Chasing LAS in Lao

Parameterising a Risk Assessment Methodology for Direct Discharge Scenarios

Mick Whelan

Roger Van Egmond, Chris Sparham, Sean O'Connor, Chris Finnegan and Martin Vaughan (Unilever)

Jean Lacoursière and Lena Vought (Kristianstad University)

Ian Guymer, Jonty Pearson and Kay Fox (Warwick University)

www.cranfield.ac.uk

Conventional ERA

Exposure Assessment

EMISSION AND RELEASE ESTIMATES

FATE AND DISTRIBUTION MODELLING

PREDICTED ENVIRONMENTAL CONCENTRATION (PEC)

Effects Assessment

EFFECTS DATA

EXTRAPOLATION

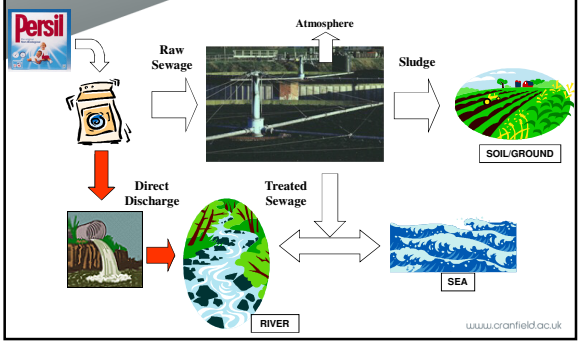
PREDICTED NO-EFFECT CONCENTRATION (PNEC)

Risk ?

PEC/PNEC > 1 ?

www.cranfield.ac.uk

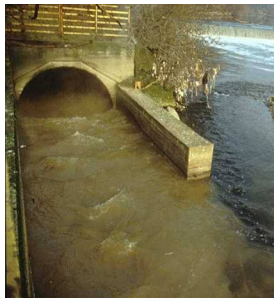
Background



www.cranfield.ac.uk

Direct Discharge

Under DD, stream ecology can be affected by high BOD (and low DO concentrations), free ammonia, SS and other potentially harmful constituents. So does conventional ERA make sense?



Untreated discharge of raw sewage to surface waters

www.cranfield.ac.uk

ERA for DD Some guidelines

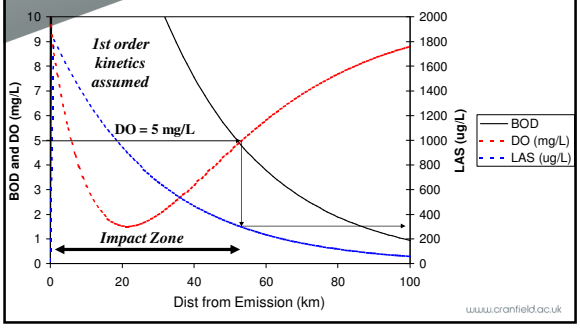
Detergent ingredients should not significantly delay or impair the recovery processes in polluted rivers.

Detergent ingredients should degrade at least as fast as BOD and ammonia.

AISE/CESIO Limlette III Workshop (1995)

The Impact Zone An illustration

Predicted BOD, LAS and DO concs in generic scenario



www.cranfield.ac.uk

Data Requirements for DD ERA

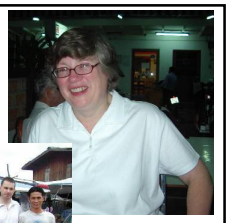
Cranfield UNIVERSITY

***PNEC* for impact zone (threshold for recovery function inhibition)**

Means of estimating model parameters for operational use (e.g. using simple lab tests)

