National Nuclear Laboratory

Remediation Technology Demonstrators

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National Nuclear Laboratory

Presentation scope

- Extent of NNL studies on remediation technologies, including:
- Brief illustration of experimental work
- More detailed look at novel/interesting modelling studies

NNL studies experimental studies (in brief)

- **A very wide range of experimental studies over the last 10 years, including:**

  - Electrokinetics (including collaboration with UKAEA)
  - FIRS™ technology at different scales
  - Others, including soil washing
  - Characterisation of real soil from several NDA sites

Scope of NNL modelling studies

- **Modelling studies including:**

- **Development of the ReCLAIM tool for simple scoping/screening type assessments – including effectiveness of capping**

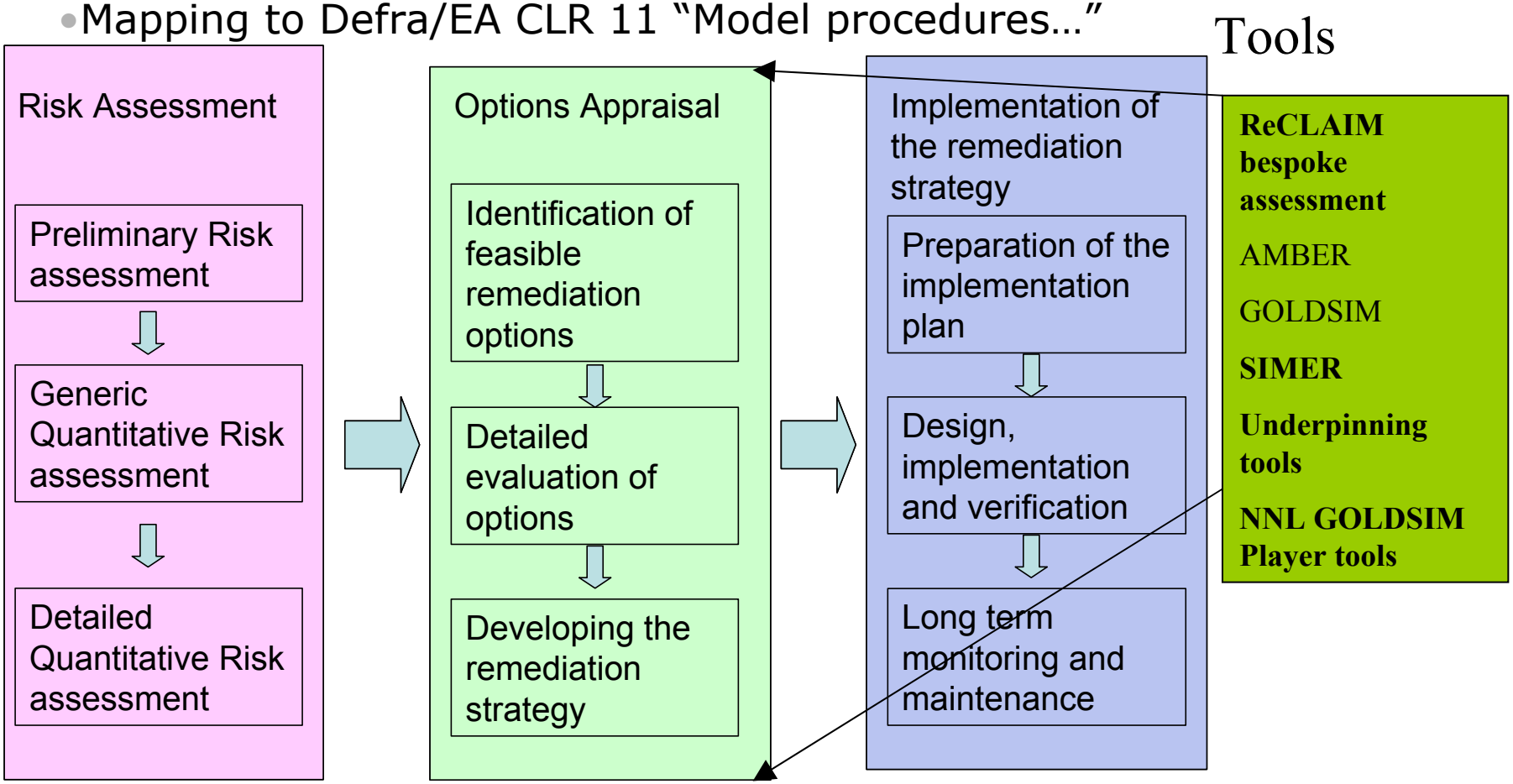
- Underpinning modelling to understand chemical/biological processes affecting soil and groundwater processes

- **Developing tools such as SimER, TRAFFIC and GOLDSIM models to evaluate the effect(iveness) of remediation methods**

- GOLDSIM player compatible tools to support high remediation decision making

Fit with Tiered approach to contaminated land decision making

- Mapping to Defra/EA CLR 11 "Model procedures…"



Tools supporting remediation decisions

Use modelling:

- To understand what experimental studies are telling us, and
- To simulate what might occur in the field as part of the decision making/design process.

NNL examples:

- Reclaim tool re: capping thickness
- Simulating laboratory electrokinetics experiments
- PRB performance at:
  - (a) The Oak Ridge Y-12 PRB trench
  - (b) Hypothetical UK implementation

