Overview of technologies for chemistry and sampling

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Plan

- Field analysis and how to use it
- Summary of available field tools
- Methodologies to integrate and manage data
- Sampling issues
- Final thoughts

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Field Analysis

Portable instruments and test kits to measure the nature, quantities and spread of contamination in the field in real-time




- Rapid (~1 h)
- High sample throughput (20 samples per h)
- Relatively low cost (10 – 30 euros per sample)

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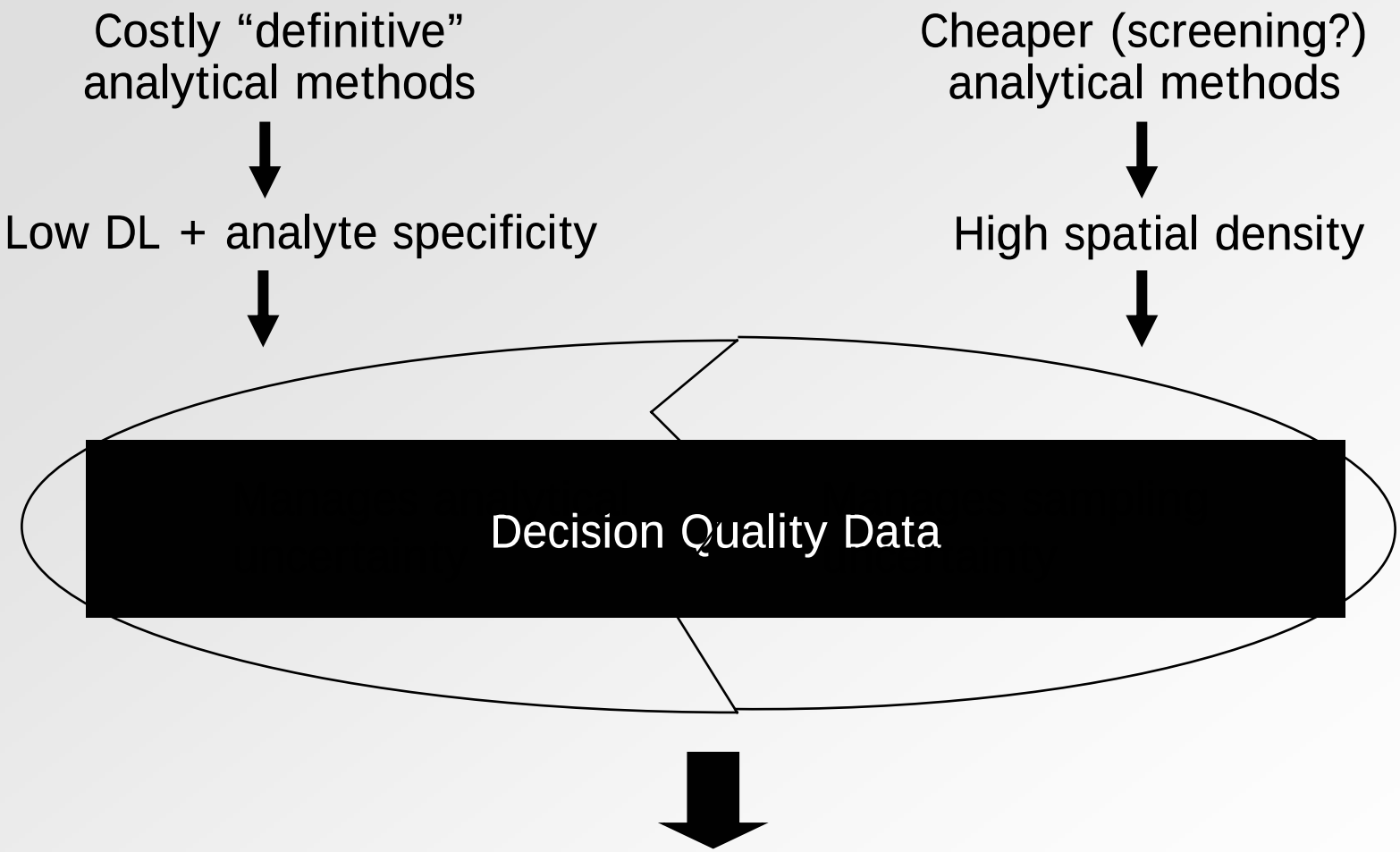
Field Analysis

