Considerations for Characterization of PAHs at Skeet Ranges and the Possible Future of PAH Risk Assessment

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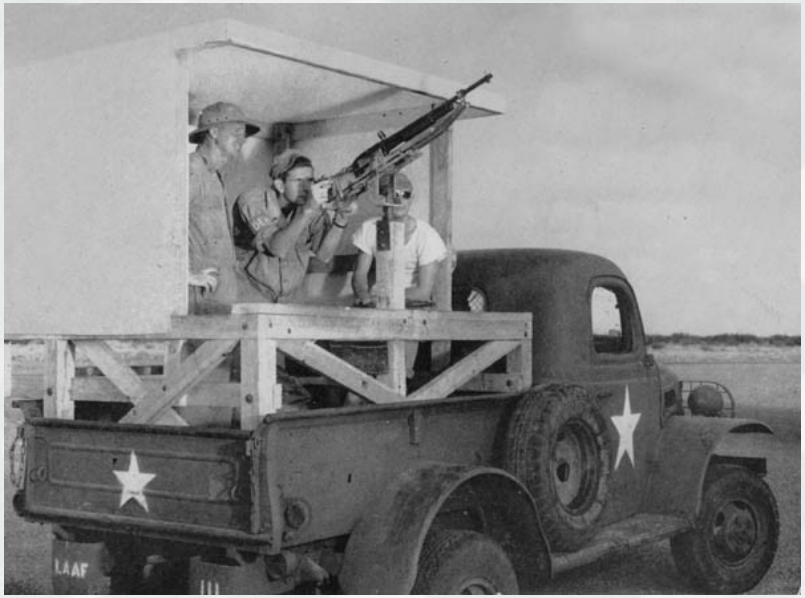
Shooting Skeet as Gunnery Training Component



Students, Using Shotguns Specially Mounted on Turrets, Learn How to Operate the Turrets as they Fire at Clay Pigeons Released from 40-foot High Towers

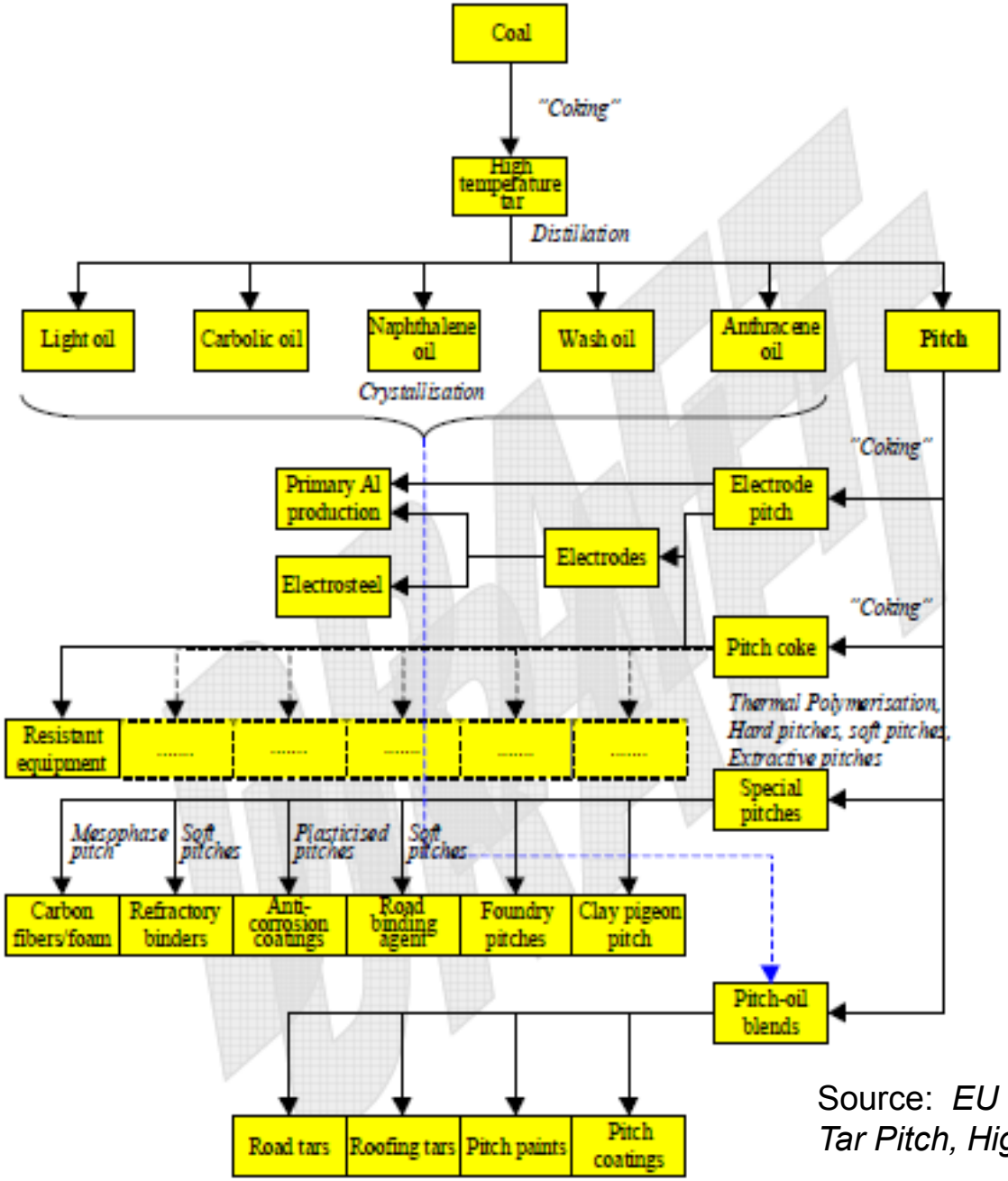
Photos provided by: Kingman Army Airfield Historical Society

Clay Pigeons Are Not MC Why Study It?

