PFAS Environmental Risk Assessment: Moving beyond Tier 1 criteria

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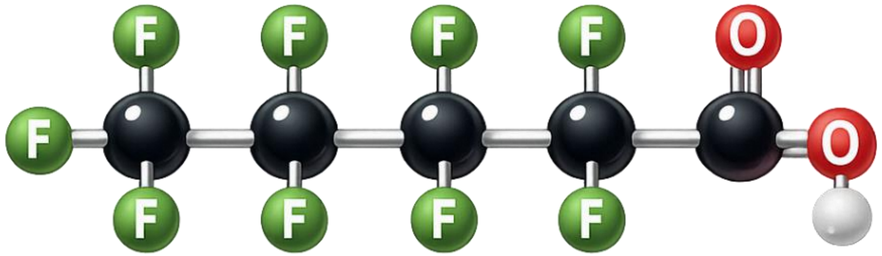
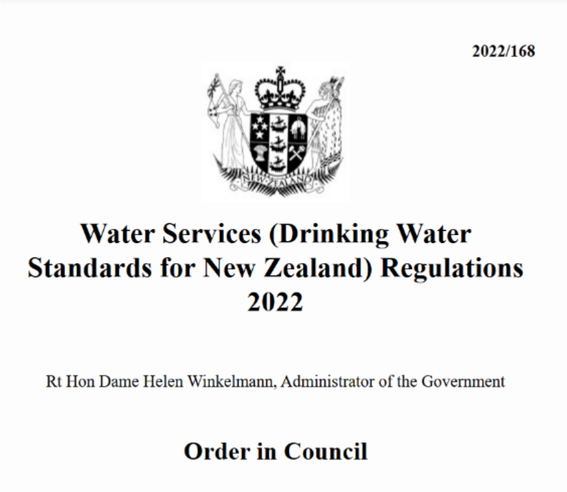
Introduction

- PFAS stands for per- and polyfluoroalkyl substances
- PFAS are a large group of synthetic “forever chemicals” that resist breakdown and can persist and bioaccumulate in water, soil, wildlife, and people over time
- Durable and water, grease, and heat-resistant
- Used in firefighting foams, consumer products, building materials, textiles and industrial applications
- Found at high levels in areas where firefighting foams have been used
- Ubiquitous in settings subject to anthropogenic influence



