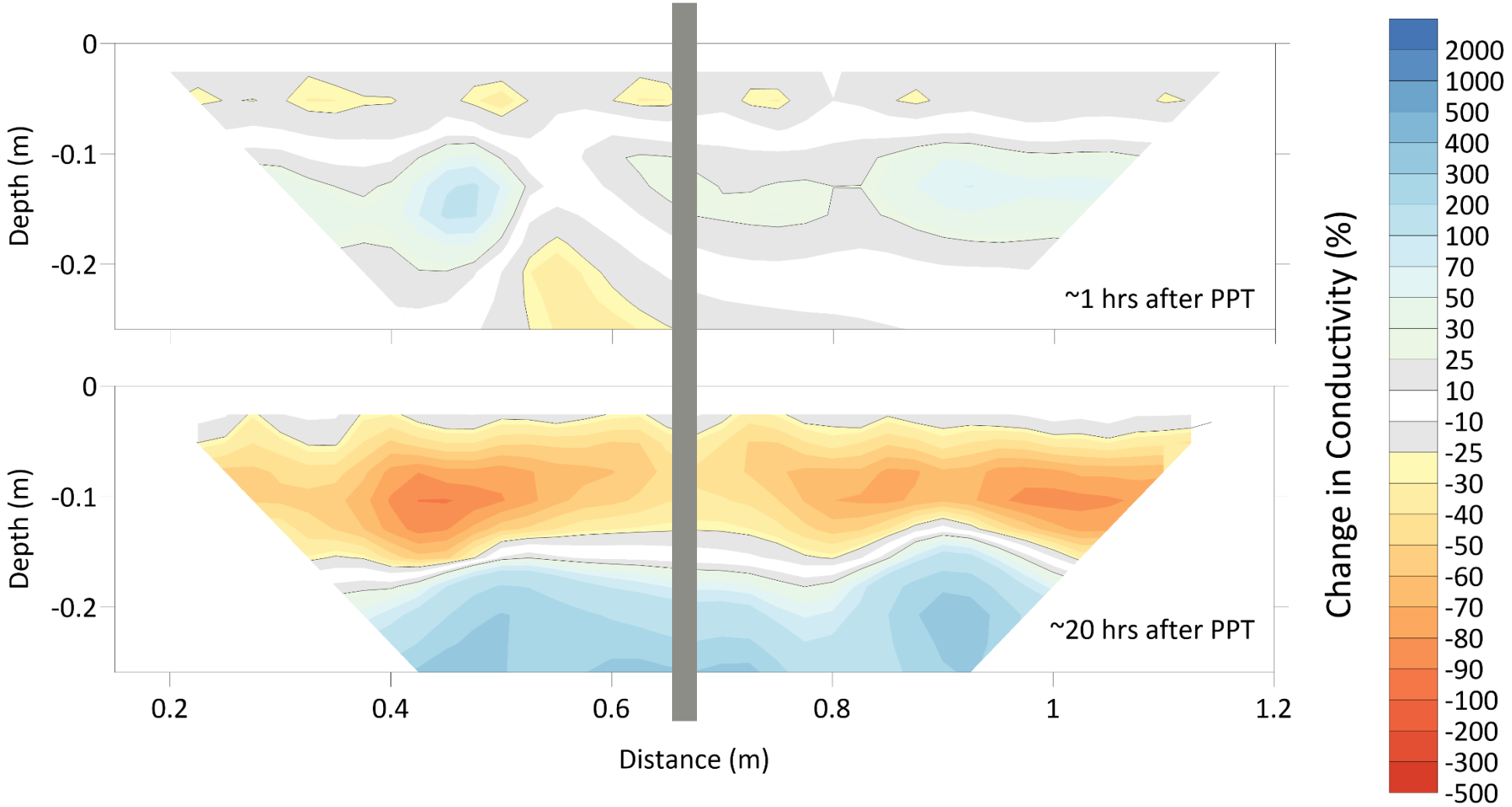
Wetting Image: Res Diff from Bkgnd



Results Cont.



