REGENESIS®

Andrew Kiggen
Southeast District Manager

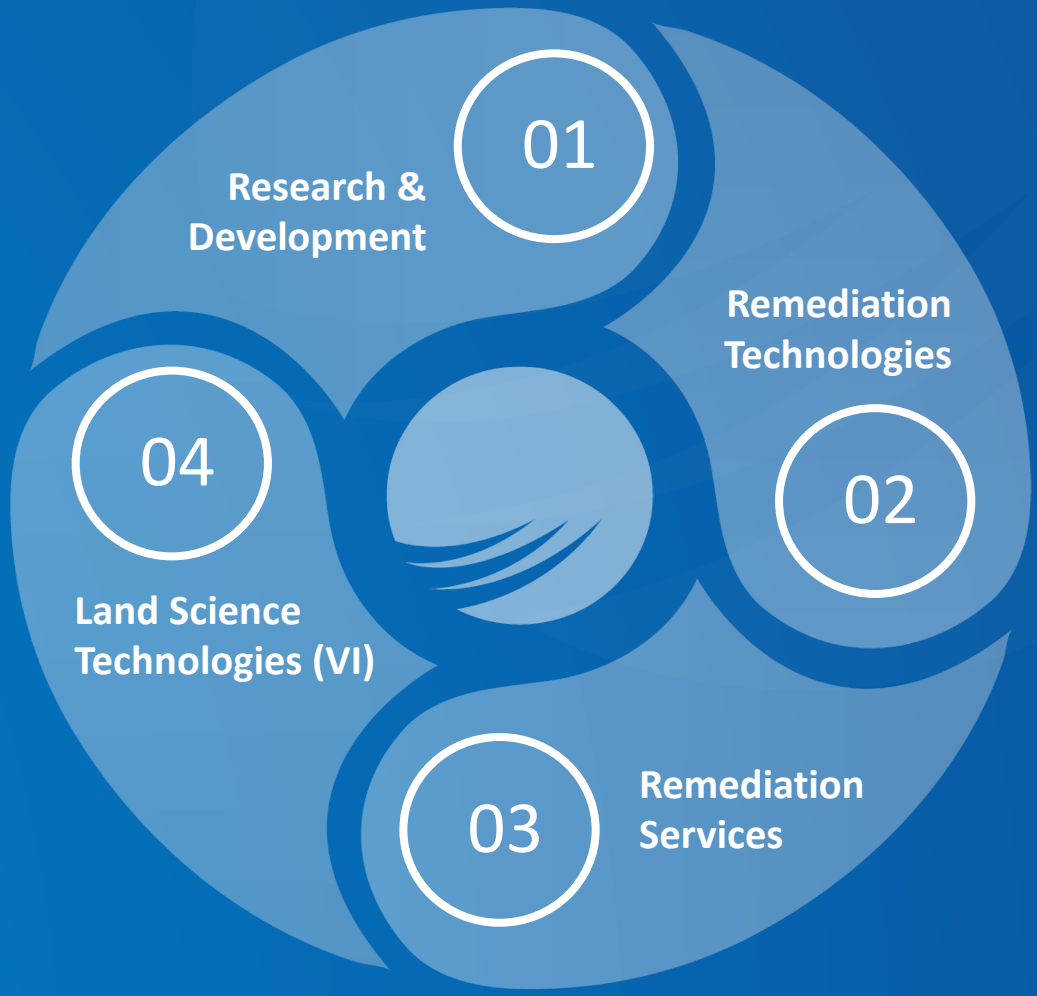
About REGENESIS:

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

Technologies Offered:

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

28+ Years in Business



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Outline

- Site History
  - Geologic Setting
- Remediation Objectives and Challenges
- Project Implementation
- Current Status

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Site History

- **1940:**
  - San Diego County: 300,000
- **1940:**
  - Aerospace Facility Opens
- **1941:**
  - 10,000 Employees

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Site History

C. 1982

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Site History

- **2018**
  - San Diego County: 3,300,000
  - Facility Closes
- **$1 Billion+ Bayfront Redevelopment**
  - Hotel
  - Convention Center
  - Recreational Facilities

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Geology

- **Sweetwater Alluvium**
  - Unconsolidated stream deposits
    - Sandy silt, sand, cobbles
  - Groundwater:
    - 80-110 ft below ground surface
    - Flowing towards Bay
- **Impacted by chlorinated solvents from industrial activity**
  - Up to 10 mg/L TCE
- **High Sulfates ~ 400 mg/L**

