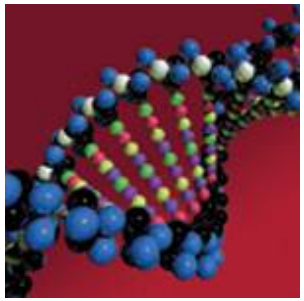
Human Health Risk Assessment



Undeveloped Stony Creek Floodplain

Noblesville, Indiana

May 14, 2009

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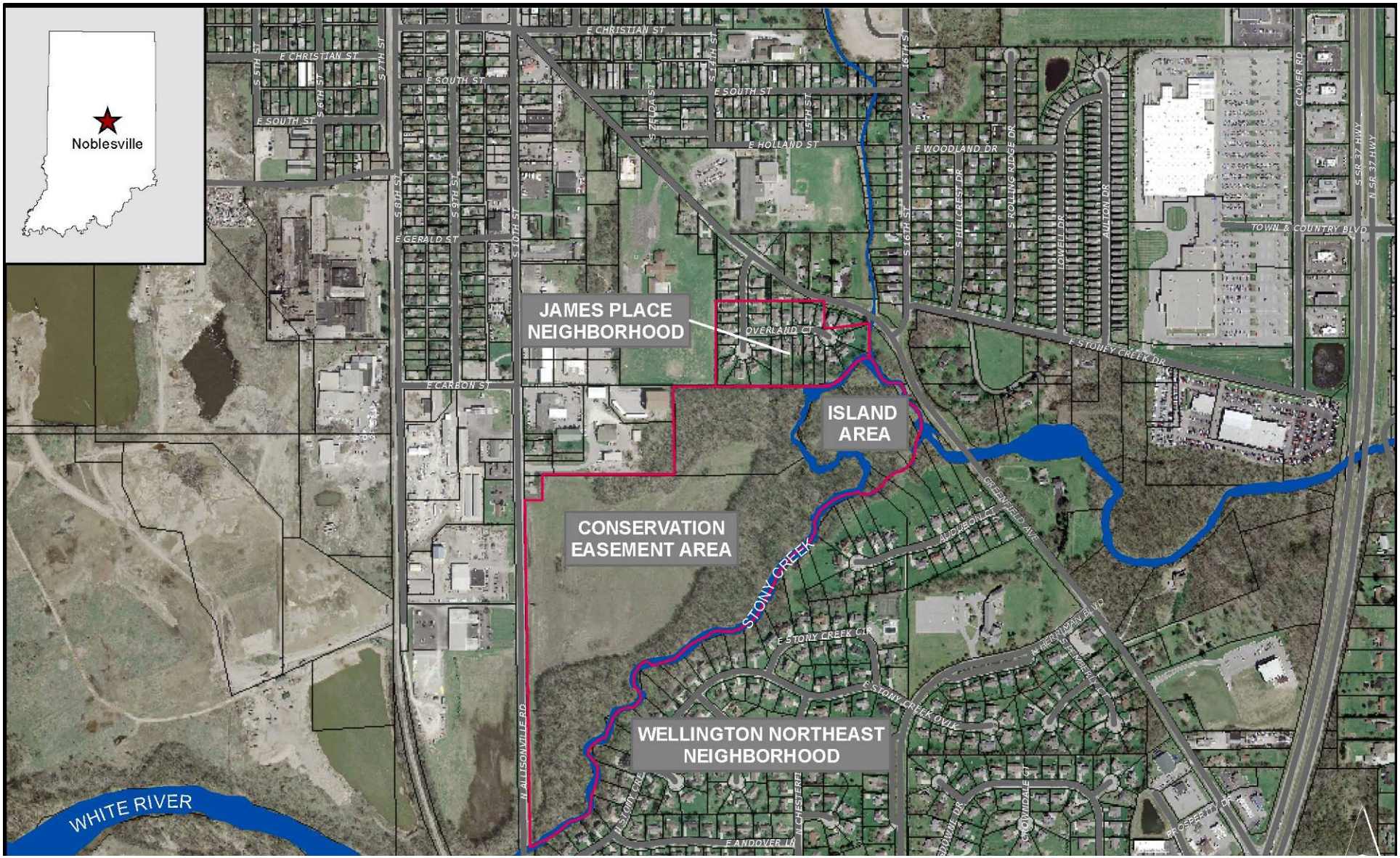
Presentation Overview

