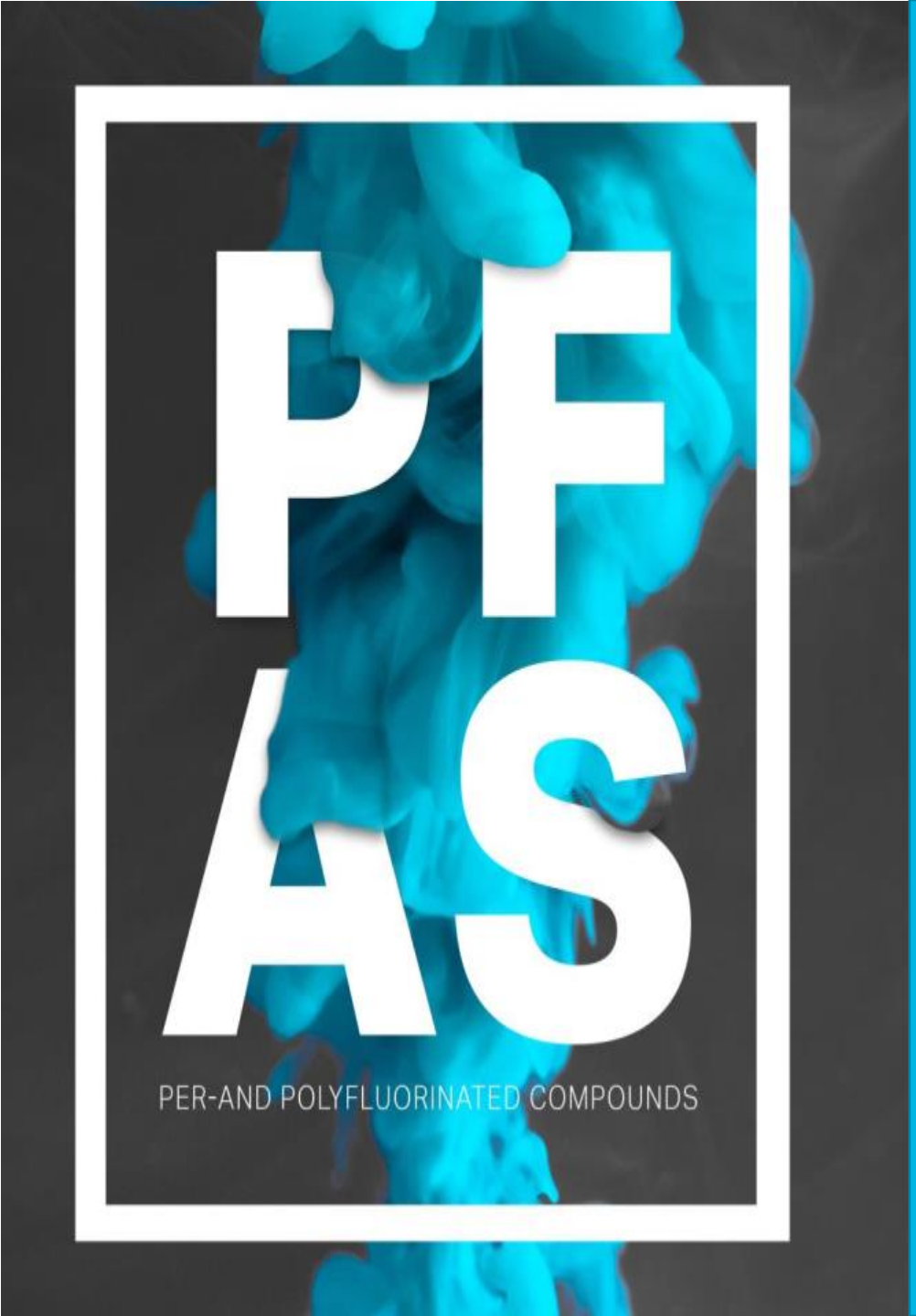


PFAS PATHWAYS AND MIGRATION CHARACTERISION

Almost everywhere and in everything?

