Detailed Ecological Risk Assessment: N.E. British Columbia: Wildlife Protection and Extractable Aliphatic Hydrocarbons

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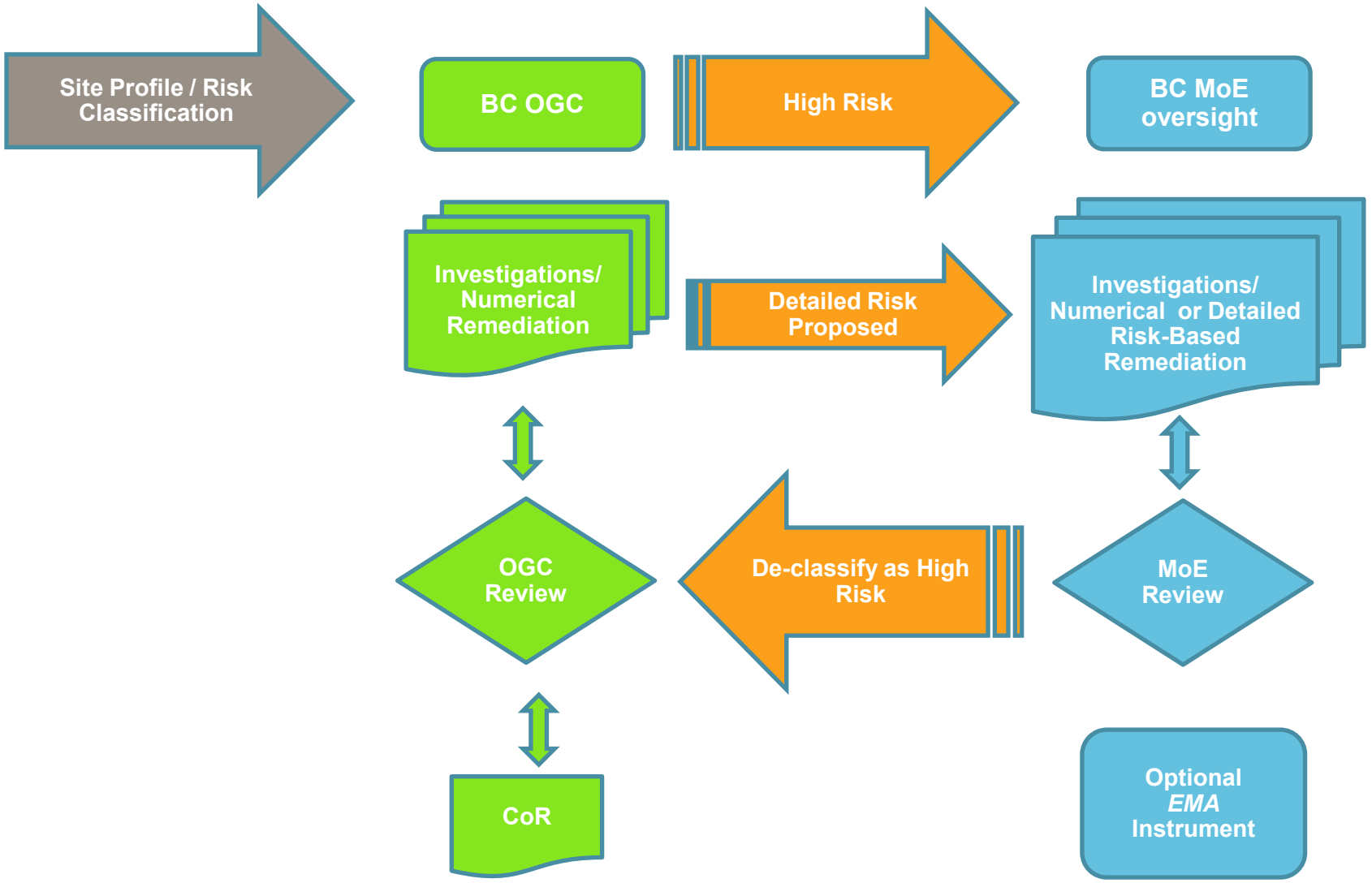
AECOM

