Organised by the Institution of Civil Engineers' Geospatial Engineering Board, this one-day event heard from a wide range of speakers, bringing experience from across the utility services providers, contractors, academia and even an excavator manufacturer. *GW* editor Stephen Booth reports.

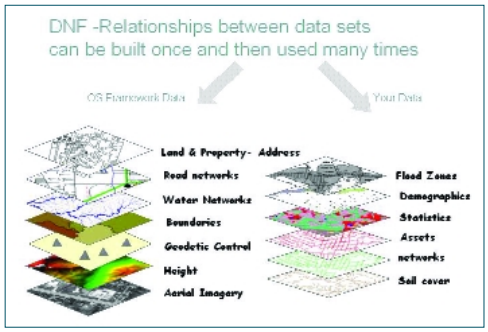
Coordinated utility services: pipedreams or a geospatial future?

One of my tasks as a site quantity surveyor working on high pressure gas pipeline construction in the 1960s was to record as-laid information about the main. We measured depth of cover over the pipe, changes of direction in degrees (based on the records of the bending machine operator!), the position of land drains and other services, and took occasional offsets to field boundaries. It wasn't serious coordinated data and looking back with the comfort of hindsight it was surely inadequate for a high pressure gas main, but it did provide the client with some record of what his contractor had built. How much better are we today?

Accurate geospatial information about the proximity of buried services is essential before starting to dig by machine. It will save time, money and above all, provide a reasonably safe operating environment for those involved. Yet the information that exists amongst utility companies varies from the well coordinated to the non existent. Privatisation in the early 1990s did not always help. Since those riproaring Thatcherite days when we were told that the market would deliver everything consumers needed far more efficiently and economically, ownership of utility companies has passed from one to another and sometimes it was the historic records that got lost.

It may come as a surprise but the problem has been with us for years. Some of Europe's major cities continue to rely on Roman sewers and in the South of France recently I have seen telecoms and electricity cables attached to a 2000-year old city wall. More seriously, poorly protected gas and water mains laid in the 19th century have crumbled away to leave no more than a horizontal hole passing through the surrounding clay. And even today, it is claimed, as many as 25 per cent of electrofusion joints on polyethylene pipe are substandard.

It is supposed to be very different. Utility companies accurately record the position of their mains and store the information within advanced GIS and retrieval systems. Many mains are made of plastic so it won't corrode and there are numerous clever technologies available for accurately locating mains and cables before digging commences. It is even possible for guided moles to avoid digging up roads altogether. However, this rosy picture is not quite what it seems, as we shall see.



DNF is an initiative to encourage greater connectivity between mapping data holders. It aims to create a permanent and difinitive base to which geospatial information can be referenced.

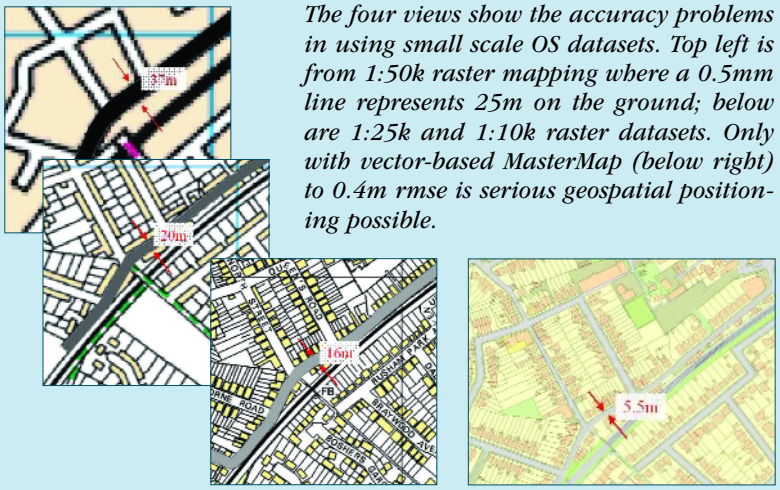
Whose job?

There cannot be many readers of this journal who have not had to deal with the problem of locating buried services. Engineers regard it as the surveyors' job; the surveyors only wish the engineers had employed them when the main was first laid to accurately record its position. And if you're just part of the frustrated general public fuming at yet another delay as contractors dig up the road then, whatever the pundits say you will firmly believe that such activities are the major cause of delay on the road network. In fact, according to TRL the transport industry's research body, disruption due to roadworks accounts for only around ten per cent of delays on the network (this will provide little comfort to the residents of one Glasgow street which saw it dug up no less than 223 times in one year).

The ICE and ICES have been working together for some years now on a range of engineering surveying matters. Organised by their joint Geospatial Engineering Board, the intro to the day by conference chairman Martin Cullen of Glagow Caledonian University (he describes himself as 'a civil engineer who teaches') ran from the Greeks and Romans to Bazalgette and Privatisation. Cullen told us that modern society has been a victim of its own success. A higher quality of life has meant greater demands on our services as people use more water and burn more energy. Data collection and distribution however has not moved on. Today people are less prepared to accept an 'His Master's Voice' approach from government. They are better educated and many have access to the web. There are a greater range of buried services – sewers, gas, electricity, cable, water, telecoms. Accurately locating and geospatially positioning all of these requires standards and that is where our problem may lie.

