Effective In-Situ LNAPL and DNAPL Site Remediation Using Innovative Surfactant Enhanced Remediation Techniques

Ivey-sol Remediation Presentation
ESAA 2020 Webinar Series
June 10, 2020

IVEY-SOL® Surfactant Technology
"TODAY'S ENVIRONMENTAL SOLUTIONS FOR A BETTER TOMORROW"

Ivey
www.iveyinternational.com

esaa Environmental Services Association of Alberta

CHEMCO inc.

In consideration of COVID-19 Impact on Environmental Industry We Are Giving Attendees Preferred Client Discount of 5% on IVEY Products For Balance of 2020

Ivey International Inc.

The annual listing of 10 companies that are at the forefront of providing Environmental Technology solutions and transforming businesses

IVEY-SOL®
Surfactant Technology
"TODAY'S ENVIRONMENTAL SOLUTIONS FOR A BETTER TOMORROW"

DECON IT®
Non-Ionic Surface Cleaner

Our Products Are Free of Unwanted Impurities
PFOA & PFOS Free
1,4 Dioxane Free
Dioxins, Furans, and PCB Free
Tested and Free For USEPA Regulated Compounds

The new Ivey-sol formulation called PFAS-SOL® is effective for aiding in-situ PFAS remediation

NAPL LNAPL DNAPL PSH Free Product

Non-aqueous phase liquids (NAPL) are liquid solution contaminants that do not dissolve in or easily mix with water (hydrophobic), like oil, gasoline and petroleum products, chlorinated solvents. NAPL contaminates soil, groundwater, and can generate vapor intrusion.

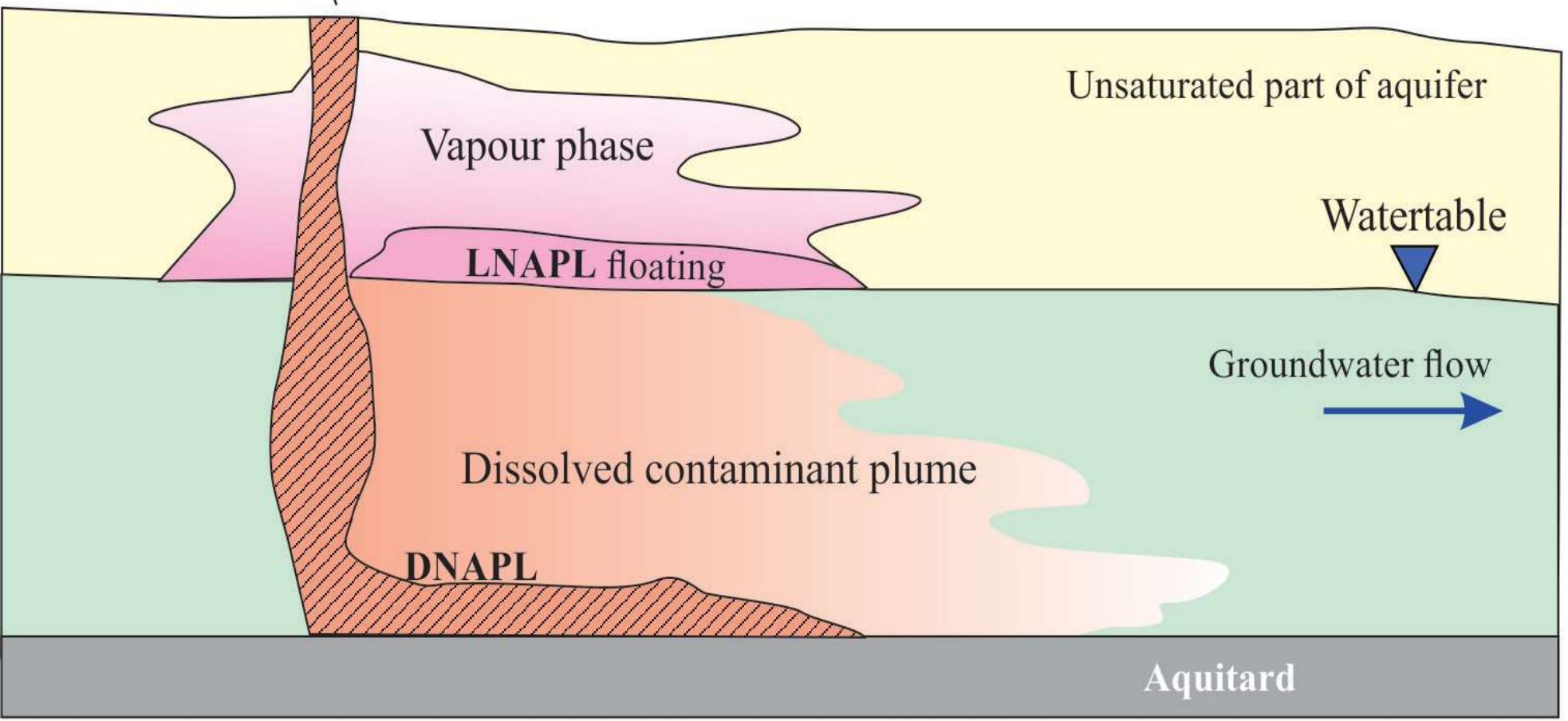
Light NAPL [LNAPL] have a lower density than water so they will tend to float on the groundwater table.

Dense NAPL [DNAPL] are denser than water so will tend to sink below groundwater table.

NAPLs are immiscible in, or do not dissolve in groundwater. They can become trapped in pore spaces (*interfacial tension → pathway interference*) and sorb to soil surfaces - limiting availability for physical, biological and chemical remediation.

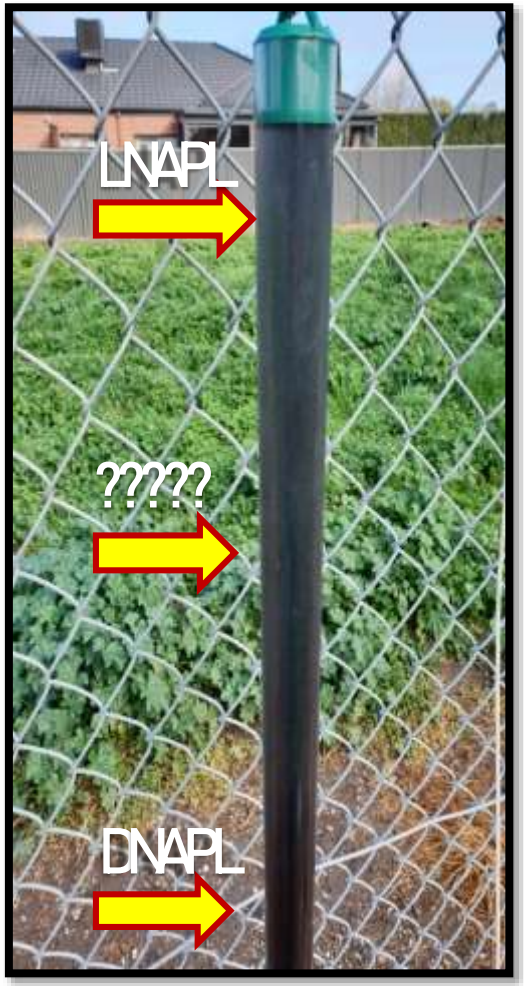
LNAPL = Light non-aqueous phase liquid (e.g. petroleum, benzene)
pronounced 'ell napple'

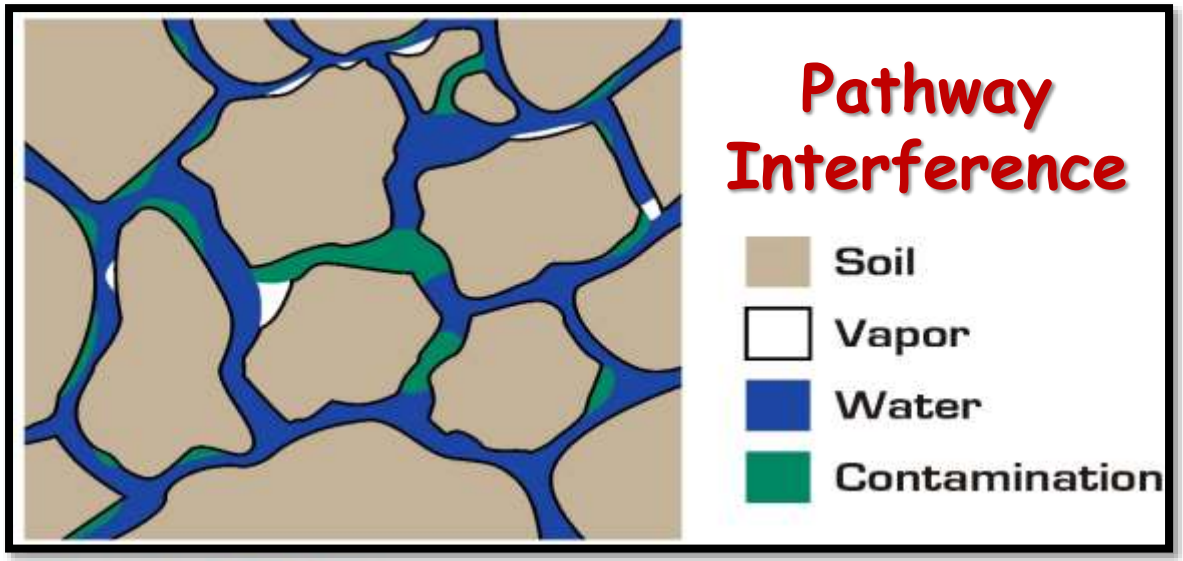
DNAPL = Dense non-aqueous phase liquid (e.g. coal tar, creosote
Trichlorethylene (solvent))
pronounced 'dee napple'



Organic contaminants, like petroleum fuels and solvents may be present as a free liquid, dissolved liquid (in water) and as vapour

Sources: UST, AST, Pipelines, Surface Spills, Truck Rollovers, Sabotage, Off-shore Spills, etc.



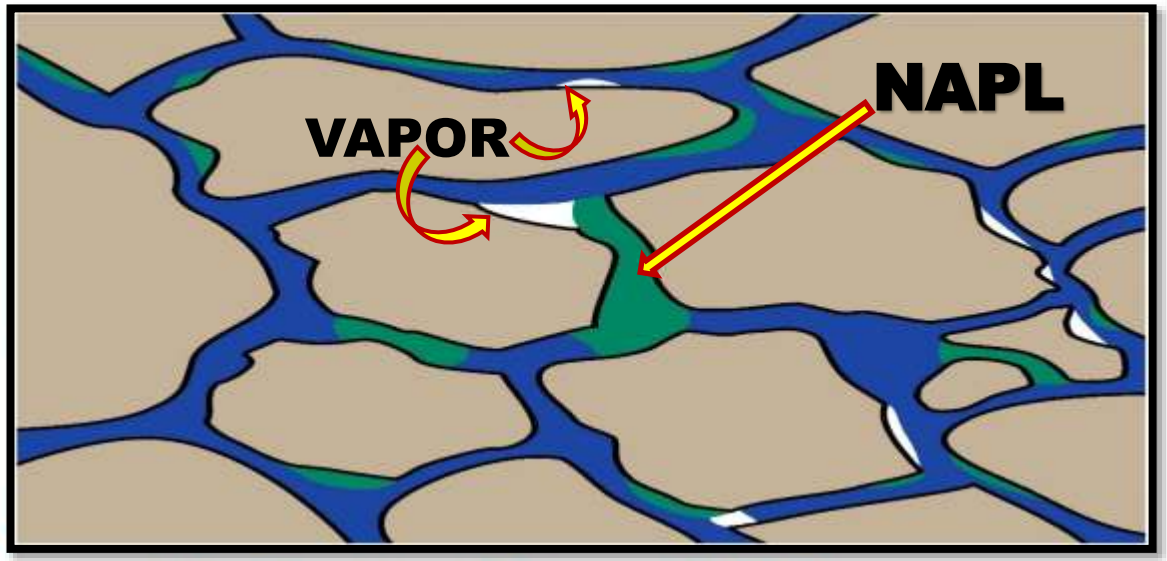


Mobile NAPL

NAPL body is continuous and its capillary pressure is high enough to exceed groundwater pore entry pressure, displace groundwater, and migrate through the subsurface.

Potentially Mobile NAPL

NAPL body is continuous, but its capillary pressure is not high enough to exceed groundwater pore entry pressure; under current conditions, it will not displace groundwater and migrate. If conditions change (for example, drilling through a potentially mobile DNAPL body, soil fracturing), potentially mobile DNAPL may mobilize and begin migrating.

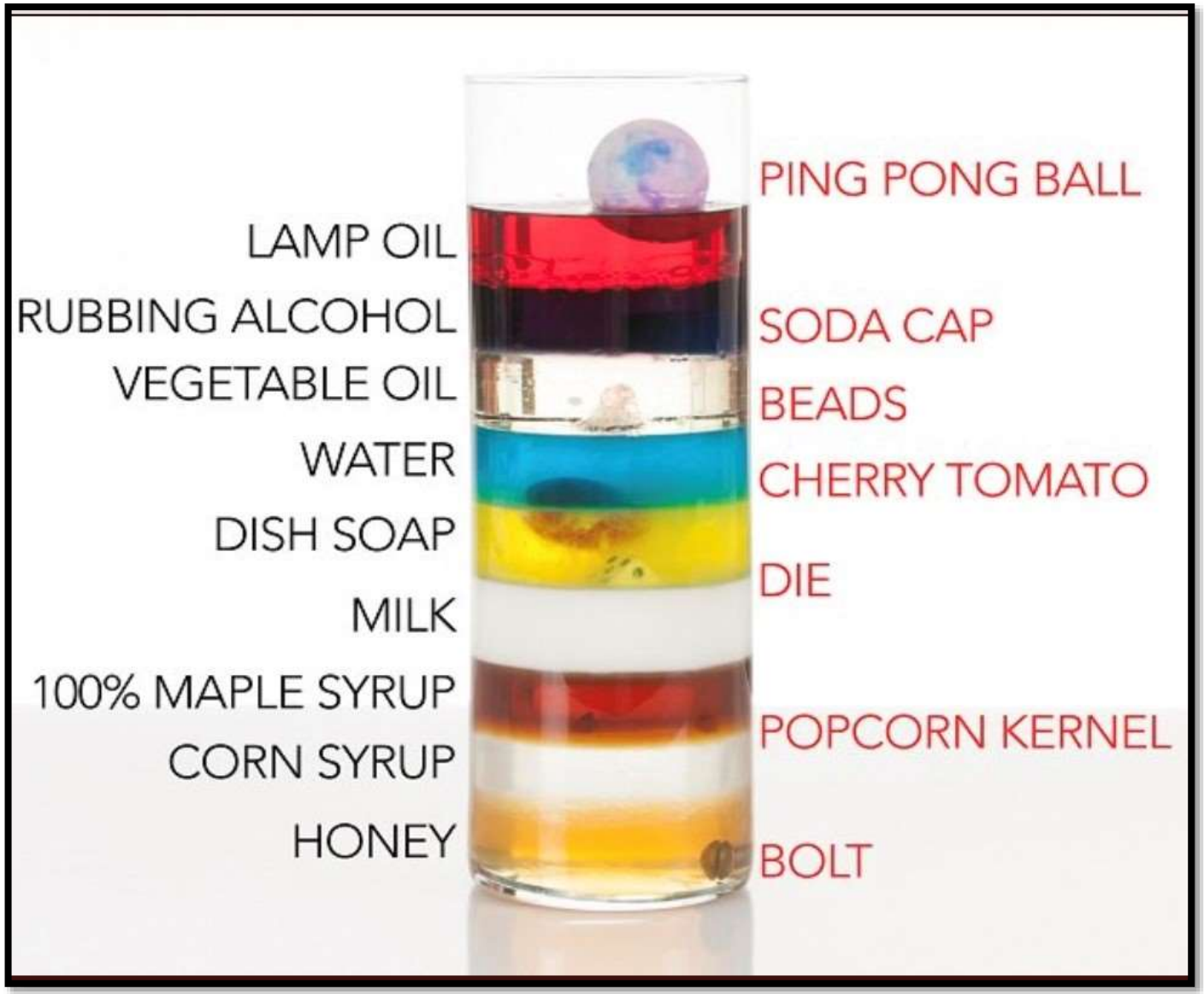


Immobile Residual Phase NAPL

"Droplets" of NAPL called ganglia are present in the pore spaces but are not connected to other NAPL ganglia. They are immobile because they cannot exceed the capillary pressure and displace groundwater in the formation.

Interfacial Tension (dynes/cm) is the force that holds the surface of a particular phase together, and exists when two phases: gas/oil, oil/water, or gas/water come in contact. Interfacial tension can immobilize (trap) LNAPL and DNAPL within pore spaces → source of mass-flux = Rebound!

