REGENESIS

PlumeStop™

COLLOIDAL BIOMATRIX

securing rapid risk reduction and accelerated bioremediation
using a dispersive injectable reagent

PlumeStop™ Colloidal Biomatrix

- What it is and how it works
- Performance in the lab
- Performance in the field
- Usage

PlumeStop™ – what it is

"A highly dispersive, injectable sorbent and microbial growth matrix"

- Colloidal activated carbon (1 – 2 µm)
  - Size of a bacterium – suspends as 'liquid'
  - Huge surface area – extremely fast sorption/concentration reductions
- Anti-clumping / distribution supporting surface treatment (patent applied for)
  - Enables wide-area distribution through the soil matrix
- Low-solubility / controlled availability matrix nutrients
  - Support in-matrix contaminant biodegradation
  - Does not impact groundwater

PlumeStop™ Colloidal Biomatrix

- BioMatrix
  - Soil-surface network
  - Host to bacteria
  - Close contact with sorbed contaminant
  - Couples with Aerobic, Anaerobic, or MNA
- Contaminants Treated
  - Petroleum Hycrocarbons (TPH, BTEX, etc)
  - CVOCs including ethenes and ethanes
  - MTBE, pesticides, and more

PlumeStop™ – how it works

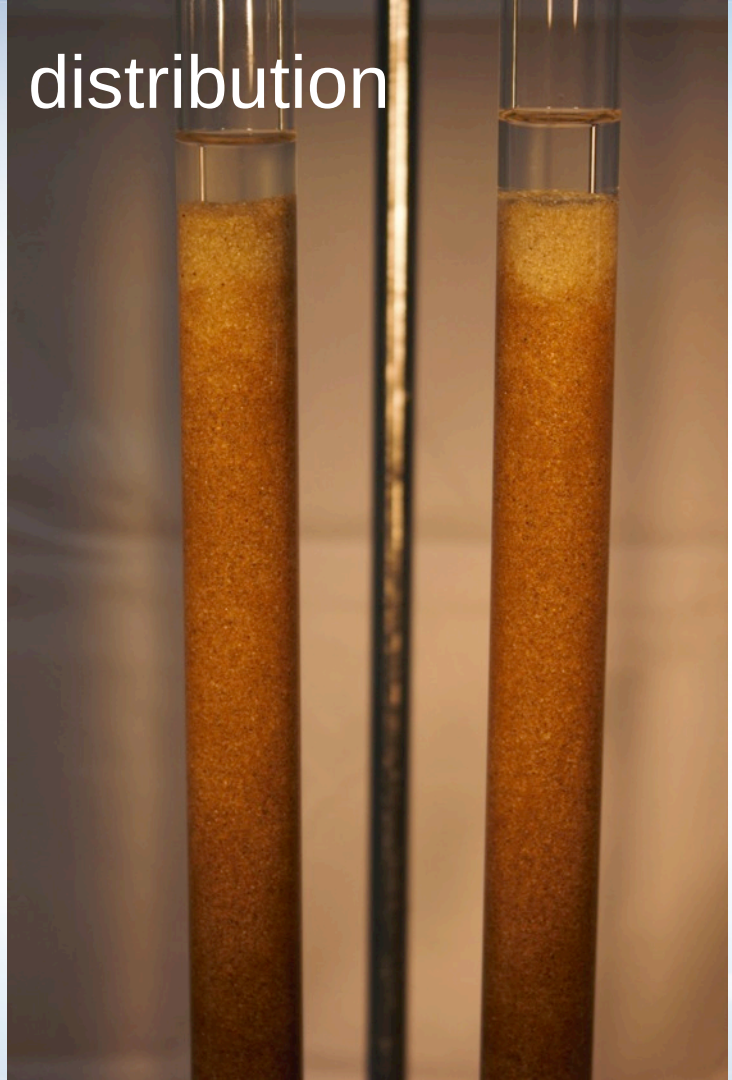
- Wide subsurface dispersion
  - Simple application
  - Ability to address restricted access areas, deep plumes, etc.
- Sorbs contaminants rapidly
  - Rapid concentration reductions (multiple OOM days to weeks)
- Accelerates biodegradation
- Long-term efficacy

Critical Questions for the Technology

- Can it effectively distribute in situ?
- How effective is contaminant sorption?
- What happens to sorbed contaminants?
- How does it perform in the field?

