REGENESIS®

Enhancing Excavations, Rapid Remediation

SABCS: Vancouver, BC

Keith Munsey – West Region Technical Specialist

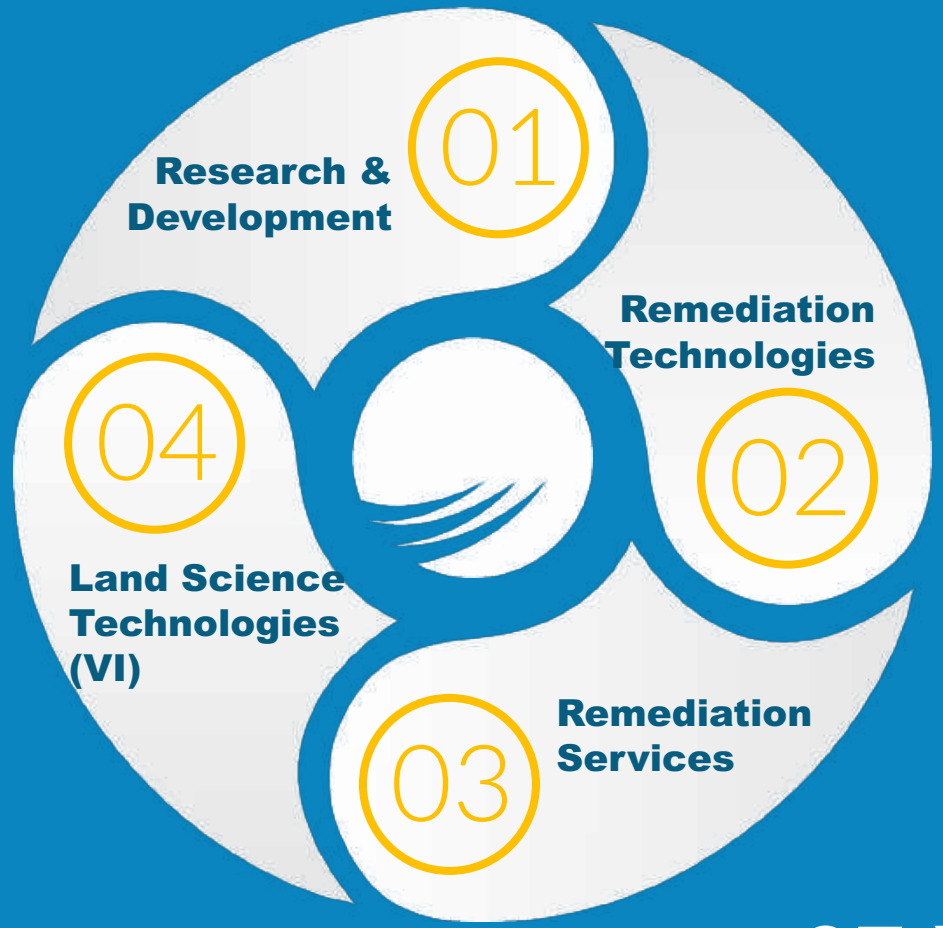
REGENESIS

Agenda

- **Who is Regenesis?**
- **PetroFix – What is it?**
- **How to use PetroFix to enhance excavations.**
- **Is PetroFix best for my site?**
- **Case Studies**

WHAT WE DO

We develop cutting-edge technologies to clean up soil and groundwater *in-situ*.



TECHNOLOGY CLASSES:

- **Enhanced Aerobic Biodegradation**
- **Enhanced Anaerobic Biodegradation**
- ***In Situ* Chemical Oxidation (ISCO)**
- **Bioaugmentation**
- **Metals Immobilization**
- ***In Situ* Chemical Reduction (ISCR)**
- ***In Situ* Sorption and Biodegradation**