- It does not originate from munitions or ordnance; resulted from use of MEC
- Scoring in MRSPP assesses MC and any incidental nonmunition-related contaminants
- Whether chemicals contained in skeet pose an unacceptable risk needs to be answered (or otherwise addressed) to close out the site

Target Composition

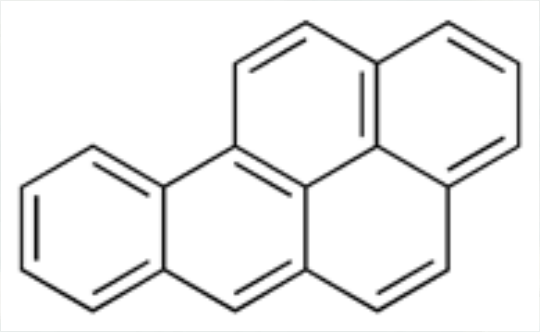
- Clay and binder; ~30% composition is coal tar pitch especially during 1940s
  - Provided the right balance between surviving throw and shattering when hit with shot
- Less toxic and more degradable targets now being manufactured
  - Petroleum pitch, soy etc
- Coal tar pitch is a complex mixture of organic compounds



Source: *EU Risk Assessment of Coal Tar Pitch, High Temperature,* draft 2007

Coal Tar Pitch

- Polycyclic aromatic hydrocarbons (PAHs) chemical class of most concern due to toxicity



- Benzo(a)pyrene most studied
  - ► Carcinogen
- Low soil screening level; 15 µg/kg