REGENESIS

PlumeStop™ distribution



Plume Stop

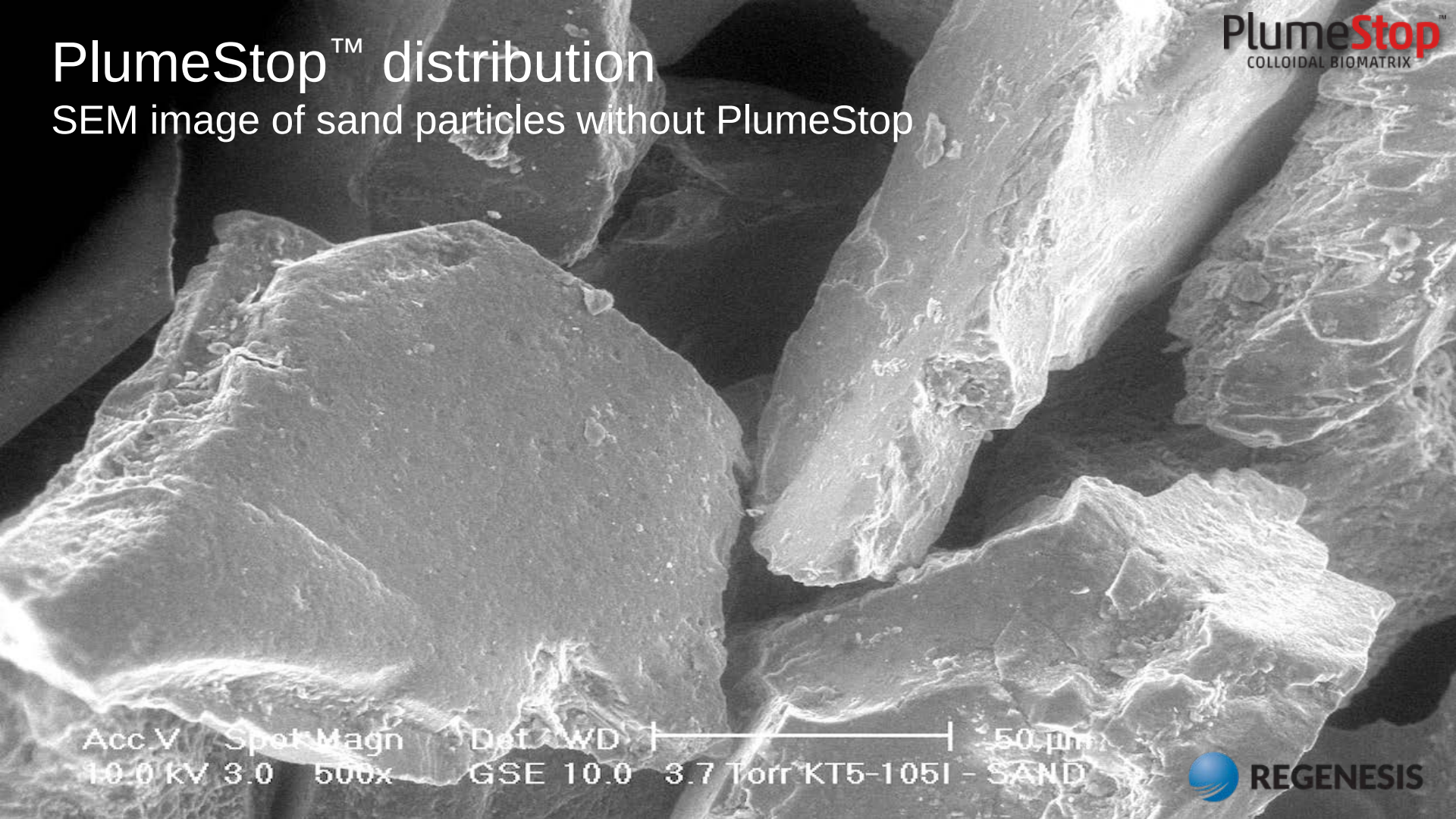
Powdered Activated Carbon

repeat

long column vid

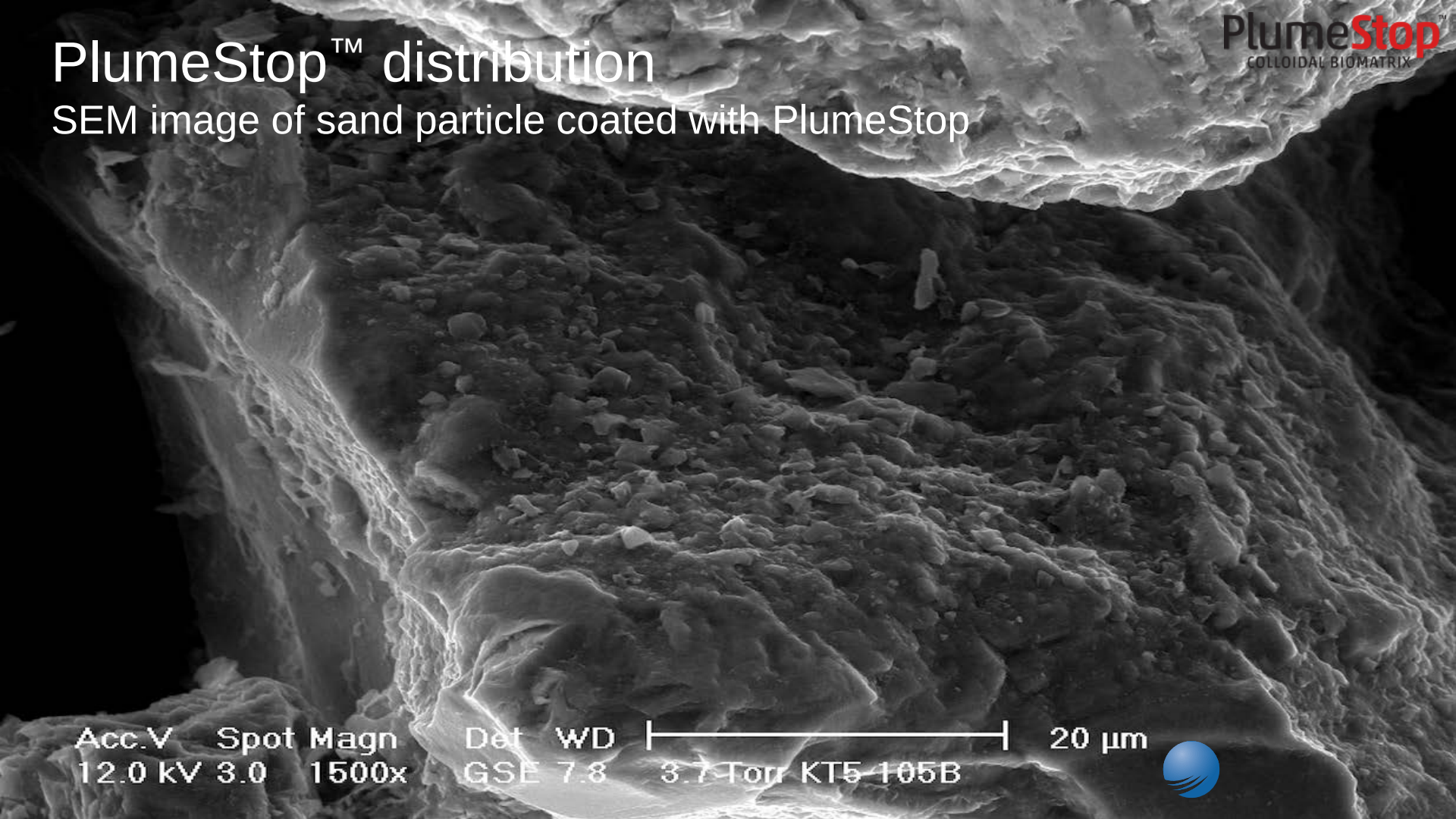
PlumeStop™ distribution

SEM image of sand particles without PlumeStop



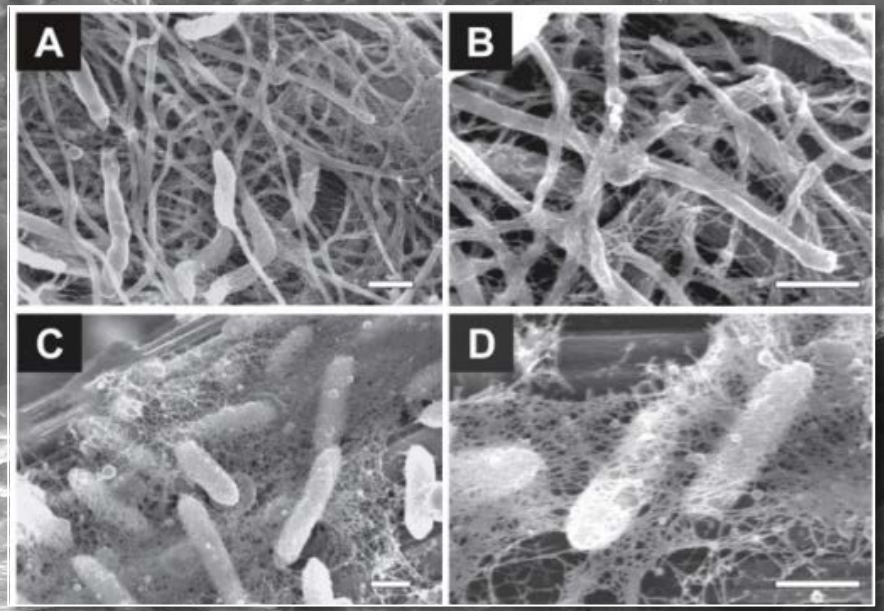
PlumeStop™ distribution

SEM image of sand particle coated with PlumeStop



PlumeStop™ distribution

PlumeStop
COLLOIDAL BIOMATRIX



Acc.V Spot Magn Det WD 20 µm
12.0 kV 8.0 1000x GSE 8.3 4.6 Torr KT5-105B

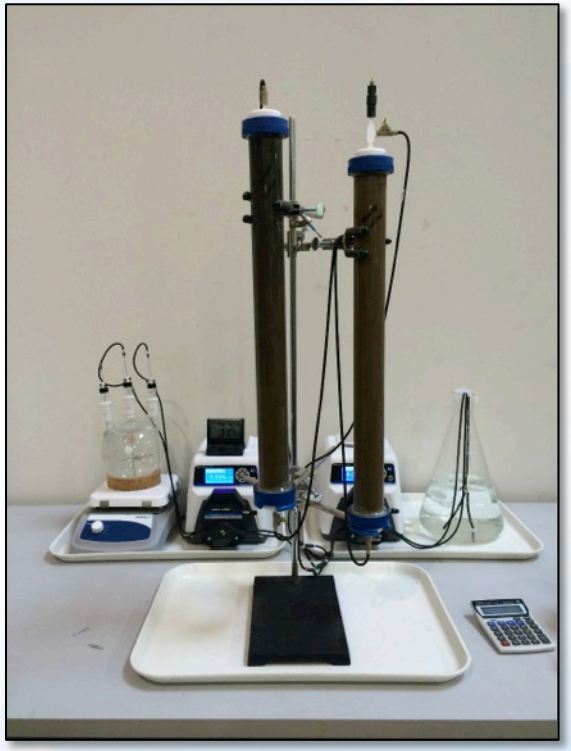
PlumeStop™: sorption capacity