27 Years in Business/35,000 sites

REGENESIS

SITE TY

Treating cor
mitigating va
We've seen ju

Dry Cleaners

Chlorinated Solvent

Contaminant treatable with REGENESIS Products

	LAC		ISCO			Aerobic Bio	Anaerobic Bio				ISCR	
Range of Treatable Contaminants	PlumeStop®	PetroFix®	RegenOx®	PetroCleanze	PersulfOx®	ORC® Advanced	3DME®	HRC®	HRC-X®	BDI® Plus	CRS®	S-MicroZVI™
BTEX												
Benzene	✓	✓	✓	✓	✓	✓						
Toluene	✓	✓	✓	✓	✓	✓						
Ethylbenzene	✓	✓	✓	✓	✓	✓						
Xylene	✓	✓	✓	✓	✓	✓						
Petroleum Hydrocarbons												
Gasoline Range Organics (GRO) (C_6-C_{10-12})	✓	✓	✓	✓	✓	✓						
Diesel Range Organics (DRO) (C_{8-12}-C_{24-36})	✓	✓	✓	✓	✓	✓						
Oil Range Organics (ORO) (C_{25-32})	✓	✓	✓	✓	✓	✓						
Creosote (coal tar)	✓	✓	✓	✓	✓	✓						
Oxygenates												
Methyl tert-butyl ether (MTBE)	✓	✓	✓	✓	✓	✓						
Tert-butyl alcohol (TBA)			✓	✓	✓	✓						
Chlorinated Solvents												
Tetrachloroethylene (PCE)	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓
Trichloroethene (TCE)	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓
Dichloroethene (DCE)	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Vinyl chloride (VC)	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tetrachloroethane	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓
Trichloroethane (TCA)	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓
Dichloroethane (DCA)	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Carbon tetrachloride	✓		✓	✓	✓		✓	✓	✓		✓	✓
Chloroethane	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓
Chloroform	✓		✓	✓	✓		✓	✓	✓		✓	✓
Chloromethane	✓		✓	✓	✓		✓	✓	✓		✓	✓
Chlorotoluene	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓
Methylene chloride	✓		✓	✓	✓		✓	✓	✓		✓	✓
Dichloropropane	✓		✓	✓	✓		✓	✓	✓		✓	✓
Dichloropropene	✓		✓	✓	✓		✓	✓	✓		✓	✓
Hexachlorobutadiene	✓		✓	✓	✓		✓	✓	✓		✓	✓
Trichloropropane	✓		✓	✓	✓		✓	✓	✓		✓	✓
Bis(2-chloroethyl)ether	✓		✓	✓	✓		✓	✓	✓		✓	✓
Bis(2-chloroethoxy)methane	✓		✓	✓	✓		✓	✓	✓		✓	✓
PAHs												
Acenaphthene	✓	✓	✓	✓	✓	✓						
Acenaphthylene	✓	✓	✓	✓	✓	✓						
Anthracene	✓	✓	✓	✓	✓	✓						
Benzo(a)anthracene	✓	✓	✓	✓	✓	✓						
Benzo(a)pyrene	✓	✓	✓	✓	✓	✓						
Benzo(b)fluoranthene	✓	✓	✓	✓	✓	✓						
Benzo(ghi)perylene	✓	✓	✓	✓	✓	✓						
Chrysene	✓	✓	✓	✓	✓	✓						
Dibenzo(a,h)anthracene	✓	✓	✓	✓	✓	✓						
Fluorene	✓	✓	✓	✓	✓	✓						
Naphthalene	✓	✓	✓	✓	✓	✓						
Phenathrene	✓	✓	✓	✓	✓	✓						
Pyrene	✓	✓	✓	✓	✓	✓						
Aromatics												
2-chlorophenol	✓		✓	✓	✓	✓						
2,4-dichlorophenol	✓		✓	✓	✓	✓						
2,4-dinitrophenol	✓		✓	✓	✓	✓						
4-chloro-3-methyl phenol	✓		✓	✓	✓	✓						
4-iso-propyltoluene	✓		✓	✓	✓	✓						
4-nitrophenol	✓		✓	✓	✓	✓						

nt of Defense

Hydrocarbons
ted Solvents
alkanes
rgetics
y Metals
FOS, PFOA)

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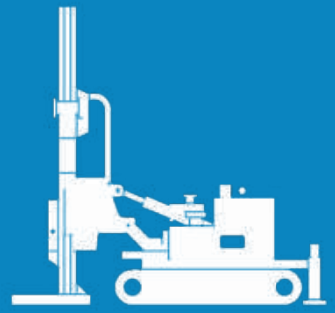
REMEDIAL APPROACHES OFFERED:



DIRECT PUSH INJECTION

- **In-Situ Chemical Oxidation (ISCO)**
- **In-Situ Chemical Reduction (ISCR)**
- **Bioaugmentation**
- **In Situ Sorption & Biodegradation**
- **Enhanced Aerobic Bioremediation**
- **Enhanced Anaerobic Bioremediation**

HORIZONTAL DRILL:

- ISCO
- ISCR
- Bioaugmentation
- In Situ Sorption & Biodegradation
- Enhanced Aerobic Bioremediation
- Enhanced Anaerobic Bioremediation

