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# Risk assessment and prioritisation of pesticide point sources – Catchment scale

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# Overview

- Introduction
- Point sources of pesticide contamination in Denmark
- Challenges
- Strategy
- Database of pesticides
- Tool for risk assessment and prioritisation of pesticide point sources at a catchment scale
- Ongoing work
- Summary

# Introduction

- Danish drinking water supply:

## Groundwater

- Water treatment: aeration and filtration (few exceptions)

So

- We need very clean groundwater

But

- Pesticides are found in the groundwater
- Several water supply wells closed due to pesticide problems (limit value 0.1 µg/L (single compound), 0.5 µg/L (sum of pesticides))
- Contribution from point sources unknown

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# Pesticide point sources

- Old landfills
  - Plant nurseries
  - Farm yards and areas associated with the preparation and cleaning of pesticide spraying equipment
  - Accidental spills
- 
- Estimated up to 100.000 point sources of pesticide contamination in Denmark
  - Estimated 10% give rise to significant groundwater contamination
  - Task: How to find the 10%?

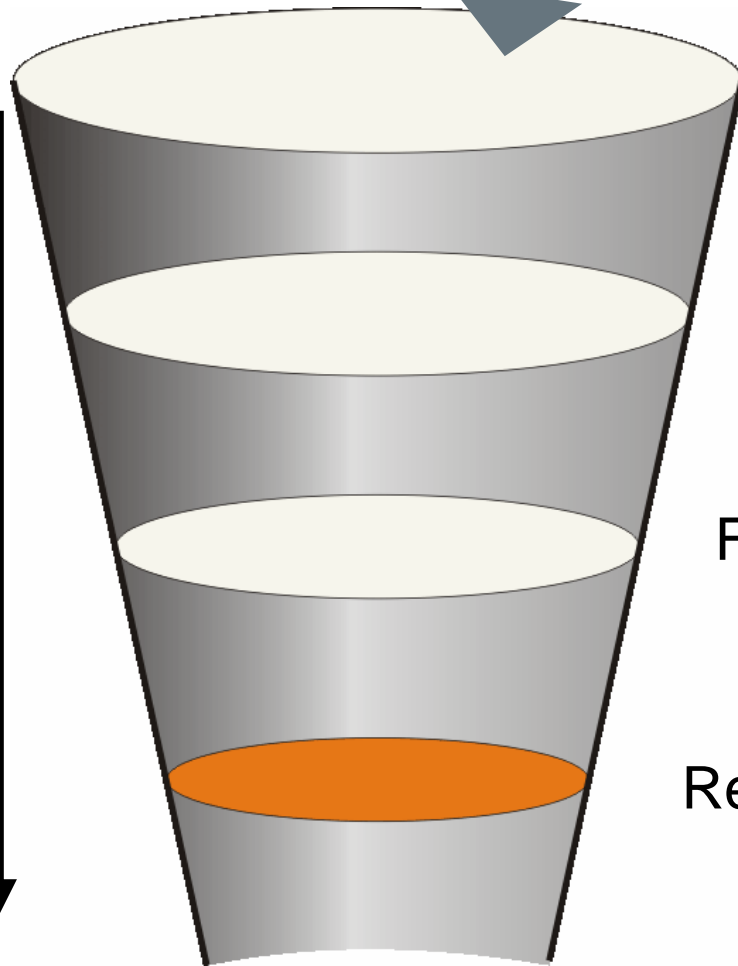
# Challenges

- Many different pesticides
- Many point sources
- Only little information

# Strategy

Pesticide point sources

Decreasing number of sites  
Increasing cost per site



Point sources in areas important to the water supply – e.g. catchment areas

**Initial risk assessment based on known information**

Field investigations

Remediation

# 5 sub projects

- Pesticide database (Phase 1)
- Tool for risk assessment at a catchment scale (Phase 1)
- Field investigations of pesticide point sources (Phase 2, ongoing work)
- Remediation techniques for pesticide point sources
- Environmental economy

Phase 1 was carried out 2005-2006 by consulting company NIRAS and Danish Institute of Agricultural Sciences (now a part of Aarhus University).

