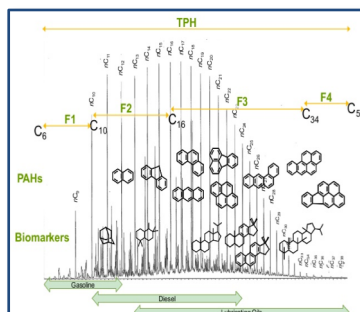
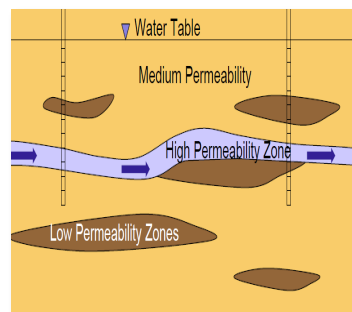


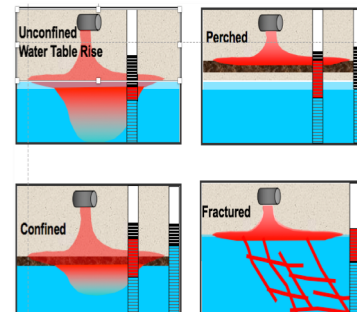
CHOOSING THE RIGHT SCALE APPROPRIATE TOOLS TO SUPPORT SUCCESSFUL OUTCOMES



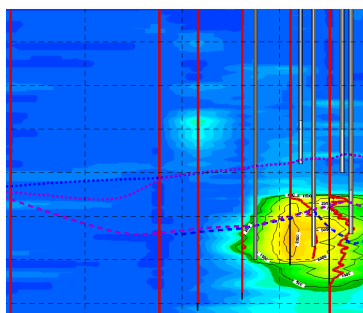
LNAPL
CHEMISTRY



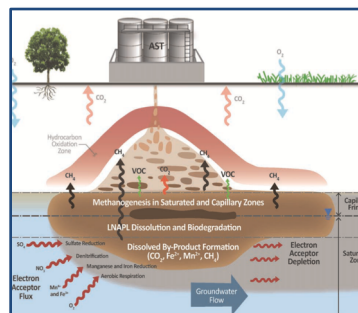
SOIL
PERMEABILITY



GROUND
WATER



DISSOLVED
PHASE



VAPOR PHASE



SPATIAL
ALIGNMENT



Systematic Approach

INTERSTATE COUNCIL ON TECHNOLOGY REGULATION

Search this website ...

Navigating this Website

- 1 Introduction
- 2 LNAPL Regulatory Context, Challenges, and Outreach
- 3 Key LNAPL Concepts
- 4 LNAPL Conceptual Site Model (LCSM)
- 5 LNAPL Concerns, Remedial Goals, Objectives, and Technology Groups
- 6 LNAPL Remedial Technology Selection
- Additional Information

LNAPL Update

Welcome

Light Non-Aqueous Phase Liquid (LNAPL) Site Management: LCSM Evolution, Decision Process, and Remedial Technologies (LNAPL-3)

1. How to Use the Document

In 2009, ITRC published [LNAPL-1: Evaluating Natural Source Zone Depletion at Sites with LNAPL \(ITRC 2009b\)](#) and [LNAPL-2: Evaluating LNAPL Remedial Technologies for Achieving Project Goals \(ITRC 2009a\)](#) to aid in the understanding, cleanup, and management of LNAPL at thousands of sites with varied uses and complexities. These documents have been effective in assisting implementing agencies, responsible parties, and other practitioners to identify concerns, discriminate between LNAPL composition and saturation-based goals, to screen remedial technologies efficiently, to better define metrics and endpoints for removal of LNAPL to the "maximum extent practicable" and to move

Light Non-Aqueous Phase Liquid (LNAPL) Management is the process of LNAPL site assessment, monitoring, LNAPL Conceptual Site Model development, identification and validation of relevant LNAPL concerns, and the possible application of remediation technologies. The presence of LNAPL can create challenges at any site. In the subsurface, LNAPL can be difficult to assess or recover accurately and can lead to:

- human health, ecological risk, and exposure concerns (e.g., vapor, groundwater, and soil contamination)

<https://lnapl-3.itrcweb.org/>



WHY HIGH RESOLUTION?

Where we were 10 years ago...

By F Payne: *Remediation Hydraulics*

What's really there...

