Applying Lessons Learned from ISCO to *In Situ* Remediation of Brine Spills

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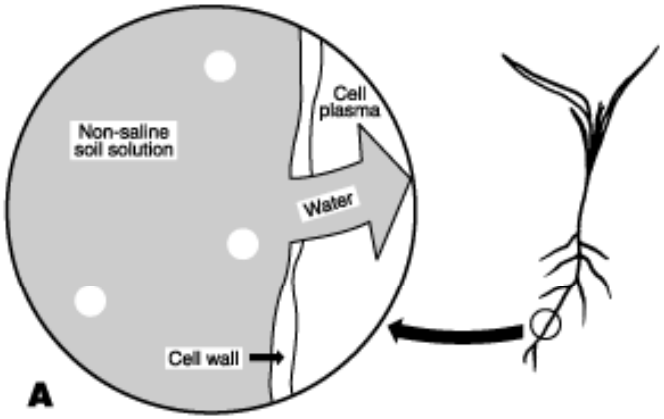
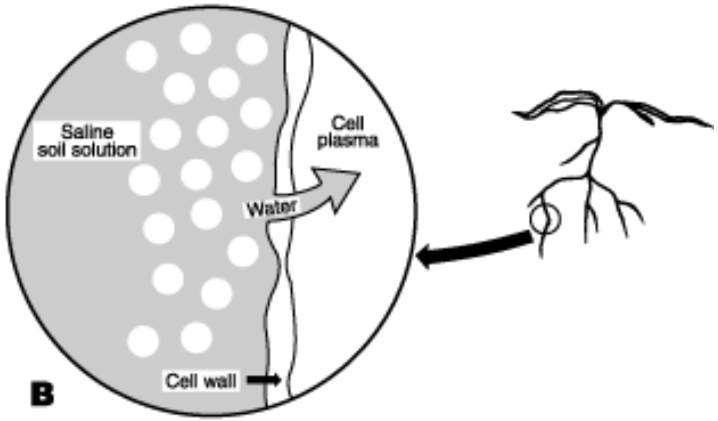
Spills of produced water or brine on soil result in two types of damage:





- Excess salinity
  - Creates an osmotic imbalance that reduces water uptake by plant roots. Plants can go into drought stress even though there is plenty of water in the soil.

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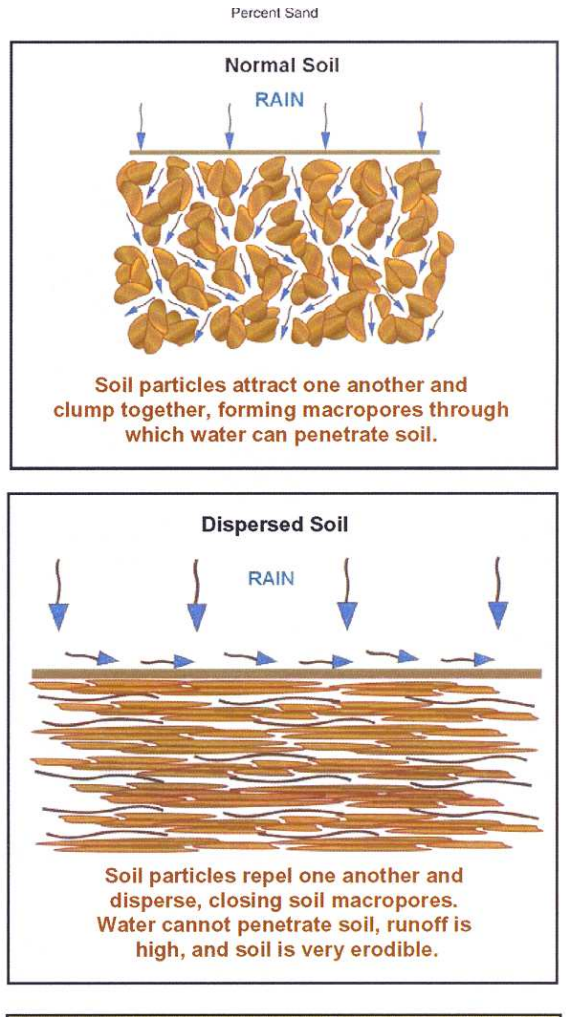


- Excess sodicity (an excess of sodium)
  - Destroys soil structure by dispersing clays
  - Produces a hardpan that will not transmit water
  - Erosion

