

Petroleum Remediation via In Situ Bio-Reactors

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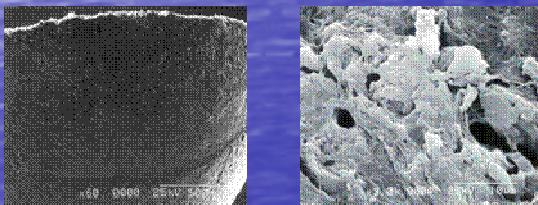
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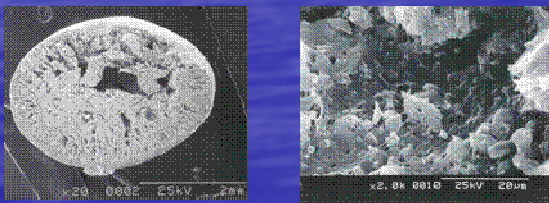
From Humble Beginnings.....



Exterior of Bio-Sep



Interior of Bio-Sep



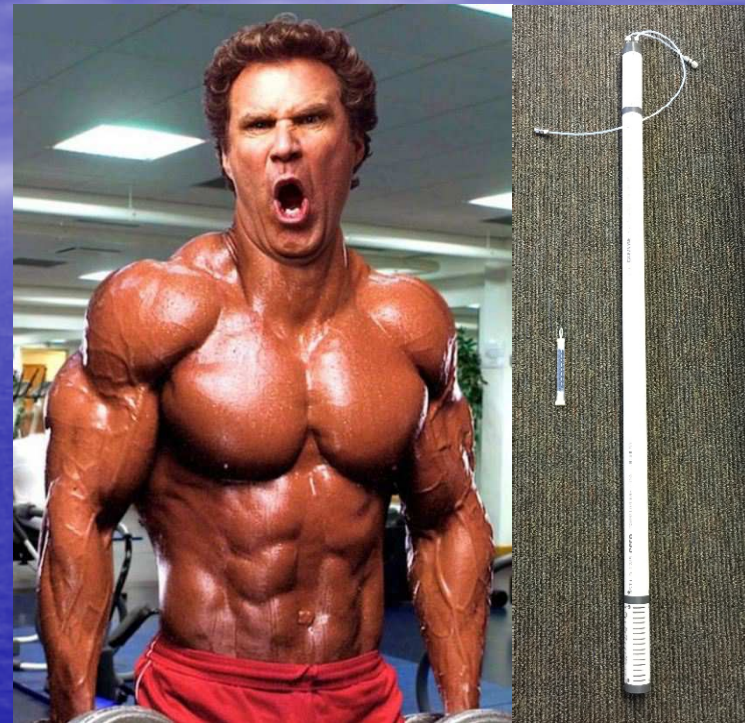
The Bio-Trap® Sampler:

- Rapid formations of indigenous bacteria bio-films
- Multitude of microbial populations identification and quantification analyzes

The Bio-Trap...



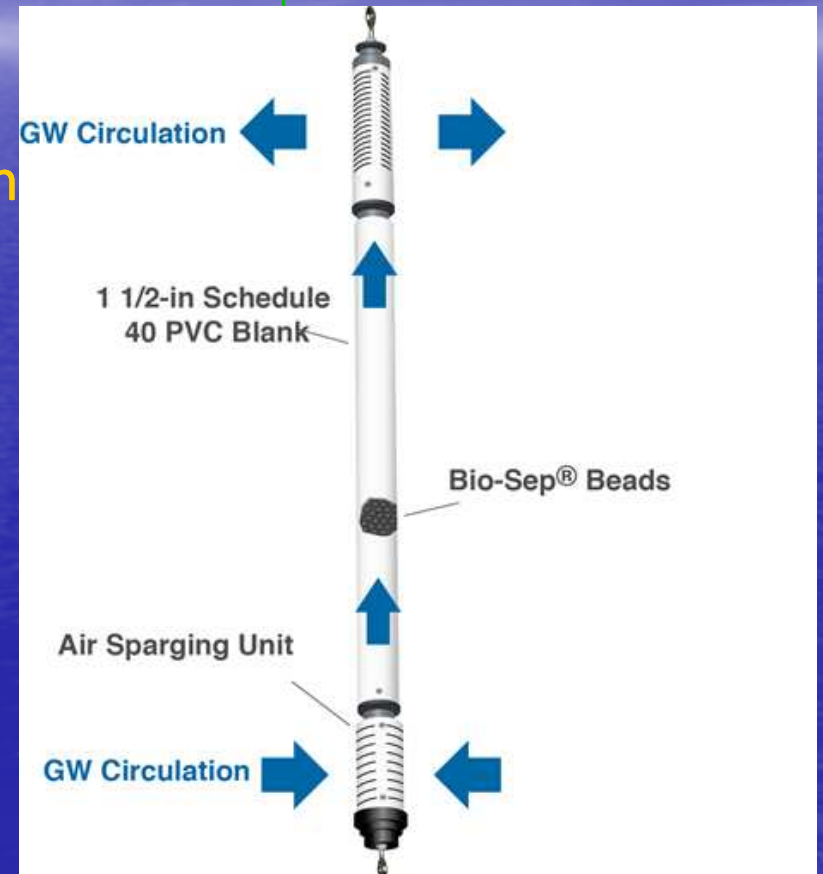
The Bio-Trap...



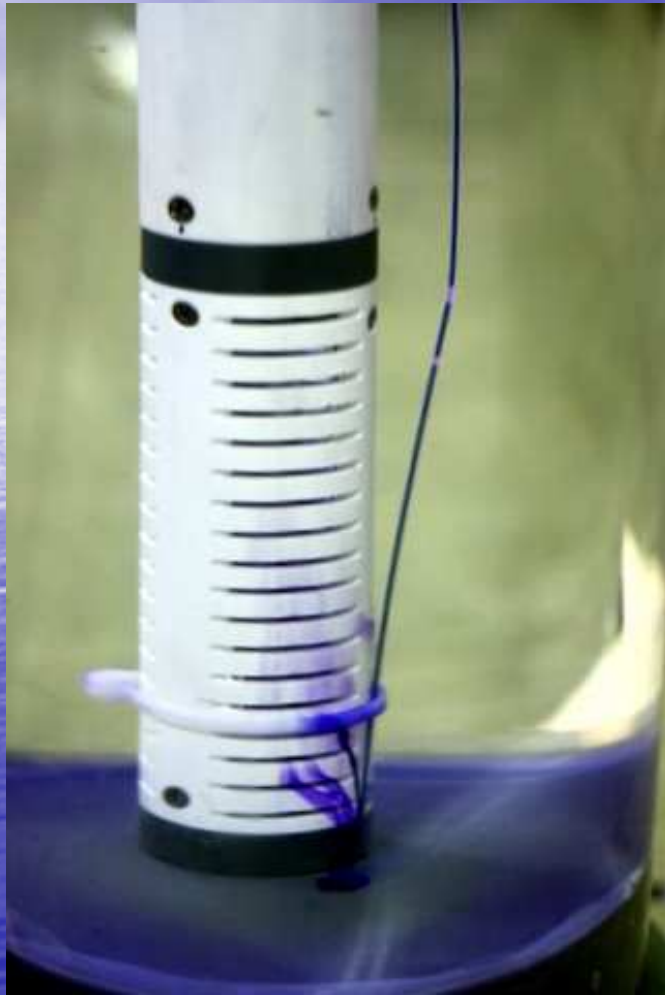
On Steroids

Operation of an Aerobic Bioreactor at Hydrocarbon Sites

- Bio-Sep beads, nutrient addition, and air sparging encourage microbial growth and reproduction
- Contaminated groundwater is treated as it moves through the column of Bio-Sep beads
- Water exiting the reactor carries hydrocarbon-degrading microbes into the aquifer