Paul McCabe

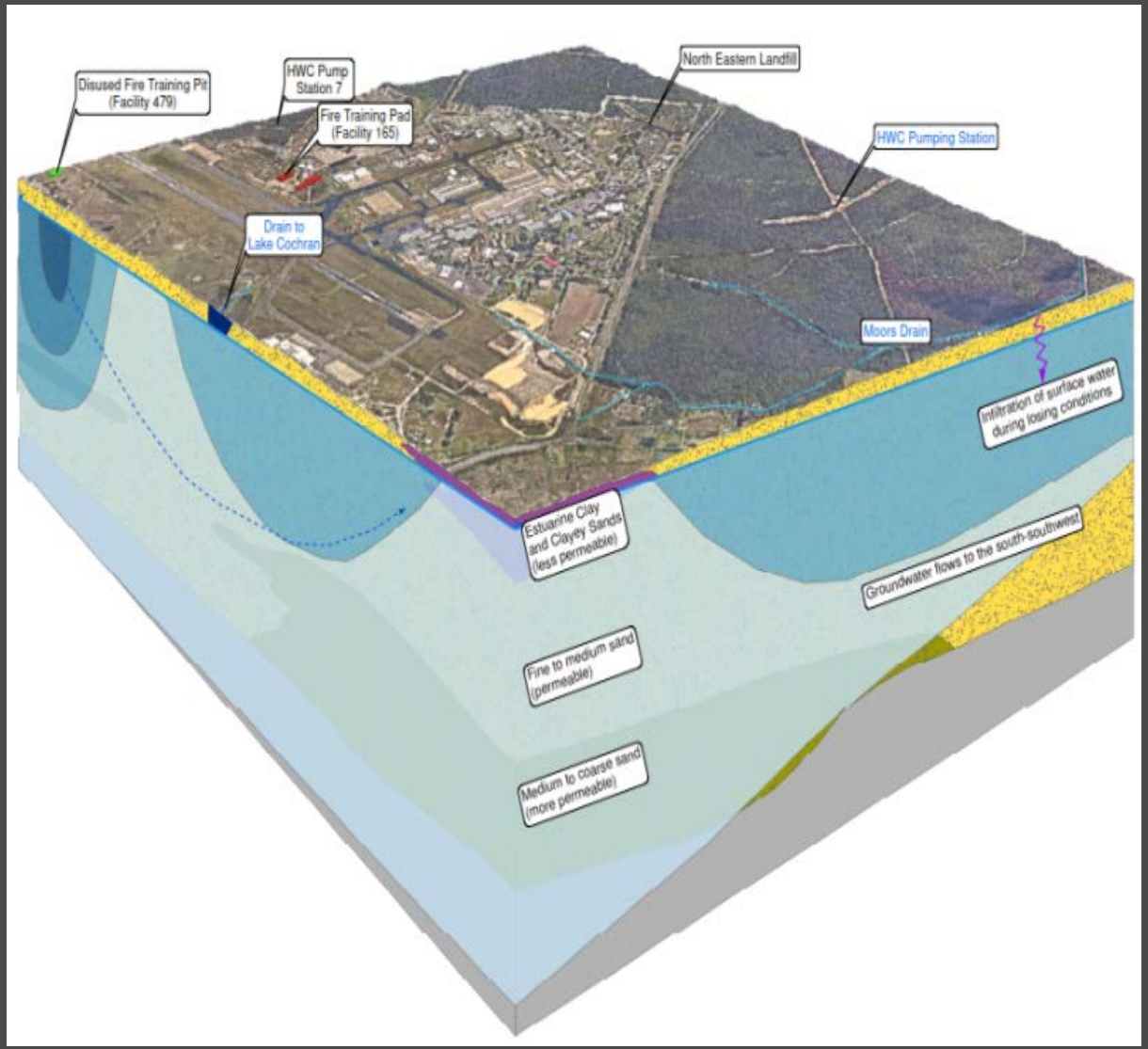
Technical Director
AECOM, Sydney

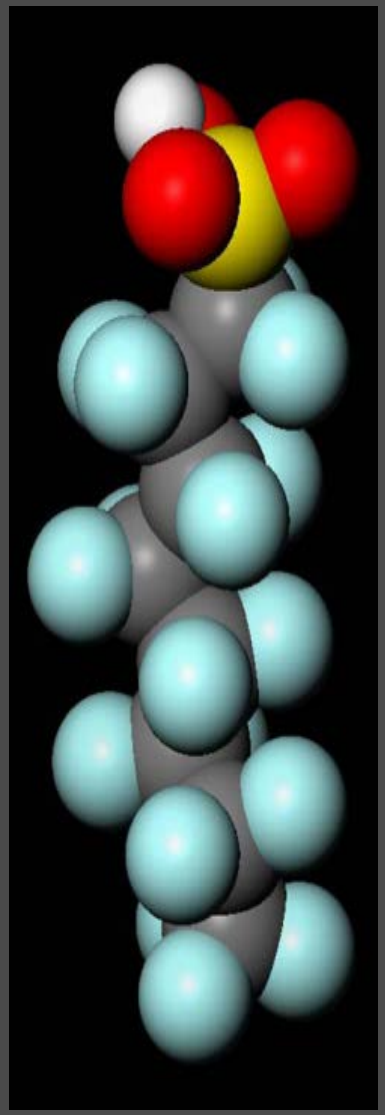
What will be covered?