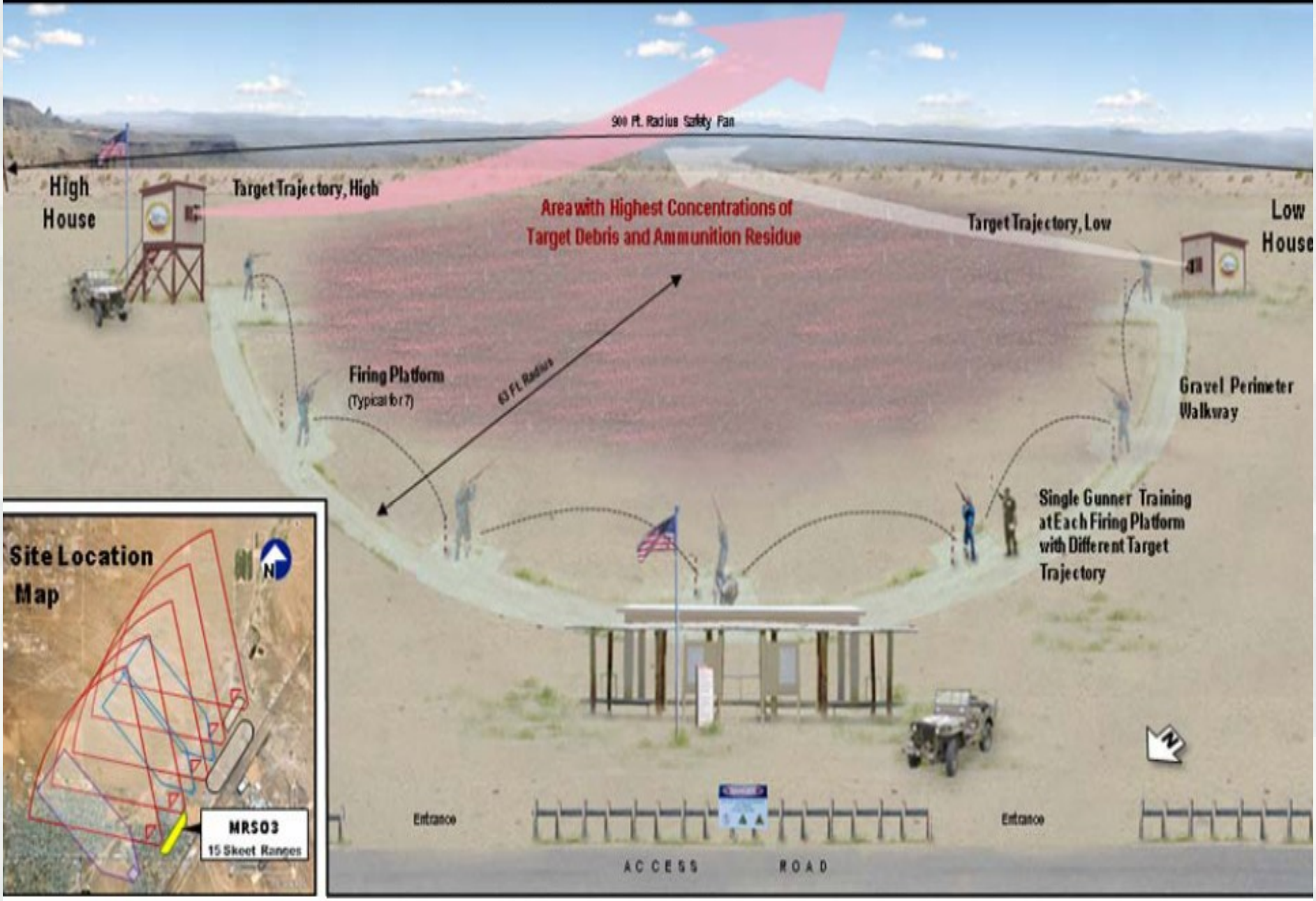
Source: EPA Regional Screening Level

Investigation Strategies

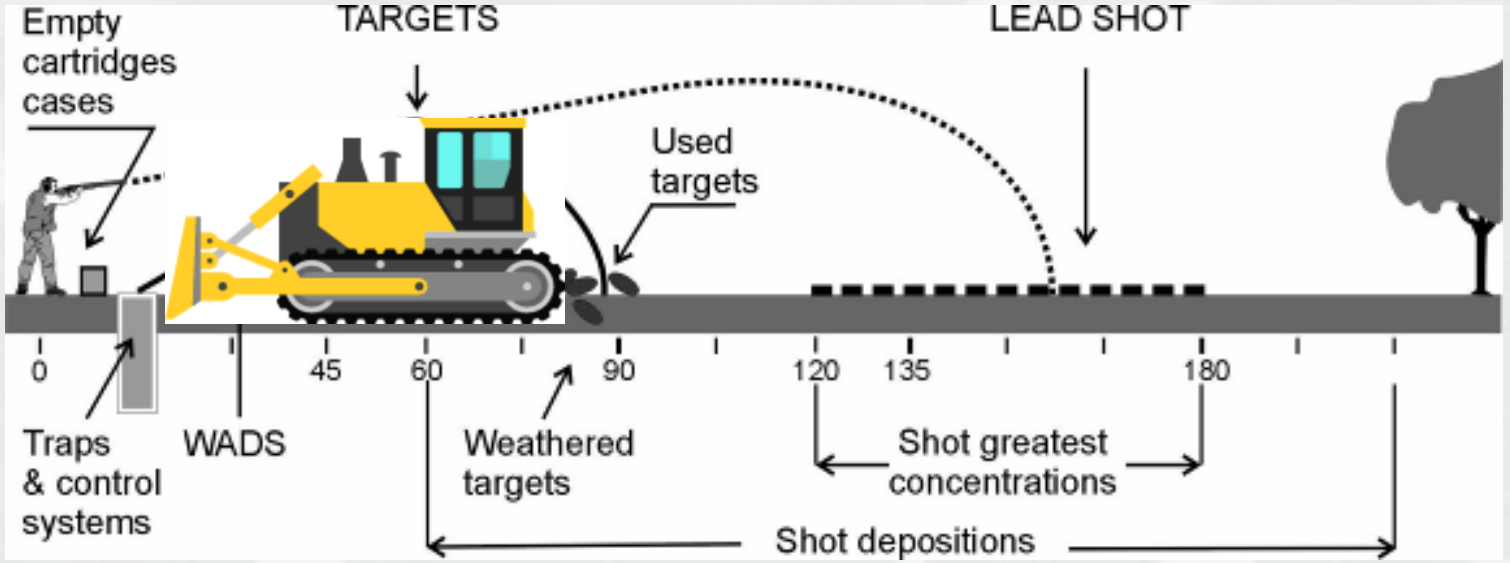
- Conceptual Site Model – consider past and subsequent site use
- PAHs in skeet not highly mobile
  - ▶ Soil will be media of primary concern
- Consider ambient sources
  - ▶ Roadways
  - ▶ Runoff from surface sealant
  - ▶ Forensics may add value at some sites