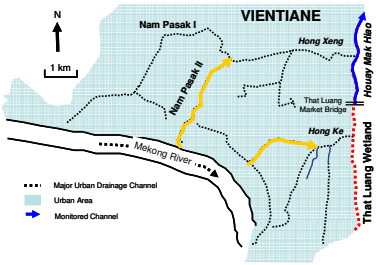
www.cranfield.ac.uk

The Lao connection



Unilever

Vientiane



Pop (Lao): 6.5 m
Pop (VTE): 331 000
GDP: $2100 cap^{-1} yr^{-1}

www.cranfield.ac.uk

Vientiane

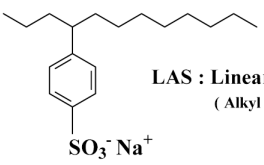
"Following the plug"

www.cranfield.ac.uk

Chasing LAS in Lao

A model HPC ingredient

High tonnage anionic surfactant
Readily biodegradable
Log K_{OW} ($C_{11.6}$) = 3.32
PNEC ca 0.25 mg/L
Environmental behaviour well characterised

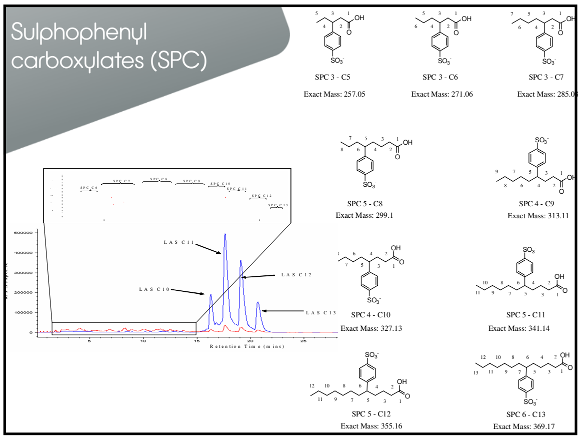


LAS : Linear Alkyl Benzene Sulfonate
(Alkyl Chain : C_{10} - C_{13})

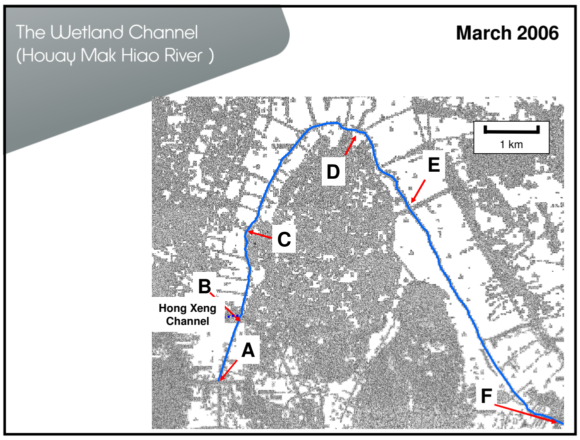
$SO_3^- Na^+$

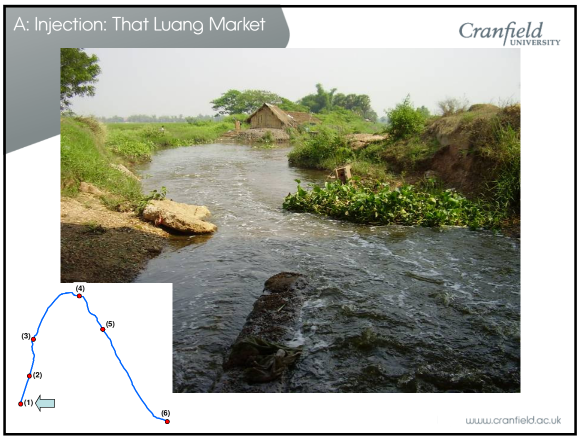
Typically C_{10}:C_{11}:$C1_2$:C_{13}=13:30:33:24