- Conceptual Site Models
- Sources
- Pathways
- Receptors

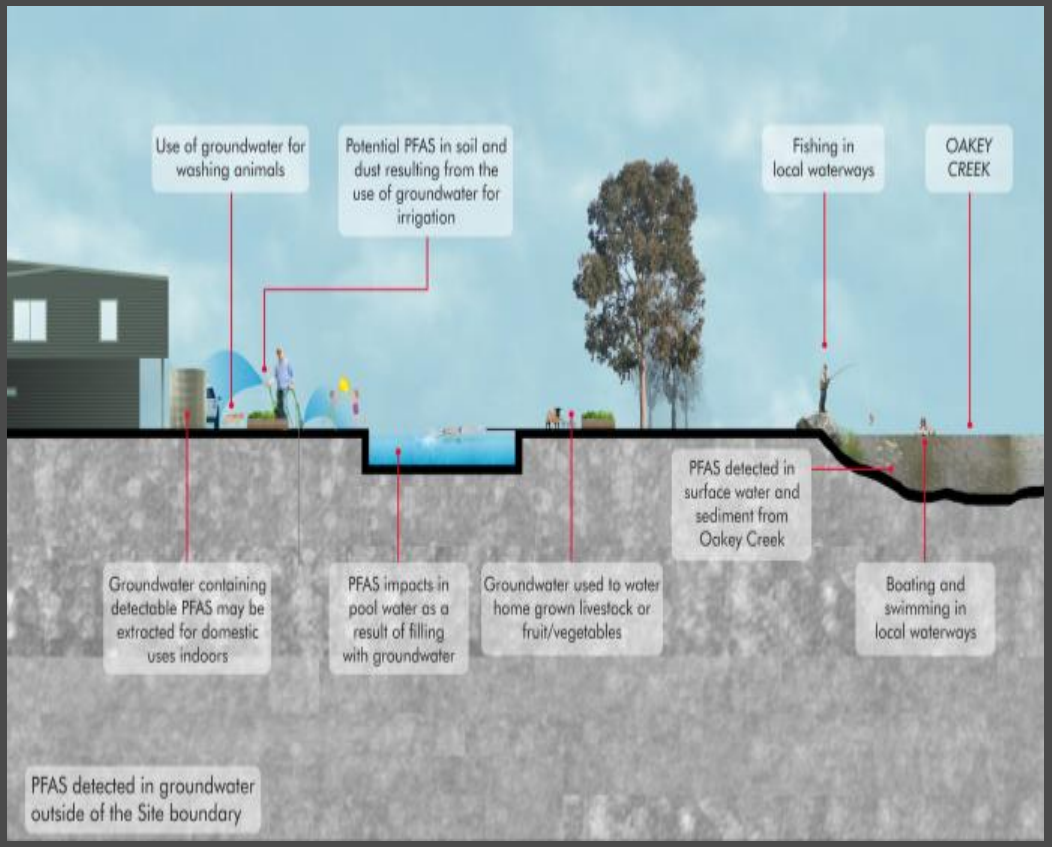
CONCEPTUAL SITE MODELS

Conceptual Site Models – Complex and very site specific





Conceptual Site Models – Complex and very site specific (continued)



Considerations

- History
- PFAS used
- Multiple areas
- Primary sources
- Secondary sources
- Soil chemistry
- Hydrology *
- Hydrogeology *
- Migration
- Receptors
- Time
- Risks
- Community
- Evolving knowledge

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SOURCES

Sources – AFFF Concentrate

TYPICAL CONCENTRATIONS

3M Lightwater

PFOS – 17,000 – 4,860,000 ppb

PFOA – 1,190 – 75,122 ppb

Ansulite™

- Up to PFOS ~ 5 µg/L
- Up to PFOA ~ 700 µg/L
- 6:2 FtS ~ 130,000 µg/L

Primary Source Areas – Fire Control and Training Areas

- History of use
- Construction
- Co-contaminants
- Waste Management
- Soil types
- Drainage
- Hydrogeology

