

ILLINOIS PETROLEUM RESOURCES BOARD

INCREASING AWARENESS - RESTORING THE LAND



A Novel Process for Brine Remediation at an Illinois site



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Illinois Petroleum Resources Board (IPRB)

Restoration

IPRB expertise and industry provided funding is utilized in the clean-up and restoration of abandoned oilfield sites in Illinois. IPRB's goal is to restore abandoned sites previously used for oil and gas production back to commercial or agricultural use at no cost to current land owners.

Brine Scars

Brine damage is caused by salt water intrusion into soil resulting in increased salinity and loss of soil structure.

The loss of soil structure is caused by an increase in the concentration of sodium ion (sodicity).

This in turn, unsets the balance of calcium ion and causes the soil (usually clay) to lose its integrity thus, interdicting the ability of the soil to transport water.

In saline soil plants cannot get water and die of drought and the soil seals over with a hardpan preventing water infiltration. This leaves a “brine scar” devoid of vegetation and subject to erosion.



Traditional Brine Remediation



- Soil Excavation and Replacement but...
 - unreliable...How do you know what the operator brings in for replacement?
- Cultivation of the site and the incorporation of gypsum and fertilizer as amendments but...
 - was there sufficient soil sampling to document the initial and subsequent conditions at the site?
 - brine components at depth will rise vertically by capillary suction into this zone when soils dry out
 - amendments can only go as deep as the agricultural tools instead of as deep as the salt is located
- *Sometimes* irrigation is planned but...
 - traditionally “Mother Nature” is the only water source.

Cool-Ox[®] Brine-Buster[™]

- A novel process of rapid delivery of amendments and fresh water **to exactly where the salts are located**, resulting in increased infiltration and reduction of salinity.
- A “**green**” alternative to excavation and off-site disposal.
- **Cool-Ox[®]** is a patented, field proven technology for efficiently treating soil and groundwater impacted with petroleum hydrocarbons, and halogenated organics. Now Cool-Ox Brine Buster offers a unique delivery system for amendments that allows deep injection of amendments and intense mixing.

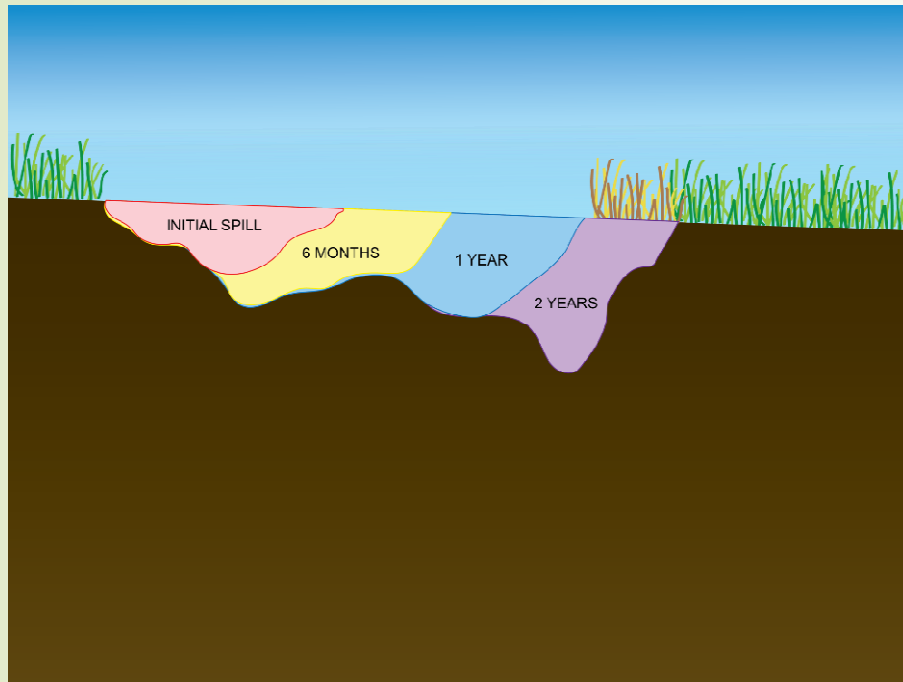


Cool-Ox[®] Brine-Buster[™]