# Pesticide database

Data for risk assessment of pesticide point sources with respect to the risk of contamination of groundwater resources.

173 compounds (pesticides and degradation products) often analysed in Danish groundwater:

- Common name, CAS-no., Danish STANDAT code, systematic IUPAC name and molecular formula.

61 compounds found in Danish groundwater:

- Physical and chemical properties (molar weight, density, solubility etc.)
- Chemical structure
- Distribution coefficients ( $K_{ow}$ ,  $K_{oc}$ ,  $K_d$ )
- Degradation pathways
- Degradation rates in different media and under different conditions

Various values have been found in the literature and a “best bet” for Danish conditions is defined for each parameter

**[www.pesticiddata.dk](http://www.pesticiddata.dk)**

**Log in: pesticide**

**Password: pesticide**

# Screen dump from pesticide database

Pesticiddata Lokalitetsdata Risikovurdering Vejledning

Vis pesticidoplysninger Problemløsning

**Stofvalg** Vælg et stof  
 Bentazon A  
 Søg andre steder: [Middeldatabasen](#) [Miljøstyrelsen](#)  
[Parametre og målebetingelser](#)

**Generelle oplysninger**  
 Stofnavn: **Bentazon**  
 CAS Kode: **25057-89-0** STANDAT kode **9944**  
 Systematisk navn: **3-isopropyl-(1H)-2,1,3-benzoethiazin-4-(3H)-one-2,2-dioxide**  
 Molekylformel: **C<sub>10</sub>H<sub>12</sub>N<sub>2</sub>O<sub>3</sub>S**  
[Strukturformel](#)  
[Metabolitter](#) [Download ->](#) [Detaljer](#) [Stofliste](#)

**Parametre**  
 Oversigt  
[Molvægt](#) [Detaljer](#)  
[Massefylde](#) [Detaljer](#)  
[Opløselighed](#) [Detaljer](#)  
[Damptryk](#) [Detaljer](#)  
[Henry's konstant](#) [Detaljer](#)  
k<sub>ow</sub> [Detaljer](#) B ◀ 2 ▶▶ af 4 Værdi: 0,35  
[k<sub>oc</sub>](#) [Detaljer](#)  
[k<sub>d</sub>](#) [Detaljer](#)  
[Diff. koefficient i vand](#) [Detaljer](#)  
[pk<sub>50</sub>](#) [Detaljer](#)  
[Halveringstid](#) [Detaljer](#)

**Målebetingelser** [Download \(dim.las\)](#)  

Overordnet	Redoxmiljø	Medium	Kulstof
Bedste bud	Ja	Nej	Nej
Beregnet		Opdatering	
Datakvalitet	God	Forsøgstype	
Temperatur	22	Redox	
Kulstofindhold		Medium	
pH	7	Land	
Bemærkninger			

C

**Reference** D [Review Report for the active substance BENTAZONE – European Commission – Health and Consumer Protection Directorate- General. Report nr. 7585/VI/97-final – 30. November 2000](#)