Secondary Source Areas

- Pavements
- Drainage lines
- Landfills
- Effluent treatment plants
- Sewerage Treatment Plants & lagoons
- Biosolids
- Stormwater Ponds

Soils – On site

TYPICAL CONCENTRATIONS

- Light use - < 1mg/kg
- Heavy use 20-2600 mg/kg

FUN FACT

- Influence of soil composition
- OC, pH, Clay + silt, Ca, Fe +Al oxides
- Mostly in top 3m
- Differential distribution with depth

Soil – Off site

TYPICAL CONCENTRATIONS

- Up to ~ 1 mg/kg

FUN FACT

- Typically surface
- Distribution by floodwater and irrigation

Source Areas – Matrices That Sorb – Coffee Rock

TYPICAL CONCENTRATIONS

- ~ 5 mg/kg
- Neutral leach results ~ 150 µg/L

FUN FACT

- PFAS affinity for Fe and Organics ?

Source Areas – Matrices That Sorb - Concrete

TYPICAL CONCENTRATIONS

- ~ 0.08 mg/kg
- Neutral leach results ~ 50 µg/L

Source Areas – Water runoff from a training ground

PATHWAYS

Pathway – Groundwater – On site

TYPICAL CONCENTRATIONS

- Typical - Up to 980 µg/L
- Extreme – 23,000 ug/l
- Multiple source areas within site is common

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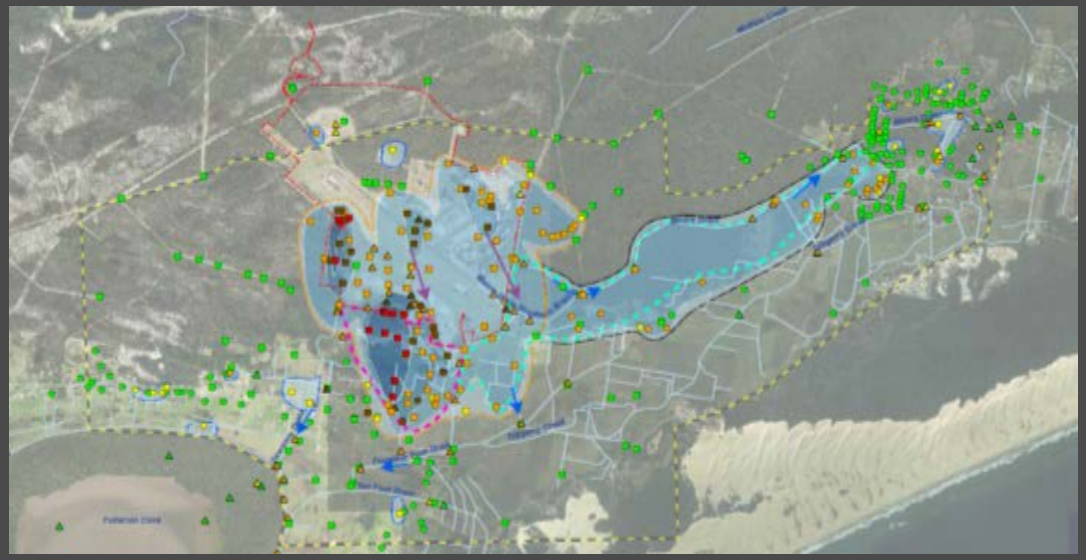
Pathway – Groundwater – Off site



TYPICAL CONCENTRATIONS

- Up to ~150 µg/L
- Plumes to 15 km in Australia
- 10s of km^2
- Continuous discharge – mass flux
- Interaction with surface water
- Impacts of irrigation
- Off-site sources

Pathway – Surface Water – On site

TYPICAL CONCENTRATIONS

- Major pathway
- Typical - to 85 µg/L
- Episodic discharge
- Interaction with groundwater

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Pathway – Surface Water – Off site

TYPICAL CONCENTRATIONS

- Up to 25 µg/L
- Seasonal and event based fluctuations
- Secondary Contamination of Groundwater
- 5 km -180 km impact

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Pathway – Sediment

TYPICAL CONCENTRATIONS

- On site up to 40 mg/kg
- Off site ~1 mg/kg
- Pathway, source and sink
- Marine interaction

