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Hydrology and hydraulics of treatment wetlands constructed on drained peatlands

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Treatment wetlands are globally used for wastewater purification purposes. In Finland, these wetlands are commonly peatland-based and are used to treat runoff from peat extraction sites and peatland forestry. Wetlands are also used for polishing municipal wastewaters and mining waters. In peat extraction the structures are usually called overland flow areas (OFAs), which are traditionally established on pristine peatlands. However, nowadays establishing of new peat extraction sites is guided to drained peatland areas due to the Finnish Peat Use Strategy, which leads difficulties to find undisturbed peatland area for OFA. Therefore treatment wetlands have had to construct also on drained peatland areas. In drained areas peat physical properties have changed due to oxidation and subsidence and the water flow pathways differs from OFAs flow patterns, which maybe have effect on purification results. Thus in the present study we aim to clarify the hydrology and hydraulic properties of treatment wetlands constructed on drained peatland areas. For this purposes, 20 treatment wetlands on drained peatland areas across Finland were detailed measured for peat hydraulic conductivity. In selected areas, runoff was continuously monitored, flow distribution at treatment areas was studied and water residence times measured with tracer tests using potassium iodide (KI). Generally, in the study areas, the ditches had been completely blocked, partly blocked e.g with peat dams or not blocked at all. The ditches were located partly parallel to the flow direction and partly perpendicular to it. The distribution of water to the wetlands has been implemented in many different ways e.g. by distribution ditch or by perforated pipes. Based on the results, in majority of the wetlands, the peat drainage has clearly affected the hydraulic properties of wetlands, but not on all sites. In more than half of the wetlands (12), the median hydraulic conductivity of peat drastically decreased at the depth below 20 cm (or 10 cm). Two site it decreased at the depth of 40 cm, and at five sites, it was high at all depth investigated (down to 60-70 cm). The outflow proportion to inflow varied from 20 % to 97 %, which means that the part of the water infiltrated into the groundwater. Evaporation can explain part of the observed reduced water flow especially in dense tree stands. More than half of the wetlands contained also dry areas, meaning that treatment wetlands constructed on drained area have problems with even water distribution to the wetland. Ditches are also potential preferential flow paths and the shortest observed residence time was less than one day, but a much longer residence time was also recorded. The water flow in these treatment wetlands consequently occur only at the surface layer (0-20 cm) of peat, not deeper, or in the ditches, which may have impact on water purification results.