Oil & Gas Commission – BC MoE Linkage



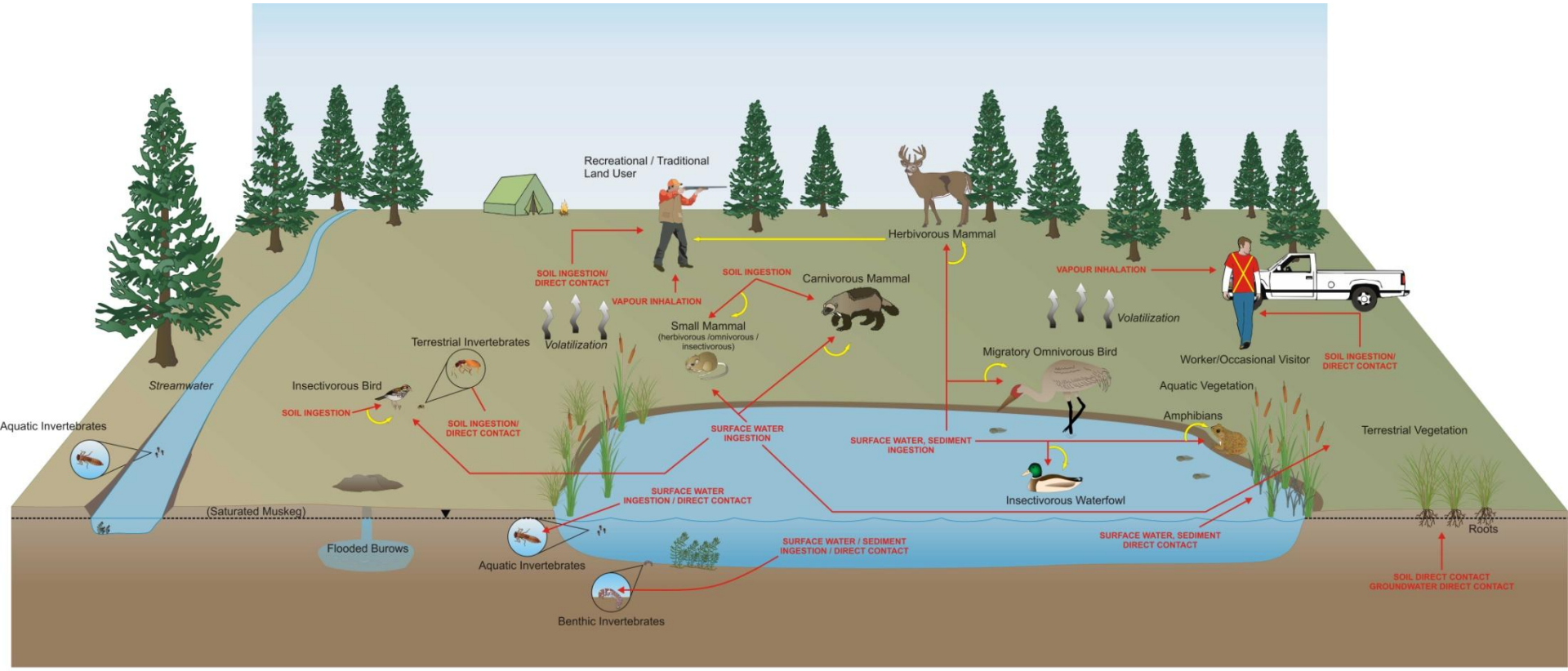
Detailed Ecological Risk Assessment Content

1. Comprehensive Problem Formulation
2. Comprehensive Understanding of Exposure
3. Ecologically Relevant Effects Assessment
4. Risk Characterization
5. Uncertainty Analysis

Rationale for Selection of Wildlife Receptors

Receptor	Societal Value	Ecology/ Feeding Guild	Susceptibility/ Exposure	Habitat scale	Data Availability
Nelson's sharp-tail sparrow	BC Red Listed (high)	Migratory passerine insectivore	Ground nesting and ground foraging (high)	Small wetland areas	Limited
Caribou	BC Red Listed SARA Sch. 1 (high)	Ungulate mammalian herbivore	Observed feeding on site (high/moderate)	Large home range	Moderate/ limited
Wolverine	BC Blue Listed Fur bearing (moderate)	Mammalian omnivore/ carnivore	Contaminants not bioaccumulative (low)	Large home range	Limited
Meadow vole	(low)	Small mammalian herbivore/ insectivore	Close contact with soil (high)	Small – within site	Good

Conceptual Site Model



Dietary Component (Food Chain Uptake)

Direct Exposure Pathway

Wildlife Exposure Models

$$ADD_{pot} = \left(\sum_{k=1}^{m} (C_k \times FS \times I_{df} \times FR_k)\right)/BW$$

