Wellington NZ Promenade at Sunset

Riding the Waves of Change

Navigating Global Public Health Threats and Climate Challenges from Regulations to Operations

Nicole McLellan
Water Treatment Process Specialist
Stantec

Agenda

1. Emerging Public Health Threats & Considerations for Water Regulators

2. Tackling Emerging Contaminants & Implications for Water Treatment

3. Embracing a New Normal & Developing a Path Forward for Operators

Global Water-Climate Challenges

- Population Growth
- Urbanisation
- Climate Change & Natural Disasters
- Emerging Contaminants

…are putting pressure on water resources worldwide

Global Water-Climate Challenges

Water Quantity

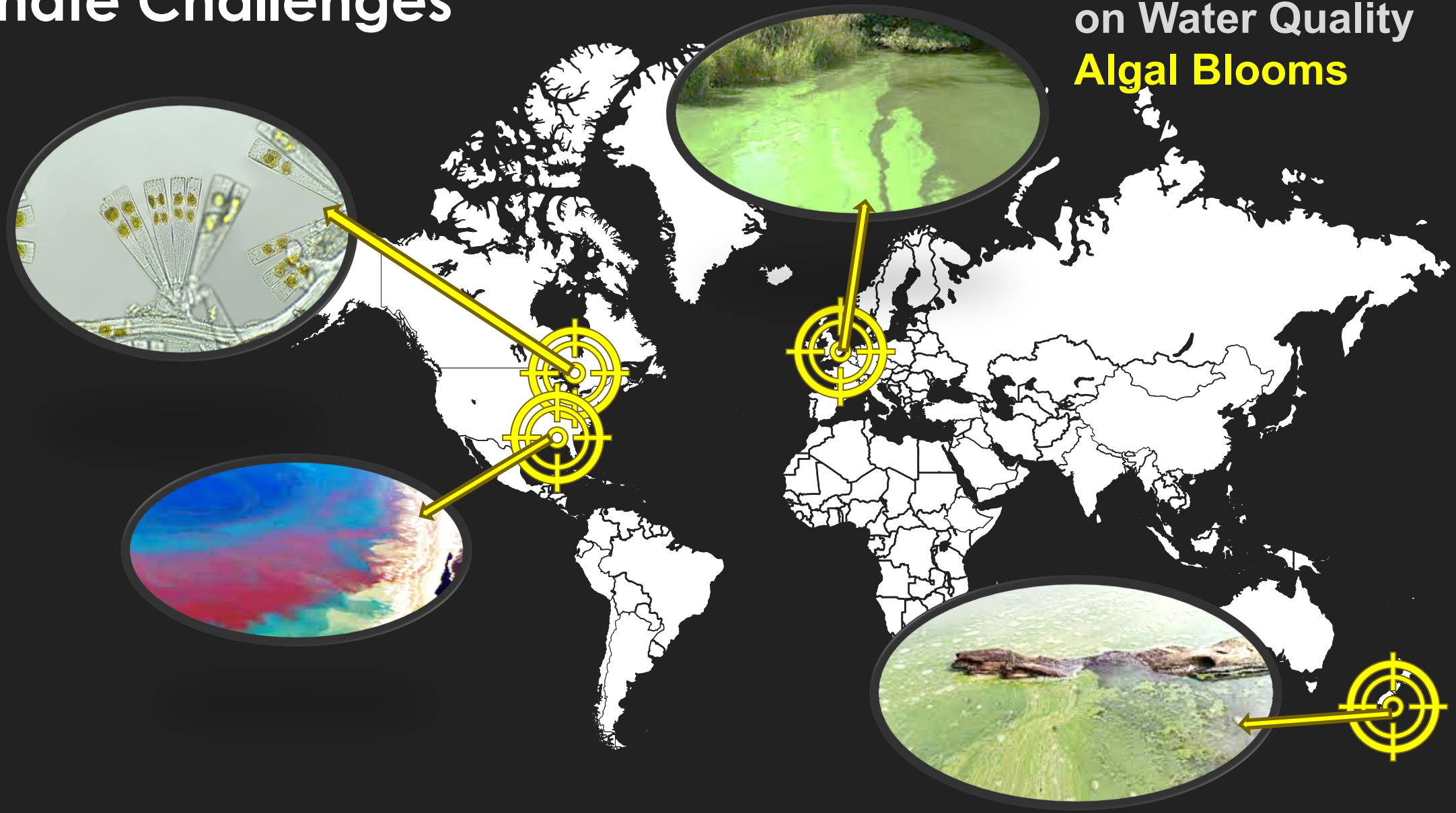
RIDING THE WAVES OF CHANGE

Global Water-Climate Challenges

Water Quantity
Seasonal Impacts on Water Quality

Global Water-Climate Challenges

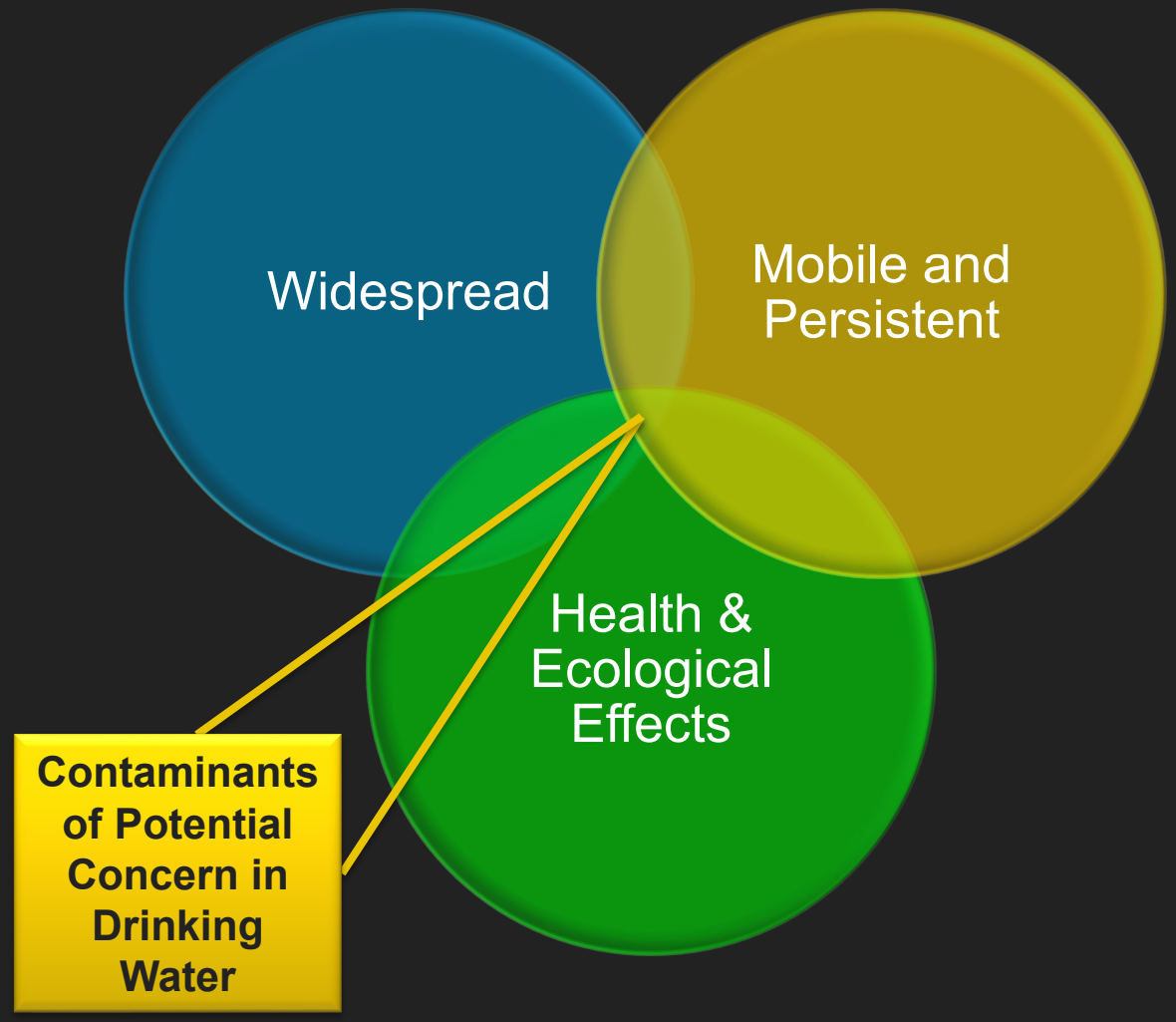
Water Quantity
Seasonal Impacts
on Water Quality
Algal Blooms