Conclusions

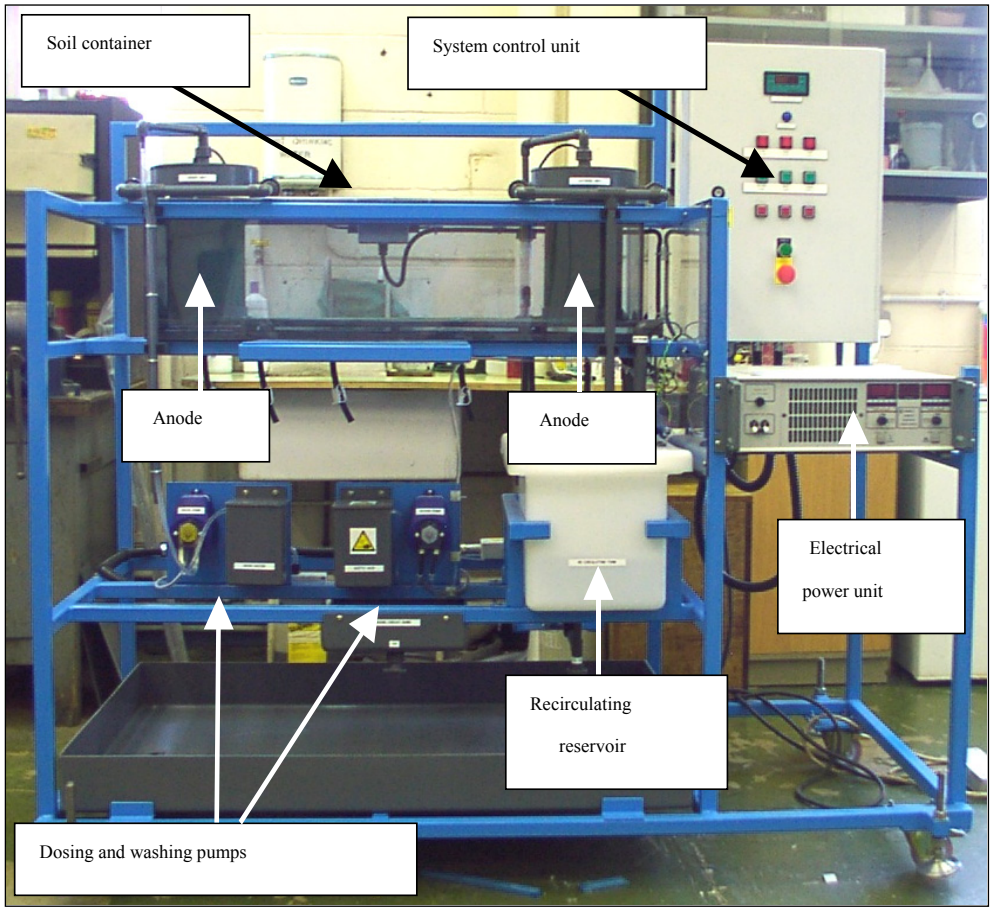
NNL has developed very advanced tools for simulating remediation. We use these to:

- To understanding what experimental studies are telling us, and
- To simulate what might occur in the field as part of the decision making/design process.

Benefits of such modelling is that:

- It tells us what might work and its effectiveness (BPEO);
- Optimise the outcome (BPM).
- **Help avoid costly mistakes**

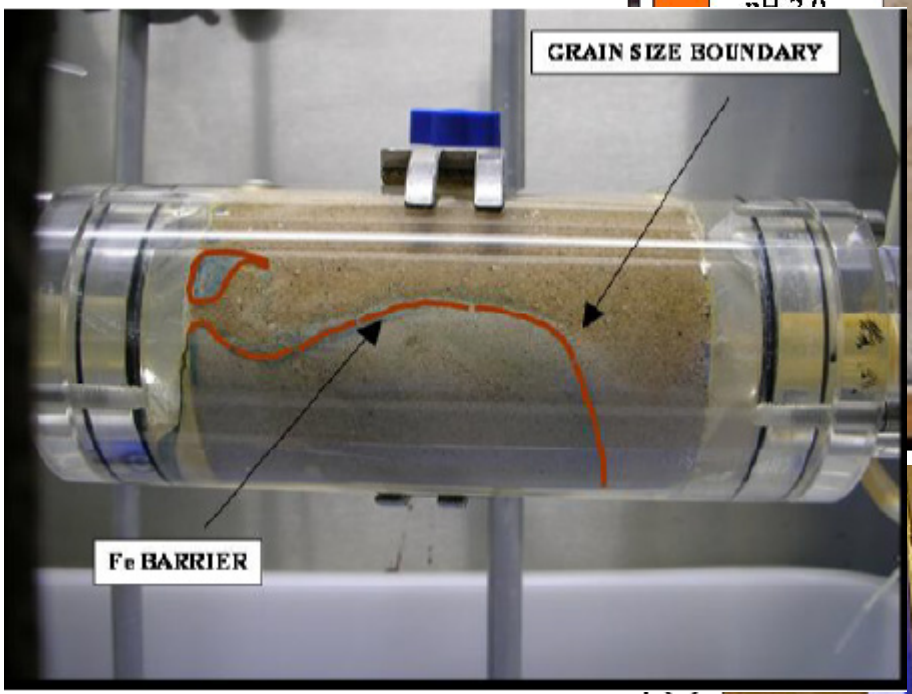
Electrokinetics



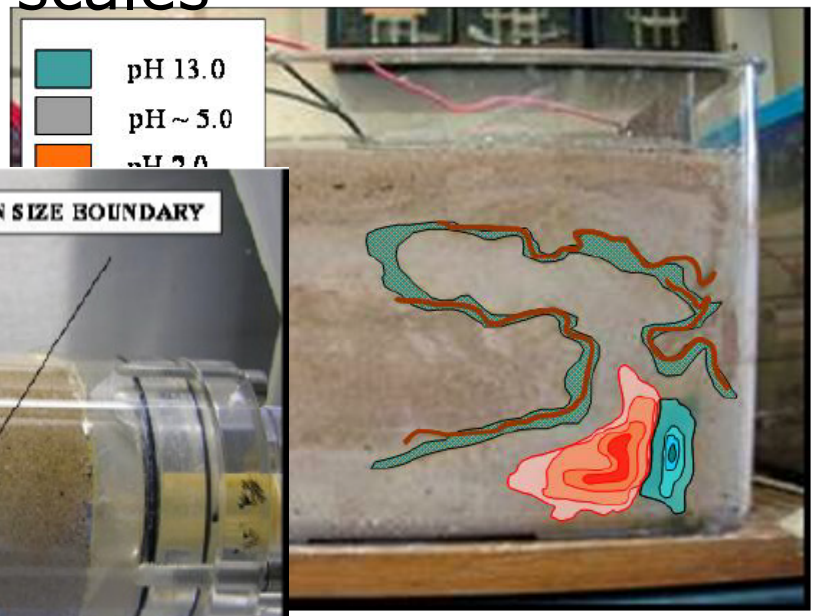
- Experimental set-up building on previous bench scale experiments
- Sellafield and Dounreay contaminated soils
- Artificial groundwater
- Results indicated an effective removal of Sr from Sellafield soils
- Cs could not be removed from real contaminated soils