Aerobic Bioreactor Flow Pattern

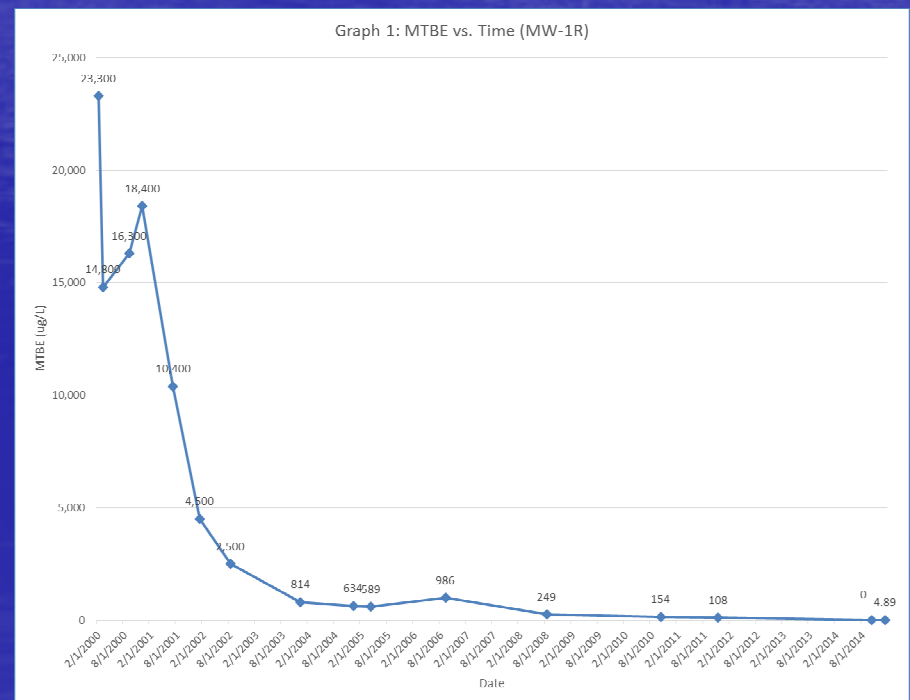
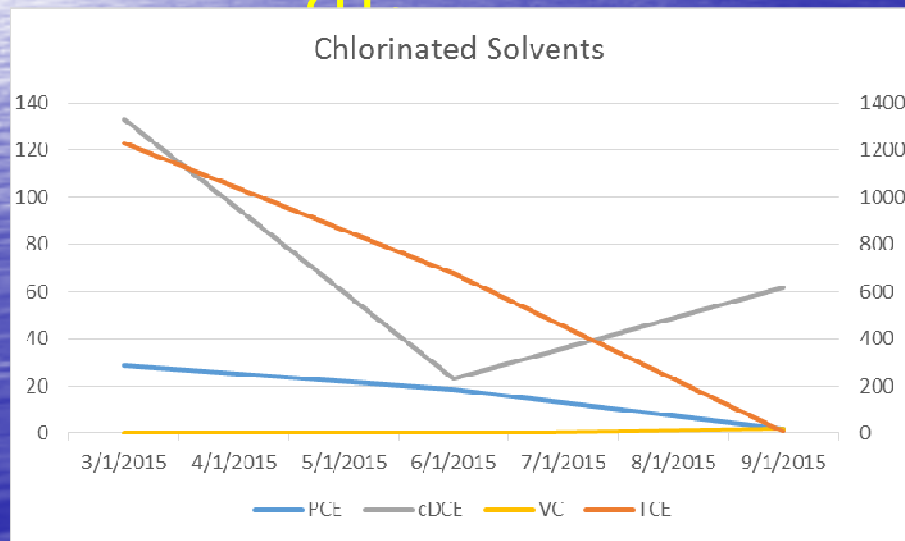


From MTBE to PCE



PCE et
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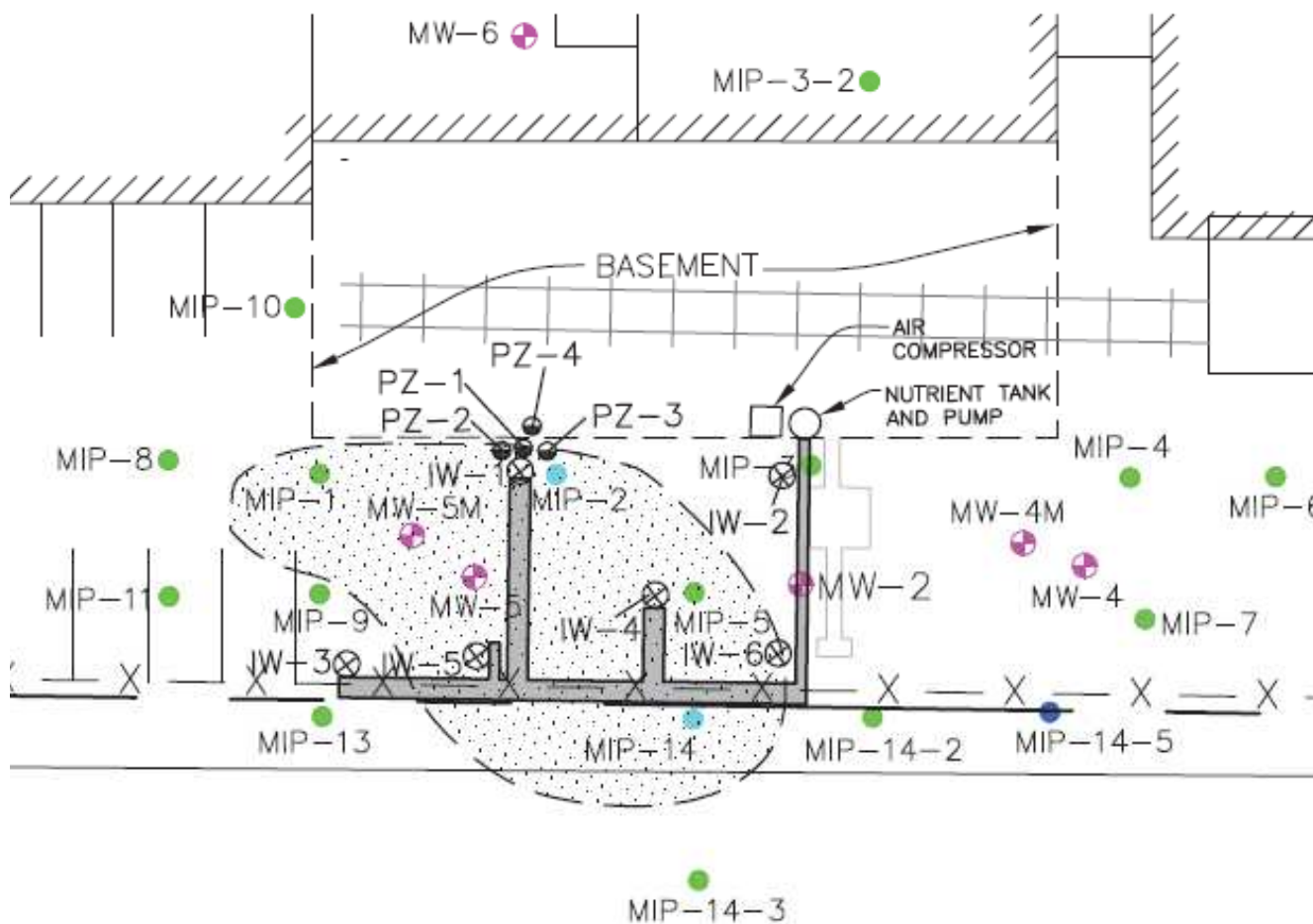
MTBE



