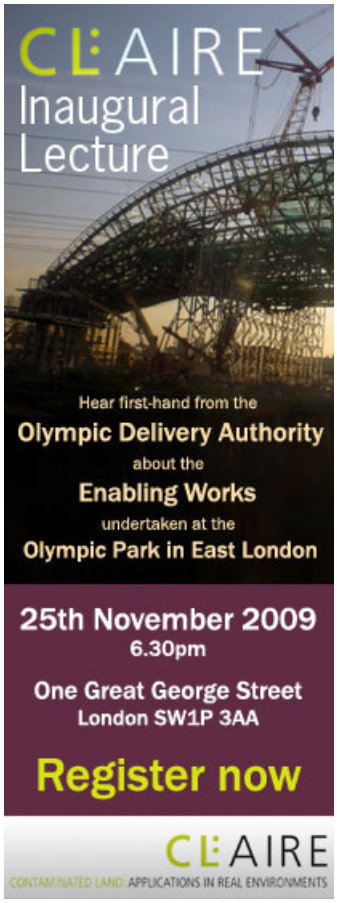
Special Event



Upcoming events

November 2009

Mo	Tu	We	Th	Fr	Sa	Su
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

November

Groundwater Protection & Research Group - Fate and Transport Short Course
November 10, 2009 - November 12, 2009

Applying the Environment Agency's Remedial Targets Methodology
November 11, 2009

Applying the Environment Agency's Remedial Targets Methodology
November 11, 2009

FEATURE: The use of portable X-Ray Fluorescence (pXRF) in screening high risk (allotment) sites

Tuesday, 22 September 2009

In this month's Feature Article, **Mark Edwards** of Lancaster City Council shares their experience of screening the city's allotments for metal contamination using a hand-held pXRF (portable X-Ray Fluorescence) device. The article explains the procedures and thought processes the council underwent last year in conducting this investigation over a total of 535 allotments as part of regulatory obligations under Part IIa of the Environmental Protection Act.

Local Authorities (LAs) have a statutory duty to provide food growing areas for residents under legislation dating back over 100 years, e.g. Small Holding and Allotments Act 1908 and Planning Policy Guidance Note 17: Planning for Open Space, Sport and Recreation, 2002.

Lancaster City District has around 610 allotments, of which approximately 533 are owned and rented to allotment societies by Lancaster City Council itself. Generally, allotment gardeners take the growing of edible vegetables, and to a lesser extent chickens and flowers, very seriously and are considered to be "high end" consumers of home (or allotment) grown vegetable/fruit produce. Clearly then any soil contamination present may have a significant impact upon the health of allotment gardeners and their families.

As part of the investigation, a total of 535 allotments were sampled and screened. Most LAs have little money for the sampling and laboratory analysis of soils and to test 535 individual allotments would costs many thousands of pounds. Over the last decade or so several rapid and low cost field screening techniques have come to market and their use, accuracy and acceptance has increased correspondingly.

At a 2008 meeting of the Lancashire Contaminated Land Officers Group a successful business case was made for the joint LA purchase of a pXRF that would enable contributing councils to call upon this jointly owned resource to quickly, inexpensively and accurately screen soils from sites of concern. Six LAs, in addition to Lancashire County Council, contributed to the purchase cost of the pXRF. The machine purchased is a Thermo-Niton XLt 700 series and it is held centrally at the county analyst's laboratory so that all LAs who had jointly purchased the machine can call upon it. This, however, does not preclude the deployment of the pXRF directly to site. However, for the most accurate, reproducible results and for health and safety purposes it is best to use the pXRF in a controlled workbench environment.

The pXRF does not have a sealed radioisotope source. However, notification to the Health and Safety Executive is required under the terms of the Ionising Radiation Regulations 1999 (Reg 6(2)). This is a formality, requiring a 28 day pre-notification period and development and compliance with control measures/local rules. The council sought advice from its Radiological Protection Advisor. The use of the machine in both a typical field scenario and a workbench setting was assessed and the radiation emitted and received by the operator was monitored using appropriate dose rate monitoring equipment for low energy x-rays. The pXRF is weatherproof and appropriate for field use. However, in order to enhance accuracy/reproducibility of results and to comply with the as low as reasonably achievable (ALARA) principle at the heart of radiological protection, it was decided to use the pXRF in a workbench setting in a shielded test stand.