WELLS

- ISCO
- ISCR
- Sorption
- Enhanced Anaer… Bioremediation

EXCAVATION

- Soil Mixing & Handling

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PetroFIX Remediation Fluid

Evolution of Activated Carbon For In Situ Hydrocarbon Remediation

- Micron scale activated carbon (1-2 µm ∅) and water suspension, +30%

- Slow and rapid release electron acceptors (NO_3 and SO_4) in separate bucket

- Ships in totes and drums

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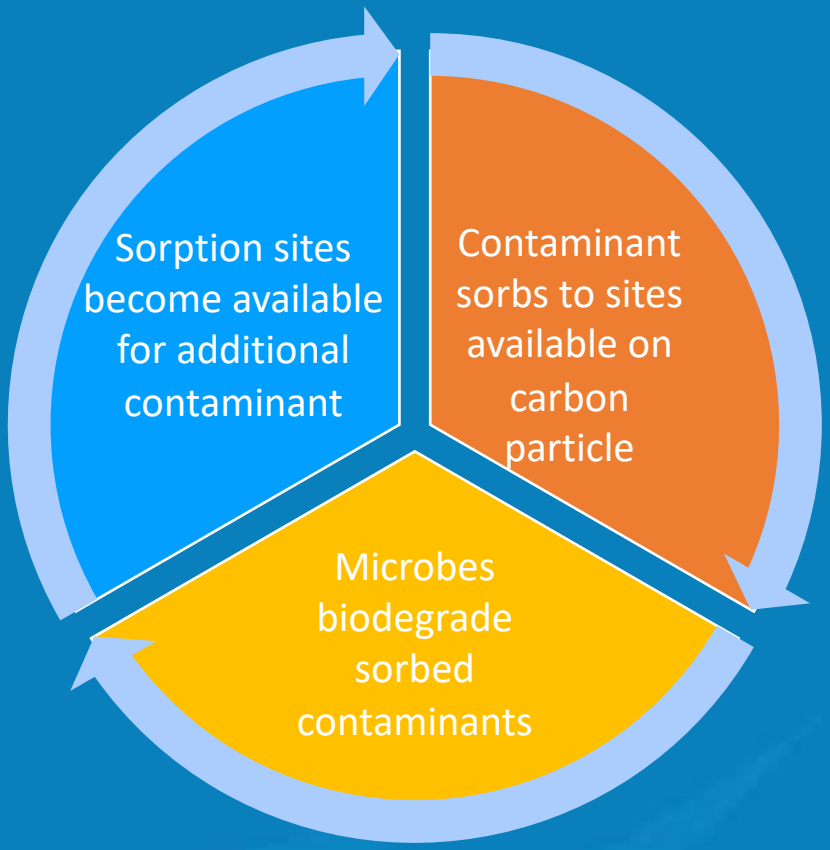
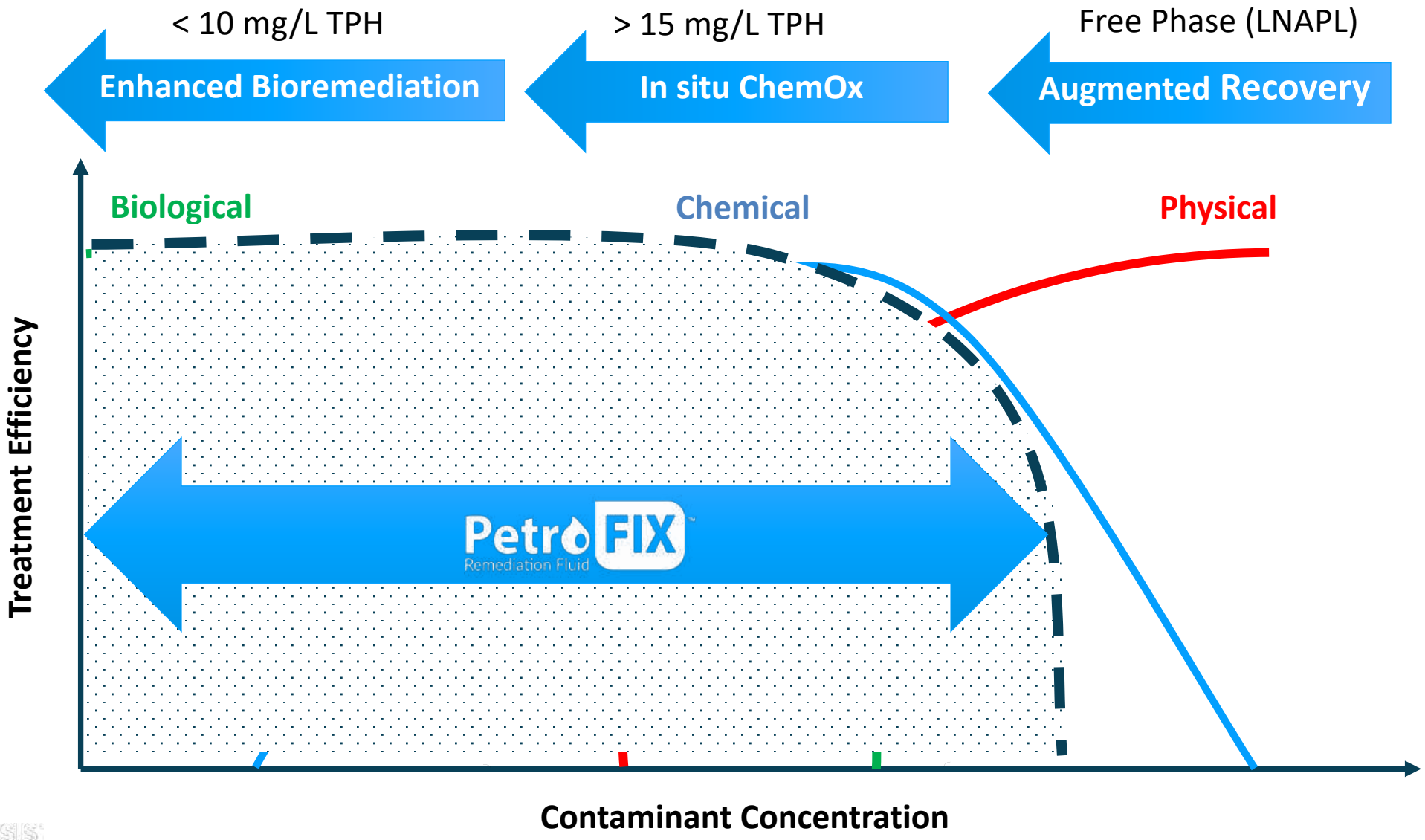
Mode of Action