1. Introduction
2. Exposure Assessment
3. Toxicity Assessment
4. Risk Characterization
5. Conclusions and questions

Site Location



HHRA Goals and Approach

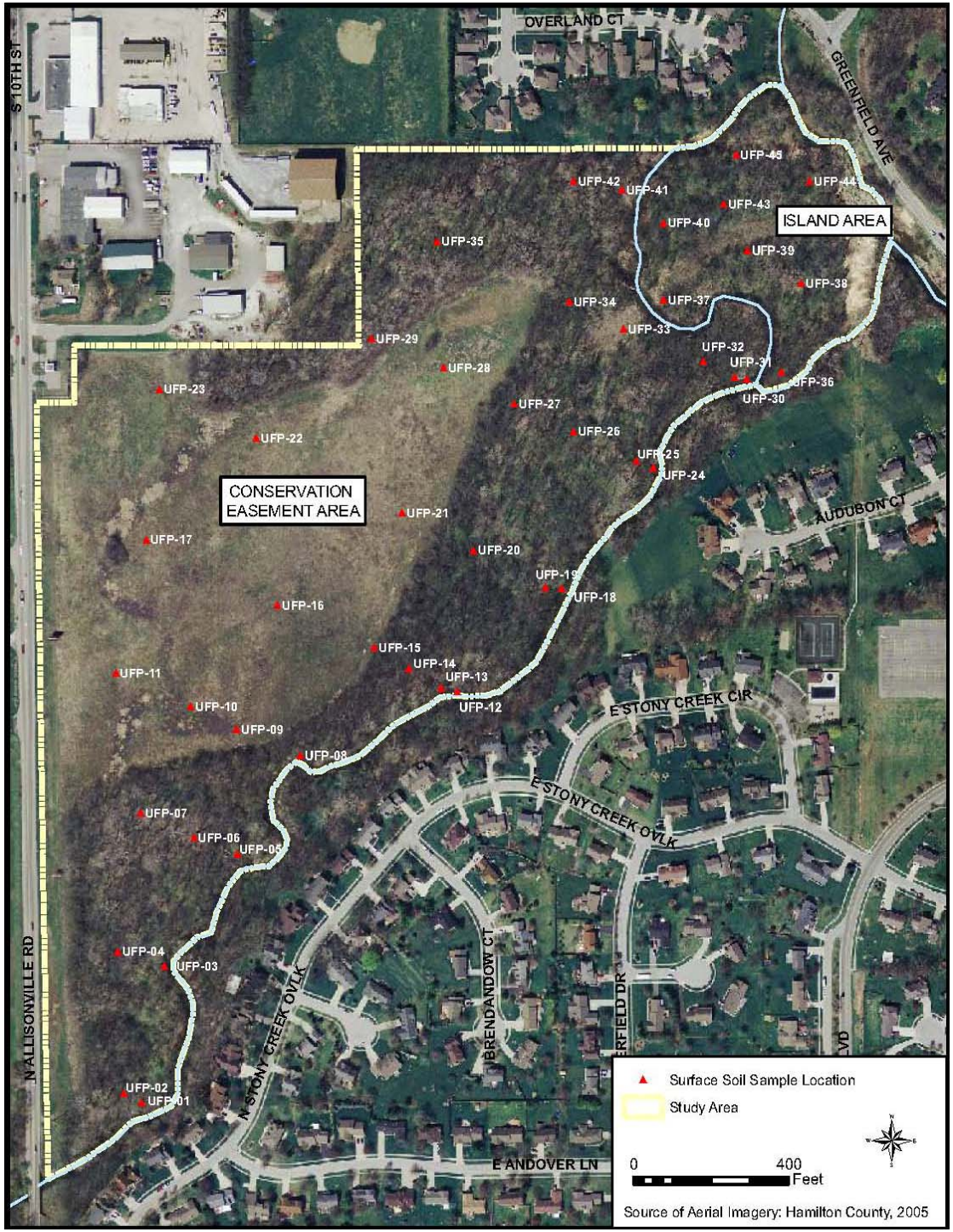
- Purpose: to evaluate potential human health risks from exposure to study area soil
- Streamlined approach
  - Concentrations of PCBs in soil are compared to a site specific risk-based closure level (RBC)
  - RBC calculated using IDEM equations, reflecting study area uses and updates to USEPA guidance
  - Consistent with HHRAs conducted for James Place and Wellington Northeast
  - Cancer risks and hazard quotients also calculated and compared to benchmarks of acceptable risk and hazard

