

DTA for effluent assessment and control: UK experience

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Overview

Conventional approaches to effluent control

Why use DTA?

Research and implementation in the UK

Possible applications of DTA

Use of DTA within IPPC

Possible future developments

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Chemical-specific approach to regulating effluent discharges

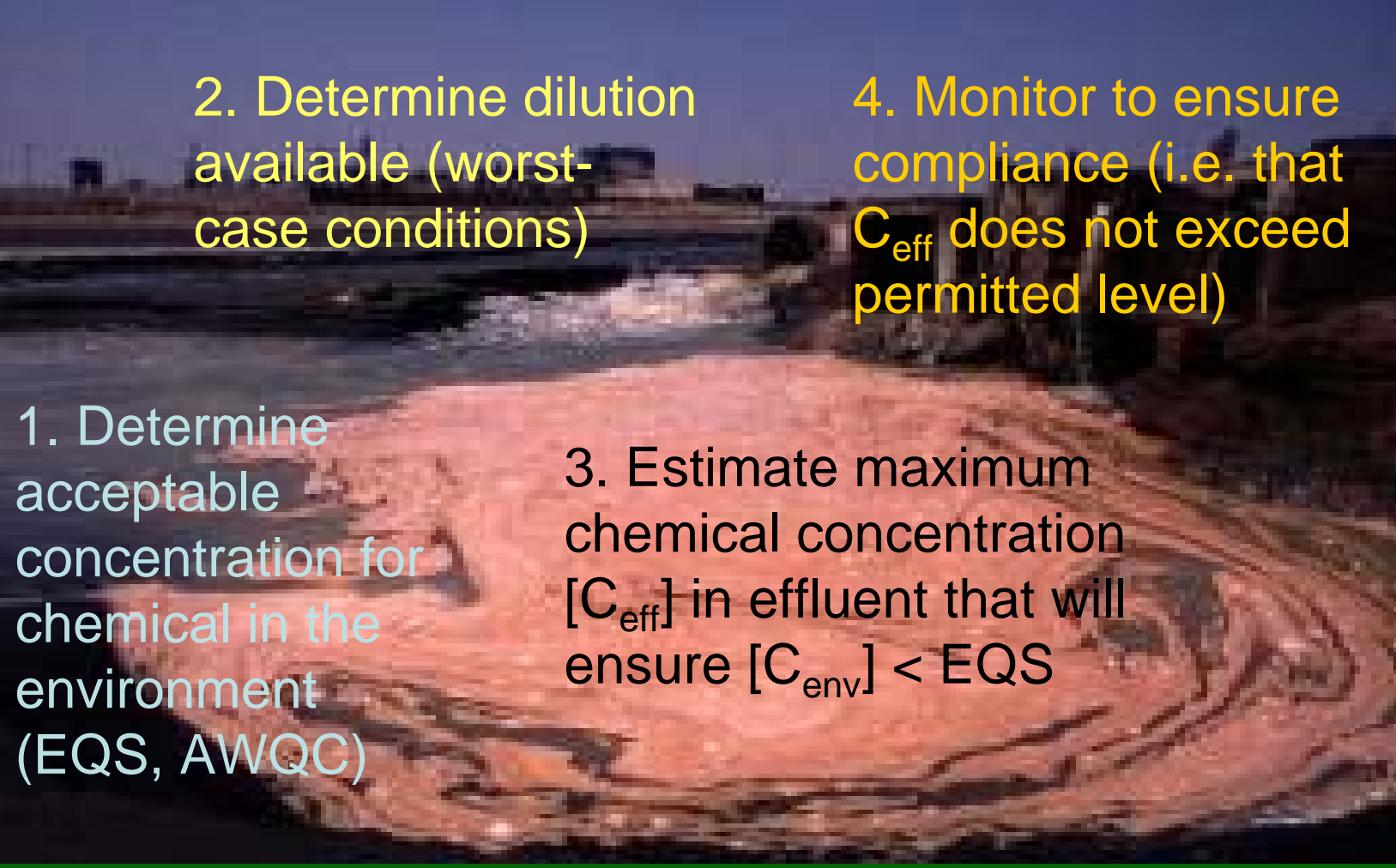


Basic premise ...