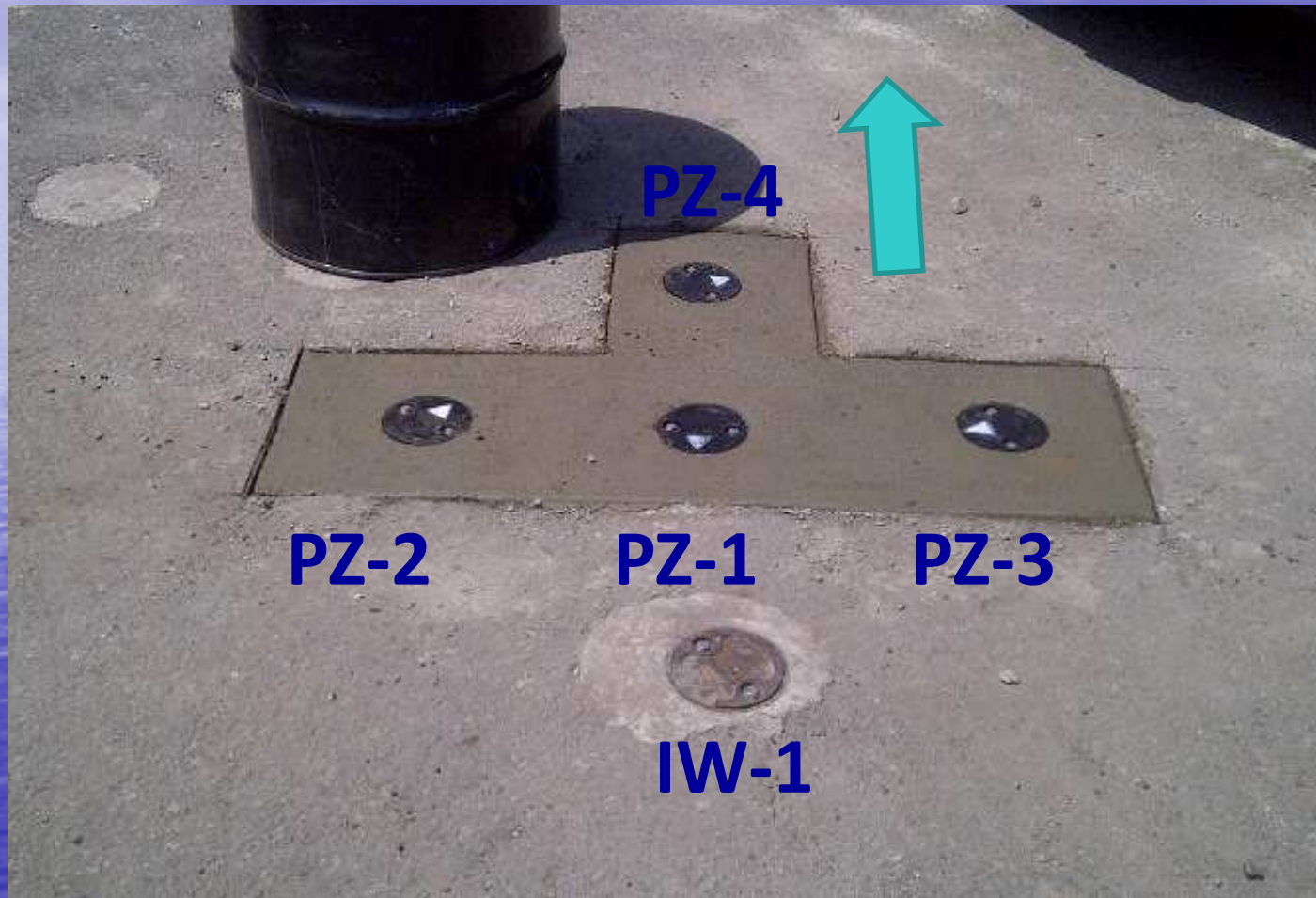
Case Study No. 1, Toluene

- Former Industrial site in northern New Jersey
- Toluene UST was removed in October 2001
- Previous remedial efforts failed to achieve goals
- Soil and groundwater contamination and free phase toluene product has historically been observed in the pilot study area
- Levels of toluene potentially inhibitory, up to 430,000 ug/L