An integrated Data Solution



Reliable (cost-effective) scientifically defensible decisions

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The value of field analysis

- Field analysis allows us to:
  - reduce uncertainty associated with contaminant heterogeneity
  - manage errors associated with sampling
- Also allows us to save significant amounts of project time
- Double positive – more defensible decisions and lower project costs

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Summary of available field tools

ORGANICS

- Chemical test kits
- Immunoassays
- UV Fluorescence
- Electrochemical method
- PID
- Portable GC/MS
- In situ probes

INORGANICS

- Portable XRF
- Colorimetric test kits

- Toxicity tests

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Organics – chemical test kits

PetroFLAG
- Turbidimetric test for TPH
- Rapid, low cost
- Not predictive for PAH and may suffer from interferences

RemediAID
- Colorimetric test for TPH
- Easy to use
- Less interferences

Hanby Test Kit
- Rapid
- Only qualitative
- Suffers from interferences
- Solvent particularly hazardous

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Organics – Immunoassays

RaPID Assay

- Competitive ELISA test using paramagnetic beads
- Test available for a range of compounds (BTEX-TPH, PAH)
- Sensitive (~0.1 ppm)
- Batch test, requires training
- Can overestimate, but still predictive
- Auditable results as a print-out

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Organics – UV Fluorescence

SiteLAB UVF-3100

- Wavelength of reflected UV fluorescence allows measurement of TPH, PAH and PCB
- Easy and low per sample cost
- Measurement window often too small

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Organics – Electrochemical method

L-2000 DX

- Chloride selective electrode for chlorinated solvents
- Only low cost tool available for this contaminant
- Lack of specificity (PCE and TCE)

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Organics – PID

UltraRAE PID

- Measures volatile hydrocarbons by gas analysis
- Very rapid and easy to use
- Most common field tool
- Requires regular calibration
- Can suffer from interferences (depends on filter used)

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Organics – Portable GC/MS

Hapsite

- Semi-volatile organics analysis (TCE, carbon tetrachloride, BTEX chlorinated benzenes
- Highly specific and sensitive (ppb)
- Requires training and auditable QC/QA
- Hardware expensive

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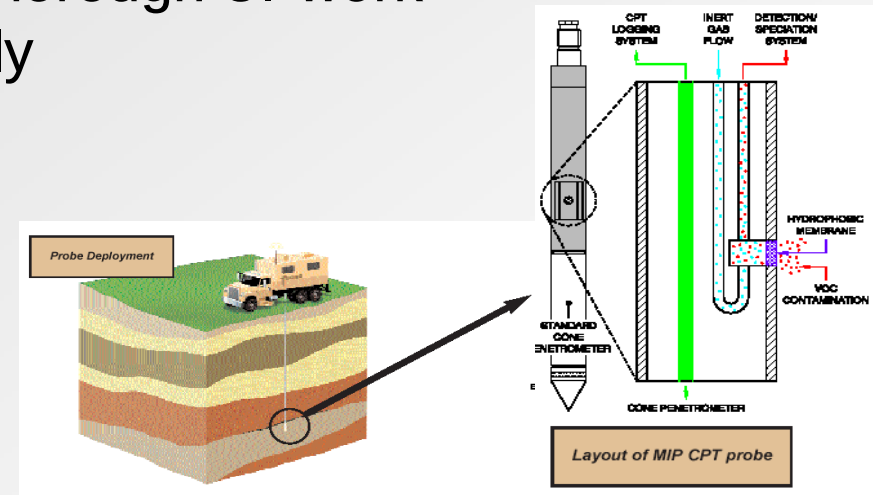
Organics – in situ probes

MIP & ROST

- MIP (Membrane Interface Probe) – volatiles and semi-volatiles
- ROST (Rapid Optical Screening Tool; laser induced fluorescence) – heavy-end hydrocarbons
- Only true in situ field tool
- Excellent for thorough SI work
- Qualitative only



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Inorganics – Portable XRF

Niton XLi/XLp/XLt 700

- Reflected produced x-rays give quantitation and speciation
- Excellent tool for metals analysis
- Hardware expensive, but low per sample cost
- Can be interferences and detection limit issues

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Inorganics – colorimetric tests