PlumeStop COLLOIDAL BIOMATRIX

Q: Does the treatment to secure distribution negatively affect sorption capacity?

Column Study

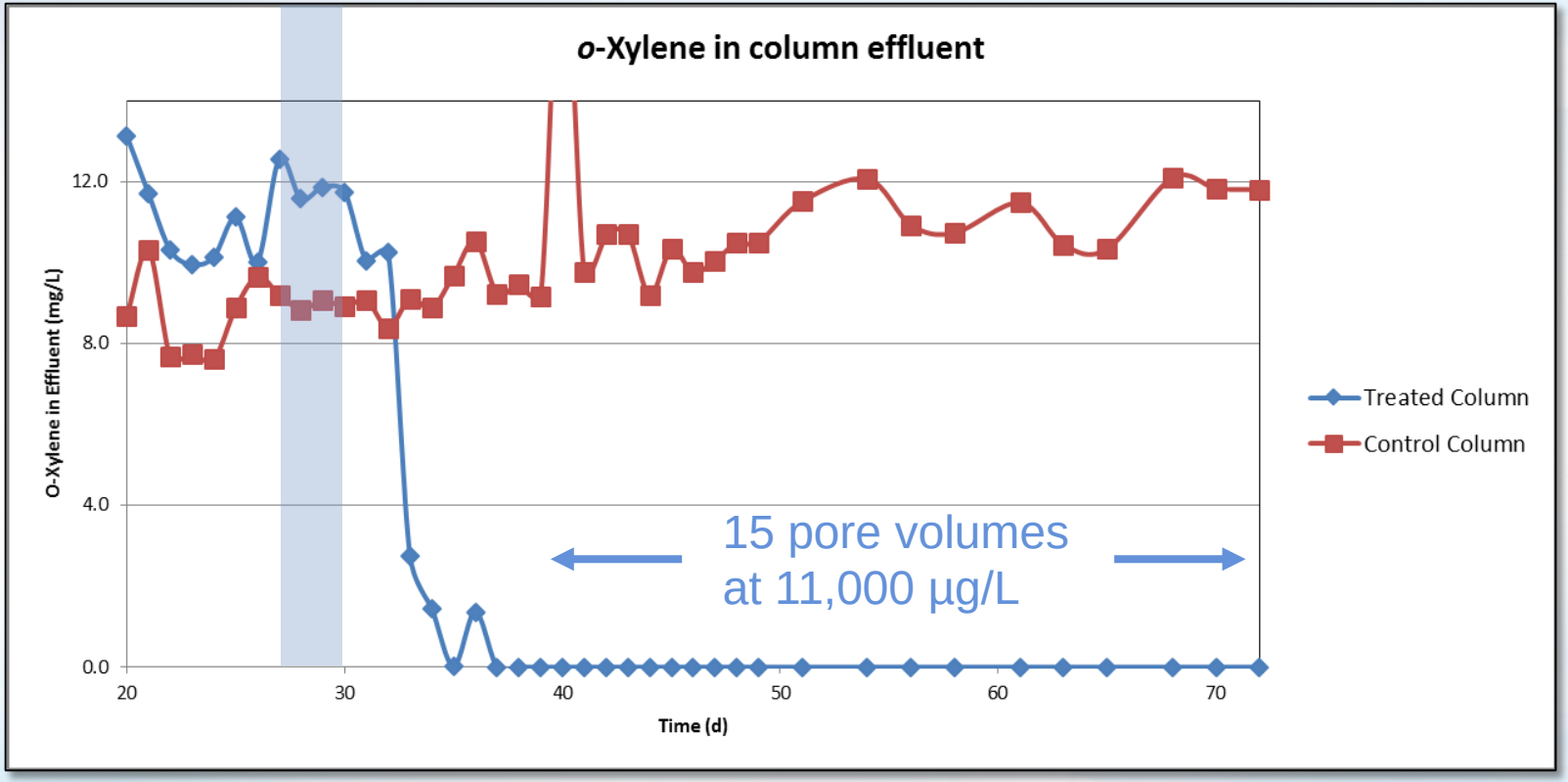
1. Feed ~10 mg/L *o*-xylene by blending water and saturated xylene in-line
2. Monitor both column effluents daily
3. Feed plume stop dose into “treated” column
4. Continue xylene feed on both
5. Continue daily monitoring



REGENESIS

PlumeStop™: Sorption Capacity

PlumeStop™ COLLOIDAL BIOMATRIX



REGENESIS

PlumeStop™: post-sorption biodegradation

PlumeStop COLLOIDAL BIOMATRIX

Q: Does biodegradation proceed post-sorption?

