Challenges in Implementing Innovative
Technologies & Approaches within Existing
Contaminated Land Regulatory Frameworks

Adrian Heggie – WSP Australia November 2018





# What's the Issue?

- Innovation inevitable & part of normal scientific,
   engineering & business practices
- Business & administrative practices usually make provisions to permit innovation
- But guidance, enshrined within regulatory processes, can inhibit innovation

Innovation in investigation technologies and practices in Contaminated Land Assessment has become stymied by our CLM regulatory frameworks



# A brief look at the history of innovations in CLM

Early 1990s: CLM in its formative age

- Minimal guidance derived from USA and Netherlands
- Steep learning curve for consultants and regulators
- Learning "on the job"
- New methods & old methods were all 'new'
- Little resistance to innovative methods
- Contaminated land EPA auditor scheme did not exist till 1999



# A brief look at the history of innovations in CLM

# 2000s: CLM in its regulated age

- National guidance created NEPM 1999
- State regulators' auditor schemes 1999
  - processes regulated, but flexibility for methodologies
- Review of the first (1999) NEPM 2007- 2013
- CRC CARE technical reports form basis of revised NEPM
- NEPM 2013: Specifies recommended <u>measurement</u> methodologies
- NEPM linked to state regulations



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# The Genesis of Resistance to Change

- Auditors are obliged to initially accept only NEPM endorsed methods.
- Consultants must demonstrate alternative (new/different/non-endorsed) methods are valid & better than standard methods.
- & convince the auditor or regulator.
- Technical errors in guidance

Re: passive vapour sampling, NEPM 2013 states:

"The absorbed mass cannot be equated to a concentration because the volume of air associated with the absorbed mass is largely unknown."



# The Style of the Guidance Inhibits Innovation

- The guidance is too prescriptive for regulated guidance
- What may be accurate in 2009 can be old & redundant 5 or 10 years later
- Guidance should be worded to accommodate scientific and technological advancement



# **A Changing Australian Attitude**

- Australian attitude to innovative measurement methodologies pre 2000 (pre growth of regulatory controls) was highly embracive of change
- Currently Australia is highly protective of existing regulated methods
- All currently endorsed methods were in place before regulatory guidance – what chance for new methods?



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# **Embracing and Promoting Innovation**



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### The Cases of Three Innovative Measurement Methods

- Passive soil vapour measurement (WMS\_LU samplers)
- Passive mass flux (measuring vapour emission strengths)
- Headspace-in-vial soil vapour measurement



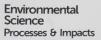
### **Passive Mass Flux Chambers**

- Developed and launched in Australia
- Published in a refereed journal
- Used under developer's supervision on numerous Australian projects, and some Chinese projects
- Auditor and regulator acceptance limited by inappropriate and incorrect wording in NEPM 2013 re use of surface vapour flux measurements
- Method is included in endorsed sampling methods in China



### **New Flux Method Published**









quantify vapour intrusion into indoor air

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A new instrumental method (a passive flux chamber) to quantify emission rates of volatile organic compounds (VOCs) from natural ground surfaces and floors or pavements was developed and tested against the traditional emission isolation flux chamber (the dynamic flux chamber). Dynamic flux chambers have been used for some decades to measure diffusive mass flux of VOCs at contaminated sites thereby providing quantitative estimates of the contribution of contaminant vapour fluxes to indoor air concentrations for human health risk assessments. The new method described here measures diffusive mass flux from surfaces utilising a high uptake rate passive absorptive sampling tube placed within a chamber to capture the mass molecular flux. The passive flux chamber was developed to provide a technically simpler and more cost effective means of quantifying vapour intrusion rates into buildings where the dominant pathway for VOC intrusion through floors is molecular diffusion rather than pressure driven advective flows through floor gaps and cracks. The passive flux chamber operation is based on the principal of molecular diffusion and the random movement of molecules in the gaseous phase. The efficiency of the passive chamber in capturing the total mass flux was tested by measuring comparative concentrations in adjacent identical chambers, one fitted with and the other without an absorptive sampling tube. For chambers fitted with sampling tubes the internal chamber concentrations of VOCs were on average 85% lower than for co-located chambers not fitted with the absorption tubes. demonstrating a high rate of capture of VOC flux into the chamber and a close and satisfactory approximation of mass flux. Eighteen field comparisons of surface fluxes measured by the passive and dynamic flux chamber methods showed that on average the passive chambers produced flux rates a factor of two greater than the dynamic flux chambers.