By F Payne: *Remediation*
Hydraulics

Impact on Conceptual Site Models

1 ft/day

Example: Distribution
of Transport Velocities

1 ft/day

100 ft/day

0.1 ft/day

0.01 ft/day

By F Payne: *Remediation*

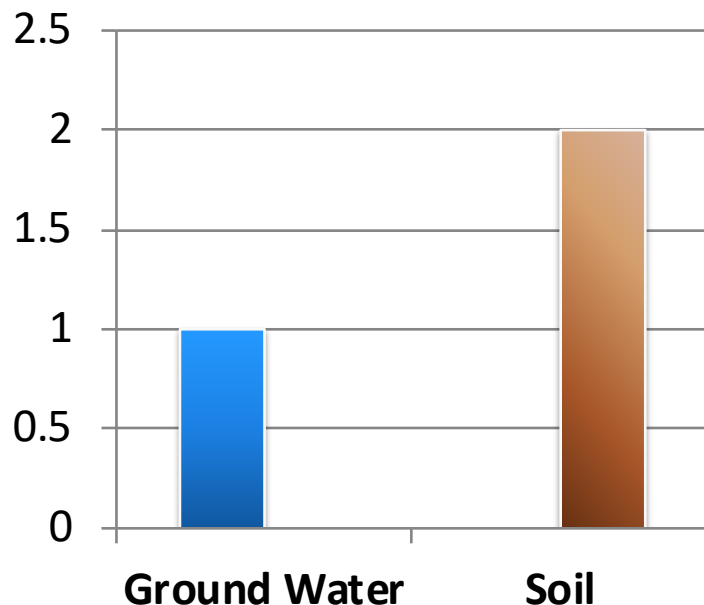


RISK BASED VS. REMEDIATION MEASUREMENTS

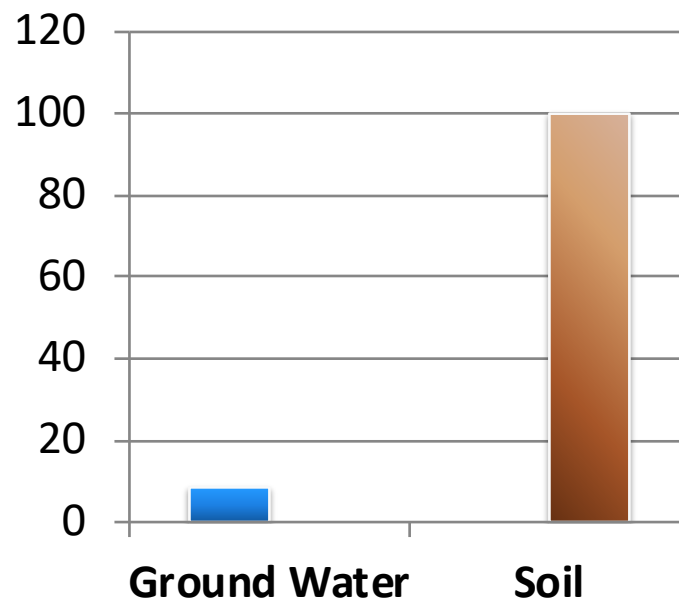


The Mass Loading is in the Soil

Soil and Ground Water Contamination (ppm)



Contaminant Load mg / 100 cu. ft.



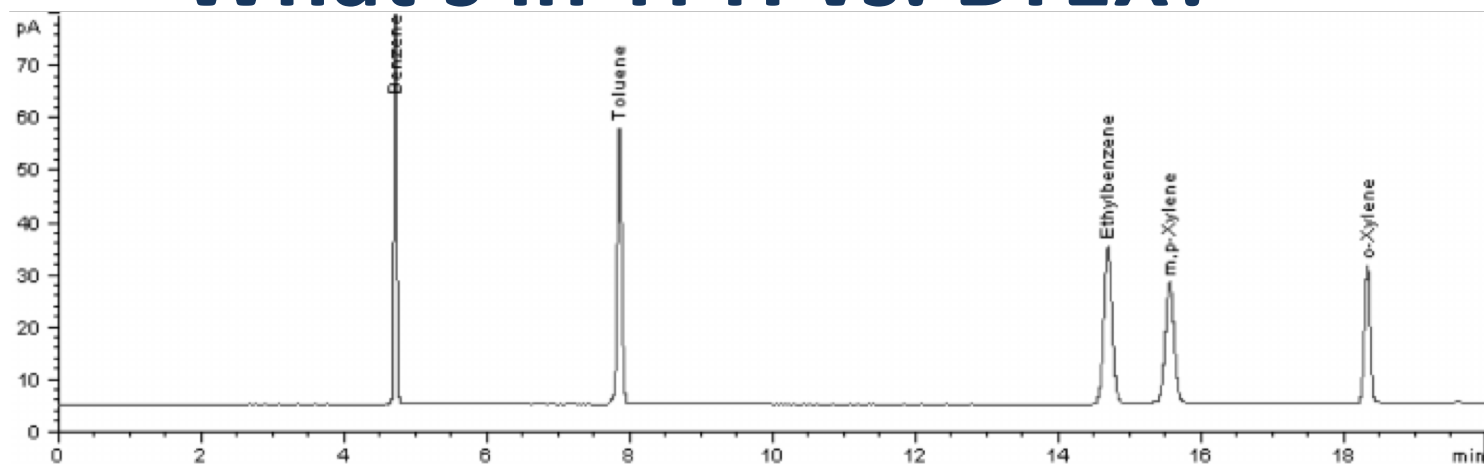
***If you design to only treat the dissolved phase contaminant,
you get REBOUND***