The pXRF can detect a range of metal and metalloid elements from phosphorus to uranium in the Periodic Table. It cannot detect asbestos, pesticides or dioxins/furans; contaminants which, anecdotally, are of concern to some allotment holders and secretaries.

A brief desk study was undertaken for each allotment site using the council's Geographical Information System to assess the potential for previous land uses to have contaminated the soils; none of the sites had a previous recorded historical use that would have given rise to concern of soil contamination. However, the importation of wastes, e.g. ash, clinker etc, of various descriptions to sites is well known and the potential for contamination exists.

The council's Property Service section provided details of the allotment sites. Contact was made with allotment secretaries via a letter and factsheet. Several copies of the factsheet were provided and a request made to display the factsheet on the allotment notice board to advise all plot holders of the nature of the sampling works. This consultation process was carried out concurrently with the council's consultation on its second draft Contaminated Land Inspection Strategy. The council was mindful of the desire not to cause undue alarm/concern within the allotment gardening community and used the SNIFFER[1] document "Communicating Understanding of Contaminated Land Risks, 1999" – imminently to be updated, to guide us in this objective. In practice, at this first stage of sampling, there were no concerned plot holders (several plot holders asked, however, about any ulterior council motives!). Site meetings were offered and accepted by all allotment secretaries prior to the sampling to further explain the sampling and assessment protocols.

At the site meetings sampling dates and access were arranged. Also, where possible, the site plans were obtained showing plot numbers and layouts (many sites had split plots – in such cases it was decided to retrieve one soil sample per whole plot).

Groundwater Protection & Research Group - Unsaturated Zone Processes Short Course
November 13, 2009

LQM - Introduction to Chemistry for Contaminated Land
November 17, 2009

View Full Calendar

It was intended that the pXRF was only to be used as a screening tool and that any samples screened that raised concerns due to elevated metal/metalloid concentrations would be highlighted for traditional laboratory chemical analyses where appropriate.

The sampling protocol itself was purposefully simplistic. The surface soils, at a random location on each plot but usually close to edible produce, were disturbed by heeling or digging with a trowel to a depth of c.75mm and approximately 100g of soil retrieved directly into a labeled plastic sandwich/freezer bag which was then secured. One such soil sample was retrieved from every accessible whole plot. Plots exclusively given over to raising hens or secured by high fencing were not sampled; which accounted for in the region of 13% of the total number of plots. The rationale for not digging deeper sampling pits was that generally the soils are very well tended. They are prepared at least once a year by addition of manures and other fertilizers and dug over to a depth of at least 400mm which has the effect of homogenising this soil interval. The majority of the six generic types of edible plants/produce specified in the Environment Agency Report SR3[2] root predominantly within the top 1000mm of the soil profile. Soil preparation by tilling also exerts some control on the depth of the rooting system. And so it is likely that any significant contamination present would be discovered by near surface sampling.

The samples were taken to the laboratory and securely stored and were not, due to the metal/metalloid nature of the contaminants of interest, stored in a cold room or preserved/fixed and were analysed in batches normally within one/two weeks of sampling.

After discussions with Niton it was considered that on the first set of analyses the pXRF machine should be used with a 180 seconds run per sample. The accuracy of the pXRF improves (up to a point) in direct proportion to the run time of the machine. Whilst not achieving an optimum limit of detection it was felt that this time was a good compromise taking into account the considerable amount of time taken to screen hundreds of soil samples. To screen the sample for more than 180 seconds produces little by way of improvement in the limits of detection for the contaminants under consideration. The machine was checked for calibration on every use against a silica sand with effectively no contaminants and also against a laboratory prepared reference sample. No significant drift/errors were noted.