- Reagent kits for specific metals and cyanide
- Can have significant interferences and bias (still predictive)
- Relatively simple
- May require specific application development for soil

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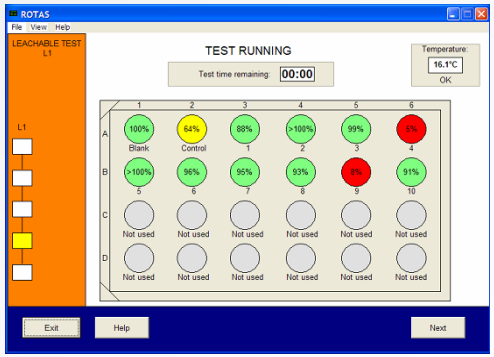
Toxicity Test

ROTAS™

- Bacterial bioluminescence total (acute) toxicity test
- Provides an estimate of total contaminant burden
- Detects the widest range of contaminants
- Easy, rapid, auditable
- Detection limit issues



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Methodologies to integrate and manage data

- How do I work with field and lab data?
- Can I make decisions on a field tool result?
- If I can quantify errors, can I account for these to give more certain, defensible decisions?

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How to integrate field analytics

- Cybersense has developed CyPlans™ – tool to assess technical and economic value of using field analytics within projects and facilitates integration

- CyPlans™ for SI and remediation work

- They include:
  - deriving data quality objectives
  - decision rule development
  - demonstration of method applicability

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How to manage field and lab data

- DUMAT™ is an on-site data management tool – DST
- Allows decisions to be taken with field tool data using a pre-defined level of confidence (e.g. 95%)
- Takes both fixed lab and field data and estimates all measurement errors
- Can be continuously updated as project proceeds improving accuracy
- First tool to allow project-specific management of laboratory and field data uncertainty

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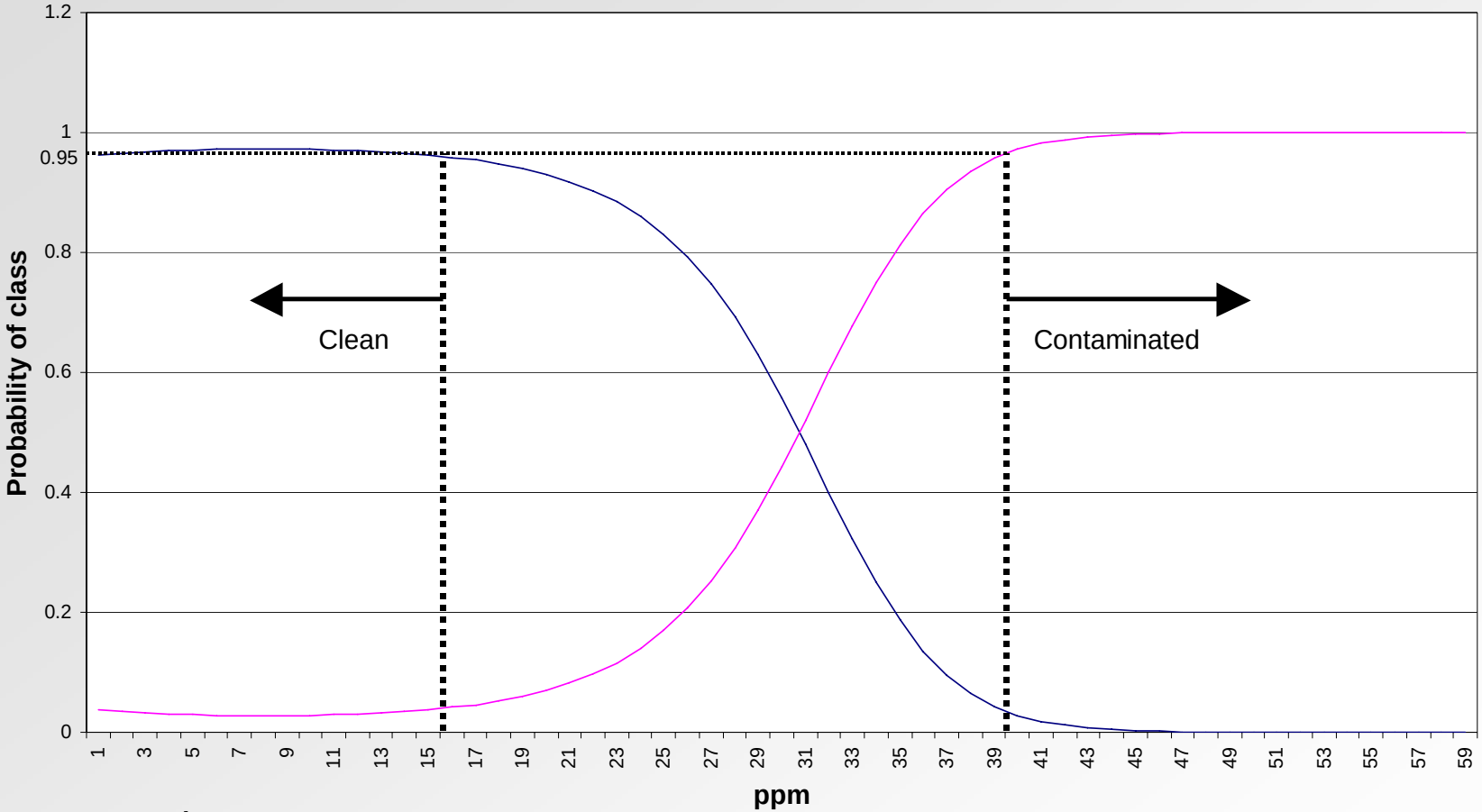
DUMAT™