FIRS technology generating in-situ Fe(OH)3 layers at different scales

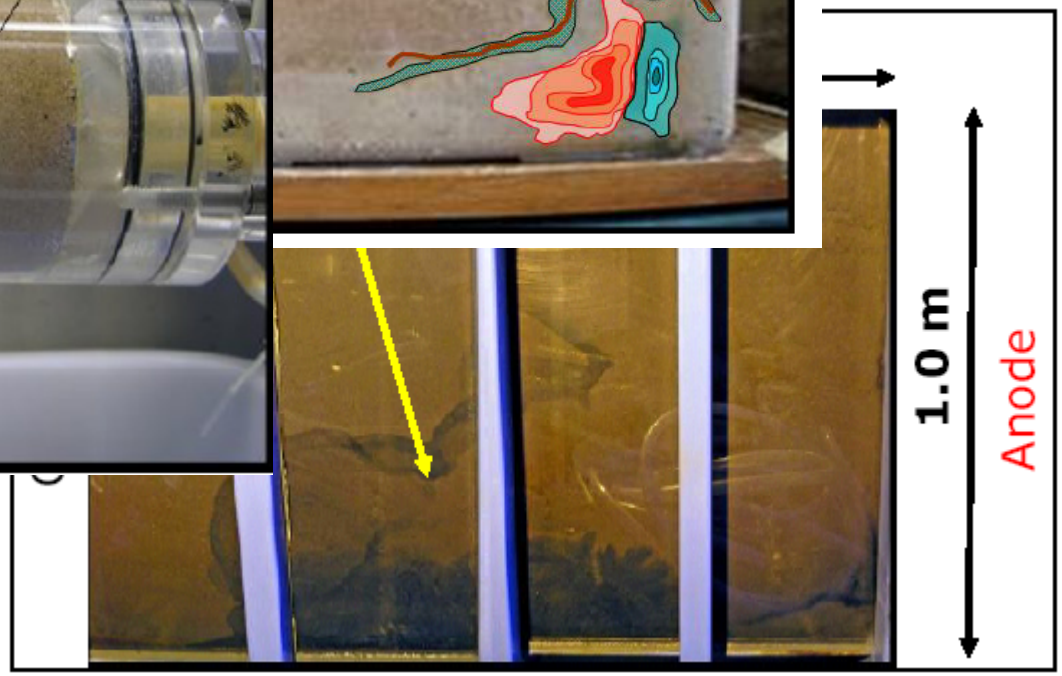
40 hours



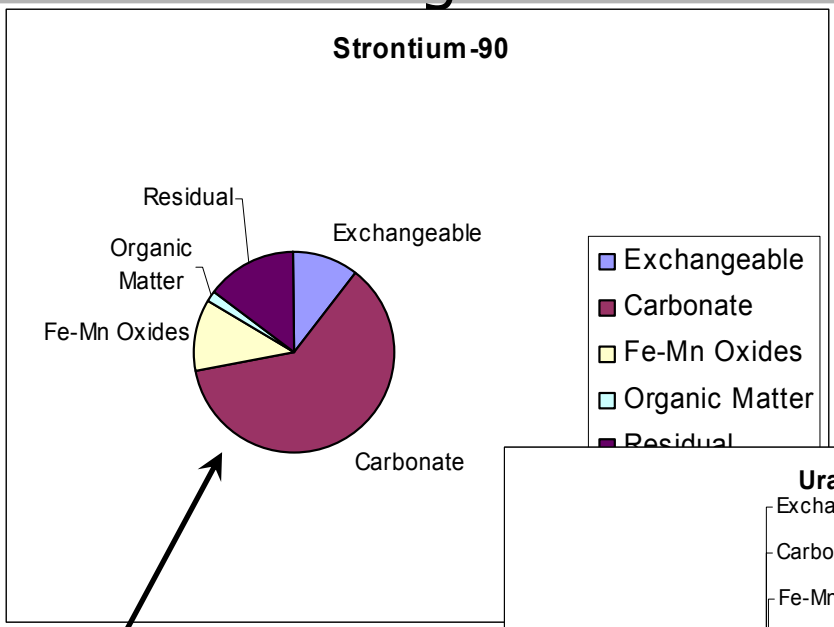
5 days

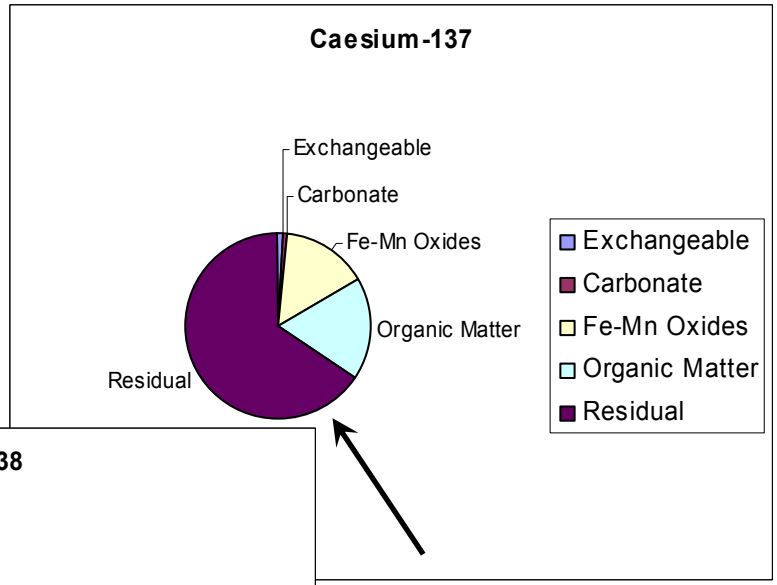


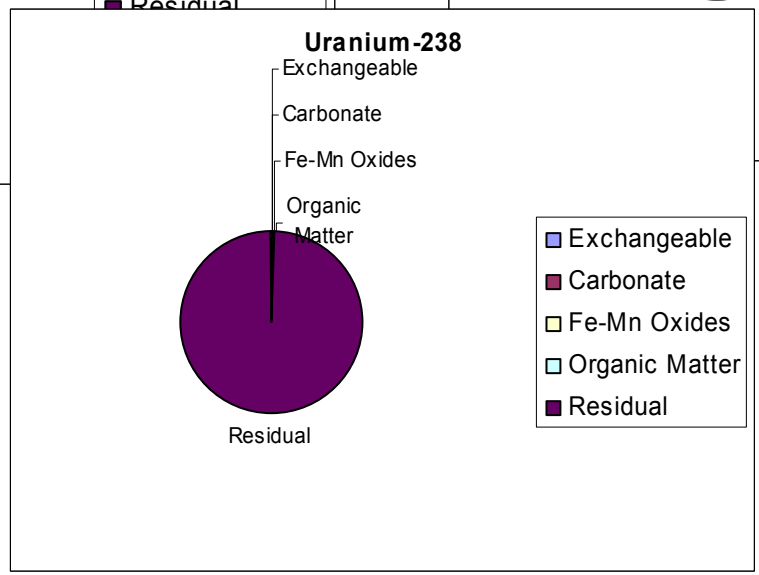
6 weeks



Selective leaching of contaminated soils from 5 real sites e.g. Bradwell







Sr-90 on easily removable sites

Cs-137 Strong binding on the clay rich soil

ReCLAIM – In context of remediation

Dose and screening level calculator

53 radionuclides

19 exposure pathways

4 exposure configurations

Can calculate exposure from user defined cap thicknesses

Highly user configurable

Being used on several sites

Download free from nnl.co.uk

NNL are developing new ReCLAIM training courses

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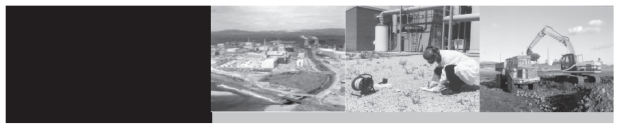
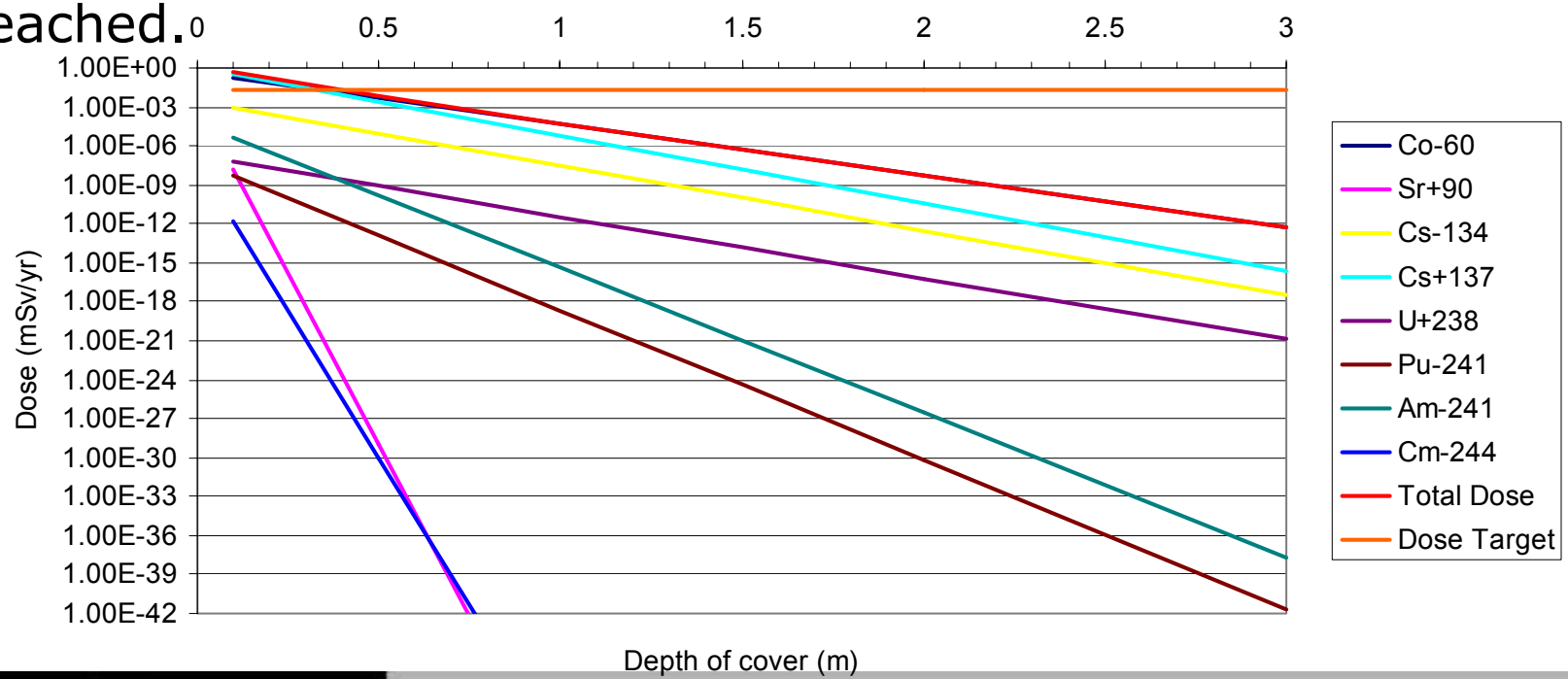