Sampling Overview

- Soil samples collected in 2006-2008
  - SCSIP Rounds 2, 3 and 4 focused on land immediately adjacent to residential properties; not intended to characterize entire study area
  - The more comprehensive 2008 floodplain soil sampling conducted in accordance with USEPA-approved Risk Assessment Work Plan
- HHRA primarily relies on the 2008 floodplain soil sampling program

2008 Soil Sampling Program

- 37 surface (0-0.5 ft) soil samples from CEA, 8 from Island Area
- Collected with hand auger from transects spaced every 100 m perpendicular to the creek
- High sample density near creek, low density far from creek

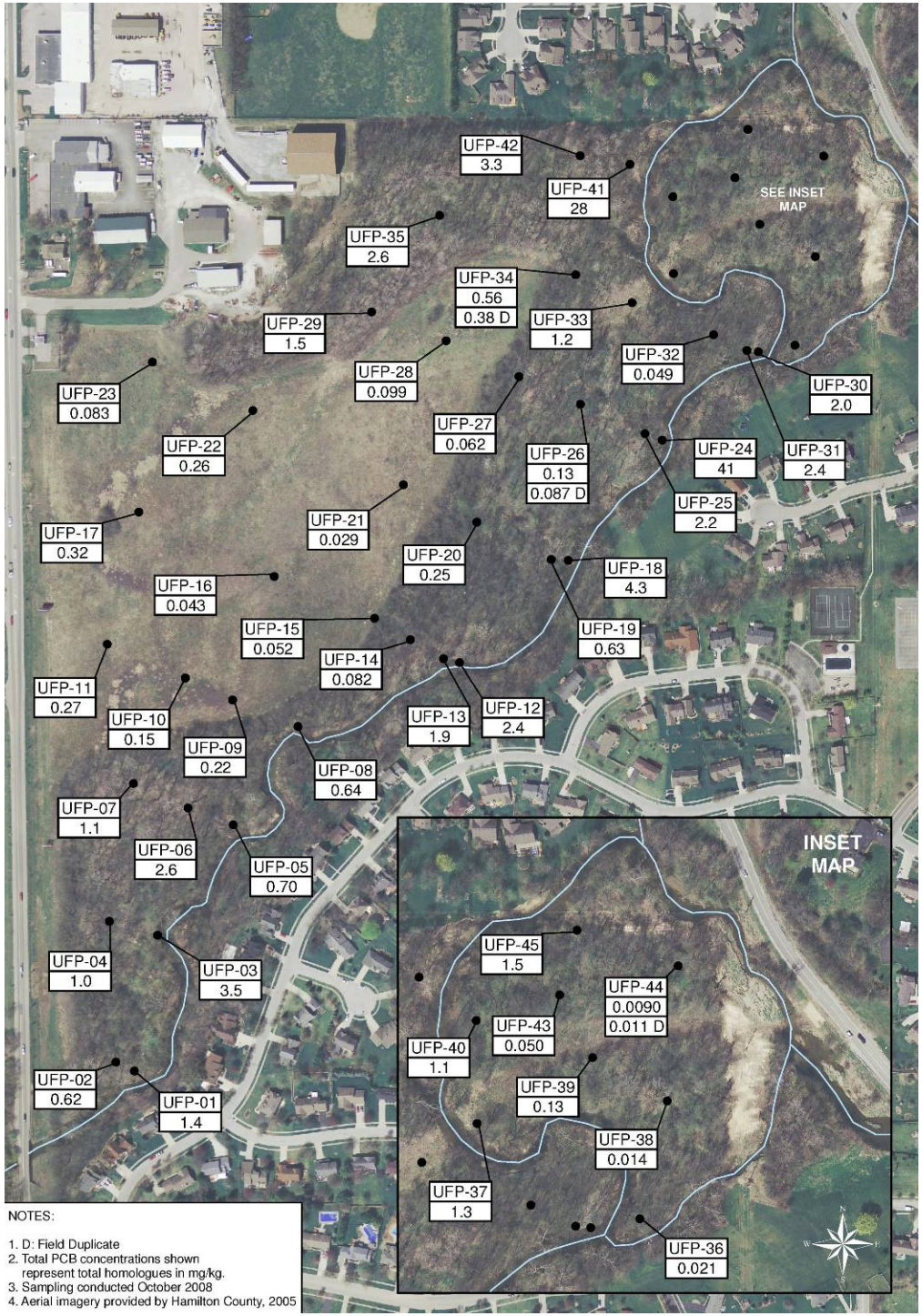


Analysis Overview

- All 45 soil samples analyzed for PCB homologues (USEPA Method 690) by Alpha Analytical
- Subset of 10 also analyzed for PCB Aroclors (modified USEPA Method 8082) by Heritage Analytical

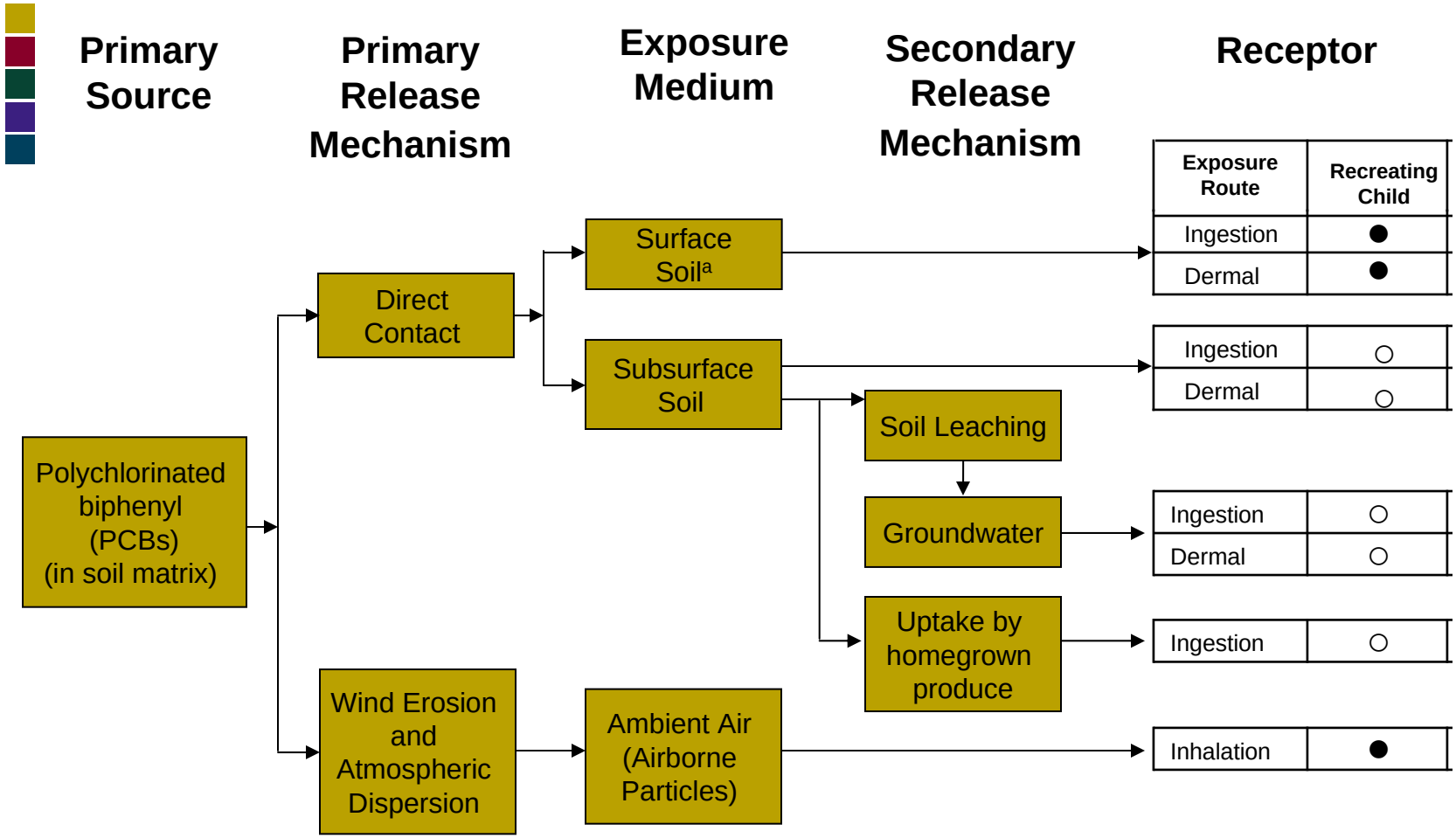
Analyte	Det. Freq.	Mean Conc. mg/kg	95% UCL Conc. mg/kg	Min. Det. Conc. mg/kg	Max. Det. Conc. mg/kg
Total PCBs (Homologues)	45 / 45	2.5	5.2	0.0098	41.3
Total PCBs (Aroclors)	7 / 10	1.1	1.5	0.31	2.7