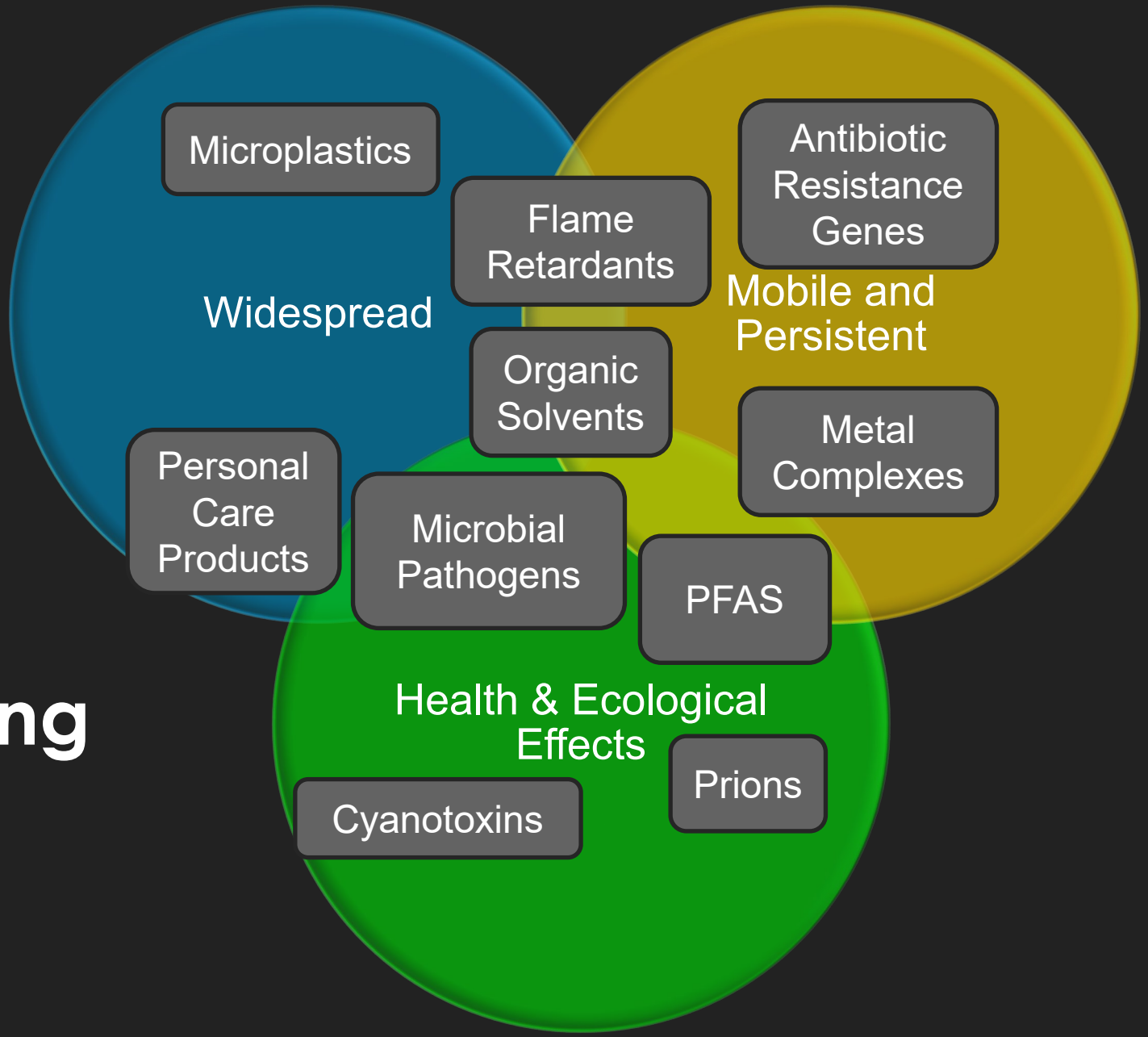
How do we define Emerging Contaminants?