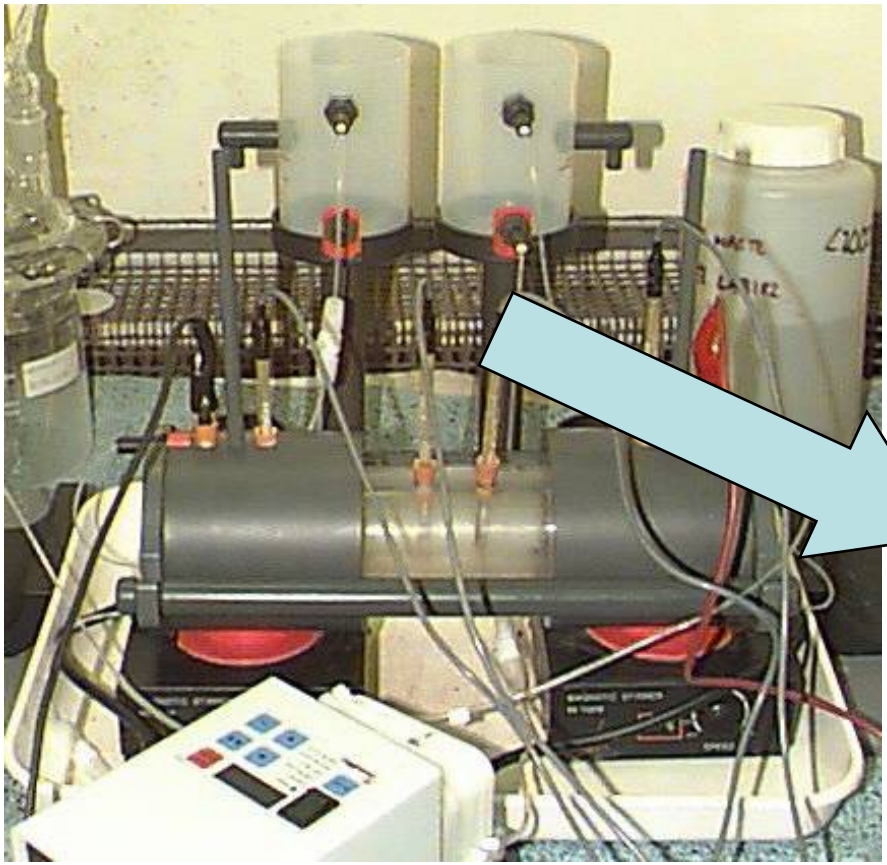
ReCLAIM – In context of remediation (2)

1. How is dose reduced as a result of x% source removal?

2. What thickness of cap above contaminated land is acceptable? e.g. increase cap thickness until a dose target is reached.