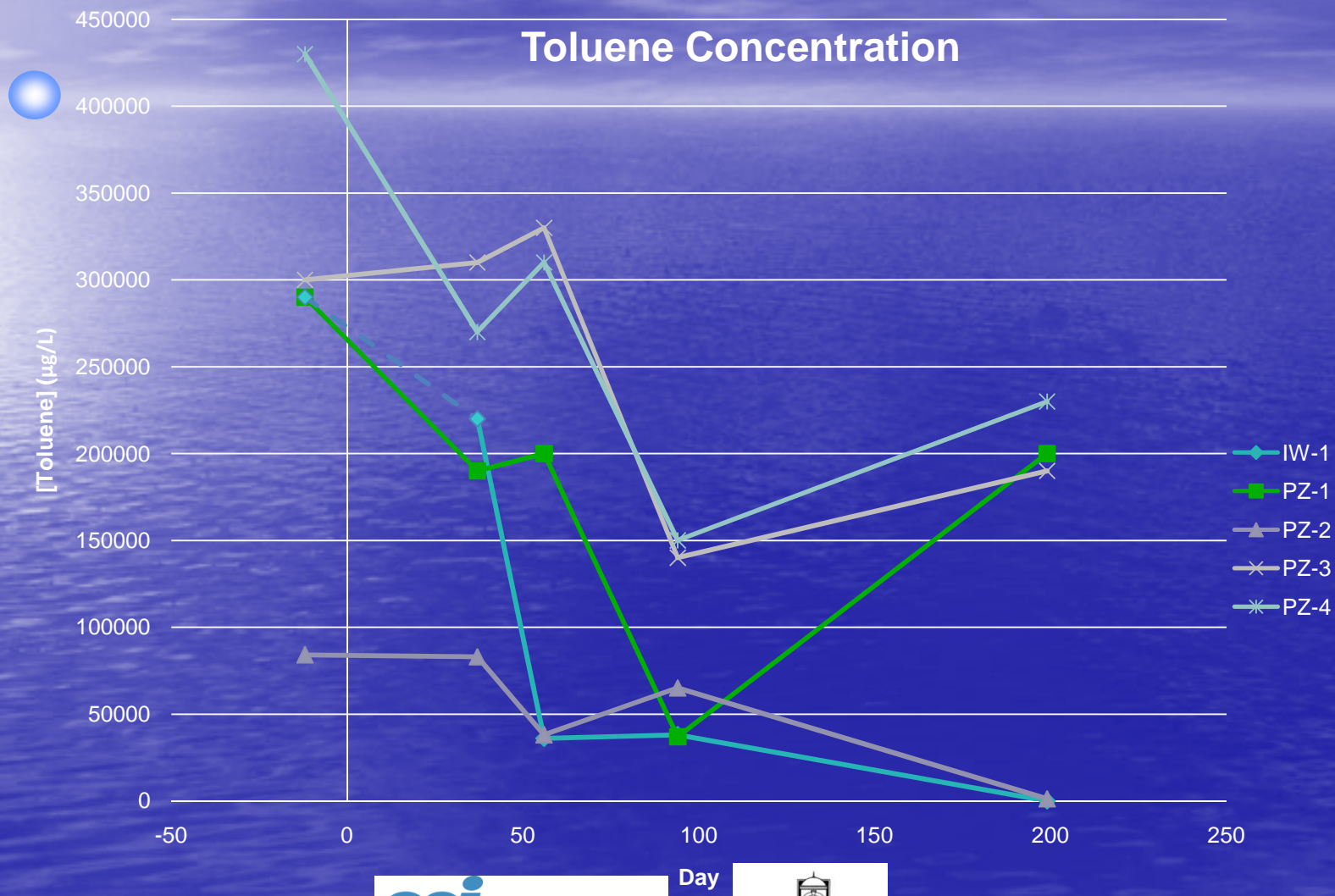
Aerobic Bioreactor, Test Site 1



Pilot Study Results - IW-1 and Piezometers

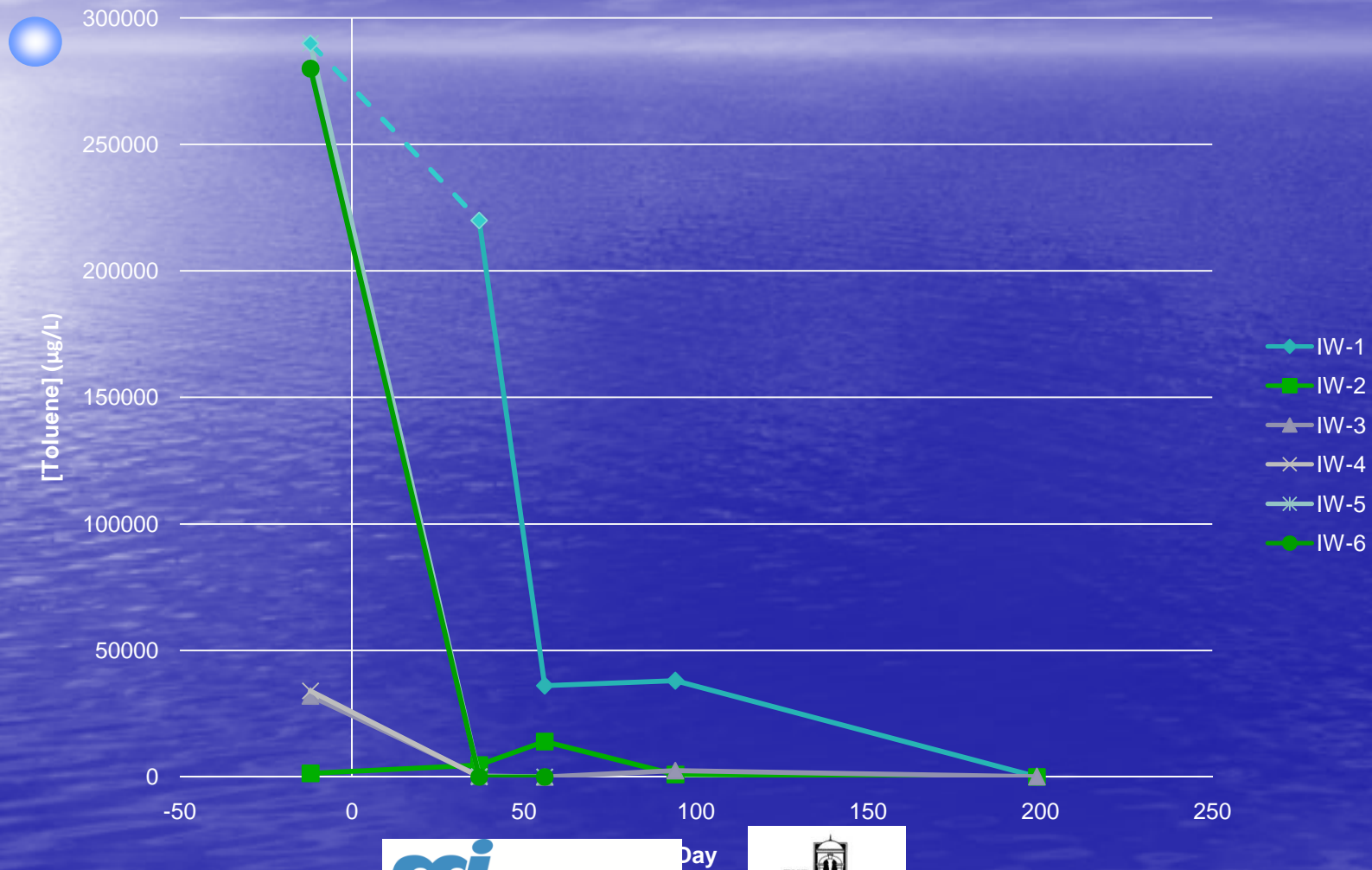


Pilot Study Results – IW-1 and Piezometers



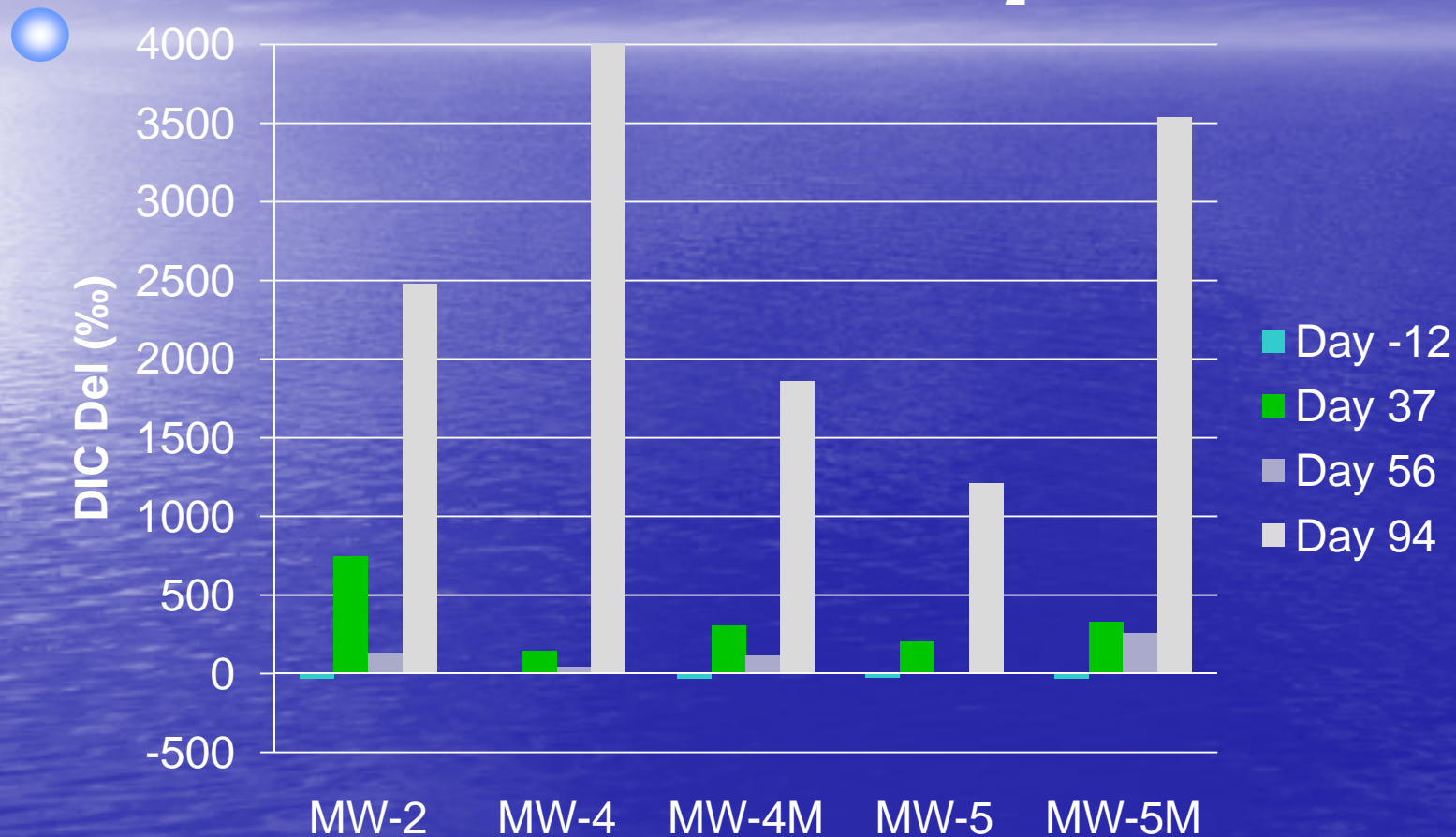
Pilot Study Results – ISBR Wells

Toluene Concentrations