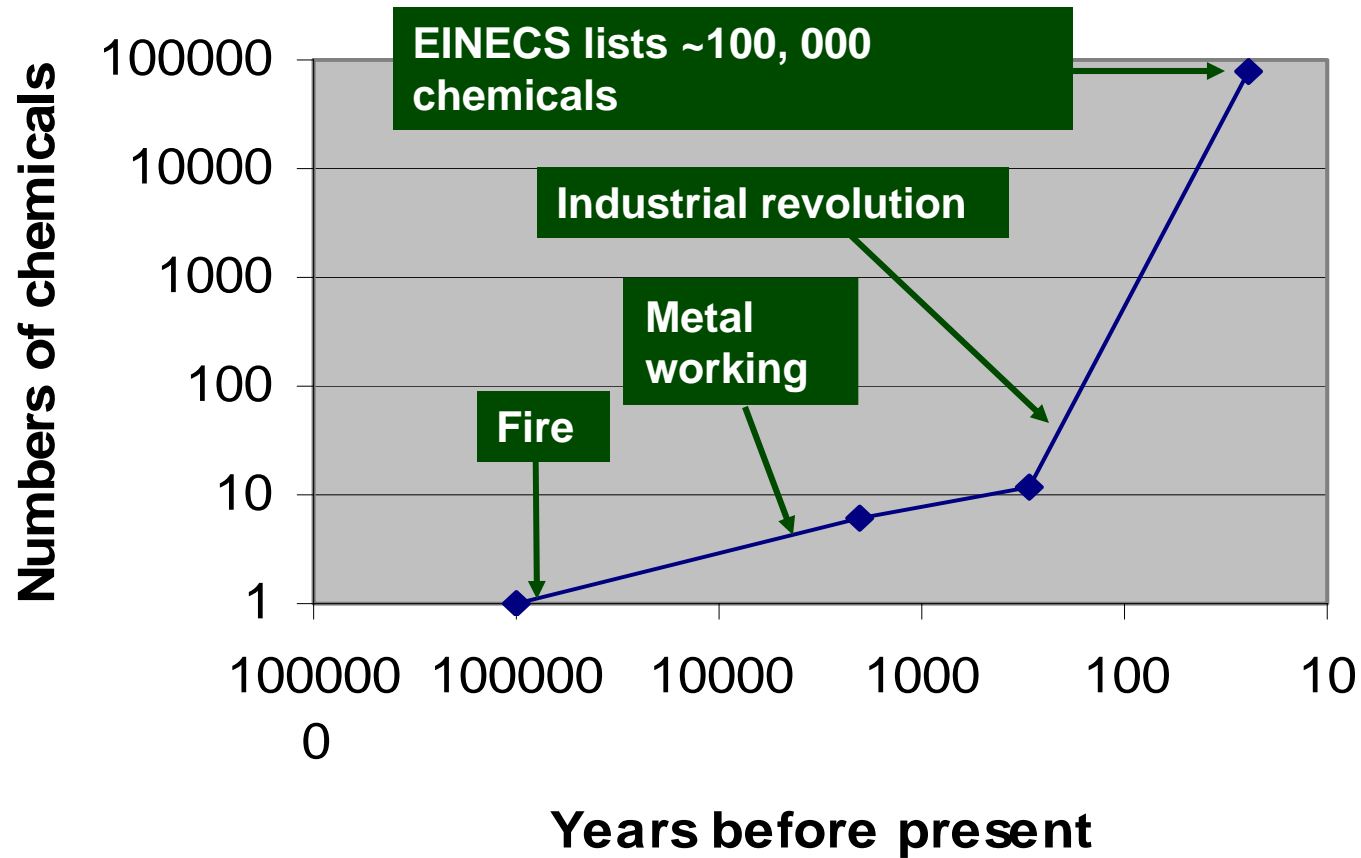
1. Toxicity in effluents is due to the chemicals present
2. By limiting the concentrations of chemicals released we can ensure effluent does not cause unacceptable toxicity

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Chemical-specific approach

- 
1. Determine acceptable concentration for chemical in the environment (EQS, AWQC)
 2. Determine dilution available (worst-case conditions)
 3. Estimate maximum chemical concentration [C_{eff}] in effluent that will ensure [C_{env}] < EQS
 4. Monitor to ensure compliance (i.e. that C_{eff} does not exceed permitted level)

Chemicals - scale of the problem



Limitations of the chemical-specific approach

We have EQSs for only ~100 of the 100,000 chemicals in use

We don't understand how mixtures of chemicals interact

There are many chemicals and breakdown products present in effluents that we do not know about