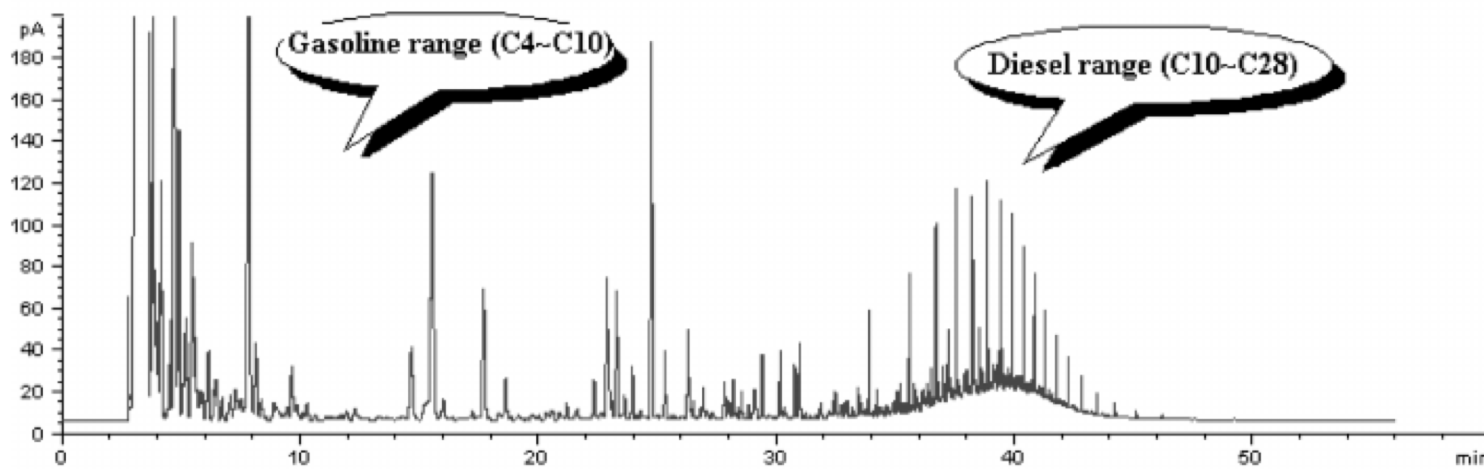
LNAPL CHEMISTRY



What's in TPH vs. BTEX?



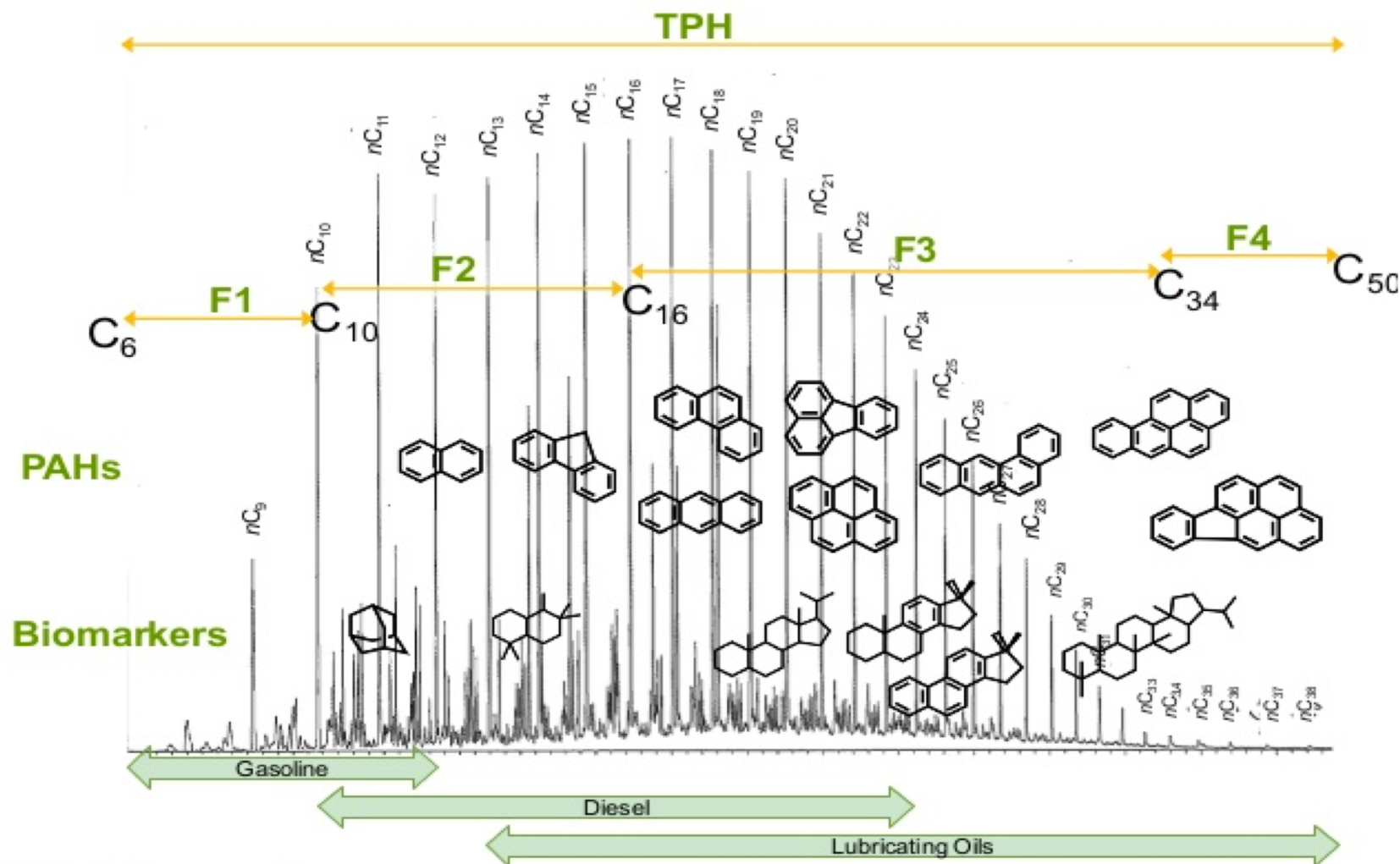
(a)