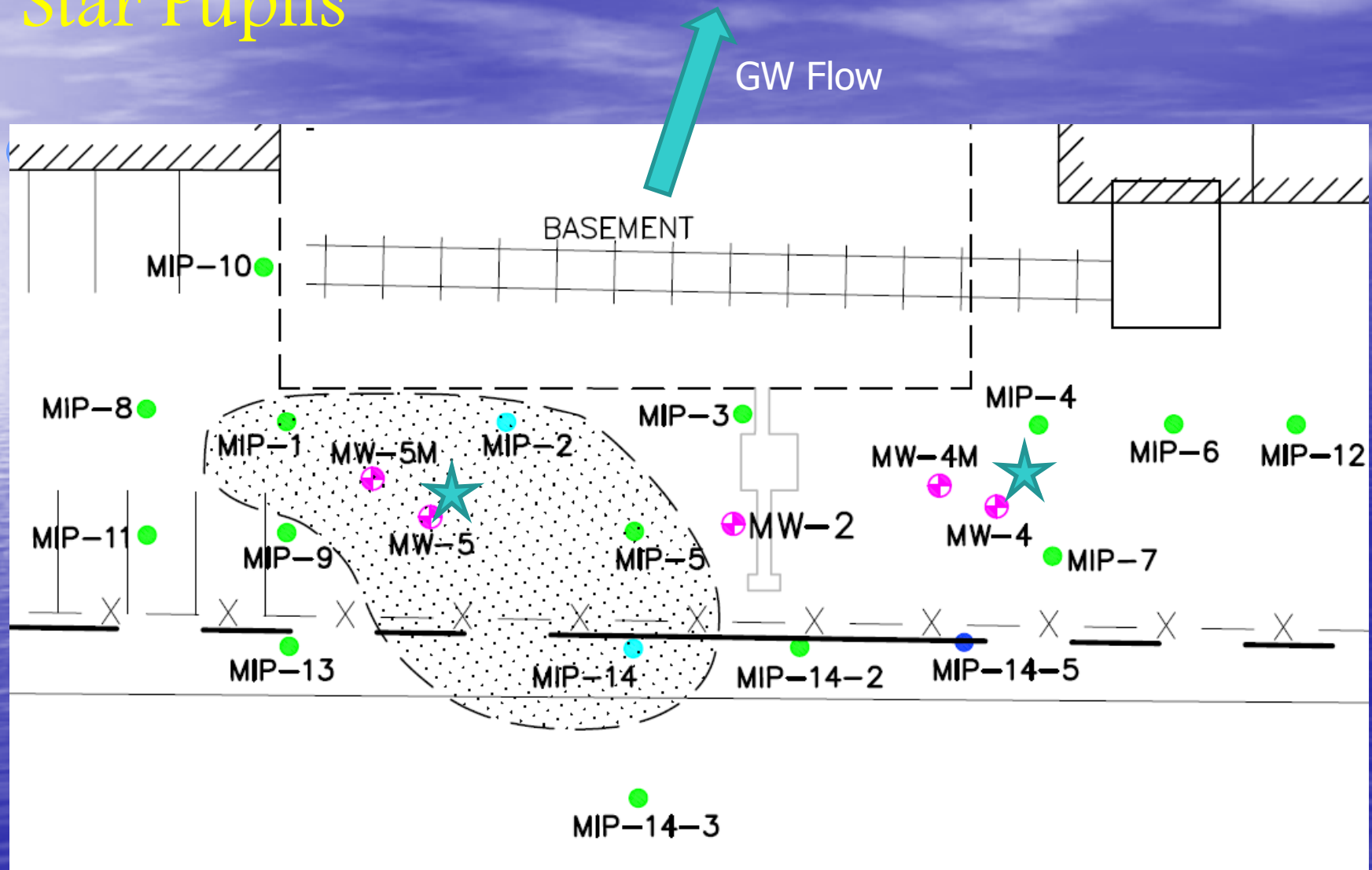


Pilot Study Results – Monitoring Well Results

^{13}C Utilized for CO_2



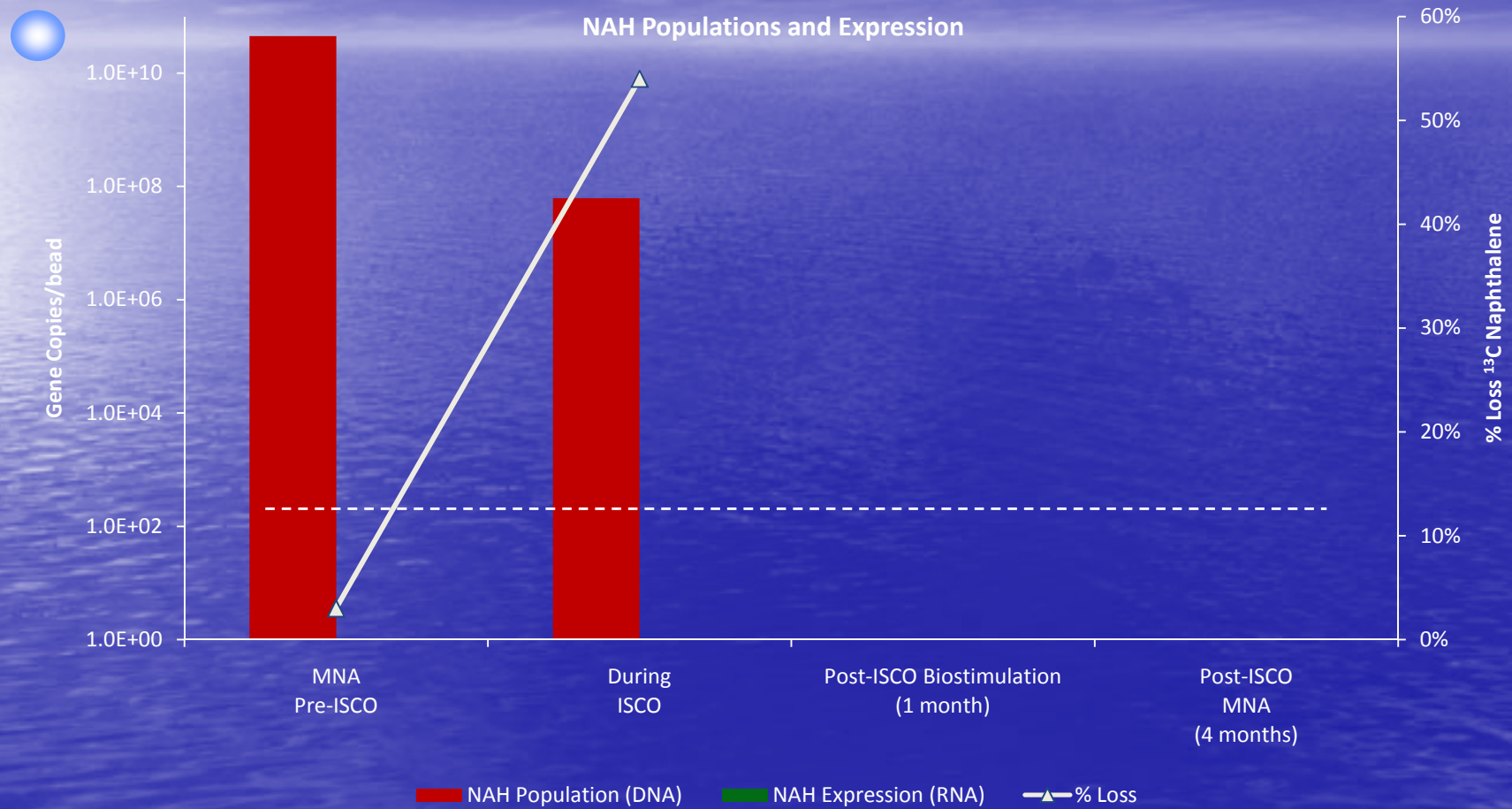
Star Pupils



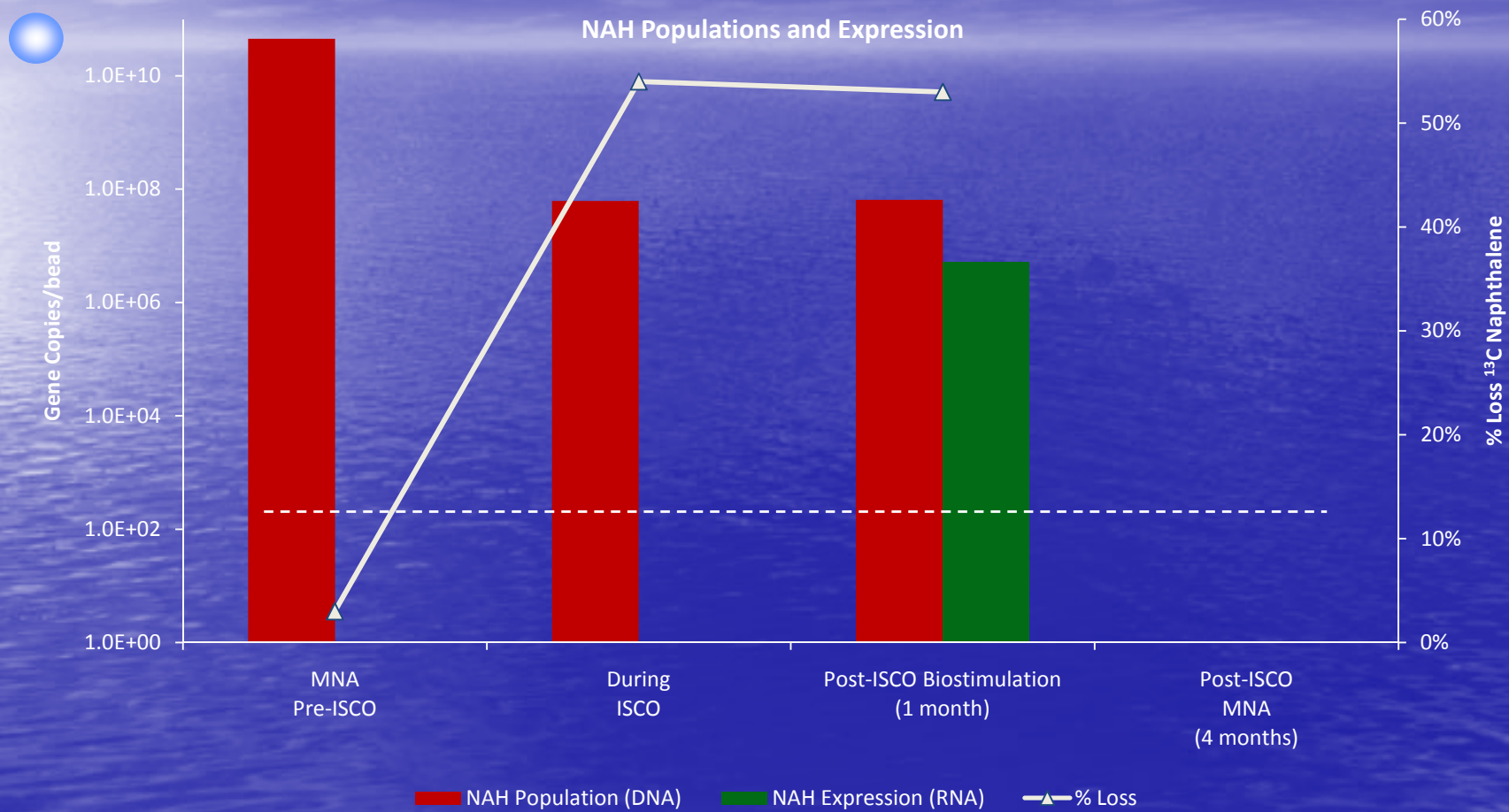
Case Study No. 2, Chemical Oxidation & Bio Reactors, Unusual Friends