Incidental soil

$$ADD_{pot} = \left(\sum_{k=1}^{m} (C_k \times I_{ff} \times FR_k)\right)/BW$$

Dietary food items

$$ADD_{adj} = SUF \times ADD_{pot}$$

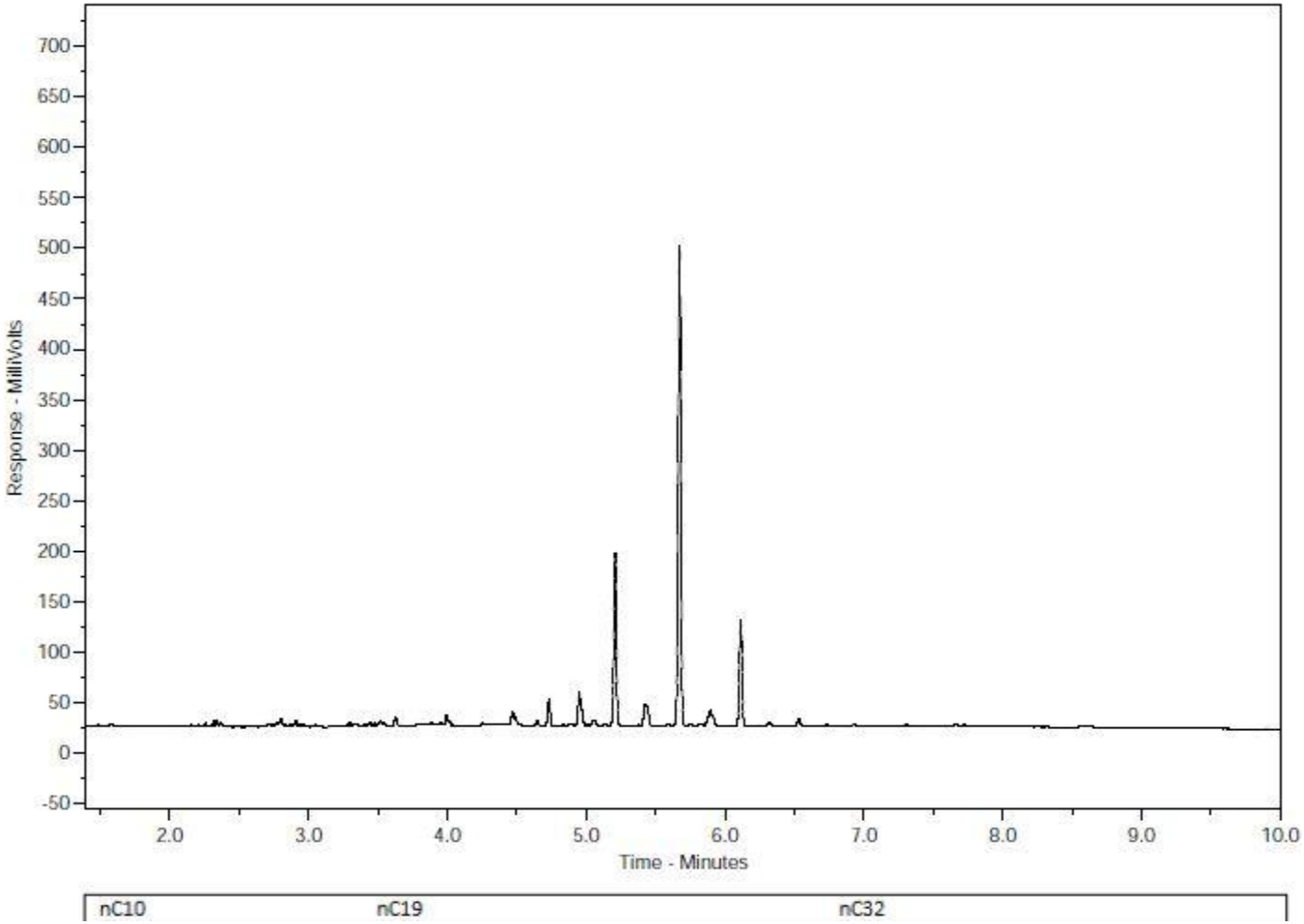
Seasonal Adjusted Dose

Do Aliphatic Hydrocarbons Transfer Through Food Chains ?

- MacLeod *et al.* (2004) _ fugacity model predicting food chain transfer to fish, mammals and birds
  - No field validation and used carbon ranges too low (C_3 – C_{12}) for weathered crude
- Chaineau *et al.* (1996) _ field scale uptake study using 1.2% hyrocarbon contaminated soil
  - After 110 days of growth maize stems and leaves showed no detectable aliphatic or aromatic hydrocarbon
- Brandt *et al.* (2002) _ field scale, multi year quantification of poly-aromatic hydrocarbons (PAH) in soil and terrestrial biota
  - mice and grasshoppers consistently displayed lower tissue PAH then frogs and vegetation

