

wood.

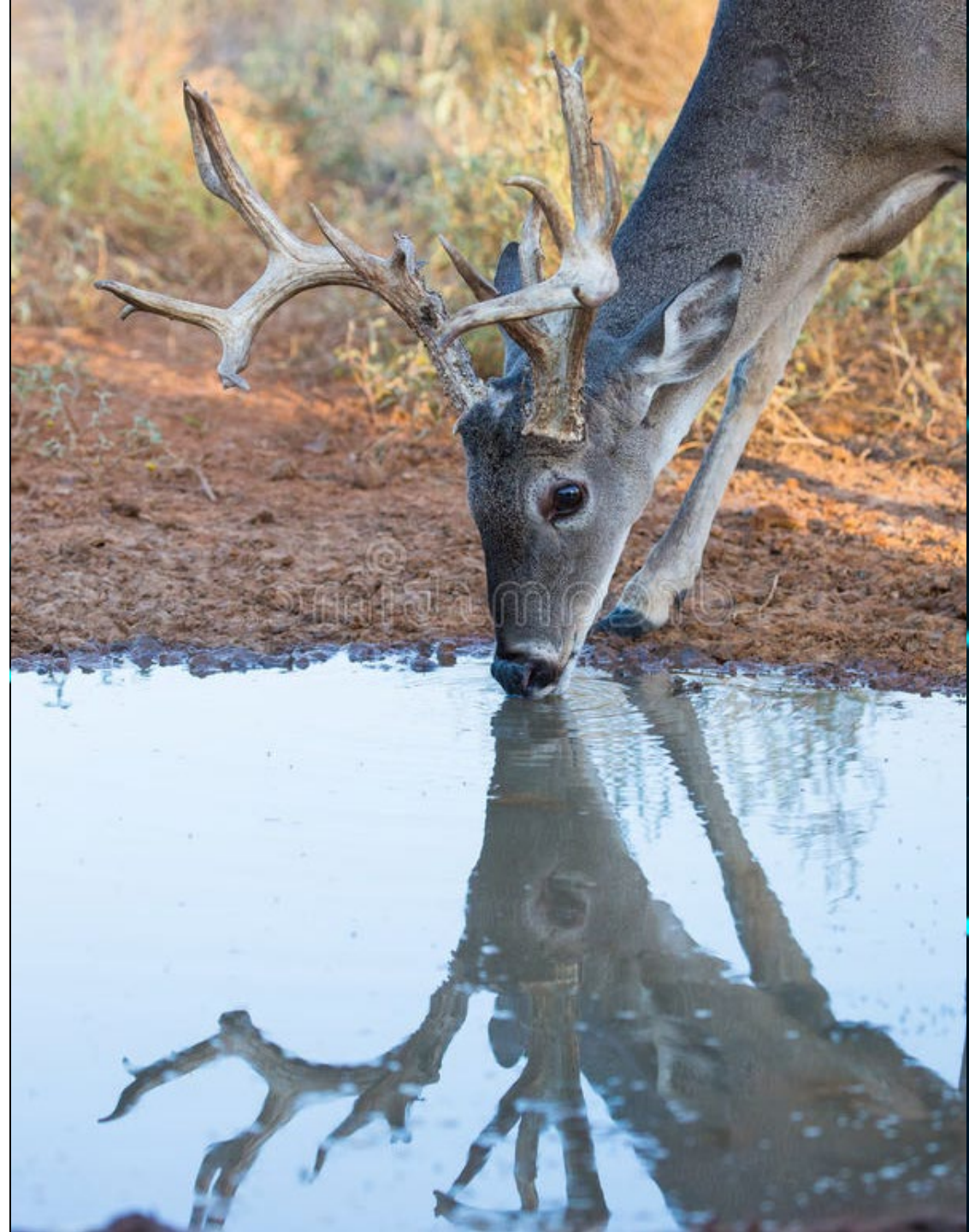
Protecting Human Health from Consumption of PFOS in Deer Meat