(b)



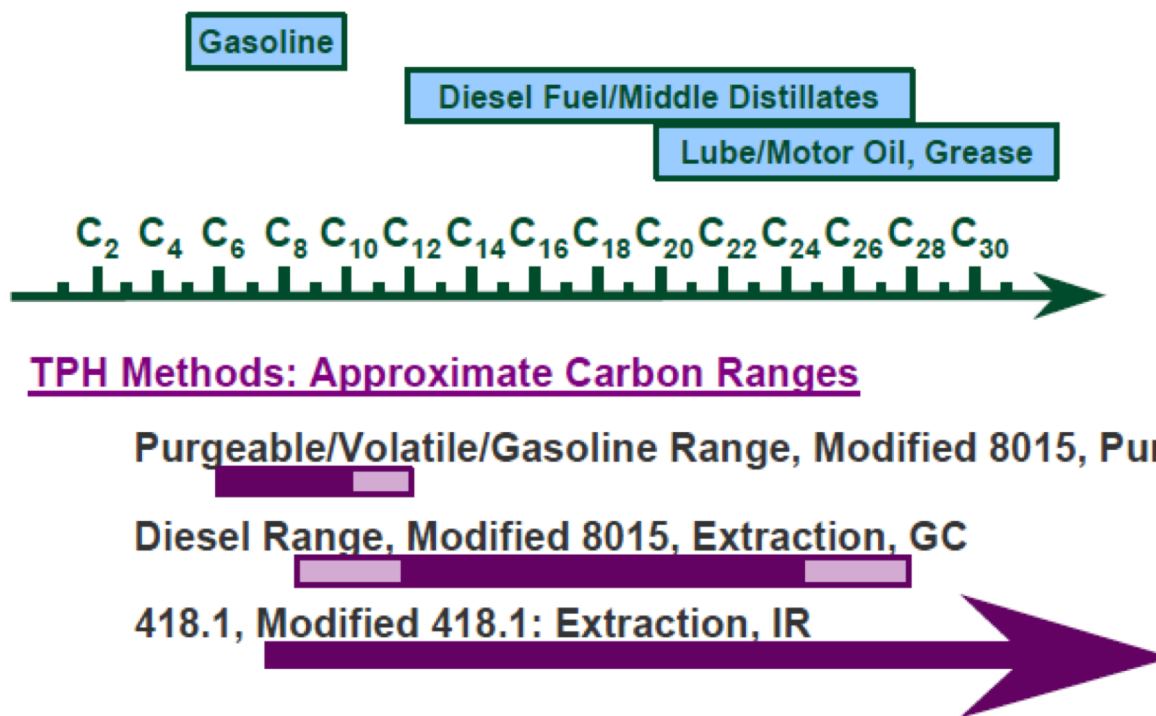
Where are the PAHs?