For example:

- *If the field result is <19 ppm there is >95% certainty that the sample is 'clean'*
- *If the field result is >40 ppm there is >95% certainty that the sample is 'contaminated'*

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Sampling issues

- We typically analyse 1 mg soil (half a pinhead) for every tonne of soil
- We know smaller sub-samples produce more variable results
- Particle size affects contaminant distribution
- Contaminants vary in how they spread through soil - nugget effect
- The Minimum Economic Volume can drive sampling frequency

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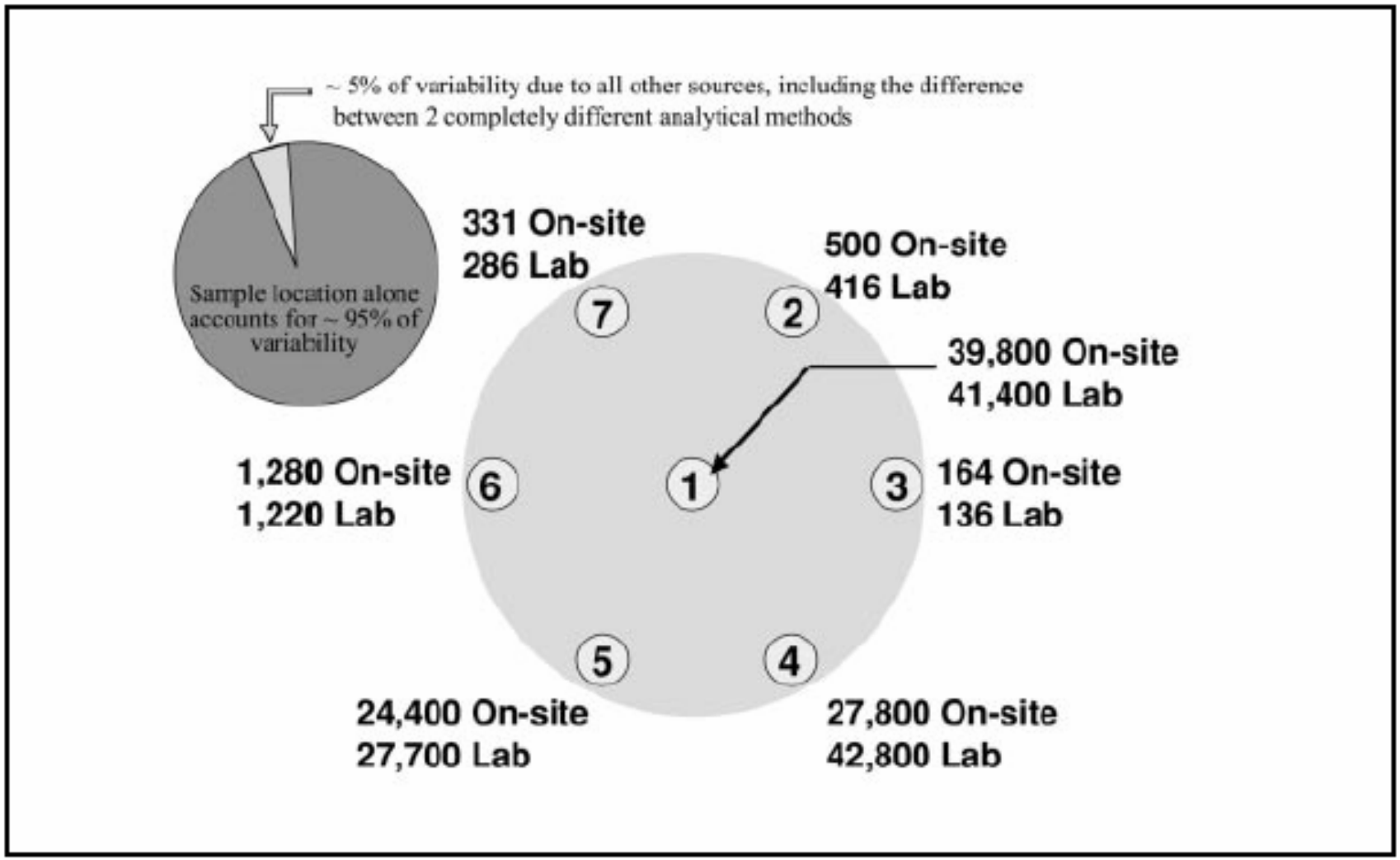
Example of sampling and contaminant heterogeneity