Former Pease AFB, NH

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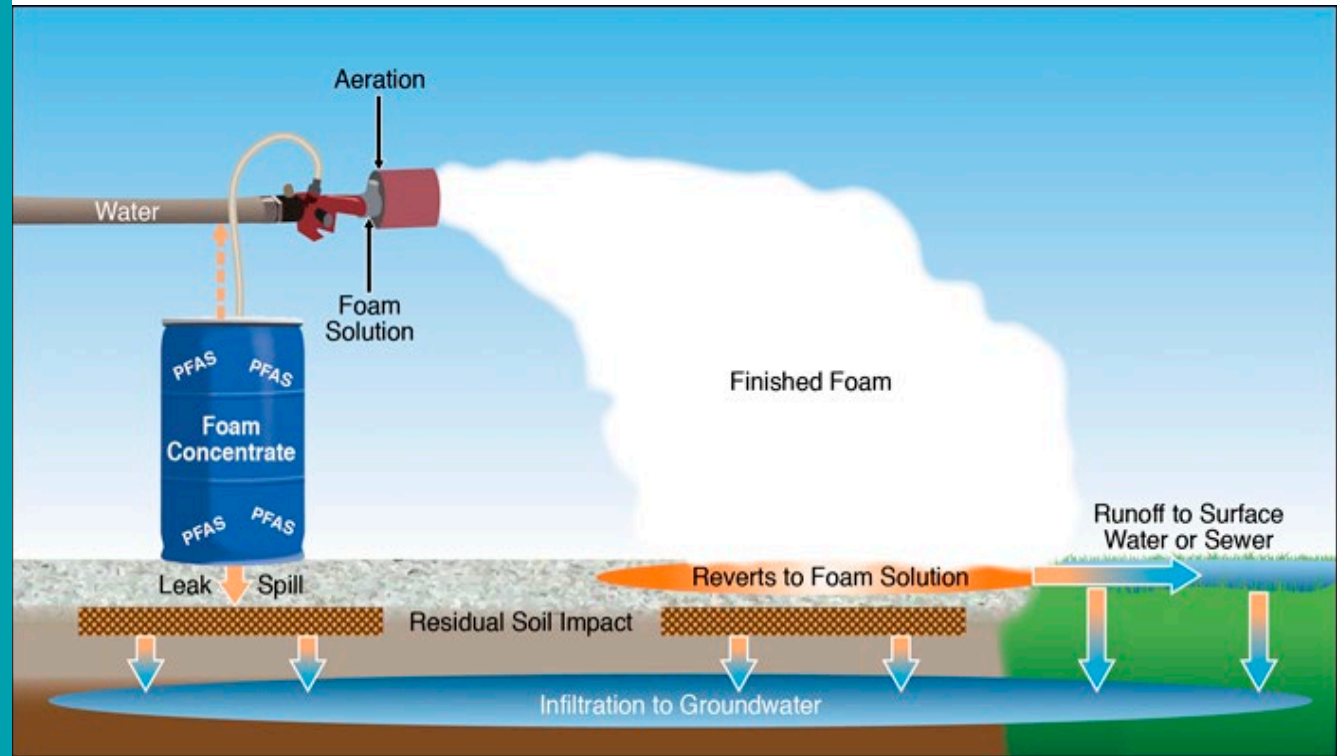
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Introduction

- AFFFs used for fire fighting at former installation
- PFAS detected in surface water
- Surrounding woods are frequented by hunters



Statement of Problem

- Could deer meat (venison) hunted in areas with PFAS in pose a health concern if consumed by humans?



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Desktop Study

- Hazard Identification
- Exposure assessment
- Toxicity Assessment
- Risk Characterization
- Uncertainty
- Sensitivity Analysis
- Conclusions



Hazard Identification

Investigation characterized PFOS, PFOA, and PFBS

Focus on PFOS

- Higher biomagnification factors than PFOA or PFBS
- Elimination half lives PFOS > PFOA > PFBS
- PFOS more toxic than other PFAS compounds
- Health effects of PFOS are currently more researched than other PFAS
- Study is appropriate and conservative.