Emerging Contaminants are not well defined in the literature.

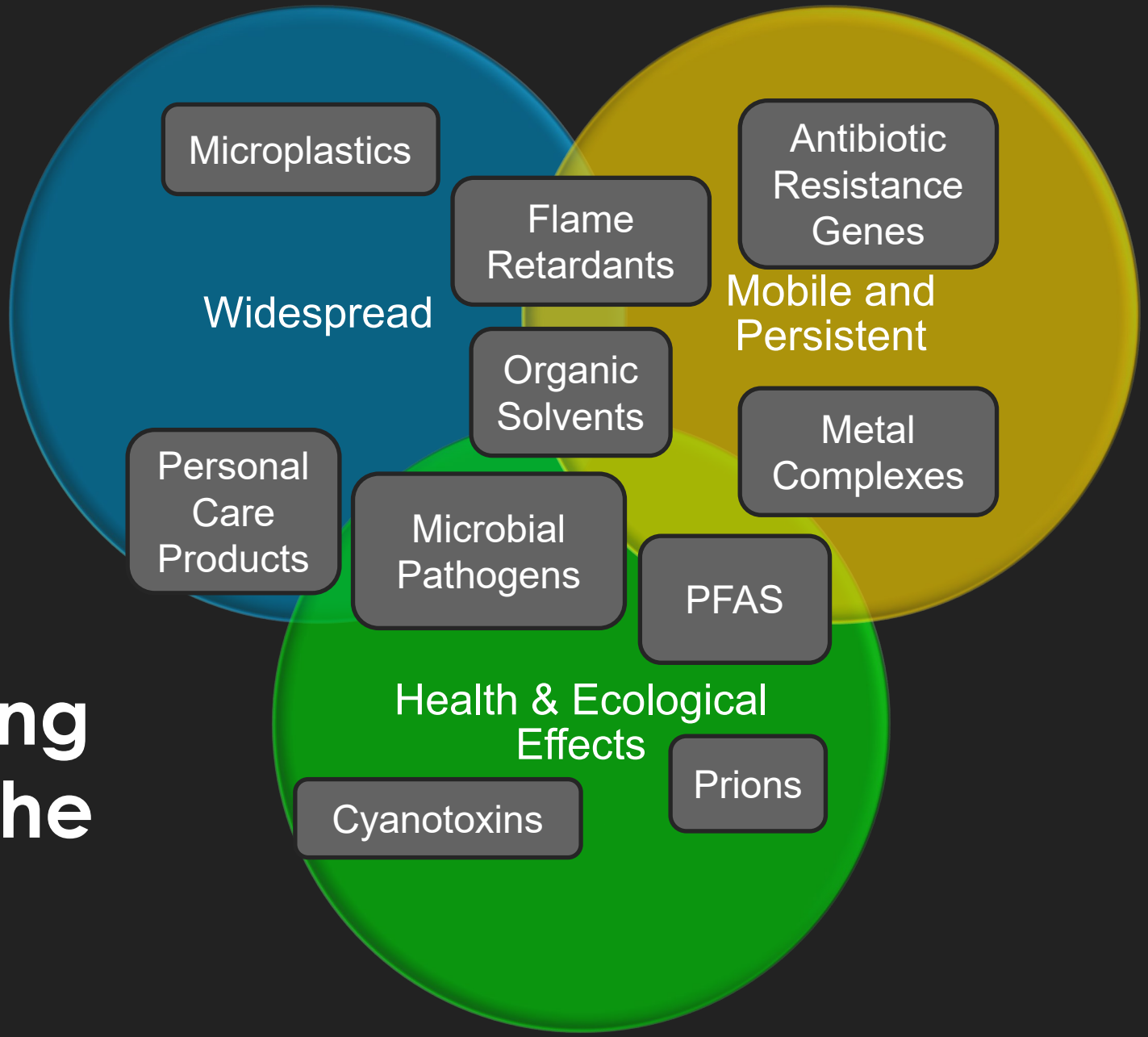
- Contaminants that are not currently regulated and not routinely monitored
- Widespread occurrence
- Highly mobile and/or persistent in the environment
- Pose a human health or environmental risk