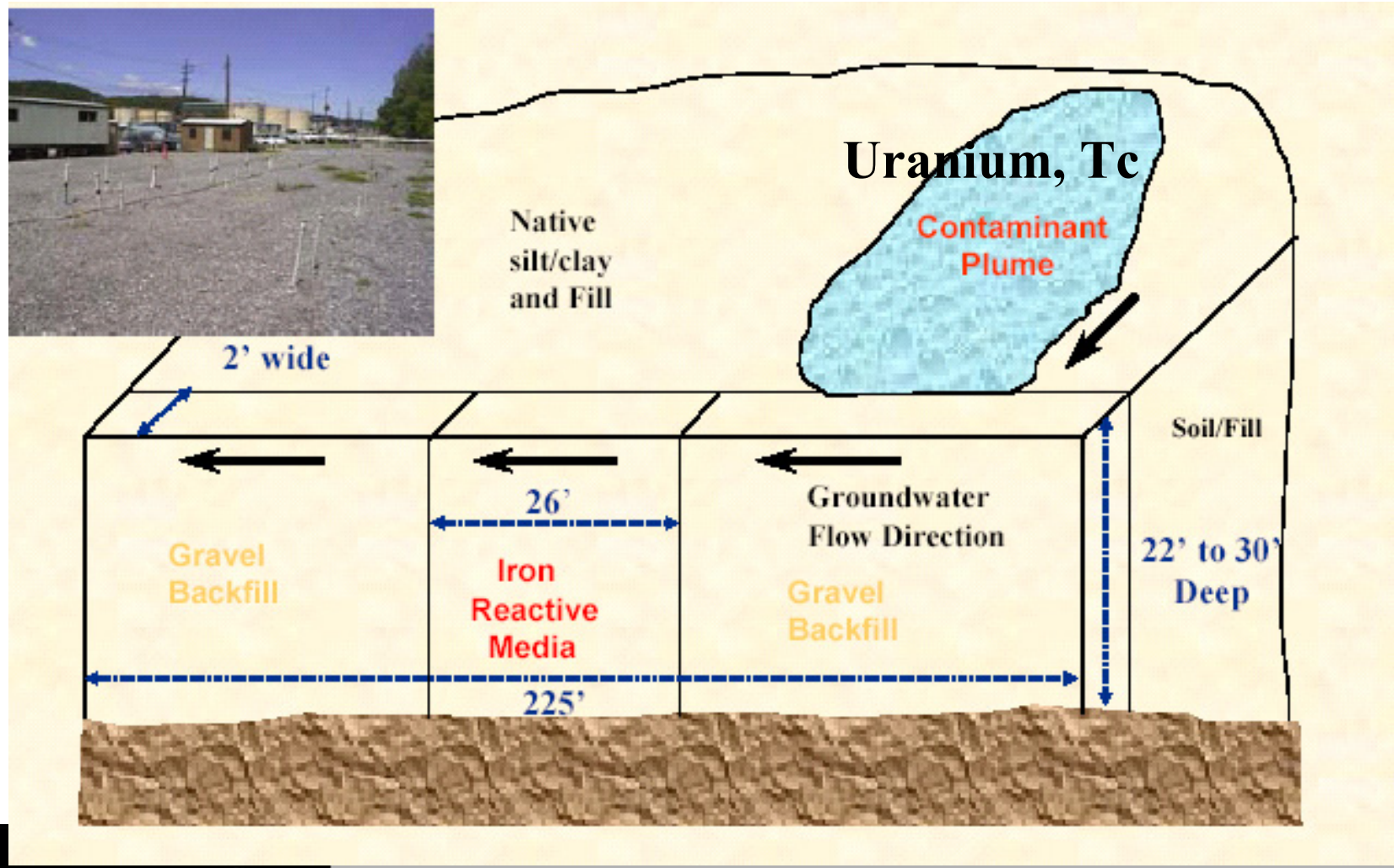
Electrokinetics lab scale simulation



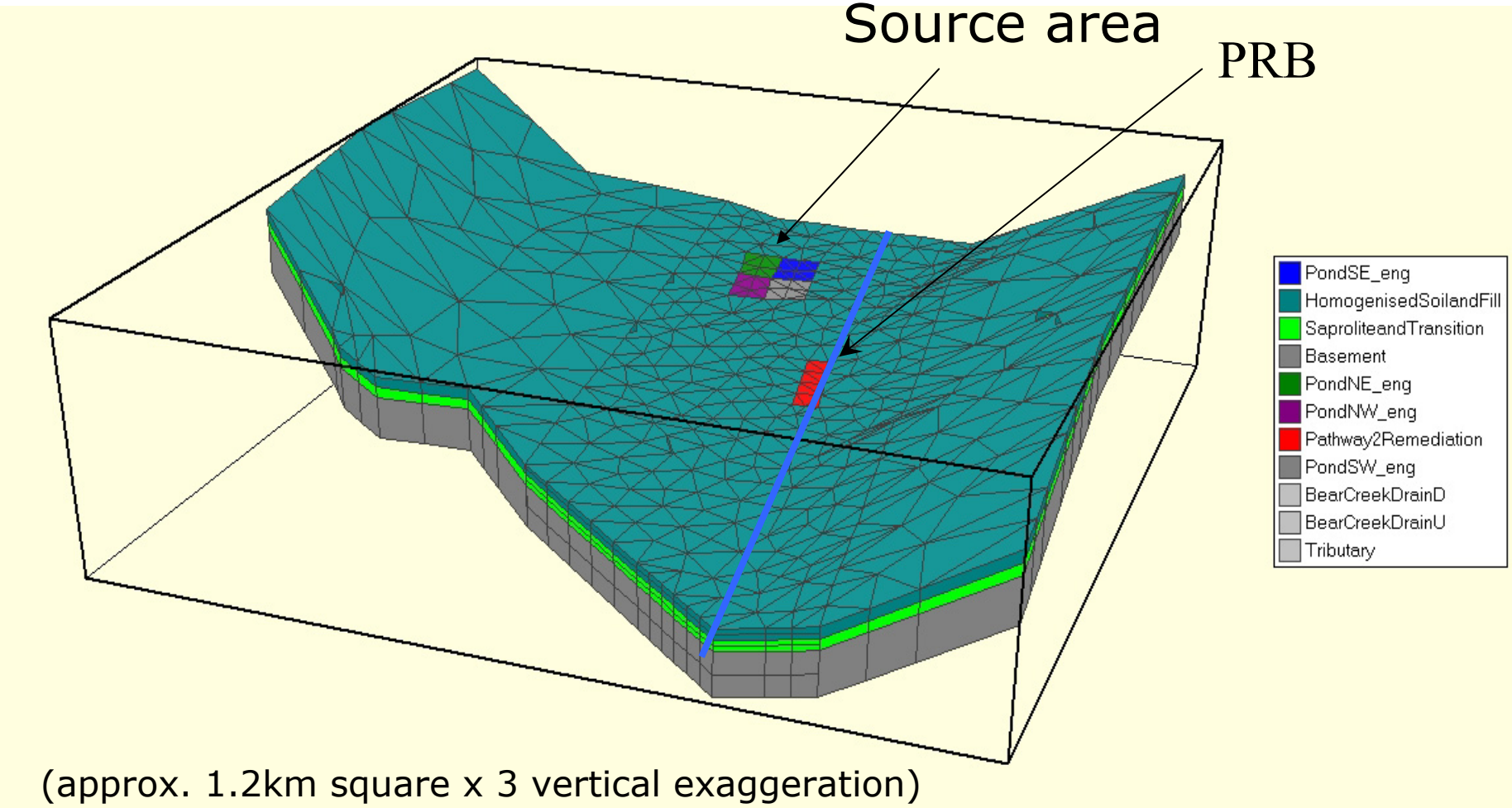
Modelling Sr movement Utilising the TRAFFIC code:

GLview 3D Plug-in