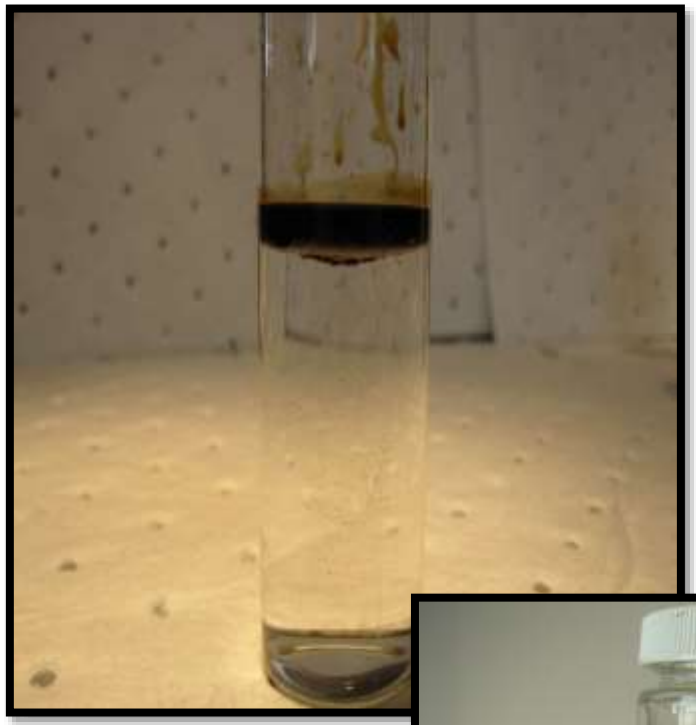
NAPL Density Affects Its Behavior In Soil, Groundwater, and Vapor Phase Intrusion



Knowing how contaminants, like NAPL, tend to behave allows us an opportunity to improve how we investigate and remediate impacted sites.

Allowing us to take a more forensic approach…

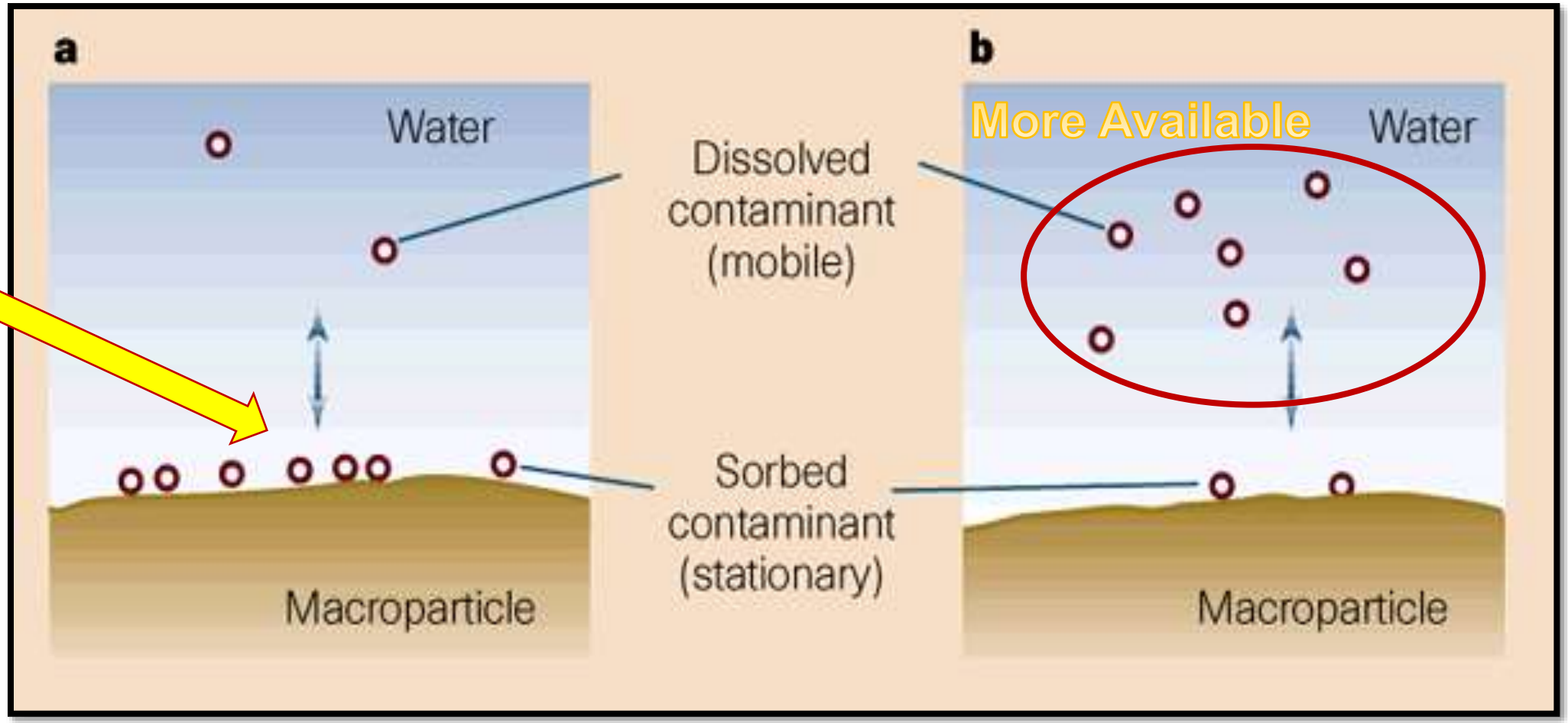
Phase Partitioning → NAPL Formation and/or Sorption Both Limit Contaminant Availability for Remediation



SORPTION

Hydrophobic organic chemicals exhibit limited solubility in groundwater. As a result the contaminants (Vapors, Dissolved, Sorbed, or NAPL) *Phase Partition* and sorb (i.e., absorb and adsorb) onto the soil surfaces or form NAPL (Globules or Layers). Contaminant Sorption & NAPL negatively effects Availability for Remediation.

Sorbed or NAPL Phase Globules With Limited Availability For Remediation



Sorption Literature Reference

The growing concern regarding contaminant sorption, and its reduced availability for remediation, has been well cited in literature as demonstrated by the following quotation:

"During the past decade, much discussion has centered on the unavailability of absorbed compounds to soil microorganisms; it is generally now assumed that desorption and diffusion of bound contaminants to the aqueous phase is required for microbial degradation."

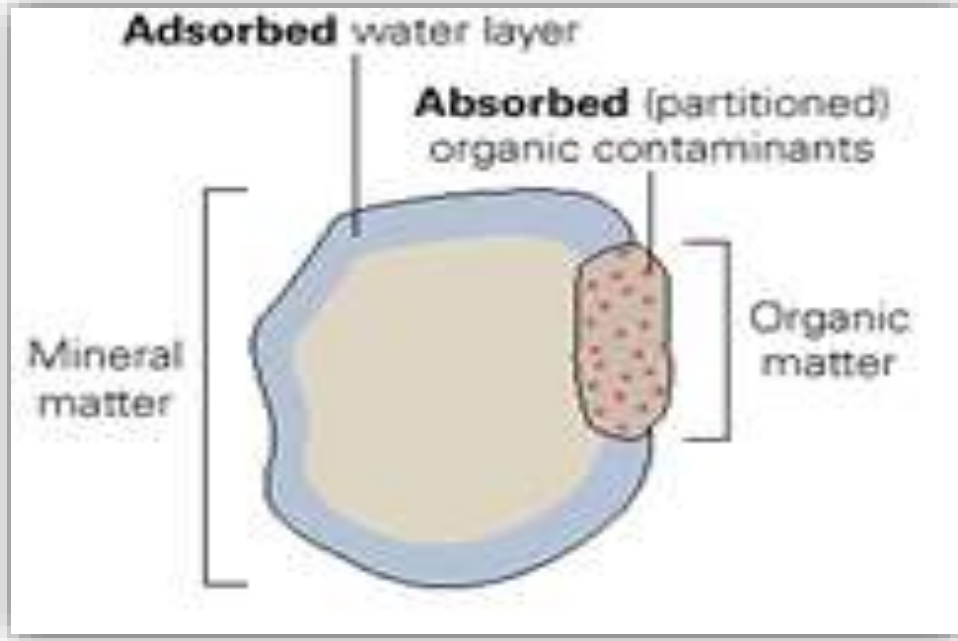
(W.P. Inskeep, J.M. Wraith, C.G. Johnston, Hazardous Substance Research Center, 2005).

FACT

Sorption Limits Contaminant Availability For Remediation

Sorption or NAPL Formation Limits Contamination Availability For All Forms of Remediation

Ivey-sol Overcomes This Limitation To Improve Their Remediation!



Sorption / NAPL limits the *'Availability'* of Contaminants for in-situ and ex-situ remediation by *limiting their mobility*. As a result, they are:

- **Less *'Physically Available'* for** — **Multi-Phase Extraction (MPE), Pump & Treatment, and Soil Washing;**
- **Less *'Biologically Available'* for** — **Bioremediation (Aerobic or Anaerobic), and**
- **Less *'Chemically Available'* for** — **Chemical Oxidation or Reduction**

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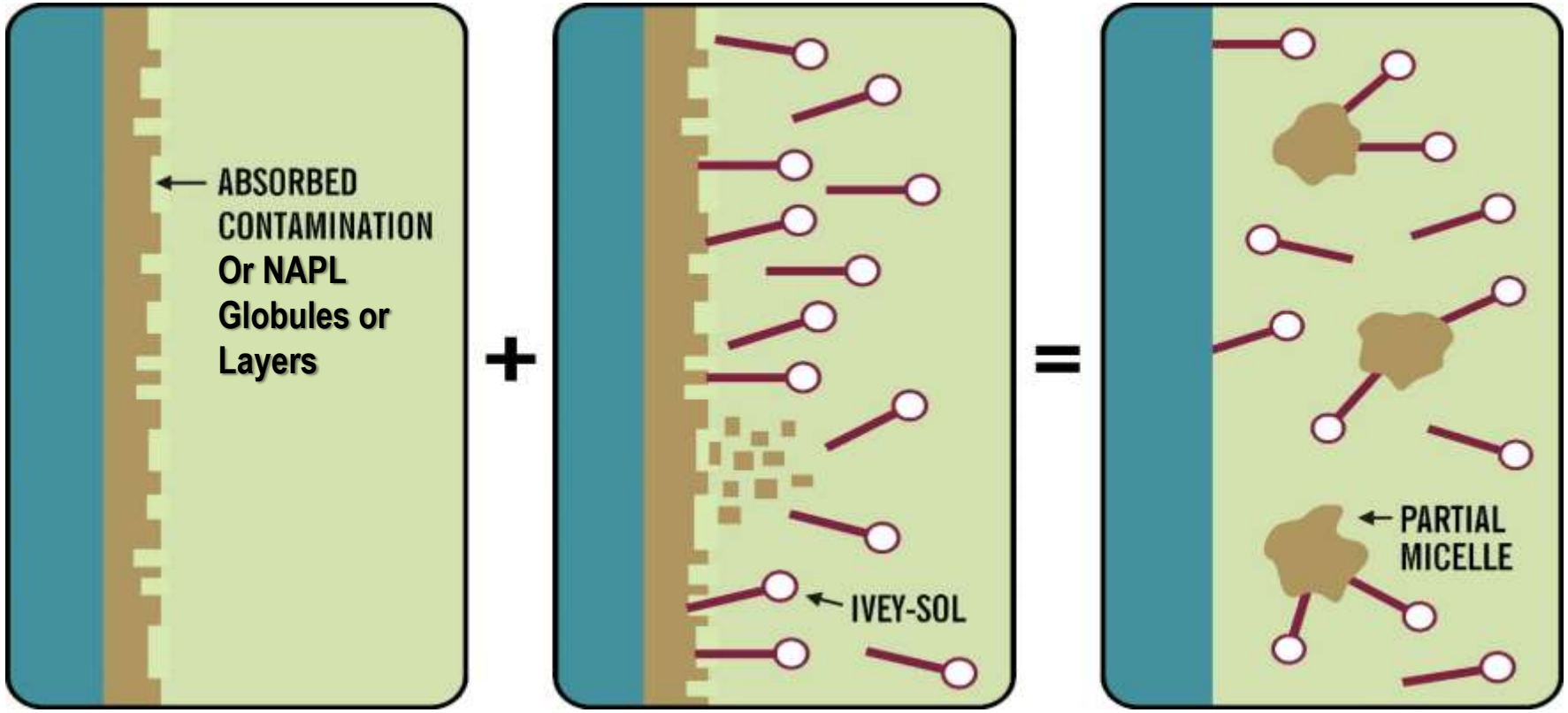
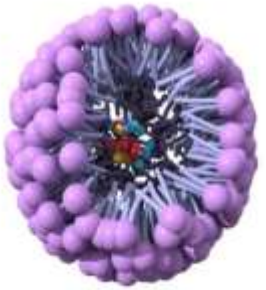




How >99% of all other surfactants work by encapsulating the contaminants hindering their 'Availability' for remediation.

Ivey-sol® mechanism is selective and works below the CMC

Increasing Physical, Biological and Chemical Availability For Enhanced Remediation

Biodegradable, pH Neutral, Non-toxic, Effective For Treating Broad Ranges of Contamination

(Peer Reviewed Journal Paper Available On Request Available)

IVEY-SOL®
Surfactant Technology
www.iveyinternational.com

Selective Below CMC on Sorbed, NAPL, Dissolved and Vapor Phases

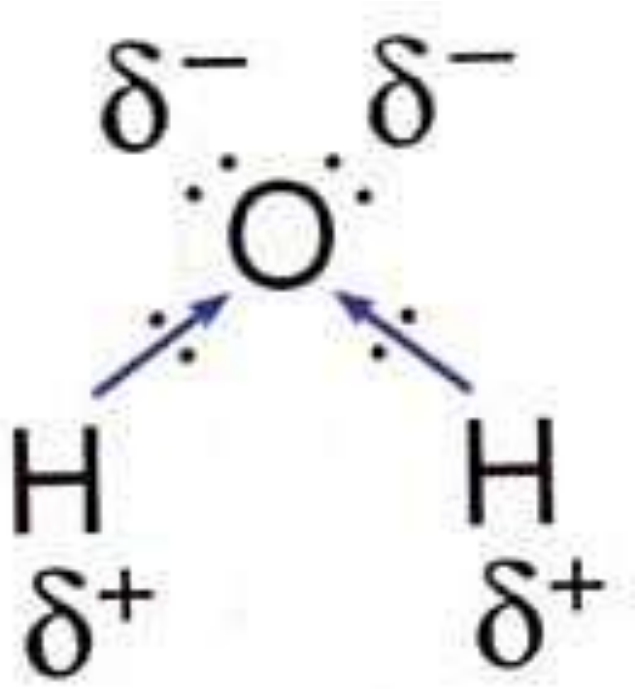
- **Ivey-sol® 103** — BTEX, Jet Fuel, Gasoline
- **Ivey-sol® 106** — Diesel (Light-Medium-Heavy), PAH's, Heating Oils
- **Ivey-sol® 106 (Cl)** — Chlorinated Solvents
- **Ivey-sol® 108** — Motor Oil, Lubricants, Bunker-C
- **DECON-IT ®** — Equipment Decontamination Product

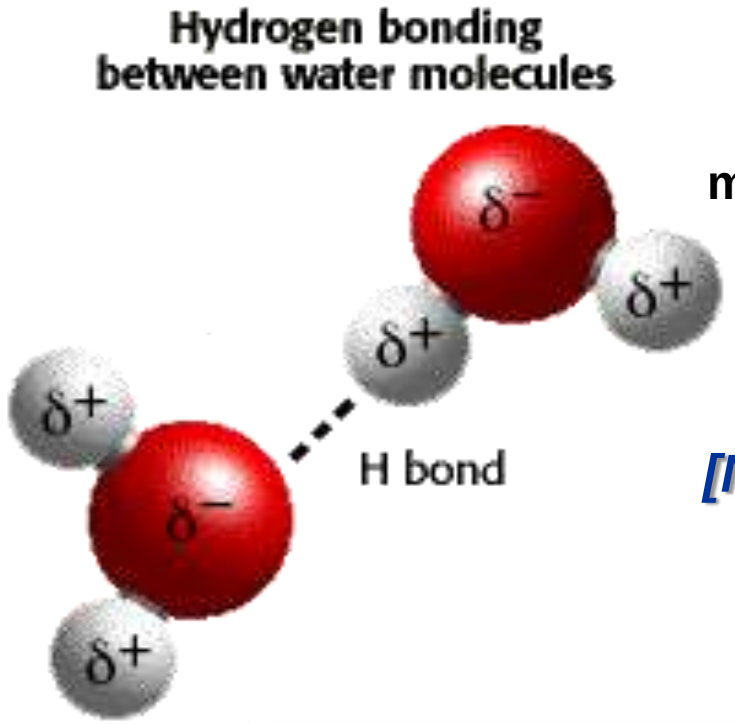
Dilute 1:50+ With Water -> So A Little Will Goes A Long Way -> Increasing Availability