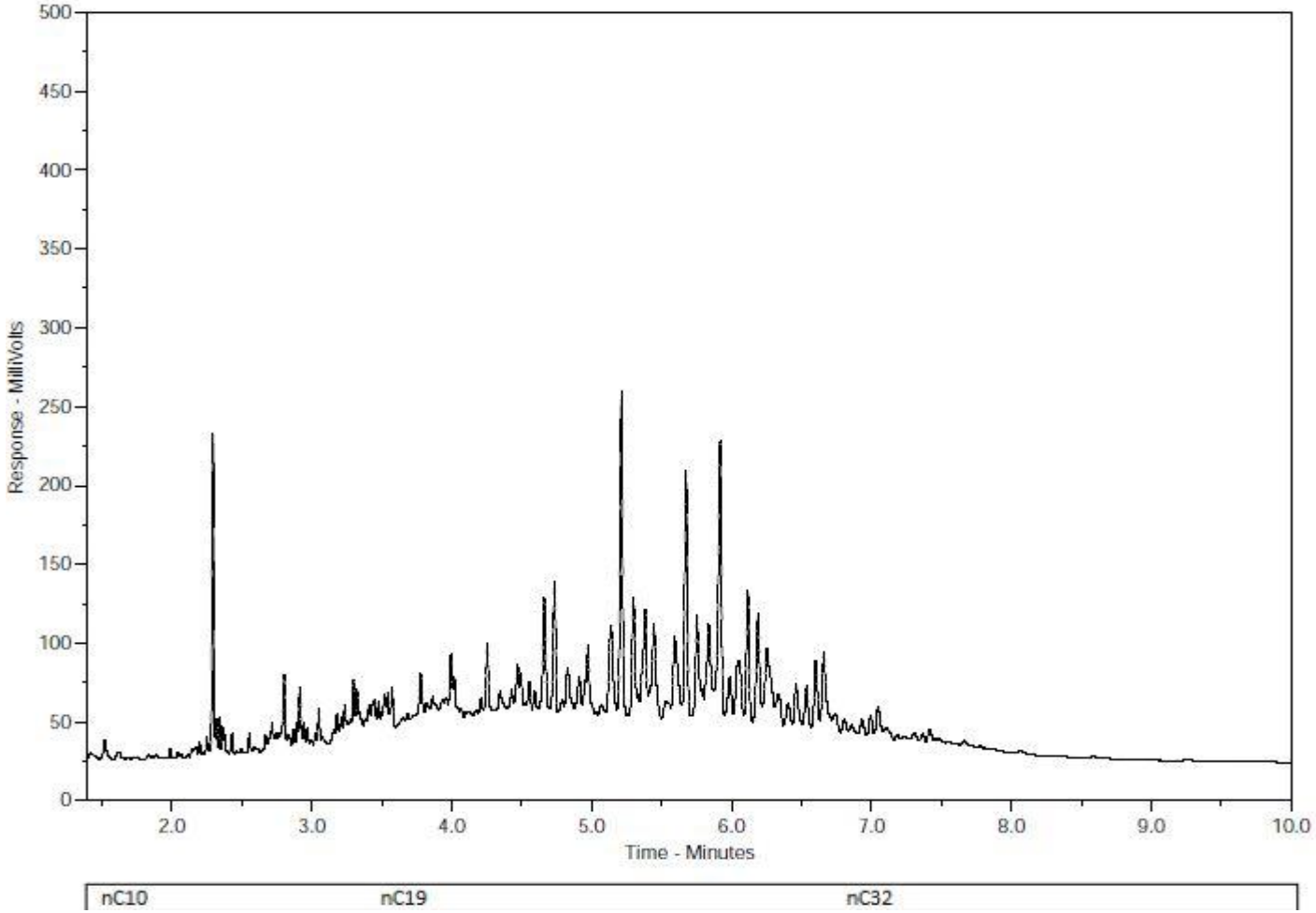
Aliphatic Hydrocarbons in Food Chains: Salix leaves

