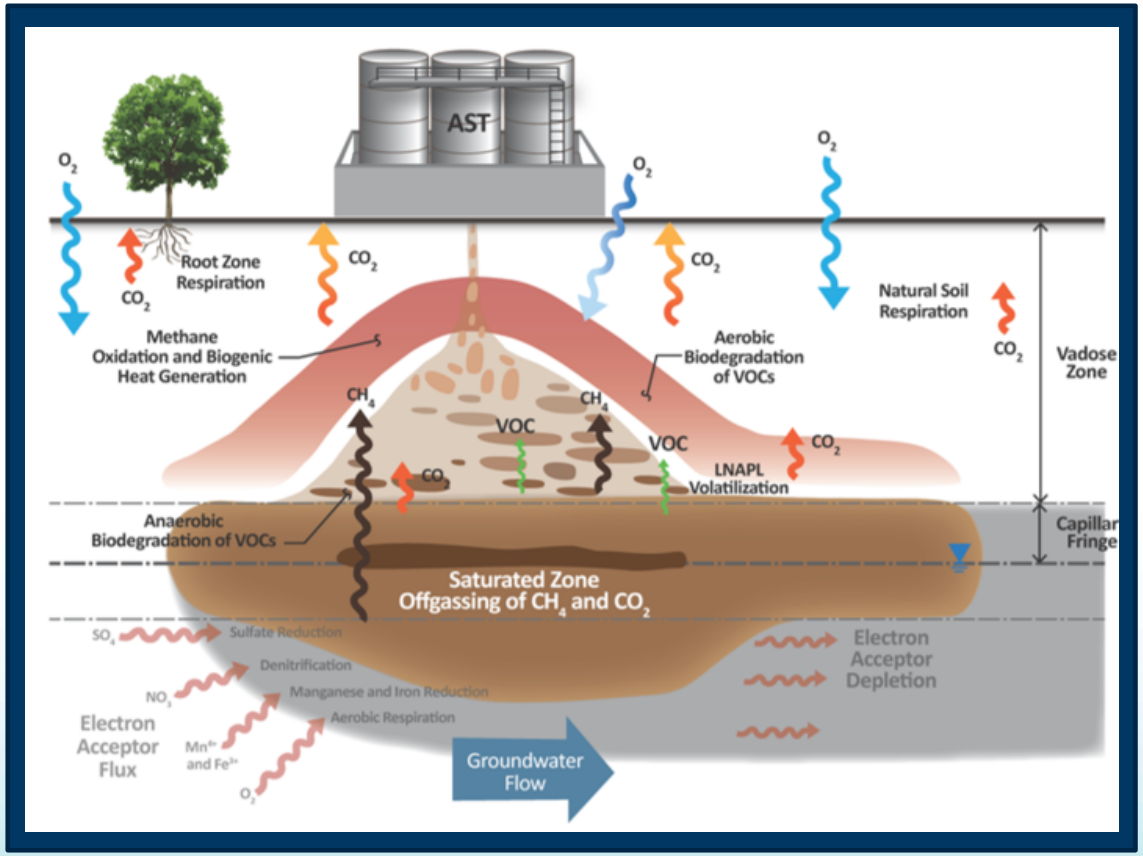
Assessing the Genetic Potential for Natural Source Zone Depletion at a Petroleum-Contaminated Site

Molecular Tools to Navigate Your Diagnostic Exploration

microbialinsights

NATURAL SOURCE ZONE DEPLETION (NSZD)



API. 2017. Quantification of Vapor Phase- Related Natural Source Zone Depletion Processes. American Petroleum Institute.

What is it

LNAPL mass loss through a number of naturally-occurring processes. A complex phenomenon.

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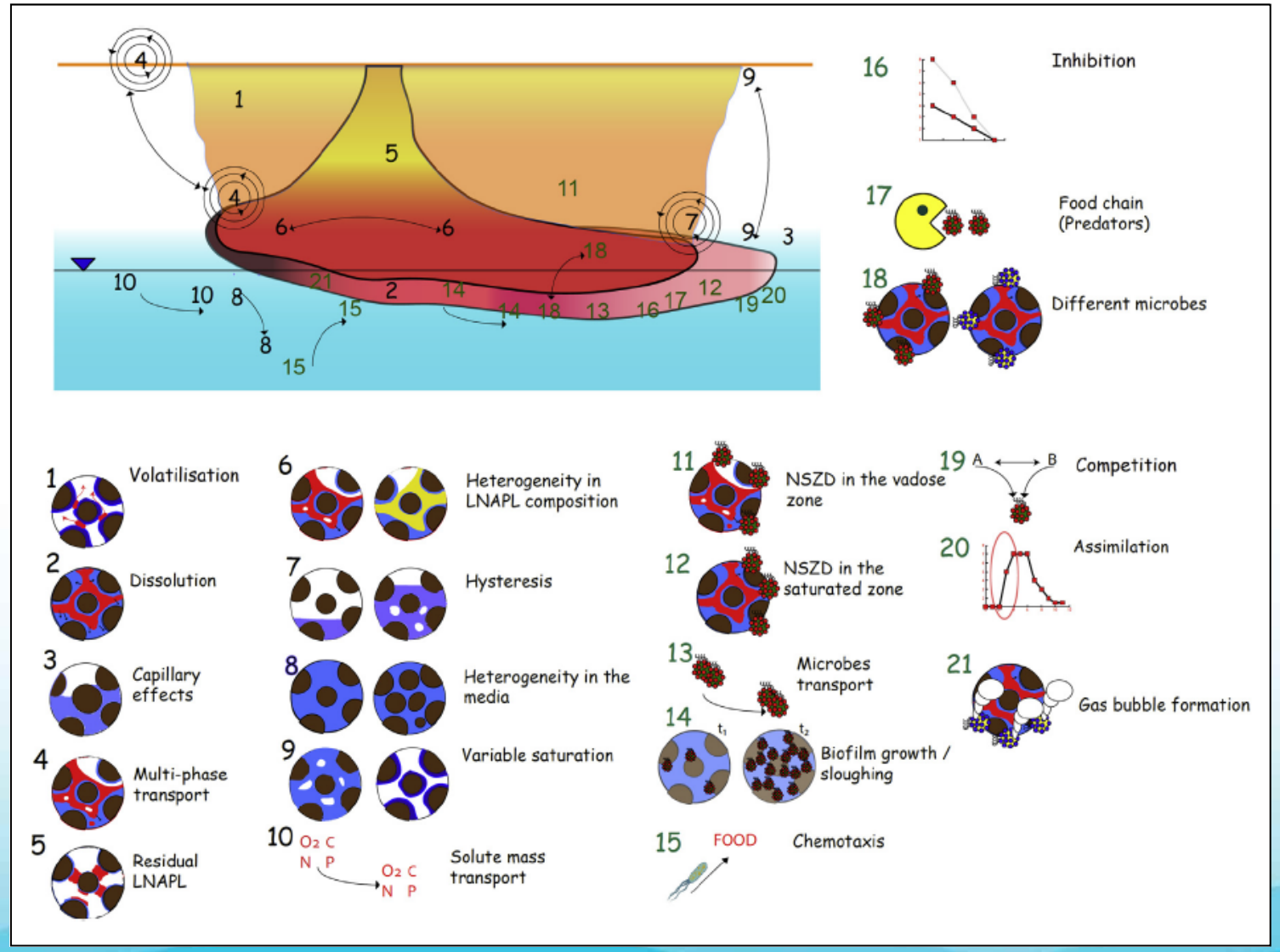

Lari et al. Natural source zone depletion of LNAPL: A critical review supporting modelling approaches. Water Research (2019).