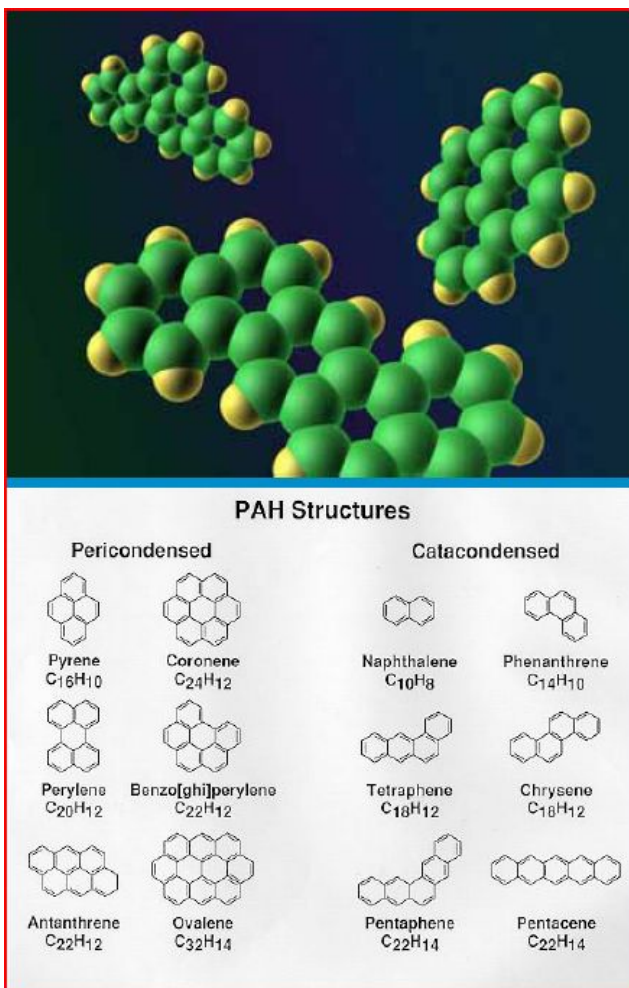
Know Your Lab Results

FIGURE 1. CARBON NUMBER RANGES ADDRESSED BY TPH ANALYTICAL METHODS

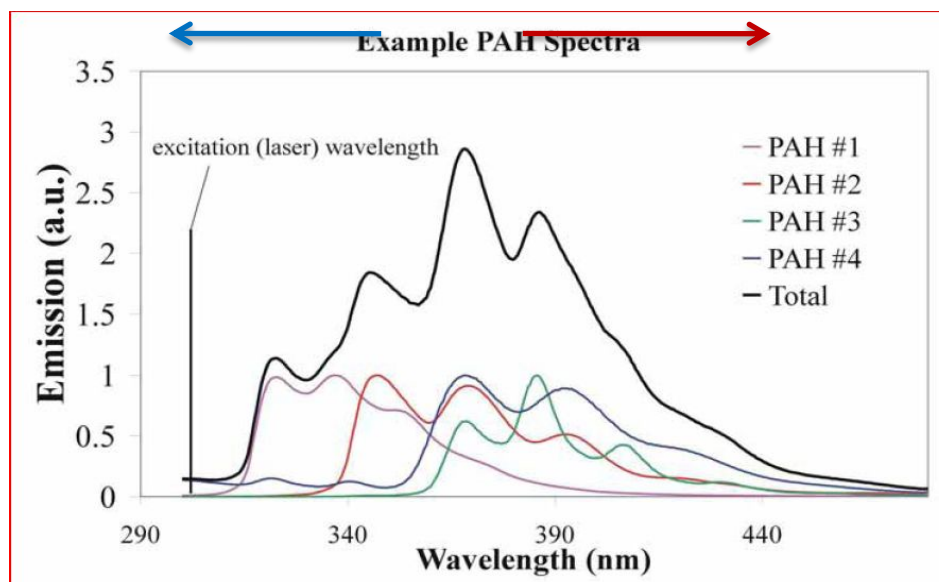




Free-Phase PAHs Fluoresce



- Each PAH has a unique fluorescence spectrum
- Heavier PAHs have longer wavelengths