ALS Sample ID: L1044695-7
Client Sample ID: SALIX 11-07



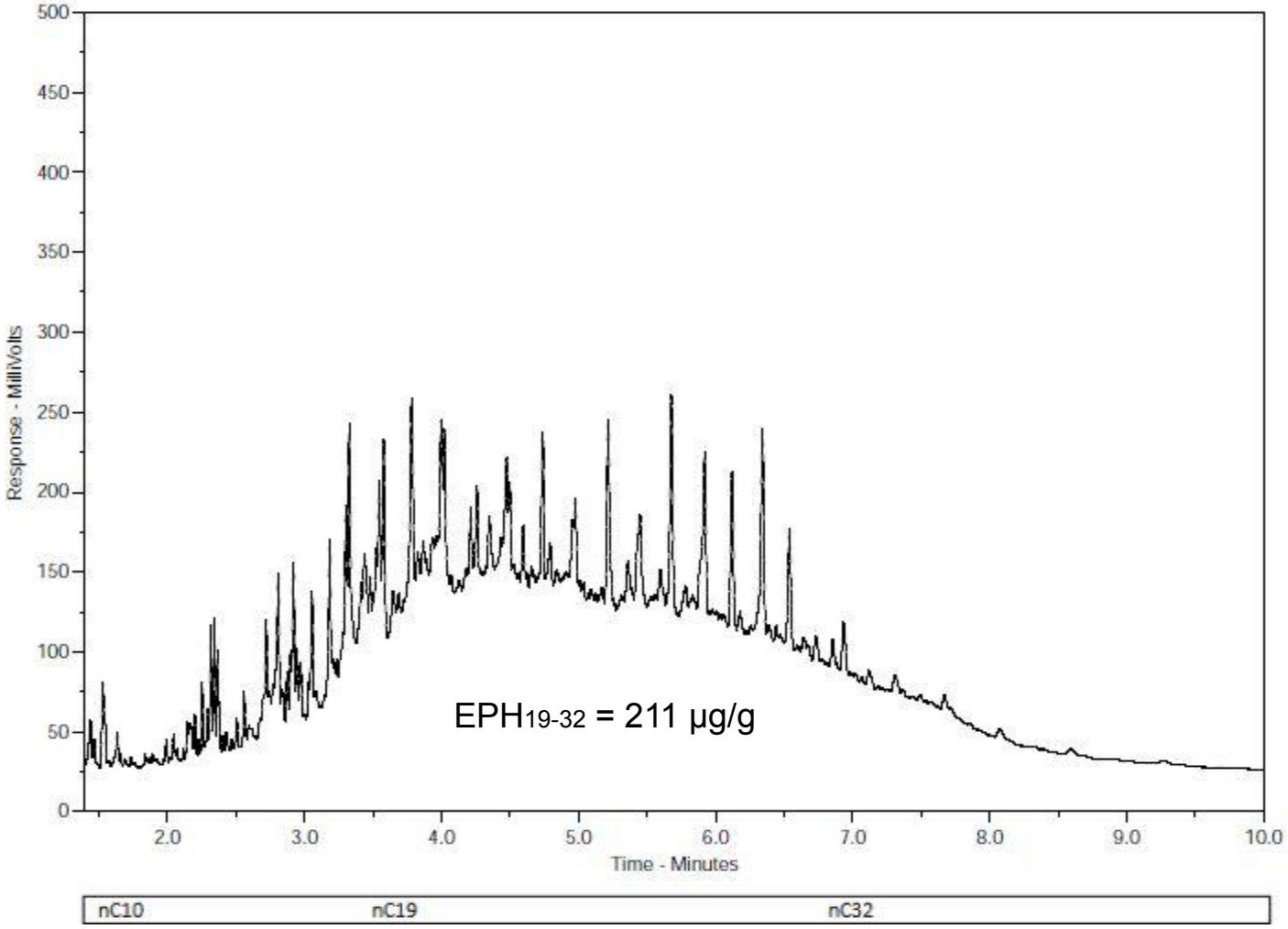
Aliphatic Hydrocarbons in Food Chains: Frogs

ALS Sample ID: L1044695-40
Client Sample ID: ONSITE FROGS SMALL



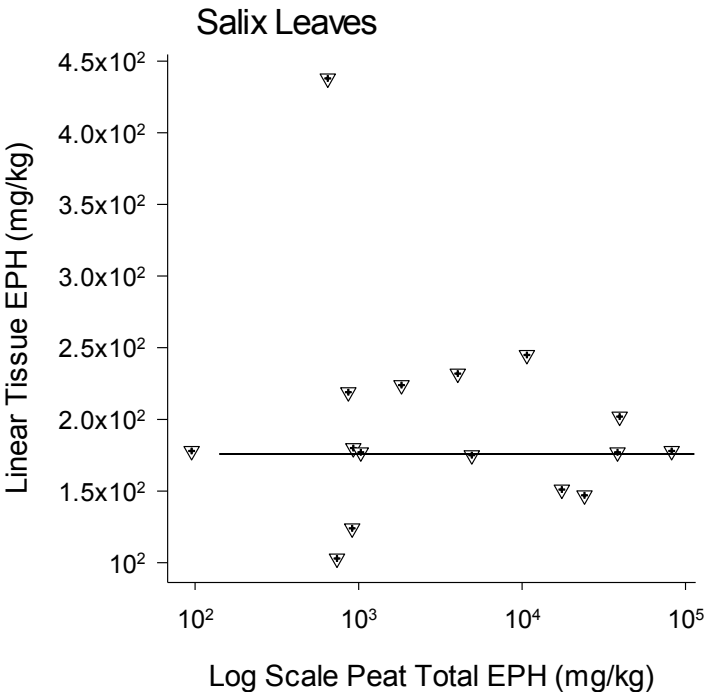
Aliphatic Hydrocarbons in Food Chains: Carex shoots