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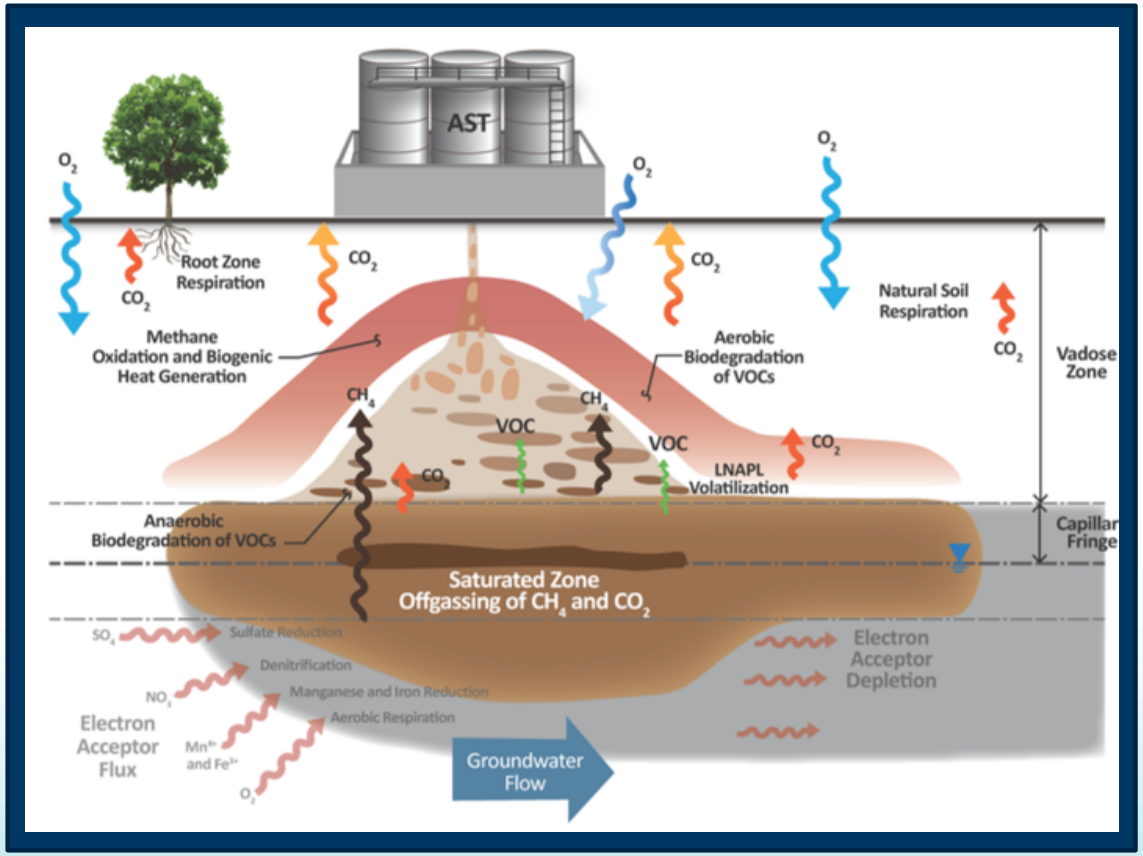


API. 2017. Quantification of Vapor Phase- Related Natural Source Zone Depletion Processes. American Petroleum Institute.

Why is it important

This phenomenon is rarely accounted for in conceptual site models.

NATURAL SOURCE ZONE DEPLETION (NSZD)

Examples of Site-Wide Average NSZD Rate Measurements at Field Sites

NSZD Study	Number of Sites	Site-Wide NSZD Rate (All Sites) (Gallons/Acre/Year)	Site-Wide NSZD Rate (Middle 50%) (Gallons/Acre/Year)	Reference
Refinery terminal sites	6	2100–7700	2400–3700	McCoy 2012
1979 crude oil spill	1	1600	—	Sihota et al. 2011
Seasonal range		310–1100	—	Sihota et al. 2016
Refinery/terminal sites	2	1100–1700	1250–1550	Workgroup, L.A. LNAPL 2015
Fuel/diesel/gasoline	5	300–3100	1050–2700	Piontek et al. 2014
Diverse petroleum sites	11	300–5600	600–800	Palaia 2016
All studies	25	300–7700	700–2800	

Garg et al. Overview of natural source zone depletion: Processes, controlling factors, and composition change. Groundwater Monitoring & Remediation (2017).

How do we get there?

HOW DO I GET TO MILAN? – LET ME DRAW YOU A MAP

Albuquerque

YOU ARE HERE

(Austin)

HOW DO I GET TO MILAN? – LET ME DRAW YOU A MAP

Albuquerque

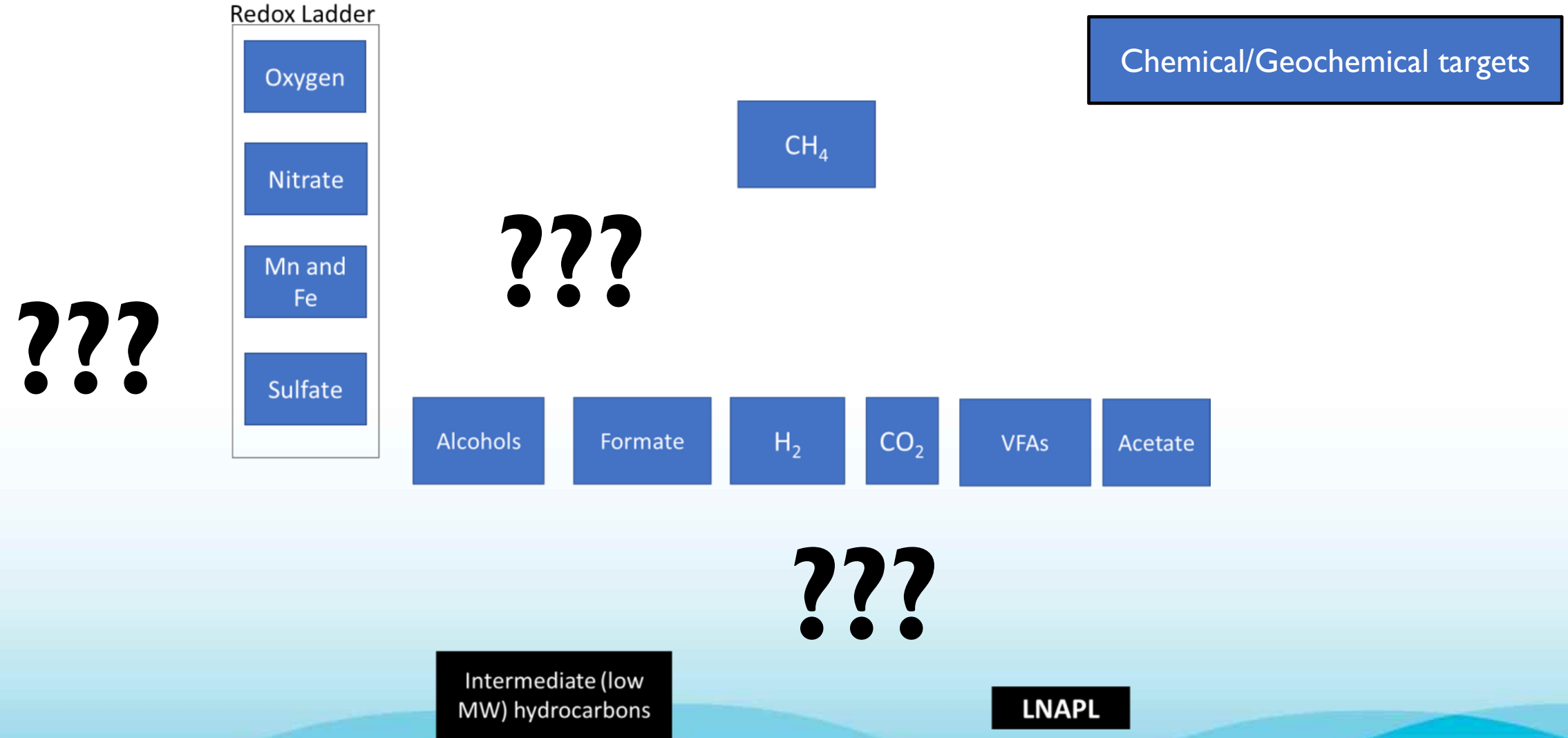
???