PFOS ranges 0.0075 ug/L to 6.5 ug/L

Exposure Assessment

PFOS in Deer Meat

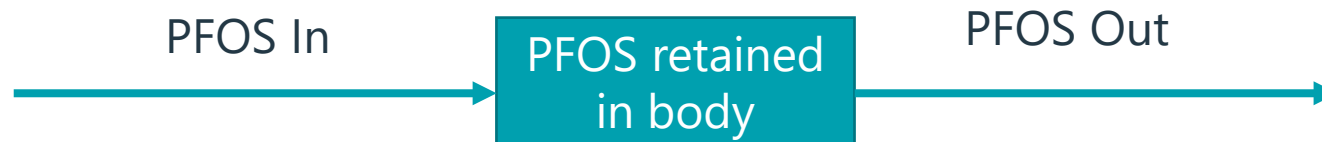
One compartment, first order, steady-state model:

$$WB_{SS} = \frac{ADD * t_{1/2}}{\ln(2)} \quad \text{(Equation 1)}$$

WB_{SS} = whole body steady state mass of PFOS (mg)

ADD = average daily dose of PFOS (mg/day)

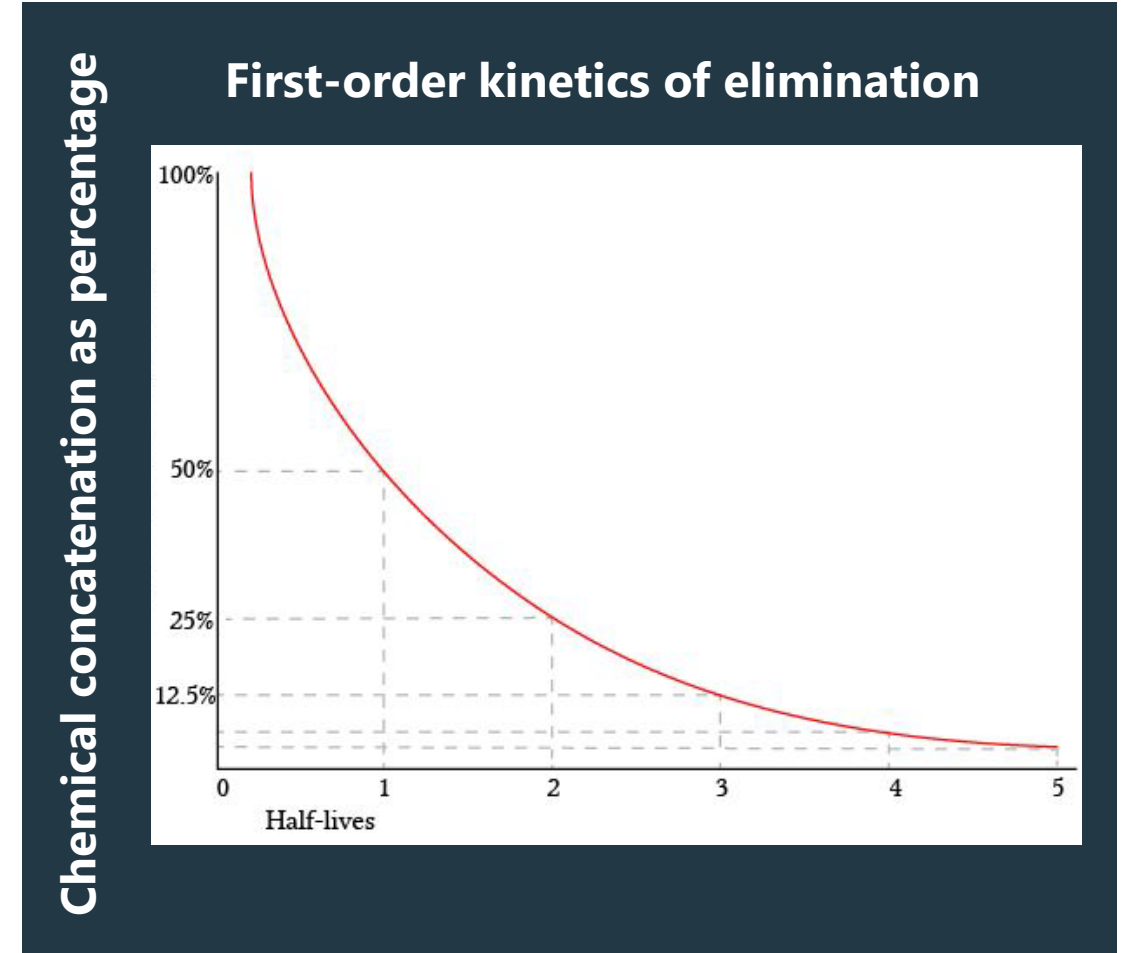
$t_{1/2}$ = elimination half life of PFOS (days)