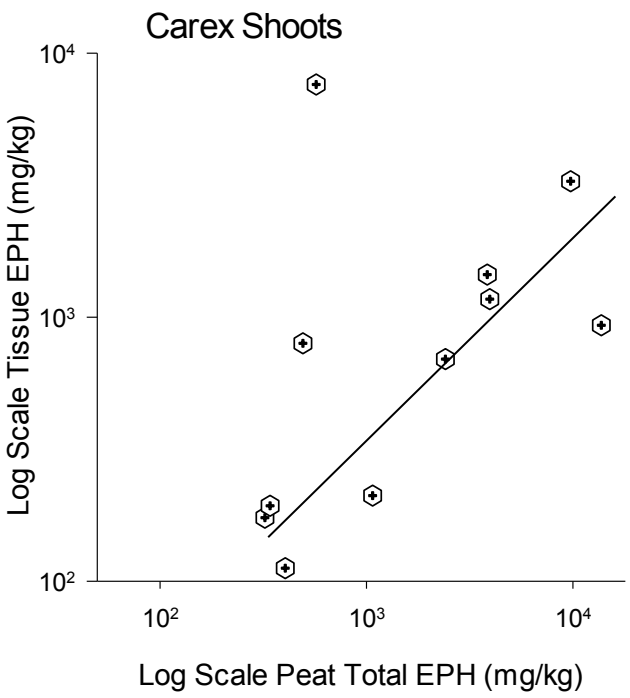
ALS Sample ID: L1044695-33
Client Sample ID: CAREX 11-15



$EPH_{19\text{-}32}$ = 211 µg/g

Soil – Vegetation Tissue EPH Relationship





Carex shoot EPH influenced by adsorbed peat ?

Aliphatic Hydrocarbons: Wildlife Toxicity Reference Values (TRVs)

EPH Wildlife Toxicity Reference Values

CCME CWS Basis for Livestock Protection:

Stober (1962),Vetraglichkeitsprufungen mit roh und Heizol an Rindern (*Research of cattle tolerability to raw and heating oil*)

CCME CWS Basis for Human Health Protection (aliphatic fractions c8-c16 & c17-c34)

Edwards *et al*, (1997) , Total Petroleum Hydrocarbon Criteria Working Group Series, Volume 4

Toxicological Studies Used in CCME TRVs

- Stober (1962) Stalled cattle orally dosed raw oil
  - Toxic threshold (weathered) = **8 mL / kg body weight**
  - Toxic threshold (fresh) = **2.5 mL / kg body weight**
  - Toxic threshold (naptha) = **4 mL / kg body weight**
  - Effects on digestive system and liver

n = 1

- Edwards *et al.* (1997) Rats orally dosed
  - Aliphatic c8-c17 hydrocarbon streams (unpublished)
    - Lowest observed effects = **500 mg / kg body weight**
    - Increased liver weight and size (reversible)
  - Aliphatic c17-c34 mineral oil (Smith *et al.* 1996)
    - Lowest observed effects = **2000 mg / kg body weight**
    - Mineral oil nodules in the liver tissue with associated inflammation

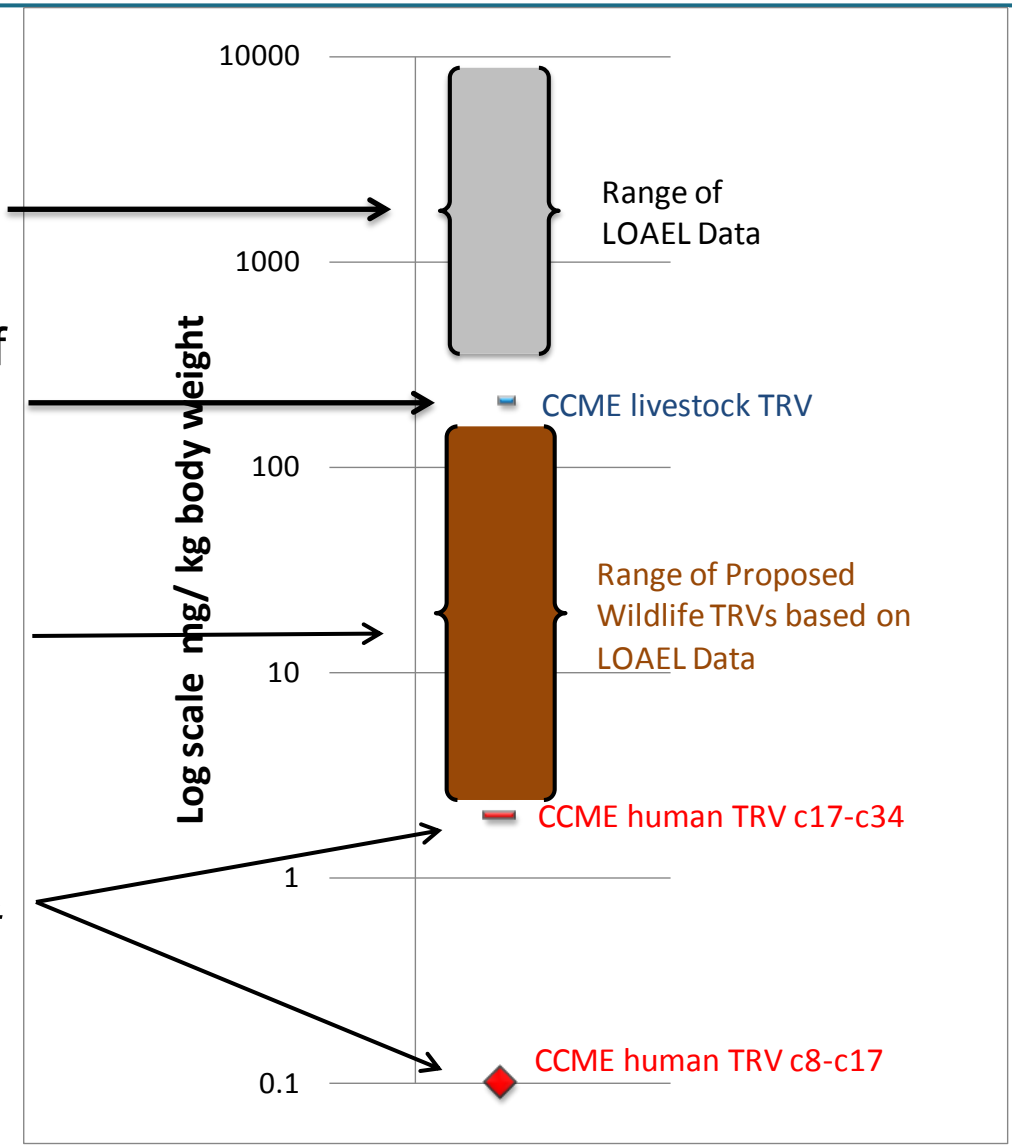
Application of Uncertainty Factors (UF) in TRVs