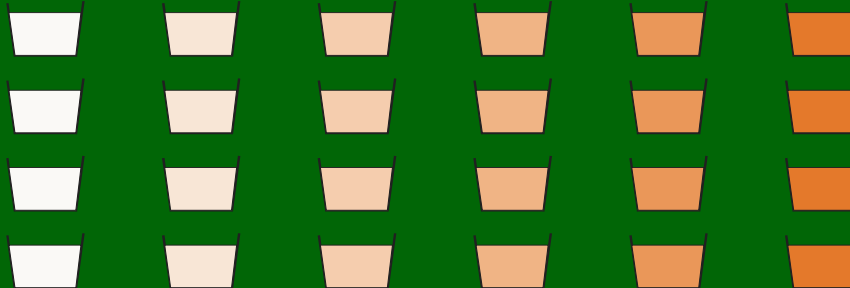
Costs of chemical monitoring to assess compliance

What is DTA?

- *Daphnia* 48h immobilisation test

Specified dilution medium → Range of effluent dilutions Neonates <24h old

20°C , low illumination



assess at 24h and 48h

- Determine toxicity of environmental samples or liquid effluents to living organisms
- Incorporates effects of all toxic substances present

estimate toxicity
(EC₅₀, no effect conc)

Hazard-based or risk-based?

HAZARD-BASED

- Assessment and control of toxicity at “end of pipe”
- Takes no account of dilution in receiving water



RISK-BASED

- Takes account of available dilution (and possibly persistence)
- Compare effluent conc in receiving water with no effect conc derived from toxicity testing



Advantages of DTA

Provides information on the combined effects of substances in effluents

Addresses effects of chemicals for which we cannot set a threshold

Includes effects of chemicals we don't know about

Addresses possible interactions between chemicals

Reduced need for chemical monitoring, especially complex effluents

But ...

DTA doesn't tell us anything about what is responsible for toxicity

If toxicity is unacceptable (e.g. effluent concentration is still toxic even after dilution) we need to identify the chemical(s) responsible, or at least the source

For simple effluents, chemical-specific approach may be adequate

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UK Experience with DTA

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DTA in the UK - R&D

Toxicity-Based
Consents Pilot
Study

R&D into test methods, Quality Control,
screening tests, Technical Guidance

DTA Demonstration
Programme

- collaboration between regulator & industry
- overseen by joint industry/regulator group

1995

2000

2005

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DTA in the UK

- key technical elements

Test methods for assessing toxicity of discharges to both FW and SW

Acute toxicity only (i.e. short-term tests)

Quality Control procedures to promote consistency and accuracy in testing

- Decision-making framework to identify discharges giving rise to unacceptable/acceptable toxicity
- Screening methods, allowing rapid testing at low cost