www.cranfield.ac.uk

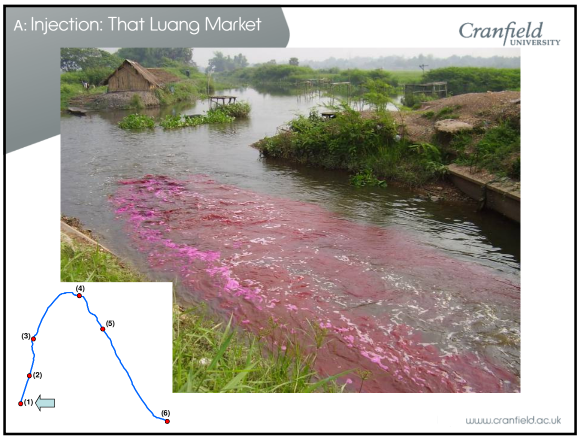

Sulphophenyl carboxylates (SPC)
LAS C11
LAS C12
LAS C10
LAS C13
SPC 3 - C5
Exact Mass: 257.05
SPC 3 - C6
Exact Mass: 271.06
SPC 3 - C7
SPC 5 - C8
Exact Mass: 299.1
SPC 4 - C9
Exact Mass: 313.11
SPC 4 - C10
Exact Mass: 327.13
SPC 5 - C11
Exact Mass: 341.14
SPC 5 - C12
Exact Mass: 355.16
SPC 6 - C13
Exact Mass: 369.17


WQ Analysis VTE-style
Cranfield UNIVERSITY


The Wetland Channel
(Houay Mak Hiao River)
March 2006
1 km
D
E
C
B
Hong Xeng
Channel
A
F

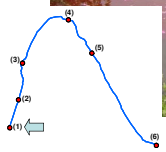

A: Injection: That Luang Market
Cranfield UNIVERSITY
(4)
(5)
(3)
(2)
(1)
(6)
www.cranfield.ac.uk


A: Injection: That Luang Market
Cranfield UNIVERSITY
(4)
(5)
(3)
(2)
(1)
(6)
www.cranfield.ac.uk


A: Injection: That Luang Market
Cranfield UNIVERSITY
(4)
(5)
(3)
(2)
(1)
(6)
www.cranfield.ac.uk

A: Injection: That Luang Market

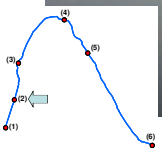
Cranfield UNIVERSITY



www.cranfield.ac.uk

B: Junction

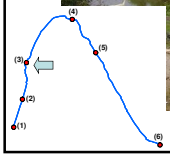
Cranfield UNIVERSITY



www.cranfield.ac.uk

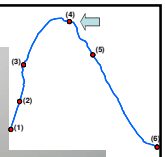
C: Pepsi Bridge

Cranfield UNIVERSITY



www.cranfield.ac.uk

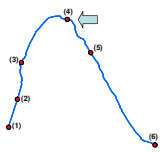
D: "Snake"



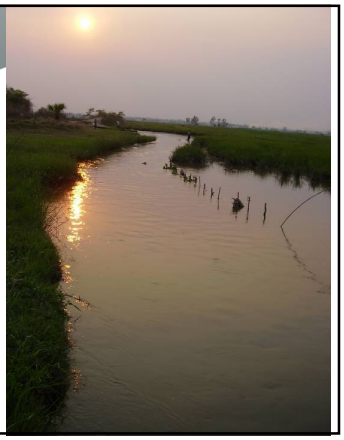
Looking downstream

www.cranfield.ac.uk

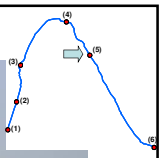
D: "Snake"