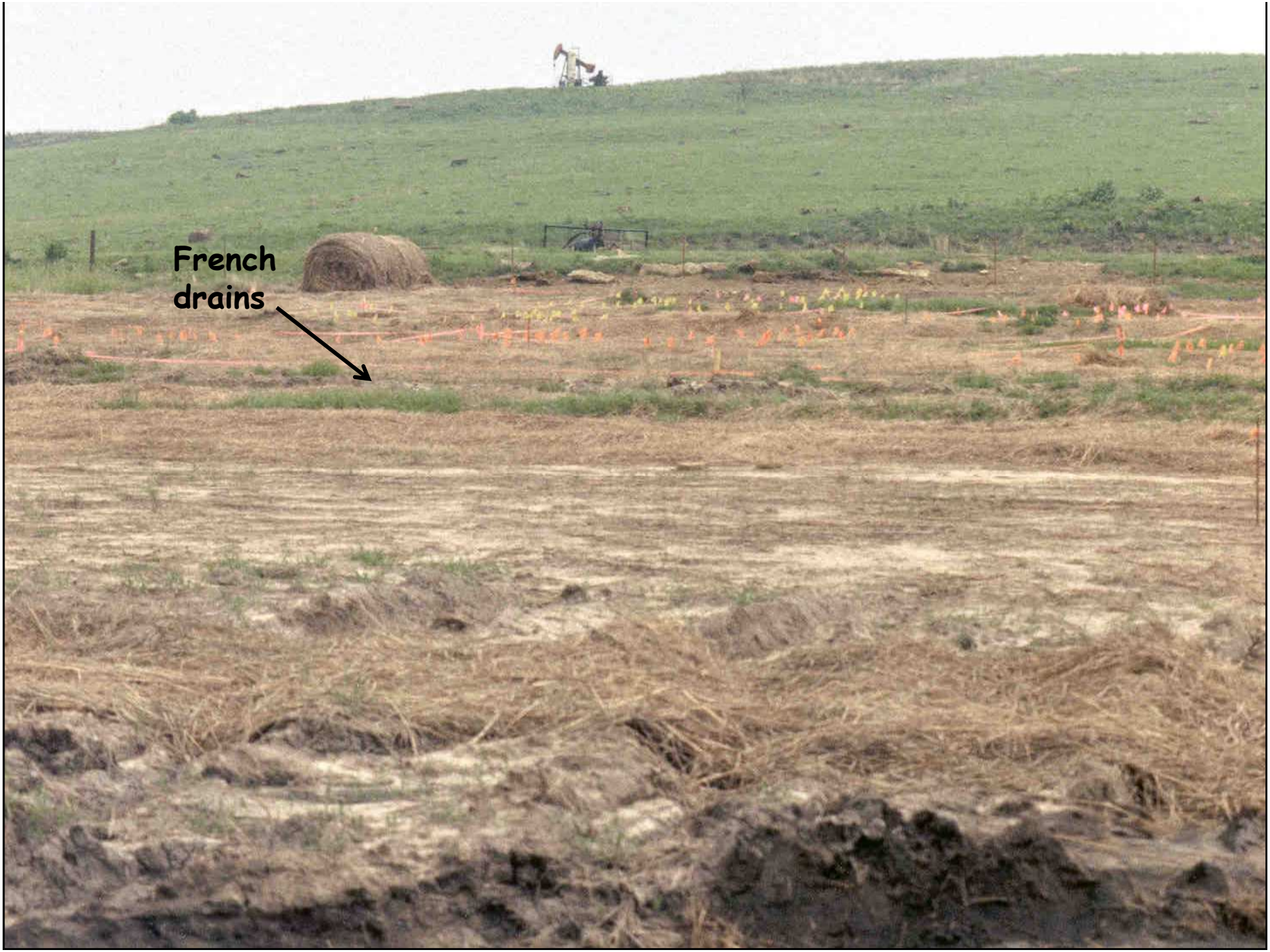
Both salinity and sodicity must be addressed in any successful remediation of a brine impacted site

Remediation of a Brine Spill In Brief

- First response
  - Flushing and containment (over saturated soil)
- Reducing salinity
  - Breaking open the soil
    - Ripping and tilling
  - Bulking agents
    - Organic matter (hay) to increase permeability and hold moisture
  - Fresh water
    - Rainfall or irrigation
    - Top dressing with hay to reduce evaporation and runoff

Remediation of a Brine Spill In Brief

- Reducing salinity, cont.
  - Drainage
    - Natural drainage patterns
    - Protection of groundwater
    - French drains
      - Leachate disposal
- Reducing sodicity
  - Soluble calcium ion to reverse sodic reaction with clays
    - Gypsum
      - Solubility issues limits effectiveness to tilled depth
    - Citric acid and calcium carbonate (natural or amended)
- Revegetation
  - Restoring fertility
  - Taking advantage of plant root systems

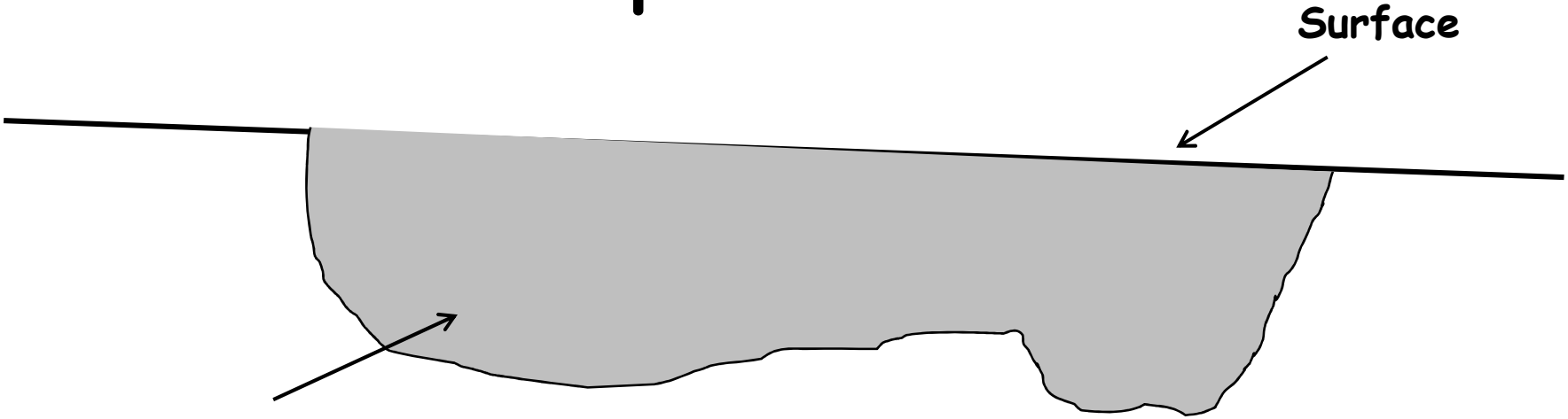

French
drains

Remediation of a Brine Spill In Brief

- If done correctly and you get enough **water** and you have good **drainage** from the site, one treatment may do the job
- Not uncommon for repeat treatments to be required especially for severely impacted sites
  - Repeat treatments often don't get done
- How can we improve the chances of that treatment is done correctly and reduce probability of return treatments?