Simulating PRB effectiveness at a real site: Y12 area at Oak Ridge - context



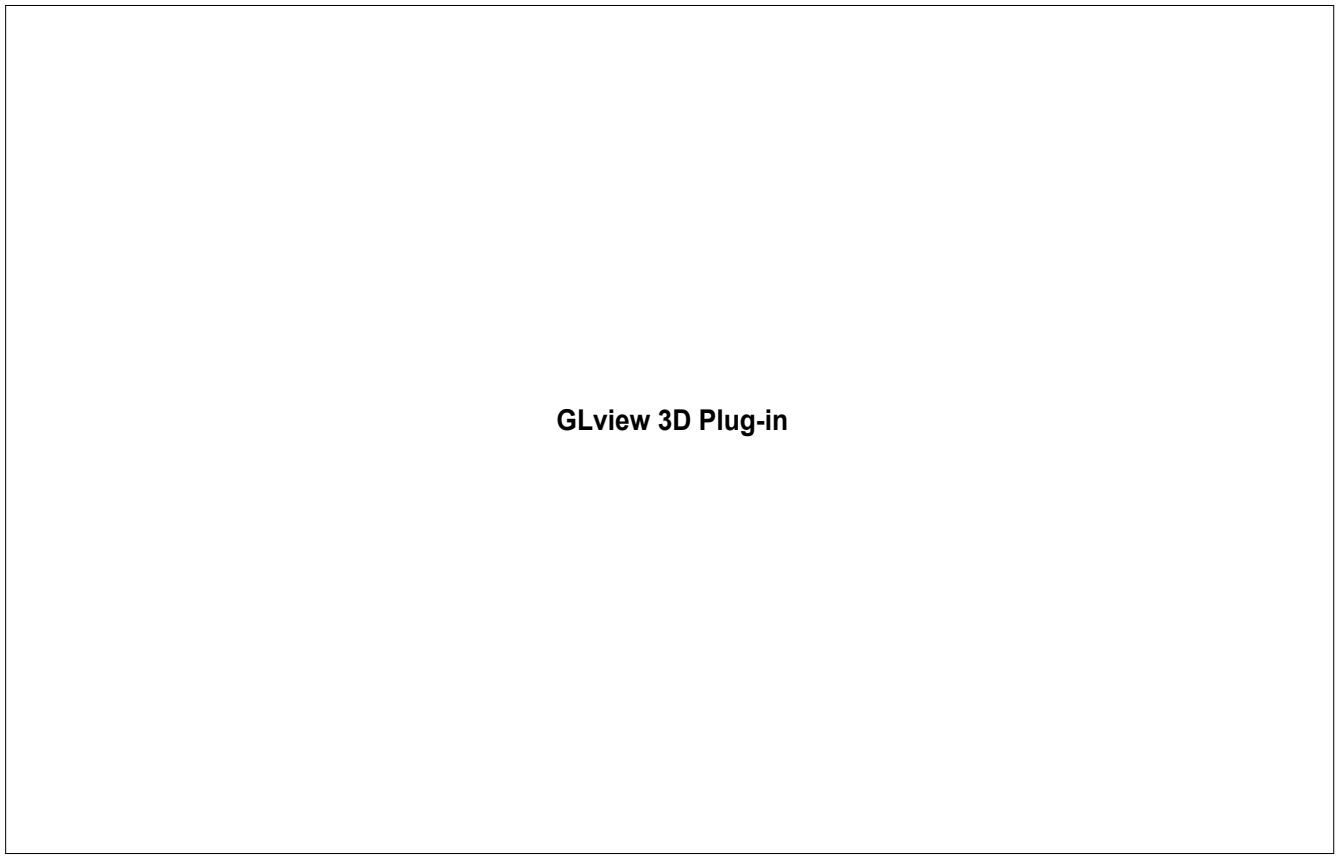
SimER Y-12 site model domain



(approx. 1.2km square x 3 vertical exaggeration)

