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Multi-phase geophysical survey to characterise waste materials in a modern engineered landfill site

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The future mining potential of a landfill site requires the assessment of the likely volume and distribution of recoverable materials of value, within an overall waste body. Whilst more recently constructed landfill sites may have some record of the type and volume of waste deposited, as well as information concerning the extent of an overall site, there is often scant information available for older landfills. For such sites, the potential for the recovery of waste materials will require some form of rapid characterisation (valorisation) of the waste, such that the cost-effectiveness of any mining operation may be estimated.

Geophysical survey techniques offer the potential to rapidly delineate variations in material properties and may be deployed at a range of scales to suit the dimensions of a site or expected level of heterogeneity within the waste. The majority of geophysical techniques are also non-invasive, which is particularly important where potentially hazardous waste is expected, or where the integrity of environmental protection measures such as geotextile membranes must be maintained.

This case study presents the application of number of geophysical survey techniques to characterise the waste within a filled portion of an active landfill in Normandy, France (Les Champs Jouault) and is a pilot site for the RAWFILL project. The site has been operational since April 2009 and was chosen in part due to the large volume of information concerning the construction and nature of the waste materials deposited. This permitted a reasonably well-constrained interpretation of the geophysical data collected. The site poses a number of interesting issues relating to the fact that the site generates and harvest biogas/methane from the waste materials utilising an injected/recirculated leachate system, with individual waste cells fully sealed with an impermeable geomembrane (liner), which also sits above the waste and is then covered with natural soils. The presence of the liner above the waste prohibited the use of Electrical Resistivity Tomography (ERT) for the geophysical characterisation.

The case study presented used multiple phases of geophysical survey to characterise the solid

waste, as well as to target intrusive sampling undertaken at the site. A number of geophysical techniques were applied, including Ground Penetrating Radar (GPR), Electro-Magnetic (EM) and Magnetic techniques, as well as seismic techniques (Multi-channel Analysis of Surface Waves (MASW) and Horizontal to Vertical Signal Ratio (HVSR)). The initial survey provided valuable information concerning the thickness of cover above the geomembrane across the survey area, the extent of individual cells as well as variations in waste condition/composition within individual cells and the overall thickness of waste materials/depth to subgrade/bedrock.

The measured geophysical properties have been used to model both the lateral and vertical extents of the landfill as well as to map the distribution of material properties (potential resource). Preliminary findings were used to target a tranche of intrusive sampling (and further geophysical investigation) designed to ground-truth the geophysical data, with the knowledge gained from this exercise used to valorise the potentially recoverable waste materials present in the form of a Resource Distribution Model (RDM).