DTA Demonstration Programme

- Expert Group Recommendations

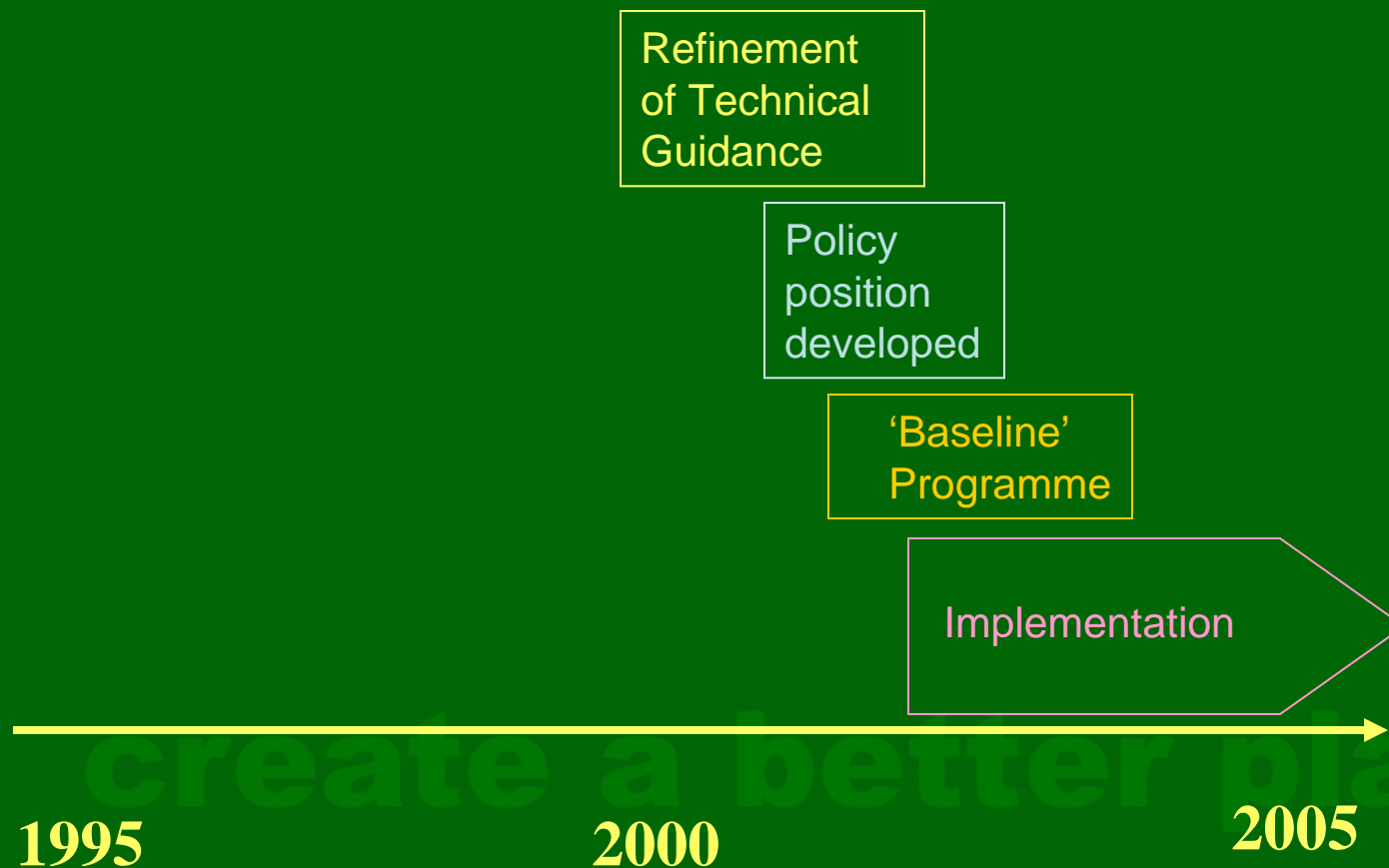
A DTA approach ...

is ready for use and should be used to assess and control industrial effluents

should be used as a 'trigger' for action by industry rather than applied as a pass/fail licence condition

Operators of all IPPC licensed processes with direct releases to receiving waters should be required to provide [acute] DTA data on their effluents