# Tool for risk assessment and prioritisation – catchment scale

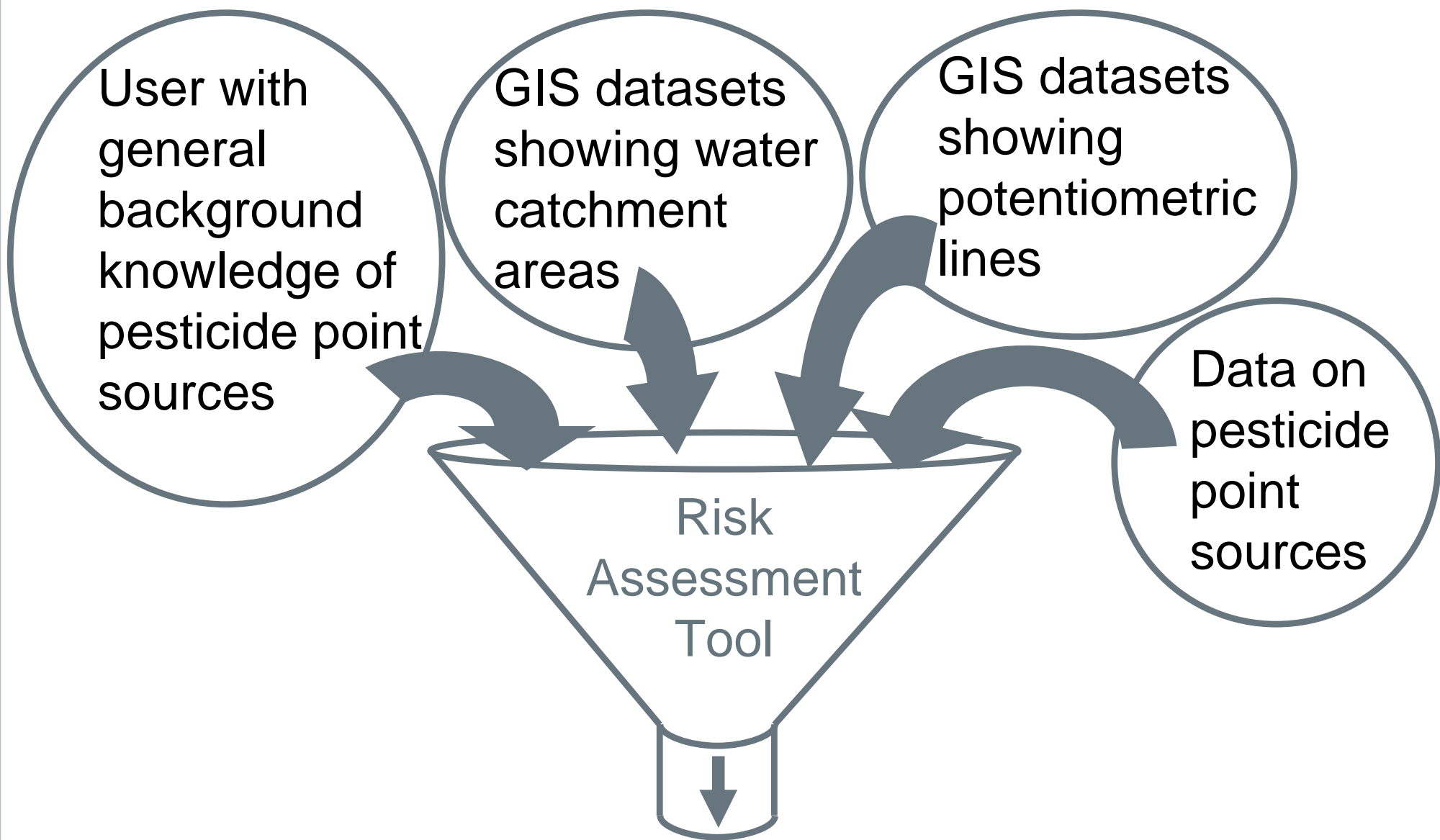
- A tool is needed to identify which point sources require further investigation and subsequent remediation.

## Challenges

- Point sources: Often very little information on conditions and pollution levels
- Catchment areas: Often only little data on hydrological conditions

## Objectives:

- An initial risk assessment of point sources in a water catchment area can be carried out within one day.
- The risk assessment can be dynamic.



# Details on the calculation

Only little information available → simple model

- Degradation and sorption
- Vertical transport in the unsaturated zone: meta model of MACRO
- Horizontal transport: assumed perpendicular to the potentiometric lines of the primary groundwater aquifer
- Local catchment zone
- When using the tool it is important to remember – as with any model - that the output data is no better than the input data

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# Risk assessment of a catchment area – tool with three steps