All Lowest Observed Adverse Effects (LOAEL) data within the grey area.

Livestock TRV: Application of UF of 10 to Stober,1962 LOAEL

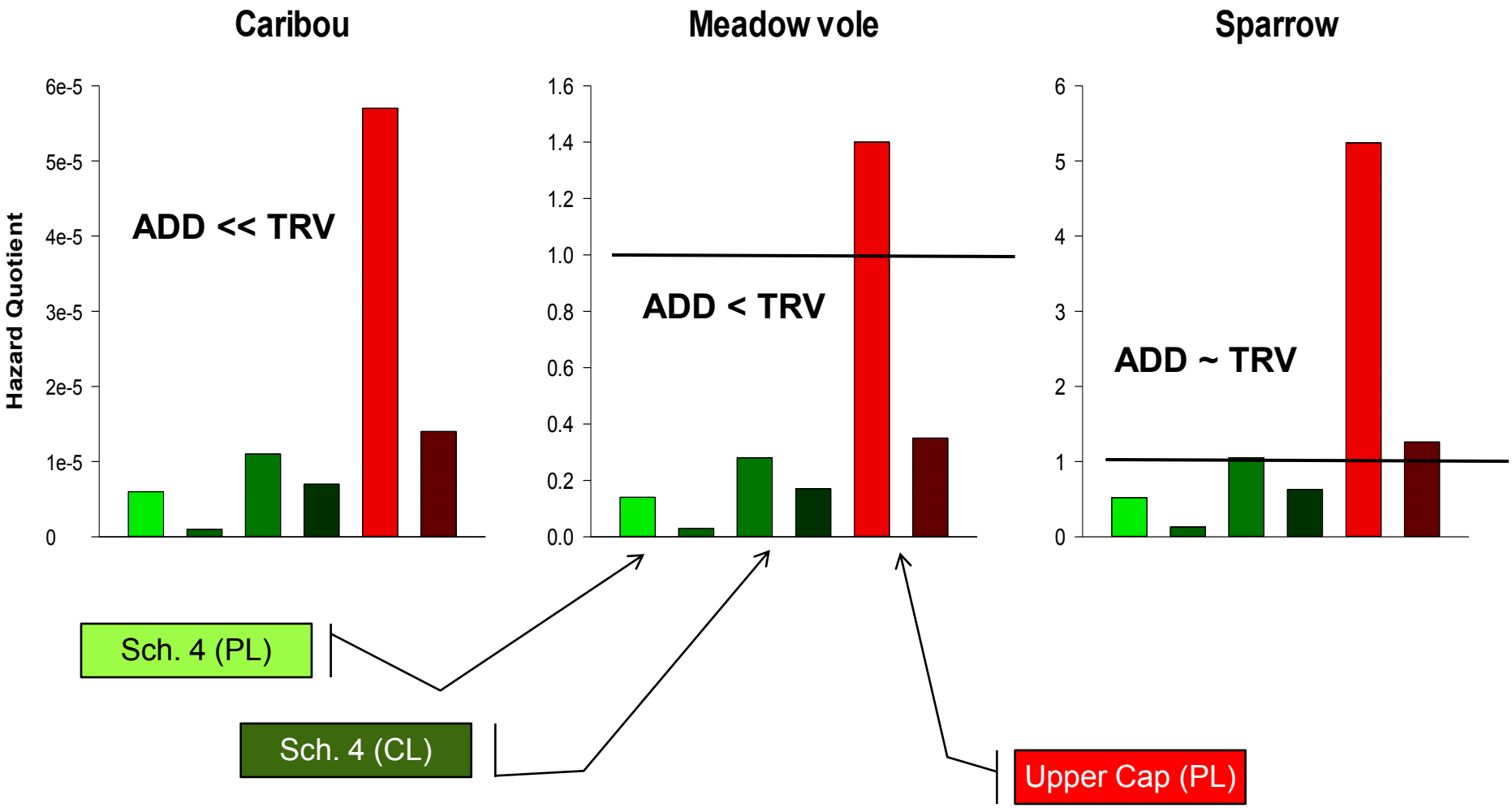
Wildlife TRV: Apply range of UF to Edwards *et al*, 1997 LOAELs

