Pathway for Land Application of Biosolids Derived Biochar

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South East Water

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Acknowledgements

Outline

01 Background

02 Biochar production and analysis

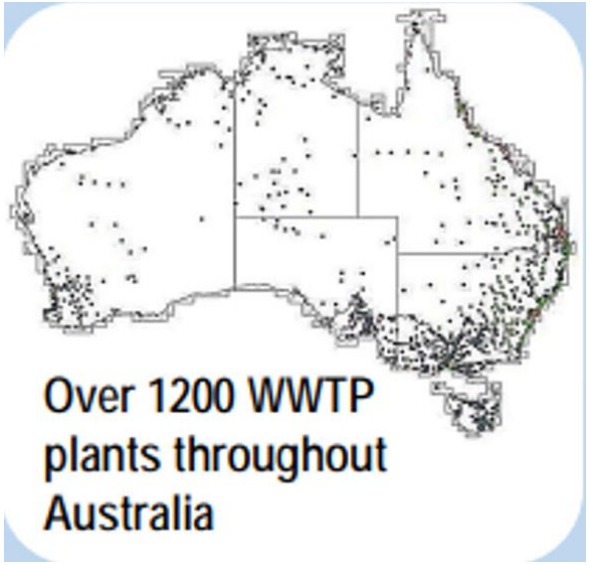
03 Will biochar meet resource quality criteria in the Qld End of Waste Code Biochar ?

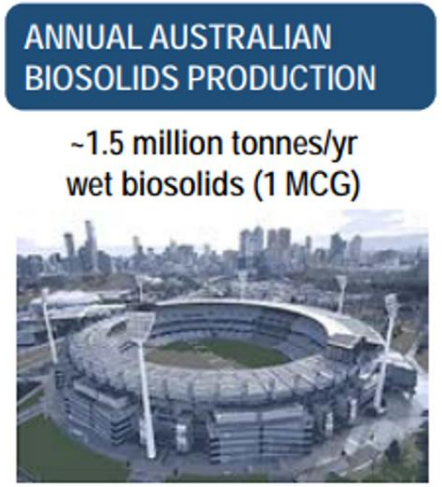
04 What are the conditions for biochar use in soil application?

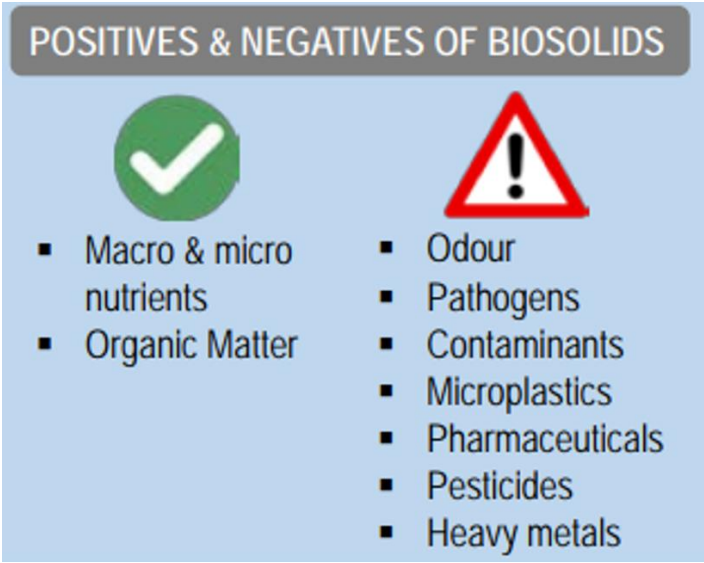
05 What are the concerns with End of Waste Code Biochar ?

Background

- Biosolids production in Australia is 372,000 dry tons/year
- 80% of biosolids are used in agriculture
- Land application might not be a feasible option due to regulatory environment around PFAS limits in biosolids and receiving soils
- PFAS NEMP 3.0 released in March
- Biosolids management is becoming complex and challenging
- Biochar is a Plan B option
- Qld End of Waste Code Biochar released in May 2025







Applying for a permission for the application of biosolids to land

Notification from EPA Vic - August 2021

- "When applying to EPA for a permission for the application of biosolids to land (A15 Biosolids supply or use), EPA recommends that you look to the PFOS, PFHxS and PFOA concentration values outlined in the Queensland Department of Environment and Science 'End of Waste Code Biosolids (ENEW07359617)' publication, published in January 2020 until otherwise advised".