Dallas

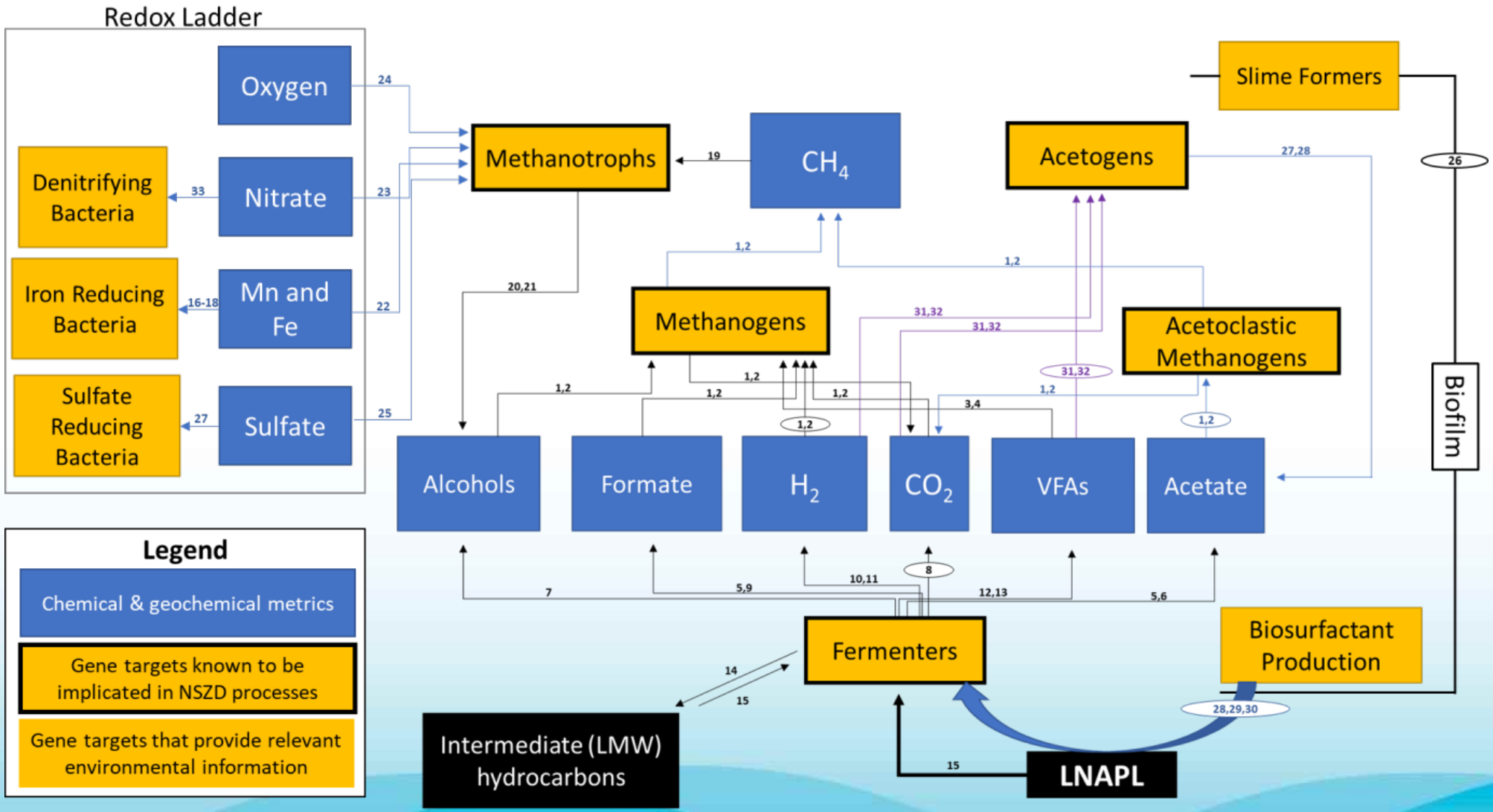
YOU ARE HERE

(Austin)

NATURAL SOURCE ZONE DEPLETION (NSZD)



QUANTARRAY-NSZD TARGETS



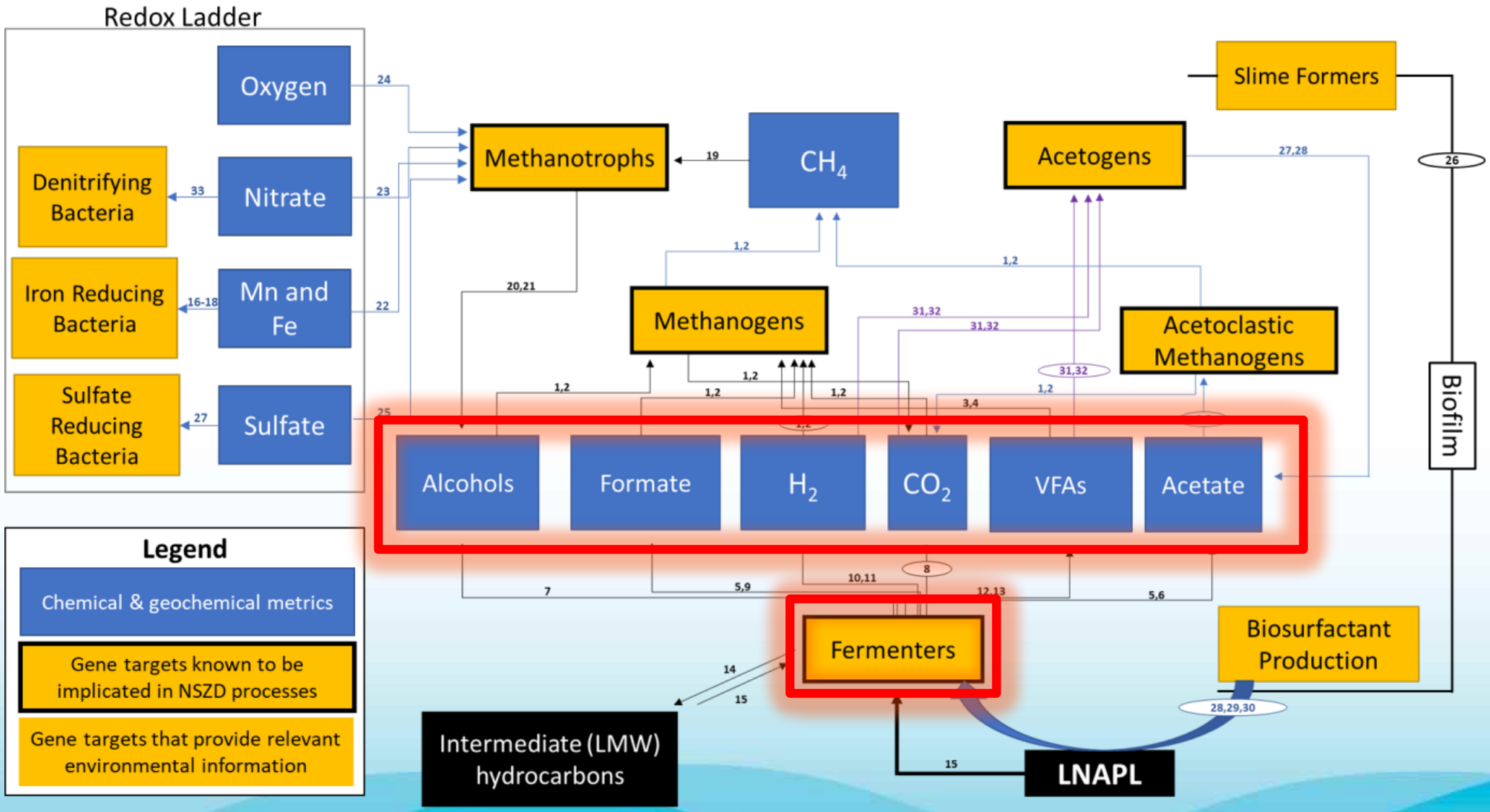
QuantArray® Analysis

Quantifying a broad spectrum of microorganisms and functional genes in a single analysis. Microbial Insights offers five versions of QuantArray®:

QuantArray®-Petro	QuantArray®-NSZD
For genes corresponding to **petroleum hydrocarbon** sites	For gene targets related to **Natural Source Zone Depletion** (NSZD)

QuantArray®
MOLECULAR BIOLOGICAL TOOL

QUANTARRAY-NSZD TARGETS



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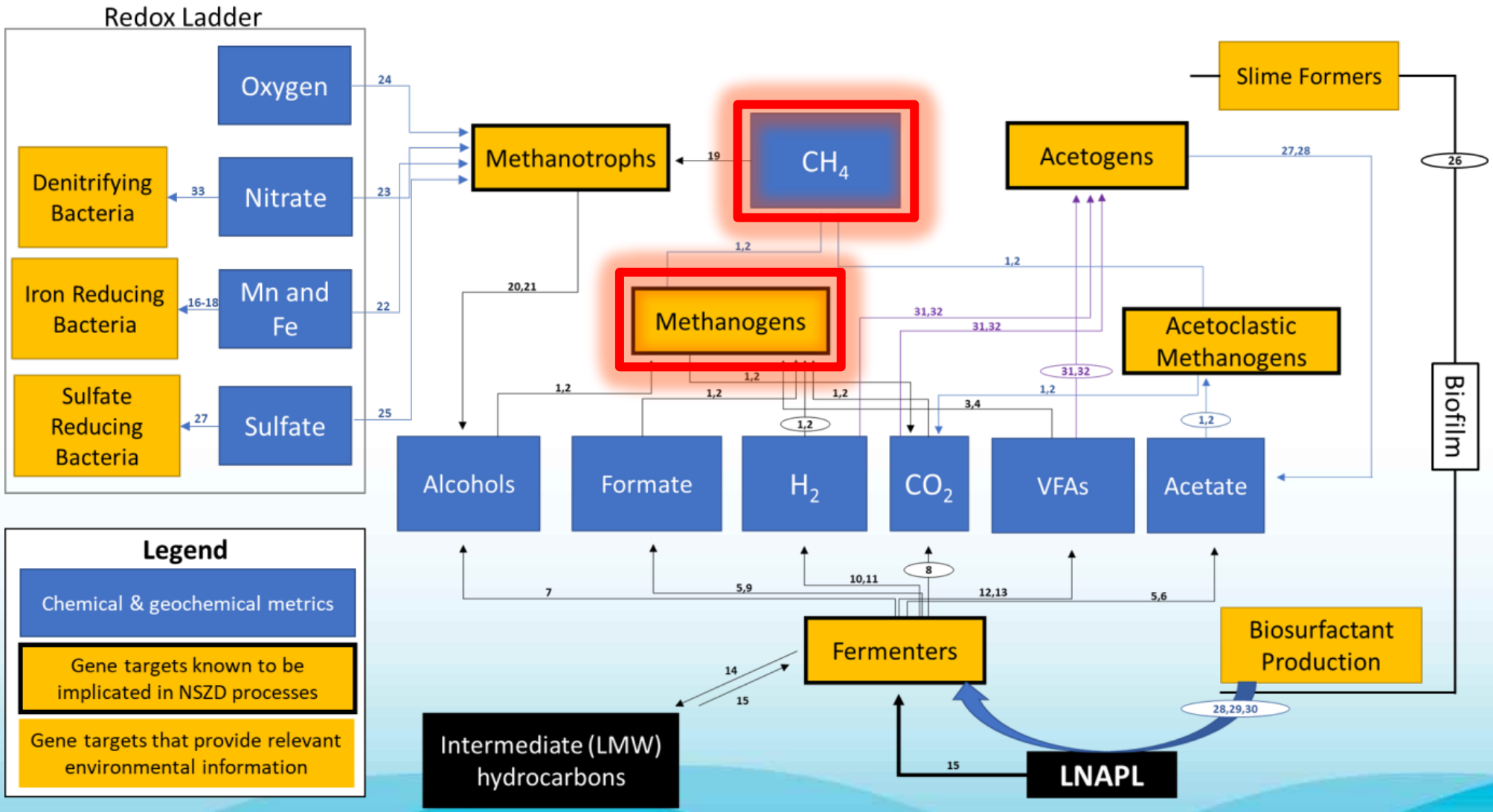