Water Beading On Fine Sand

Ivey-sol® Also Overcomes Surface Tension of Water

Hydrogen Bonding



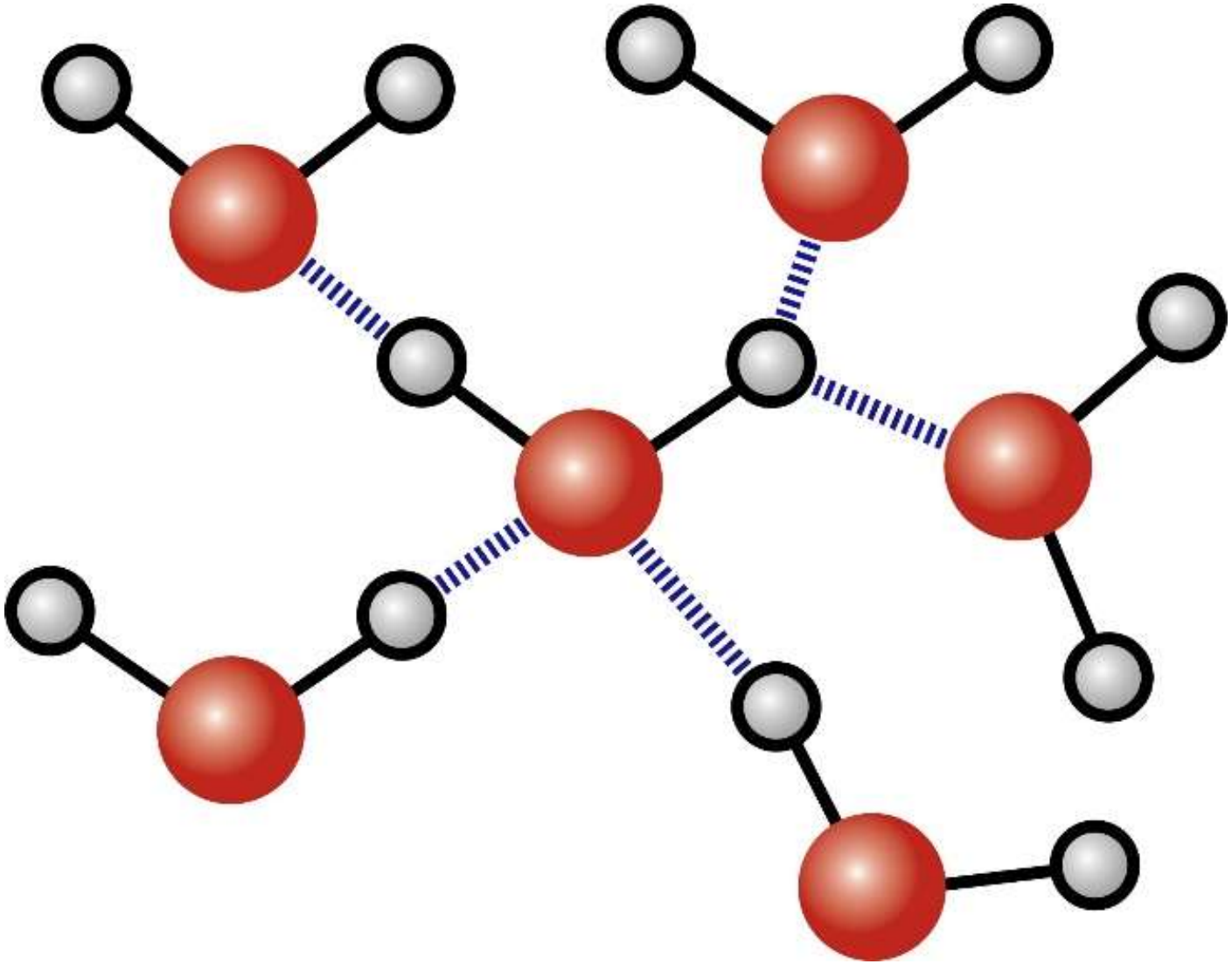


Oxygen (O) on one water molecule is attracted to Hydrogen (H) on neighboring water molecule - giving rise to ***Hydrogen-Bonding.***

[Now we know why a belly-flop on water hurts! Has surface tension of 73 dynes]

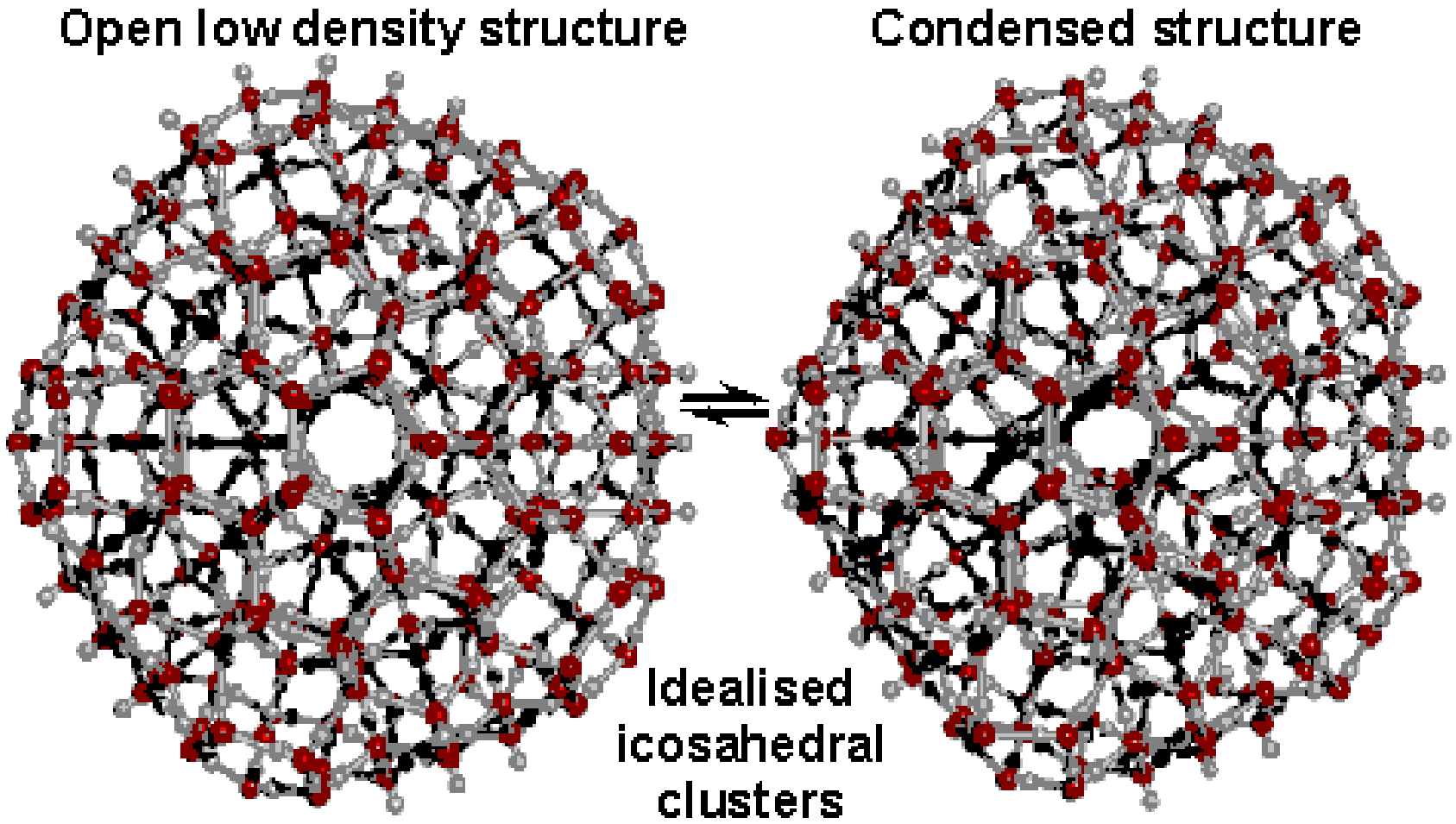
FACT: **Oxygen (O) is more electronegative than Hydrogen (H) Yielding its Polarity Analogous to behaving like magnets.**

Hydrogen Bonding Expanded



Water Is A 3-Dimensional '*Cluster*' - With Surface Tension of 73 Dynes
Water Cluster Size Limits (K) It's Ability To Move In Finer Texture Geology

Ivey-sol® Makes Water Clusters Smaller So Enter And Move More Easily Through Finer Grain Soils *(Lower Surface Tension < 30 Dynes)*

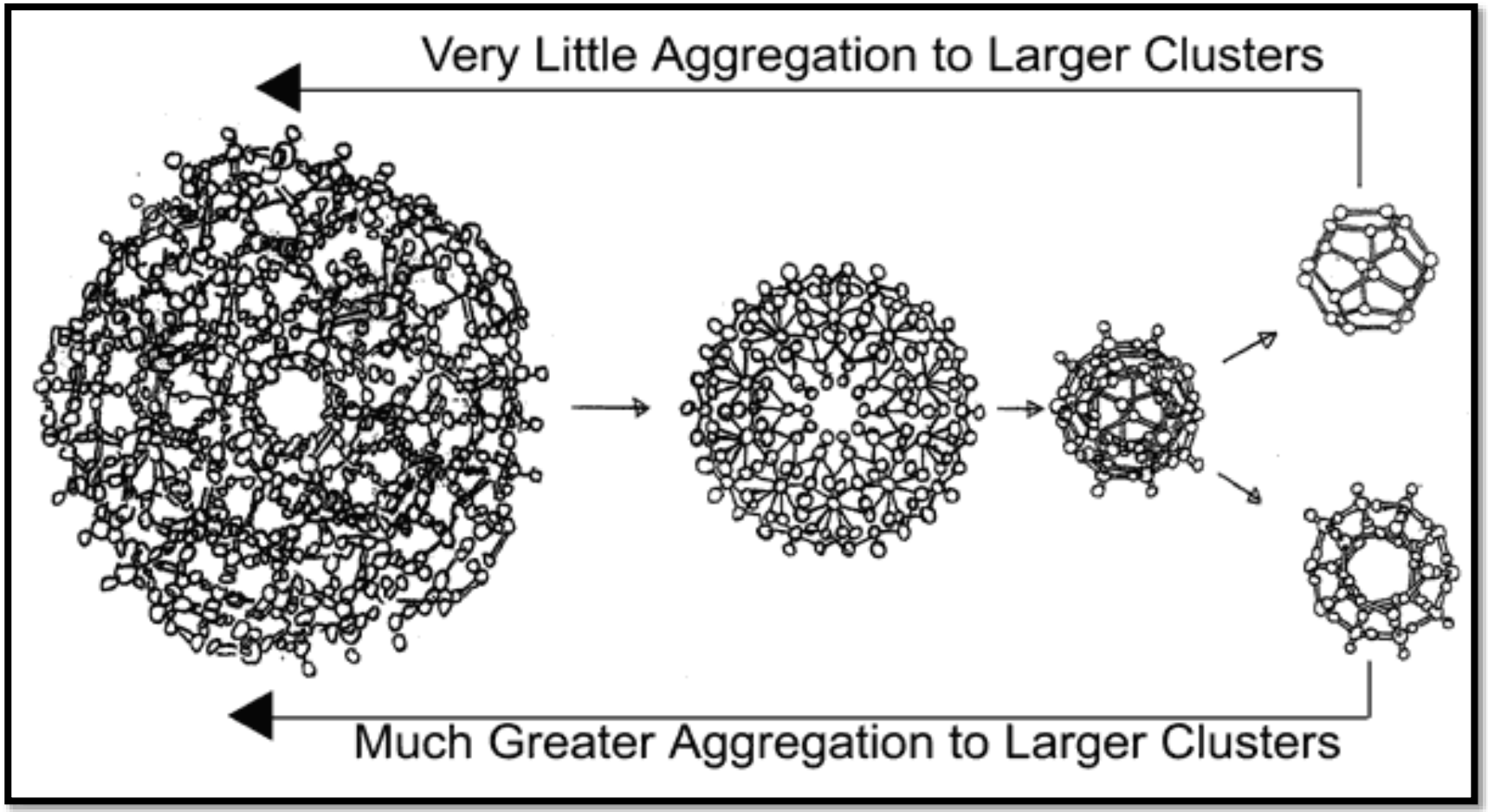


Ivey-sol Reduces The Size of Water Clusters

(Lower Surface Tension from 73 Dynes to < 30 dynes)

Allowing Access & Regress within Finer Grain Soil Textures

Temporarily Improving K



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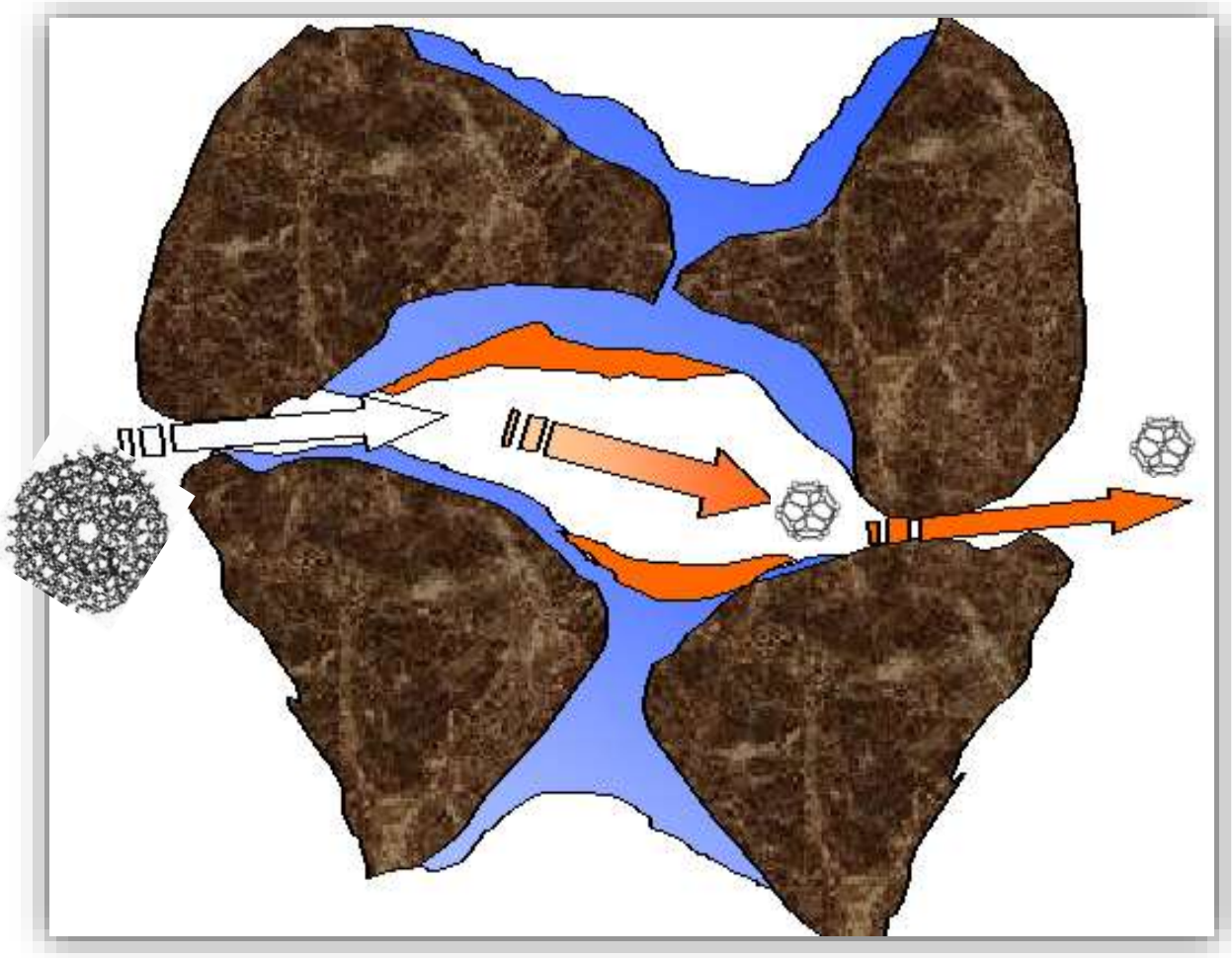
Over Coming Low K and Retardation Within Finer Grain Geology Containing NAPL



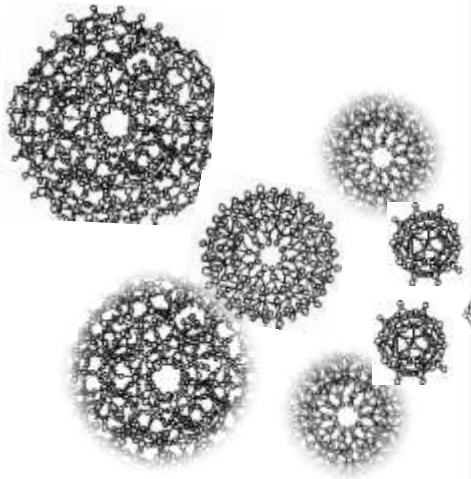
It's a well accepted understanding that water and contaminants flow much slower in finer grain soils than coarse grain soil.

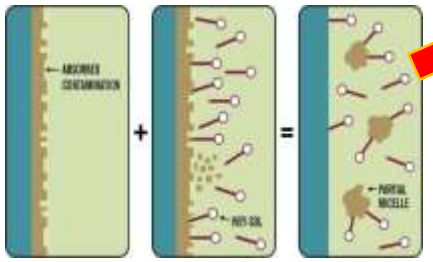
This limitation makes contaminant remediation in fine grain soil more difficult.