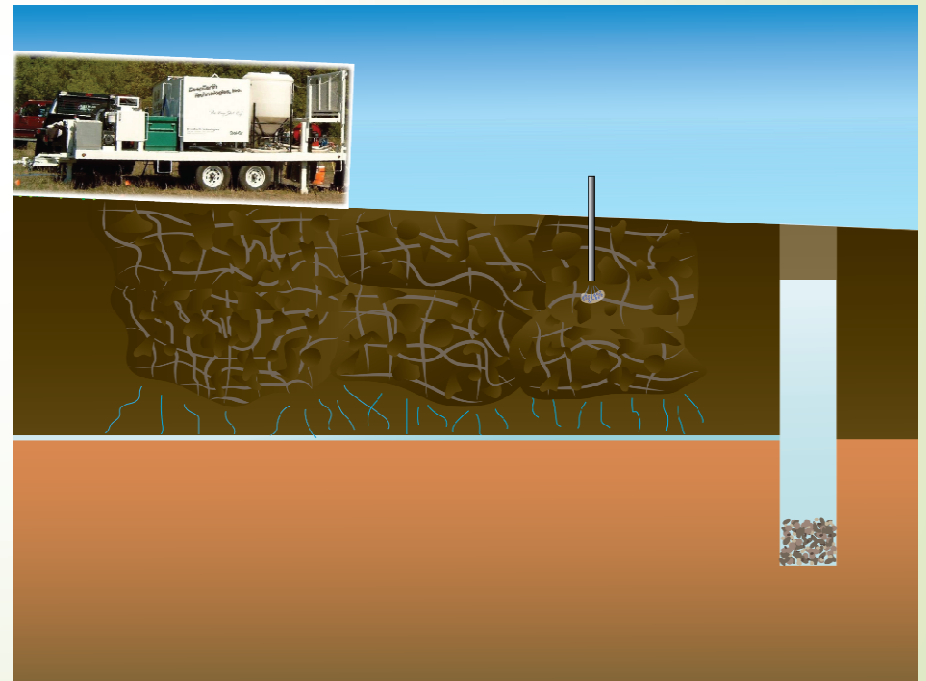
- Cool-Ox Brine Buster amendments consists of
 - Rapid and slow-release sources of calcium
 - Chelating agents to maintain calcium in an active form
 - An amendment to encourage mixing on a small scale
 - An injectable source of organic matter to hold moisture and help rebuild fertility
 - All coupled with a high-pressure delivery system and fresh water injection



Treatment



Brine Scar



Treatment

Demonstration Site in IL



The Demonstration Site

- The salt embedded with high concentrations at 6-7 feet bgs.
- A layer of clay at approximately 6 feet.
- Average EC of the site was between 26 mS/cm to about 49 mS/cm
- West end of site is 100 ft from a creek

Approval Process

- Step 1:** A meeting was between DTI and the Illinois Petroleum Resource Board (IPRB) to learn about the site, explain the technology and application methods.
- Step 2:** Provide remedial design and costs
- Step 3:** Finalize design and implementation dates with the IPRB and the subcontractor, Dee Drilling, responsible for the trenching.