DeepEarth Technologies, Inc.
"The Deep Shot Rig" #3
DeepEarth Technologies
Cool-Air

How can this methodology be applied to brine spill remediation?



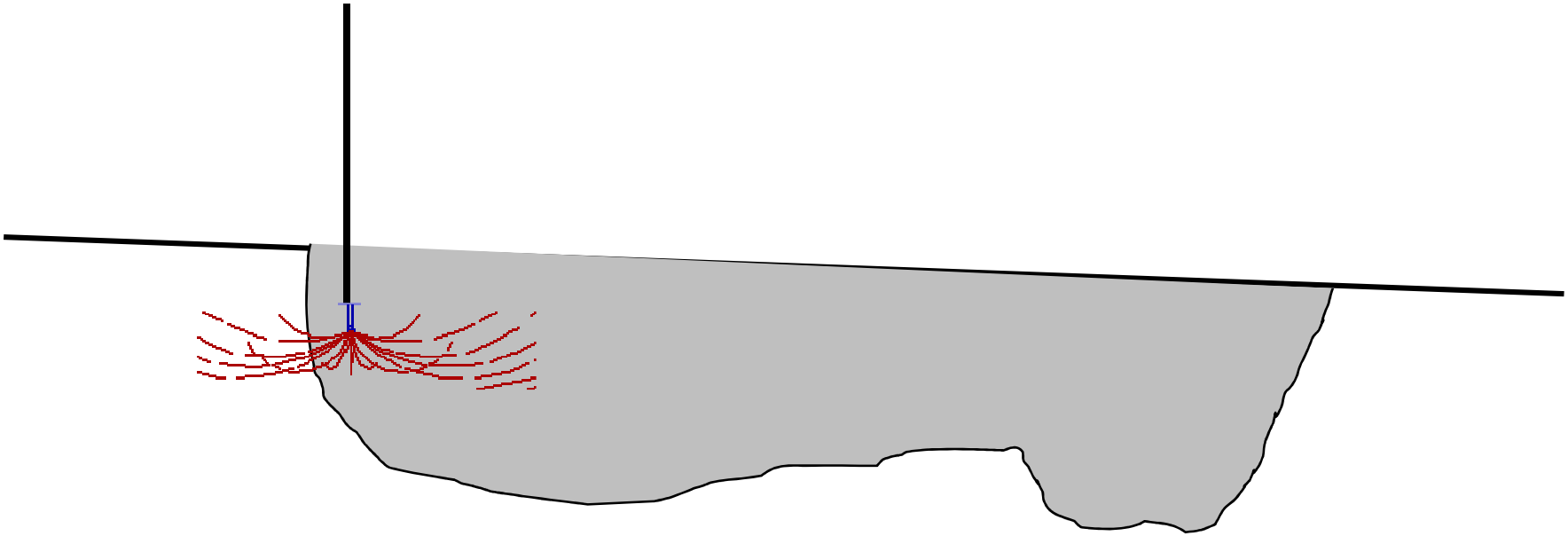
How about gypsum flour? Or citric acid and calcium carbonate?

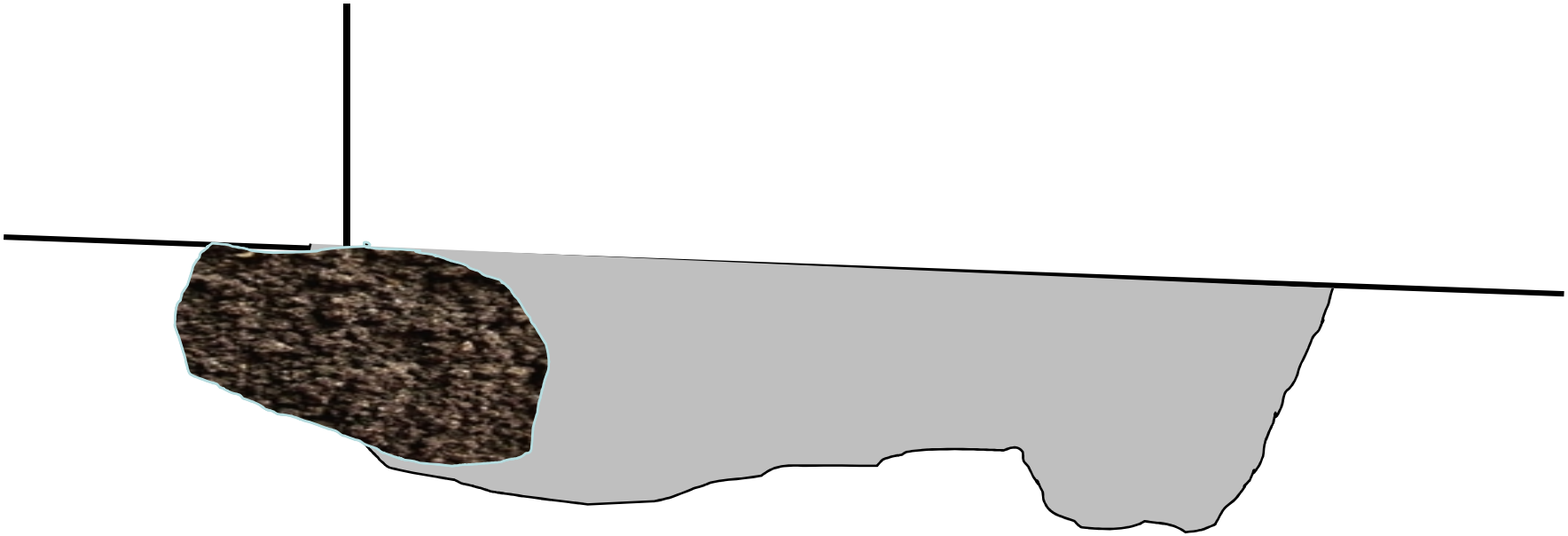
How about microhumates?