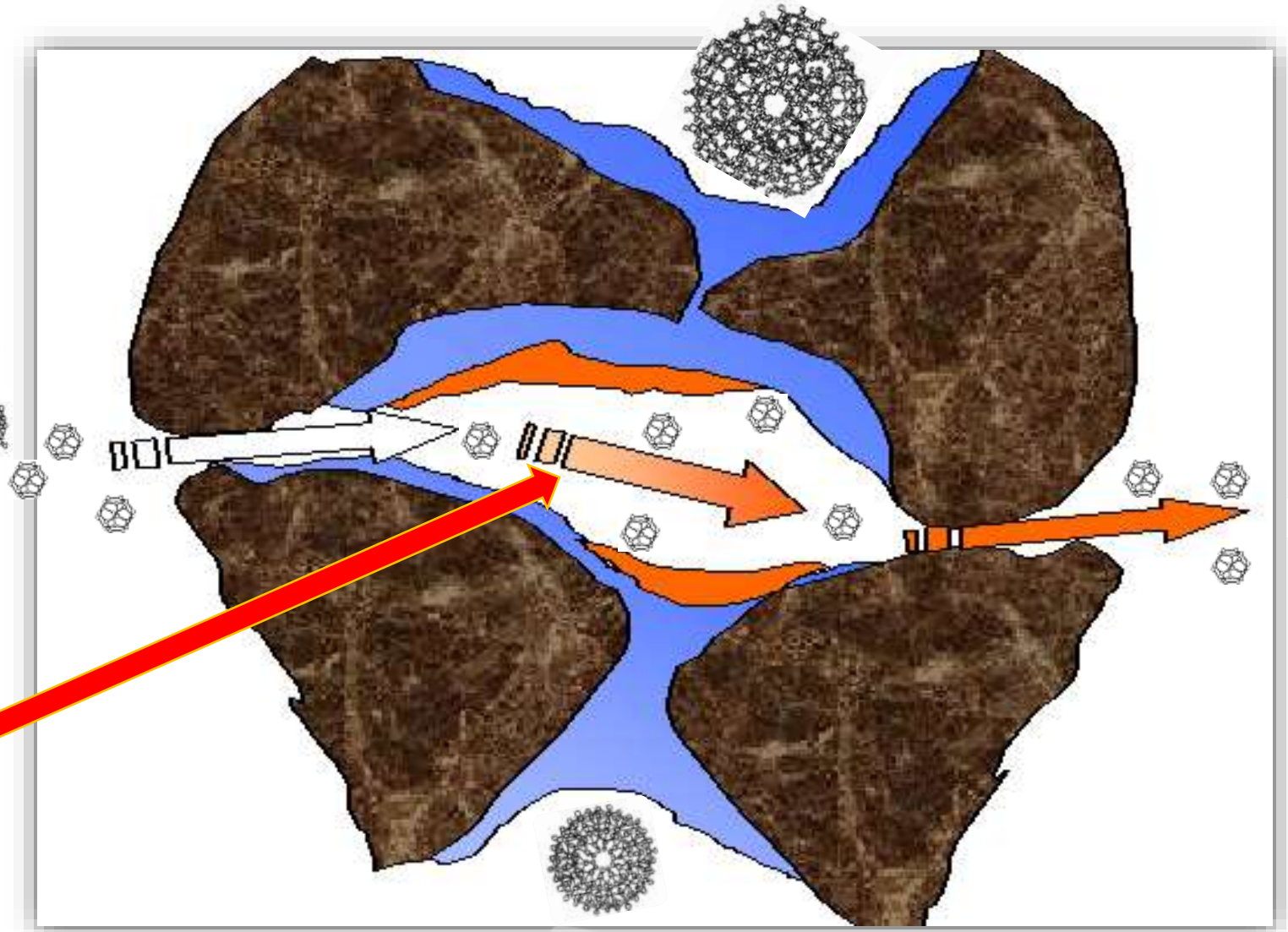
If we could overcome this limitation in fine texture soil, improve the 'apparent K' and improve the controlled movement (transmissivity) of contaminants across pore spaces (lower retardation), we could improve all forms of Remediation!

Ivey-sol Overcomes Low K and Retardation In Finer Grain Soil Improving Access, Regress, and Remediation

ACCESS







Interfacial Tension Will Effect NAPL Behaviors

More Available (Physio-Bio-Chem)

REGRESS

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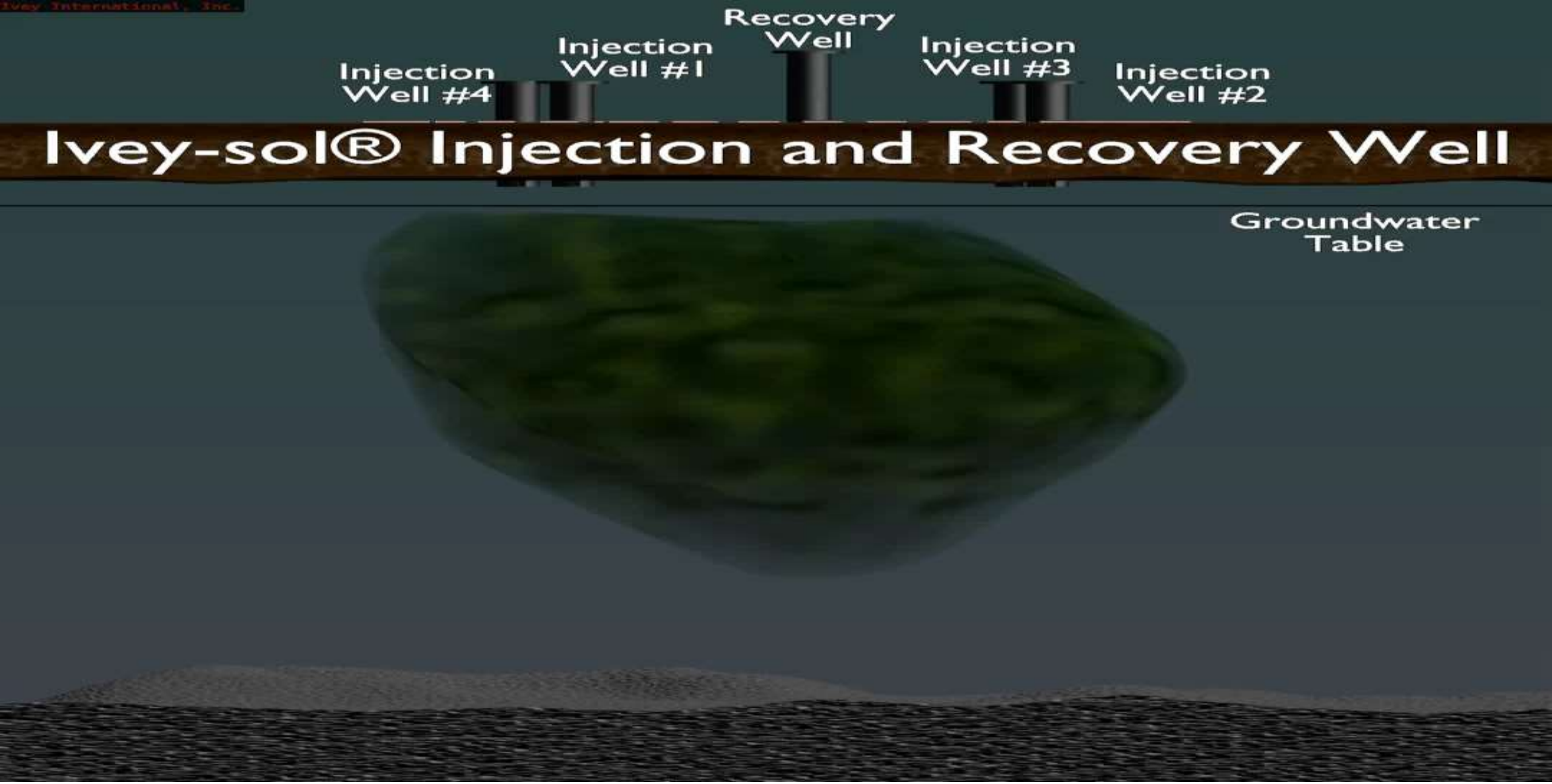
3 Dimensional Animations

In-situ '*Push-Pull*' Ivey-sol® Application Options

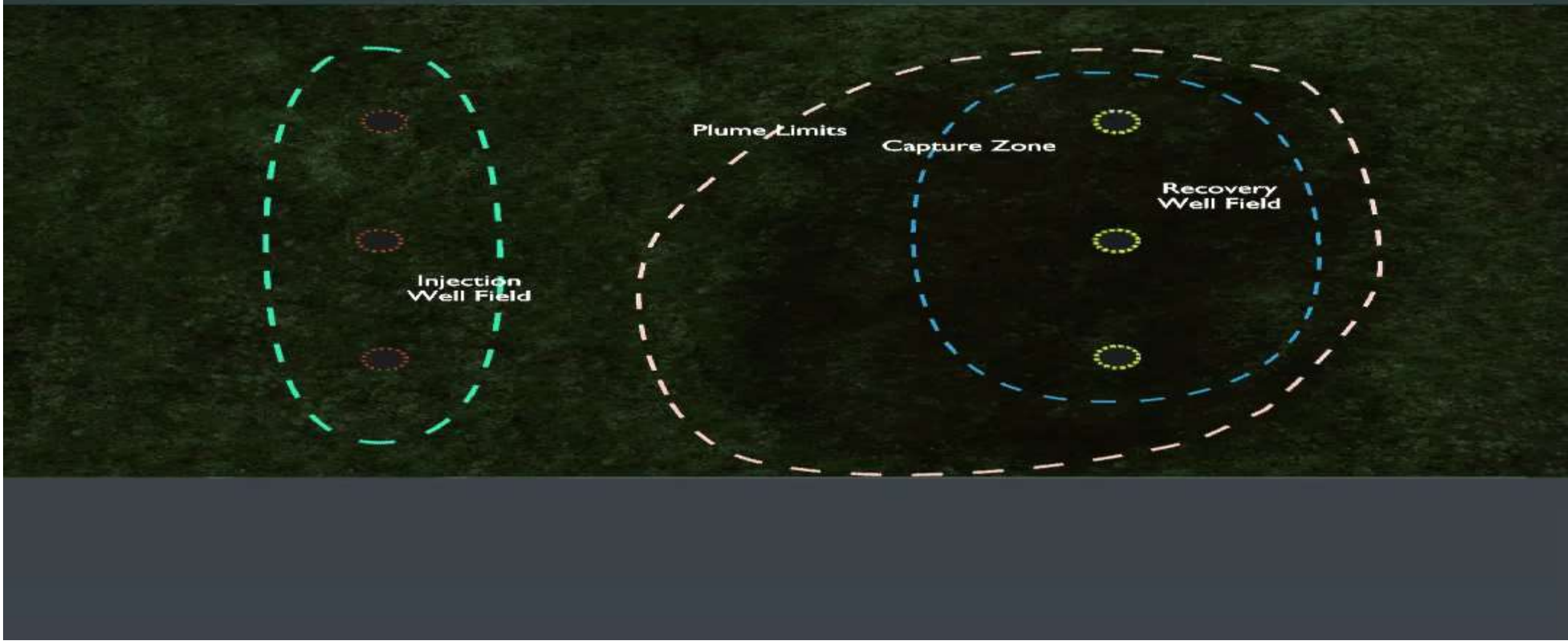
Link For PDF Version To See Ivey-sol Animations:

http://www.iveyinternational.com/videopresentation

Ivey-sol® Injection and Diffusion Radius


Injection Well #4
Injection Well #1
Recovery Well
Injection Well #3
Injection Well #2
Ivey-sol® Injection and Recovery Well
Groundwater Table

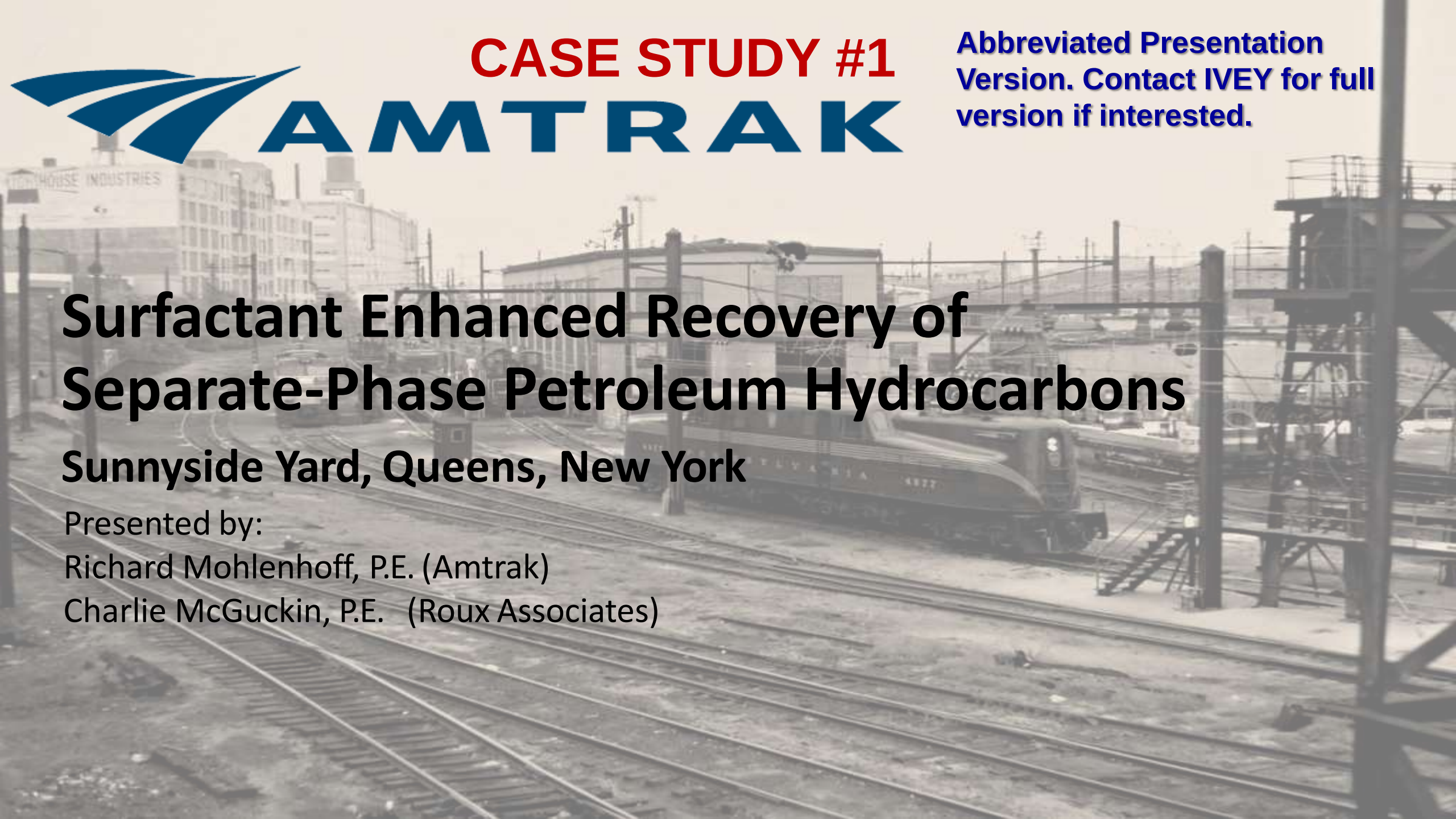
Ivey-sol® Injection and Recovery Well Fields



CASE STUDY #1

AMTRAK

Abbreviated Presentation Version. Contact IVEY for full version if interested.