Prioritising Emerging Contaminants for Regulations



Prioritising Emerging Contaminants in the Face of Climate Change



Philosophy of Control

Emerging contaminants will be managed by considering:

- **Sources and Sinks** in the environment
- Effective **Treatment Barriers**
- Understanding their **Ultimate Fate** in waste streams

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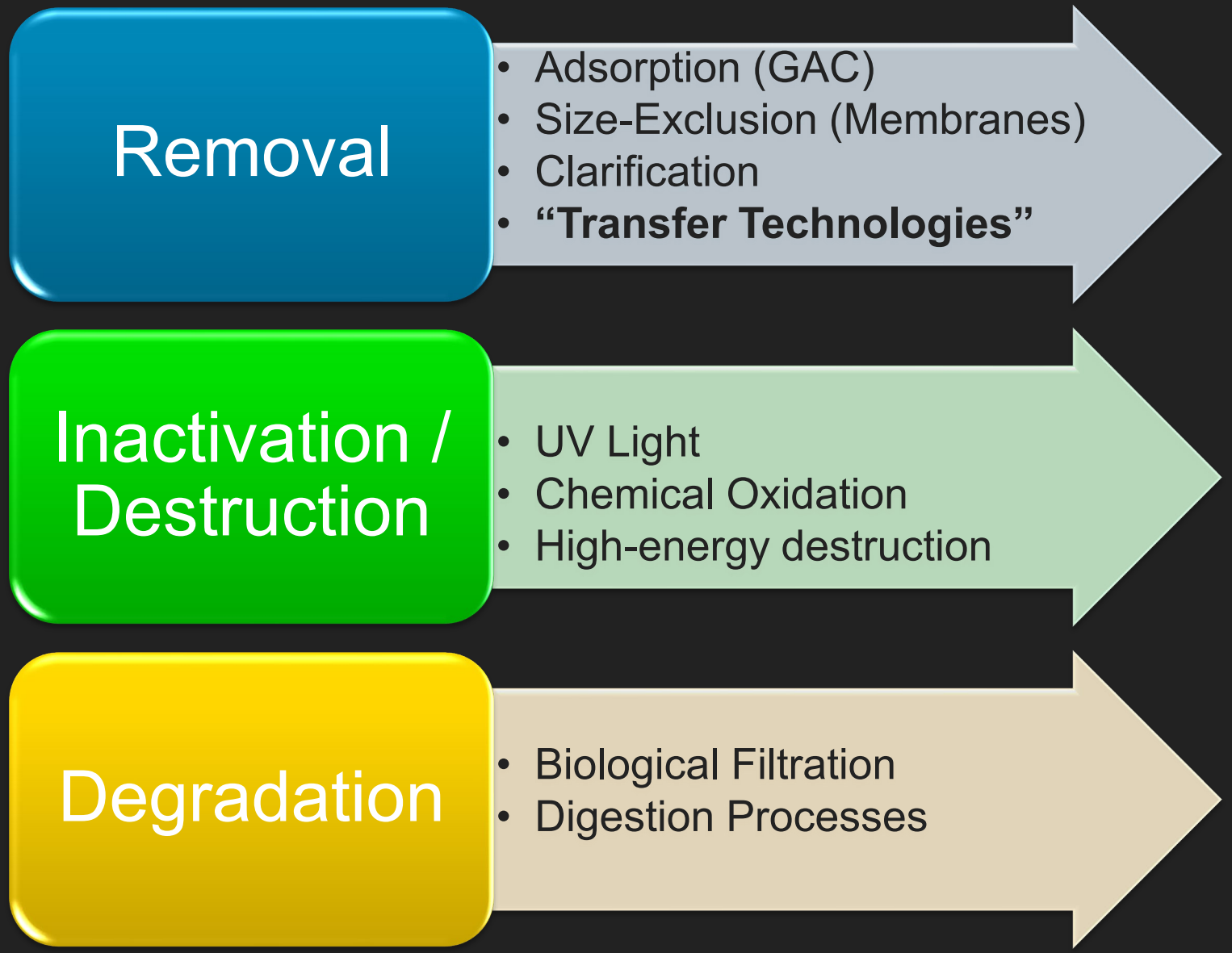
Tackling Emerging Contaminants & Implications for Water Treatment