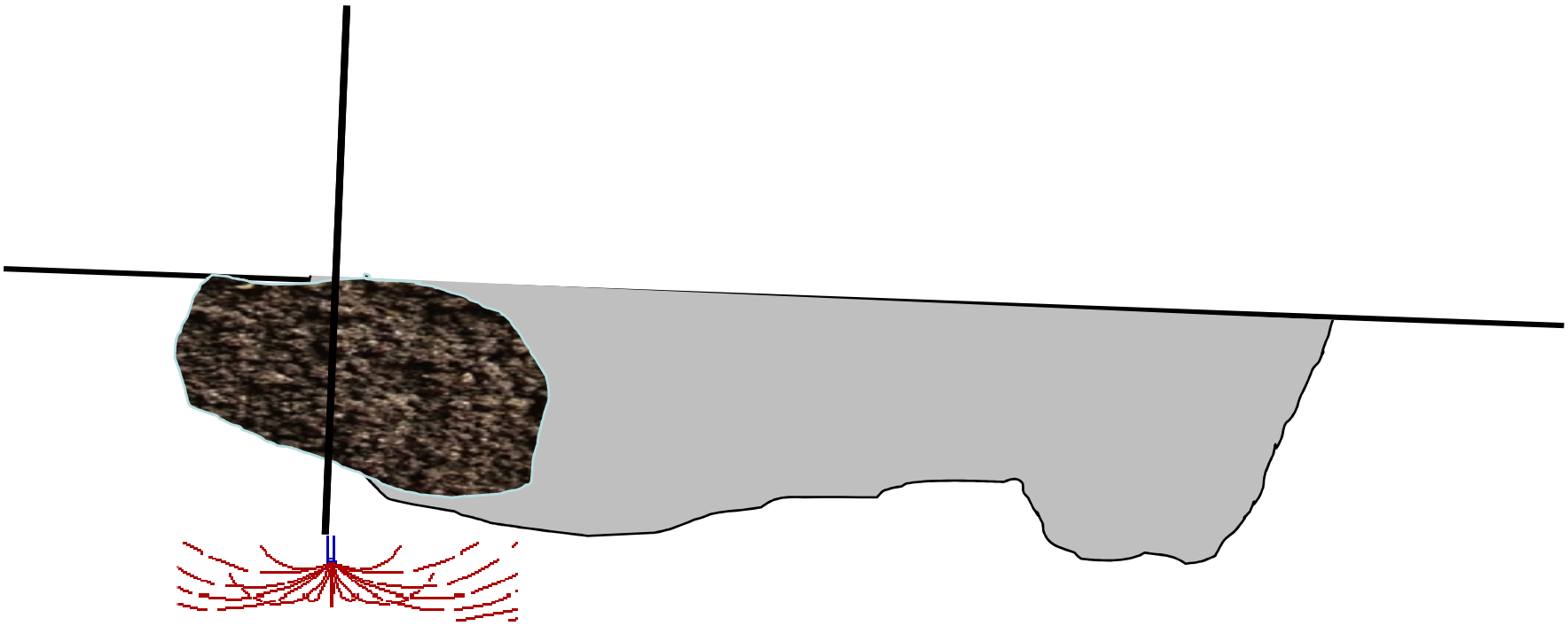
Injection of gypsum would overcome the tillling limitation

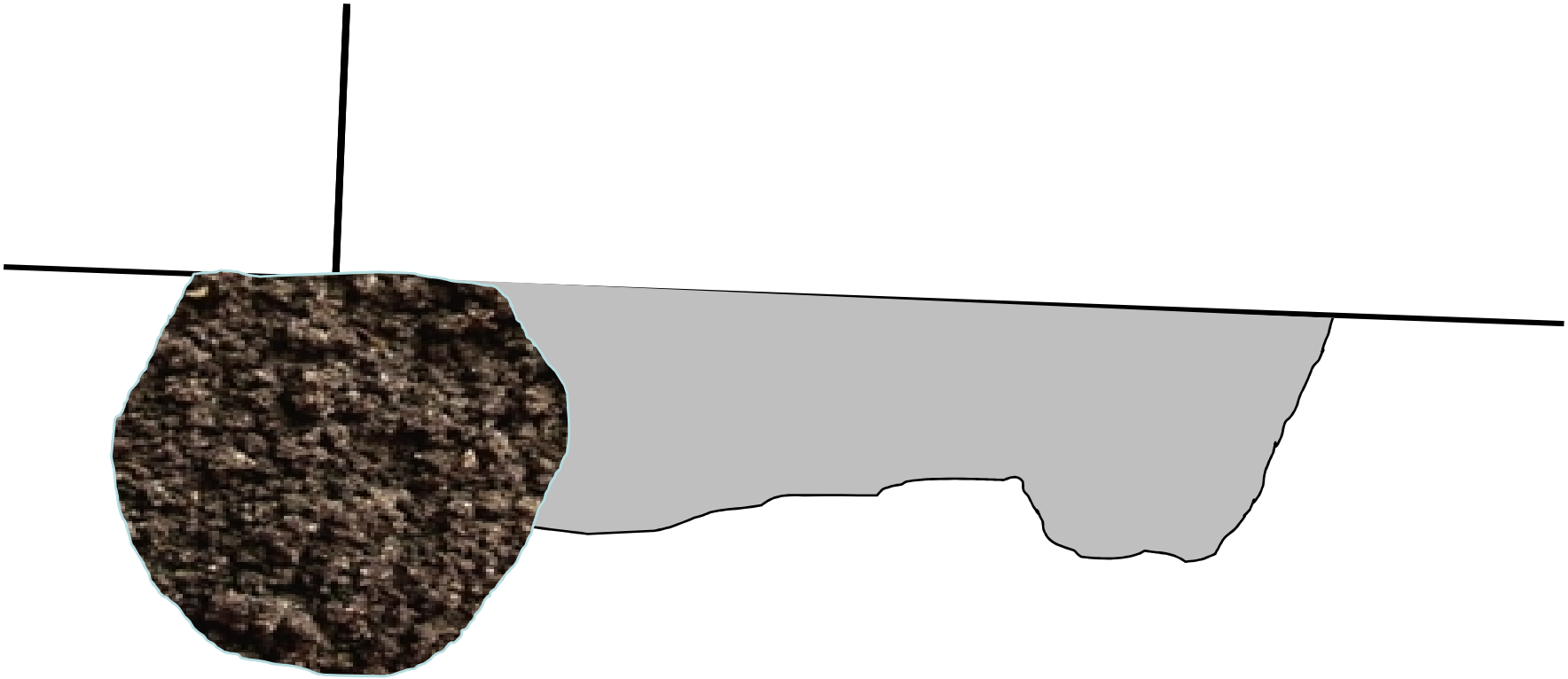
Humates would help maintain permeability, hold moisture, and provide fertility base for revegetation