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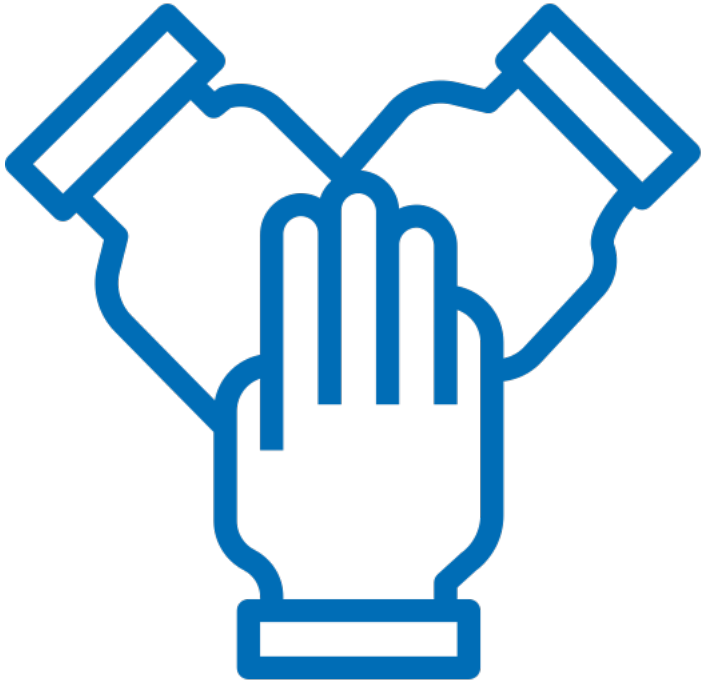
Multi-Party Cooperation

- **Regulator:**
  - Regional Water Quality Control Board
- **Consultants:**
  - 3 International Consultants
- **Driller:**
  - Local driller for tough and deep drilling conditions
- **Applicator:**
  - Local applicator (mixing and injection)
- **Product Vendors:**
  - REGENESIS, Others



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Remedial Challenges

- Large Footprint
- Deep Groundwater
- Development Timeframe
- High Sulfates

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Remedial Choices

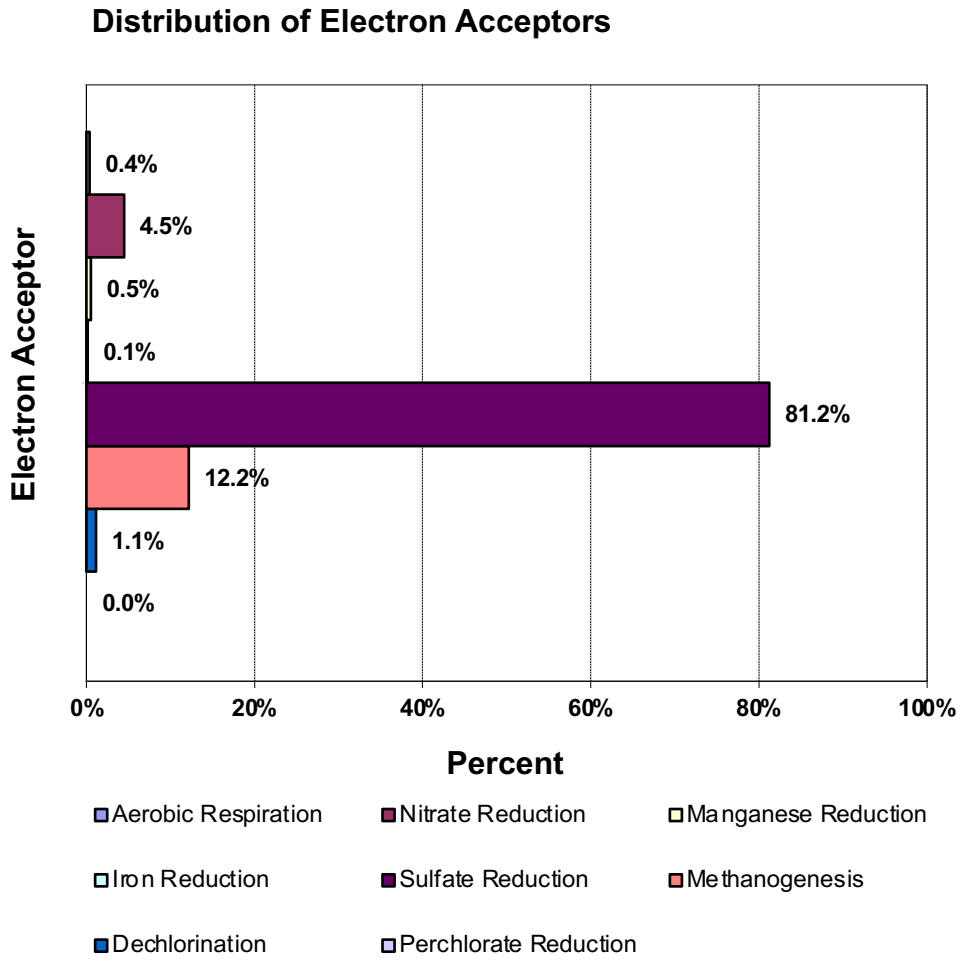
Consultant Recommendations:

- Enhanced bioremediation or
- In Situ Chemical Reduction (ISCR) enhanced bioremediation – **Sulfidated MicroZVI**

Key Consideration:

High sulfate concentrations limit effectiveness of biological amendments

- >80% used for sulfate reduction vs 1% used for dechlorination
- Bioremediation alone: greater volumes, time
- Cost analysis justifies using ISCR enhanced bioremediation



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S-MicroZVI Properties

Rapid Reactivity with TCE

- ~30-40 x that of bare iron
- TCE → cDCE yield < ~10%

Slow Reactivity with Water

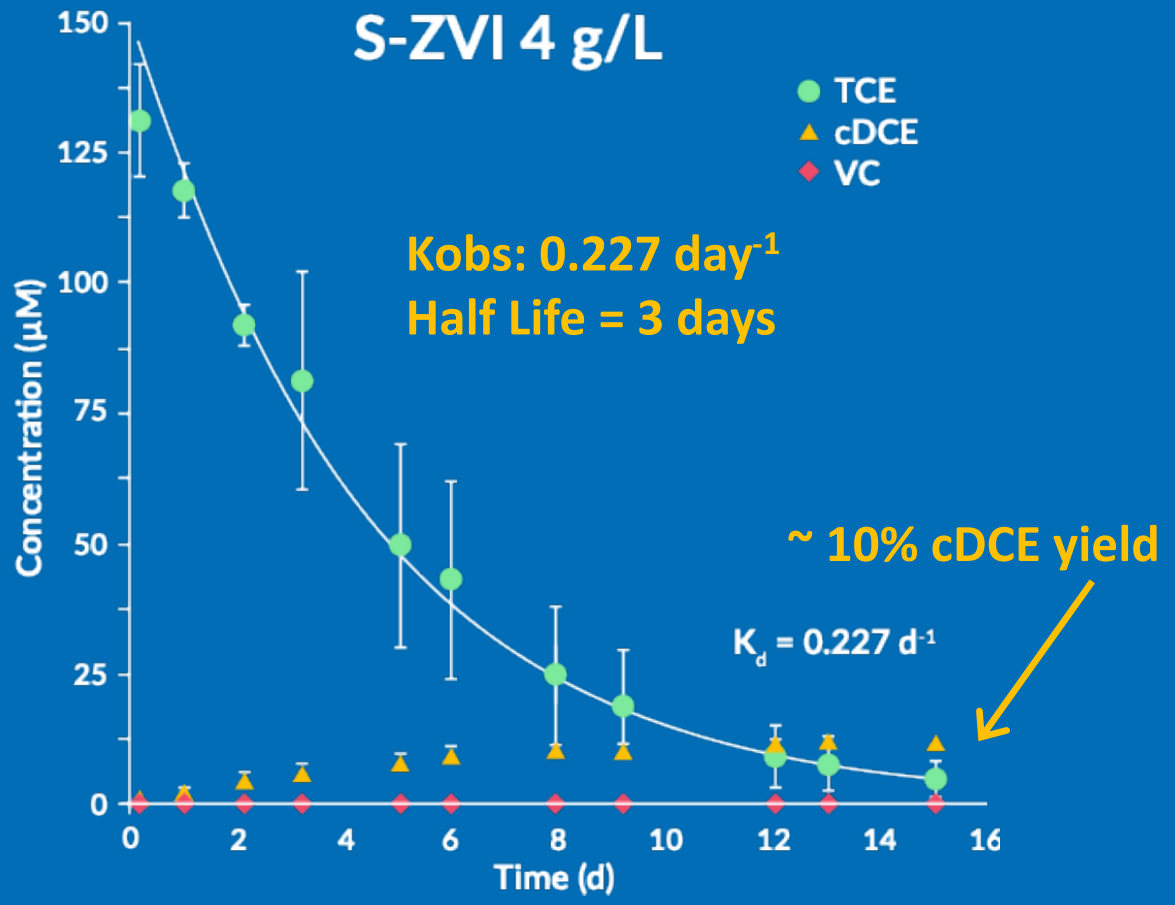
- Sulfidation inhibits hydrolysis reactions: Extends persistence