Chemical Characterization: PCBs in Soil (mg/kg)



Exposure Assessment: Scenarios

- Use of study area influenced by
  - Conservation easement prohibitions
  - Flooding
  - Dense vegetation
  - Surrounding land use
- Most plausible users are children from abutting properties
- Adults (e.g., residents, utility maintenance workers) also plausible, but their exposure intensity is lower than that of children
- Hunting not plausible in study area, but possible on adjacent parcel
  - Deer are herbivorous
  - Plants do not significantly take up PCBs
  - Therefore, human exposure to PCBs from consumption of game negligible



Conceptual Site Model for the Human Health Risk Assessment

Key:

- ● Complete exposure pathway evaluated in the risk assessment.
- ○ Incomplete exposure pathway

[a] Surface soil exposure at depths from 0 to <0.5 feet below ground surface.

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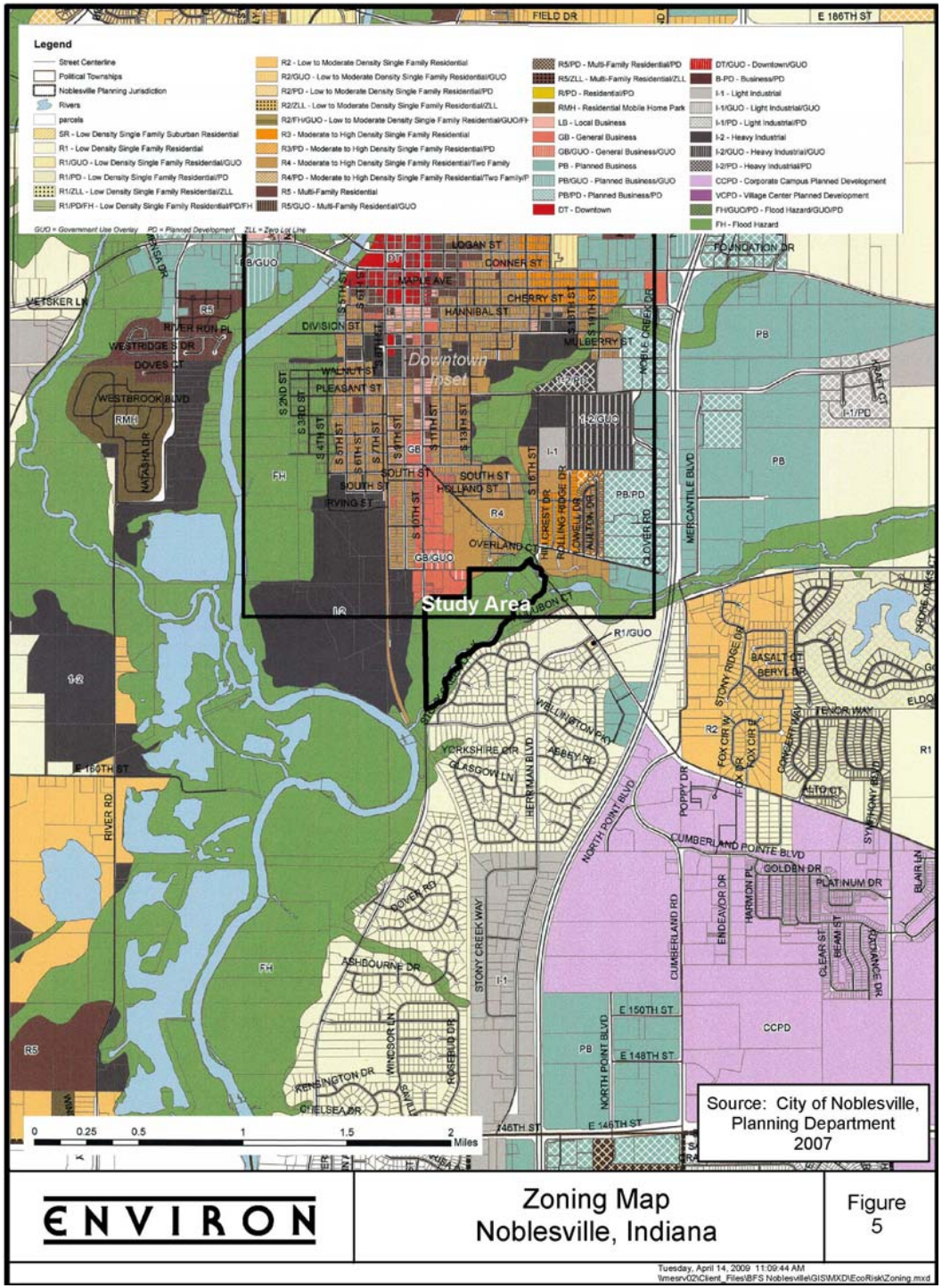
Future Use

- Zoned as FH (Flood Hazard)
- CEA is compensatory wetland leased by city of Noblesville for 50 years
- Future use unlikely to be significantly different from current use



Exposure Assumptions

- Pathways
  - Incidental ingestion of soil
  - Dermal contact with soil
  - Inhalation of windblown particulates
- Exposure frequency
  - 1 day/week, 8.5 months/year = 37 days/year
- Skin surface area seasonal- and age-weighted
- Exposure point concentration
  - 95% UCL = 5.2 mg/kg
- Toxicity criteria from USEPA IRIS
  - Cancer slope factor = 2.0 $(mg/kg\text{-}day)^{-1}$
  - Noncancer reference dose = 0.00002 mg/kg-day

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Table 2. Site-Specific Exposure Assumptions for the Recreational Scenario
Undeveloped Floodplain of Stony Creek
Noblesville, Indiana