Surfactant Enhanced Recovery of Separate-Phase Petroleum Hydrocarbons

Sunnyside Yard, Queens, New York

Presented by:
Richard Mohlenhoff, P.E. (Amtrak)
Charlie McGuckin, P.E. (Roux Associates)

Site History

- Located in Sunnyside Yard, Queens, New York
- Over 100 years of service
- State Superfund Site
- Six Operable Units (OUs)
- 130 acre Site
- OU-3 LNAPL and PCB Plume

ROUX

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OU-3 Record of Decision

Cleanup Standards

- PCBs < 25ppm
- Lead < 3,900 ppm
- cPAHs < 25 ppm (total of 7 compounds)
- SVOCs < 500 ppm
- LNAPL thickness < 0.1 foot

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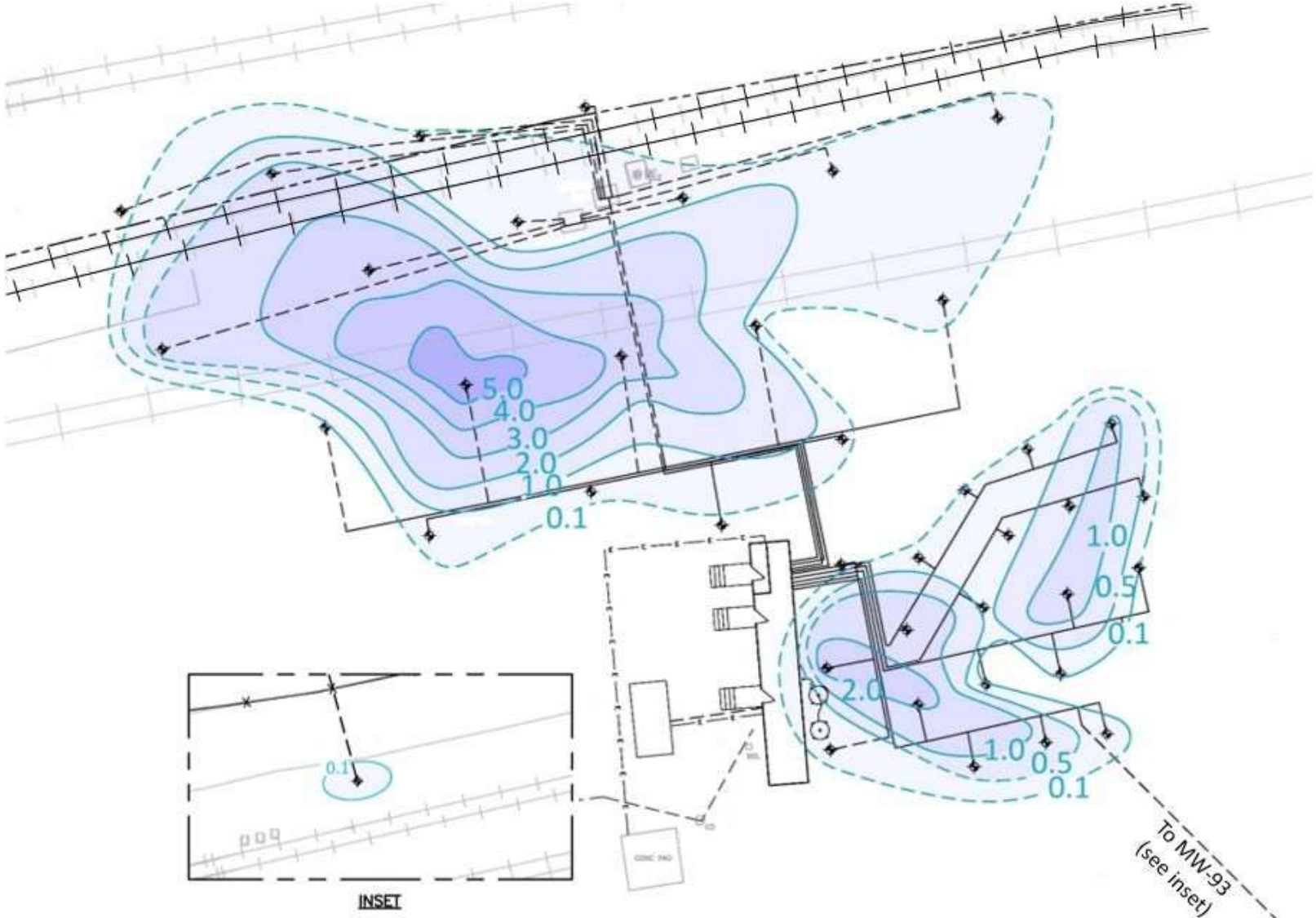
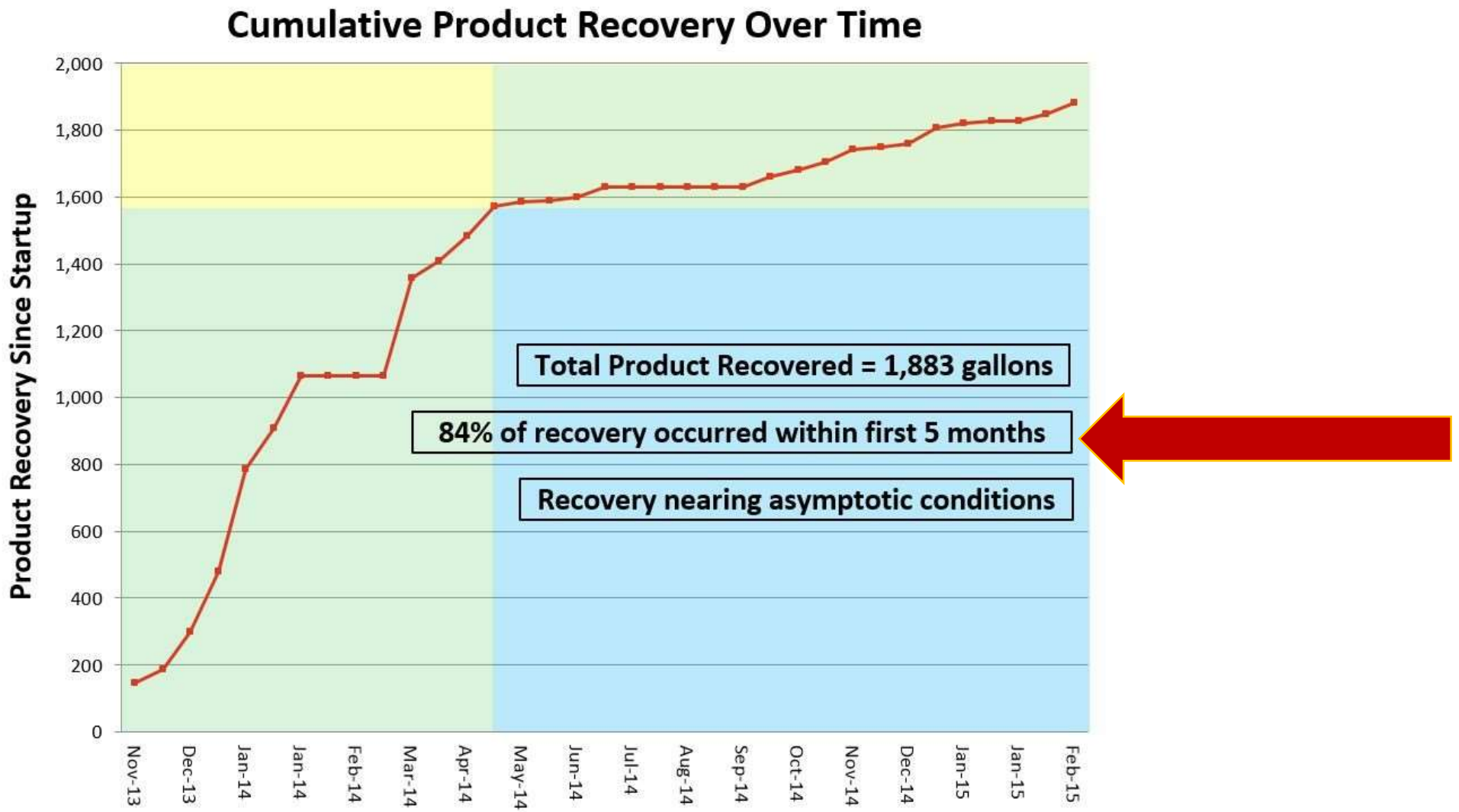
Dual Phase Vacuum Extraction (DPVE) System



June 2013

Dual Phase Vacuum Extraction (DPVE) System

DPVE System Performance



Ivey-sol® Surfactant Technology

- Composition
  - Several patented non-ionic surfactant formulations
- Applications
  - Desorb and liberate free-phase LNAPL and/or sorbed petroleum hydrocarbons
- Mechanism
  - Makes the contaminants more miscible in the aqueous phase, increasing the “physical availability”
- Additional Uses
  - Enhances bioremediation

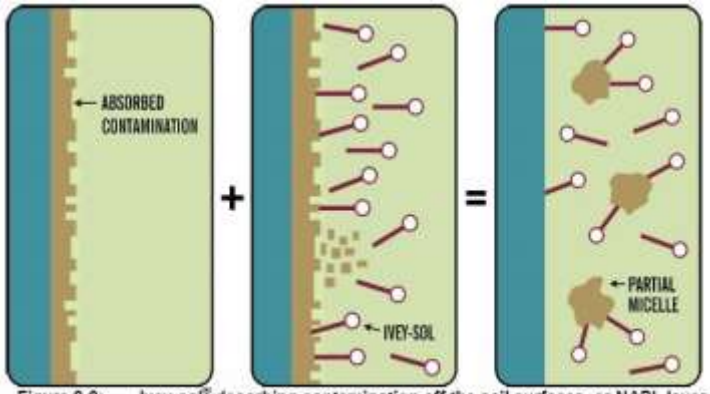
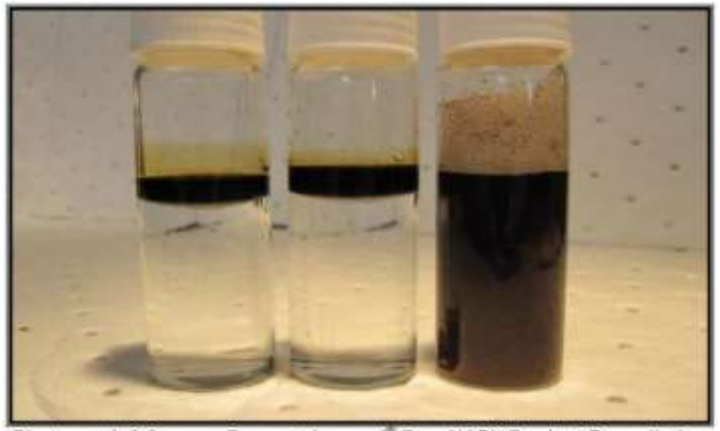


Figure 2-2: Ivey-sol® desorbing contamination off the soil surfaces, or NAPL layer making it more ‘Available’ for in-situ or ex-situ remediation.



Photograph 2-2: Pre-post Ivey-sol® Free NAPL Product Remediation

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“Today's Environmental Solutions For A Better Tomorrow”™

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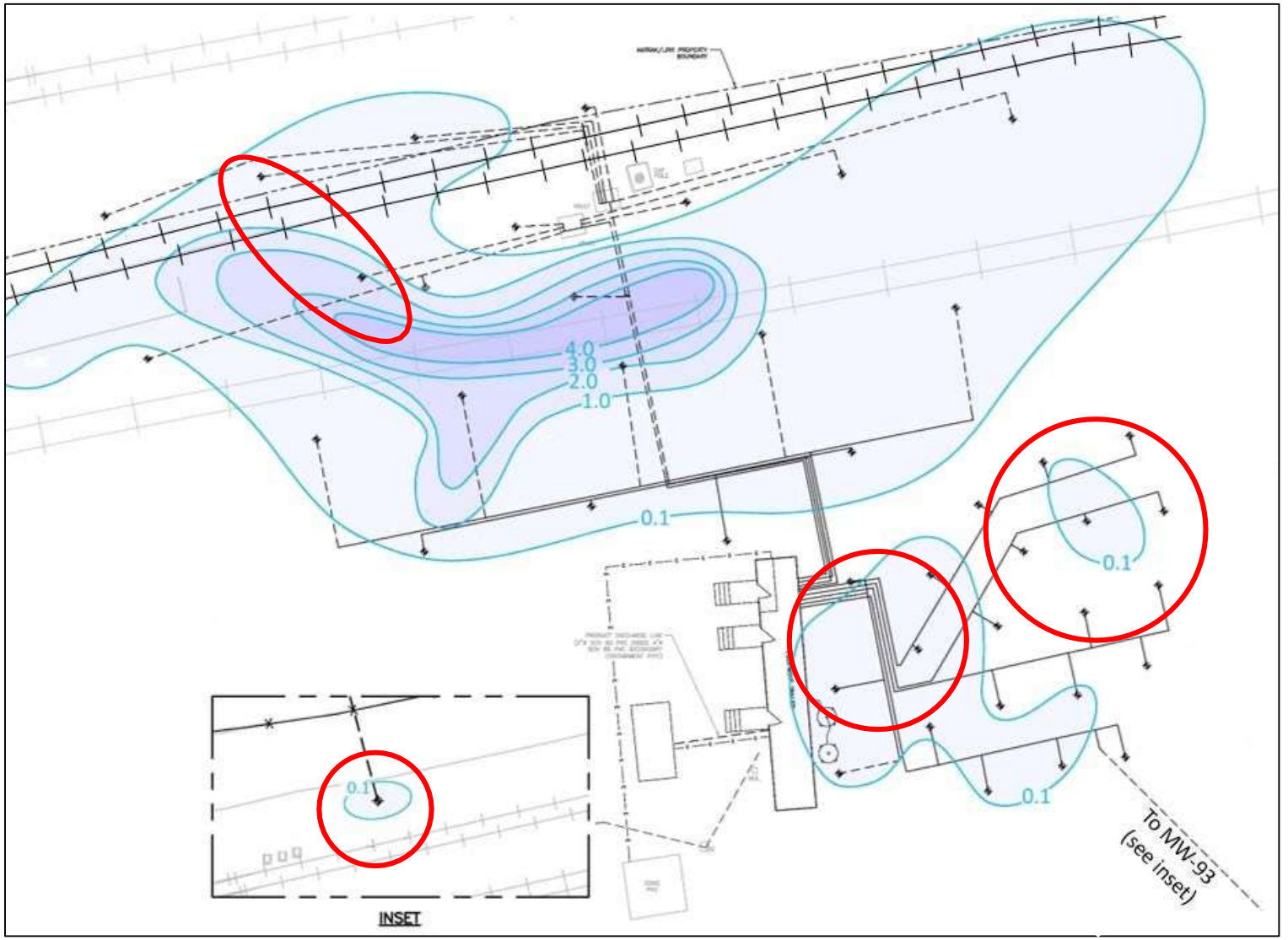
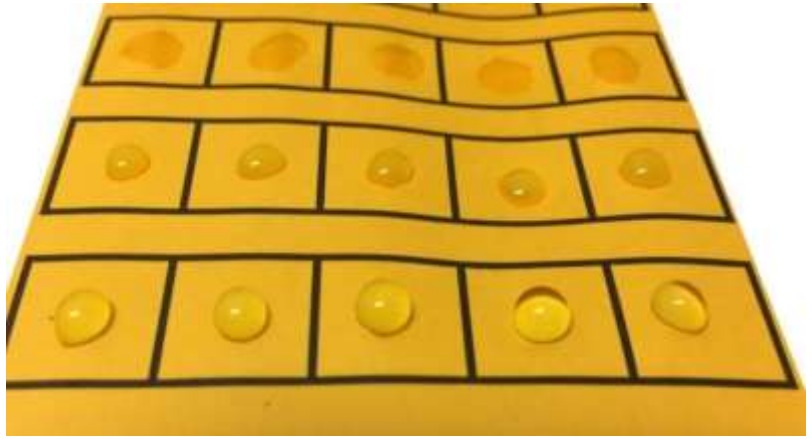
Injection Areas (8 LNAPL Wells)



Pilot Study Methods

1. Injection (gravity fed/geoprobe)
   - Experimented with surfactant to water ratios
   - Experimented with volumes of total mixture
2. Extraction (DPVE system)
   - Removed at least 3x the injection volume
   - Continued extraction until no surfactant was present
3. Extract from injection point or nearby extraction well



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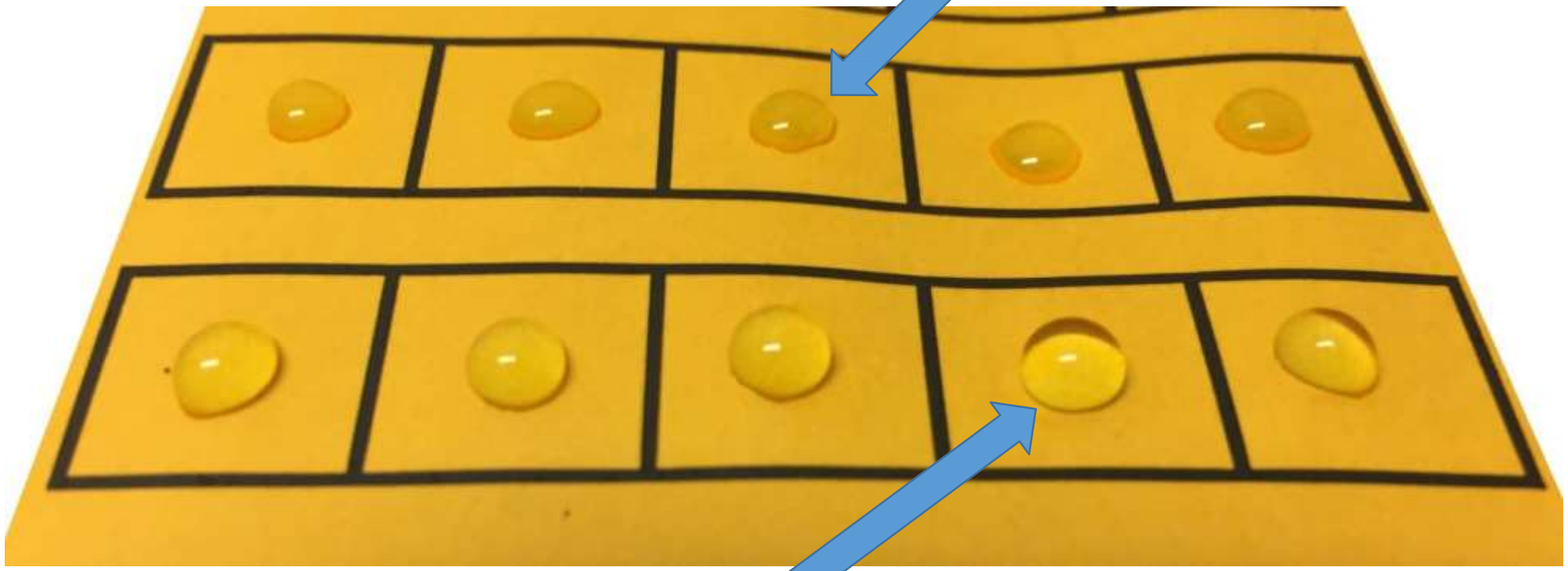
Water mixed with Surfactant