SECTION 2

Water Treatment Mechanisms for Contaminant Management



Framework for Management of Multiple Emerging Contaminants

Treatment Efficacy	Treatment Mechanism: Removal	Treatment Mechanism: Inactivation/ Destruction	Treatment Mechanism: Degradation
Broad-Spectrum Effectiveness			
Effective for Some of this Class			
Little to No Effectiveness			

R.I.D.D. Framework for Metal Complexes

Metal Complexes	Removal	Inactivation / Destruction	Degradation
Broad-Spectrum Effectiveness	RO/NF membranes		
Effective for Some Contaminants or Conditions	Ion exchange Adsorption Conventional WTP	Chemical Oxidation/Reduction	Biological remediation
Little to No Effectiveness			Conventional WWTP

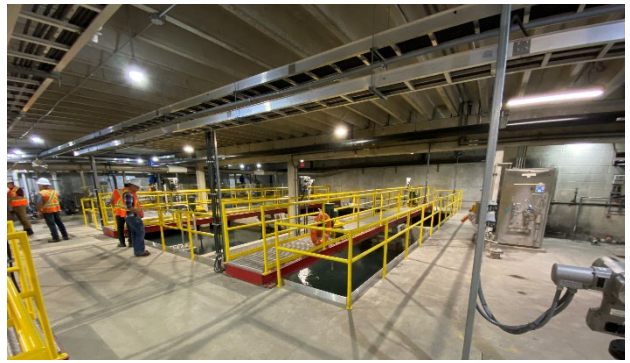
R.I.D.D. Framework for Flame Retardants

Flame Retardants	Removal	Inactivation / Destruction	Degradation
Broad-Spectrum Effectiveness	RO membranes Adsorption	High energy destructive technologies	
Effective for Some Contaminants or Conditions	Ion exchange NF membranes	AOPs Chemical oxidation	
Little to No Effectiveness	Conventional WTP Conventional WWTP		Biological remediation Conventional WWTP

R.I.D.D. Framework for Microbial Pathogens

Microbial Pathogens	Removal	Inactivation / Destruction	Degradation
Broad-Spectrum Effectiveness	RO/NF membranes	UV light AOPs High Energy Destructive Technologies	
Effective for Some Contaminants or Conditions	Adsorption UF membranes Specialty Coagulants Conventional WTP	Advanced WWTP Chemical oxidation	WWTP Disinfection Biological remediation
Little to No Effectiveness	MF membranes Ion Exchange Conventional WWTP		Conventional WWTP

Emerging Contaminant Management Framework: *Case Study 1*



Item	Description
Problem Statement	• **Primary river water supply** with potential industrial contamination upstream • Elevated **PFAS** in River • **Algal Bloom Risk** in River • **Taste & Odour** Concerns • Groundwater wells also available
Existing Treatment	• Conventional coagulation, flocculation, sedimentation with PAC (powdered activated carbon) dosing • Dual-media filtration (GAC) • Disinfection: Chlorination
Planning Approach	• Evaluate efficacy of existing treatment train & **identify gaps in treatment** • **Evaluate alternative processes** to improve resilience of treatment

PFAS, T&O, Algae, Cyanotoxins		Treatment Mechanism		
		Source Water Management	Removal*	Inactivation / Destruction
Treatment Efficacy	Broad-Spectrum	• Blending • Alternative supply	• Membranes • GAC contactors	• *Requires high-energy destructive technology*
	Effective for Some	• Aeration	• GAC replacement • PAC dosing	• Ozonation
	Little to No Effectiveness	• Additional intake pipe location	• DAF alternative	

* Removal technologies require waste management practices for PFAS

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* Removal technologies require waste management practices for PFAS		LEGEND		
		LOWER COST	MODERATE COST	HIGH COST

How Resilient is Your Facility in the Face of Emerging Challenges?