DTA in the UK - Implementation



Options for implementation - two examples

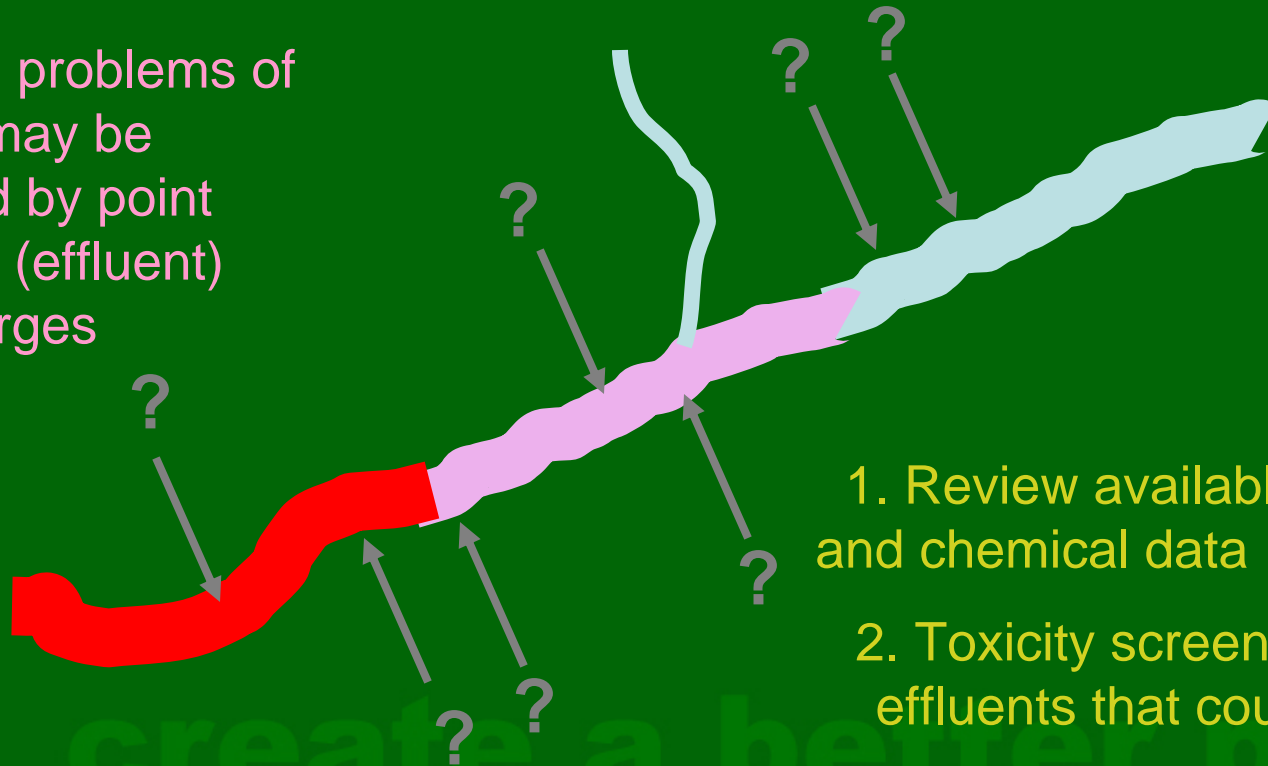


1. Impacts at the river basin level
2. IPPC - permit applications

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Poor biology in a river basin - are point sources responsible?