Source: Dakota Technologies



DIRECT SENSING TECHNOLOGIES

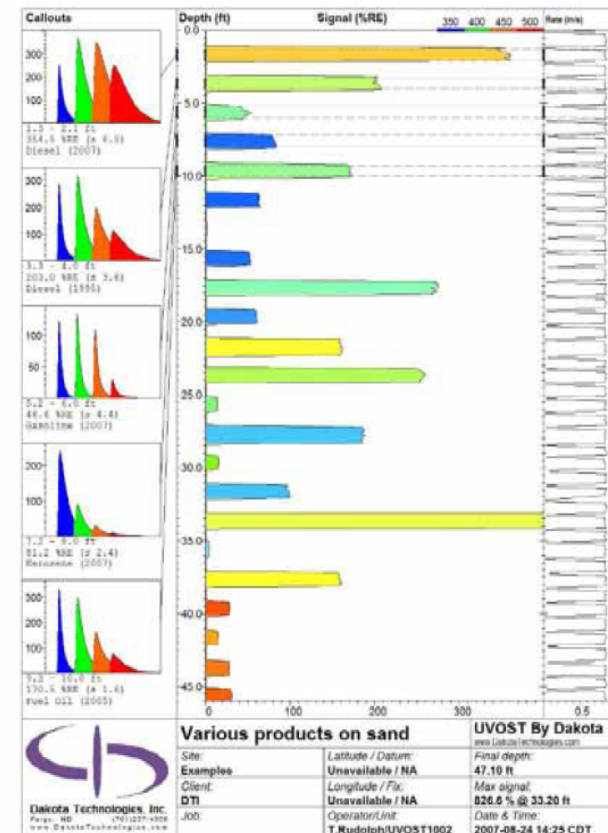


Direct Push Technologies





LIF-UVOST®



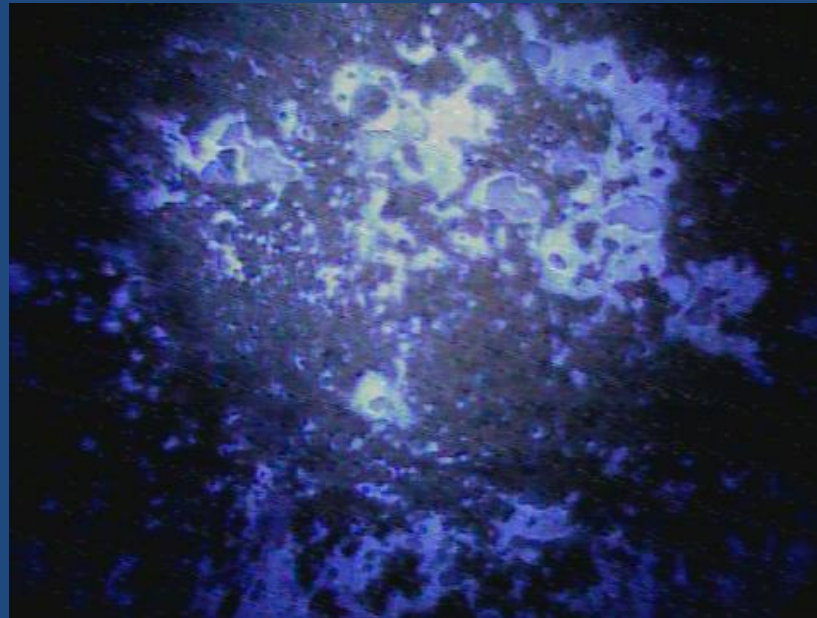
OIP Description

- **OIP Probe:** Robust with simple connection to the trunkline.
- **Driveable:** Using 7822 series machines and drive cushions.
- **Compatible:** With Geoprobe 1.5 inch and 1.75 inch rod systems.



OIP UV Image

9.5 mm

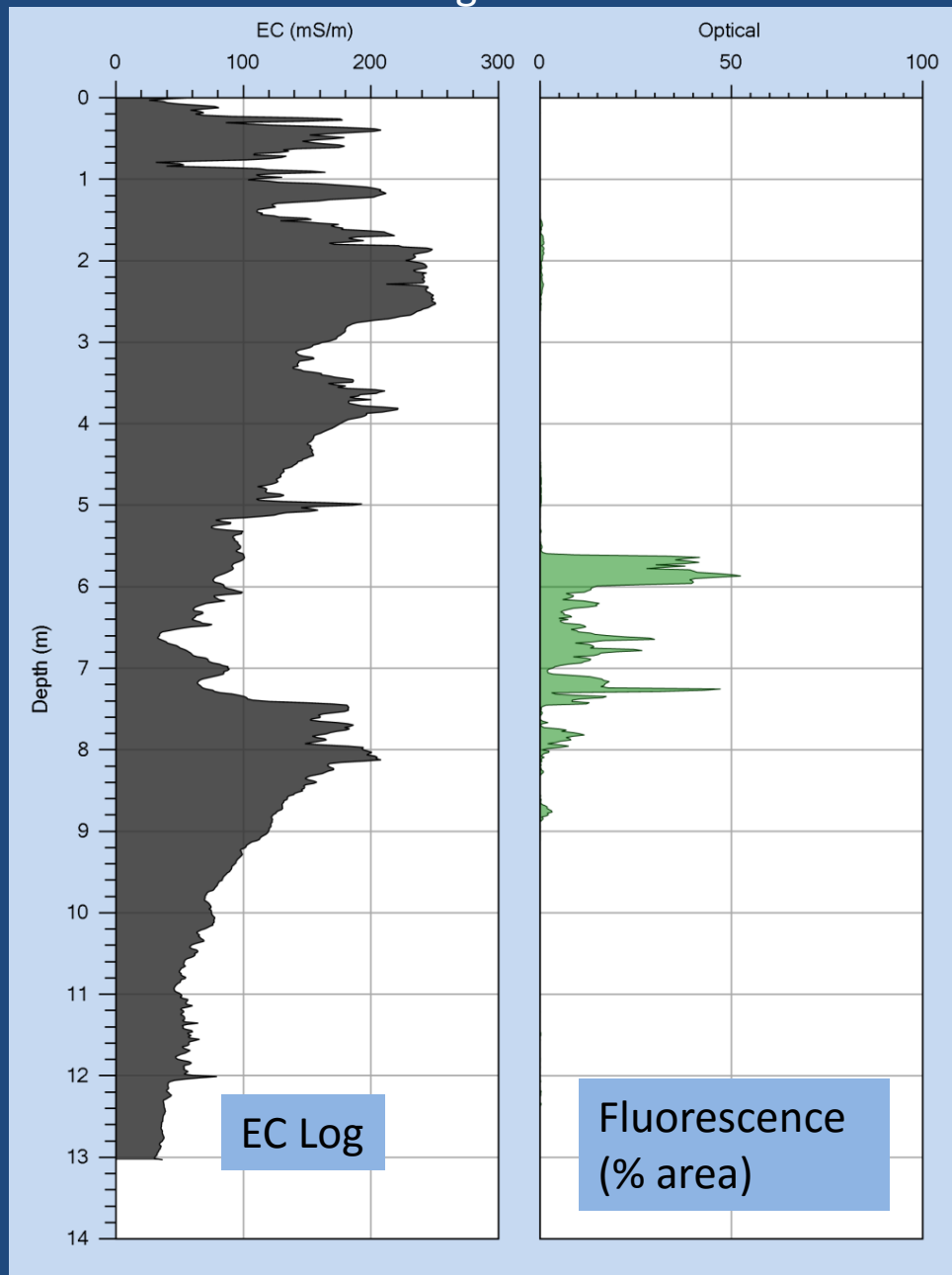


7 mm

Typical OIP image of hydrocarbon fluorescence using the UV light source.