Dual Function Liquid Activated Carbon Amendment Consisting of:

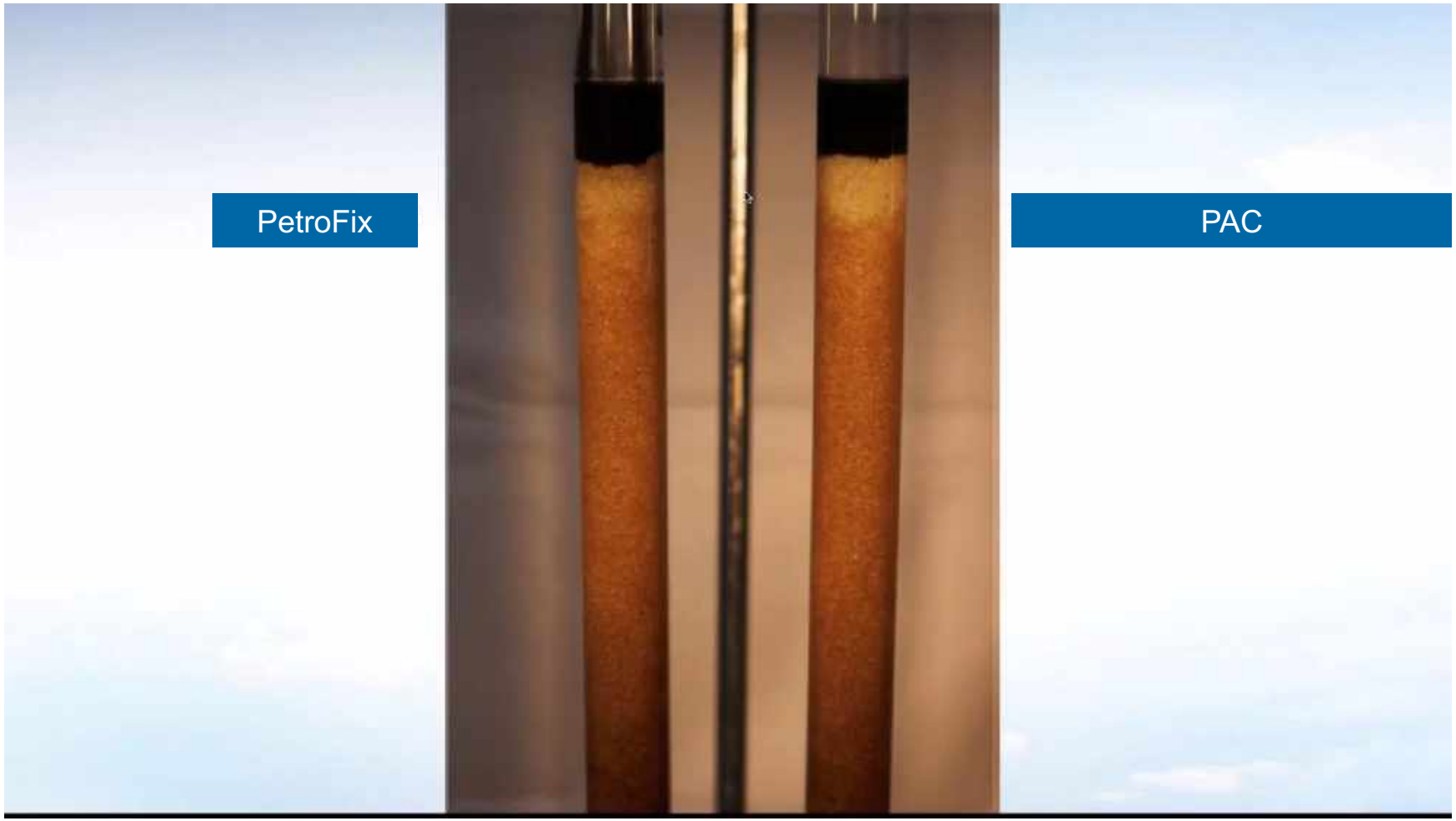
1. 1-2 µm micron-sized activated carbon particles and slow-release sulphate electron acceptor
2. Nitrate and sulfate electron acceptor mix
3. Carbon adsorption life extended as stimulated or natural biodegradation progresses