Passive diffusive flux chambers - a new method to

rsc.li/espi

#### Environmental significance

A newly developed flux chamber method to quantify diffusive mass fluxes of vapours from contaminated land, through building foundations into living and working environments, provides a technically simpler and more cost effective method to determine environmental health risks for building occupants. Being simpler, compact and more portable, the passive flux chamber provides a suitable and convenient measurement method to quantify health risks from contaminant vapour fluxes in locations of limited space and access, and in remote locations on account of easy portability. Conceptually simple, the method

#### Introduction

measurement of mass fluxes of volatile organic compounds Aneja measured ammonia emissions from soil, and Li et al. (VOCs) from ground surfaces and floor pavements. U.S. EPA' and measured biogenic nitric oxide emissions from agricultural soil. Eklund<sup>2</sup> described an "emission isolation flux chamber", now Static flux chambers, which rely on a conceptually different

Aneja et al.3 describe the use of the dynamic flux chambers by various researchers. Hill et al.4 used a dynamic flux chamber to Flux chambers have been used for several decades for the measure biogenic sulphur fluxes from a salt marsh; Roelle and

commonly termed the dynamic flux chamber, for the measure- principle of operation, have also been used by various ment of surface VOC emissions to air at contaminated sites. researchers; Devol et al." and Marani and Alvala" measured Dynamic flux chambers have also been used to measure surface methane fluxes from aquatic habitats on floodplain waters of emission of various compounds in a variety of other applications. the Amazon River using floating chambers; and Sun et al.\* measured methane from natural wetlands in northeast China. WSP Australia, Sydney, NSW 2000, Australia. E-mail: adrian.heggie@wsp.com, Tel:
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Whereas the dynamic flux chamber technique involves the
collection of a vapour sample from the chamber void after an \*Leeder Consulting, QLD, Australia. E-mail: bill storropoulos@sgs.com; Tel: +65 (0) equilibrium is reached between inward flux and chamber dilution air flow (sweep air), sampling from the static chamber

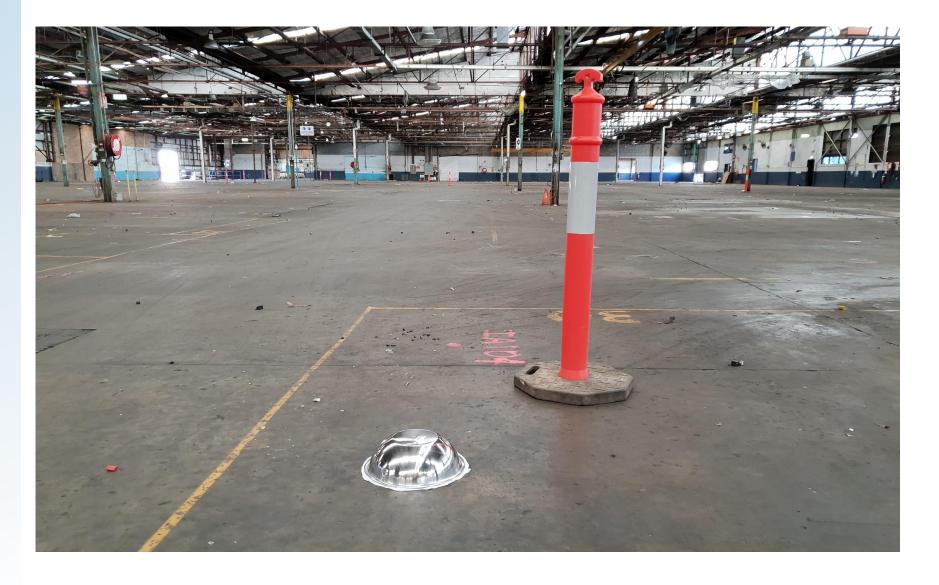
Environ. Sci.: Processes Impacts, 2018. 20, 523-530 | 523

# **New Flux Method**





# **New Flux Method – in use now in Australia**





# Headspace-in-vial soil vapour measurement

- A recent local development / application of established measurement and analytical principles
- Regulator's position:
  - "Not published"
  - "...the method has merit as a screening tool.."
  - "..evidence is lacking to demonstrate the method has been generally accepted as reliable and quantitative by <u>industry</u> and <u>other jurisdictions</u>."
- Auditors accept it as a screening tool



# **Headspace-in-vial Sampling**







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# The outlook for acceptance of new methods

- May require a generational change
- A new generation of guidance?
  - with a new approach to the role and style of guidance
- Perhaps just more perseverance?

# The Positive Spin

- Innovation is inevitable
- It can either be encouraged and supported or resisted
- Implementation of new methods is the best way to prove their usefulness
- Outward looking regulators & auditors are interested and accepting