PFAS Molecule

Challenging Tier 1 assessment process

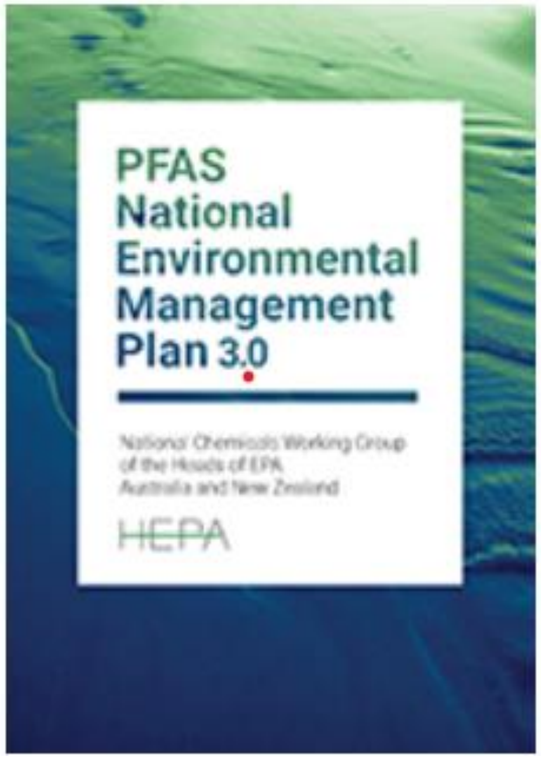


2022/168

Water Services (Drinking Water Standards for New Zealand) Regulations 2022

Rt Hon Dame Helen Winkelmann, Administrator of the Government

Order in Council



Australian & New Zealand
GUIDELINES FOR FRESH & MARINE WATER QUALITY

SOIL	WATER
HIL A (Residential) **0.003 mg/kg** (PFOS + PFHxS sum – PFAS NEMP 3.0)	Drinking water **0.07 pg/L** (PFOS + PFHxS sum – PFAS NEMP. 3.0)
Ecological – indirect **0.003 mg/kg** (PFOS only – PFAS NEMP.3.0 / ASC NEMP)	Recreational water **2 pg/L** (PFOS + PFHxS sum – PFAS NEMP 3.0)
Ecological – direct **1 mg/kg** (PFOS only – PFAS NEMP.3 0 / ASC NEMP)	Biota screening value **0.0005 pg/L** (PFOS – ANZG, 2026)
Ecological – direct **1 mg/kg** (PPOS only – PFAS NEMP.3.0 / ASC NEMP)	99% species protection **0.02 µg/L** (PFOS freshwater – ANZG, 2025)

