

# Depth-Resolved Limnological Profiling and Integrated Social-Ecological Assessment for 800 MW Floating Solar in an ESA Rank 1 Tropical Forest Reserve Reservoir

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**Keywords:** *floating photovoltaic; thermal stratification; microplastics baseline; social impact assessment; tropical reservoir*

## Abstract:

Benjamins et al. (2024), reviewing 85 studies across all floating photovoltaic (FPV) environmental research, concluded that standardised ecological assessment protocols remain absent and that no existing study has applied depth-resolved multi-parameter profiling at any FPV installation. This gap is most acute in tropical forest reserve catchments where deep stratification, high biodiversity, and indigenous land-use histories converge.

This paper presents the environmental assessment methodology for the 800 MW Hybrid Hydro-Floating Solar project at Kenyir Reservoir in Terengganu, Malaysia, two orders of magnitude larger than any FPV site with published limnological data. The project spans 1,440 hectares of a 36,900-hectare reservoir within the Tembat Forest Reserve, classified as ESA Rank 1 under Malaysia's National Physical Plan and situated within the T-PL 1 wildlife corridor for Malayan tiger, Asian elephant, and Malayan tapir.

The methodology centres on 48-hour diurnal monitoring with vertical profiling at 1-metre intervals to 30 metres depth across littoral, limnetic, and control zones. Thermal profiling revealed a vertical differential of 5.02°C, exceeding the 2–3°C range in temperate studies, with the thermocline coinciding precisely with the oxycline. FPV shading would therefore affect only the well-oxygenated epilimnion while the hypoxic hypolimnion remains unaffected. Three additional contributions distinguish this work: microplastics baseline characterisation, the first globally for any FPV site; a Social Impact Assessment of 719 respondents documenting intergenerational displacement effects on renewable energy acceptance; and avian collision risk assessment along 9.87 km of transmission line traversing the wildlife corridor.

This is the first environmental assessment to integrate depth-resolved limnological profiling, microplastics characterisation, intergenerational social analysis, and wildlife corridor assessment within a single EIA framework for FPV. The methodology is transferable to over one million water bodies worldwide identified as suitable for floating solar.