NERC-funded PhD CASE Studentship 2012-15

Securing resilient public water supply from groundwater resources at transient risk from uncertain DNAPL chlorinated solvent contamination

supported by Severn Trent Water Ltd and the Environment Agency

Supervisors:
Dr Michael Rivett, Water Sciences Research Group (Hydrogeology), University of Birmingham
Prof David Lerner, Catchment Science Centre, University of Sheffield.

Further information available from
Dr Michael Rivett - M.O.Rivett@bham.ac.uk 0121 414 3957

Deadline for electronic applications: 31 October 2012
Via links at http://www.birmingham.ac.uk/schools/gees/courses/postgraduate/phd.aspx

Detailed Project Description

Industry driver
Water company public-supply wells in urbanised catchments are often at risk of uncertain, transient and long-term contamination from third-party sites contaminated with DNAPL (dense non-aqueous phase liquid) chlorinated solvent sources. Since DNAPL – solvent remediation has proven highly difficult, water companies wanting to utilise urban groundwater are faced with developing new supplies, or continuing to use and treat contaminated supplies at solvent risk. Identification of a site’s risk to solvent deterioration and factoring that into multi-million pound decision-making processes on new site location, treatment needs or well abandonment is hence of key concern to the CASE partners, Severn Trent Water (STW) and the Environment Agency (EA), supporting this research.

Scientific challenges
Tools are needed that assess risks to supply wells from surrounding contaminant sources. One of the few probabilistic risk-based management tools available is the University of Sheffield’s BOS (Borehole Optimisation System) risk management tool. The capability of this modelling tool will be further developed in the CASE studentship, specifically to incorporate the influence of transient processes. Such influences may arise from changing flow patterns due to the presence of new wells, old well closures, gradual decay of DNAPL source terms and natural climate and, or anthropogenic changes to recharge of groundwater.

Research Aims
This University of Birmingham (UoB) and University of Sheffield (UoS) CASE research collaboration will contribute to an overarching water industry goal of securing resilient public water supply from groundwater resources at transient risk from uncertain DNAPL chlorinated solvent contamination. The PhD aims: (1) to develop supply well centred risk-based management modelling tools that manage transient water-quality risks posed by DNAPL (and other) contaminants; (2) to better understand the uncertainty of time-variant interactions between supply wells and surrounding DNAPL sources and their effective incorporation to modelling tools; and, (3) to undertake concentration-time series sampling of pumping wells and use these and archive datasets to validate developed modelling tool transient capabilities.

Research Approach
The research will involve model development, validation and application, incorporation and development of recent transient-based process understanding to models, collation and trend/statistical analysis of archive data and undertaking new field tests on (supply) wells with STW and
the Environment Agency. Historical and new field data will mainly be drawn from solvent-contaminated sandstone aquifers in the Midlands, e.g. Birmingham, Nottingham, Coventry. Key tasks linked to similar numbered aims are outlined below.

- **Task (1)** is underpinned by the development by UoS over 10 years of the BOS software. Novel development of BOS will occur via: the introduction of reverse tracking in order to predict the probability that a particular contaminated site is a significant source to the modelled supply well; and, the addition of time-variant modelling capability to allow estimation of probabilistic risks with time.

- **Task (2)** will assess transient processes with a view to their effective incorporation in the modelling tool. The research will adapt and develop DNAPL source zone longevity models developed in North America to the UK context in collaboration with Prof Brusseau of the University of Arizona. Transient flow regimes due to well abstraction variability will be evaluated against transients in urban recharge arising from anthropogenic (e.g., mains leakage) or natural - climate change or variability inherent to sampling-analysis protocols.

- **Task (3)** to establish sensitivity of concentration transients due to abstraction variability (separating from DNAPL source-term declines) will be achieved with the case partners through acquisition of new targeted datasets involving short/long-term (supply) well pumping tests with time-series concentration sampling. Archive and obtained targeted datasets will allow validation of the developed BOS tool transient capabilities.

**Student training**
The student will receive high quality training through five highly regarded institutions. UoB’s MSc Hydrogeology will develop core skills, including modelling. Training will occur in ARC-GIS, field/lab methods, student supervision (for MSc students doing PhD-linked projects), teaching (for demonstrating), UoB’s research student training package. UoS will provide BOS training and U. Arizona source-term training. STW will provide in-house training giving water-company perspective and business/technology best practice on catchment management risk assessment and supporting areas. The EA will provide current regulatory/policy steering of the project. The student will be given opportunity to present at university research seminars and national and international conferences.

**Supervisors’ example research publications**