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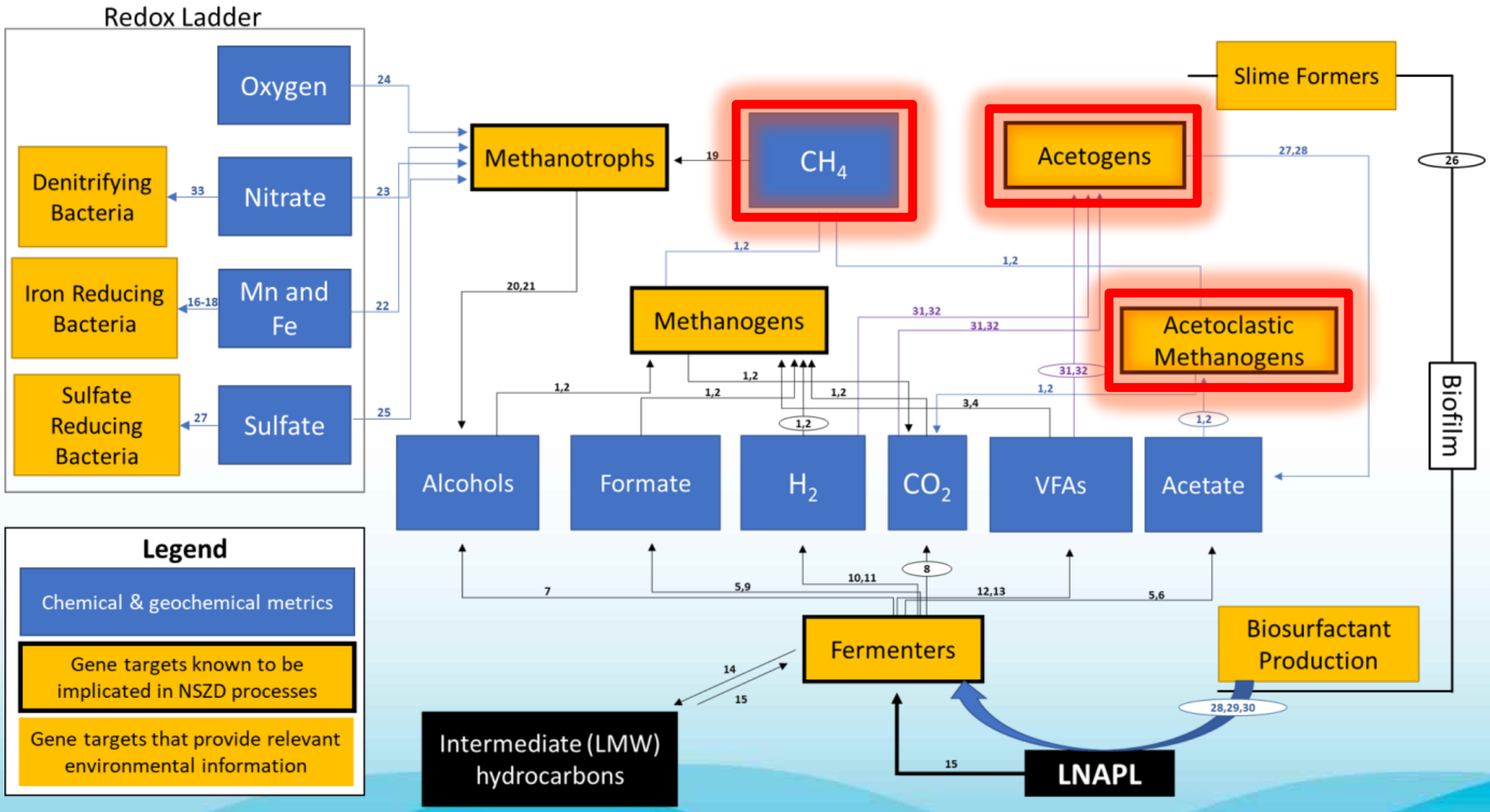

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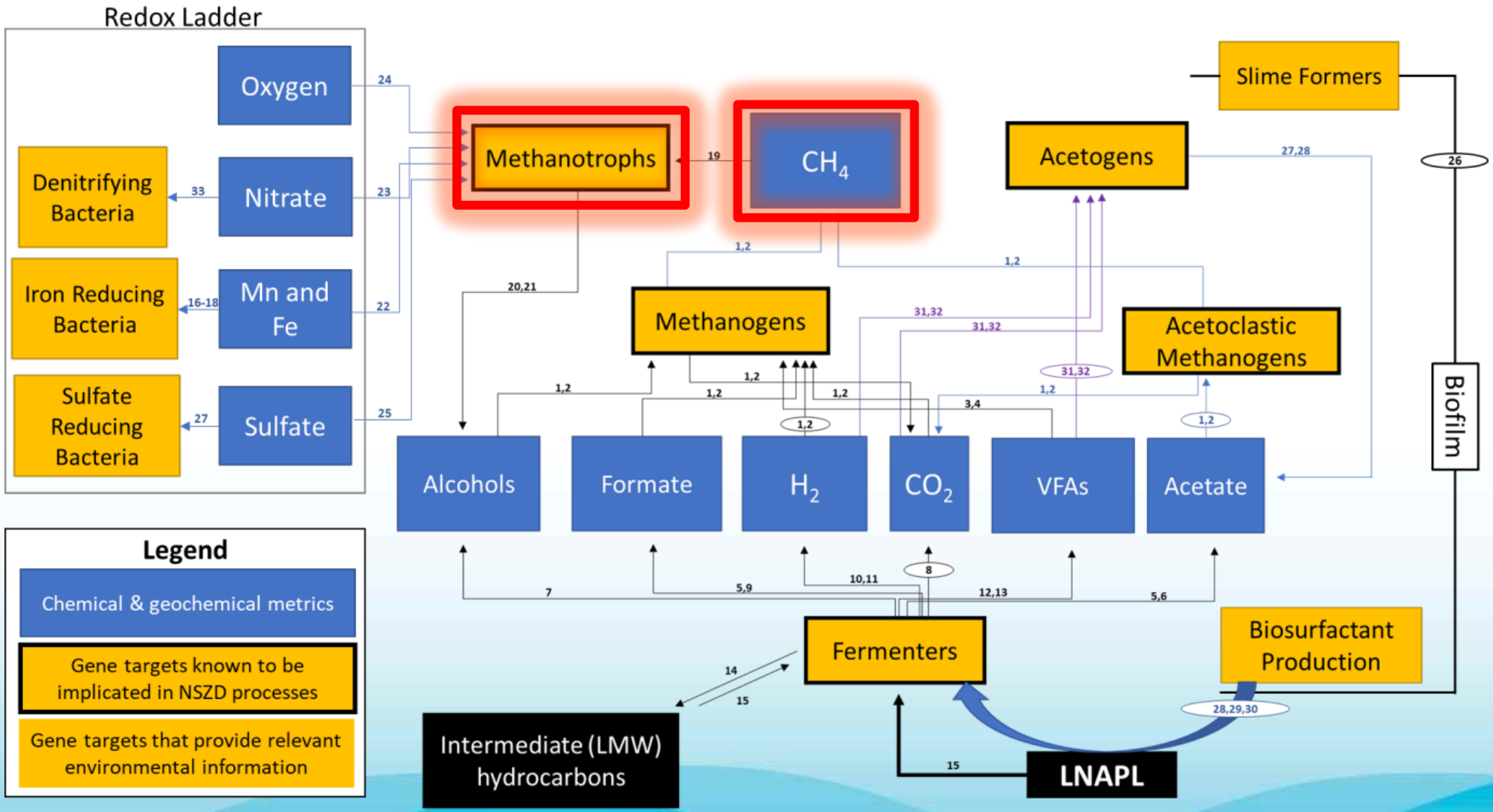