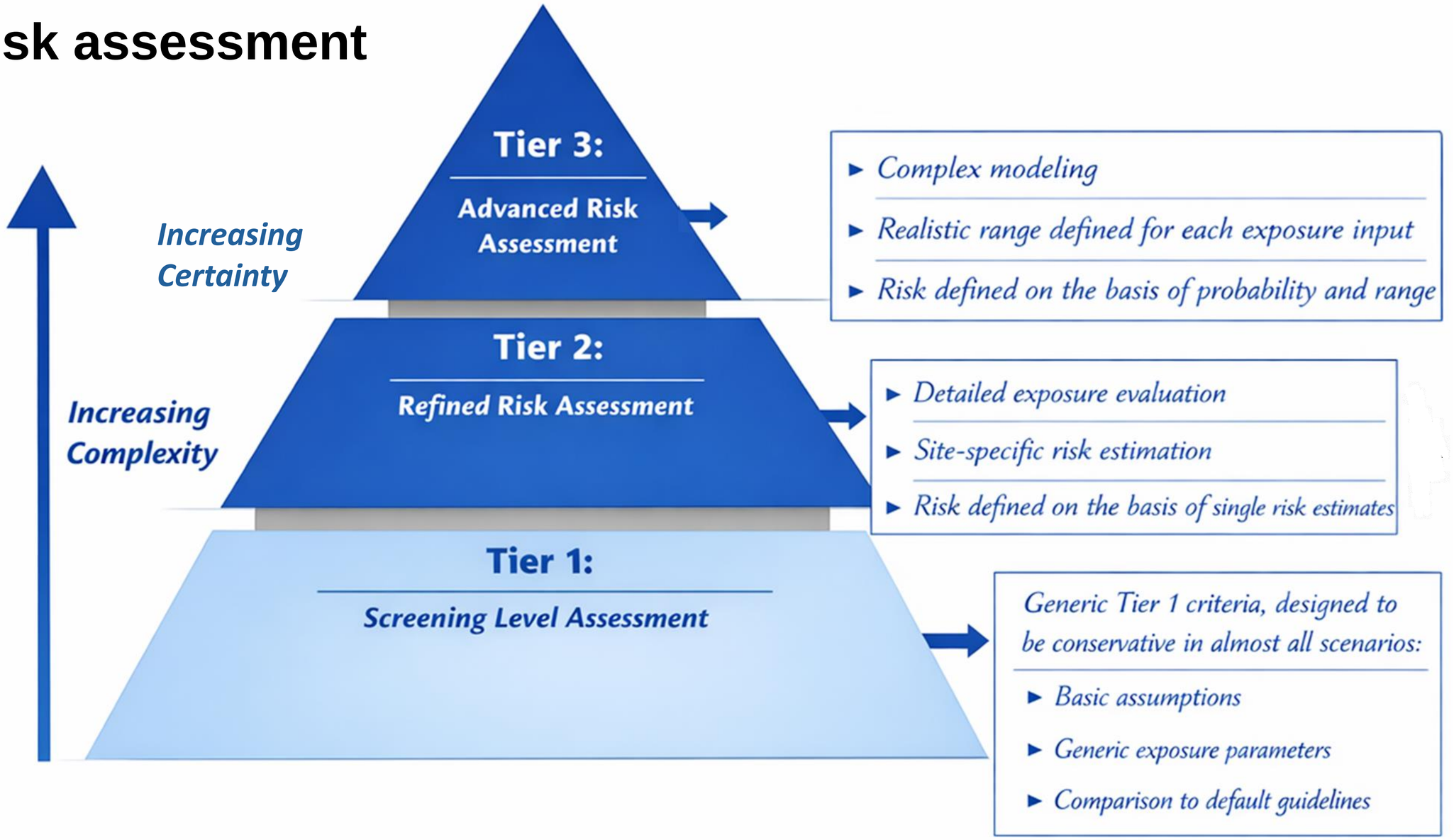
Regulatory uncertainty

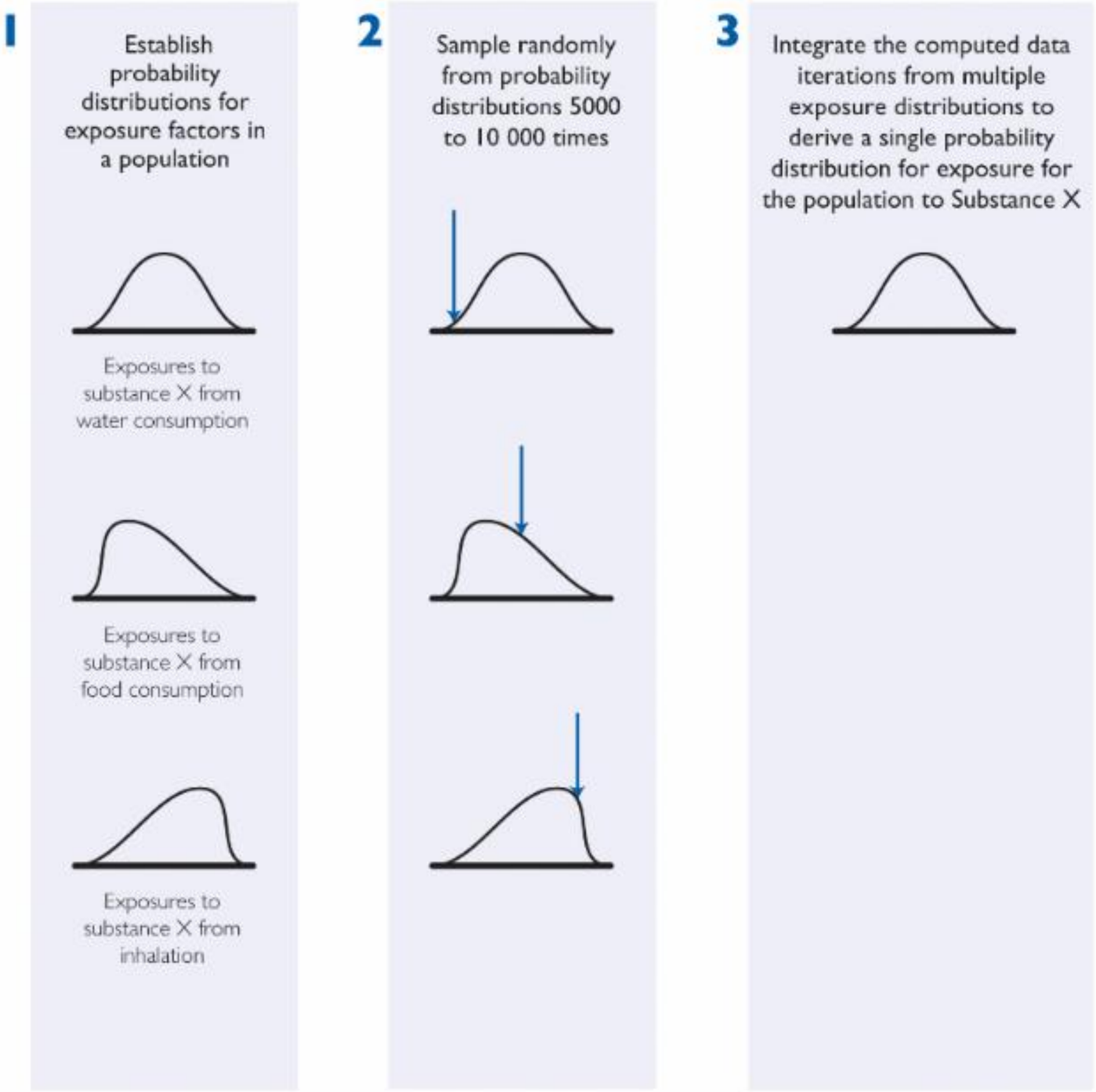
- Increasing regulatory conservatism internationally
- Uncertainty surrounding future regulatory approaches
- Increasing community awareness and fear about PFAS