Benzene Degradation Batch-Equilibrium Study

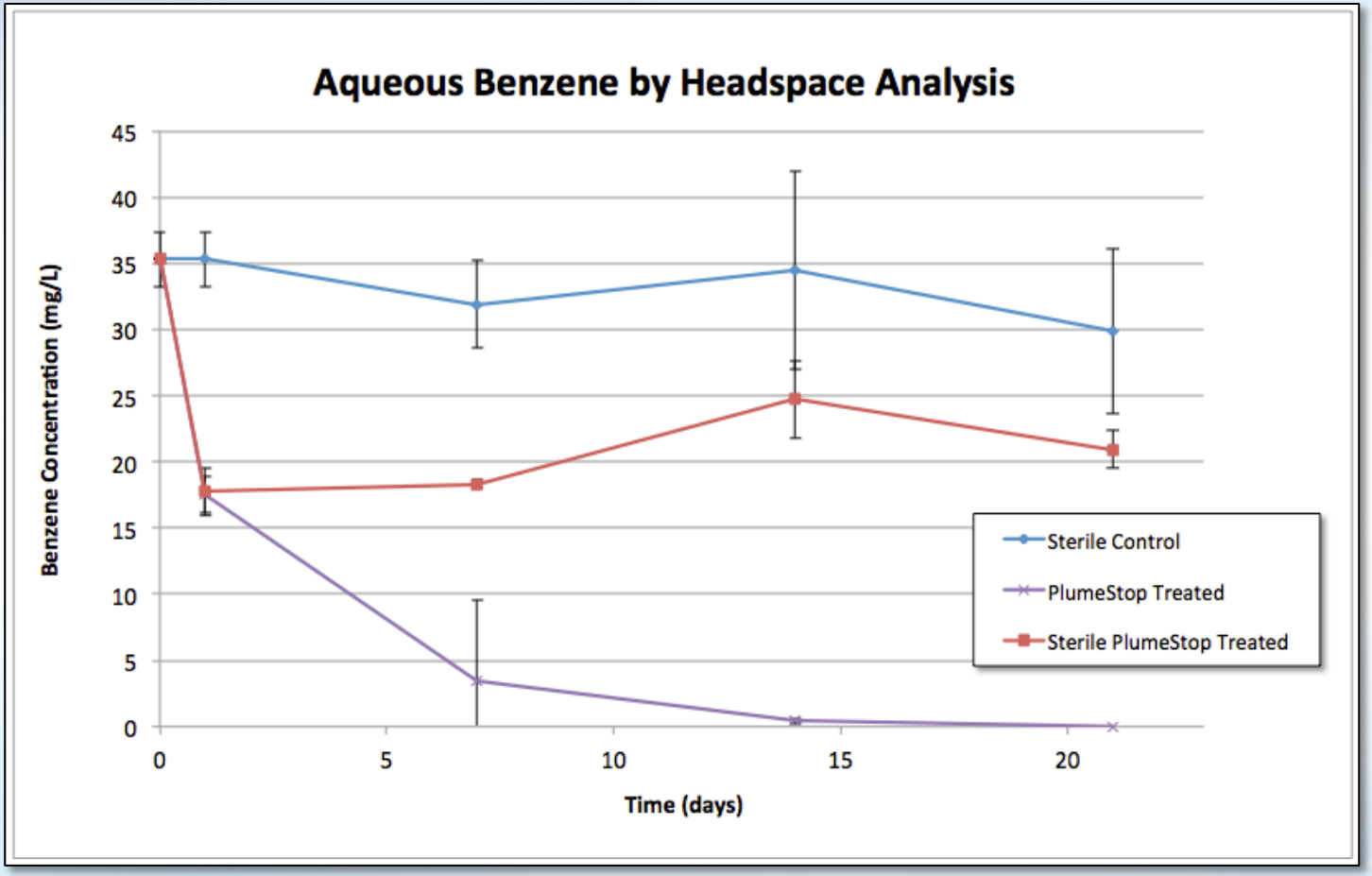
- Soil-water slurry microcosms
  - Treatment 1: **with PlumeStop (live)**
  - Treatment 2: **with PlumeStop (sterile)**
  - Treatment 3: **no PlumeStop (sterile)**
- Sampled destructively in triplicate
  - Days 1, 7, 14, 21

- **Water concentration** monitored by head-space analysis
- **Total benzene mass** monitored by whole-system extraction

REGENESIS

PlumeStop™: post-sorption biodegradation

PlumeStop COLLOIDAL BIOMATRIX



REGENESIS

PlumeStop™: post-sorption biodegradation

PlumeStop COLLOIDAL BIOMATRIX

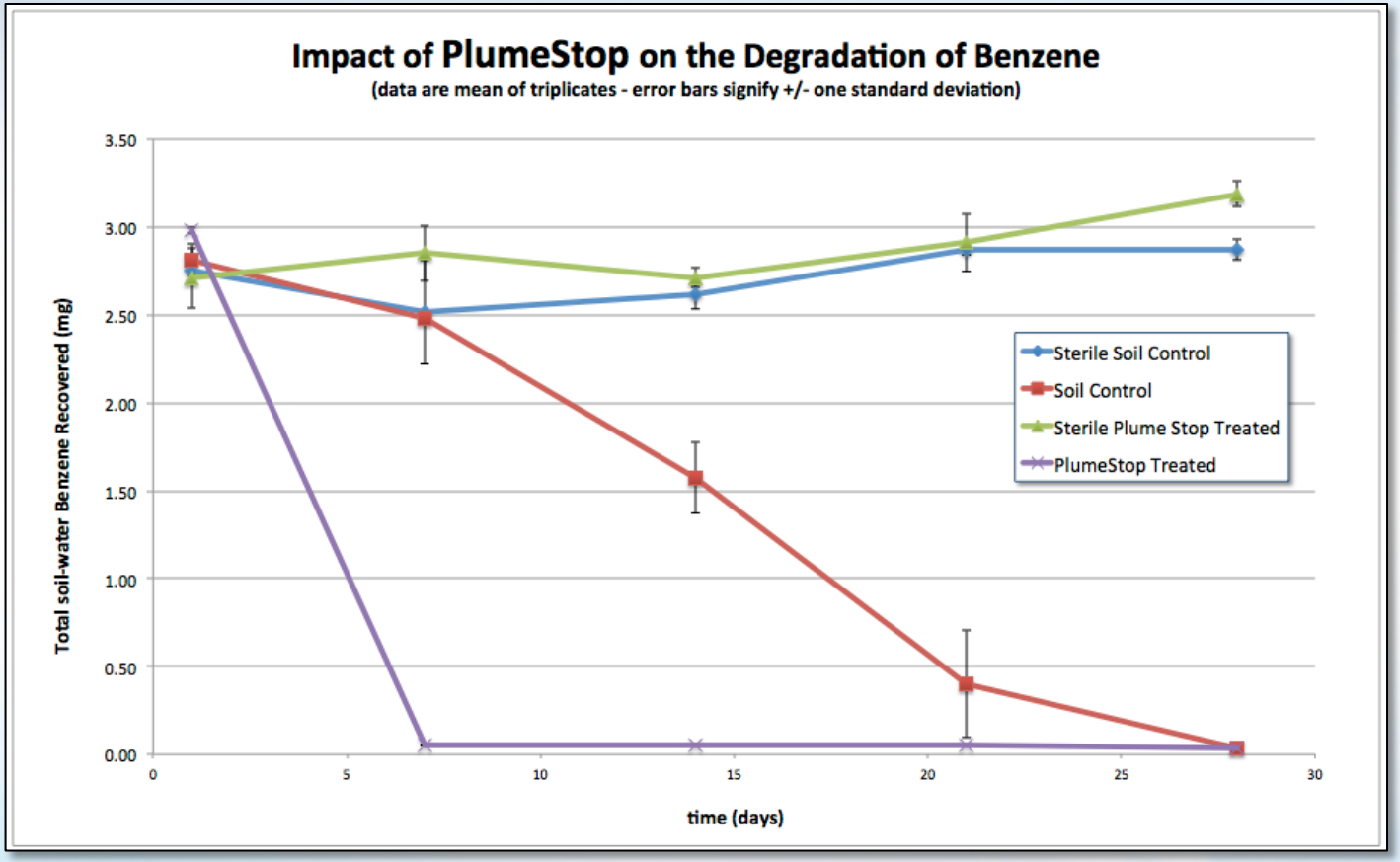
Q: Is net contaminant degradation rate enhanced, inhibited or unaffected by sorption into the biomatrix?