Treatment Range for PetroFix



PetroFix is Designed to Easily Inject Into an Aquifer

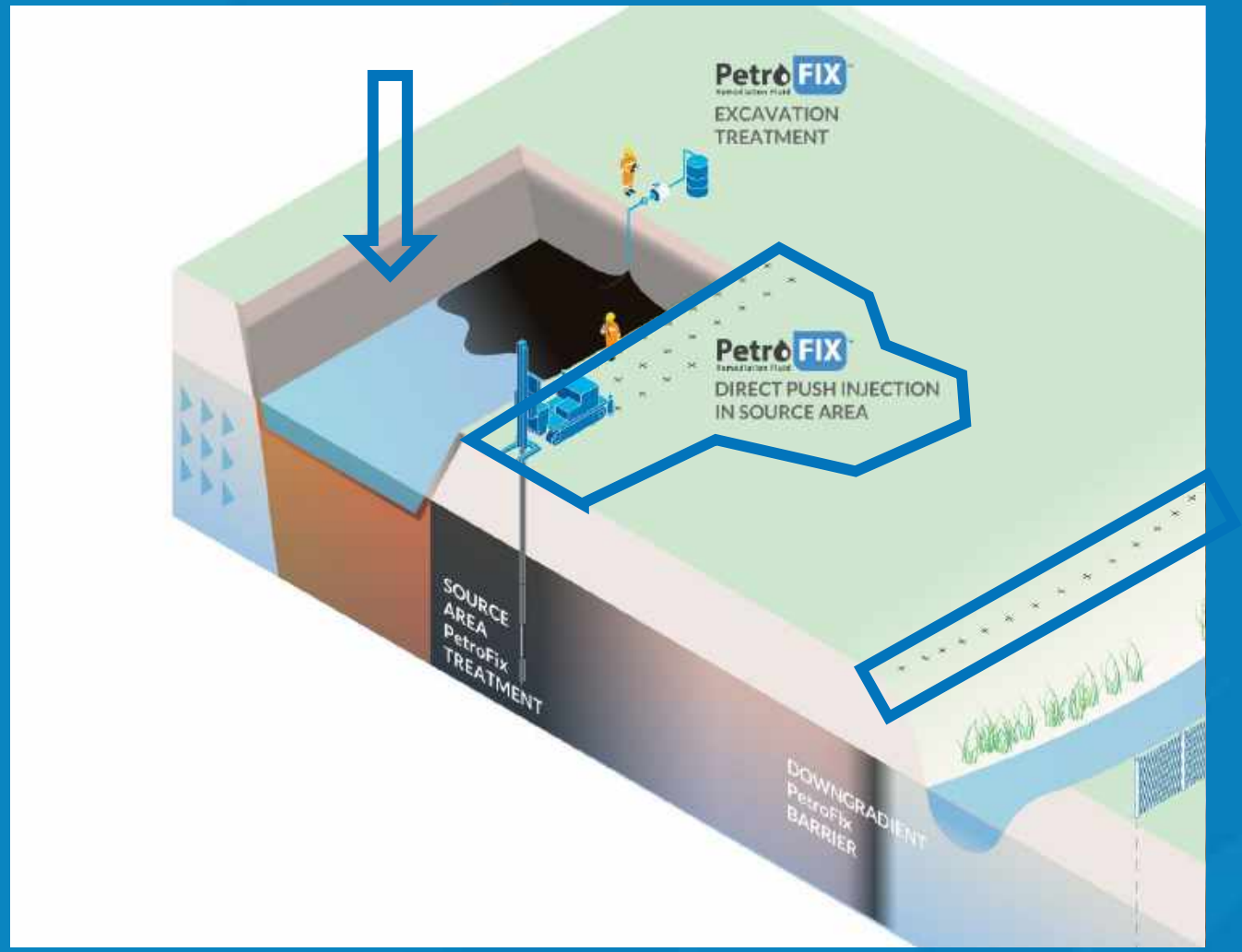


Typical Application Scenarios – Applies to In Situ Spill Response and Typical Remediation Sites

- **Spray or Mix PetroFix in conjunction with emergency or remedial excavation of source soils**
- **PetroFix grid around point of loss post recovery to halt migration of contamination, or grid injection to treat existing groundwater plume**
- **PetroFix Barrier to protect a property boundary or water body**

Benefits

- ✓ Remediation of plume
- ✓ Protection of sensitive receptors