A need for more nuanced investigation and risk assessment approaches

Country	Period	Guideline (µg/L)	
		Drinking water	Recreational water
United States	2016	PFOS: 0.07	–
	2024	PFOS: 0.004 PFHxS: 0.01	–
Australia	2018 / 2019	PFOS+PFHxS: 0.07	PFOS+PFHxS: 2
	2025 / 2026	**PFOS: 0.008** **PFHxS: 0.03**	**PFOS: 0.16 (draft)** **PFHxS: 0.3 (draft)**
New Zealand	2022	PFOS+PFHxS: 0.07	–

Tiered risk assessment





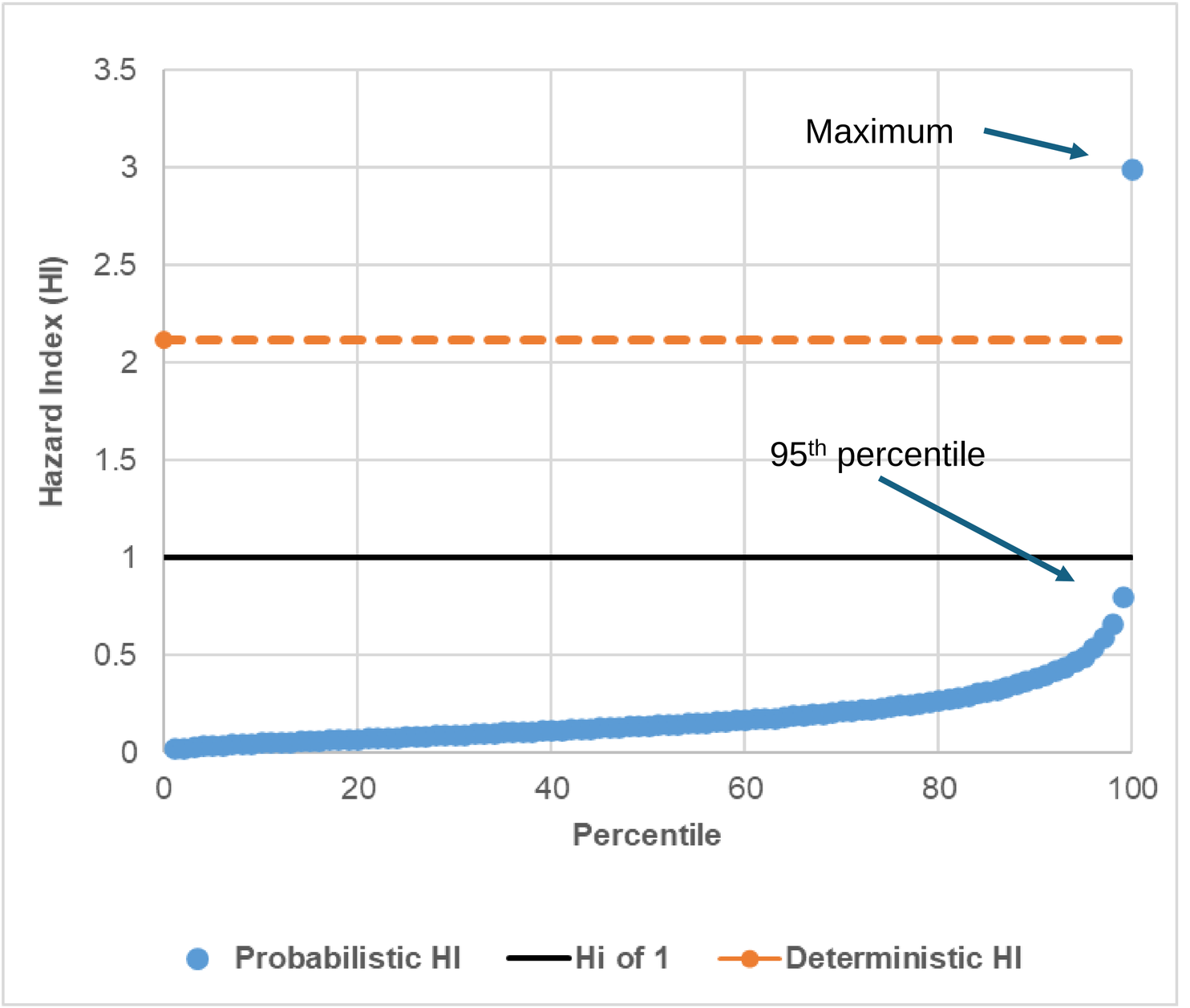
Probabilistic risk assessment

- Each exposure parameter represented by a distribution rather than a single reasonable maximum (or minimum) value.
- Inputs selected for each model made randomly, based on a probability function
- Each element of the risk calculation is run 10,000x
- Advantages over single input/output values
  - Reduction in conservatism
  - More accurate reflection of human variability
  - Simultaneous assessment of uncertainty and sensitivity, across multiple exposure parameters and pathway scenarios
  - Supports the development more practical contamination management strategies

Case study – domestic use of groundwater

$$Hazard\ Index\ (HI) = \frac{Estimated\ dose}{Safe\ dose}$$

- Multiple exposure pathways
  - Recreational use (sprinklers, pool water)
  - Irrigation of fruit and vegetables
  - Domestic production and consumption of poultry eggs