Irregular edges Loses its beading and Absorbed by the paper



Water free of Surfactant

Forms near-perfect circles Retains its beading Does Not absorb into the paper

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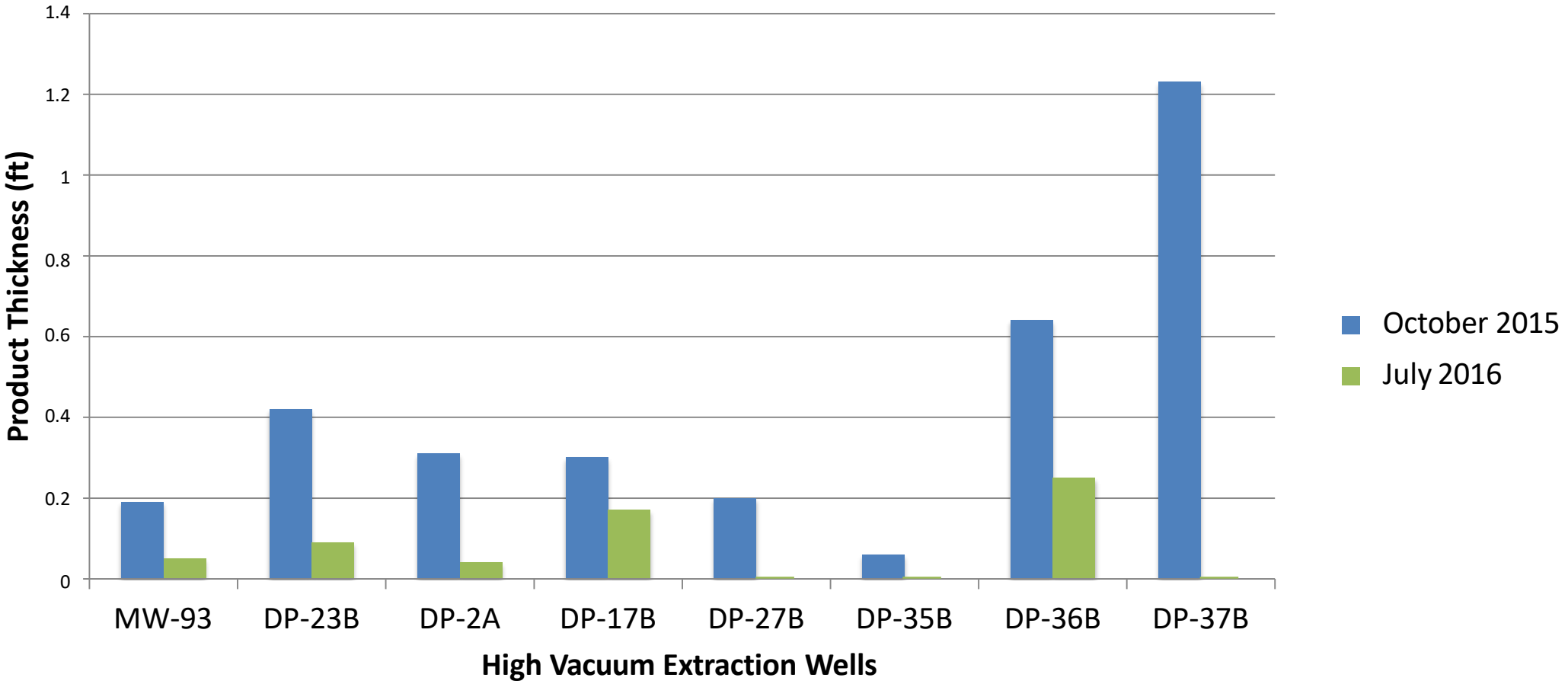
Pilot Study Results

(IVEY On-site For 1 Week Application)

Product (LNAPL) Thickness, Before and After Ivey-sol® 3 Application 1-week Pilot



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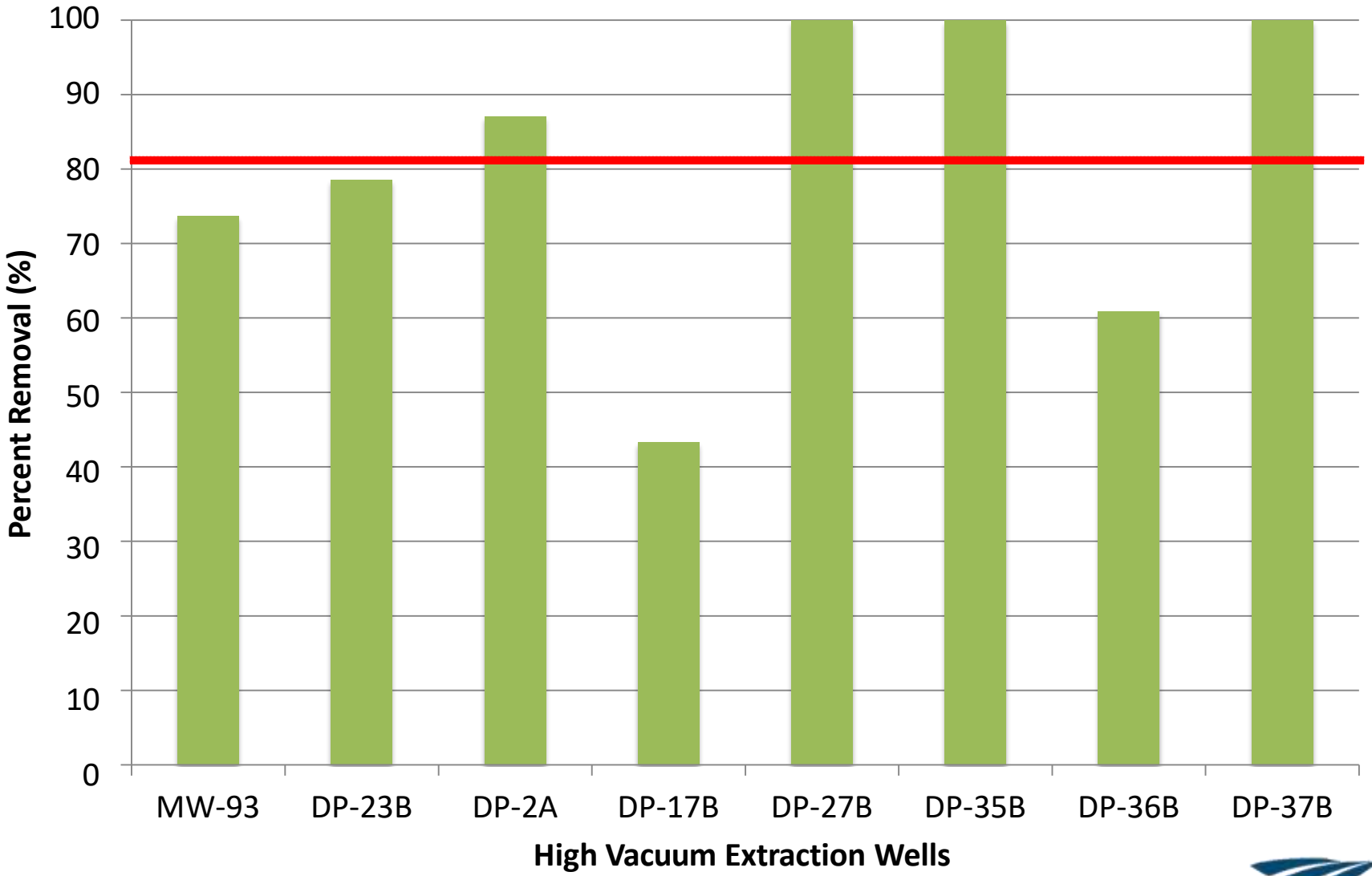
Free Product (NAPL) Percent Removal
3 Applications in 1 week

81% Average LNAPL Mass Removal



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Conclusions

- SPH recovery was enhanced by the increase of SPH solubility
- Free product was not observed in the extracted groundwater
- Reduction of SPH thickness was usually observed within 24 hours of surfactant injection and persisted for several weeks or longer
- Low concentration ratios of surfactant (1:20) are effective and higher concentrations do not increase effectiveness
- Low injection volumes or injection rates were generally needed in OU-3 due to the low permeability soil conditions and high groundwater table

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CASE STUDY #2

Abbreviated Presentation Version. Contact IVEY for full version if interested.

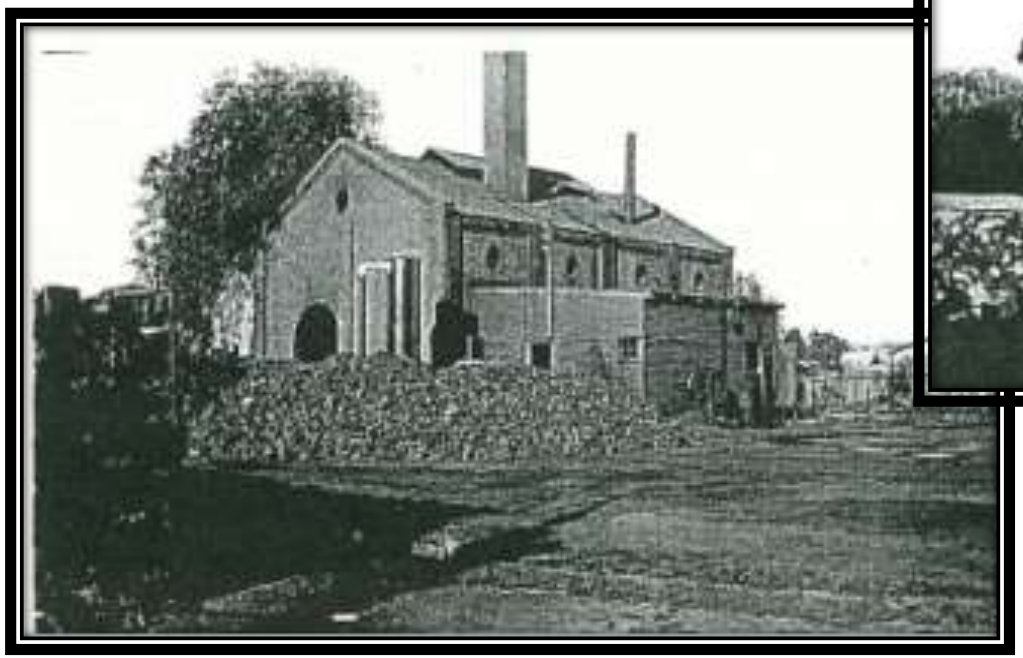
Sustainable outcomes with Ivey-sol® surfactant enhanced aquifer remediation (SEAR) of coal tar NAPL

Australasian Groundwater Conference 2019,
Updated 15 January 2020

Daniel Hirth, CEnvP
BlueSphere Environmental Pty Ltd
113 Ferrars Street
Southbank, VIC 3006
Australia

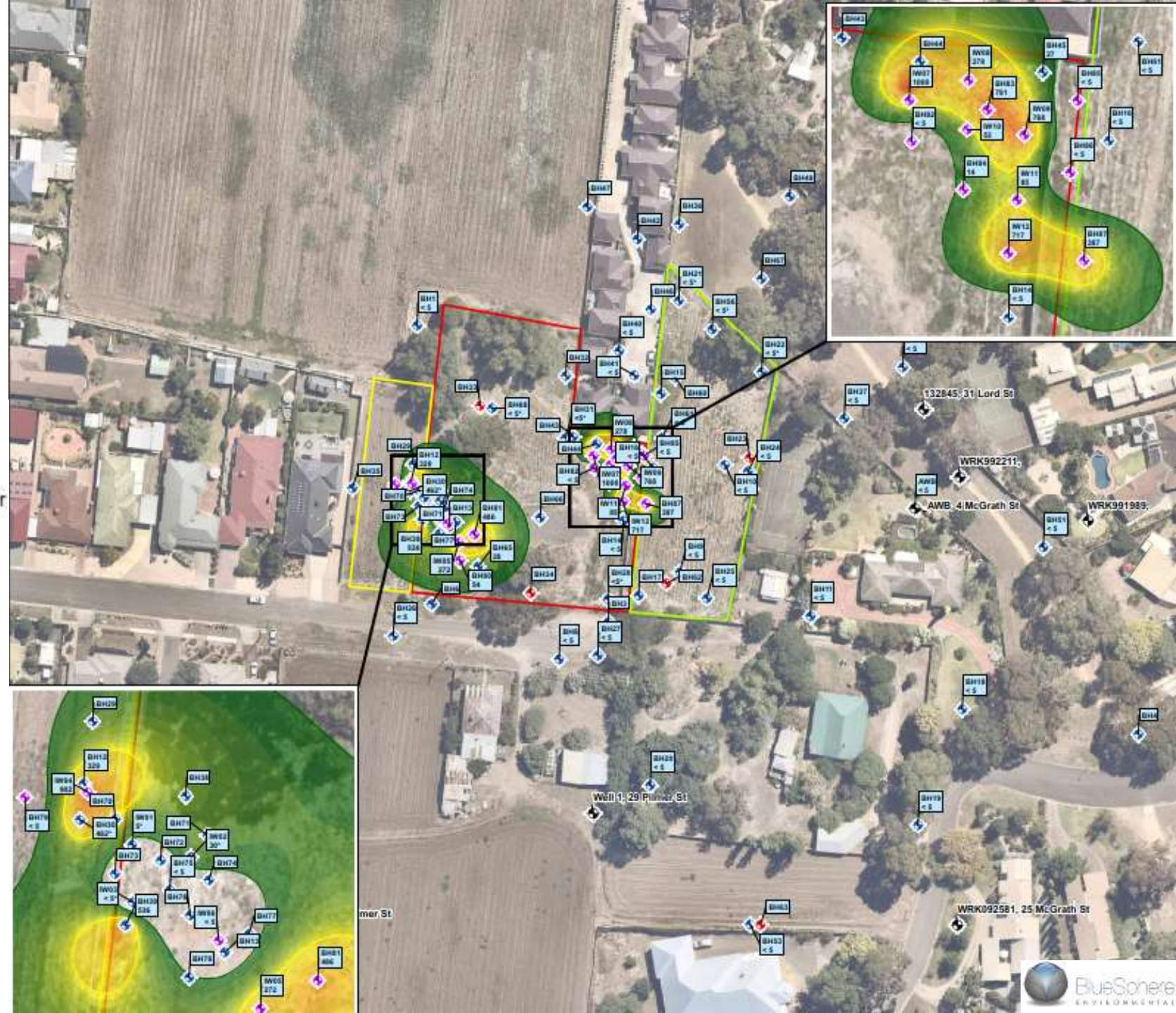
Background

Rural gasworks from 1889-1973
Coke, tar and ammonia by-products generated
Soil and groundwater impacted.

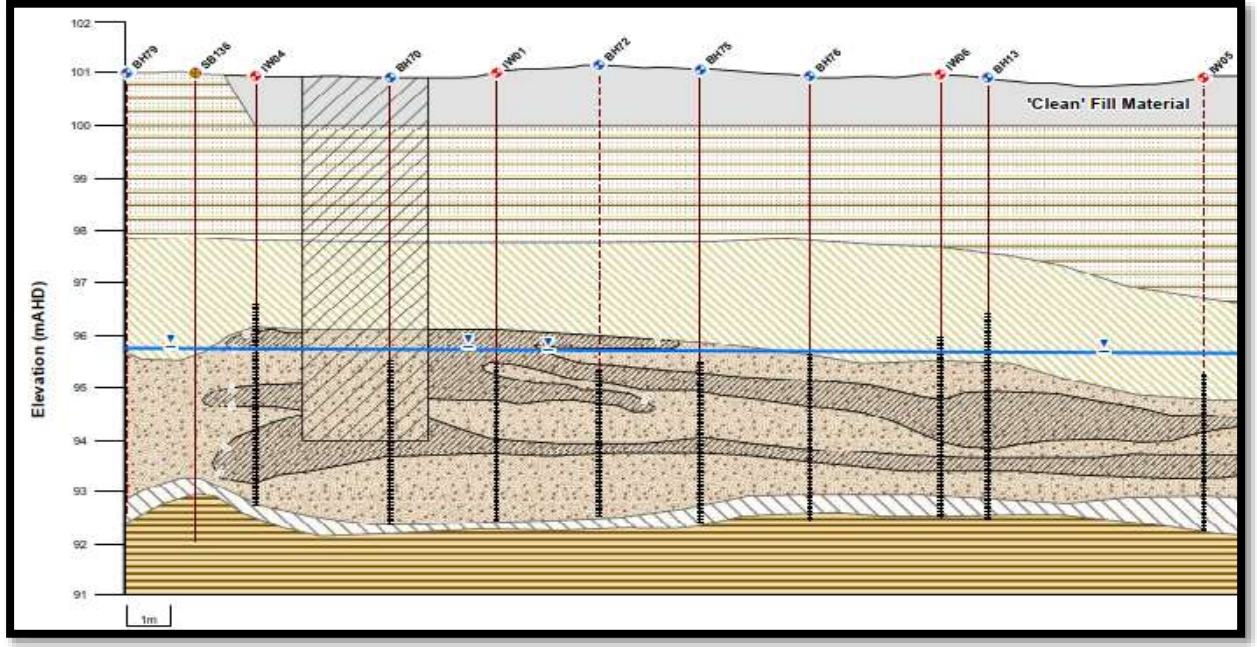


Background

Two source zones: former tar/liquor disposal wells. Plan shows dissolved naphthalene as an indicator of NAPL.