MRS03 - 15 Skeet Ranges

Former Kingman Ground-to-Ground Gunnery Range



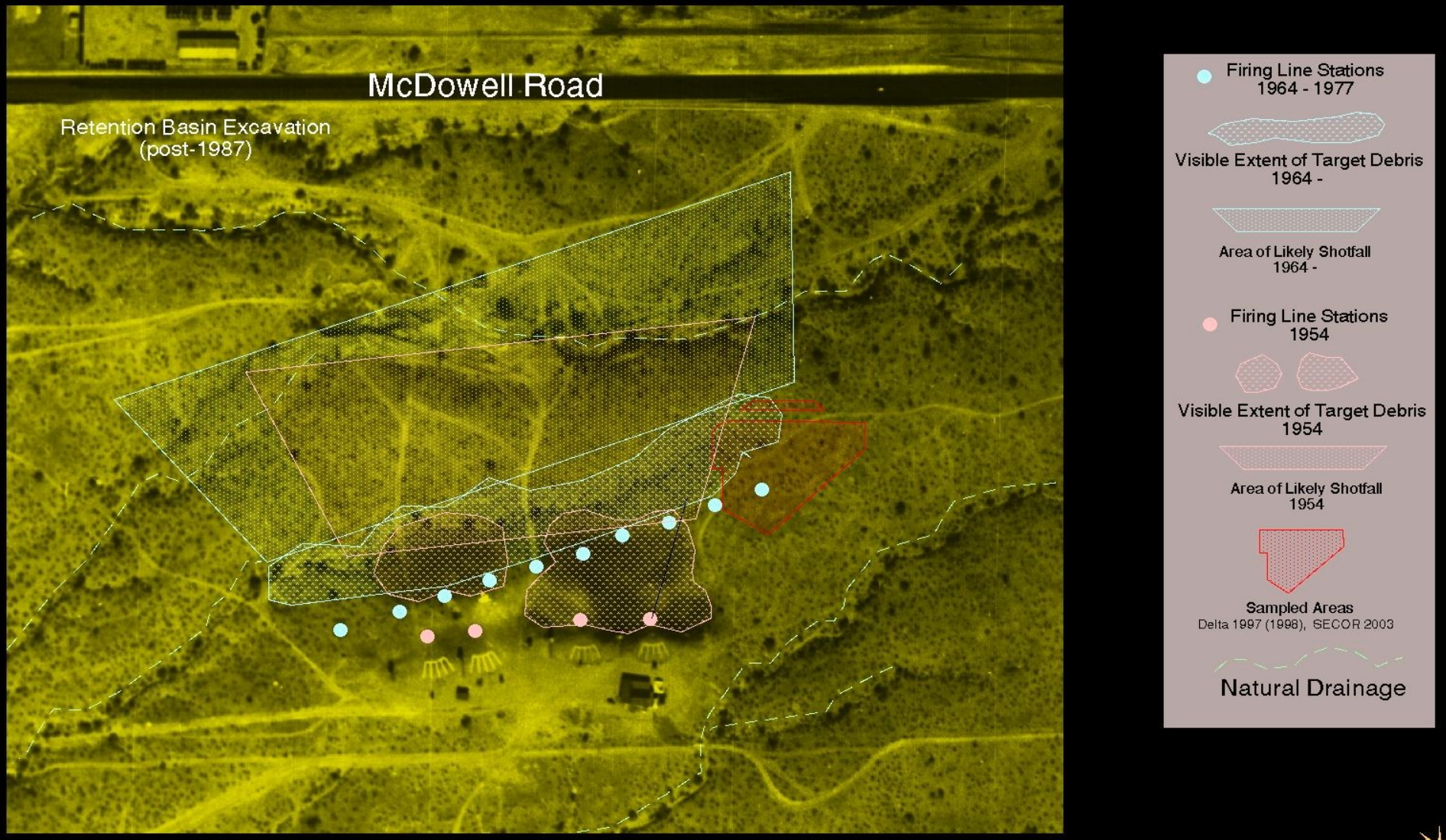
Conceptual Model (cont.)