Log 8-1



The OIP Log

- Images captured every 15mm (.05 ft.).
- Images are analyzed for fluorescence in real time.
- The percent of the image area representing fuel fluorescence is recorded on the log.



3.0m
0% detected



5.7m
50.2% detected



Membrane Interface Probe

MIP (Membrane Interface Probe)





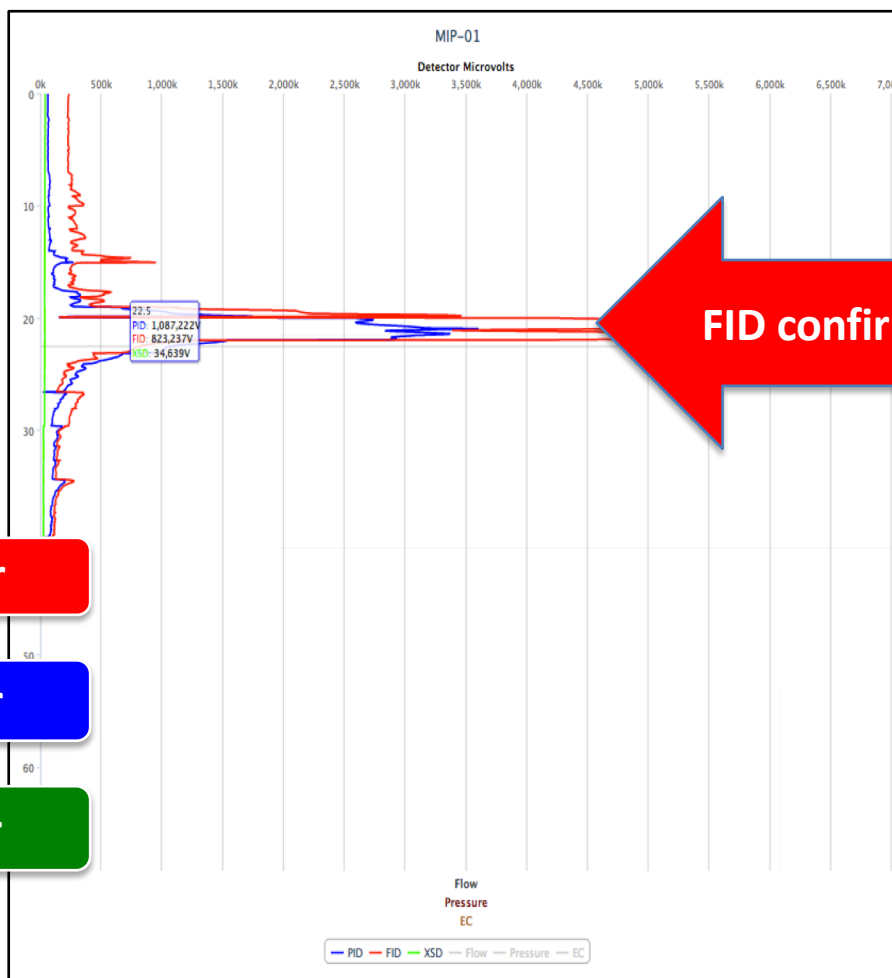
Membrane Interface Probe (MIP)

**Petroleum
Volatile Organic
Compounds**

Flame Ionization Detector

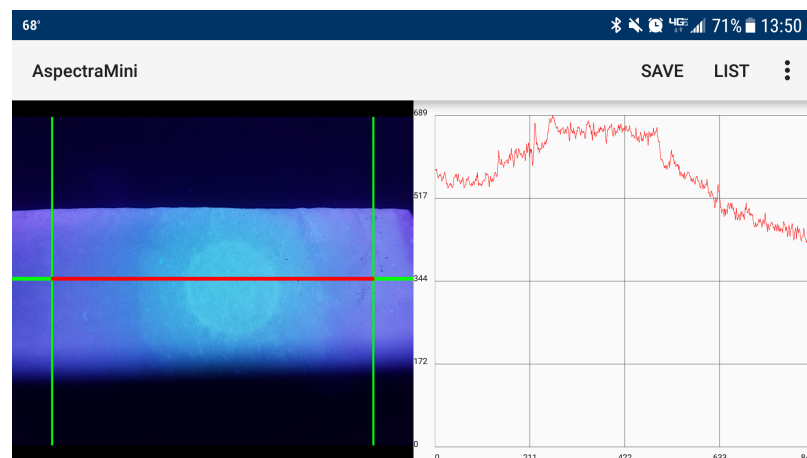
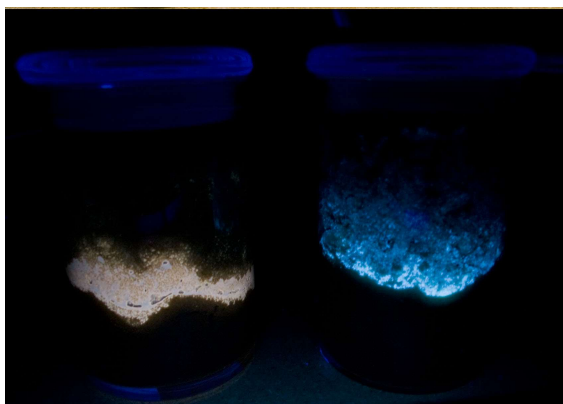
Photo Ionization Detector