Objective



Issues:

- Non-aqueous phase liquid (NAPL) presence
- Dissolved chemicals of concern: naphthalene, benzene, ammonia, cyanide (free), sulfate

Site objective:

- Remove/reduce contamination liability
- Limit impacts to adjoining sensitive receptors including residences
- Divestment of surplus land

Remediation Objective:

- Reduce source zone contaminant mass, so far as reasonably practicable.

NAPL Conceptual Model:

- Over 100 wells installed, half in the source zones.
- Alluvial aquifer 16 – 28 feet BGL (5 - 8.5 mBGL);
- Clayey lignite lower confining unit (Werribee Fm);
- Distributed NAPL beneath tar wells, minor LNAPL

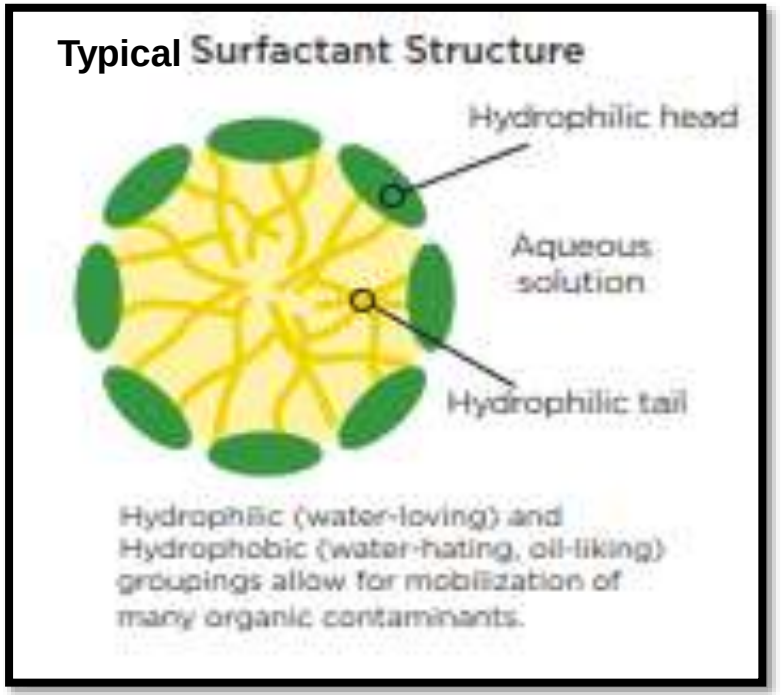
Methodology

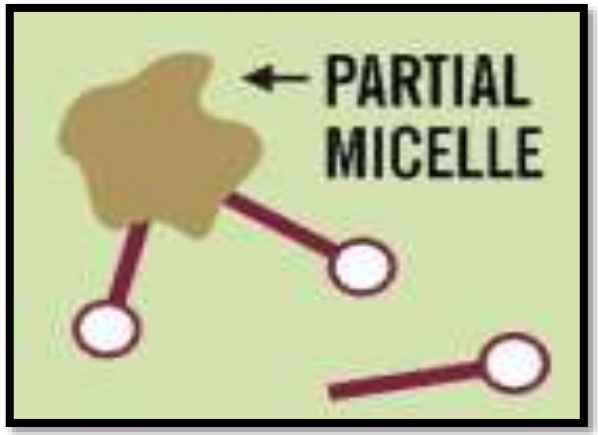
Process:
ROA → Trials → RAP → Approvals

Surfactant Enhanced Aquifer Remediation (SEAR)

We used a non-ionic, selective surfactant (Ivey-sol) engineered for use with long-chain hydrocarbons to lower the surface tension (not to emulsify).
Sub-critical micelle application
Applied through injection and recirculation
NAPL continuously removed from recirculated water
Last stage is to extract surfactant and treat

1) re-injection (limited by cyanide concentrations)
2) trade waste (primary method of disposal)
3) Off-site transport



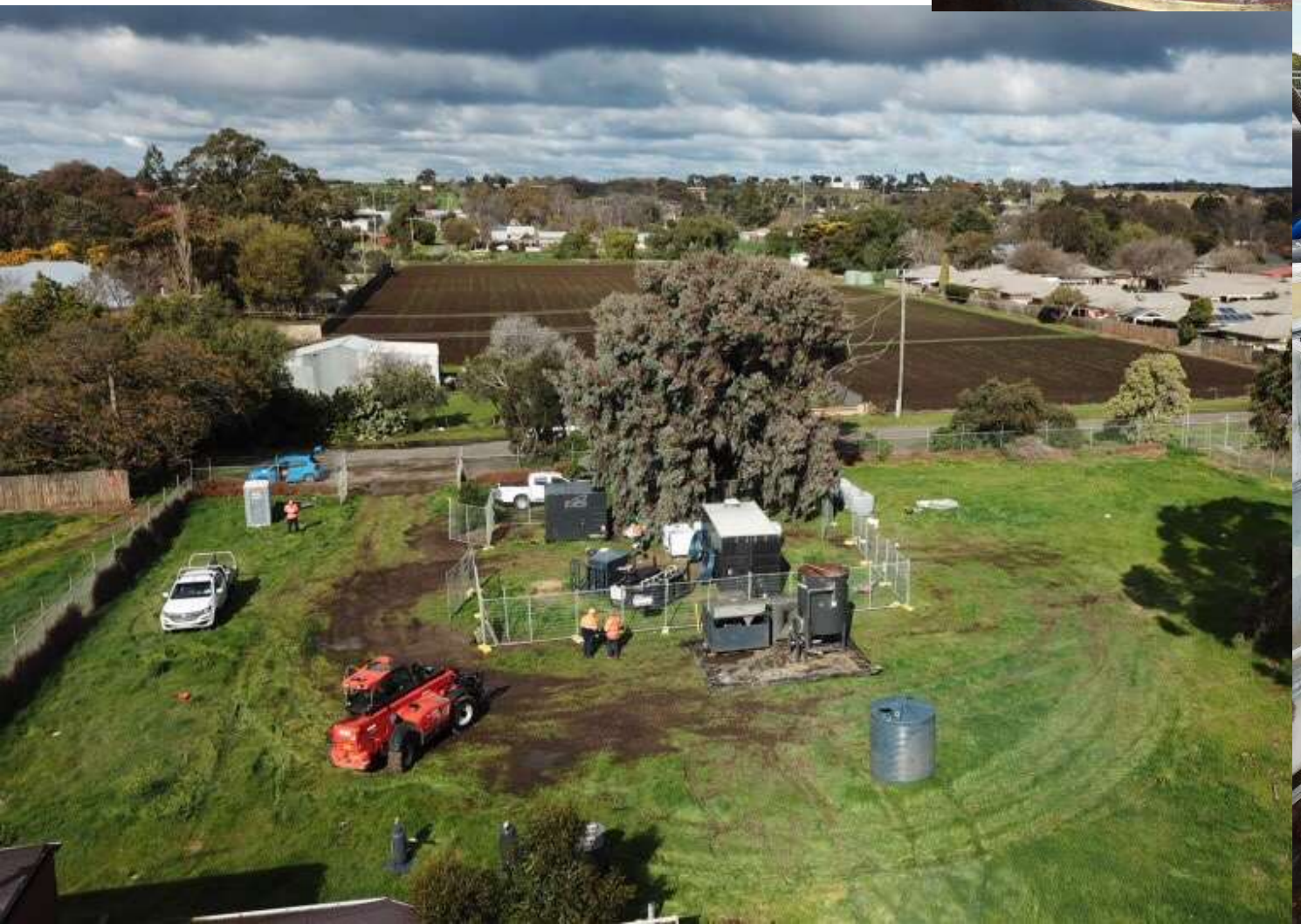


Ivey-sol only needs to form a partial micelle. So lower dosage and greater SEAR economics.

Ivey-sol does not need to emulsify contaminants. As selective below the CMC = greater precision and accuracy for in-situ SEAR applications.

Methodology

SEAR (Ivey-sol) - MPE system



Results

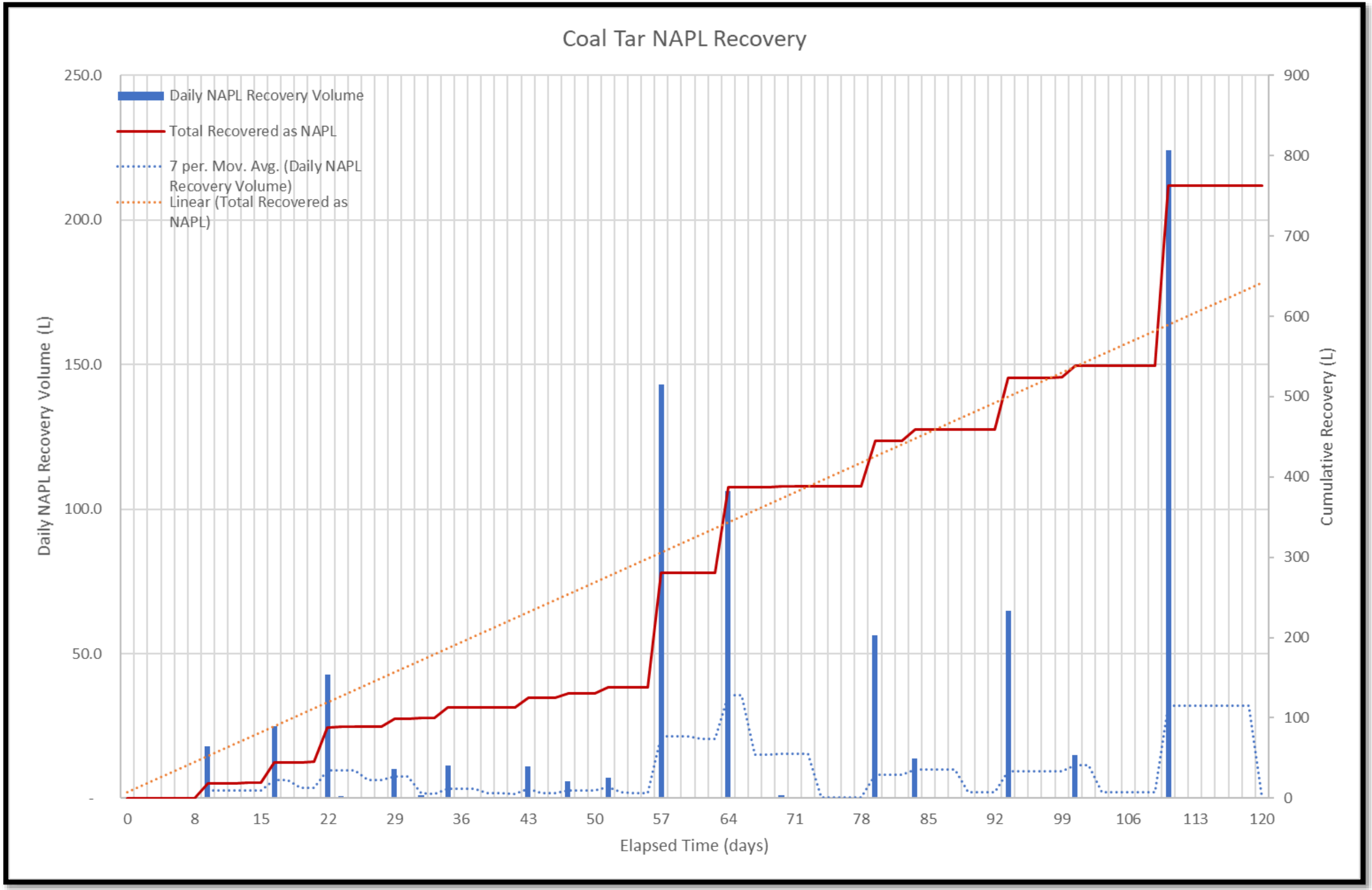
What we observed:

Very rapid NAPL coalescence (~15min); and

NAPL mobilisation for enhanced recovery (both LNAPL & DNAPL)

Both visual and quantitative NAPL recovery over Ivey-sol SEAR four (4) month application. Realizing Effective NAPL mass removal.

Results


Coal Tar NAPL Recovery
Daily NAPL Recovery Volume
Total Recovered as NAPL
7 per. Mov. Avg. (Daily NAPL Recovery Volume)
Linear (Total Recovered as NAPL)
Daily NAPL Recovery Volume (L)
Cumulative Recovery (L)
Elapsed Time (days)
250.0
200.0
150.0
100.0
50.0
-
900
800
700
600
500
400
300
200
100
0
0
8
15
22
29
36
43
50
57
64
71
78
85
92
99
106
113
120

Conclusions

- **SEAR (Ivey-sol)** with groundwater extraction can be a viable remediation method for tar NAPL in aquifers that have:
  - Limited human and environmental receptors
  - Unconsolidated sediments
  - Sufficient effective permeability for NAPL entry,
  - And sufficient, interconnected permeability for NAPL extraction.

- **Sustainability**
  - Economic: <cost than other possible methods (e.g. co-solvent, thermal, stabilisation)
  - Social: low noise, no odour, reduced street traffic
  - Environmental: Biodegradable Ivey-sol surfactant, reduced wastewater generation, reduced filter media (GAC) requirements

- **Audit CUTEP completion by late 2020**.
  - With land returned to normal use.

- ***Remediation system turn off planned for late January 2020.***

BlueSphere ENVIRONMENTAL

320,000 L Oil Storage and Processing Facility Spill
Summer 2019 – Northern AB

CASE STUDY #3

EARTHMASTER
ENVIRONMENTAL STRATEGIES INC

IVEY-SOL

Facility Oil Spill Overview

- Sumer 2019, reported failure of pump equipment led to the spill of about 320,000 liters of a mixture of crude oil and produced water at facility – northern Alberta.
- Incident reported to AER
- The facility operator reported, approximately 99% of the spilled fluids were recovered, having been contained in an on-site bermed area, which already held about 300 cubic meters (m^3) of pooled surface water.
- An amount of product nonetheless breached the containment area and was released into the local environment...migrating down a wooded slope toward a nearby fish bearing creek.

Drone footage courtesy of Earthmaster




- Earthmaster Environmental Strategies Inc. (Calgary, Alberta), was the consulting firm retained to assess cleanup options and implement the remedy for cleaning up the spill [Adam Dunn, VP Operations];

- The liquid product that breached the containment area flowed down a relatively steep slope (20-30% grade) about 180 meters to the south-southwest, affecting herbaceous vegetation and associated shrubs and trees along its pathway.

- The released fluid consisted of 66 m^3 of oil and 254 m^3 of salt/produced water; no salt impacts were detected along the spill path, however. The contaminants of concern (COC) included hydrocarbon fractions F1 (C6-C10), F2 (C10-C16) to F3 (C16-C34), benzene, toluene, ethylbenzene, and xylenes (BTEX). Max 43K ppm

- An environmental Receptor of Concern was a small fish-bearing creek coursing near the base of the slope, the released fluids did not enter the creek. There was, however, some fluid infiltration into the shallow soil horizon and some oil sorption into vegetation and surface debris.

Challenges To Remediation

- Steep slope and the presence of merchantable timber, vegetation, leaf litter, and organic debris, along with irregular surface contours, presented logistical and safety challenges facing efforts to recover the spill and clean up the area.

- A number of precipitation events, including some significant ones, including one predicting 150 ml of rain 2 days after the spill, prompting Earthmaster to delay the selection and implementation of a final cleanup remedy while it prepared for the storm

- Earthmaster installed several lined bell holes to catch runoff from the rain. The application of LIDAR (light detection and ranging) remote sensing following the storm confirmed that the bell holes were properly placed to prevent spill from reaching the creek; and

- These bell holes were used for the final applied remedy.

Remediation Option Evaluation & Selection

- Excavation and removal is a common solution for many spills into the environment, but it presented several prohibitive challenges at this site, in the form of potential environmental damage.