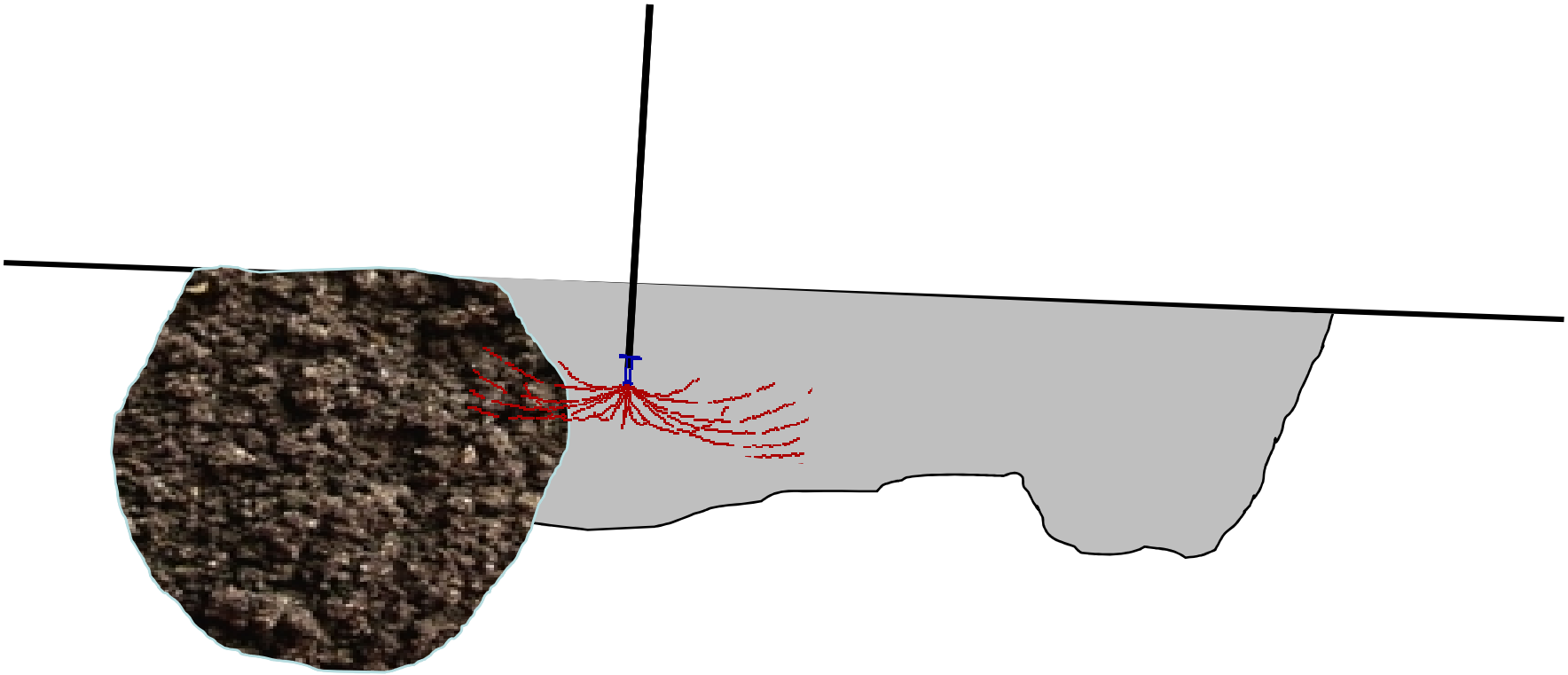

Lots of fresh water injected into the contaminated zone.