The sample results were saved by the proprietary software in both an Excel spreadsheet and a Niton specific '.ndt' file format. In the first instance the data obtained was compared to the recently withdrawn soil guideline values - SGVs (the first sampling and screening was carried out before the withdrawal of the SGVs in July 2008). The use of obsolete SGVs was in any case true to the intention of SGVs in that they were used solely as trigger values above which further professional judgment and assessment was to be used and *not* as necessarily being indicative of significant possibility of significant harm. Fifteen samples significantly exceeded their respective screening values. No precise definition of significant is provided here; for some samples it may have been a single determinand that exceeded the guideline value by say 50% whilst for another sample several determinands may have exceeded their guideline values by only an average of 10%. Clearly, an element of subjectivity was involved and professional judgment was called for.

For those plots where the soil samples exceeded their respective SGVs the allotments were re-sampled. Allotment secretaries were contacted in all cases and only one plot holder expressed concern; who was contacted by telephone and their concerns assuaged. At least 6 more near surface soil samples were retrieved from each affected plot. Each of the soil samples were mechanically agitated prior to screening with the pXRF in order that they could be as homogenous as possible. Run times were also extended on the pXRF to around 6 minutes (360 secs) in order to improve detection limits.

After the re-sampling and pXRF screening had been completed only one allotment plot returned elevated contaminant results as follows:

Cadmium Concentrations for Affected Plot

Sample 1	9.6ppm
Samples 2 to 6	<3.4ppm

Clearly at least one remaining area of soil was exhibiting slightly elevated cadmium concentrations. Given inherent shortcomings in the use of pXRF such as matrix interference, lack of sample preparation etc it was decided to submit these samples for traditional laboratory determination of cadmium concentrations and pH (which is a strong controlling factor of soil-plant cadmium uptake). This was done using appropriate wet chemistry techniques such as sampling drying, sieving, jaw crushing, grinding, extraction and ICP-MS procedures under MCERTS accreditation. The results ranged from <0.2mg/kg to 0.4mg/kg Cd and pH from 6.21 to 7.60. Generally speaking the traditional wet chemical analyses gave slightly lower cadmium concentrations than the pXRF.

These results gave the council confidence that the plot was not significantly contaminated with respect to cadmium. Had the soil concentrations been higher then face-to-face discussions would have been held with the affected plot holder(s) in line with procedures contained within the council's draft second edition Inspection Strategy and the SNIFFER document [(1)]. We would have then carried out intensive soil sampling and sampling of produce in order to derive site specific assessment criteria upon which a decision whether to remediate could have been based. In the interim we would have given recommendations as to the safer use of the allotment, e.g. liming, thorough peeling and washing of produce, more rigorous hygiene practices etc.

At completion a short letter was sent to each allotment secretary to thank them for their assistance and to inform them that with respect to *heavy metals* none of the plots sampled had significant levels of contamination. General advice was also offered regarding soil dressing/conditioning materials imported onto the sites. Those secretaries expressing opinions had found the exercise useful and re-assuring. It was also a method where, for a relatively small financial outlay, the council could offer a good deal of re-assurance to a particularly exposed cohort of individuals.

References

1. Scottish and Northern Ireland Forum for Environmental Research, *Communicating Understanding of Contaminated Land Risks*, 1999; and

2. The Environment Agency, *Updated technical background to the CLEA model*, Final Report SC050021/SR3, 2009.

For other applications of pXRF technology please read CL:AIRE Research Bulletin RB7: Field Portable X-ray Fluorescence (FPXRF): A rapid and low cost alternative for measuring metals and metalloids in soils.

[Back]

We have 5 guests online:

Get our news automatically by RSS

What is RSS?

Published by CL:AIRE, 7th Floor,1 Great Cumberland Place, London W1H 7AL, Tel: +44 (0)20 7258 5321 Fax: +44 (0)20 7258 5322 Email: enquiries@claire.co.uk

Contact Us
Website Terms and Conditions
Privacy Policy