- ✓ Controlling plume migration
- ✓ Passive long-term treatment



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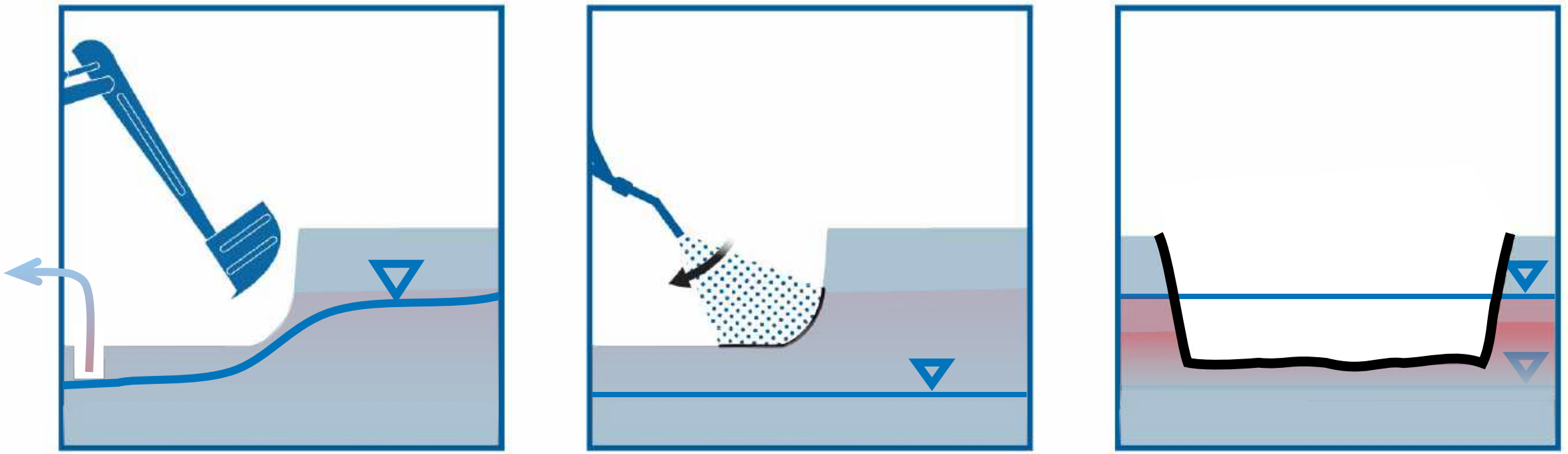
Topical PetroFix Application to excavations

- Topical application of PetroFix® onto the excavation base and sides
- Prevent contamination of the granular backfill
- Stops the infiltration and spread of contaminated groundwater in the pipe-bedding.

Preventing recontamination



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Preventative, Risk Mitigation Tool

Problems

Leaks cause liability transfer issues when negotiating leases.