	Source Water Management	Removal	Inactivation/ Destruction	Degradation
Broad-Spectrum Effectiveness				
Effective for Some of this Class				
Little to No Effectiveness				

Do your treatment barriers manage all emerging contaminants in your water supply?

Which additional technologies could improve your resiliency?

Emerging Contaminants Framework Summary

Assess Existing Conditions

- Understanding treatment mechanisms can help to identify existing gaps in process barriers

Consider Broad-Spectrum Barriers

- Broad-spectrum treatment technologies may address multiple treatment gaps

Understand “Ultimate Fate” of Contaminants

- Removal technologies may need to be coupled with waste management “destructive” technologies to mitigate the life-cycle of persistent contaminants

Evaluate Cost-Benefits

- Source water management opportunities may provide the lowest cost long-term solution

SECTION 3

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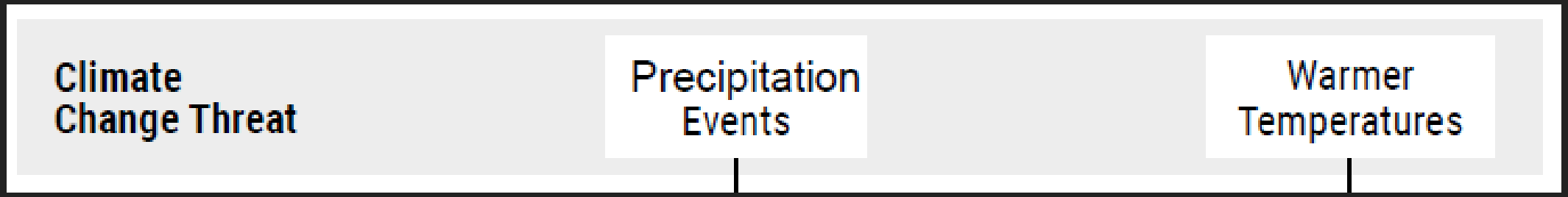
Developing a Path Forward for Operators

Operators don’t like surprises.

However, simplifying the responsibilities of operators can lead to complacency and associated errors.

It is important to maintain operator engagement with regular training and establishment of plant-specific Key Performance Indicators (KPIs) and routine evaluations of critical control points.

CASE STUDY:
WATER TREATMENT PLANT SUSCEPTIBLE TO FLOODS, WARMER SUMMERS & HARMFUL ALGAL BLOOMS



Climate Change Risk Management Framework to Prioritise Issues & Improvements

We need to weigh the **likelihood** of risk with the **consequence** of risk.

		Consequence				
		Catastrophic (5)	Major (4)	Moderate (3)	Minor (2)	Insignificant (1)
Likelihood	Almost Certain (5)	25	20	15	10	5
	Likely (4)	20	16	12	8	4
	Moderate (3)	15	12	9	6	3
	Unlikely (2)	10	8	6	4	2
	Rare (1)	5	4	3	2	1

Assessment of Water-Climate Threats

We must understand the risks to prioritize and solve them.

Risk	Likelihood of Risk	Consequence of Risk	Overall Score / Priority
1. Algal Blooms	2	2	4 →
2. Elevated organics loading	3	2.5	7.5 ↑
3. Elevated turbidity	3	1	3 ↓

Turn your risks into response.

A. Develop Action Plans and practice Response Plans on a regular basis.

B. Set progressive performance targets beyond regulatory criteria to foster a culture of optimisation and best-practices.

C. Curate a deeper understanding of risks with academic partnerships and bench-testing or piloting.

Questions?

Nicole McLellan
Nicole.mclellan@stantec.com

Calm waters under moonlight, Wellington NZ