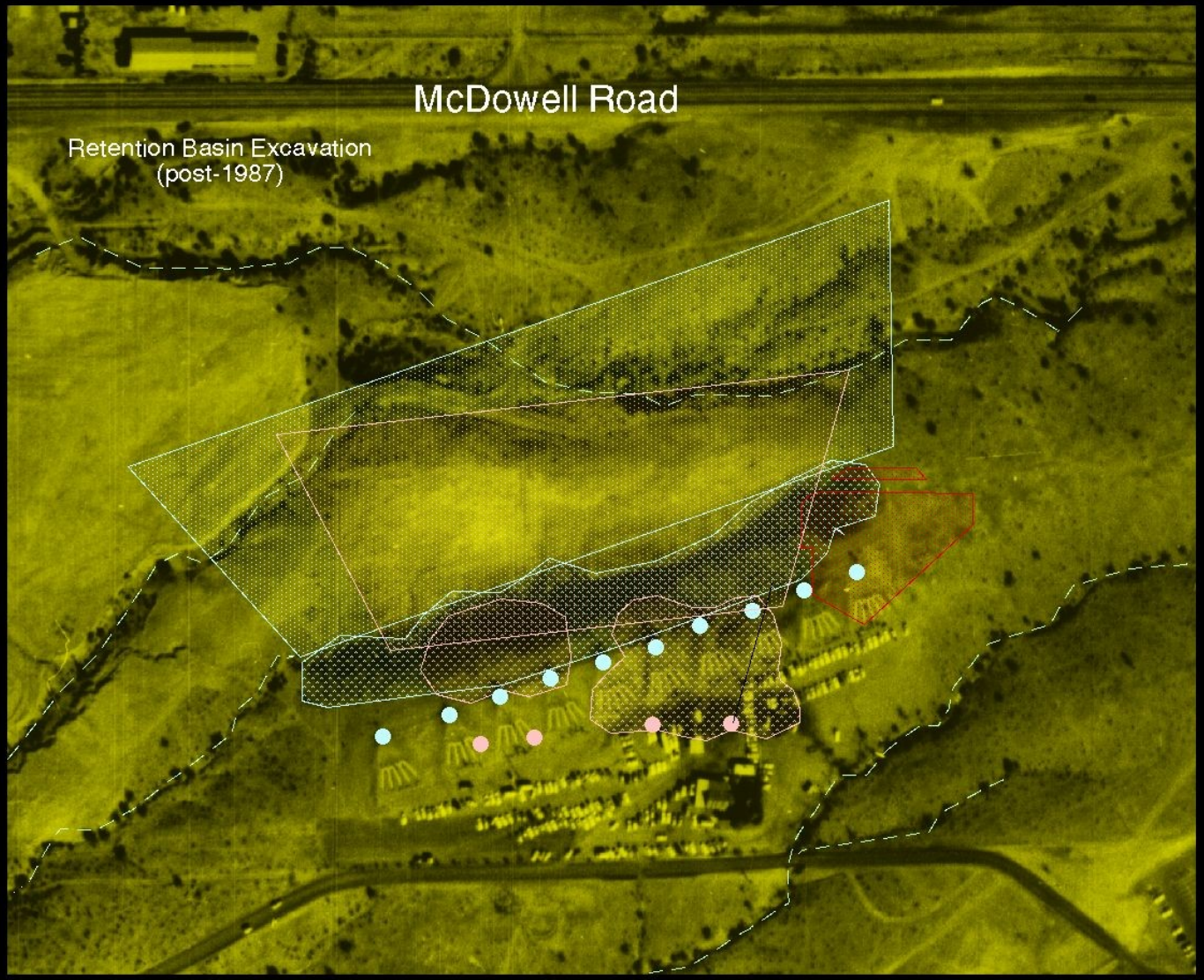


Flight paths of different materials resulting from clay target shooting (in meters, 1 m = 3.28 feet).

* ITRC, 2005

CSM Continued…..