Human TRV: Application of 100 – 1000 UF to Edwards *et al*, 1997 NOAELs

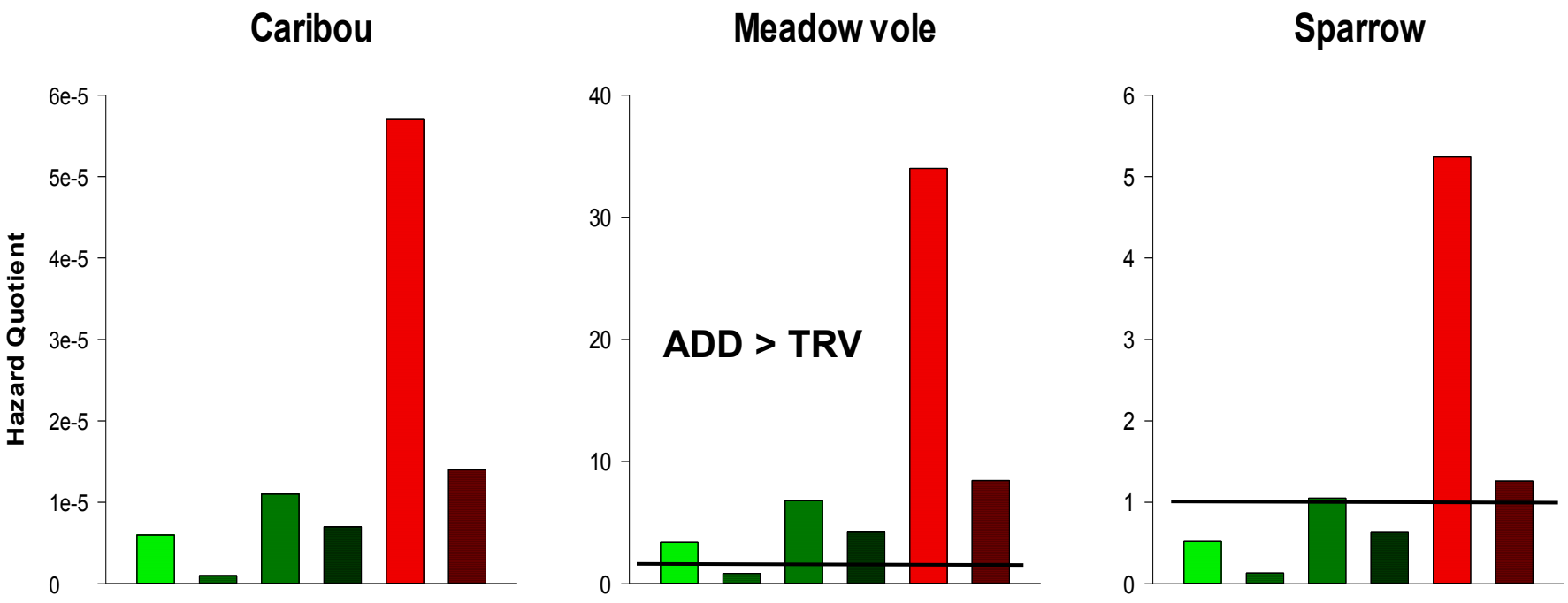


Aliphatic Hydrocarbons and Wildlife Protection: Results

Results: Incidental Soil Exposure



Results: Incidental Soil + Dietary Exposure (vole)



Soil→biota EPH uptake factor of 0.14

Risk-based remediation currently under utilized in NE British Columbia

BC MoE process has well defined guidance and can be navigated by experienced professionals

Ecological risk decisions will continue to be driven by protection of eco-contact receptors and not wildlife

Thank You

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