- "This document forms part of the state of knowledge on this topic. EPA Victoria recognises the values in this document as suitable in preventing harm to human health and the environment. EPA will assess any applications received against these criteria".

- Table 7 – Maximum Allowable Soil Contaminant Concentrations (MASCC) for PFAS

- PFAS National Environmental Management Plan 3.0 released in March 2025

End of waste code (EWOC) for biochar

- First approval for regulatory use of biochar in Australia

Biochar (EOWC010002177) May 2025

- One of the most consulted and complex codes
- Biochar producers and users are required to register with the regulator
- Any organic waste matter is biochar feedstock

EWOC for biochar – Approved uses

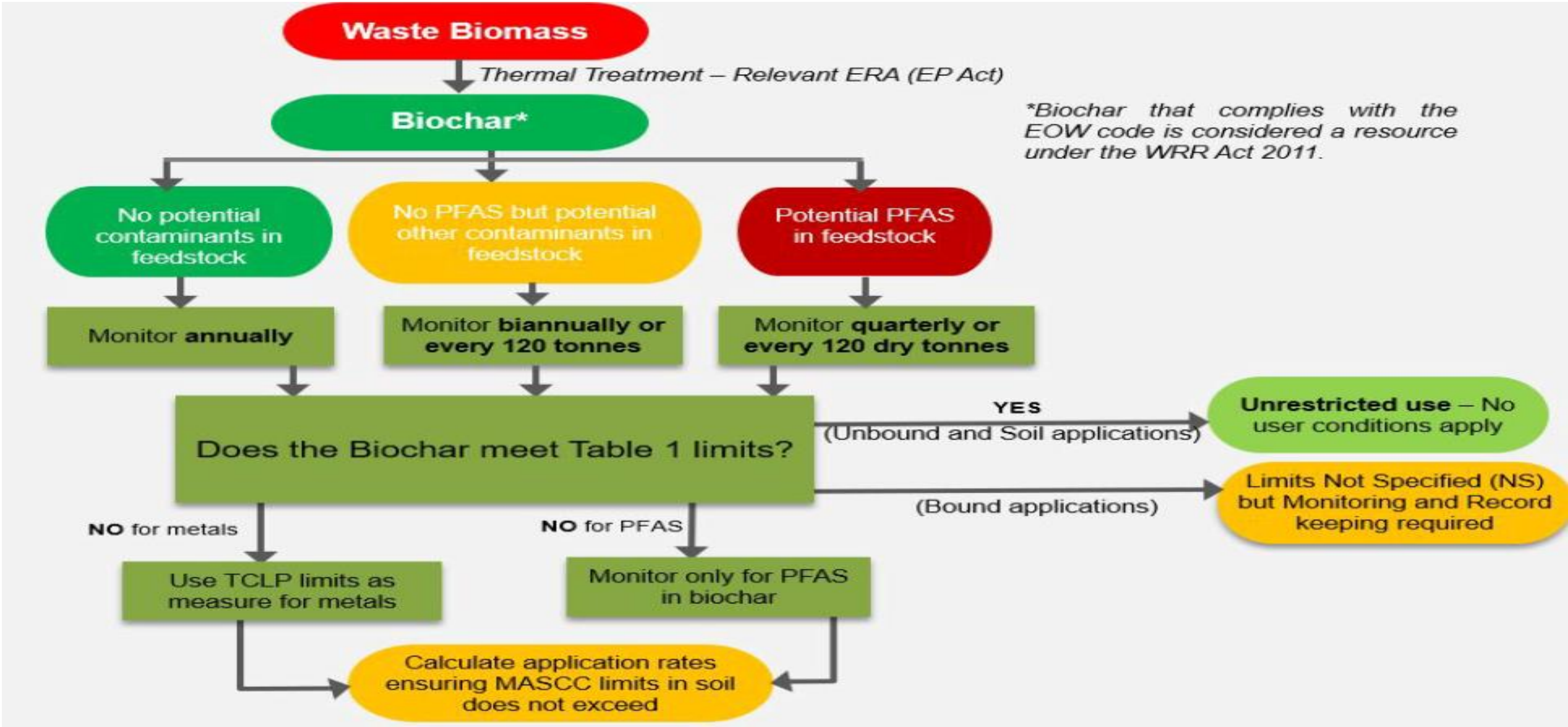
1.Soil applications – composting, fertilsers, land remediation & stabilisation, soil conditioner