Firing Line Stations
1964 - 1977

Visible Extent of Target Debris
1964 -

Area of Likely Shotfall
1964 -

Firing Line Stations
1954

Visible Extent of Target Debris
1954

Area of Likely Shotfall
1954

Sampled Areas
Delta 1997 (1998), SECOR 2003

Natural Drainage

Firing Line Stations
1964 - 1977

Visible Extent of Target Debris
1964 -

Area of Likely Shotfall
1964 -

Firing Line Stations
1954

Visible Extent of Target Debris
1954

Area of Likely Shotfall
1954

Sampled Areas
Delta 1997 (1998), SECOR 2003

Natural Drainage


3905

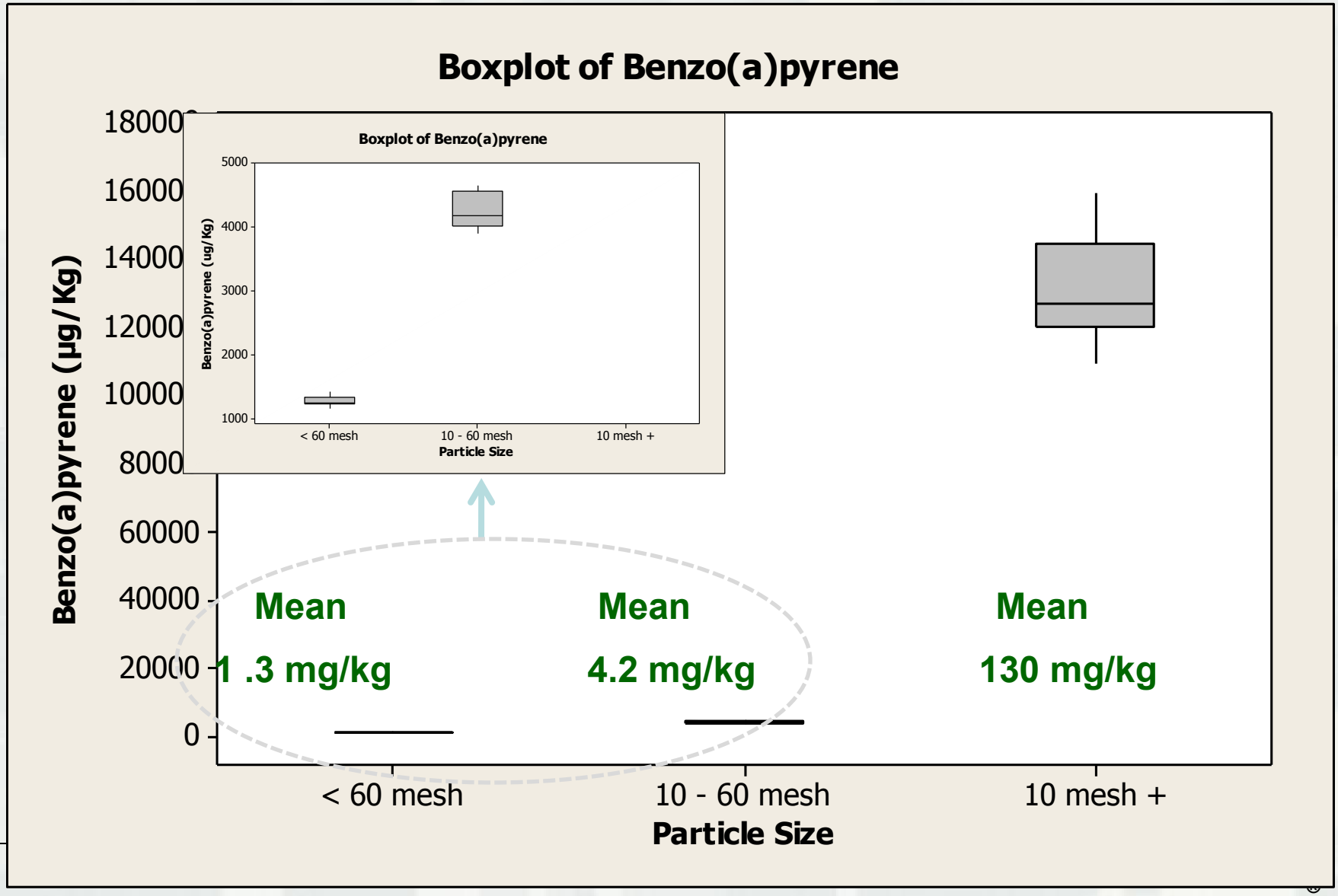
Investigation Strategies

- Reduce uncertainty in CSM and in risk assessment; better informed decisions
  - Location/ size of fragments? Likelihood of exposure?
  - Are risk assessment assumptions valid and representative of exposure?
  - Fragment size
  - Relative bioavailability

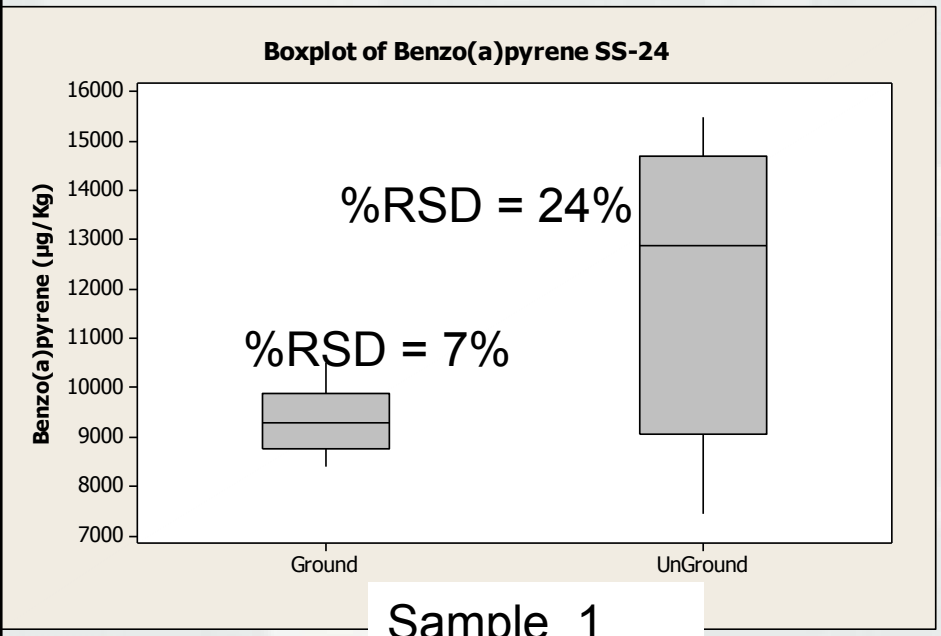
Site Inspection Results

- 108 mg/kg B(a)P
- Another MRS with less visible target debris; 6.56 mg/kg B(a)P
- Ambient 0.0135 mg/kg B(a)P
- AZ Soil Remediation Level = 0.069 mg/kg
- RSL = 0.015 mg/kg