Known problems of
WQ - may be
caused by point
source (effluent)
discharges

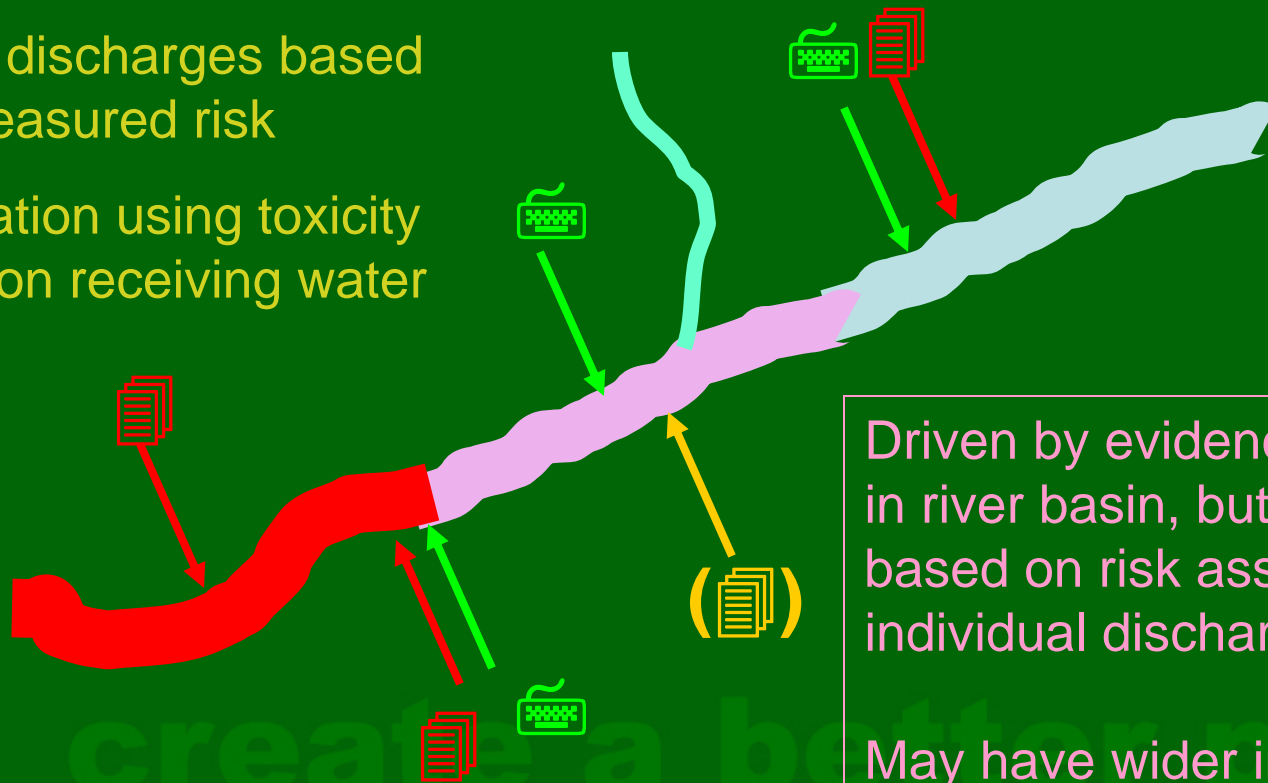


1. Review available biological and chemical data
2. Toxicity screening of all effluents that could contribute
3. Assess likely risks for all discharges

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Poor biology in a river basin - screening for toxicity

4. Rank discharges based on measured risk
5. Validation using toxicity tests on receiving water



Driven by evidence of impact in river basin, but control based on risk assessment of individual discharges

May have wider implications (e.g. under WFD, catchments with poor ecological status)

Implementation under IPPC

To receive a permit to operate, installations falling under IPPC must assess the risk to the environment from their operations

Conventionally, based on chemical-specific risk assessment

In addition, toxicity assessment required for all liquid effluents originating from processes regulated under PPC (includes chemicals sectors)

Implementation under IPPC

Unless

the effluent originates from a low impact installation
no direct discharge to controlled waters



the effluent can be considered 'simple' - all components can be identified and toxicity easily predicted

Effluents assessed (and regulated) individually, based on risk of acute toxicity

Is DTA legal?

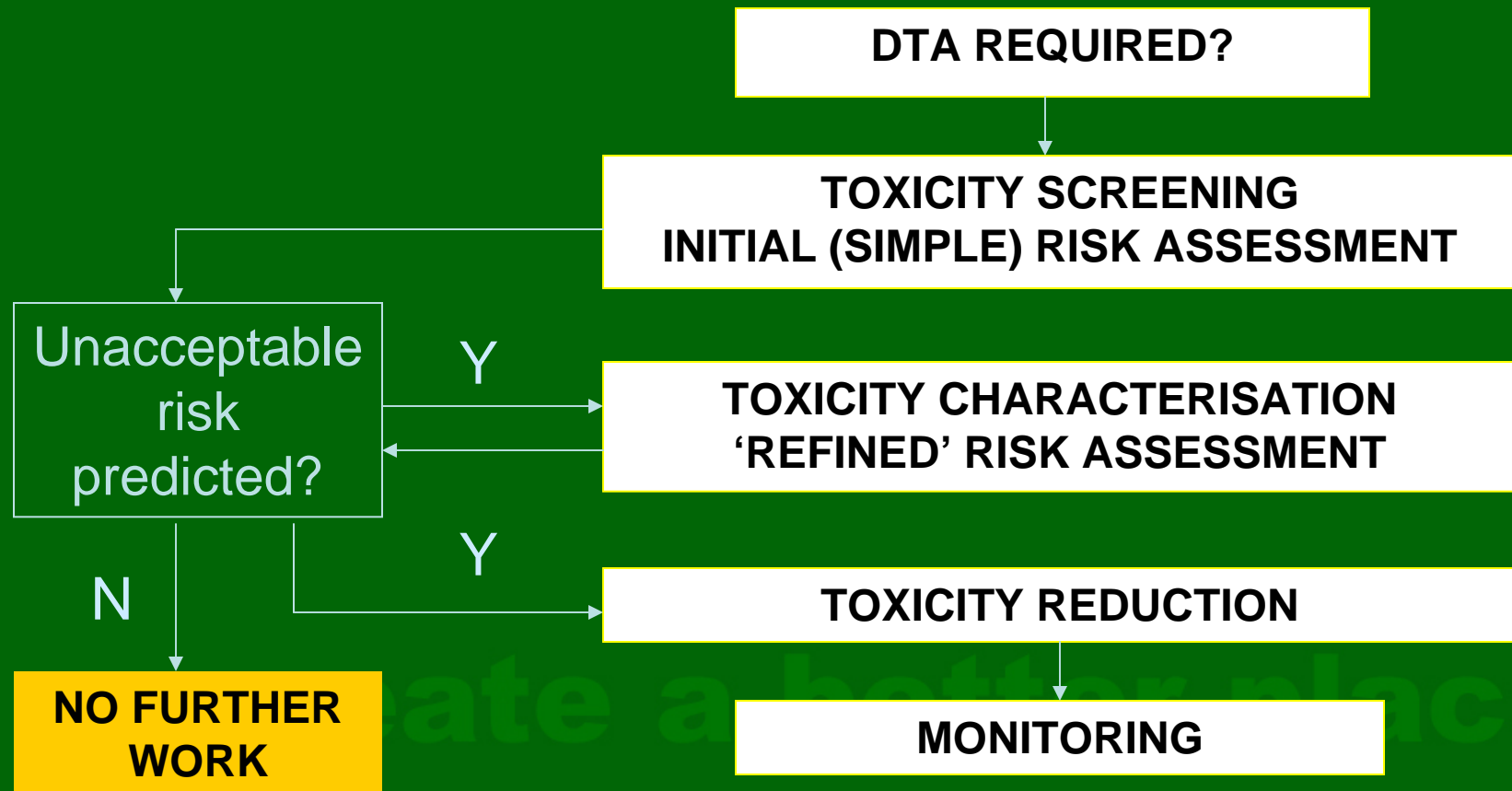
IPPC Directive requires the **prevention of pollution**