	Parameter	Value	Units	Notes
C_{sscn}	Risk-based concentration, recreational noncancer	34	mg/kg	See equations below (IDEM 2006)
C_{ssrc}	Risk-based concentration, recreational cancer	43	mg/kg	See equations below (IDEM 2006)
THQ	Target hazard quotient	1	unitless	IDEM draft policy
TR	Target risk	1.00E-05	unitless	IDEM draft policy
RFD_o	Reference dose, oral	2.0E-05	mg/kg-d	USEPA 2008 - Aroclor 1254
RFD_i	Reference dose, inhalation	NA	mg/kg-d	No inhalation RfC is available
SF_o	Cancer slope factor, oral	2.0	$(mg/kg\text{-}d)^{-1}$	USEPA 2008 - PCBs
SF_i	Cancer slope factor, inhalation	2.0	$(mg/kg\text{-}d)^{-1}$	USEPA 2008 - PCBs
$IngR_{ras}$	Ingestion rate, ages 7 to 16	100	mg/d	USEPA 2002a
$IngR_{rcs}$	Ingestion rate, ages 2 to 7	200	mg/d	USEPA 2002a
$IngF_{adj}$	Ingestion Factor Soil, age adjusted	67	mg-yr/kg-d	See equations below (IDEM 2006)
M_{ras}	Soil to skin adherence factor, ages 7 to 16	0.2	$mg/cm^2\text{-}d$	USEPA 2004 - children playing in wet soil (CTE)
M_{rcs}	Soil to skin adherence factor, ages 2 to 7	0.2	$mg/cm^2\text{-}d$	USEPA 2004 - children playing in wet soil (CTE)
ABS	Skin absorption factor	0.14	unitless	USEPA 2004 - PCBs
SA_{rcs}	Skin surface area exposed, ages 2 to 7	1,052	cm^2	USEPA 2004 - seasonally-weighted (see text)
SA_{ras}	Skin surface area exposed, ages 7 to 16	1,971	cm^2	USEPA 2004 - seasonally-weighted (see text)
SFS_{adj}	Skin Factor Soil, age adjusted	98	mg-yr/kg-d	See equations below (IDEM 2006)
VF	Volatilization factor	NA	m^3/kg	PCBs are not volatile
PEF	Particulate emission factor	1.06E+10	m^3/kg	See Table 3
$InhR_{rca}$	Inhalation rate, ages 2 to 7	8.3	m^3/d	USEPA 2002b - ages 3 to 6
$InhR_{raa}$	Inhalation rate, ages 7 to 16	12.3	m^3/d	USEPA 2002b - average of ages 6 to 15
$InhF_{adj}$	Inhalation Factor, age adjusted	3.6	$m^3\text{-}yr/kg\text{-}d$	IDEM 2006
BW_c	Body weight, ages 2 to 7	17	kg	USEPA 2002b
BW_a	Body weight, ages 7 to 16	42	kg	USEPA 2002b
EF_r	Exposure frequency	37	d/yr	1 day/week, 8.5 months/yr
ED_r	Exposure duration, ages 7 to 16	9	yr	by definition
ED_{ch}	Exposure duration, ages 2 to 7	5	yr	by definition
AT_n	Averaging time, noncancer	14	yr	USEPA 2002a
AT_c	Averaging time, cancer	70	yr	USEPA 2002a

cm: centimeter
d: day
IDEM: Indiana Department of Environmental Management
kg: kilogram
mg: milligram
PCB: polychlorinated biphenyl
RME: reasonable maximum exposure
yr: year
m: meter

Risk Characterization

- Noncancer RBC = 34 mg/kg
- Cancer RBC = 43 mg/kg
- EPC (5.2 mg/kg) << RBC (34 mg/kg)

- Hazard index (0.2) < IDEM & USEPA benchmark of 1
- Cancer risk (1×10^{-6}) < IDEM RISC benchmark of 10^{-5}

Uncertainty Analysis

- Data evaluation
  - Used most recent and representative data set
  - More intensive sampling near creek overestimates EPC
  - 95% UCL is ~5-fold higher than SWAC
- Exposure assessment
  - Exposure frequency highly individual
  - Given difficult access (flooding, dense vegetation) and legal restrictions within CEA, 37 days/year likely conservative
  - Concentrations in Island Area < residential RBC of 3.8 mg/kg

    Thus, a resident could use the island portion of his property as frequently and in the same manner as his lawn and still not encounter significant risk

Uncertainty Analysis (cont'd)

- Toxicity Assessment
  - Noncancer hazards not likely underestimated, given that RfD incorporates uncertainty factor of 300
  - Cancer risks not likely underestimated, given use of upper-bound CSF
- Risk Characterization
  - Standard USEPA and IDEM methodologies employed
  - Consistent with guidance
  - Multiple layers of conservatism may overestimated risks by several orders of magnitude

HHRA Conclusions

- **Concentrations << RBC**
  - **Excess lifetime cancer risk = 1 in 1,000,000**
  - **Hazard index = 0.2**
- **Conservative assumptions compensate for unavoidable uncertainty**
  - **Risks likely overestimated by several orders of magnitude**
- **No further evaluation warranted; no remediation needed based on human health risks**
- **Questions/discussion**