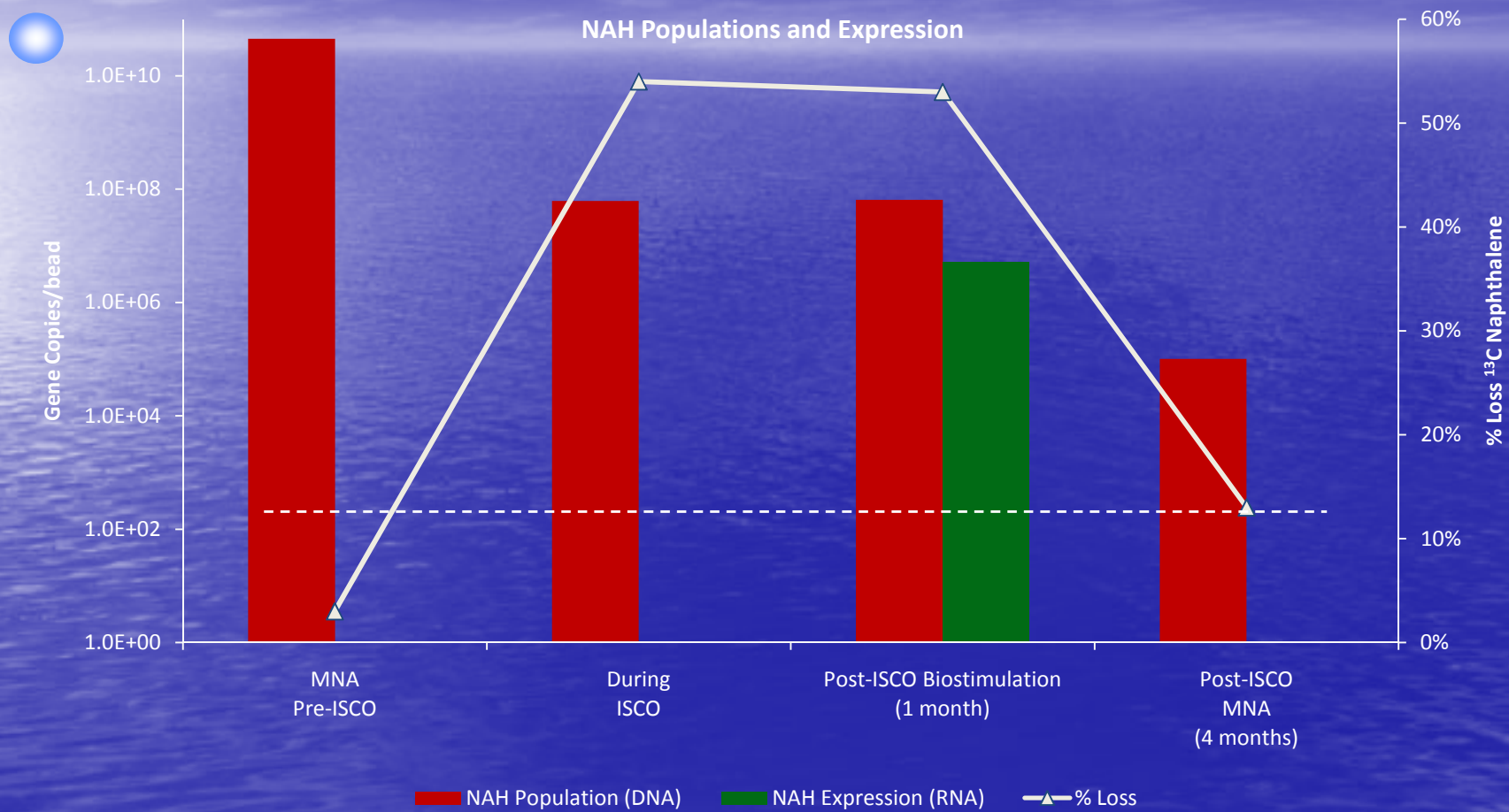
“The Fortuitous Accident”

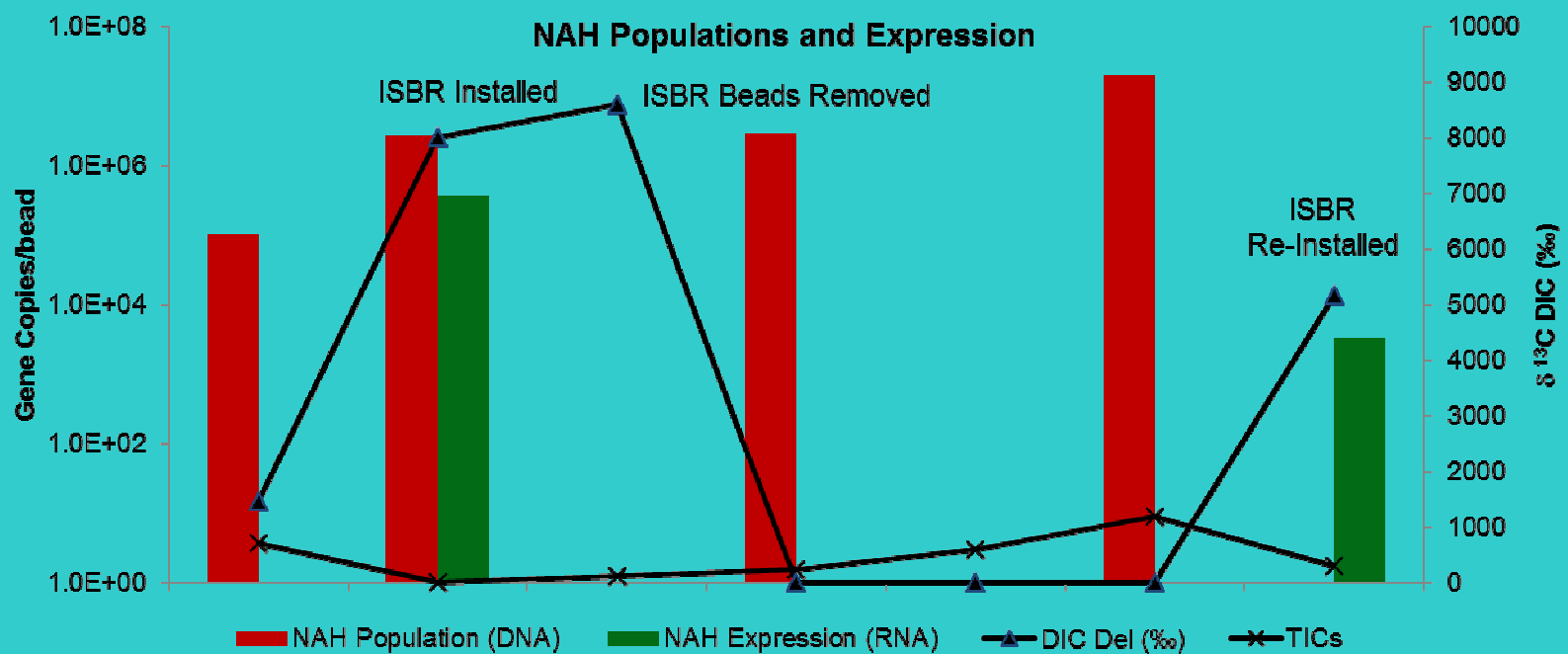


“The Fortuitous Accident”