Benzene Degradation Batch-Equilibrium Study #2

- Soil-water slurry microcosms
  - Treatment 1: **with PlumeStop (live)**
  - Treatment 2: **with PlumeStop (sterile)**
  - Treatment 3: **no PlumeStop (sterile)**
  - Treatment 4: **no PlumeStop (live)**
- Sampled destructively in triplicate
  - Days 1, 7, 14, 21, 28
- Whole-system extraction

REGENESIS

PlumeStop™: post-sorption biodegradation



Howard et al (1991) *"Handbook of Environmental Degradation Rates."* Lewis Publishers Inc. ISBN 0-87371-358-3

PlumeStop™
COLLOIDAL BIOMATRIX

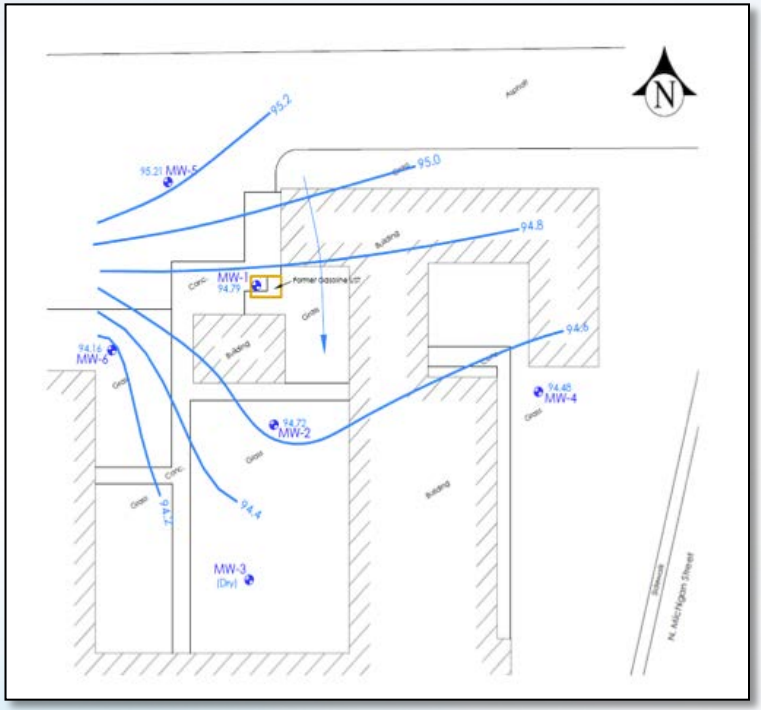