Exposure Assessment

Parameters – Half Life

- Elimination Half Life ($t_{1/2}$)
- Single-dose beef cattle exposures
 - Plasma elimination half-life = 113 days
 - Whole-body half-life = 114 days



Exposure Assessment

Parameters – ADD

PFOS entirely from water consumption:

$$ADD_{SW} = C_{SW} * WIR * f_w \quad \text{(Equation 2)}$$

ADD_{SW} = Average daily dose of PFOS (mg/day) from SW

C_{SW} = Concentration in surface water (mg/L)

WIR = Water ingestion rate (L/day)

f_w = Fraction PFOS assimilated from water (unitless)



Exposure Assessment

Parameters – WIR

$$WIR = 0.099 * BW^{0.90} \text{ (Equation 3)}$$

- Contacted Fish & Game Office
 - Average number of deer harvested over a 4-year period (63/yr)
 - Estimated pounds of edible meat (3,873 lbs.)
 - Converted to whole body weight: 148 lbs. / 67 kg

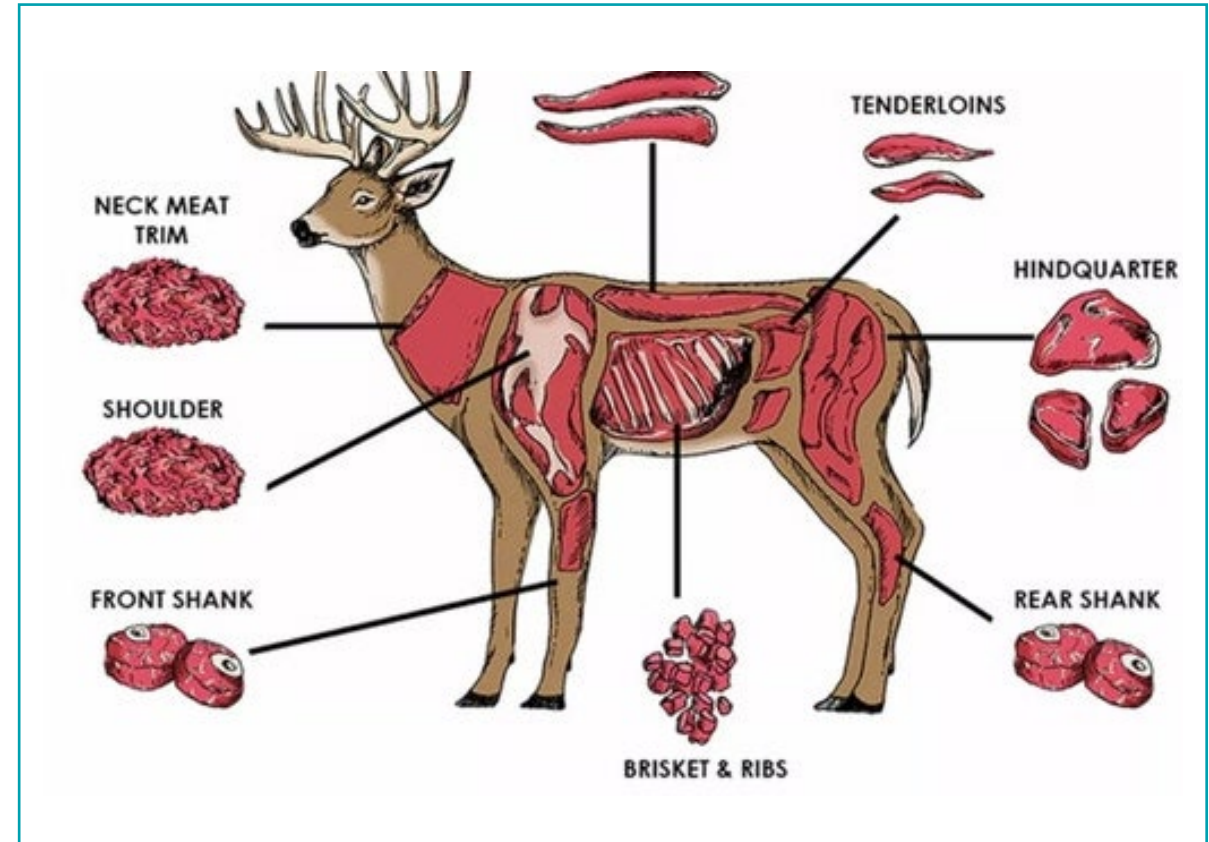
- Solving Equation 1 =
4.6 mg PFOS in the typical adult deer