2. Construction applications

Bound – concrete, asphalt for road pavement, building and construction materials for insulation, tiles and light weight aggregates

Unbound – Road stabilisation (dirt roads, road base and embankments)

End of waste code (EWOC) for biochar



South East Water Biosolids to Biochar Journey

1. Series of studies
2. Industry insights
3. Basic lab experiments
4. Pyrolysis at multiple scales

2015-16

Masters Projects – Preliminary biosolids pyrolysis study

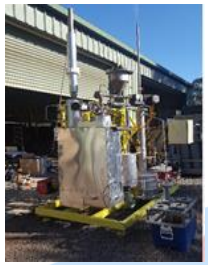
2017

R&D Project development and funding success

2018

Bench-scale trials (20-50 gm) and preliminary techno-economic assessment

TRL 4



2019 -2021

Semi-pilot scale trials (0.5-1 dry kg/hr) and

Pilot-scale trials (MK1) (12-16 dry kg/hr

TRL 5

2023

Pilot Plant (Mk2) Phase 1- (15-30 dry kg/hr) – integrated pyrolysis and gas producer

TRL 6

2025

Pilot Plant (Mk2) Phase 2 – expanded feedstocks

2026

Demonstration Integrated Plant (Mk3)-

Operate (30 dry kg/hr)