Pathway – Marine Water – Off site

TYPICAL CONCENTRATIONS

- Dynamic tidal environments
- Up to ~ 4 µg/L
- Impacts of salinity

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Pathway - Swimming Pool Water

CONCENTRATIONS

- Filled with bore water
- Up to 0.09 µg/L

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Pathways – Fruit

TYPICAL CONCENTRATIONS

- Non-detects even when growing in impacted soil and grou

FUN FACT

- N158 samples only one detect on LLD (0.001

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Pathway – Vegetables

TYPICAL CONCENTRATIONS

- Field sampling - Green leafy vegetables <0.003mg/kg mg/kg
- Uptake trials

Pathway – Fish

TYPICAL CONCENTRATIONS

- Finfish – <0.0003 – 0.012 mg/kg

FUN FACT

- Highest concentrations were greatest distances from site
- Oysters depurate PFAS 6 days depuration rates.

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Pathways – Crustaceans

CONCENTRATIONS

- Prawns up to 0.05 mg/kg

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Eggs

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CONCENTRATIONS

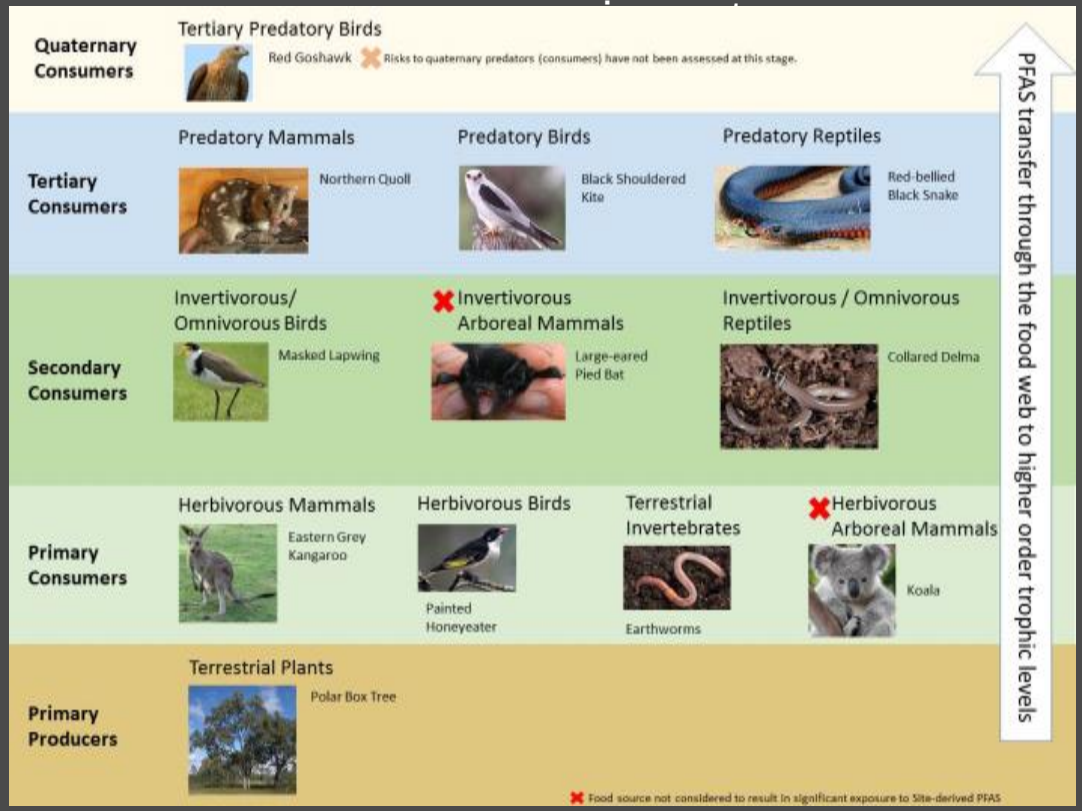
- Up to 0.15 mg/kg

FUN FACT

- Depuration rates are approx 100 days – move chickens to clean

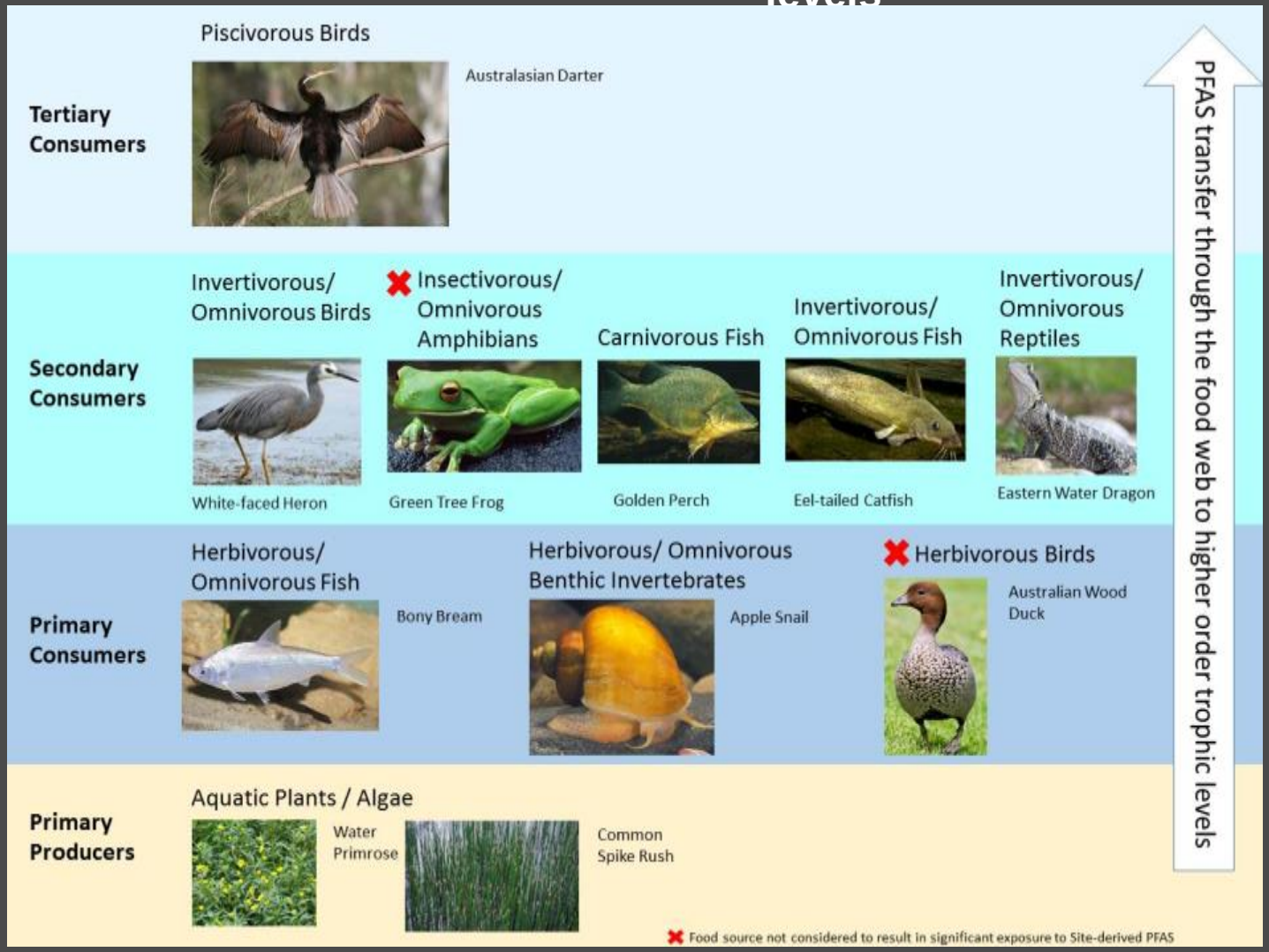
Terrestrial Biota

- Impacts in on-site rabbits
- Ducks off site 100x FSANZ
- Eagle carcass confirmed



Aquatic Biota

Detects in most trophic levels



Pathway – Grasses

TYPICAL CONCENTRATIONS

- <0.0002 – 0.0089 mg/kg

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RECEPTORS

Real Receptors – Community Impacts

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PFAS in Beer

German Beer Sampled for PFAS (Stahl, *et al*. 2014)

- 93 different beers
- PFOS detected in 46 of 93 samples
- Maximum detection 0.057 µg/L (just under drinking water guideline!)

Stahl. T, Hofmann. A, Collen. M, Falk. S, Brunn. H. 2014. Analysis of Selected Perfluoroalkyl substances (PFASs) in Beer to Evaluate the Effect of Beer Consumption on Human PFAS Exposure: A Pilot Study. European Food Research and Technology.

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