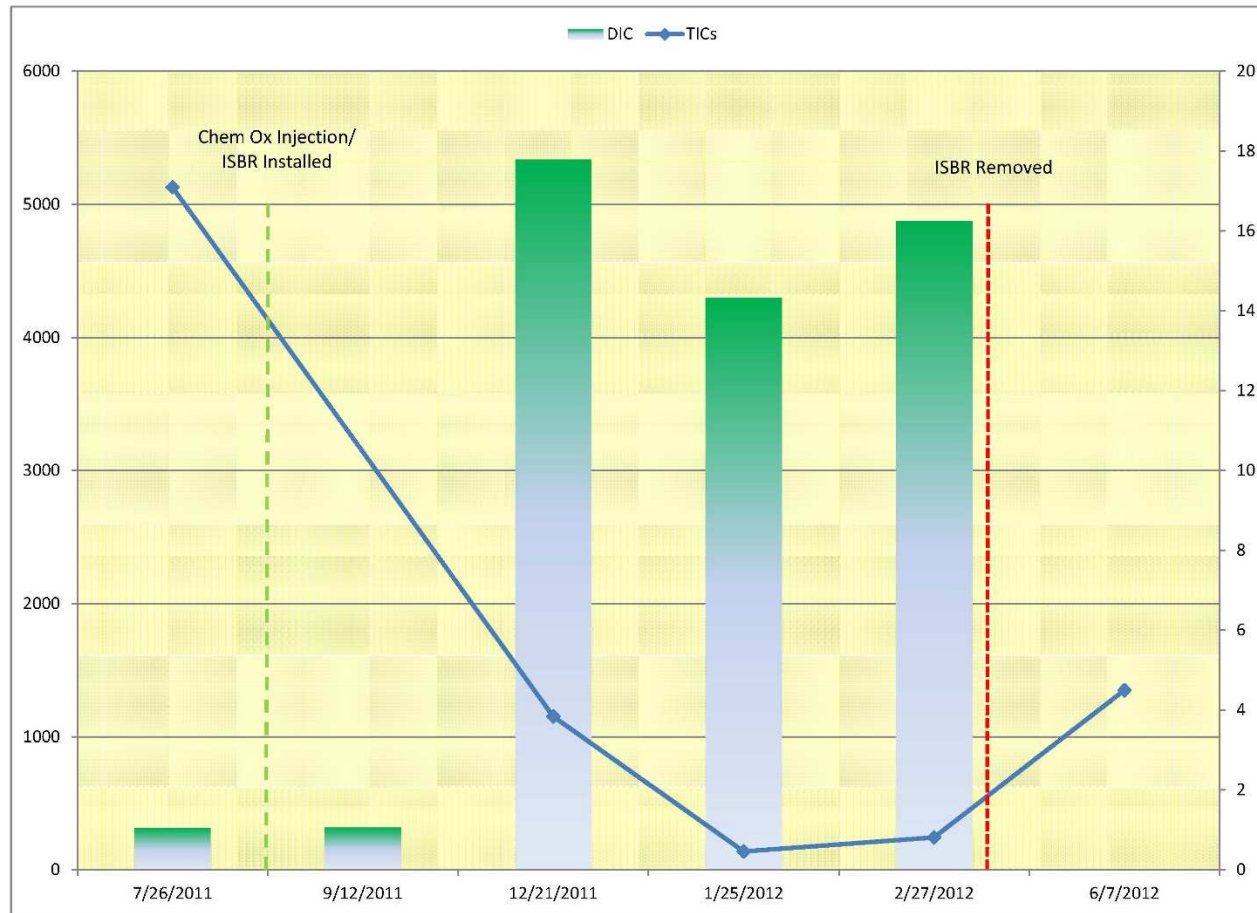


“The Fortuitous Accident”





Chem Ox and ISBRs



The combination of Chemical Oxidation & Bio-Remediation is....



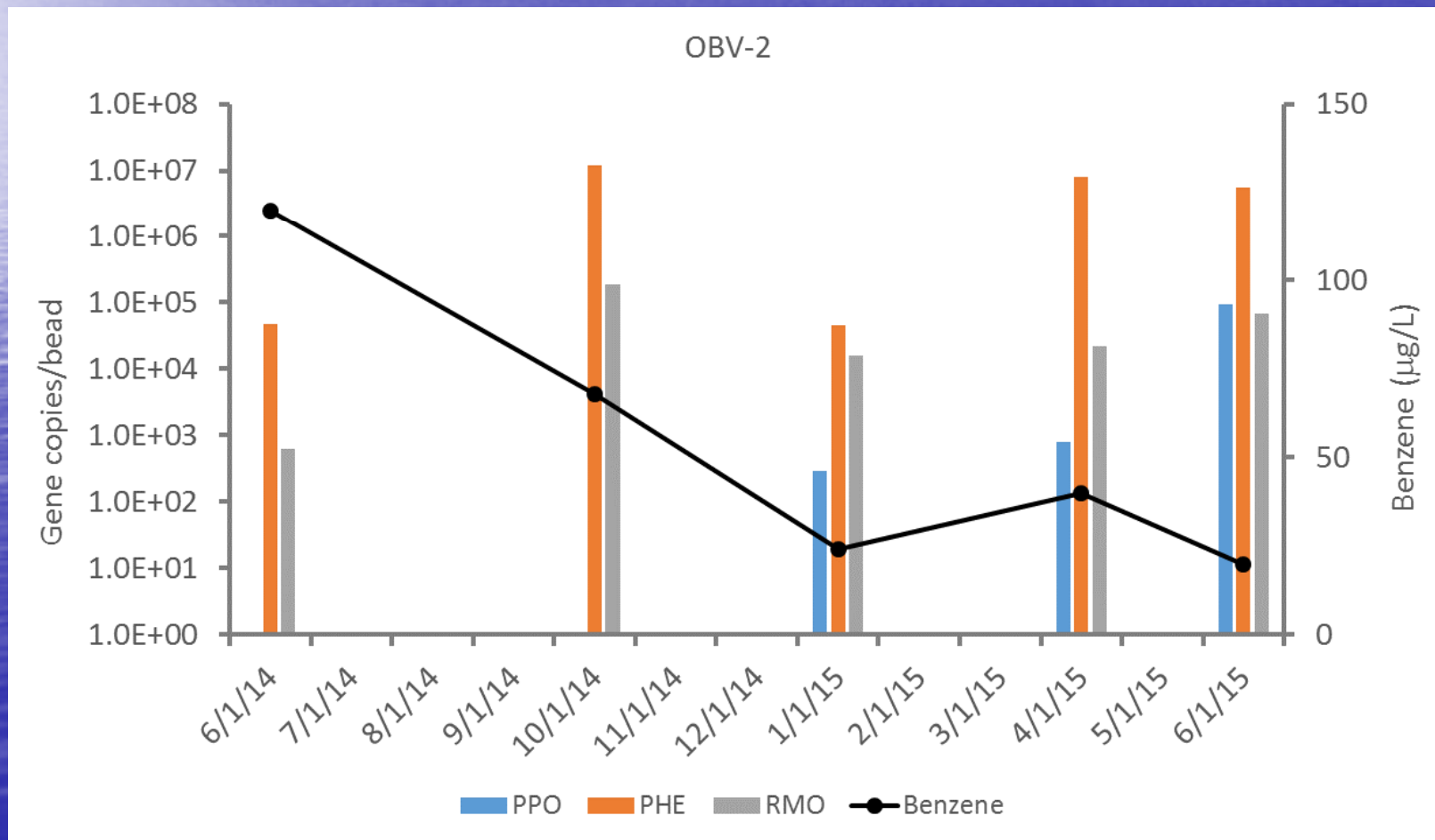
- Underutilized?
- Emerging?
- More efficient than expected.