Halogen Specific Detector





Other Chemistry Tools - Fluoroscope

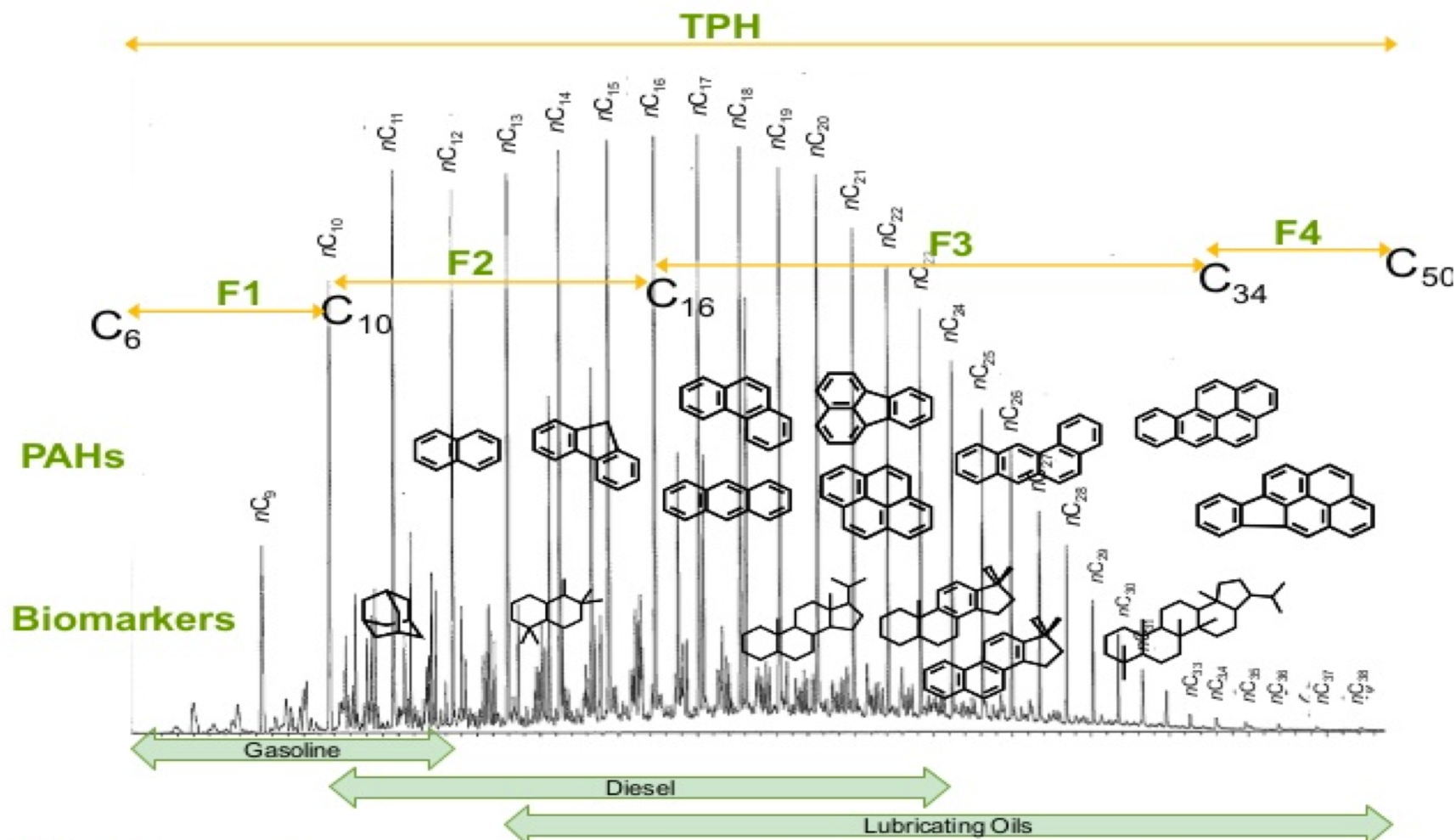




WEATHERED GASOLINE VS OTHER MID-RANGE PRODUCTS



Remember those PAHs?





Performance Testing Required!

**ASTM Standard
D7352 Standard Practice for the Membrane Interface
Probe (MIP) for Volatile Contaminant
Logging using Direct Push Methods**