TRL 8

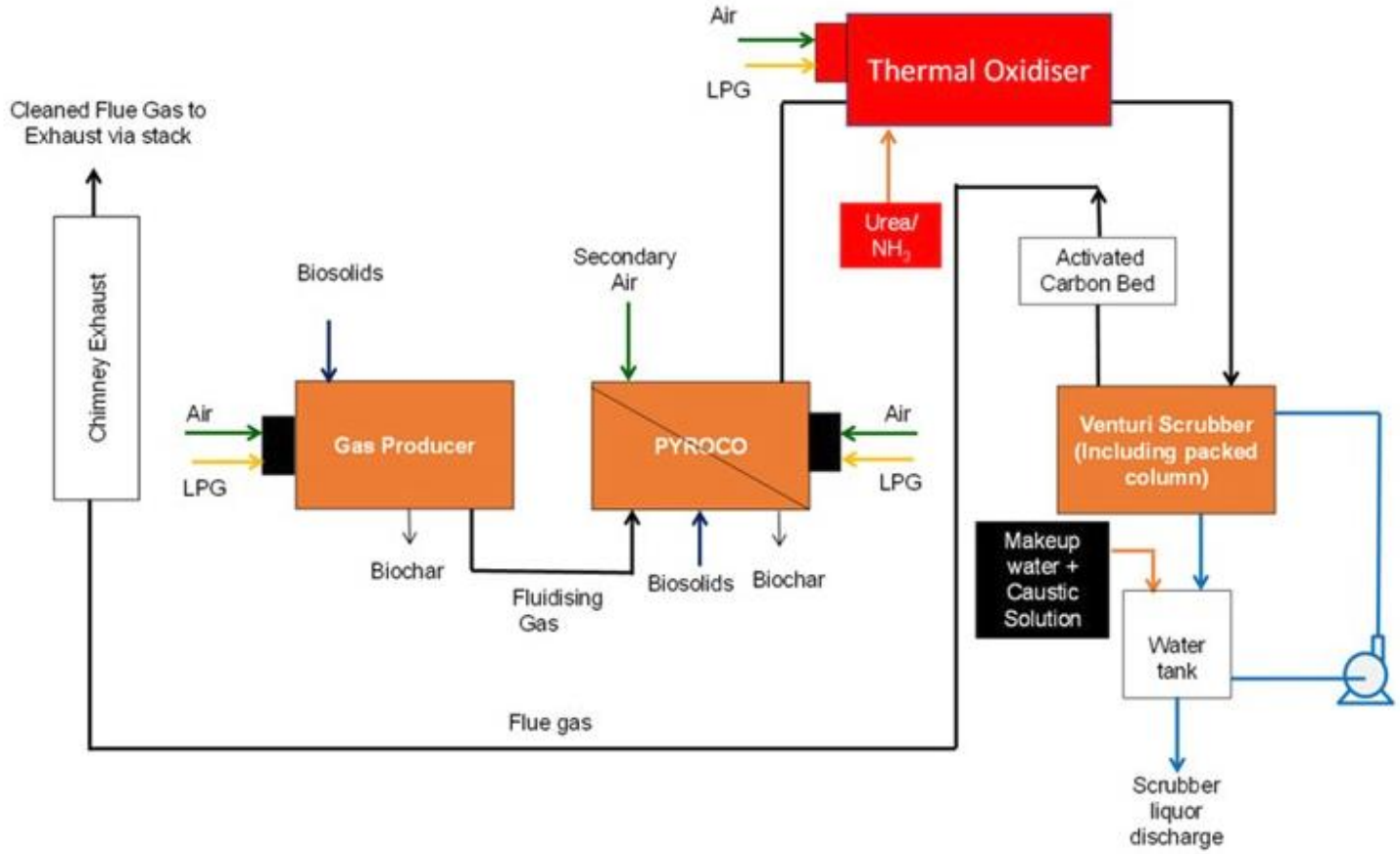
2027

First Commercial Plant-

180 dry kg/hr (15 wet tons/day from centrifuge)

Biochar production

PYROCO Mark 2 pilot plant



Process flowsheet

Biochar analysis for soil application as per EOWC

- Total metals (As, B, Cd, Cr, Cu, Pb, Hg, Ni, Se and Zn)
- Toxicity Characteristic Leaching Procedure (TCLP)
- Polychlorinated biphenyls (PCBs)
- Polycyclic aromatic hydrocarbons (PAHs)
- Per- and polyfluoroalkyl substances (PFAS)
  - PFOA
  - PFOS+PFHxS
  - Sum of PFAS

Will biochar meet EOWC resource quality criteria ?

Total Metals (mg/kg)

	EOWC Table 1 criteria	Pyroco Biochar	Gas Producer Biochar
As	20	5	5
B	100	114	153
Cd	1	2	<0.2
Cr	100	59	94
Cu	150	1400	1500
Pb	150	70	9
Hg	1	<0.05	<0.05
Ni	60	26	99
Se	5	8	4
Zn	300	2233	1287

Will biochar meet EOWC resource quality criteria ?

Toxicity Characteristic Leaching Procedure – TCLP (mg/L)

	EOWC Table 2 criteria	Pyroco Biochar	Gas Producer Biochar
As	0.1	0.02	0.02
B	0.5	0.9	4.1
Cd	0.01	0.004	ND
Cr	0.1	0.002	ND
Cu	0.2	0.5	7.4
Pb	0.0034	0.005	0.002
Hg	0.002	ND	ND
Ni	0.2	0.045	0.076
Se	0.02	0.003	0.003
Zn	2	2.2	1.3

Will biochar meet EOWC resource quality criteria ?

PCBs, PAHs and PFAS (mg/kg)

	EOWC Table 1 criteria	Pyroco Biochar	Gas Producer Biochar
PCBs	<0.2	<0.6	<0.6
PAHs - ALS	6	7 (n=3)	0.6
PAHs- Leeder	6	2.1 (n=7)	0.07
PFOS+PFHxS	0.002	<0.0002	<0.0002
PFOA	0.001	<0.0002	<0.0002
Sum of PFAS	Not specified	<0.0002	<0.0002

