SHARPER SUBSURFACE INSIGHT WITH HIGH-RESOLUTION RESISTIVITY IMAGING

In general, electrical resistivity surveys are commonly processed using a conventional approach that produces an inversion model with relatively low spatial resolution, due to limitations in both acquisition techniques and processing algorithms. This approach is suitable for interpreting large-scale structures, such as regional geological investigations. However, when applied to engineering studies that require high accuracy and detailed stratigraphic delineation, conventional processing may yield biased interpretations or results that are inconsistent with ground-truth data. As shown in Figure 1 (a survey conducted for a riverbank protection dike project along the Phong River, Moo 7, Ban Dong Subdistrict, Ubolratana District, Khon Kaen Province), the processed results do not show a clear relationship between variations in electrical resistivity and the subsurface layering inferred from borehole data (solid brown line). In addition, the thickness of the low-resistivity zone (< 23 ohm·m) appears to increase markedly between chainage 0+150 and 0+200.

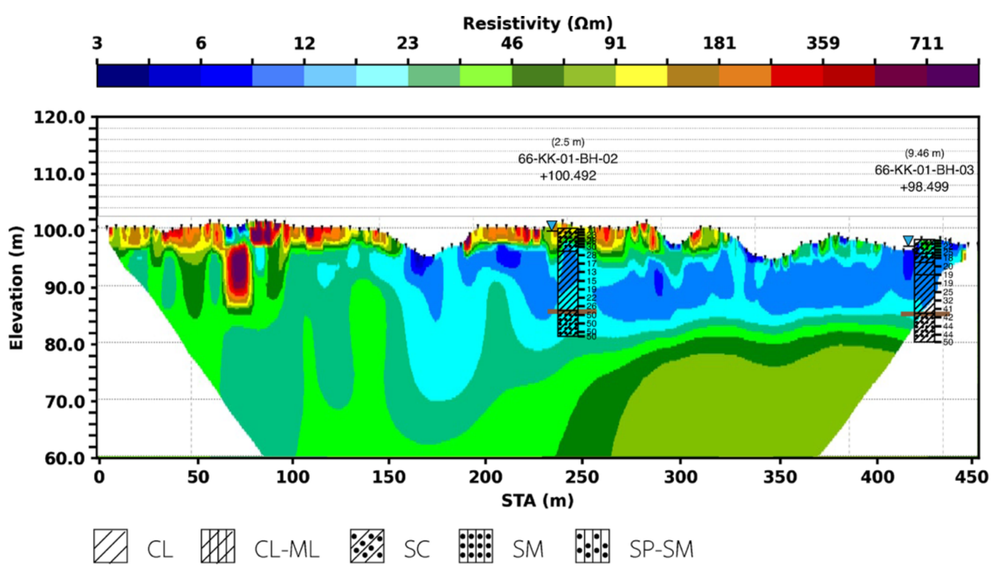

Figure 1 Inversion model of electrical resistivity for the riverbank protection dike project along the Phong River, Moo 7, Ban Dong Subdistrict, Ubolratana District, Khon Kaen Province, processed using the conventional approach. The solid brown line indicates the depth at which very dense sand was encountered from borehole data.

In contrast, when the data are processed using a High-Resolution approach, the resulting model exhibits a pronounced consistency between variations in electrical resistivity and changes in subsurface stratigraphy (Figure 2). The 23 ohm·m resistivity boundary (red line) occurs at depths close to the interface between stiff to very stiff clay and very dense sand as identified in both boreholes (solid brown line). Therefore, the 23 ohm·m boundary may be used as a proxy to estimate the depth at which very dense sand is expected within the study area. Furthermore, the High-Resolution model does not indicate any increase in the thickness of the low-resistivity zone between chainage 0+150 and 0+200, suggesting better agreement with the borehole data than the conventional approach.

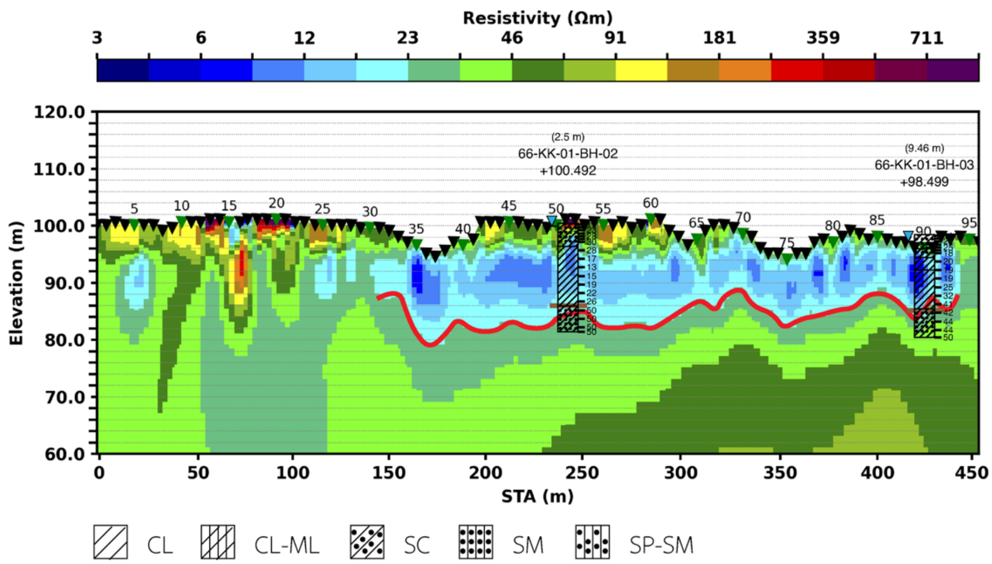

Figure 2 Inversion model of electrical resistivity for the riverbank protection dike project along the Phong River, Moo 7, Ban Dong Subdistrict, Ubolratana District, Khon Kaen Province, processed using the High-Resolution approach. The solid brown line indicates the depth at which very dense sand was encountered from borehole data, and the solid red line indicates the resistivity boundary used to estimate the expected depth of very dense sand from the model.

The comparison indicates that conventional processing of electrical resistivity survey data yields a model that does not clearly reflect stratigraphic changes consistent with borehole data, particularly between chainage 0+150 and 0+200 where the thickness of the low-resistivity zone (< 23 ohm·m) appears to increase significantly. This may lead to misinterpretation of subsurface conditions in an engineering design context. By contrast, the High-Resolution approach produces a model that is more consistent with borehole observations: the 23 ohm·m boundary occurs at depths close to the interface between stiff to very stiff clay and very dense sand, and can therefore be used as a proxy for estimating the depth to very dense sand in the study area on a sound geotechnical basis.