Site Plan

Trench Area

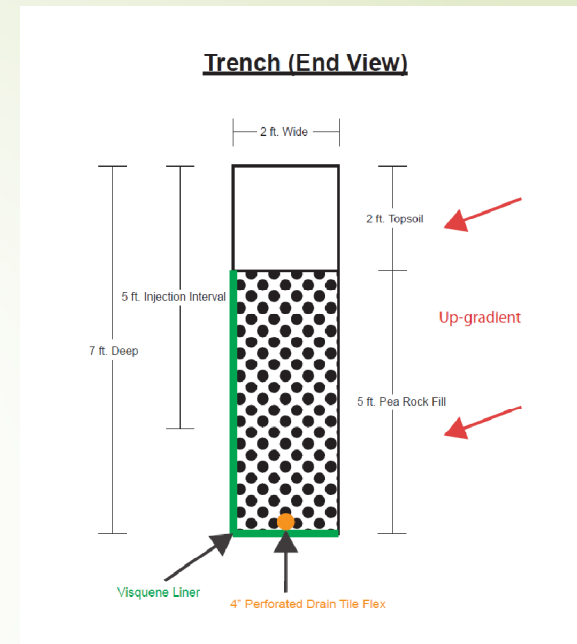
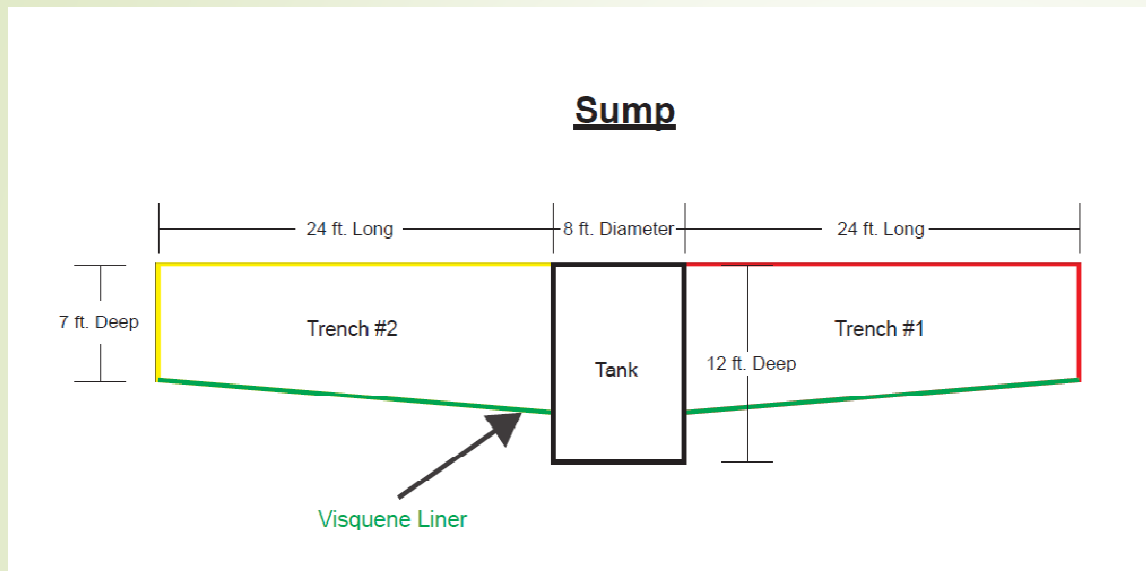
- Trench #1 (24' x 2' x 7') with Visquene Barrier
- Trench #2 (24' x 2' x 7')
- Sump
- Visquene Barrier extended across the site and upgradient covering the bottom of the trench to the surface.



- ▶ 10' to Groundwater
- ▶ Creek Level at 20' - 25'
- ▶ Supply Tank must be provided (8' Diameter, 12' Long)

- DTI positioned the treatment at the down gradient section of a brine scar approximately 210 feet long by 38 feet wide.
- This area encompasses 525 ft.² to a treatment depth of approximately 5 1/2 feet.
- Because of the potential to impact groundwater, the salt water displaced during the treatment was captured by a down gradient trench/sump combination.

Drains



- The trenching was completed by a subcontractor experienced with the client. The trench was approximately **24 inches wide by 24 feet long with a 7 foot extension** constructed along the southeast barrier of the brine scar. This is to capture any salt water that may escape from the treatment area to the surrounding clean soil.
- The trench was constructed with a **1/2 inch per foot gradient** to assure drainage from the treatment area to the collection sump.

Trench Installation



Application

- DeepEarth's **Hydro-Dart™** injection system not only delivers reagents to deep contaminated soil but also mechanically opens the soil to improve leachability of salts.
- The water that the reagent's components are suspended in during injection provides the first wave of fresh water to wash salts out of the soil.