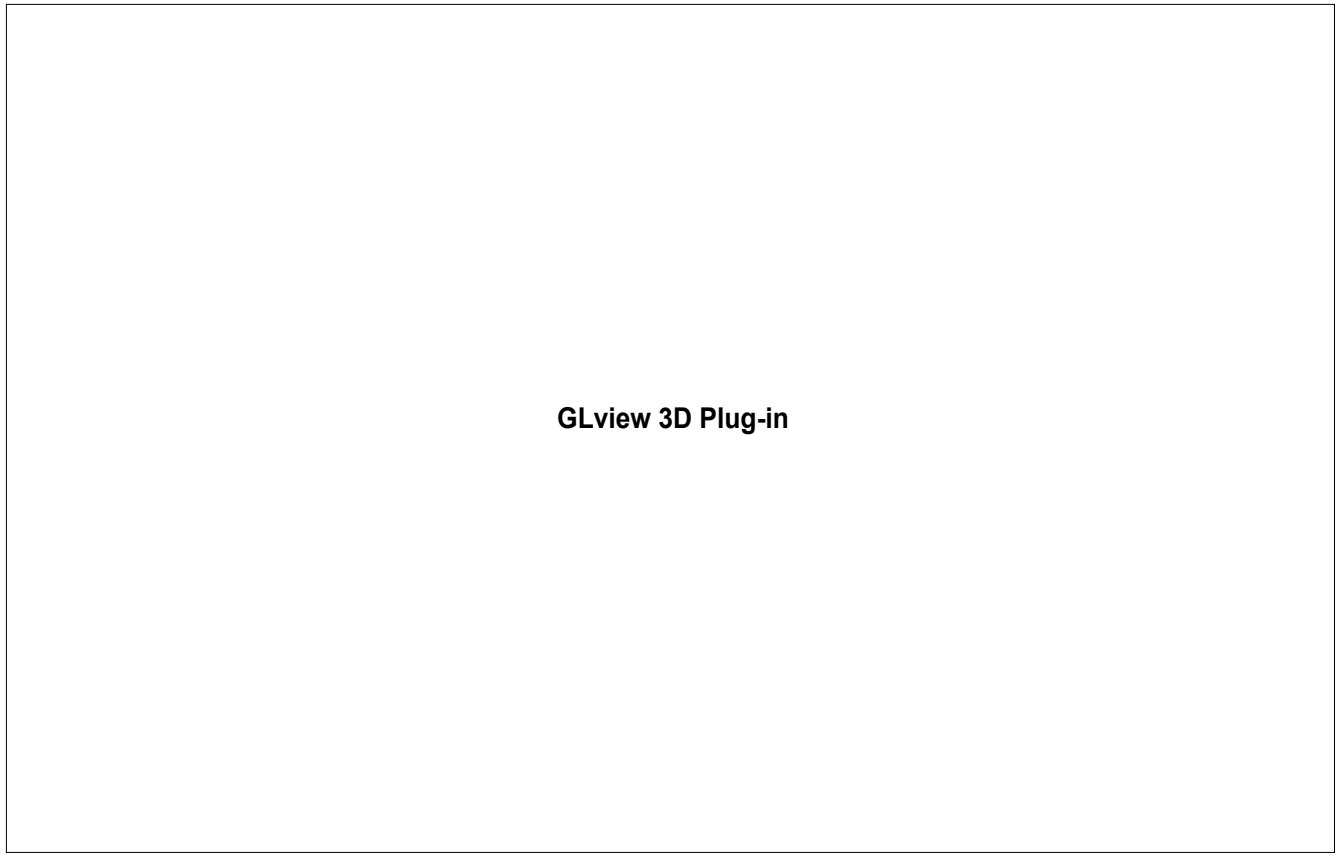
Y-12 Uranium plume development - SimER

- **(NO chemistry)**

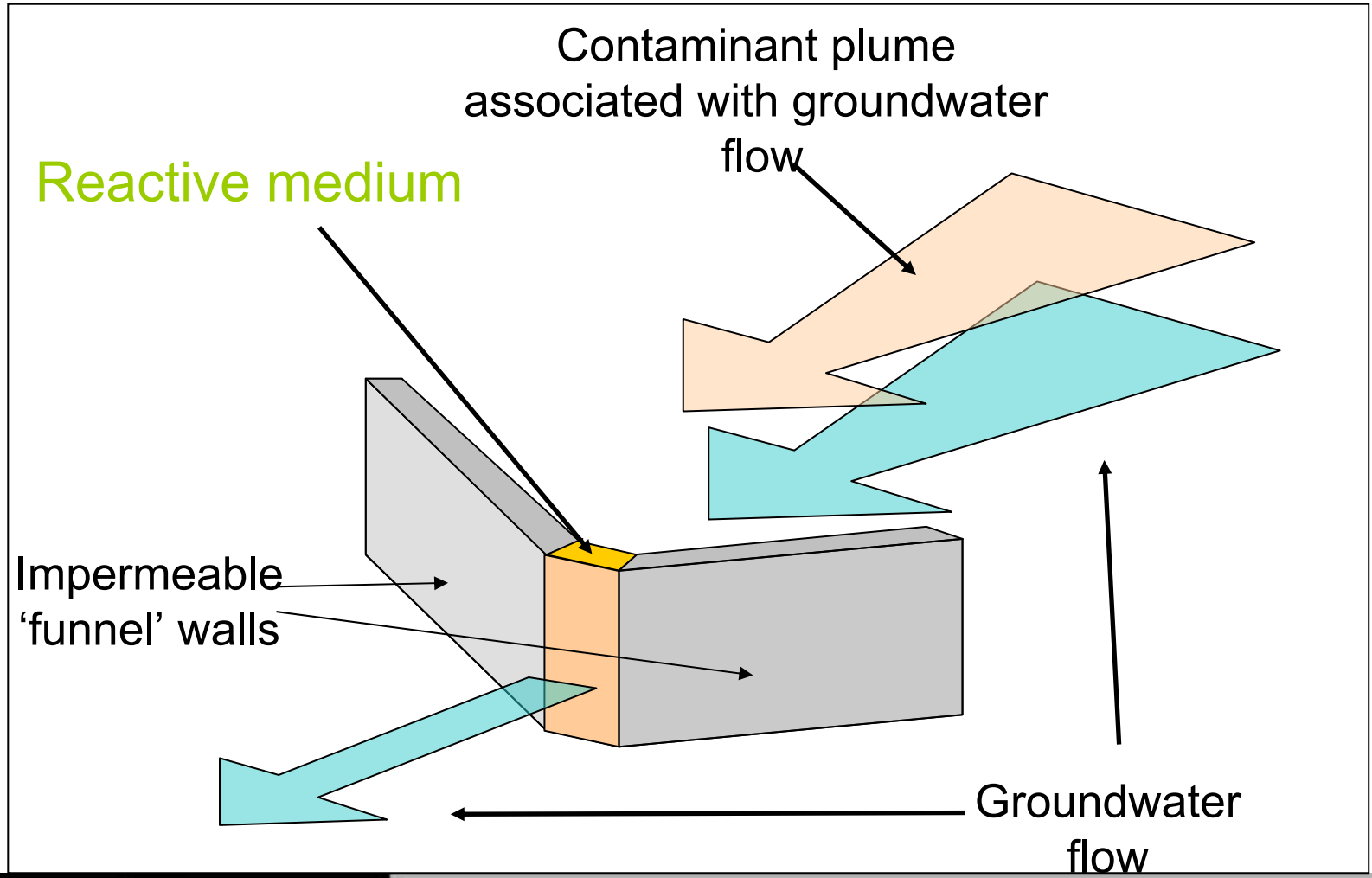
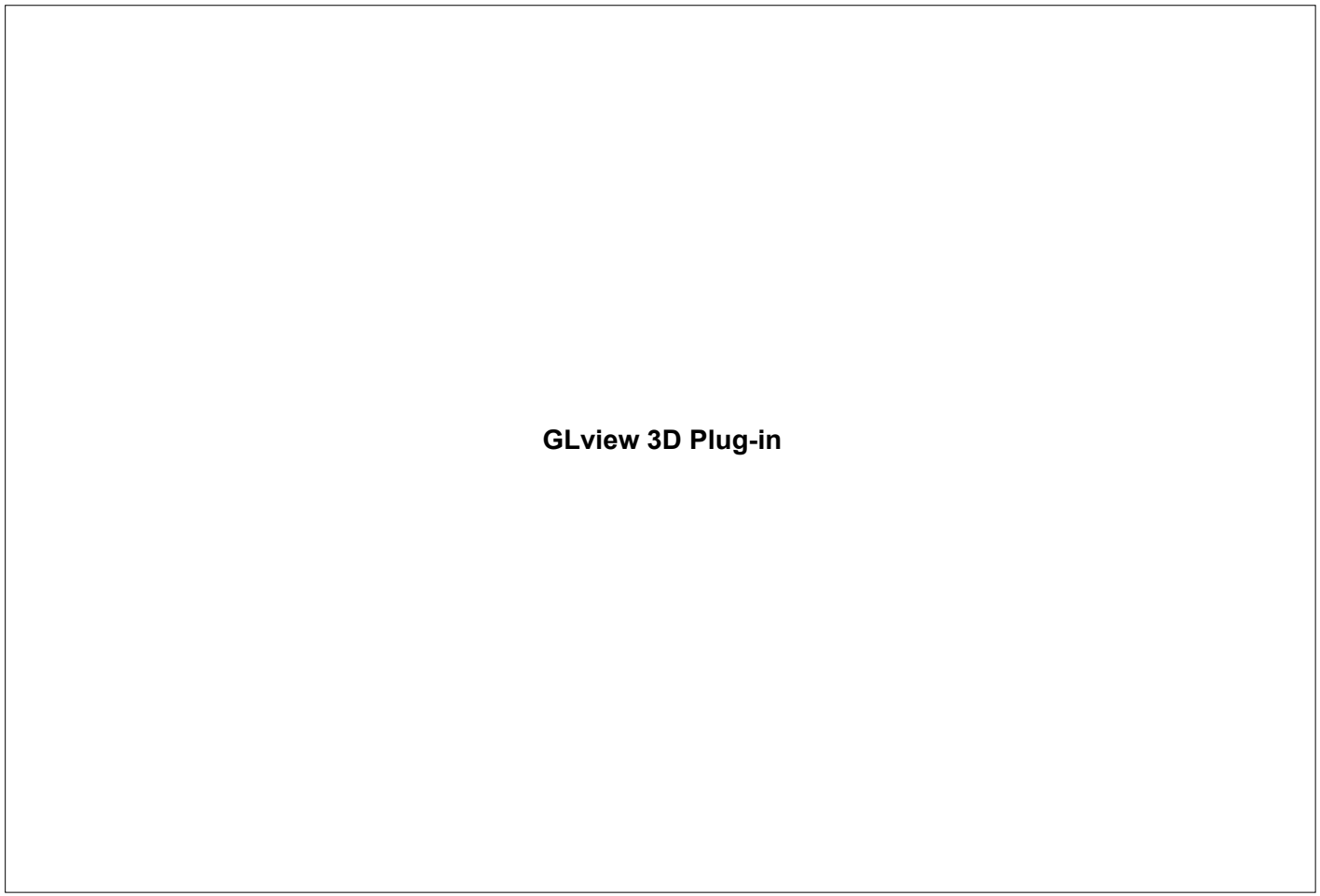


Y-12 Uranium plume development – SimER (2)

- (**With chemistry**)



Funnel and gate PRB behaviour -a cautionary tale



Modelled using both TRAFFIC and SimER – SimER below