Exposure Assessment

Edible Meat

- Edible meat:
 - 45% of PFOS accumulates in deer muscle
 - 42% of muscle is edible (calculated from F&G statistics)
- Calculates to:
 - **74 ug/kg PFOS** in edible deer meat (ww)



Toxicity Assessment



United States
Environmental Protection
Agency

Office of Water
Mail Code 4304T

EPA 822-R-16-002
May 2016

- PFOS RfD = 0.00002 mg/kg/d
- USEPA Drinking Water Advisory (2016)
- PFOS not classified by USEPA as a carcinogen

Health Effects Support Document for Perfluorooctane Sulfonate (PFOS)

Consumptions Rates

- Fish & Game
 - Average number of deer harvested per year (63)
 - Pounds of meat obtained (3,873 lbs. of meat)
 - Number of hunters 47 different hunters per year
- Daily consumption
 - 82.4 lbs. deer meat per hunter per year
 - 102 g/day \approx 1/4 pound per day (deer consumption rate)
 - \approx an **8-oz meal, 14 days per month** (deer consumption rate)



Screening Level Calculation

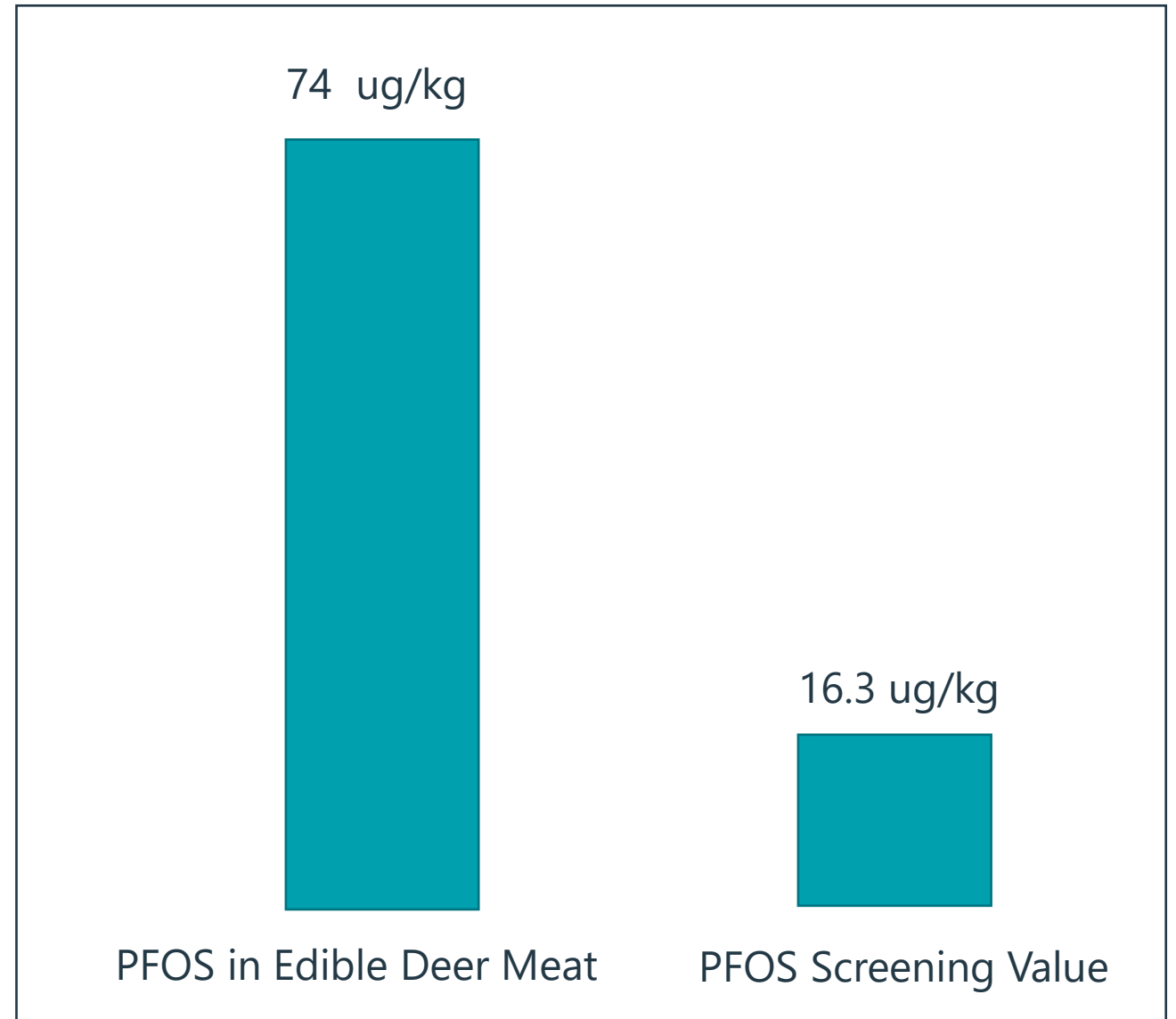
$$\text{Non - Cancer DCSV (ug/kg)} = (\text{RfD} \times \text{BW} \times \text{AT} \times \text{CF}) / (\text{IR} \times \text{EF} \times \text{ED})$$

Variable	Definition	Value
RfD	Reference Dose	0.0002 mg/kg/d
BW	Human Body Weight	80 kg (176 lbs.)