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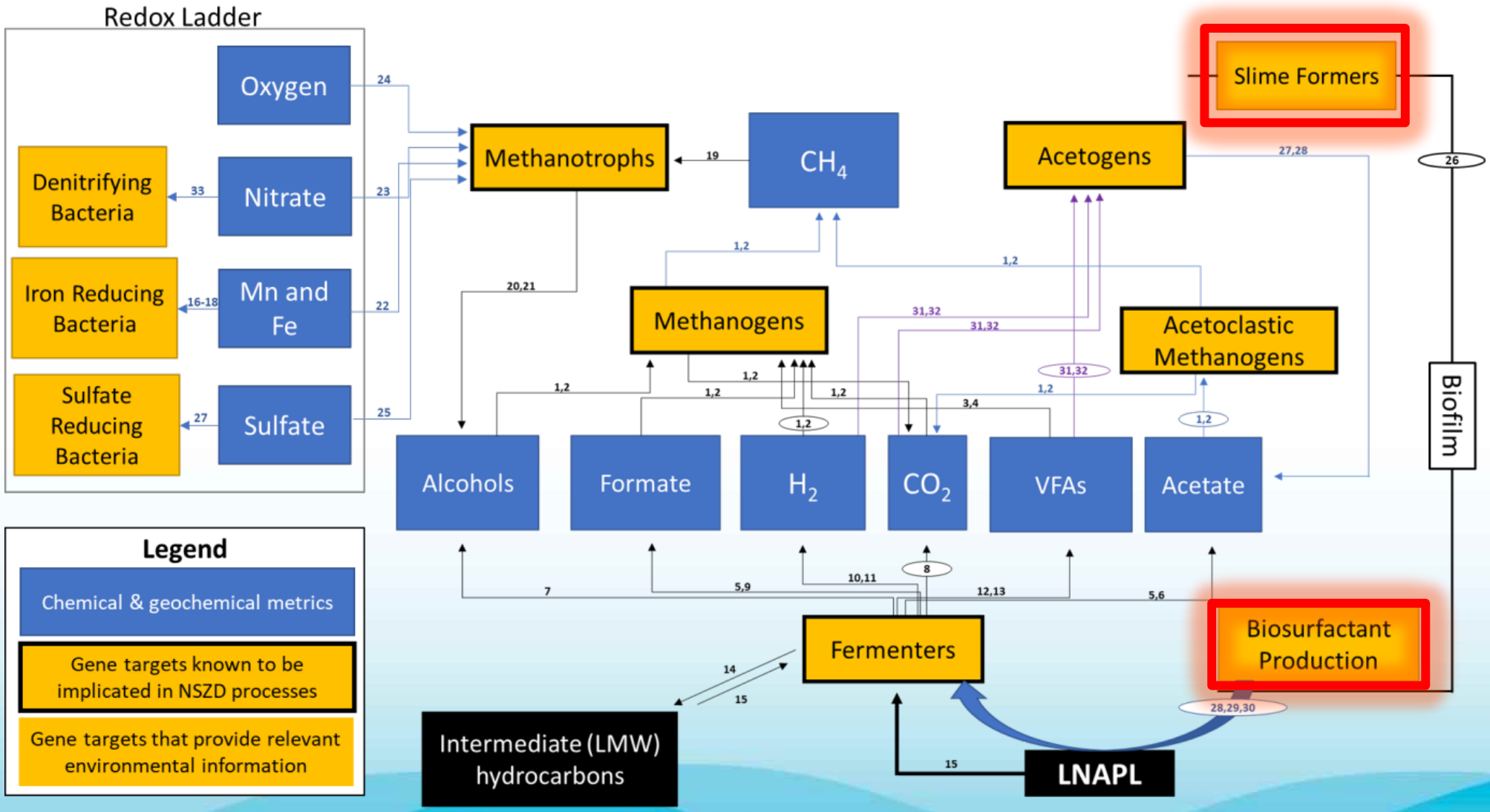

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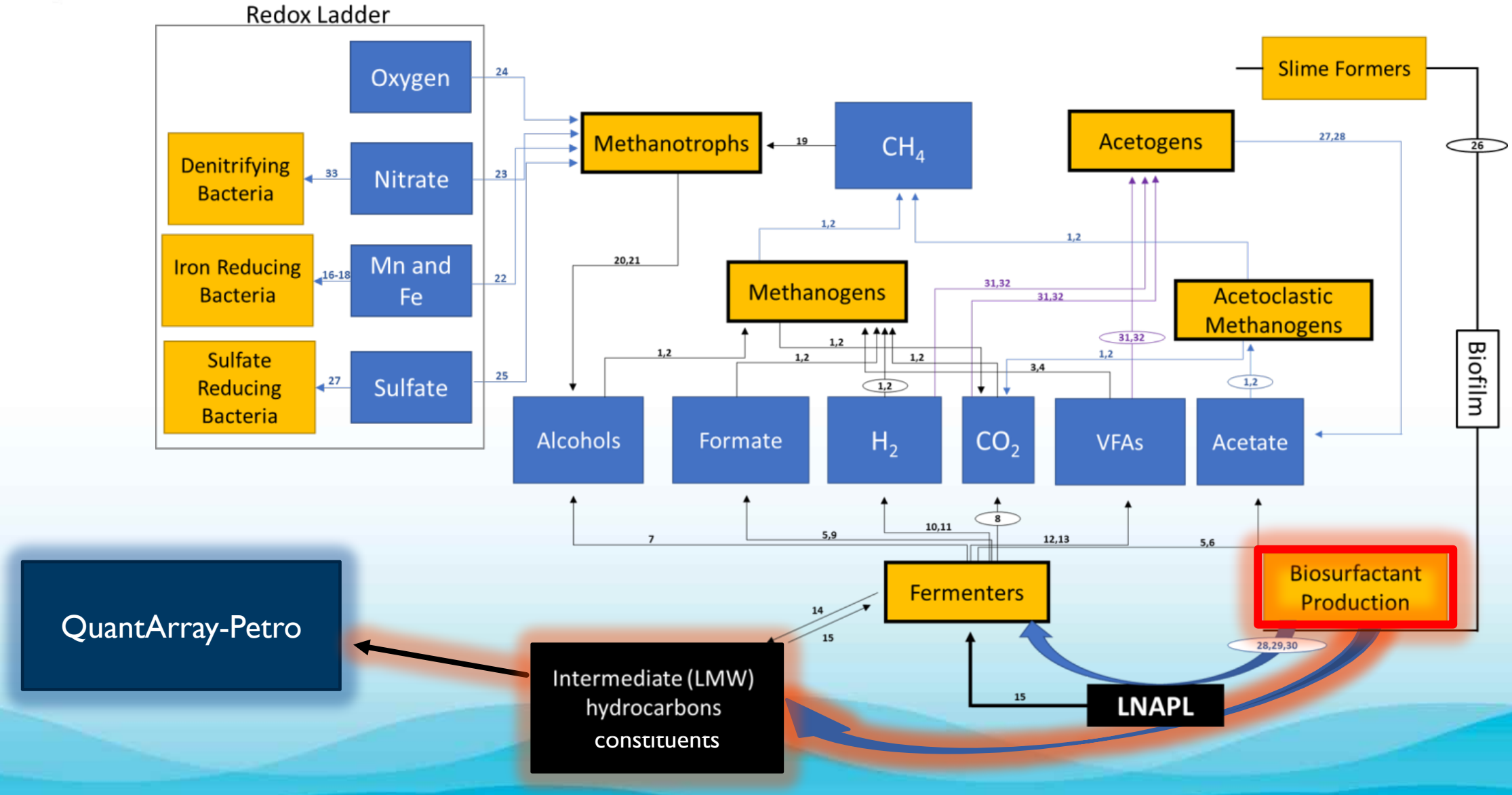


QUANTARRAY® APPLICATIONS

PETROLEUM HYDROCARBON SITE

- **LNAPL in source area**
- **Both QuantArray-Petro and QuantArray-NSZD results**
- **Helpful approach for initial site investigation or performance monitoring**