Step forward the DNF

Ordnance Survey's James Brayshaw argues that the absence of consistent mapping of utilities' apparatus was a challenge. With such a mixture of records going back 30 years or more there will be accuracy issues. The key to expediting the problem is seen by govern-



The four views show the accuracy problems in using small scale OS datasets. Top left is from 1:50k raster mapping where a 0.5mm line represents 25m on the ground; below are 1:25k and 1:10k raster datasets. Only with vector-based MasterMap (below right) to 0.4m rmse is serious geospatial positioning possible.

ment as the 2004 Traffic Management Act (TMA).

Brayshaw's colleague Marc Hobell explained the Digital National Framework (DNF) and is at pains to point out that this is not owned or created by Ordnance Survey. Although OS MasterMap is a what Hobell described as 'a coherent component' of DNF, DNF is primarily a guidance document to encourage best practice in the collection and recording of geospatial data. For instance, it encourages users never to capture data if it already exists, to capture at the largest possible scale, to use unique identifiers (the OS's TOID system), to locate within the national GPS network and to use the common mark-up language GML.

". . . the job is not to lay a pipe but to lay a pipe and capture data."

Although real-time corrections from the OS's active network of 110 GPS base stations are not yet commercially available, once this begins it will mean that users will need fewer survey grade receivers. A much lower grade receiver plus a GSM phone is all that will be required to get 20mm accuracy levels. Hobell believes that the TMA is 'only one small element of a wider data integration process'.

He also provided a timely reminder of the differences between OS's various map products. Those at 1:50k and even 1:10k are of no use in calculating road widths; you have to go to MasterMap at 1:1250 before such information can even begin to be relied on. All of this may create problems for utilities depending on which map product they used to record their mains. 'You must use the largest scale possible – it must be scaleable' explained Hobell. 'Amen to that', say surveyors.

Gas, water and T5

All of this should be good news to the gas main network manager, National Grid Transco, whose John Meehan explained that they didn't get it right because of 'changing geographies', incomplete data and data capture. One problem is that permanent features as reference points on roads, such as streetlight columns, are no longer permanent as local authorities seem to change them regularly nowadays. Nevertheless Meehan reminded all utilities that the job is not to lay a pipe but to lay a pipe *and capture data*.

For Thames Water Utilities which has over 100,000 kilometres of water mains, information is an asset which has 'a life beyond the project' and is therefore to be managed like any other (which explains why their survey department is now part of the Asset Main Group). TWU's technical information manager Phil Bailey explained that although accuracy from GPS was acceptable it was only part of their toolbox which today includes reflectorless total stations, laser scanners, GPS-enabled cameras and, most important, the qualified surveyor. Their data was captured at ±50mm (95% accuracy level) and to metadata standards yet there remain issues between recording data within MasterMap or to WGS84.

Terminal Five at Heathrow is currently one of Europe's largest construction sites. When complete, it will increase the size of the airport from 110 stands to 160. It involves many major and minor road diversions as well as entirely new road links to the trunk road and motorway system. All of it is being designed and built within a single 3D CAD model and is, according to Laing O'Rourke's chief engineer Neil Kitchener, 'a microcosm of a small town' with the added buried service of fuel mains. 'We've been very good at mapping and locating these services but we're still digging up cables!' admitted Kitchener. For newly laid cables however he assured us that subcontractors had to provide as-built records – without them there was no certificate and no energisation. All of this is undertaken within a tight regime of criticality ratings for airport safetly.

Research technologies

The conference heard from a number of academics and research organisations with substantial programmes underway to find better solutions to location and identification problems of buried services. Existing technologies to locate services include ground probing radar, acoustic devices and induced current. There is also trenchless technology which involves guiding a boring machine which threads its way through underground services and pulls a pipe or cable behind it.

Mike Farrimond thought we should be able to do better than 'I think it's a water pipe'. He is the director of UKWIR, the water industry's research body which has a £10 million five-year research programme underway, whose objectives include "the optimisation of non-intrusive techniques". The challenge is 'can we do something today to make these assets easier to find in a hundred years time?'

Jo Parker, a consultant to the water industry, considered the issue of geospatial accuracy, reminding us that everything doesn't have to be to the same accuracy. There are different levels of risk management between water and electricity services. She argued that the existing regulatory system did not encourage best practice. The new TMA is expected to change that, imposing new duties on service providers to keep accurate records of the location of their buried apparatus. Good news for the GIS business. UKWIR also has a project underway to examine the effects of the act and review its impact on the water industry.