Application



Collection in the sump tank



Cool-Ox[®] Brine-Buster[™] Injection Application
with DTI's *Hydro-Dart[™]* near the sump tank



Note foaming and
resulting mixing on
small scale in the
subsurface



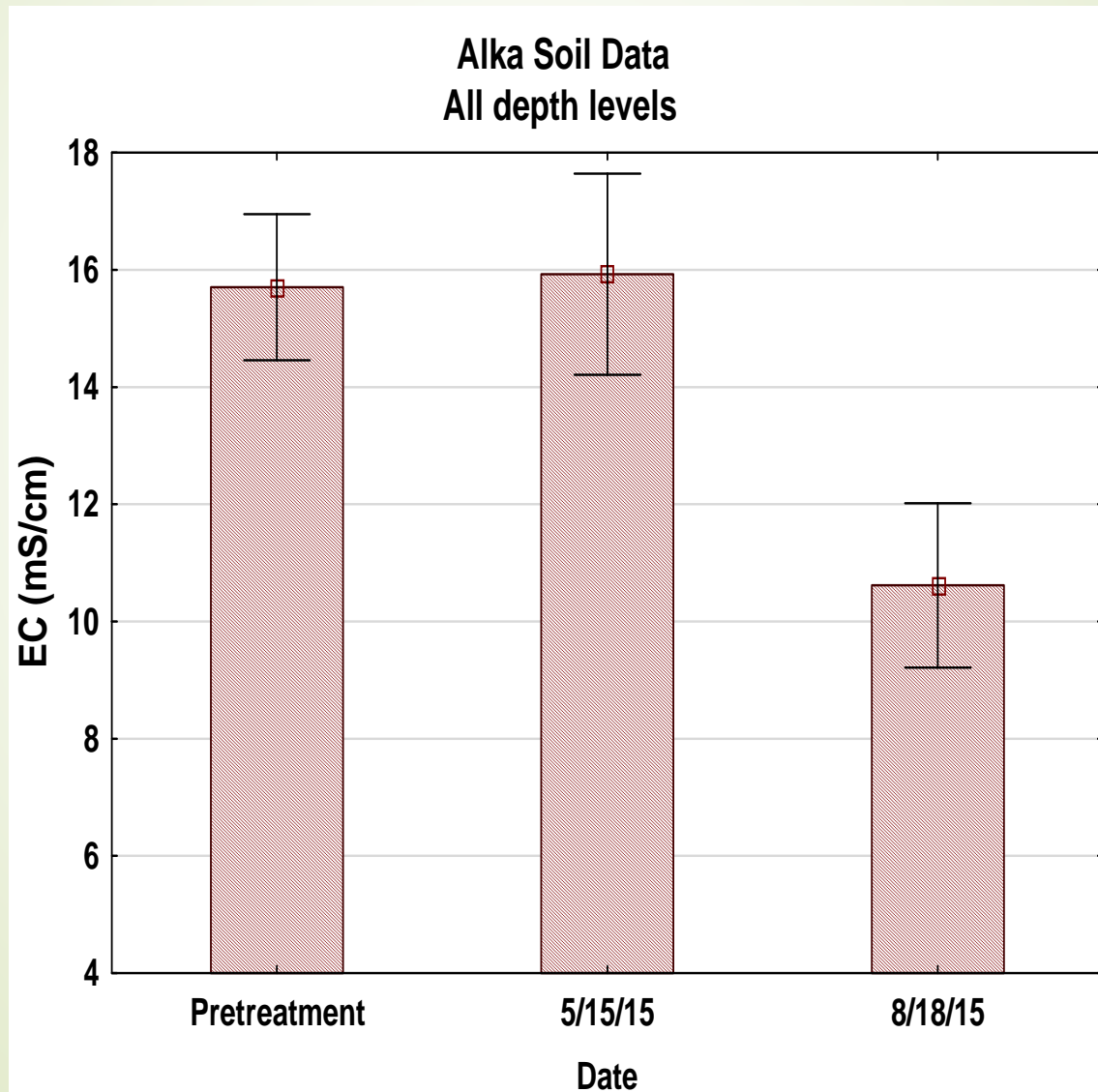
Post Application

To retain moisture in the treatment area, hay was put down.

