# Modelling Nitrogen Removal in a Coupled HRP and Unplanted Horizontal Flow Subsurface Gravel Bed Constructed Wetland

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**Abstract**
A coupled model was developed that incorporates all the major nitrogen transformation mechanisms influencing nitrogen removal in aquatic systems. The model simulates nitrogen transformation and removal processes in the high rate pond (HRP) and the subsurface constructed wetland unit (SSCW). The model considered organic nitrogen (ON), ammonia nitrogen ($NH_3$-N), and nitrate nitrogen ($NO_3^-$-N) as the major forms of nitrogen involved in the transformation chains. The influencing transformation mechanisms considered in the model include uptake of inorganic nitrogen by algae and bacteria, mineralization, sedimentation, volatilisation of ammonia and nitrification coupled with denitrification processes.
The results showed that improved nitrogen removal occurred with increase in hydraulic time of the HRP unit. It was also revealed that the HRP can effectively be used to promote nitrification and subsurface flow gravel bed constructed wetland can be used as a denitrifying unit. The most efficient mechanisms were determined using a transformation model. The model indicated that nitrification and mineralization were dominant contributing 51.1% and 14.9%, respectively. Denitrification and mineralization were most significant in the SSCW accounting for 43.5% and 16.7%, respectively. Nitrification–denitrification route was observed to be the most significant mechanism for nitrogen removal in the coupled system with an overall contribution of 53%. The model predicted the overall nitrogen removal as 37% compared to 38.4% obtained from field measurements.

**Keywords**
Modelling;
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Mineralization