1

**Registration of site data**



2

**Definition of calculation**

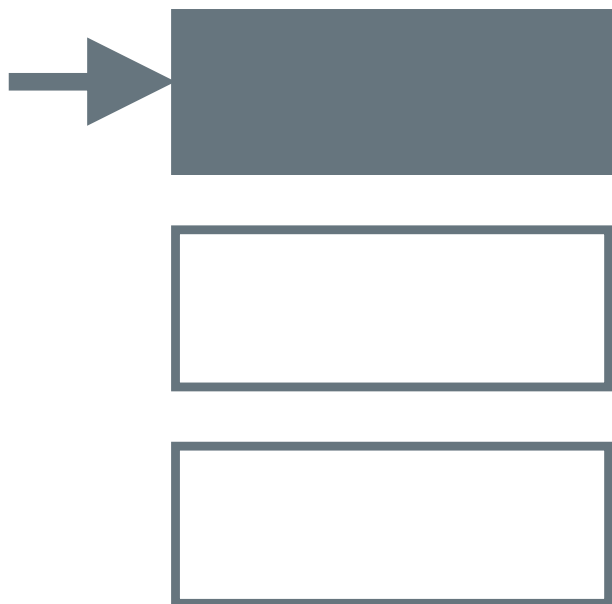


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**Calculation and visualisation**

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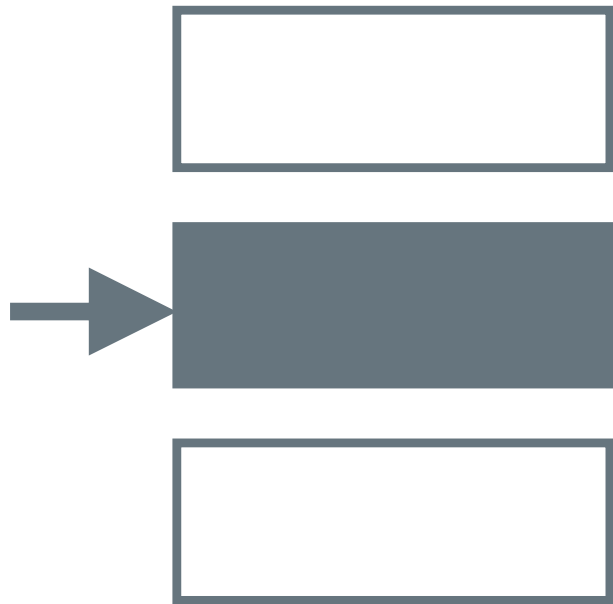
# Registration of site data



Database including

- Site type  
(e.g. farmyard)
- Location
- Historical information  
(e.g. period of operation of the point source)
- Known details on the actual levels of contamination

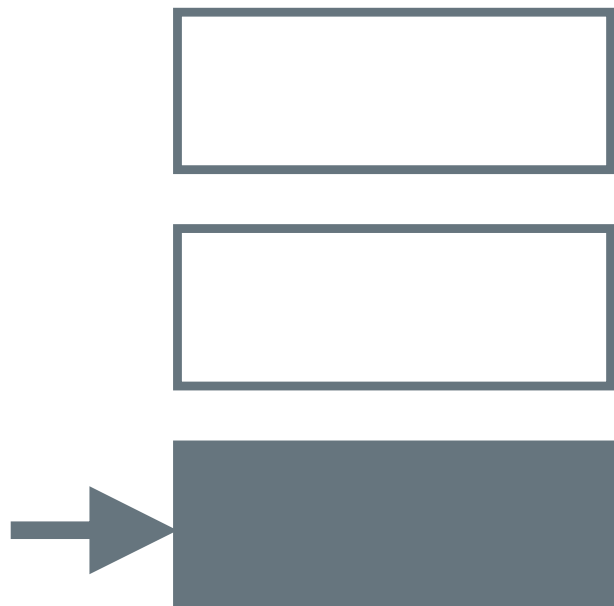
# Definition of calculation



- Selection of the catchment area to be evaluated (GIS)
- Choice of data to be included in the calculation. A series of experience-based default values can be chosen where data is lacking
- Point source load based on a soil concentration or a spill:
  - a calculation module models the vertical transport in the unsaturated zone