–performance –

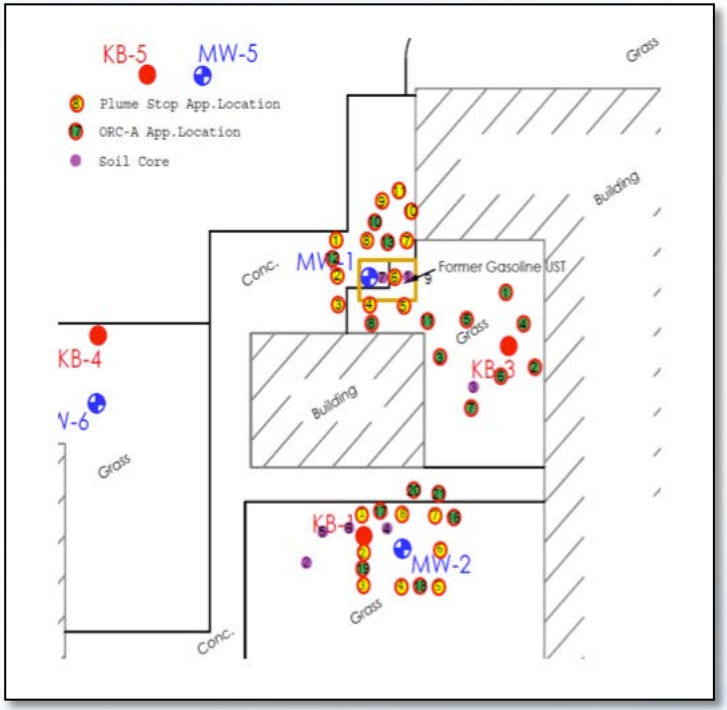
hydrocarbon site

REGENESIS

PlumeStop™
COLLOIDAL BIOMATRIX

PlumeStop™ - Performance - Field

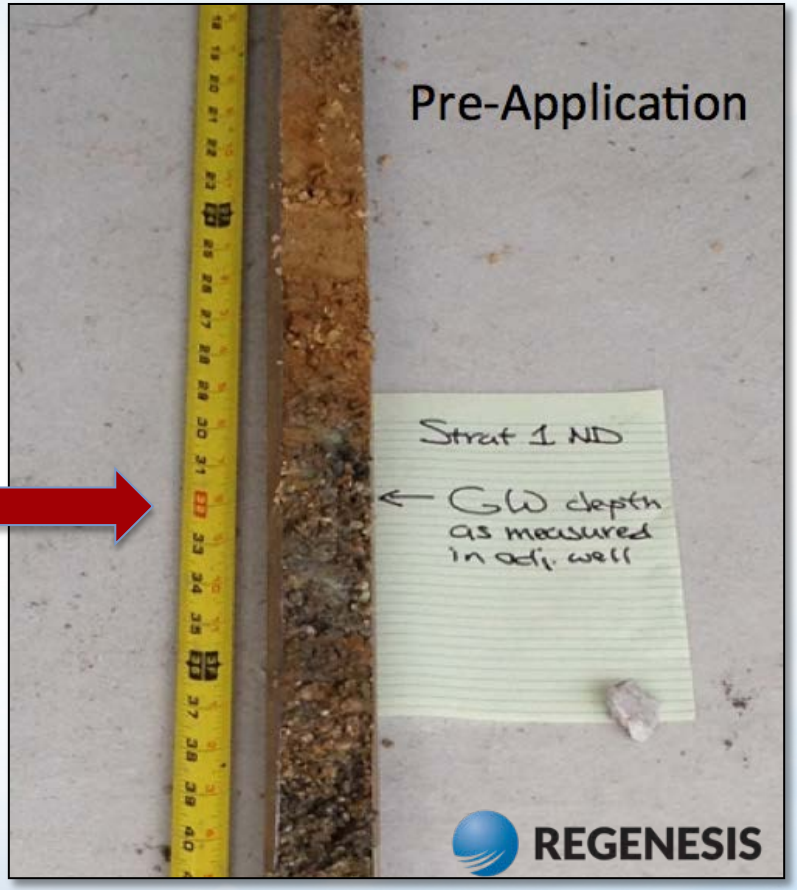




REGENESIS

PlumeStop™ - Performance - Field

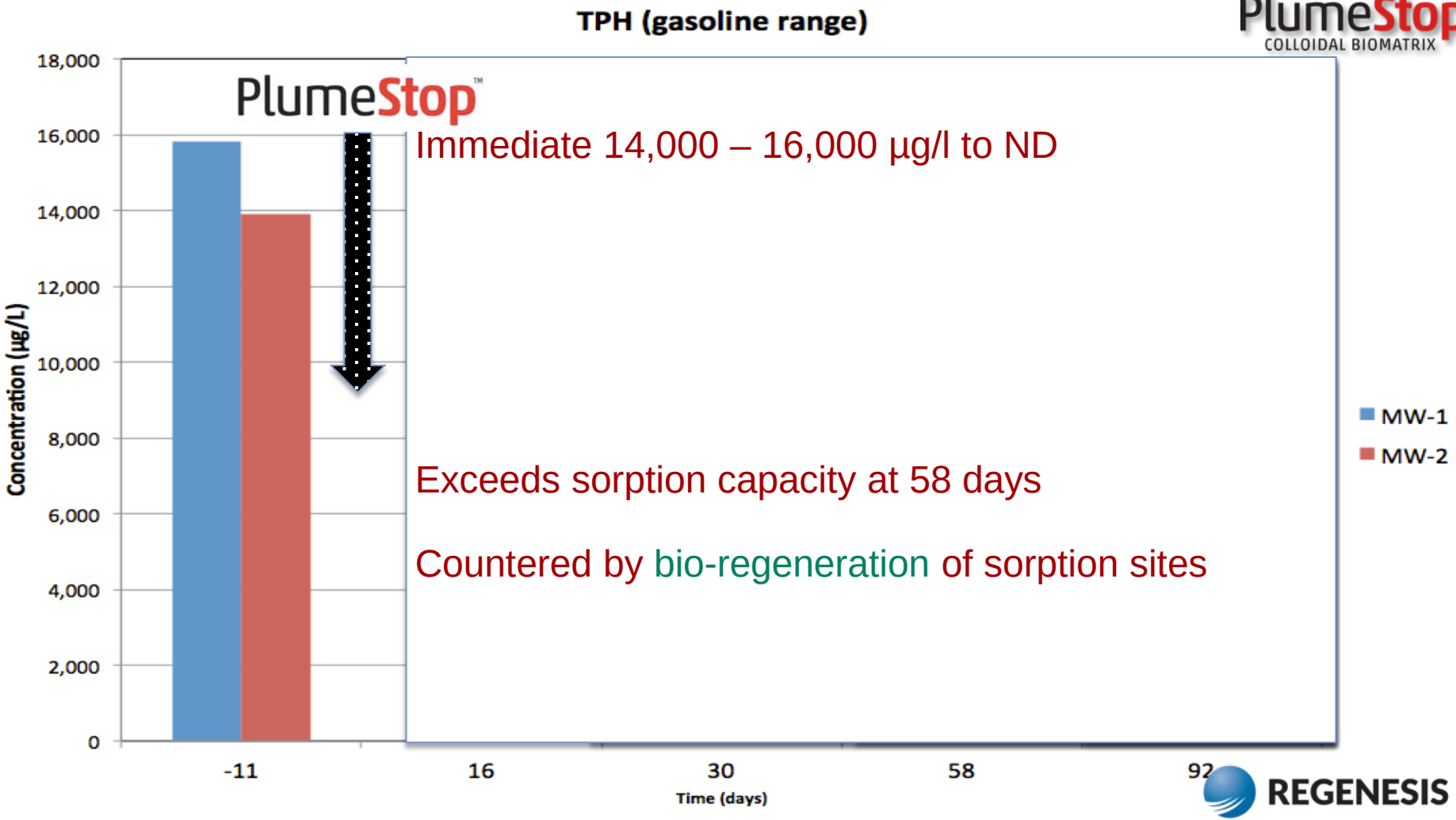
Pre-application soil cores



PlumeStop™ - Performance - Field

Post-application soil cores

PlumeStop™ COLLOIDAL BIOMATRIX



REGENESIS

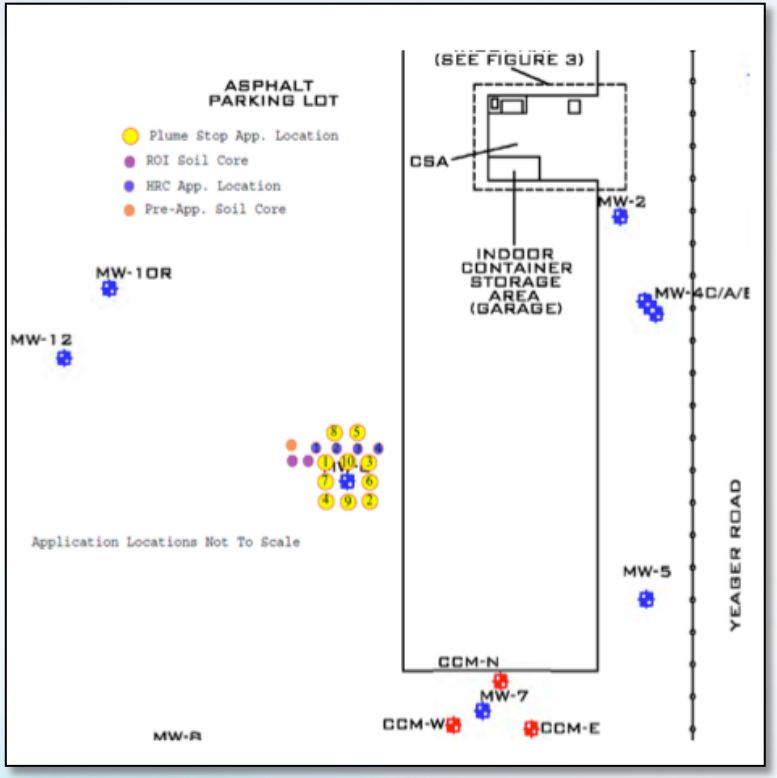
PlumeStop™
COLLOIDAL BIOMATRIX

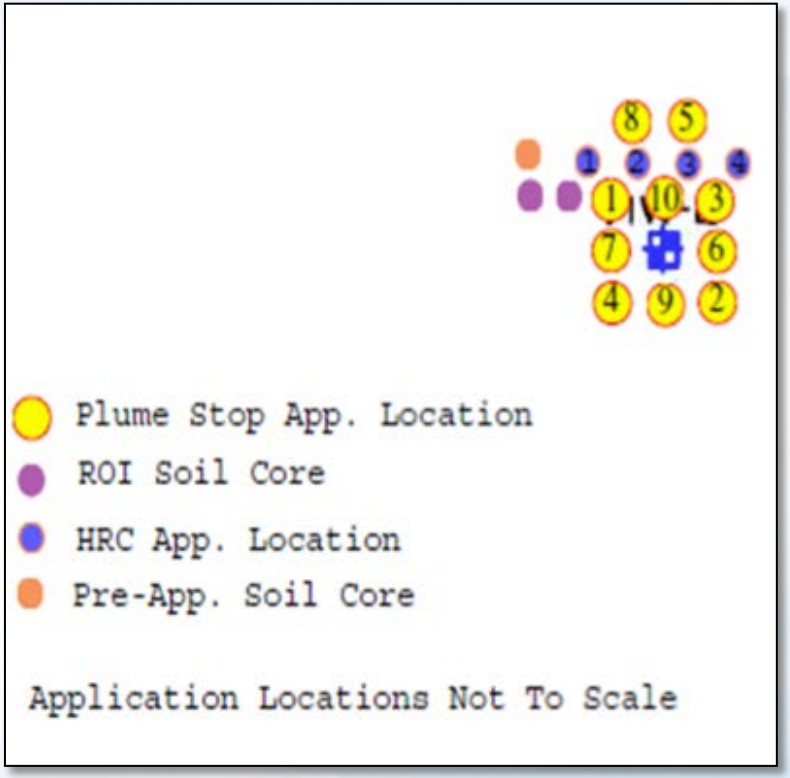
–performance –

chlorinated solvent site