Case Study No. 3, Benzene in a difficult environment

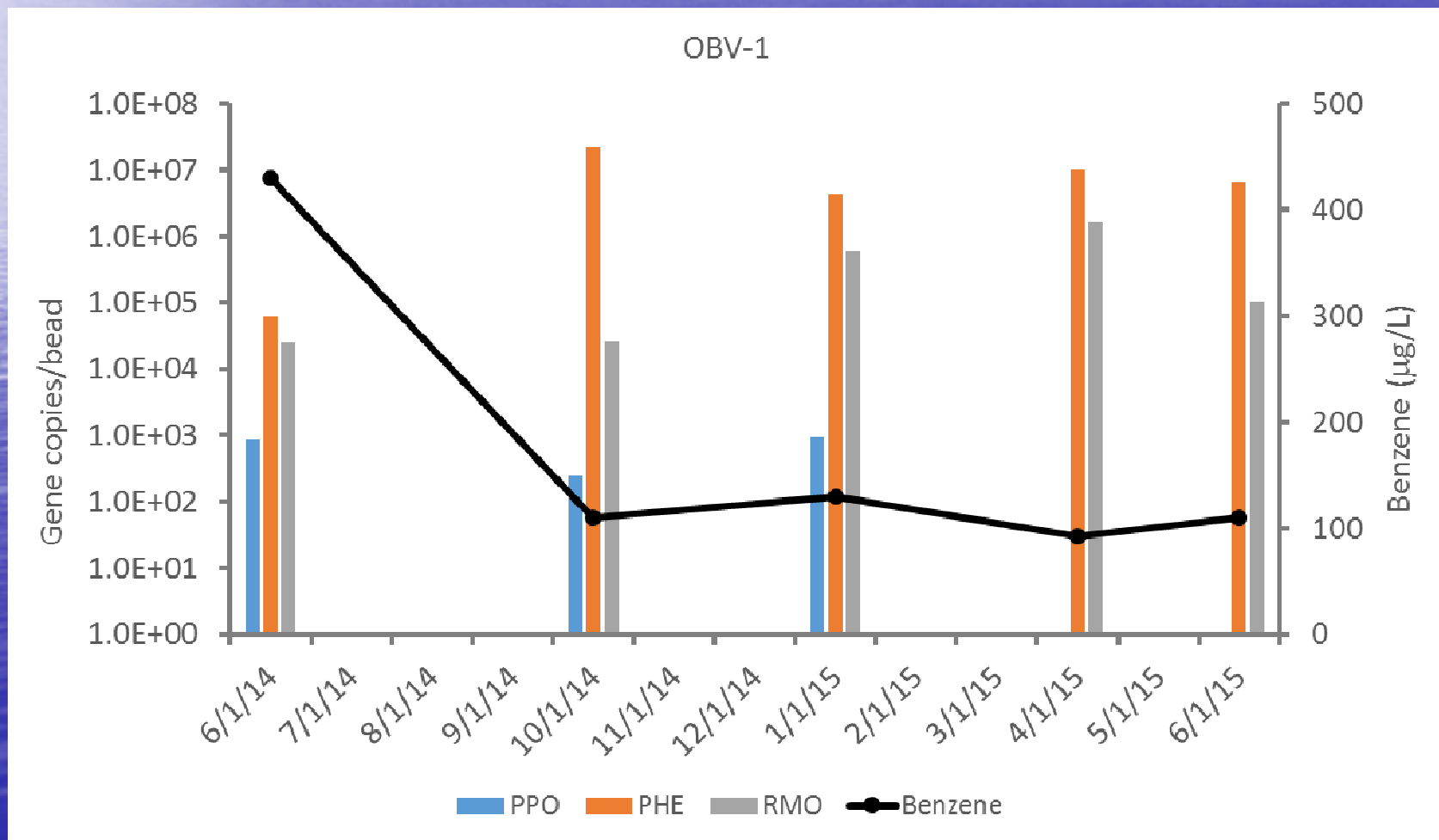
- Just Another former Industrial site in northern New Jersey
- Mid-Level benzene levels in groundwater (~ 500 ug/l)
- Meadow mat environment



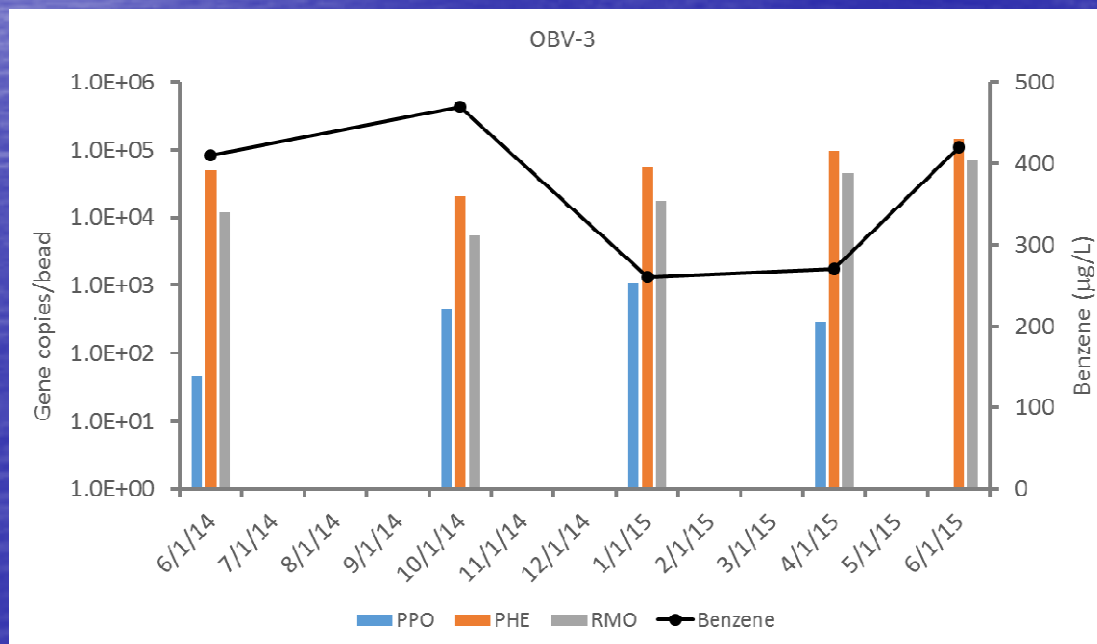
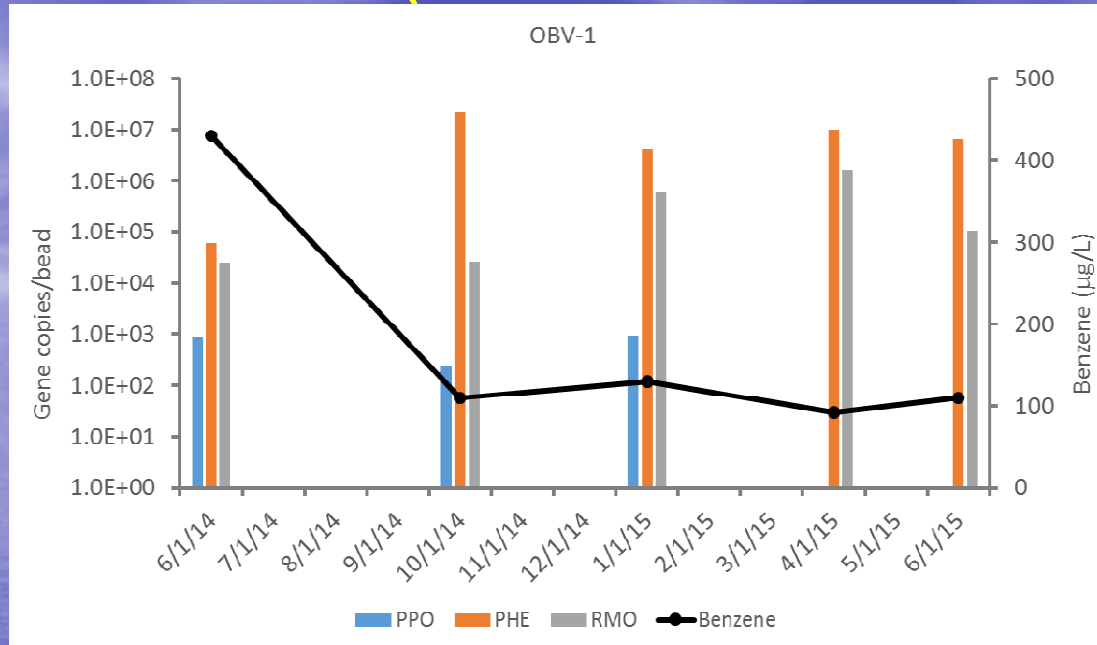
Pilot Test Results, ISBR Well OB-2; Favorite Child



Pilot Test Results, ISBR Well OB-1; Red Headed Step Child



Formation Well (15' Down-Gradient)



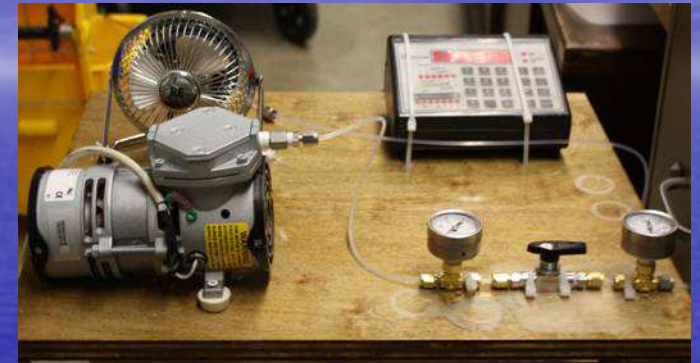
Issues



Questions?



Then: Surface equipment supporting the bioreactor



Now: *Bio-Enhance* Control Box