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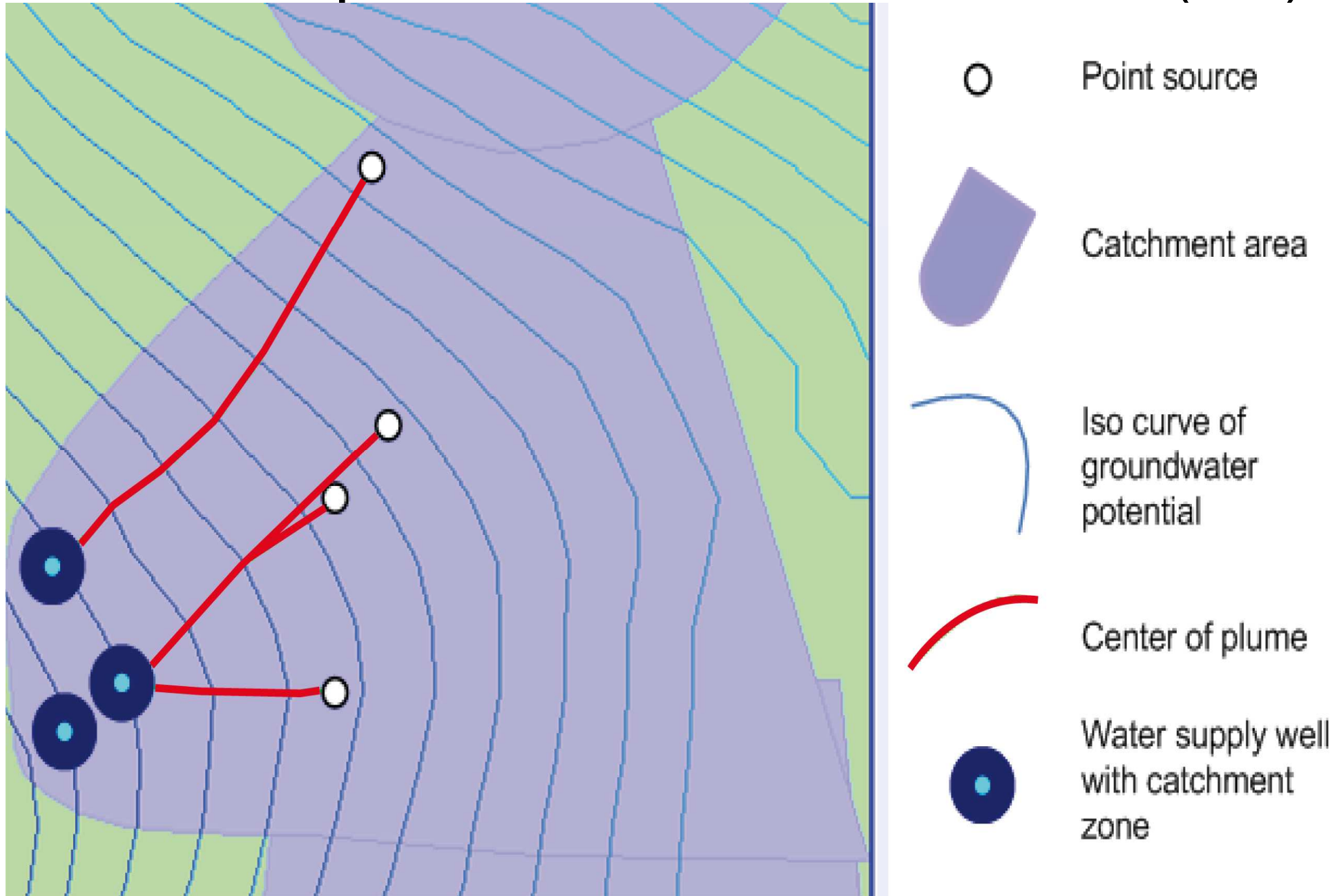
# Calculation and visualisation



- Calculation
- Visualisation of the horizontal transport in a catchment area
- Construction of a series of reports (maps, graphs, tables)