Risk of diesel/oil entering groundwater and crossing site boundaries.

Clean-up cost using traditional spill response techniques is challenging if the site is commercially active

PetroFix instantly reduces the risk and spread of pollution, avoiding environmental liability.

Solutions

Liquid form means easy application by spraying or pouring into tank bedding.

Non-hazardous and compatible with all underground infrastructure.

Can replace the water that would be added to achieve the tank bedding gravel's compaction levels.

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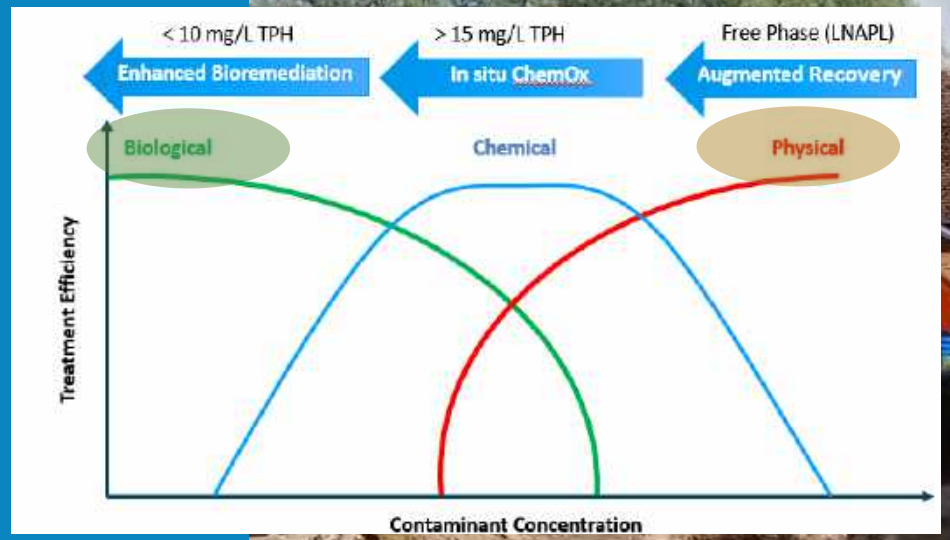
Tank basin pre and post treatment

“Is PetroFix right for every site?”



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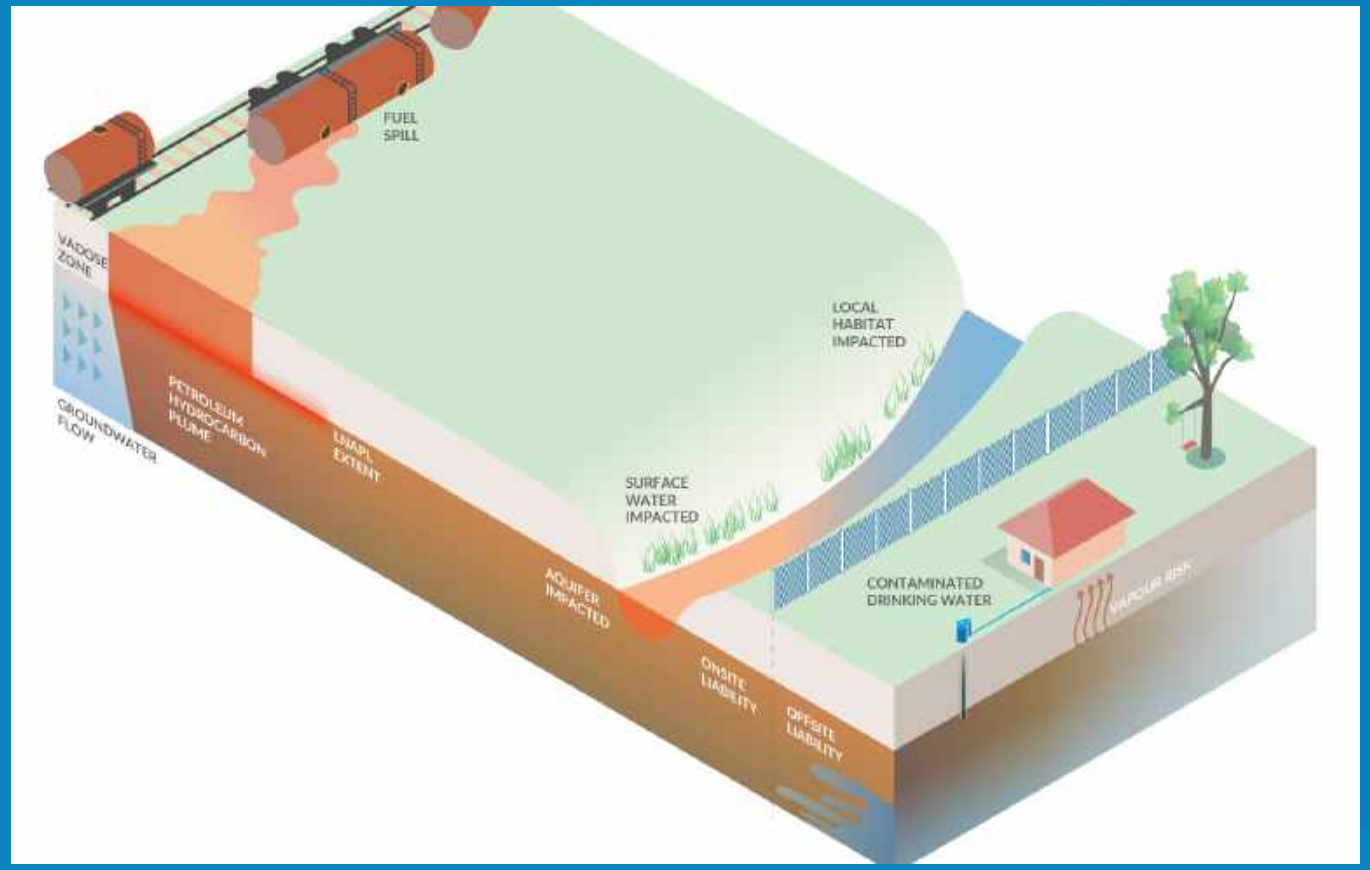
PETROFIX APPLIED INTO TRENCH FOLLOWING TRUCK ROLL-OVER