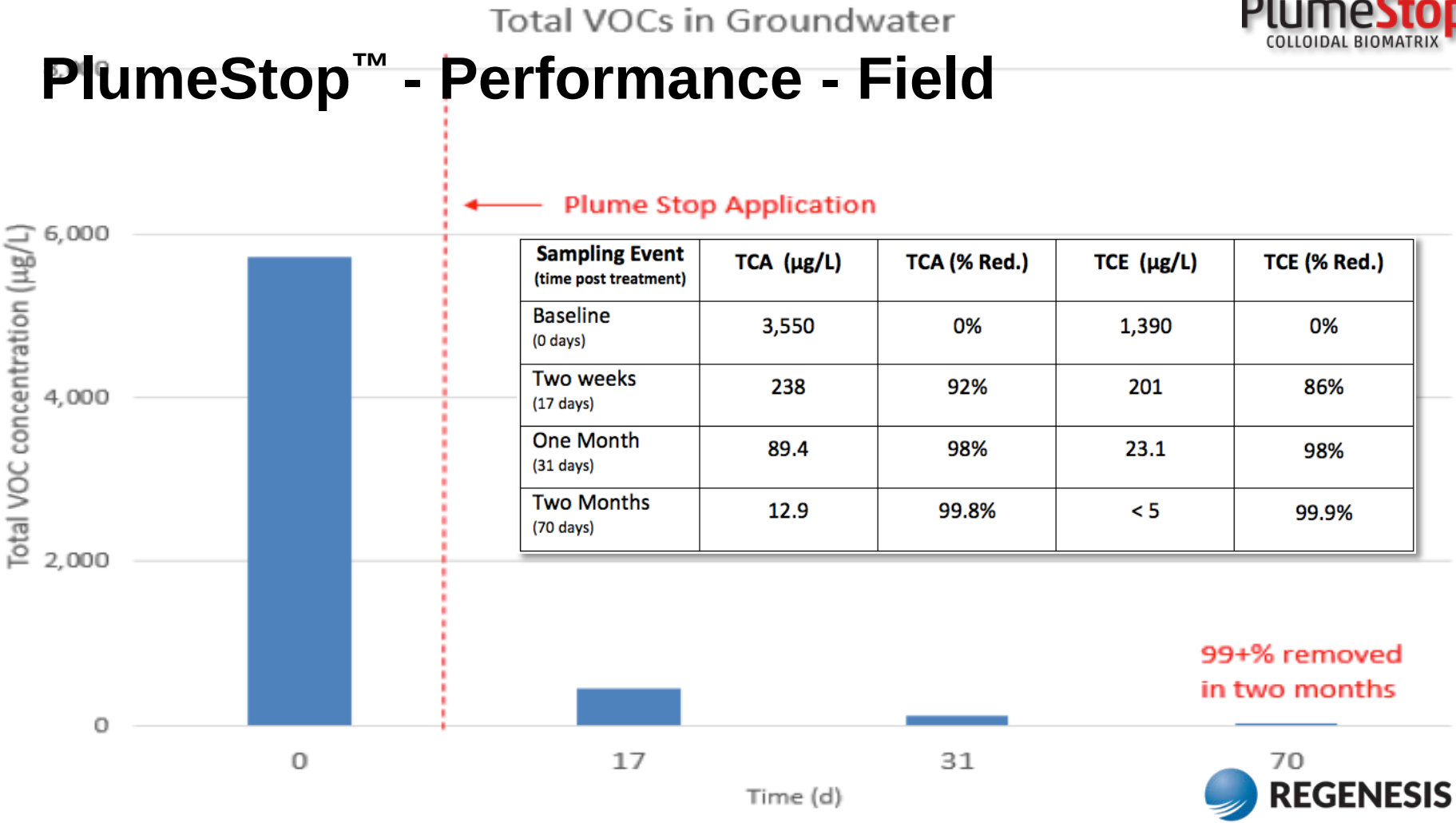
REGENESIS

PlumeStop™ - Performance - Field





PlumeStop™ - Performance - Field

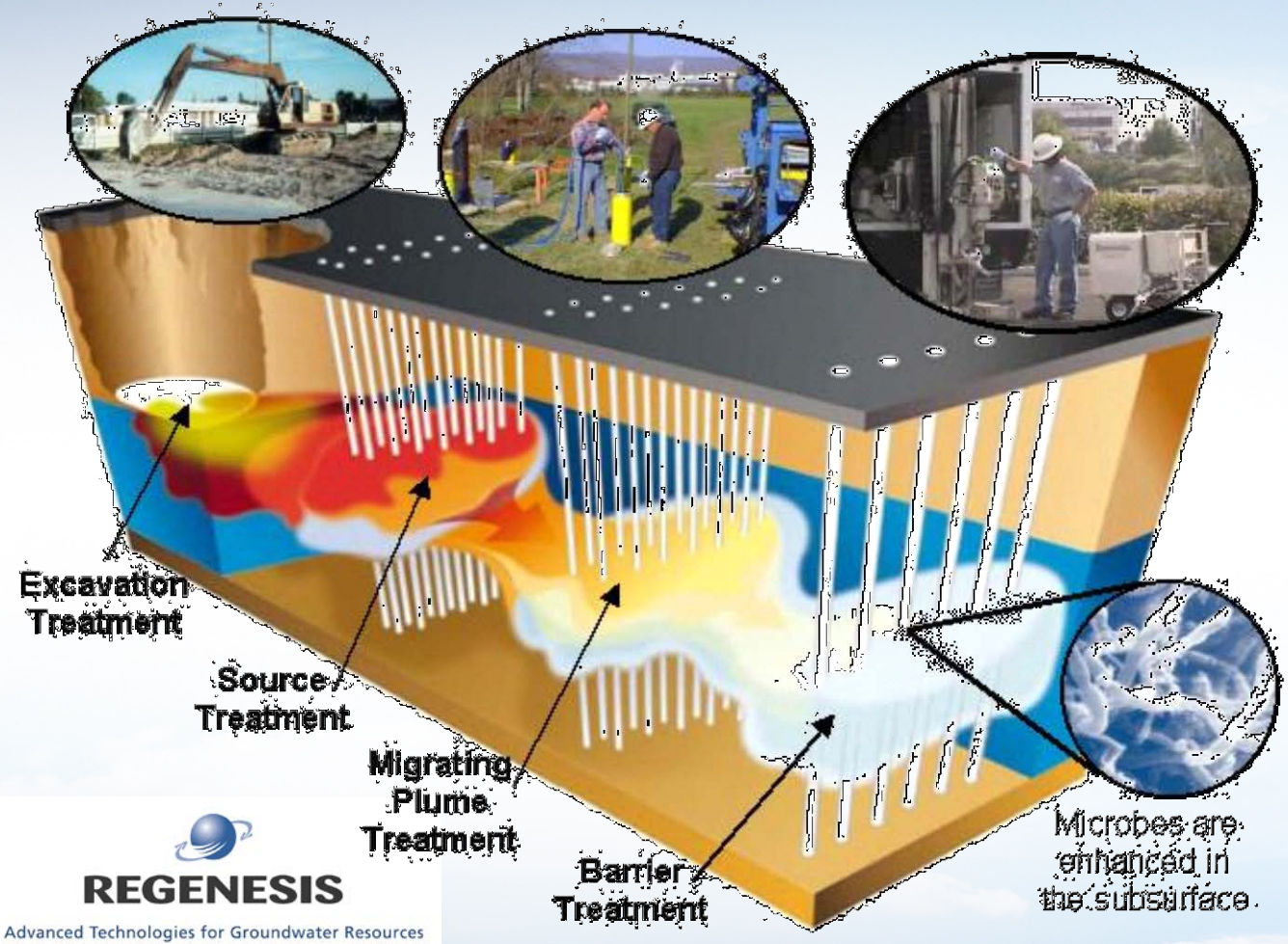


Sampling Event (time post treatment)	TCA (µg/L)	TCA (% Red.)	TCE (µg/L)	TCE (% Red.)
Baseline (0 days)	3,550	0%	1,390	0%
Two weeks (17 days)	238	92%	201	86%
One Month (31 days)	89.4	98%	23.1	98%
Two Months (70 days)	12.9	99.8%	< 5	99.9%

Critical Questions for the Technology

- Can it effectively distribute in situ?
- How effective is contaminant sorption?
- What happens to sorbed contaminants?
- How does it perform in the field?