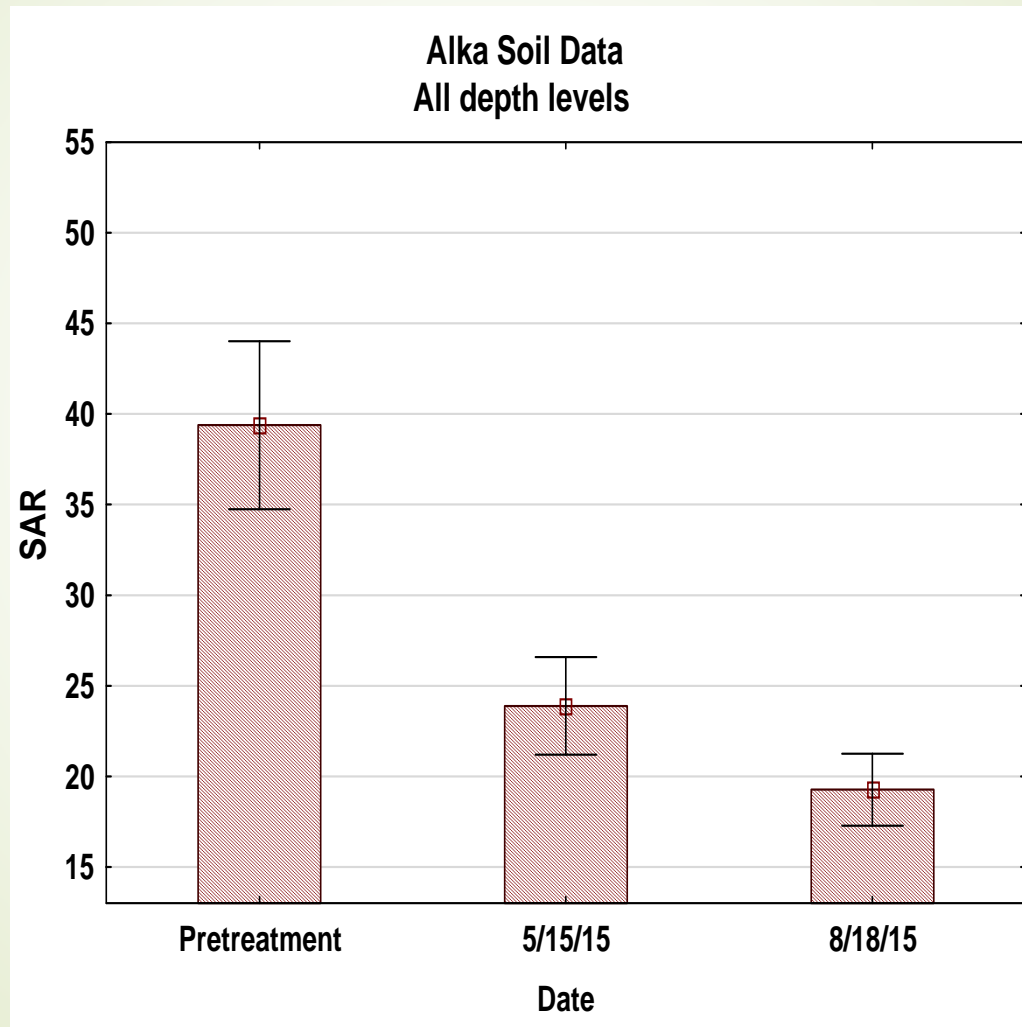


Post Application Data

Treatment occurred on 4/18/15.