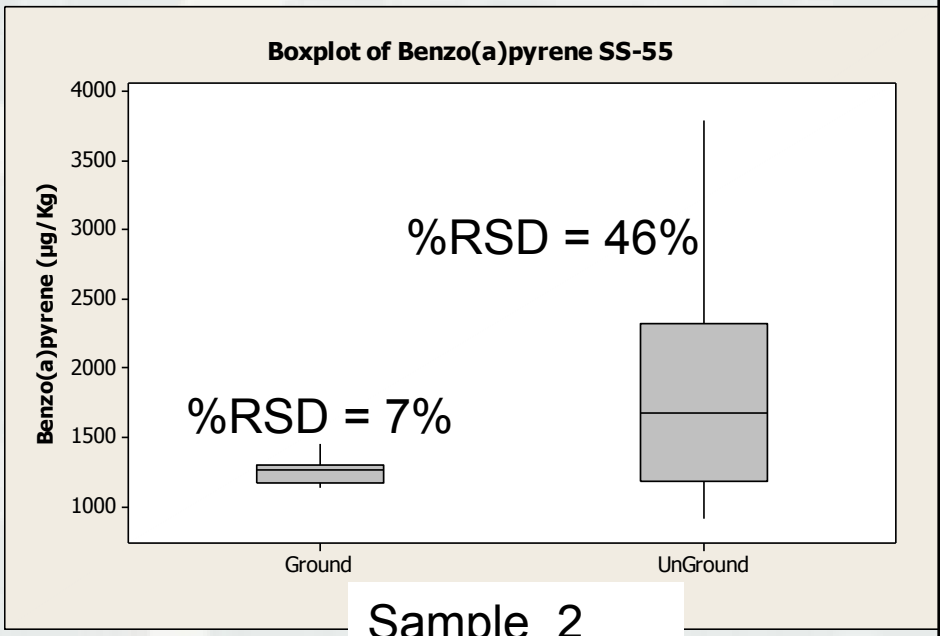
Fractionation Study



Ground (G) vs. Unground (UG) PAHs : Laboratory Sub-sampling Variability

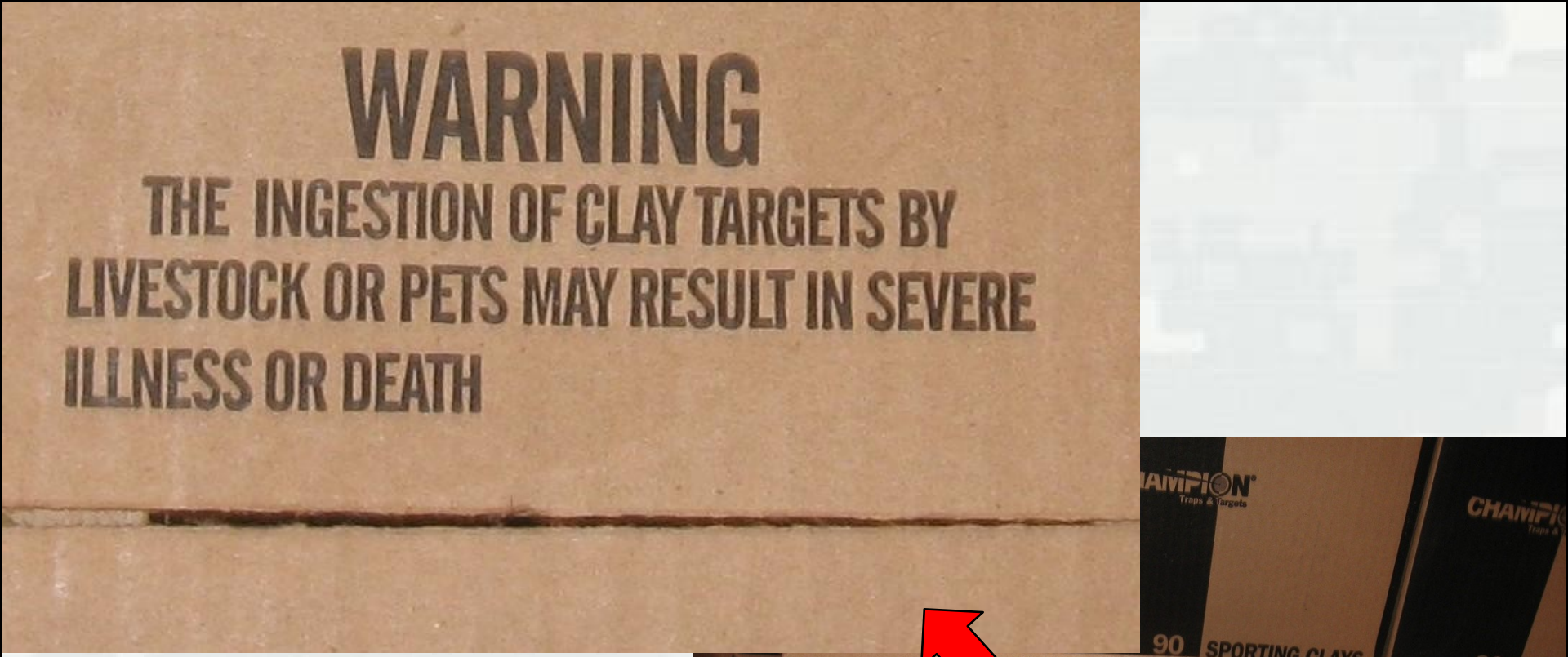


Sample 1

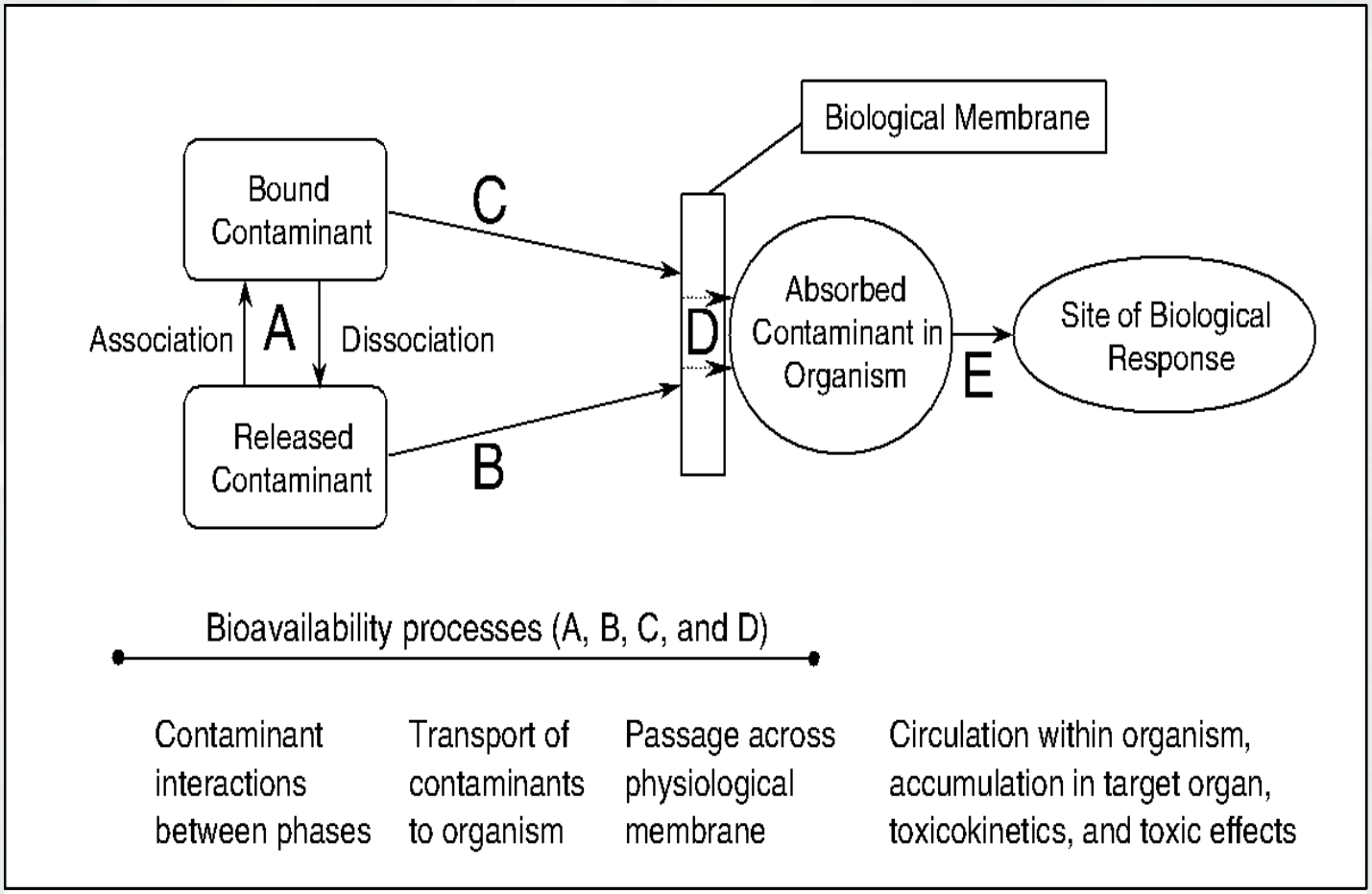


Sample 2

- Each of the sample from same ¼ acre decision unit.
- 2-kg IS of 100 increments from surface soils (0 – 2 inches)
- *n* = 15 G & UG 10-g lab replicates each by Method 8270C/3540C.



Are PAHs bioaccessible and bioavailable in weathered clay targets?



PAH bioavailability varies by compound, studies would reduce uncertainty. Relative bioavailability may range from 0.1 to 0.76, with 0.3 being typical.

ER-1743: PAH Interactions with Soil and Effects on Bioaccessibility and Bioavailability to Humans

- Goal is to produce an easy to run extraction test to model oral bioavailability
  - Examine bioavailability in soil matrix
  - Gain insight in mechanism soil pH chemistry that controls oral bioavailability
- Produce data to change default dermal absorption values
  - 13% is current default for dermal absorption
- Three year project

Potential Changes in Risk Assessment of PAHs