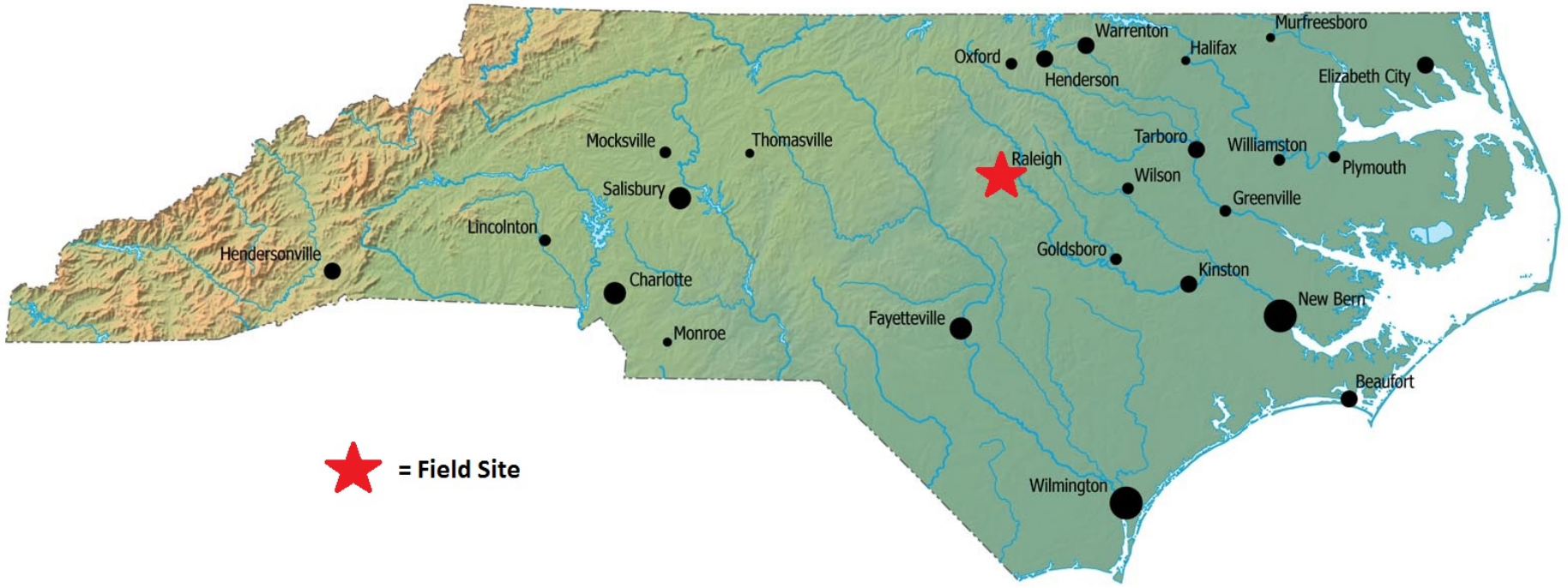
Drying Image: Res Diff from End of PPT



Preliminary Conclusion

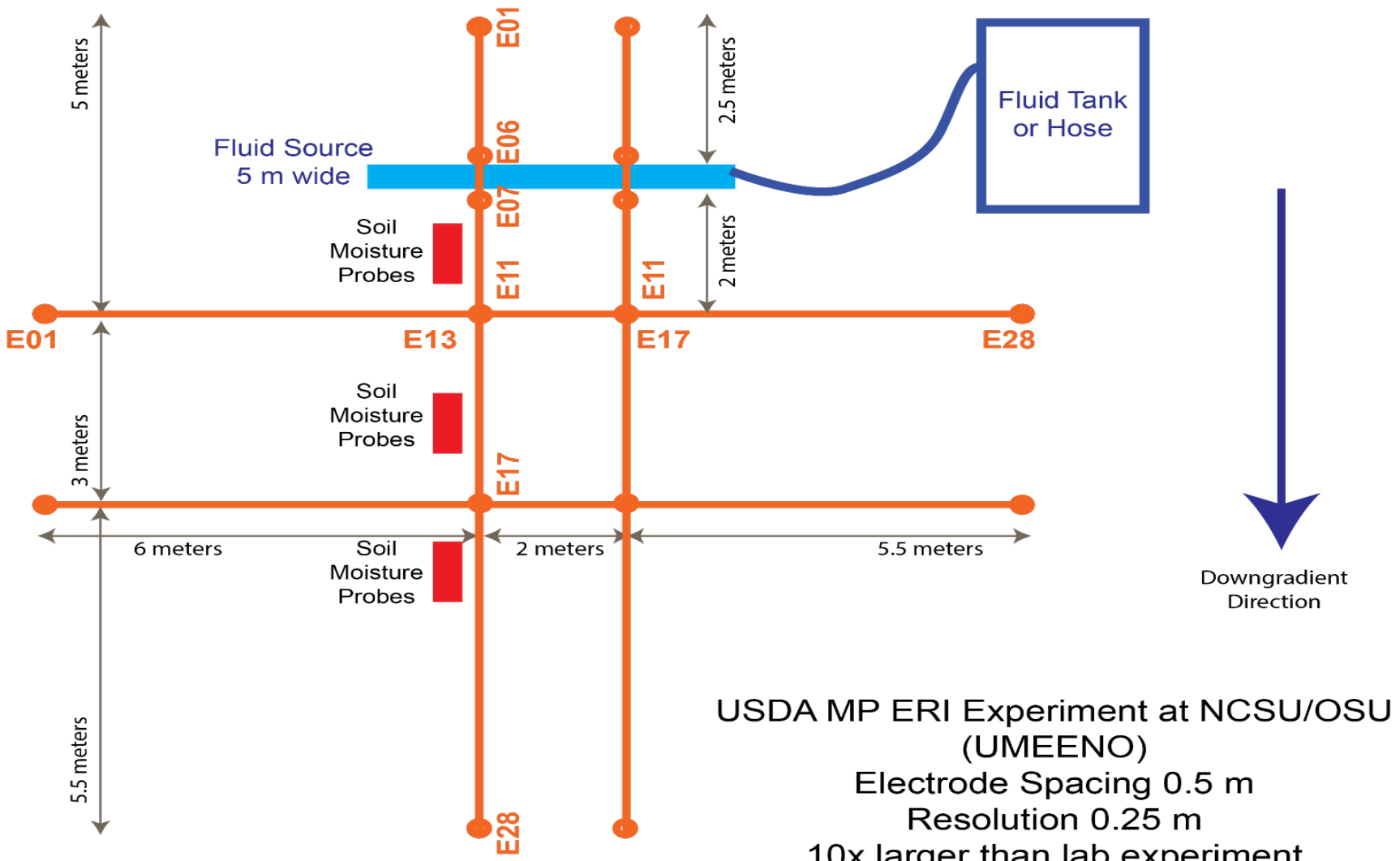
- Hypothesis not confirmed by experiment
- tank simulated vadose zone
- Expecting similar results in field

Future Work



- Returning to Raleigh, North Carolina in May, 2019
- Area of investigation is a small stream next a golf course

Future Work Cont.



USDA MP ERI Experiment at NCSU/OSU
(UMEENO)
Electrode Spacing 0.5 m
Resolution 0.25 m
10x larger than lab experiment

Flume or Weir
Runoff Measurement

Special Thanks

USDA – Agriculture and Food Research Initiative (AFRI)


Questions?