- Deforestation of the hillside would have brought about erosion problems and sedimentation threat to the nearby creek. Plus cost to pay the holder of the forest management agreement (FMA) upwards of ≥ $50,000 for the lost timber.

- Bioremediation and chemical oxidation were also deemed to be impractical for this particular spill.
  - Bioremediation would not have addressed spill migration, which threatened the waterway, and ongoing monitoring and laboratory services would have extended out several years and been very costly.
  - Stoichiometrically chemical oxidation is also very costly when used to address free-product spills, it has the potential to kill vegetation, and it requires special PPE handling (e.g., the use of protective gear) as a hazardous material, and would transport as dangerous goods (TDG) to the remote site.

Remedy chosen was flushing/washing, as opposed to excavation & off-site disposal of soils

Ivey-sol® Surfactant Remediation Technology

- Fortunately, soil sampling at site indicated the oil/water mixture that escaped from the containment area, had coursed down the hill side, rather than penetrated deeply into the soil, was more shallow and sorbed to organic matter;
- Hence Earthmaster Environmental Strategies Inc. determined they could "do a flush" rather than a "scrape" - more precisely, passive and active surface flushing rather than excavation and off-site disposal – for a more Sustainable spill clean-up.
- A surfactant-based remedy was thus deemed optimal, and due to Earthmaster's familiarity with the Ivey-sol® surfactant products, and AER's acceptance, Ivey-sol® was chosen for the site cleanup.
- The Ivey-sol® surfactant products consist of biodegradable, non-ionic, pH neutral formulations that have the unique ability to selectively desorb sorbed contaminants, including LNAPL miscible in the aqueous phase, for enhanced mass recovery.

Alberta Energy Regulator

"If you cannot monitor it, or measure it, you cannot manage it" Don Gonyea, CTDEEP Regulator

- The Alberta Energy Regulator (AER) approved the use of the Ivey-sol® technology at the spill site, preferring it to an environmentally destructive excavation alternative, and potential risk to receptor.

- IVEY has a positive history of applying its Ivey-sol® remediation products at sites in Alberta (in-situ and ex-situ applications).

- Regulators generally find the Ivey-sol® remediation products more sustainable to other remedial alternatives because they are: readily biodegradable, pH neutral, non-caustic, non-corrosive, have (3) USEPA test methods for their analysis, has a real-time field test kit available, and product is free of undesirable regulated impurities.

Ivey-sol® is free of PFOA, PFAS, 1,4 Dioxane, Dioxin, Furan, PCBs, and tested and free of USEPA Regulated compounds.

Lessons Learned – Optimizing The Ivey-sol® Application

- Ivey-sol® surfactant was deployed at the spill site, in varying concentrations using various delivery methods in checkerboard configuration. Trial No. 1: was completed using backpack sprayers (with a surfactant-to-water ratio of 1:30) followed by pressure-washing. There was not enough volume in this trial;
- Trial No. 2: increased pressure and volume. Ivey-sol® and water were mixed 1:40 in the hydrovac truck tank and applied using the pressure wand. The oil could be recovered with this application with the right technique, but splattered if too much pressure was used.
- Trial No. 3: same 1:40 ratio in hydrovac truck tank, applied using truck hose rather than pressure wand. Ivey-sol® effectively washed oil off the vegetation using this application. But not enough pressure to move the fluid to the recovery bell holes, and some suds were being produced.
- Optimizations - Ivey-sol® applications were best at 1:60 to 1:80, and small local trenches dug to collect recovered fluids (oil/water) = Very Effective. IVEY recommends 1:50 dilution for most applications

RESULTS & CONCLUSIONS

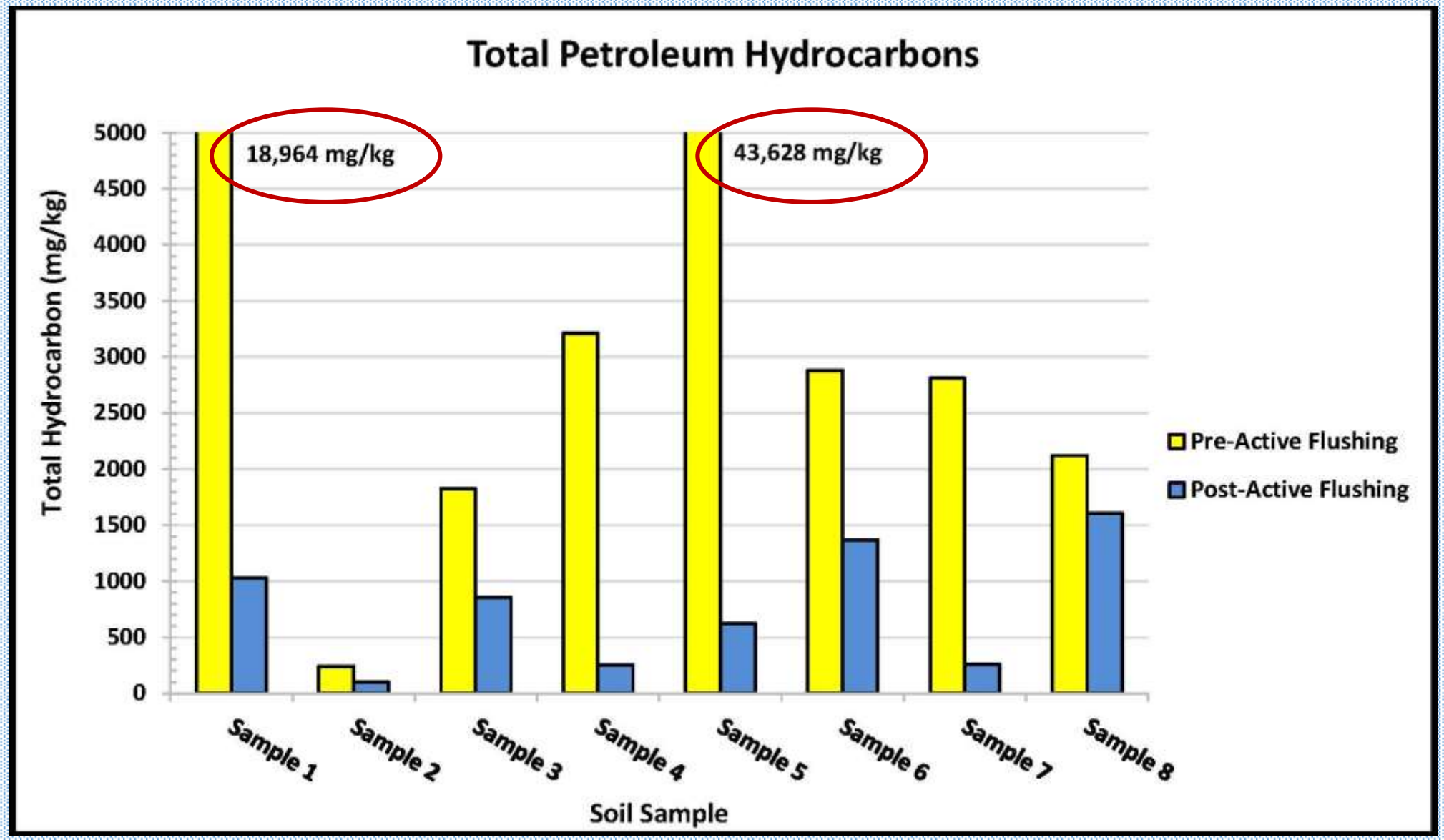
- The Ivey-sol® surfactant was applied over the course of four (4) days, and the majority of the oil on the hillside was effectively liberated and flushed into the trenches and bell holes for removal.

- Visual observations indicated that the cleanup operation was generally effective, and soil sampling confirmed these findings.

- Earthmaster decided that some heavily impacted areas where the leaf litter and vegetation was saturated with oil did not warrant the amount of surfactant and time required for complete removal. As a result, Earthmaster completed the remediation via surface soil/vegetation removal in these limited areas.

- Although the Ivey-sol® surfactant operation did not necessarily save much time compared with typical spill response operation, it did realize significant cost savings in terms of avoiding removal of merchantable timber, and the option of excavating and landfilling impacted soil and vegetation, and sediment impact risk to creek.

Example Pre To Post Ivey-sol® Soil Quality Testing



Bell-hole #3 Before and After Ivey-sol®

According to Earthmaster, there were numerous factors affecting project costs, and it was difficult to precisely quantify the cost savings attributable to choosing the Ivey-sol® flushing operation. However, Earthmaster estimated, client cost savings upwards of ~ several hundred thousand dollars.

EARTHMASTER
ENVIRONMENTAL STRATEGIES INC

TESTIMONIAL

"In July 2019 we were faced with a 320,000 liter crude oil and produced water spill at a facility in northern Alberta. With our rapid spill response strategy, utilizing the innovative Ivey-sol® surfactant remediation technology, we achieved significant time, cost, and environmentally sustainable cleanup benefits, resolving more than 99% of the spill on the hillside.

We and our client were very pleased with the outcome of this project"

Adam Dunn, Vice President, Operations
Earthmaster Environmental Strategies Inc.
Email: adamdunn@earthmaster.ab.ca Mobile: 1.403.899.5587

EARTHMASTER
ENVIRONMENTAL STRATEGIES INC

Steps To Using Ivey-sol At Petroleum & Chlorinated Remediation Sites

Step #1 (Evaluation)

Ivey-sol® Surfactant Technology

Ivey International Inc.
Suite 61-2955-156 St,
Surrey, BC, Canada V3S 2W9
Tel: 1-888-246-2744
Fax: 1-888-640-3622
Email: budivey@iveyinternational.

General Site Information Form

Client Information

Date: _____ Ivey Contact: _____
Company name: _____ Contact Person: _____
Email: _____ Phone: _____
Fax: _____ Cellular: _____
Street address: _____
Shipping address: _____

Project Information:

Project Name: _____
Project Location: _____
Project Number: _____
Regulatory Agency: _____
Land Use and Zoning (Circle): OParkland OAgricultural OResidential OCommercial OIndustrial

Site Information:

Remediation Objectives: _____
Contaminant(s) of concern (TPH, BTEX, TCE, PCB, etc.) _____
Soil Impacted: Yes / No Groundwater Impacted: Yes / No Vapor Impacts: Yes / No
Is NAPL Present: _____ Time Since Release: _____
Soil Type(s): _____ Soil Porosity: _____
Depth to Groundwater: _____ Hydraulic Conductivity (K): _____
Hydraulic Gradient: _____ Groundwater Flow Direction: _____
Area of Contamination: _____ Maximum Depth of Contamination: _____
Current Remediation Activities: _____

Monitoring Well Network Information:

Number of Existing or Proposed Monitoring Wells: _____
Number of Proposed Injection Wells: _____
Number of Proposed Extraction Wells: _____

Please Provide the Following:

- Site location map or drawing
- Site map showing source/treatment area and isoconcentration contours (if available)
- Site map showing monitoring and injection well locations and ROI estimates
- Table summarizing well construction details and GW level history
- Pilot test results (if available)
- Geologic cross section
- Copy of laboratory analytical results or summary table of contaminants of concern
- Site photographs
- Site investigation report

Please complete this site information form and return to: budivey@iveyinternational.com
©Ivey International Inc.

Step #2 (In-situ/Ex-situ Application Model Development)

Step #3 (Ivey-sol Selection)

Contaminant of Concern (COC)	Ivey-sol® Formulation Required
BTEX, Gasoline, Jet Fuel	103
Diesel (Light-Medium Heavy), PAH	106
Chlorinated Solvents (DNAPL, API <10)	106 (CL)
Motor Oil, Lubricants, Bunker-C	108

Note: For contaminants of concern (COC) not listed above contact IVEY directly.

Step #4 (Dosage Determination)

If Contamination is sorbed or dissolved Phase Apply ≤ 2% Ivey-sol
If LNAPL or DNAPL Phase Apply ≤ 4% Ivey-sol.

Step 5 (Proposal)

IVEY-SOL®
Surfactant Technology
www.iveyinternational.com

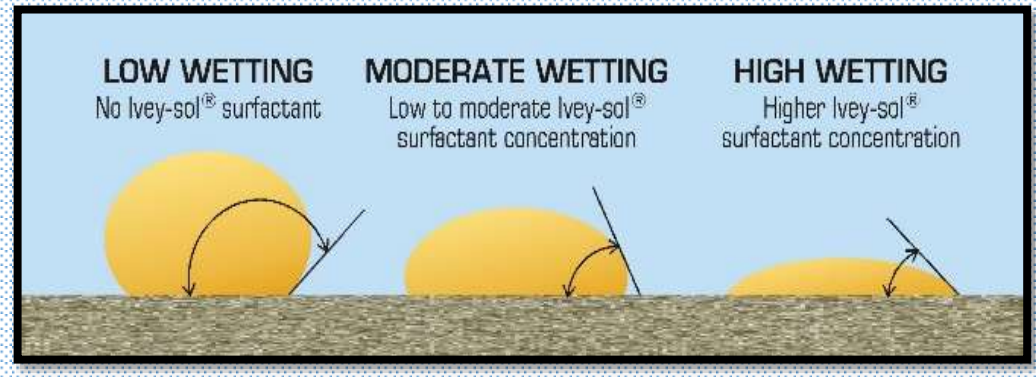
DECON IT®

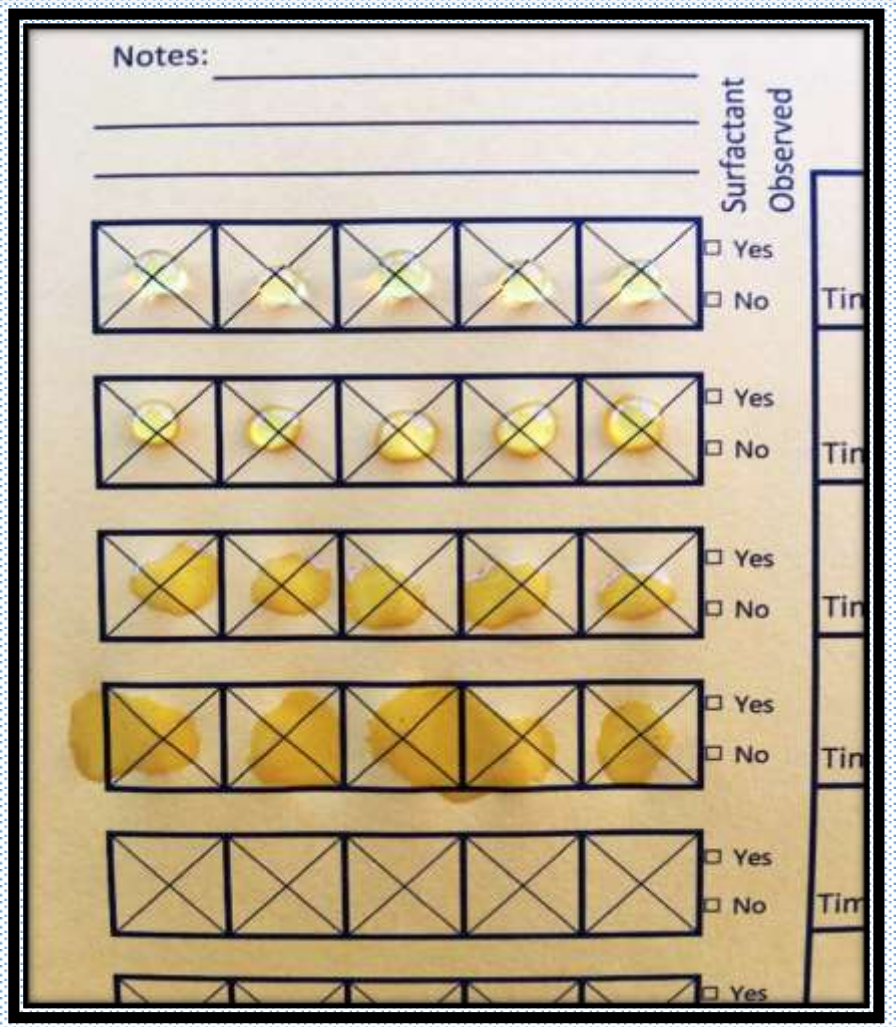
Non-Ionic Surface Cleaner

Contact IVEY For A Free Sample!

I-PACKER Low-Pressure Pneumatic Well Packer

Ivey-sol® Real Time Field Surfactant Test Kits
(100 Test Per Kit)





PETRO-WIPES Surface & Equipment Decontamination

CHEMCO inc.

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ENVIRONMENTAL EXPERTISE
& SPECIALIZED PRODUCTS

Ivey-sol® Surfactant Remediation Technology (103, 106, 106Cl, 108)
Decon-It® Equipment Decontamination Products (DECON-IT and DECON-IT *Plus*)
Petro-Wipes® Surface Equipment Decontamination Wipes (Petro-Wipes and *Plus*)
I-Packer® Low-Pressure Pneumatic Well Packer (50, 100, 150, 200 mm)
Field Surfactant Test Kits (Real-Time 100 Test / Kit)

Contact information : Jean Paré, P. Eng. – Vice-President
E-mail: jean.pare@chemco-inc.com
C: 418-953-3480 / 418-554-0152 O: 800-575-5422
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esaa Environmental Services Association of Alberta

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