“Pollution” means emissions as a result of human activity which may be harmful to human health or the **quality of the environment**

PPC Regulations require the regulator achieve a **high level of protection** for the environment as a whole

Requires use of Best Available Techniques (both process **and assessment**)

How is DTA applied under IPPC?



Toxicity screening

Screens out 'low risk' discharges so we don't spend time investigating non-toxic discharges

Abbreviated ('high throughput') methods = low cost

'Toxicity Threshold' is sufficient (no statistics)

Process assessment - sampling within 'worst case' period (toxicity, dilution)

Variability assessment - no further tests if toxicity is consistent after three samples

Preliminary risk assessment

Compare lowest no-effect conc with worst-case effluent concentration in RW after full mixing

$$\text{Risk Ratio (RR)} = \frac{\text{Diluted Conc (DC)}}{\text{Tox Threshold (TT) /100]}$$

Equivalent to chemical risk assessment but uses estimates of toxicity & dilution

Risk Ratio > 1 → more detailed investigation

Detailed Characterisation

Triggered by screening RA ($RR > 1$)

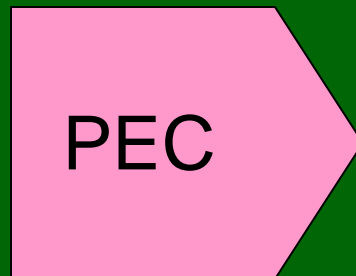
Full characterisation methods

Statistical analysis to estimate robust 'No effect' concentration

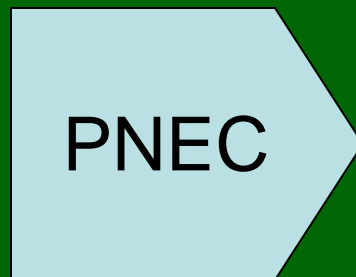
Full reporting and compliant with MCERTS QA/QC requirements

Again, sampling within 'worst case' period (toxicity, dilution) but more extensive variability assessment (based on 5 tests)

Refined Risk Assessment



Worst case dilution at 'Point of Protection'
Maximum (measured) effluent flow rate and minimum dilution



Worst case 'no effect' concentration
- e.g. MATC/ NOEC/ EC20/ EC50 X
0.3 (% v/v)

Environmental Quotient (EQ)_{DTA} = PEC / [PNEC / 100]

EQ_{DTA} > 1 → **“improvement notice” to reduce toxicity**

Possible future developments

Extend DTA Policy into additional priority sectors under IPPC

Landfill

Metals

Food & Drink

Incorporate DTA hazard assessments into WFD classifications?

Consider persistence of effluent toxicity (toxicity before/after biodegradation)

Further Information

IPPC Horizontal Guidance H1 (Appendix F)

Draft Guidance Note: Guidance on the use of
DTA in IPPC Impact Assessments

Environment Agency 'Chemicals Strategy'

(http://www.environment-agency.gov.uk/commodata/105385/chemicalstrategy_577736.pdf)

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