Looking upstream

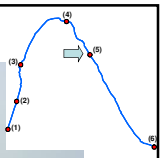


E: Ban Sok



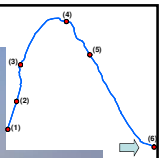
nfield.ac.uk

E: Ban Sok



anfield.ac.uk

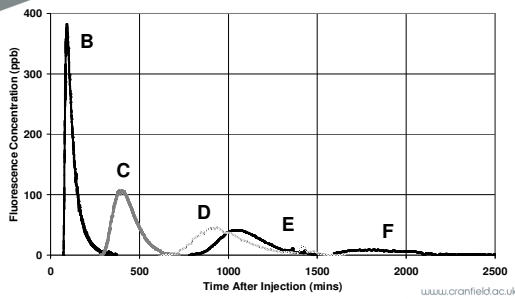
F: Na Kuai



www.cranfield.ac.uk

Dye Trace

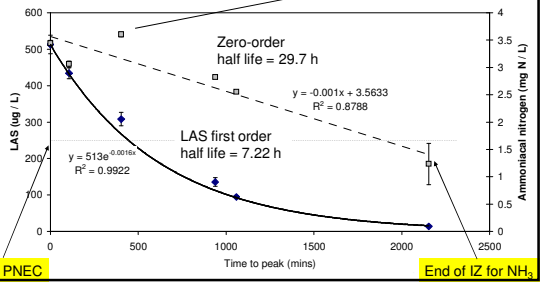
Cranfield UNIVERSITY



www.cranfield.ac.uk

LAS and NH_4^+ (Dye Trace)

Average LAS and ammoniacal nitrogen concentration ir
versus time to peak



LAS PNEC

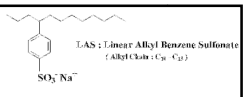
End of IZ for NH_3

Ecosystem Quality

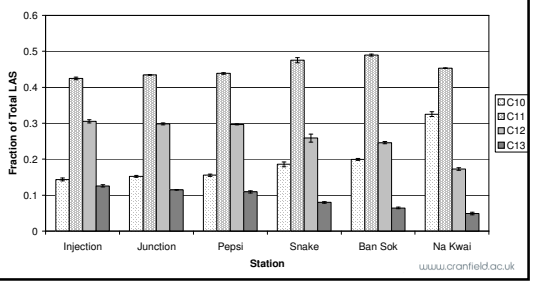
Cranfield UNIVERSITY

www.cranfield.ac.uk

LAS homologue distribution



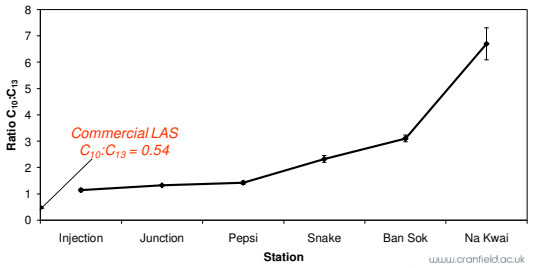
Changes in average composition of total LAS (by alkyl chain length) for dye trace samples



www.cranfield.ac.uk

C10 : C13 ratio

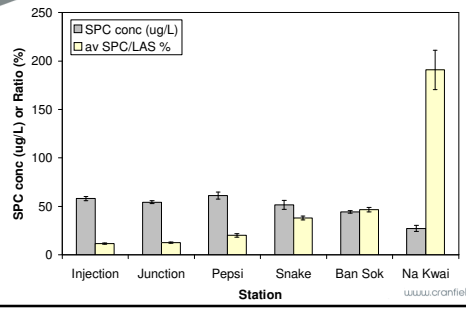
Remember – in commercial LAS
C_{10}:C_{11}:C_{12}:C_{13}=13:30:33:24



www.cranfield.ac.uk

SPC concentrations

Sulphophenyl carboxylates



www.cranfield.ac.uk

Conclusions

Cranfield UNIVERSITY

Concentrations of LAS are rapidly removed in the river channel draining Vientiane (and subjected to DD)

The ammonia story is complicated by N mineralisation (of autochthonous and exogenous organic matter), additional NH_4 emissions (e.g. by ducks) and uptake by plants

Results consistent with acceptable risk under the Impact Zone RA methodology

Need to confirm generality with other substances (readily and inherently biodegradable)

www.cranfield.ac.uk

Thanks for Listening!

The behaviour of linear alkyl benzene sulphonate under direct discharge conditions in Vientiane, Lao PDR

Read all about it!

Whelan *et al.* (2007) *Water Research* **41**, 4730-4740 [doi:10.1016/j.watres.2007.06.059]

www.cranfield.ac.uk

Cranfield UNIVERSITY

Questions?

www.cranfield.ac.uk

Handheld calibration

Cranfield UNIVERSITY