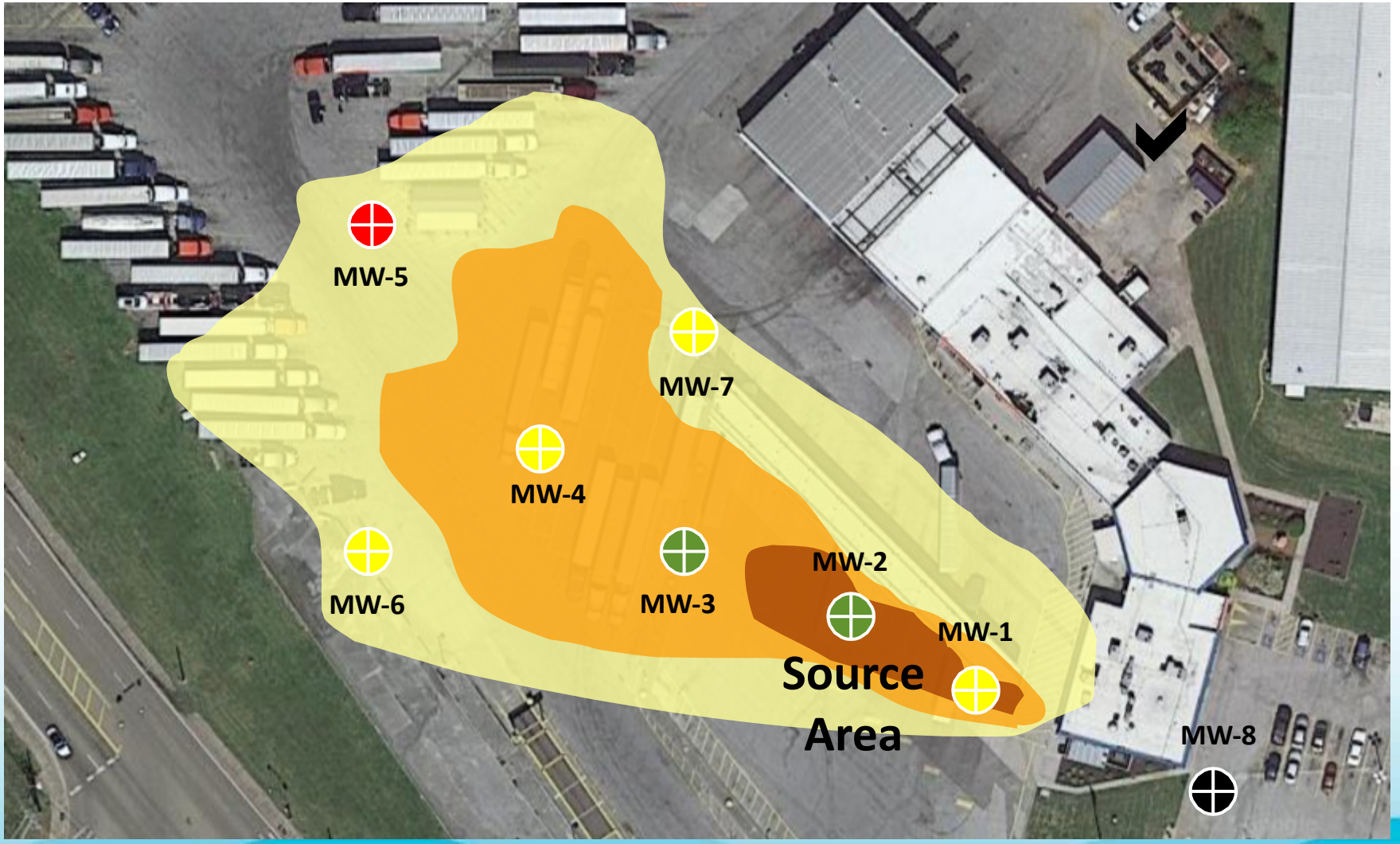
BTEX and Methane

BTEX

~60 mg/L

5-10 mg/L

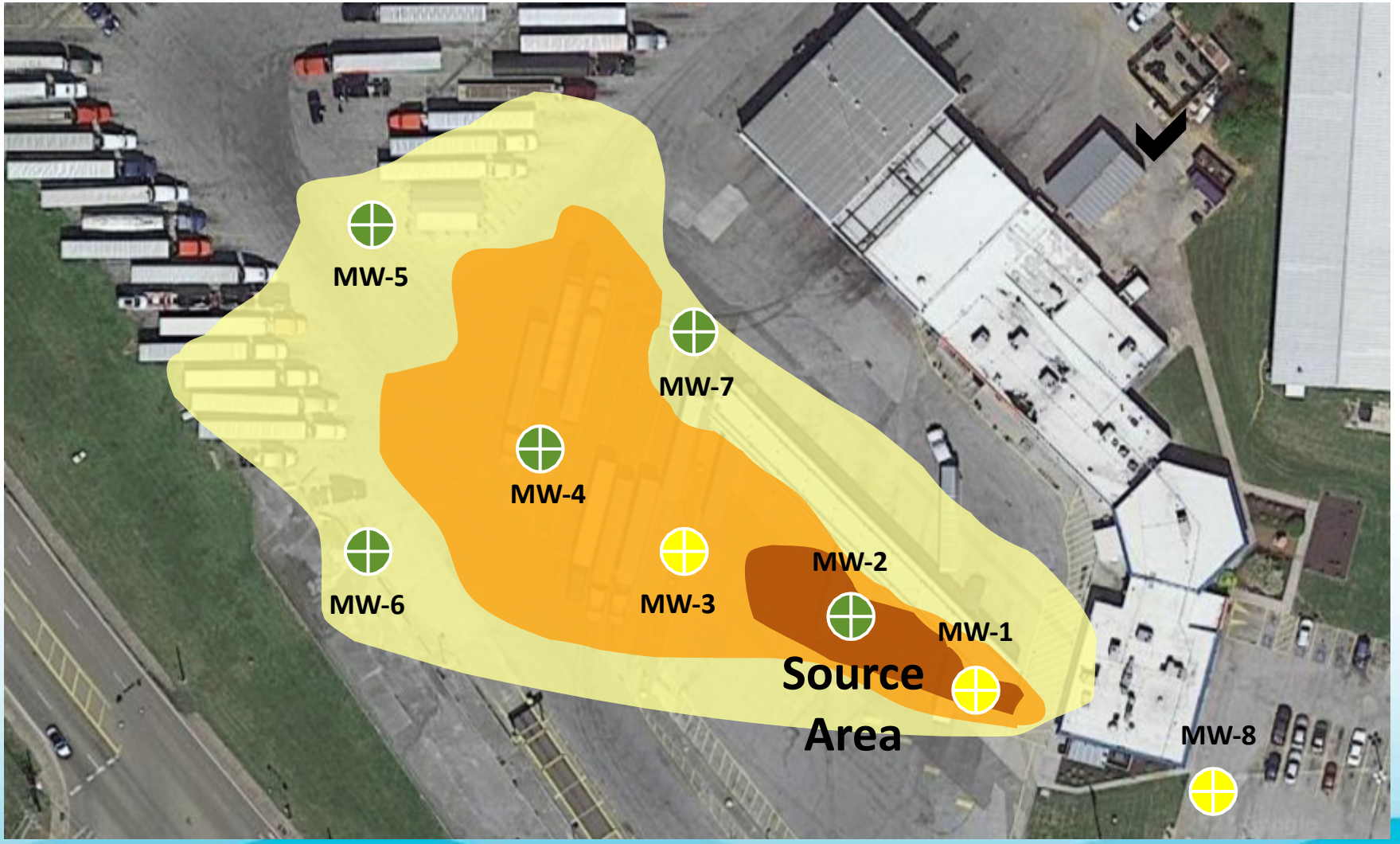
< 1 mg/L



Methane

- ND
- <1000 µg/L
- 1000 - 3000 µg/L
- >3000 µg/L

Aerobic BTEX Functional Genes

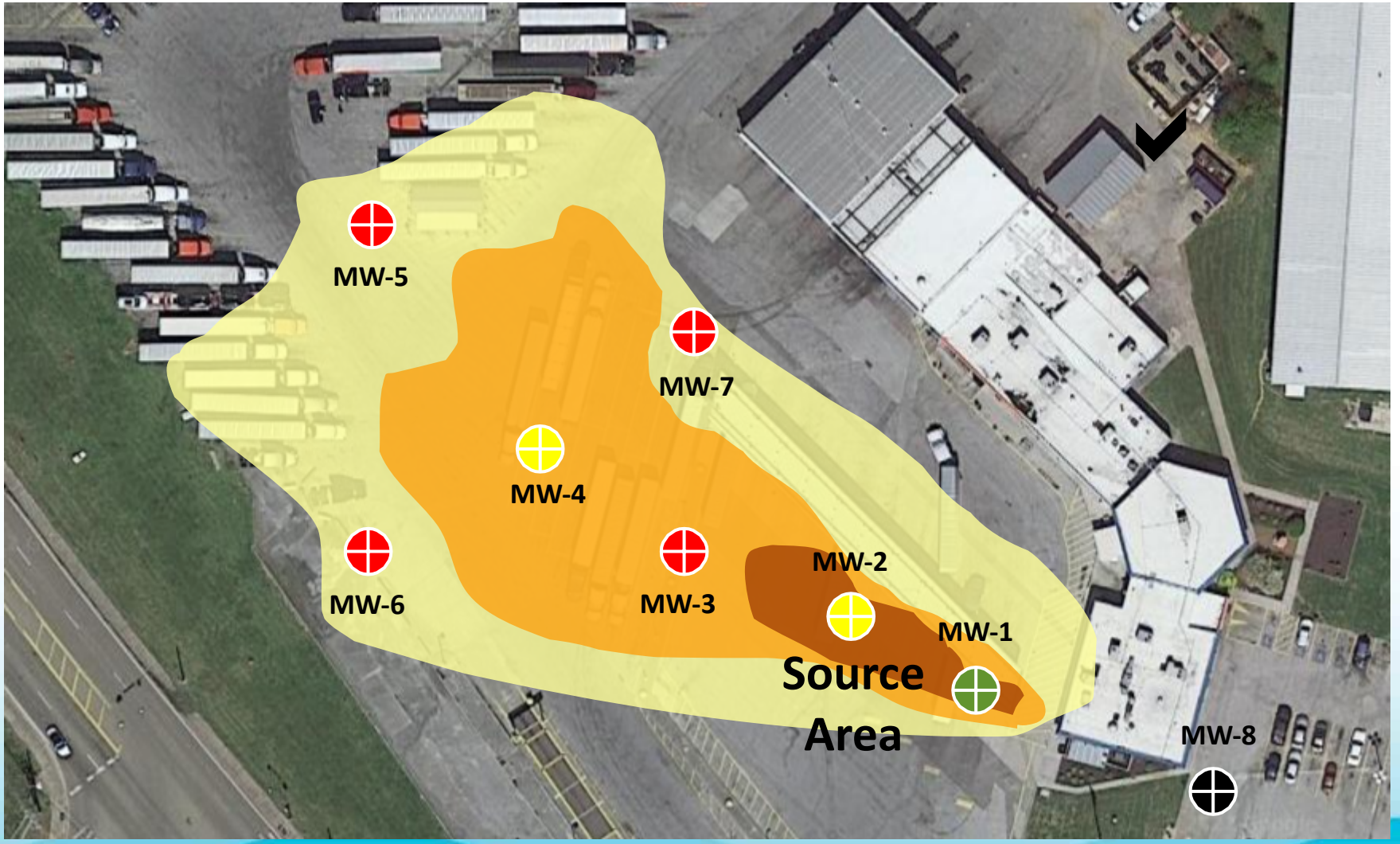


Aerobic BTEX Genes

PHE, RMO, RDEG, TOD

- ND
- <10^2 cells/mL
- 10^2 - 10^3 cells/mL
- ≥ 10^4 cells/mL

Anaerobic TEX Functional Gene

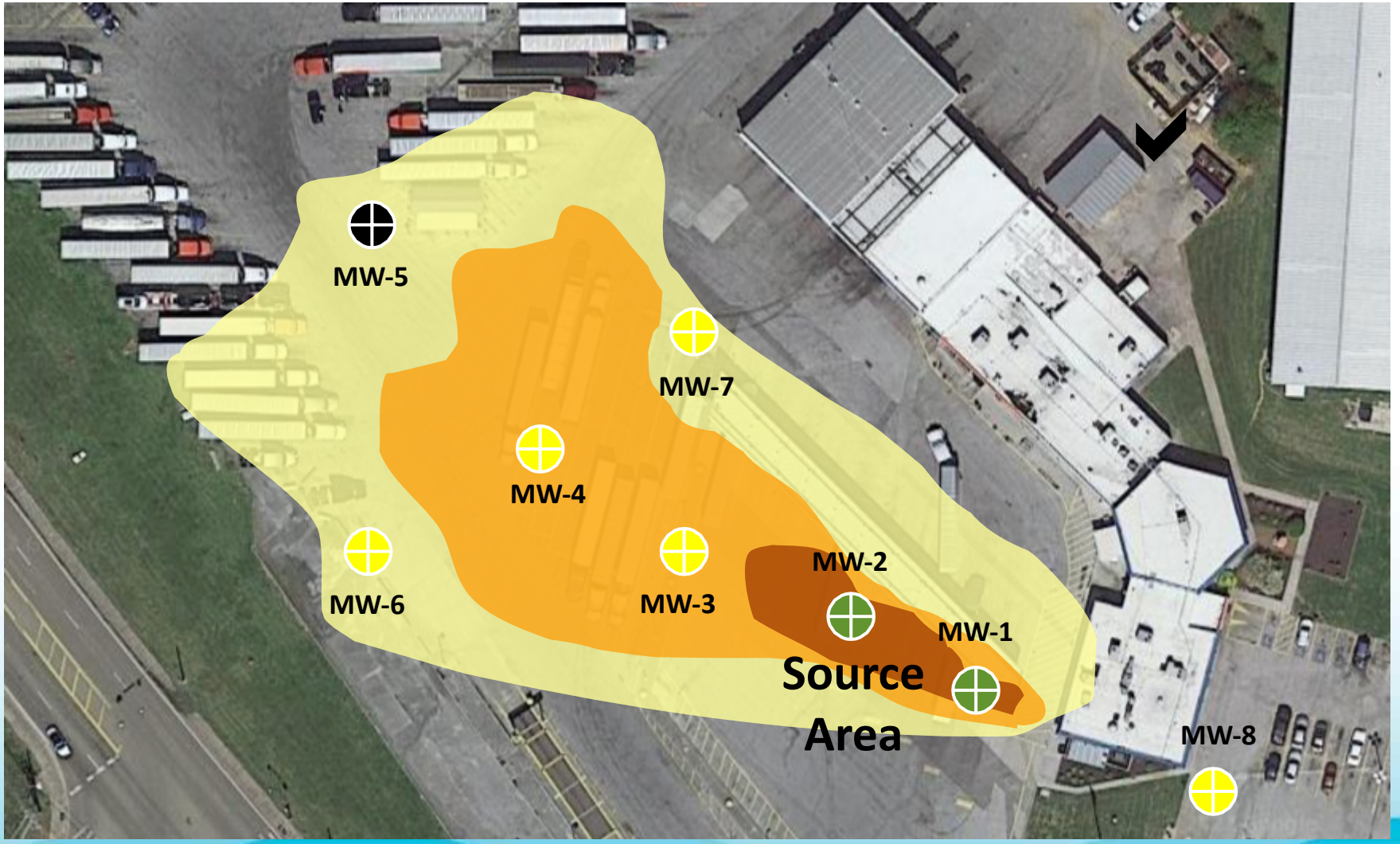


Anaerobic TEX Gene