In a separate initiative, UKWIR has joined with

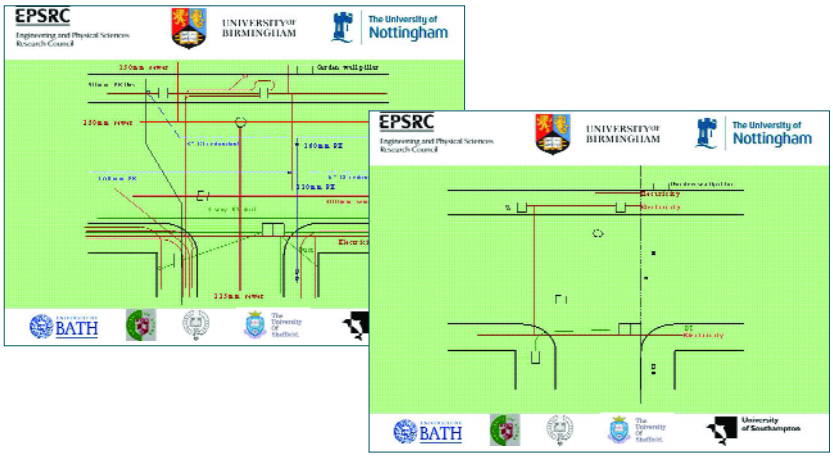
more than 20 other organisations to look at how new technologies can help with location and positioning. The target is 100 per cent location of buried services. Research to date, by Nottingham University's Professor Chris Rogers who has specialised for 20 years in buried services and trenchless technology, has not been too encouraging. A trial location project of a Hereford road junction (typical of a busy urban environment) involved 4 sewers, 11 BT cables, 15 electricity cables, 5 polyethylene pipes and 2 cast iron mains. The exposed mains were backfilled and three contractors invited to try and locate and position them. The results were not encouraging. A 50 per cent success rate was the best managed.

Also involved in the research is Nottingham Universities' IESSG which is researching augmented reality systems whereby excavator operators may have a screen in the cab to show them in 3D exactly where the services are beneath their hovering buckets. A similar system is proposed for site personnel who will wear a head-up display unit which shows services in real time as they walk around the site.

This will be good news for Russell Broad of excavator manufacturer JCB who wanted to know how far advanced was research into buried services detectors that could be mounted on an excavator. Responding, Jo Parker said that the aim was a system where the excavator would only need to know its GPS position, not carry sensors. Somehow you can't help thinking the operator would be a lot happier with a full armoury of sensors and detectors below his bucket.

Getting involved

Yet many organisations and companies with wide experience in the field and present at the event, have felt left out from the research process. Robert Biggs of Derbyshire County Council questioned whether the right people were involved: 'we have a large number of buried assets but we don't seem to be playing in the game'. Nikki Fairs of Met Surveys, which has a geophysical services division, years of practical experience in mains detection and had a stand at the accompanying small exhibition, wanted to know why no one had contacted them. Jo Parker welcomed their interest, and said that survey companies had been contacted – 'the door is open'.



Trials to locate buried services at a busy road junction (top left) by non-intrusive methods produced unreliable results (top right).

As one speaker from the floor said, the financial risk to utility companies may hinder the proposals under the TMA and it may yet be necessary to impose an altogether stronger regulatory regime than that of the new Act. Summing up the day, chairman Martin Cullen argued that although there were issues of confidentiality and security, it was not about ownership of data. He was confident that the DNF would be the norm by 2008: the problem was with inherited information, the so-called legacy data. In the meantime we need surveyors competent to choose and use the appropriate systems.

For the future, the Department of Transport would prefer an industry-driven solution rather than legislation. Cullen believes that a champion – a not for profit body – is needed to urgently carry forward the work to date of the Geospatial Engineering Board. Concluding with a ringing endorsement to GW's sister publication *GIS Professional* whose then current issue focused on location based services, he declared it was now 'over to industry'. GW

GW would like to record its thanks to the ICE for being able to attend this event.

The Traffic Management Act

The Traffic Management Act of 2004, some of which has already come into force, aims to improve the flow of Britain's road network and to reduce congestion. It seeks to do this through:

- placing a duty on local authorities to keep traffic flowing, taking account of their other duties and responsibilities, and to co-operate with other authorities to the same end,
- all traffic authorities have to appoint a "traffic manager"
- if it can be demonstrated that an authority is failing in its network management duties, then the Secretary of State for England or the National Assembly for Wales can appoint a traffic director,
- tightening existing regulations for digging up roads, giving authorities more powers to co-ordinate works effectively with the aim of minimising disruption,
- introduction of permit schemes under which those wishing to dig up particular roads have to apply for permission. Those operating permit schemes (eg local authorities) would be able to attach conditions to the permit (such as dates during which works could take place). Local authorities would have to treat their own works on an equal footing to those carried out by others,

Other powers to highway authorities include the dates and times that works may be carried out (including an up to 12-month embargo on works); powers to direct that utilities must re-surface the whole of the carriageway and higher fines for poor performance. The Act also allows "lane rental" and overstaying charging powers (under which utilities may be required to pay a daily charge every time they dig up the road, or if they take too long).

The Act will allow statutory guidance to be issued to authorities for safe working in the road and will make it possible for authorities to be required to keep records of their apparatus in the road. In both cases bringing highway authorities into line with the existing requirements on utilities.