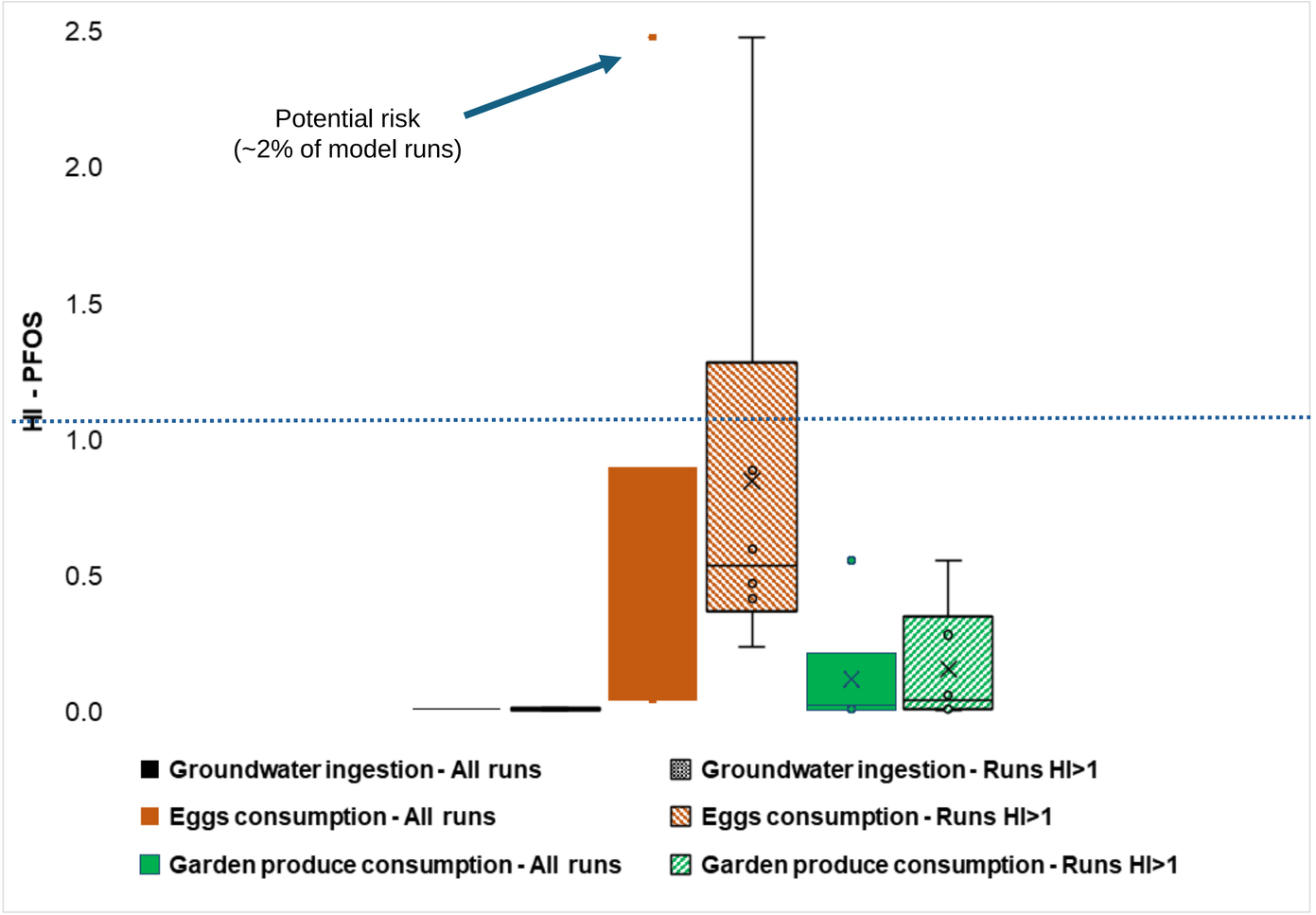
Interrogating exposure pathways

- HI>1 not predicted under any circumstances in association with:

  - The recreational use of bore water

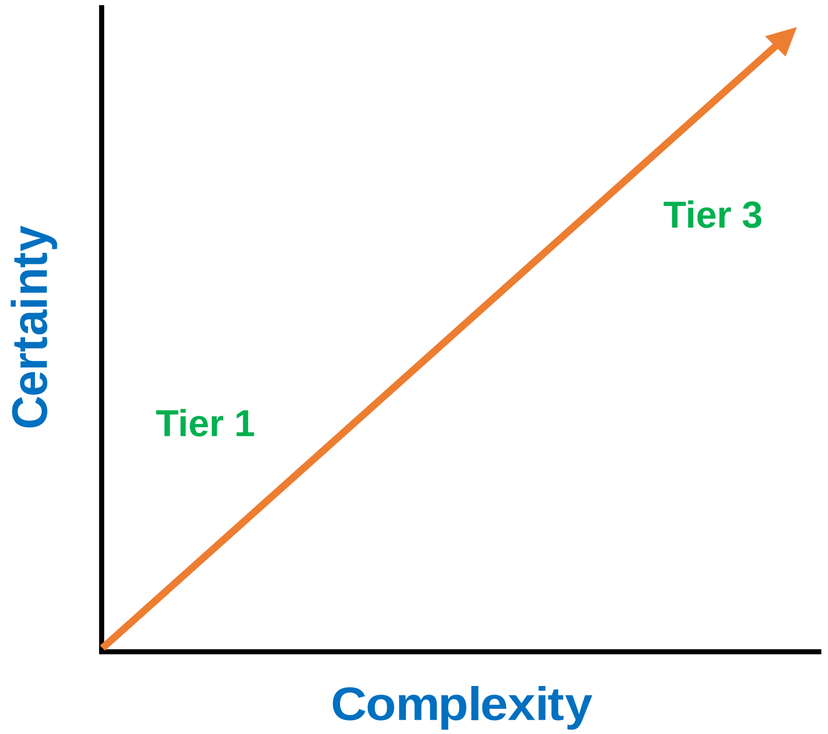
  - Irrigation and consumption of homegrown produce

- HI>1 predicted in association with the consumption of homegrown eggs in ~2% of the 10,000 model runs
- Potential risk associated with very high rates of homegrown egg consumption, combined with a heavy reliance on groundwater for poultry production
- Opportunities for targeted risk management
- Advantages for risk communication



Key takeaways

- Tier 1 and Tier 2 risk assessments significantly overestimate risk – due to the compounding of the conservatism inherent in each individual exposure parameter.
- Tier 3 risk assessment provides in a distribution of risk estimates, the advantages of which include:
  - A reduction in conservatism
  - A more accurate reflection of human variability.
  - The simultaneous assessment of uncertainty and sensitivity of parameters
  - The identification of key risk drivers, which supports clear risk communication and a basis of effective risk management
- Tier 3 assessment is not always possible – but the process provides insights that are broadly relevant to contamination investigation and risk assessment process



Thank you

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