bssA

- ND
- <10^2 cells/mL
- 10^2 - 10^3 cells/mL
- ≥ 10^4 cells/mL

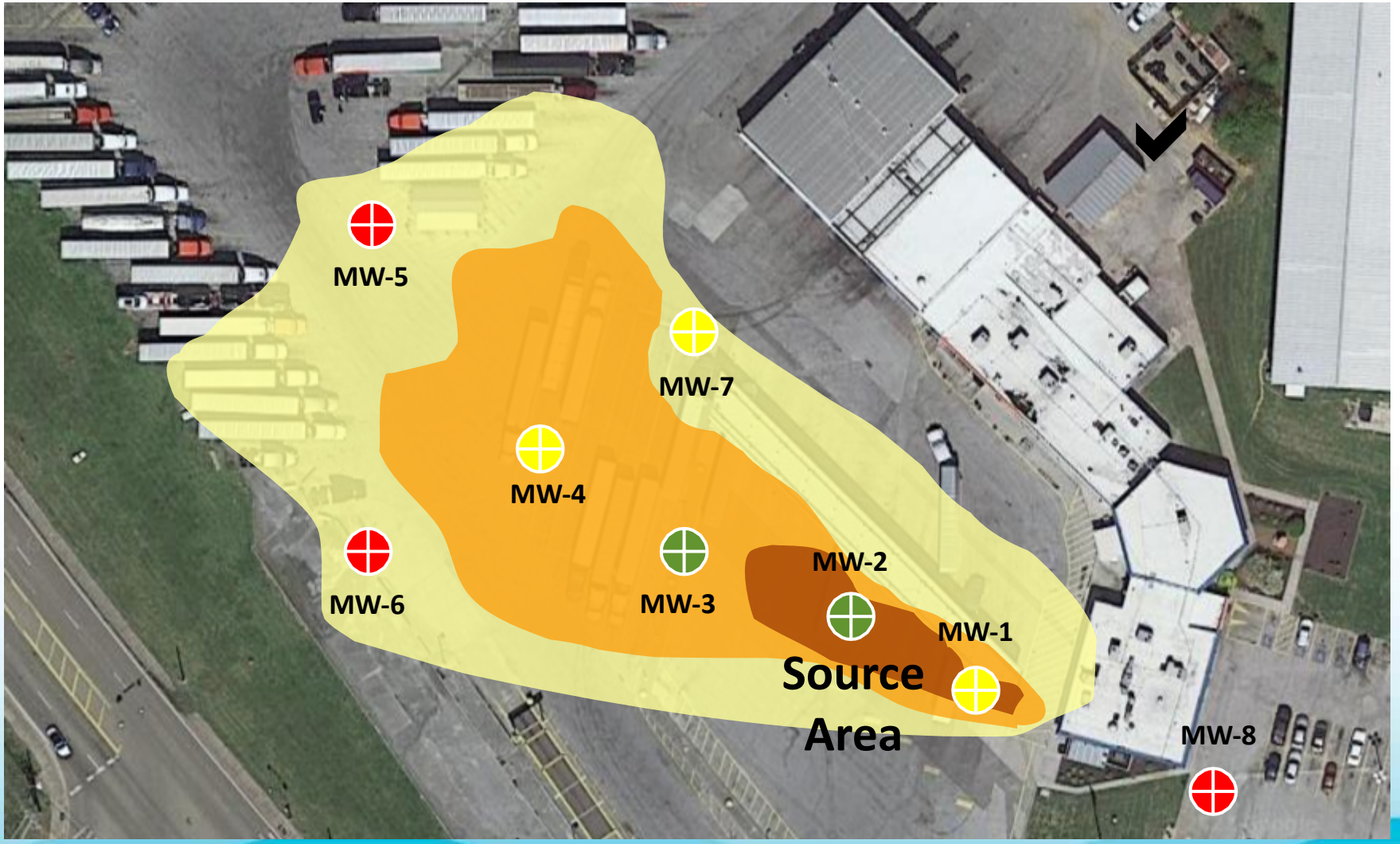
Fermenters



Fermenters

- ND
- <10^2 cells/mL
- 10^2 - 10^3 cells/mL
- ≥ 10^4 cells/mL

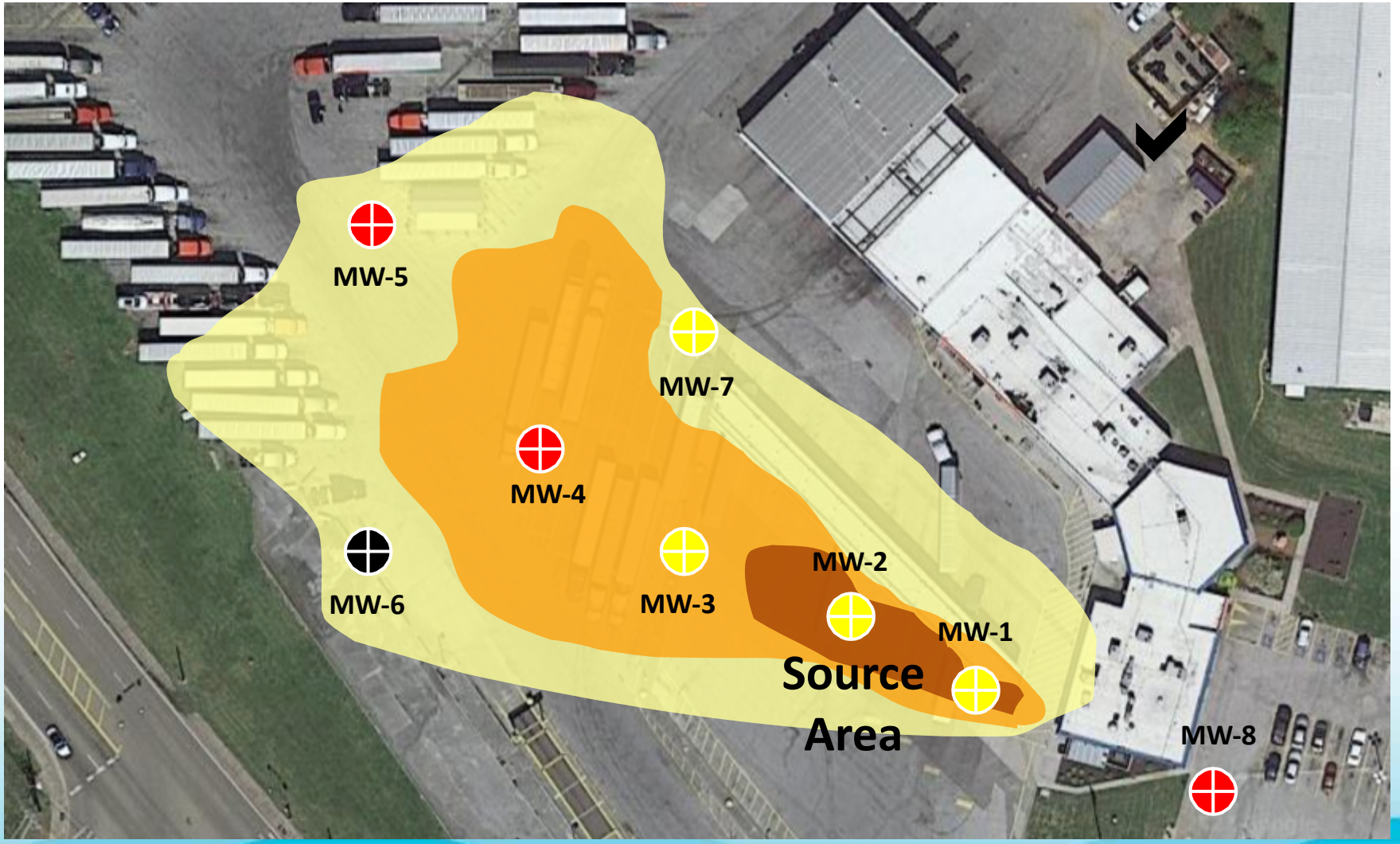
Methanogens



Methanogens

- ND
- <10^2 cells/mL
- 10^2 - 10^3 cells/mL
- ≥ 10^4 cells/mL

Biosurfactant Functional Genes



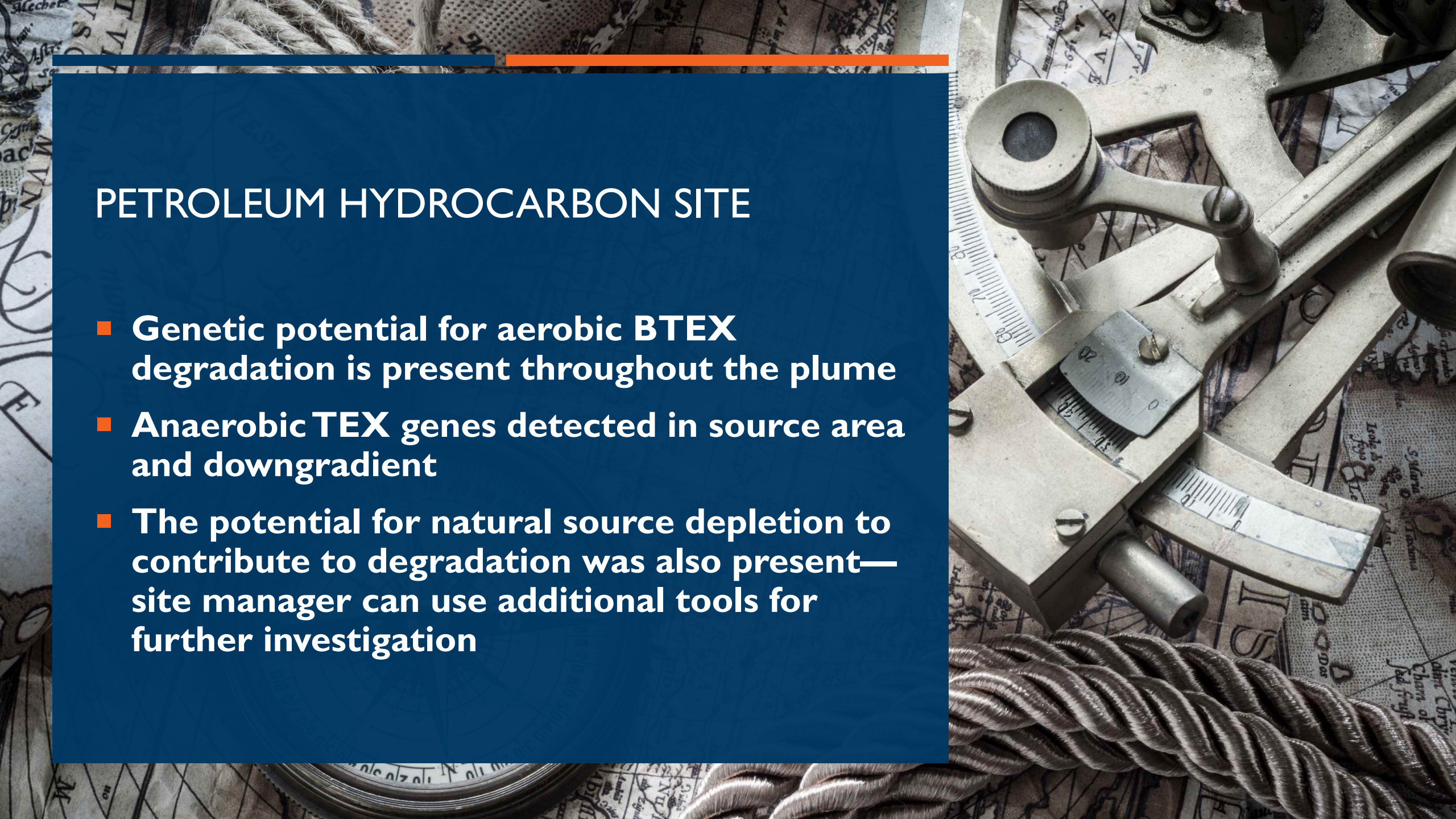
Biosurfactant Genes

SurG, SurT, SurL, SurP

- ND
- $<10^2$ cells/mL
- 10^2 - 10^3 cells/mL
- $\geq 10^4$ cells/mL

PETROLEUM HYDROCARBON SITE

- **Genetic potential for aerobic BTEX degradation is present throughout the plume**
- **Anaerobic TEX genes detected in source area and downgradient**
- **The potential for natural source depletion to contribute to degradation was also present—site manager can use additional tools for further investigation**



THANK YOU!

srosolina@microbe.com
(865) 573-8188
www.microbe.com