Negligible Sulfate Reduction

- Extends persistence

Small Particle Size

- Greater than 10 ft ROI at low pressure



Rapid Reaction Kinetics

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Two Mobilizations:

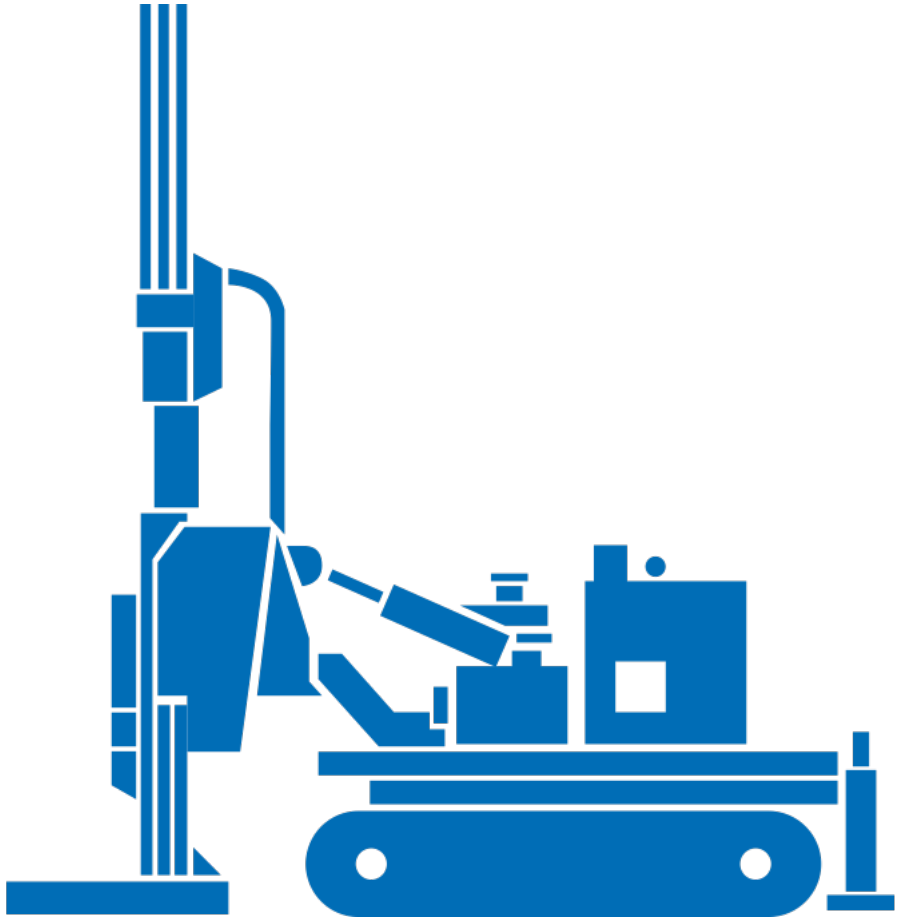
S-MicroZVI®
Sulfidated Zero-Valent Iron

Phase I & II : 2020-2022

- 266 Injection Points
- 107 days on site
- 254,000 pounds S-MicroZVI + Bio Amendment

Project Totals

- 518 Injection Points
- 185 days on site
- >1,000,000 gallons of remedial injection



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Four Barriers

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Site Map

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Implementation

Mixing Trailer and Direct Push Rig

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Implementation

Manifold Allows Injection into Multiple Points

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Implementation

Tankers for Bio Amendment addition

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Implementation

Drums of S-MicroZVI

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Implementation

Dehalococcoides application

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Implementation

Injection Next to Construction Activities – Fall 2022

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Current Status

Current Status

Questions?

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