AT	Averaging Time	9,490 days (26 years)
CF	Conversion Factor	1000 ug/mg
IR	Deer tissue ingestion rate	0.102 kg/d (1/4 lb/d)
EF	Exposure Frequency	350 days/year
ED	Exposure Duration	26 years
DCSV	Deer Consumption Screening Value	16.3 ug/kg (ww)

Risk Characterization

Finding

- PFOS in edible deer meat > screening value.
- Deer consumption pathway could not be eliminated as a significant exposure pathway.



Uncertainties

- Deer PFOS exposure via surface water only, no food
- Maximum PFOS concentration in SW
- Limited literature data for $t_{1/2}$ and tissue partitioning
- Human consumption rate



Sensitivity Analysis – Steady State Model

Modeled scenario = 74 ug/kg PFOS ww in edible deer meat

Parameter	Modeled Value	Sensitivity Analysis	PFOS in Edible Deer Meat (ug/kg ww)
T1/2	113 days	37 – 634 days	24 – 414
Csw	6.5 ug/L (max)	1.9 ug/L (ave)	22
Tissue Distribution	0.45	0.35	57
Edible Fraction	42%	30%-50%	103 - 62



Conclusions

- Conservative assumptions, desktop study
 - PFOS in edible deer meet > human health screening levels
 - PFOS exposure could not be ruled out at a significant pathway
- Elimination half-life introduces the greatest uncertainty
- Uses model to assess other wild game
- Elimination half life vs. empirical BAFs in ERA

wood.