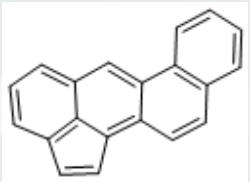
- Relative potency factors used to assess carcinogenicity of PAHs – all set relative to benzo(a)pyrene
- EPA: "Development of a Relative Potency Factor (RPF) Approach for Polycyclic Aromatic Hydrocarbon (PAH) Mixtures"
  - ► Under review by EPA Science Advisory Board
- RPF approach retained but updated by new data/science

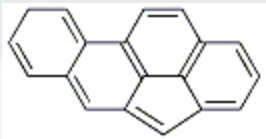
Carcinogenic PAHs and Relative Potency Factors

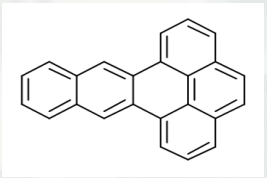
	Current RPF	Draft RPF
Benzo(a)pyrene	1	1
Benz(a)anthracene	0.1	0.2
Benzo(b)fluoranthene	0.1	0.5
Benzo(k)Fluoranthene	0.01	0.03
Chrysene	0.001	0.1
Dibenz(a,h)anthracene	1	6
Indeno(1,2,3-c,d)pyrene	0.1	0.07

Additional PAHs from 2010 RPF Assessment

- Anthanthrene
- Benzo[g,h,i]perylene
- Benzo[j]fluoranthene
- Cyclopenta[c,d]pyrene
- Dibenzo[a,e]fluoranthene
- Dibenzo[a,e]pyrene
- Dibenzo[a,h]pyrene
- Dibenzo[a,i]pyrene
- Dibenzo[a,l]pyrene
- Fluoranthene
- Benz[b,c]aceanthrylene
- Benz[e]aceanthrylene
- Benz[j]aceanthrylene (60x)
- Benz[l]aceanthrylene
- Cyclopenta[d,e,f]chrysene
- Naphtho[2,3-e]pyrene







Time for Questions?