REGENESIS



REGENESIS

Advanced Technologies for Groundwater Resources

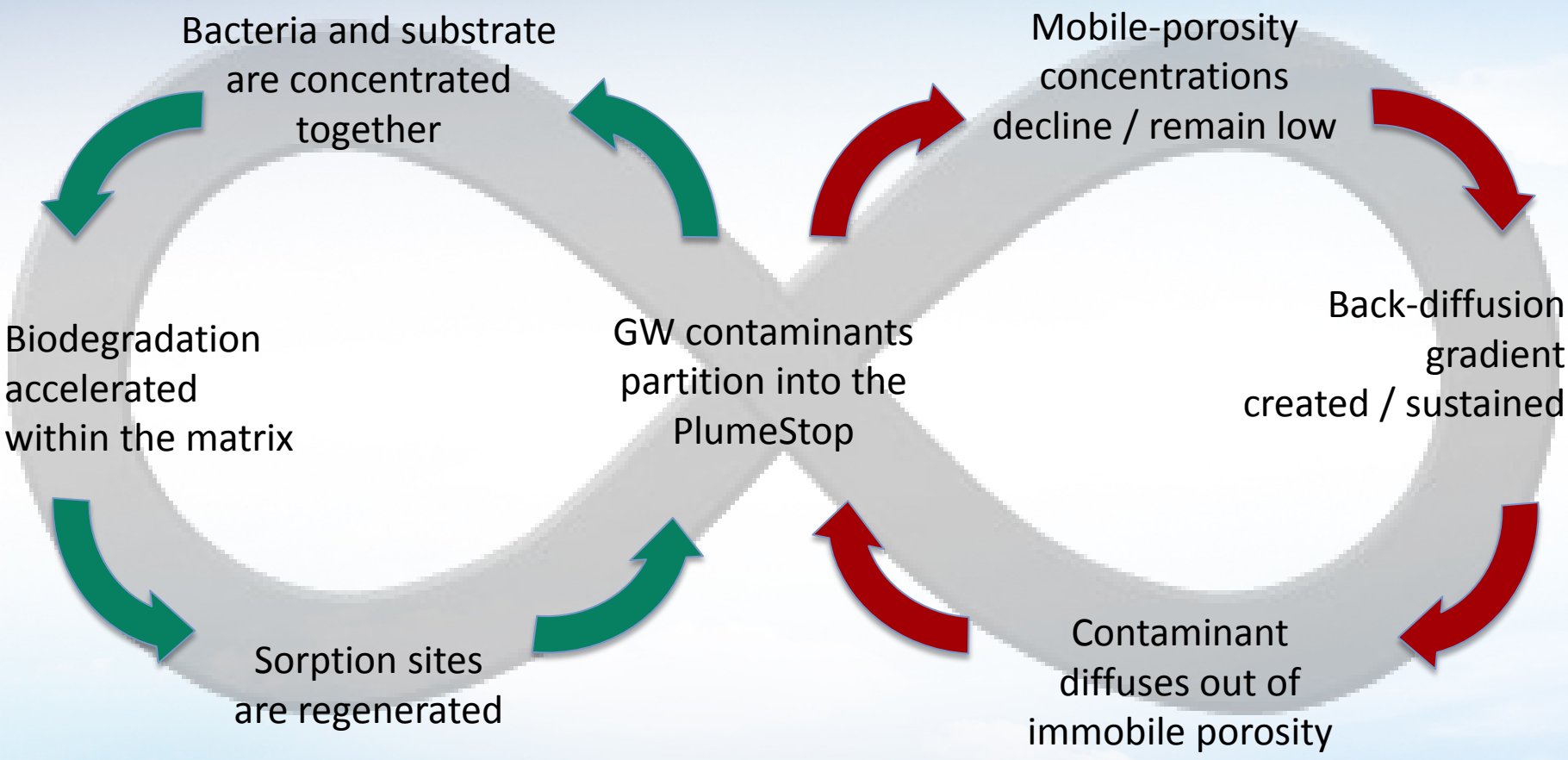
REGENESIS

PlumeStop™
COLLOIDAL BIOMATRIX

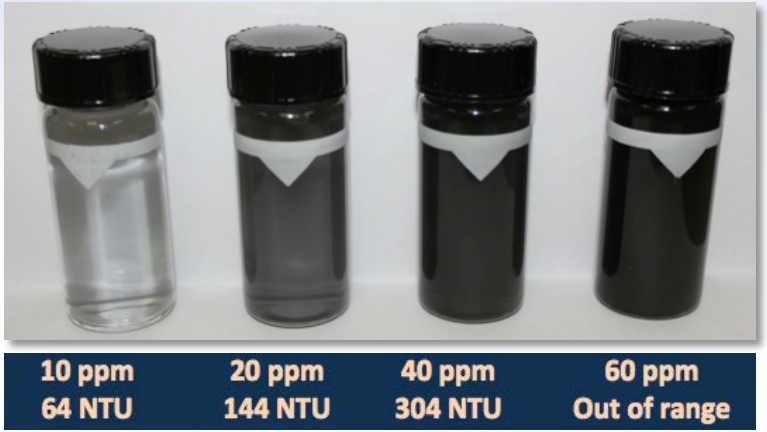
securing rapid risk reduction and accelerated bioremediation
using a dispersive injectable reagent

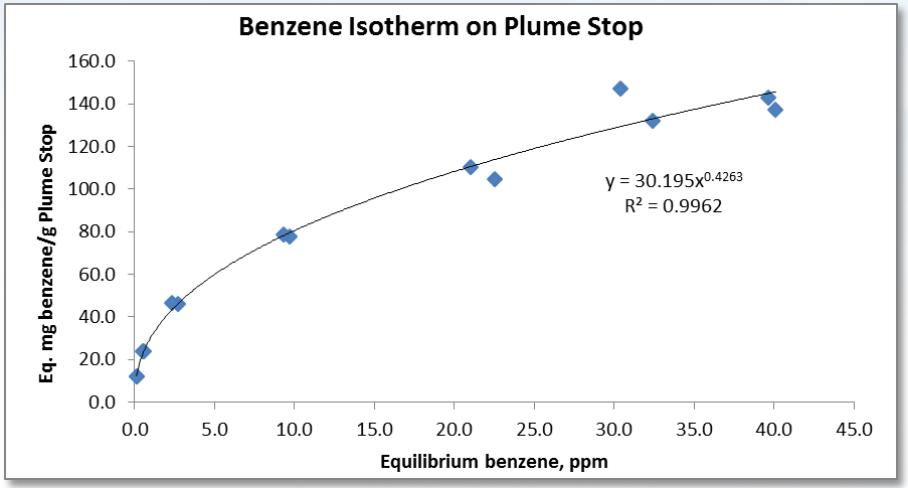
Questions?

PlumeStop™
COLLOIDAL BIOMATRIX



PlumeStop™: Sorption Capacity





(Freundlich) sorption isotherm of PlumeStop with respect to benzene

Remains similar to unmodified powdered activated carbon