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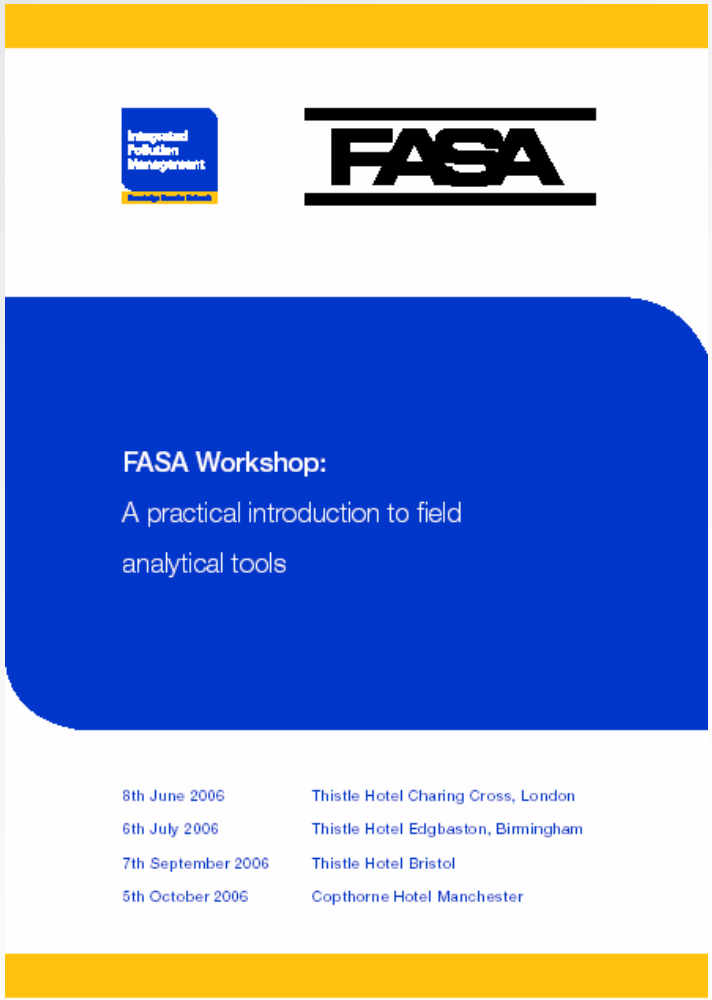
To find out more

- FASA workshops run by IPM-Net
- visit www.cysense.com



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Final thoughts

- Data quality underpins everything we do
- Lab data alone is usually insufficient to make timely, more certain and defendable decisions
- Field analysis can address the huge uncertainties typically associated with contaminated land work
- Field data must be collected and analysed appropriately
- Field tools do not just ‘bolt on’ to projects
- Data quality cannot be considered a cost issue or optional extra

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