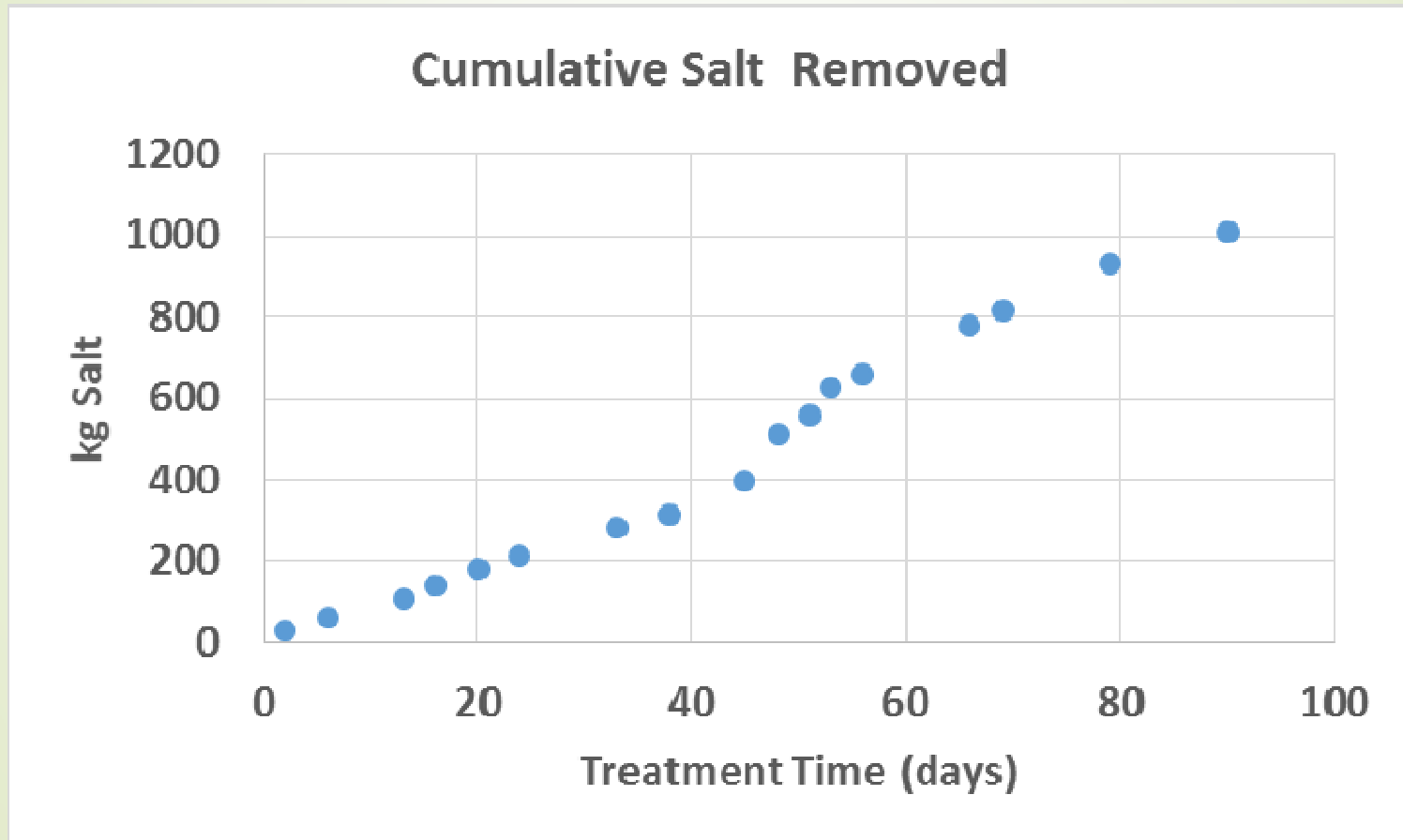


Post Application Data



Post Application Data

Treatment Occurred on 4/28/15



Drains are receiving leachate from outside the treatment area.

Results to Date

- Significant progress (statistically valid results) but we have a ways to go
- The change in average EC at the site, over a 72-inch depth, is consistent with the amount of water introduced at the site over the 3 months ending 8/1/15 (precipitation + water from original treatment).
- The average decrease in EC observed would require 15.9" of precipitation. Over the first 3 months we got 10.3" from rainfall and the original treatment was equivalent to 3.1".
- Over this period we should have collected about 85 kg of salt. We actually collected over 1,000 kg in the sump...92% more than expected!
- Over this period we should have collected around 4300 gallons of leachate. We actually collected over 20,000 gallons...79% more than expected!
- Isolation trench is in hydraulic communication with drain system

Conclusion

- EC and SAR reductions indicated good contact between calcium sources and fresh water with the treated depth interval.
- EC reductions indicate full utilization of the fresh water available in the treated area.
- Isolation trenches need to be considerably deeper than the drains.
- **Irrigate the site!** Fresh water is the key. Good mixing and contacting ensures full utilization of that fresh water.

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Cool-Ox[®] Brine-Buster[™]
*for Environmental
Restoration*

Acknowledgements

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Jack Jenkins, Restoration Committee, Illinois Petroleum Resource Board

Michael Payne, Restoration Committee, Illinois Petroleum Resource Board

Brad Richards, Executive Vice President of the Illinois Oil and Gas Association

Representatives from Natural Resources Conservation Services