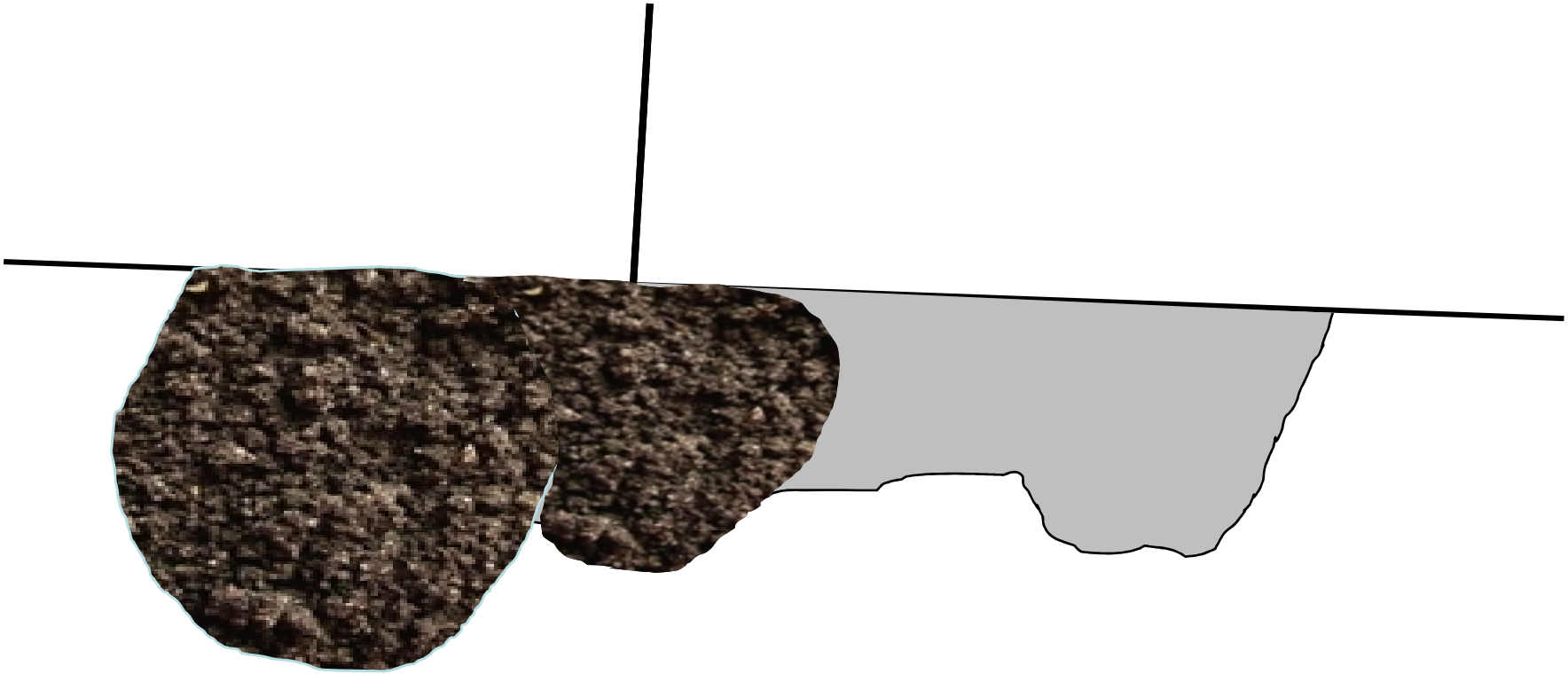


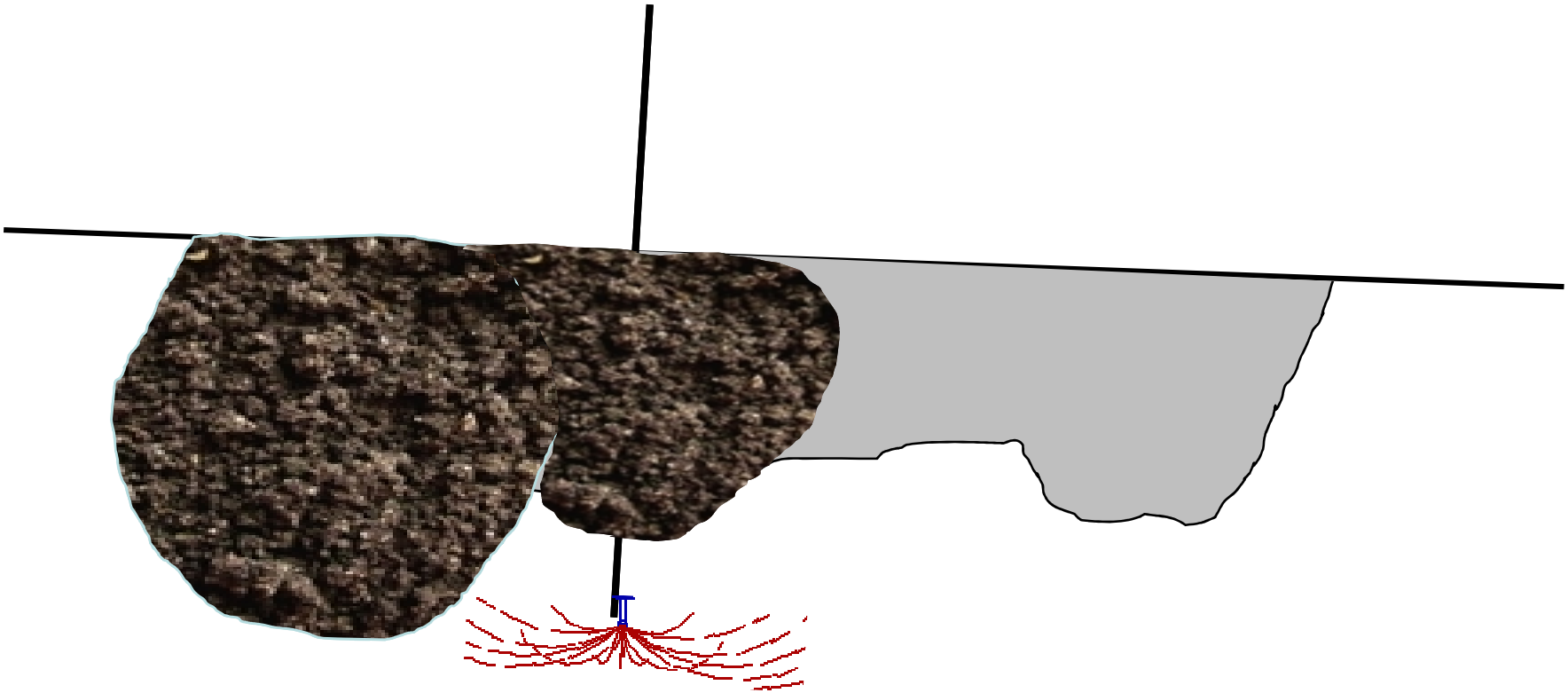


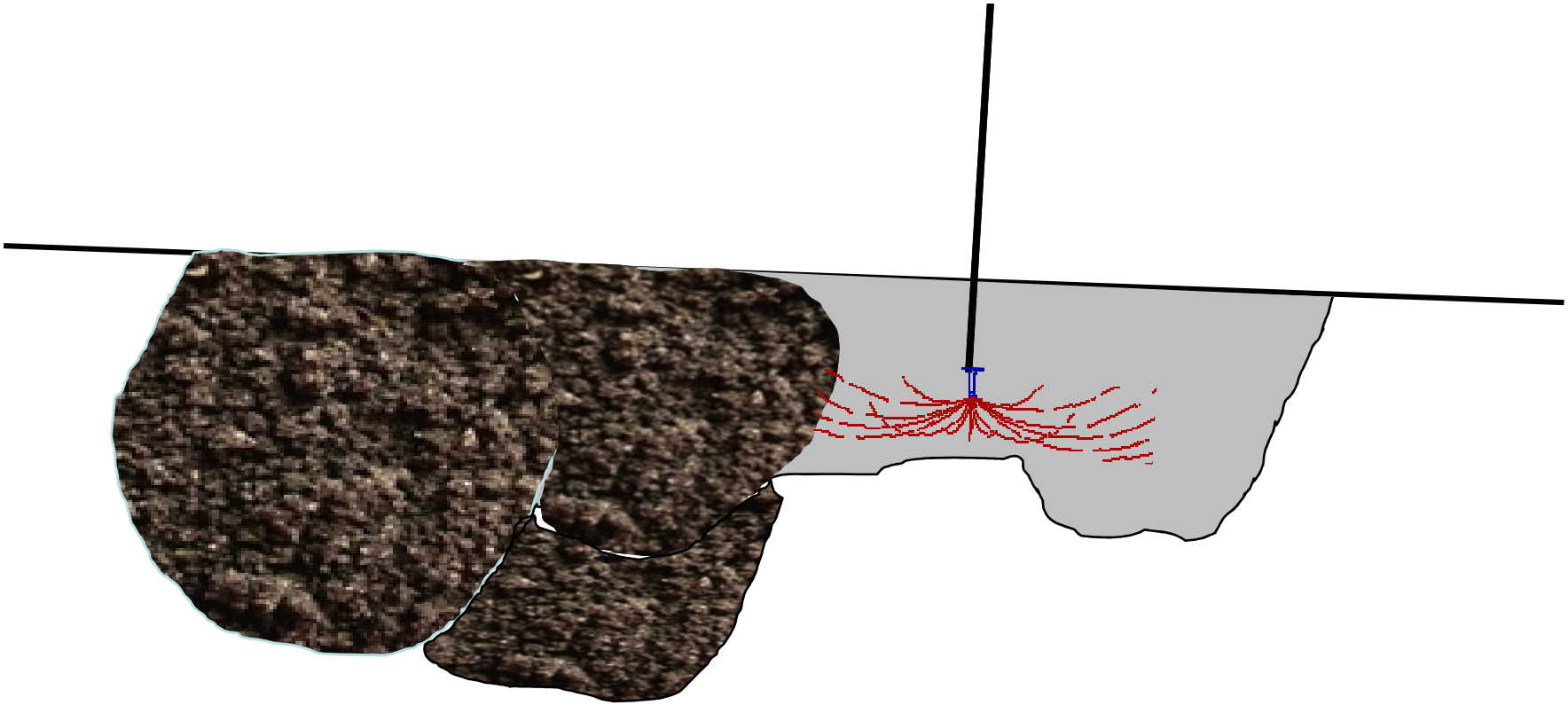


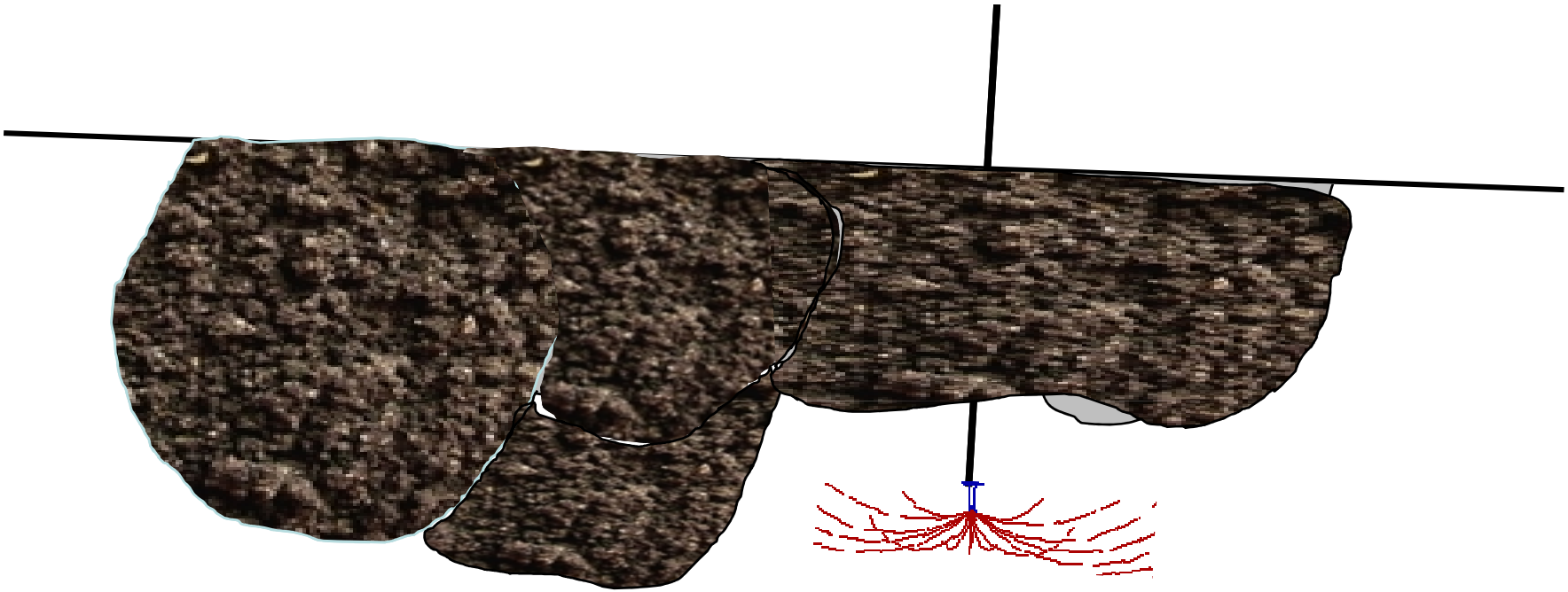






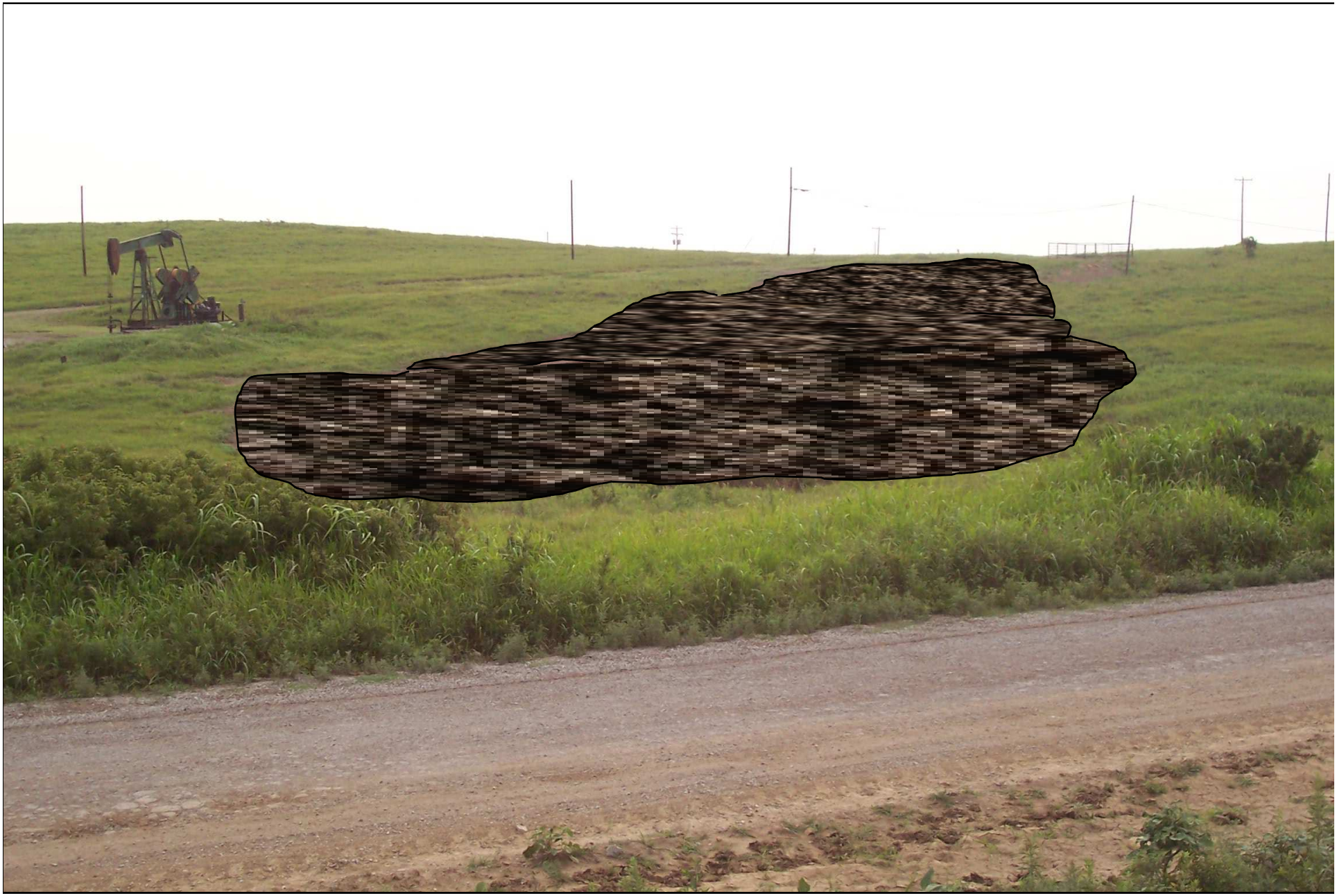






If vertical drainage is the goal then treat as far below the level of contamination as possible

If lateral drainage is the goal then treat downgradient to open a pathway for drainage



Following injection

- Top dress with thick layer of hay
  - Retain moisture
  - Prevent runoff
  - Provide seed for revegetation
  - Tack down with jute netting if necessary
- Fence the site
- Irrigate if possible

Follow on work

- Deep Earth Technologies has committed to field testing
- Likely in the Williston, ND area
- Come back next year for the results

This is how it can feel trying to remediate a brine spill


We keep developing tools we
can use though to make the
job easier

There are always going to be rough spots and everyone has to be patient


Any Questions?
SCENIC
TURNOUT
AHEAD