CASE STUDY:
PetroFix Used For *In Situ* Emergency Response Scenario to Reduce BTEX to ND

Summary

- **Approach:** Spray and Mix Application
- **Type:** Tanker Truck Roll-Over into Ditch
- **Goal:** Remediate and Reconstruct Irrigation Trench
- **Specifics:** *In Situ* Emergence Response for Rapid Remediation

Background



- A semi-truck hauling gasoline and diesel overturned into a dry irrigation ditch in MT.
- Diesel tanks ruptured and released into the ditch, impacting the shallow water table with BTEX and other constituents
- 77 meter of Irrigation ditch impacted with #2 diesel and red-dyed diesel and ditch had hydraulic connections to Yellowstone River
- 230 meter^2 excavation and 800 tons of impacted soils removed.

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In Situ Emergency Response – Truck Roll Over and Diesel Spill

- Irrigation ditch needed to be remediated and reconstructed within 45 days due to irrigation and spring planting season
- 1,090 kg PetroFix then sprayed on side walls and four feet of soils to prevent movement of dissolved contamination.
- Irrigation ditch reconstructed after PetroFix application
- BTEX, TPH and TEH at 8 sampling points reduced below screening levels x 2 events
- NO FURTHER ACTION ACHIEVED - Irrigation ditch opened again.

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Innovative Combined Solution to Speed BTEX and TPH-G Remediation at Former Gas Station Site

CASE STUDY:
Innovative Combined Solution to Speed BTEX and TPH-G Remediation at Former Gas Station Site

Former Gasoline Station: Fort Dodge, IA

- Hard clay soils resulted in little attempt to treat past releases – silty and clayey
- 186 m^2. excavation – water would infiltrate slowly
- Property transaction required remediation
- Benzene max was 16,200 µg/L and ranged down to 1,290 µg/L
- Closure goal was 290 µg/L

Excavation polish with PetroFix

Former Gasoline Station: Fort Dodge, IA

- **Combined Remedy included:**
  - Excavating contaminated soils to ~.5 m bws
  - Original plan was to use ORC Advanced pellets applied to promote biodegradation of PHCs
  - PetroFix released –
    - 1,635 kg PetroFix spray-applied to walls and floor of excavation pit
    - 500 kg ORC-A pellets to help with DO
  - Back-filled with clean soil
- **Closure Achieved**

Excavation polish with PetroFix

Key Take Aways

- **PetroFix can enhance excavations by providing sorption sites and nutrients to mitigate risk of recontamination and stimulate bioremediation.**
- **The sorptive capacity of PetroFix reduces the extent of impact during emergency response situations and can be quickly sprayed into open and active excavations.**
- **Pretreating areas where petroleum spills are likely could reduce the amount of time and cost necessary to remediate in at the time of an incident**

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