End of waste code (EWOC) for biochar

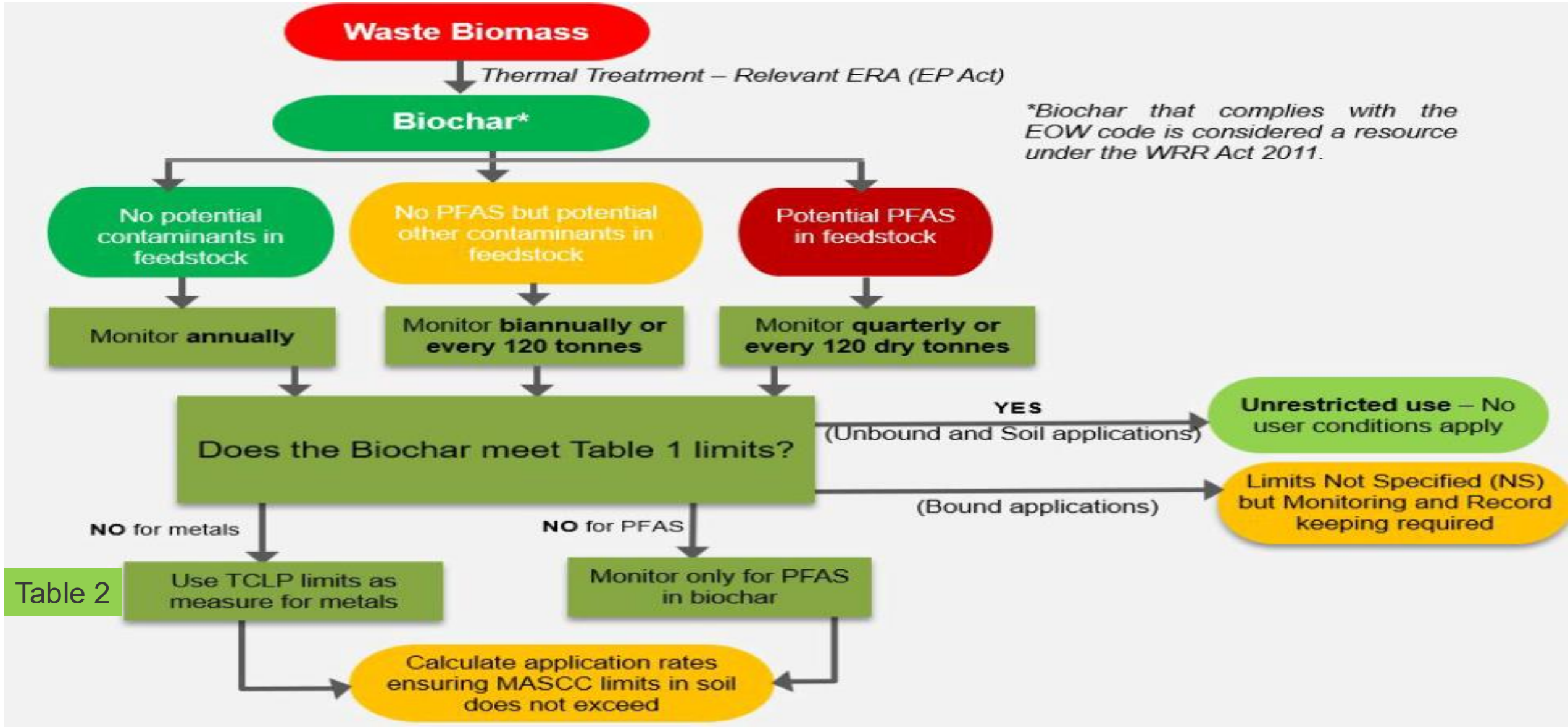


Table 2

What are the conditions for biochar use in soil application?

- All reasonable and practical measures must be taken to prevent or minimise environmental harm caused using biochar in line with biosolids guidelines.

- Must not result in soil contaminant concentrations exceeding the MASCC limits in the EOWC.

- Estimate receiving soil heavy metals concentrations (mg/kg) at various biochar application rates

Estimated receiving soil heavy metal concentrations (mg/kg) at various biochar application rates

Biochar application rate (t/ha)	Cu	Zn
10	14	20
25	33	49
50	65	97
60	78	115
90	102	151
MASCC limits (mg/kg) in EOWC	100	200

Soil mixing depth = 10 cm
Soil bulk density = 1.1 g/cm³
Soil mass = 1100 kg/m²

EVALUATION OF AGRONOMIC BENEFITS OF BIOSOLIDS BIOCHAR

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

SOiL CRC

Performance through collaboration

Soil CRC Project Partners

Soil CRC Poject Objectives

1. To evaluate agronomic effectiveness of biosolids derived biochar

2. To fortify biochar with nutrient-rich minerals to enrich available plant nutrients

3. To assess fate of heavy metals in receiving crops (wheat and canola) and soil





What are the concerns with EOWC Biochar ?

- Stringency of PFAS limits
- Total Oxidisable Precursor Assay (TOPA) testing requirements
- PFAS testing requirements

Conclusions

- Biochar is unlikely to meet all the EOWC requirements
- Biochar EOWC lacks proportionality and scientific justification
- A revised risk-based framework is needed
- Biochar in soil application - Soil CRC project underway
- Biochar in construction application - Plan B option for biochar use

New Project

Upcycling of biosolids biochar for low-carbon concrete products

RMIT

South East Water

WATER CORPORATION

TREMS

TRANSFORMATION OF RECYCLED WASTE INTO ENGINEERED MATERIALS AND SOLUTIONS

UrbanUtilities