VISUAL DRAINAGE ASSESSMENT: LAND DRAINAGE DESIGN ON THE FARM

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Abstract. *Land drainage design is based on the full characterisation of soil physical and hydraulic properties and the input of this data into standard steady-state drainage design equations to elucidate appropriate drain spacing and depth. Although in-situ and ex-situ methods for quantifying soil physical properties are long established, they are often disregarded by practitioners in the field due to time and monetary constraints. Instead, generic designs based on local knowledge/experience are used. Such generic approaches can result in poorly designed and ineffective drainage systems. There is a need for a more sustainable drainage design approach which involves farmers and contractors from start to finish. This type of in-situ site-specific drainage design must not rely on ex-situ soil physical and hydraulic testing. The new design method presented is called visual drainage assessment (VDA). The objectives of the current study were to compare designs developed using a) the VDA methodology criterion b) optimal criterion and c) generic criterion for six dairy farms in south-west Ireland. For the VDA methodology nine indicators (water seepage, texture (sand/silt/clay %), absence or presence of pan layers, structure, porosity, consistence, stone content, colour/mottling and root development) were chosen to permit inference of soil permeability or to identify characteristics that inhibit or promote particular drainage techniques. Multiple soil test pits were excavated on each site and examined with respect to each of the indicators. A classification of each was provided in relation to depth below ground level. Discrete soil horizons in each profile were delineated in light of distinctions between indicators with increasing depth. Then, using the indicators, these horizons were classified as highly, moderately or poorly permeable. Groundwater drainage systems were prescribed if highly permeable layers, which can be exploited by field drains, were overlain by moderately permeable layers, which could facilitate percolation of surface water through the profile. Shallow drainage systems incorporating disruption techniques were prescribed where poorly permeable profiles were uncovered. To establish optimal drainage design depth and spacing (assuming a design discharge capacity of 12 mm/day and mid-drain watertable depth of 0.45 m for optimal design scenarios, texture and saturated hydraulic conductivity (k_s) (measure of permeability) were determined in the laboratory using horizon specific soil samples, which were subsequently used as inputs into standard steady-state drainage design equations. Also an arbitrary generic drainage system (0.8 m deep drains at 15 m spacing) was prescribed for each site regardless of site conditions or soil characteristics. The spacing and depth achieved using the three methods were compared for each site in terms of discharge (mm/day) and watertable control (mid-drain watertable depth, m) capacity. All VDA designs were similar to the optimal design at each site in terms of drain depth and spacing. Drainage discharge capacity from the VDA designs ranged from 10.7 to 15.6 mm/day, while mid-drain watertable depths ranged from of 0.29 m to 0.73 m. The generic systems were shown to be wholly inadequate with drainage discharge capacities of 0.0 to 1.0 mm/day and estimated mid-drain watertable depth at all sites of 0.0 m. Therefore the VDA methodology described provides an alternative method of approaching land drainage design where the permeability of the soil is not measured but interpreted by visually and manually examining the soil profile. The estimated performance of drainage systems designed by VDA was much better than that attainable by generic design and was similar to that achievable by the optimal design. The method needs to be developed further and validated for a non-expert audience over a range of site and soil conditions.*

Key words: *VSA, visual, drainage design, user-friendly, site-specific.*