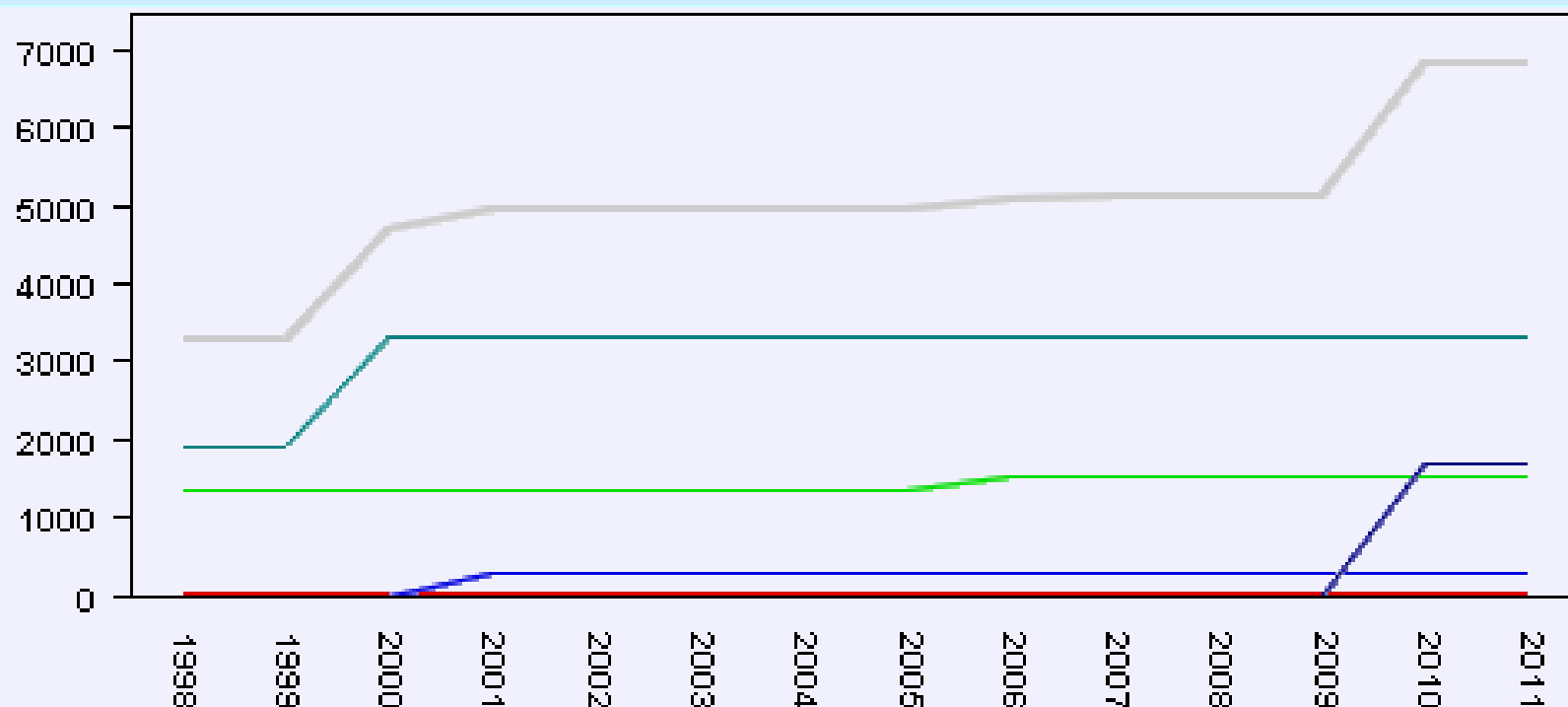
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# Screen dump from risk assessment tool (1/2)



# Screen dump from risk assessment tool (2/2)

X vandværk, flux, mg/år



Stoffer:

Alle

190 Bentazon

197 Dichlobenil

198 Dimethoat

203 Aldicarb

204 Atrazin

211 Glyphosat

212 Hexazinon

213 Isoproturon

336 BAM

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# Ongoing work

- Phase 2: a series of investigations of pesticide point sources.
  - More knowledge of the pesticide point sources
  - Validation and improvement of risk assessment tool

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# Summary

- Systematic approach to dealing with a large number of practically unknown point sources
- Database of pesticides
  - Accessible via internet
- Tool for initial risk assessment and prioritisation
  - Large number of sites
  - Sparse information
  - Test site available on internet

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