

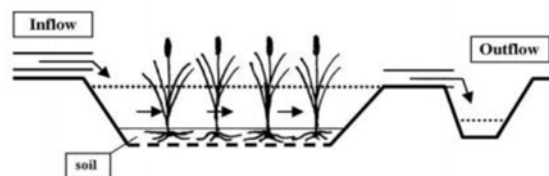


CONSTRUCTED WETLANDS - WATER TREATMENT

Constructed wetlands utilise natural processes which involve soil, vegetation, and microbes to treat water. Wastewater, stormwater or leachate flows either horizontally and/or vertically through a basin which contains wetland plants. Wetlands are well-known for the effective reduction of Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD), Phosphorus, Nitrogen, and Faecal Coliforms. They are considered simple and robust wastewater treatment systems, with lower overall maintenance, costs, and energy requirements than typical treatment. They also provide many additional benefits compared with conventional systems including the ability to accommodate fluctuating loads, provide habitat and aesthetic values, and provide additional options for water storage and reuse. Ecoteam designs vertical, horizontal and bioretention wetlands for stormwater, wastewater and all types of industries. Horizontal Wetlands can have either free water surface and/or subsurface flow.

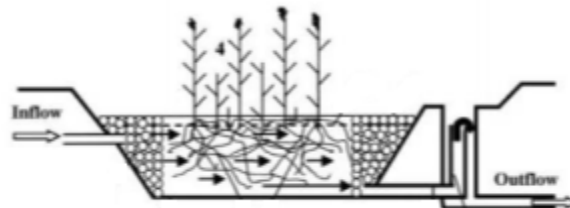
Free Water Surface Wetlands

Free Water Surface (FWS) wetlands are usually designed with a single sealed shallow basin or multiple basins in series, containing natural soil with a water depth of 200 mm to 400 mm. Emergent wetland vegetation is established in dense stands within the water column. FWS wetlands are commonly used for tertiary treatment of municipal wastewater, mine drainage water and stormwater treatment. These wetlands have the advantage of having lower construction and long-term maintenance costs; however, they require large areas for adequate treatment. They are typically designed with length to width ratios from 2:1 to 6:1, to achieve expected performance with reduced short-circuiting. FWS wetlands typically contain an aerobic layer at the surface and anaerobic conditions in the deeper substrate layer, which enhances the treatment processes. When managed correctly FWS wetlands support a wide diversity of aquatic animals in a well-balanced ecosystem which predated mosquito larvae.



Horizontal Subsurface Flow Wetlands

Horizontal Subsurface Flow Wetlands (HSSF) are typically densely-vegetated basins filled with a permeable substrate with water depths of up to 400 mm. Wastewater flows through the basin from the inlet and is filtered through plant roots before being discharged at the outlet. A range of materials can be used for a permeable substrate; however, gravel ranging from 5-20 mm is generally used as fine-pored media such as soil can cause clogging. HSSF wetlands maintain a water level below the substrate, which reduces odour, human contact and the breeding of mosquitoes. This makes HSSF constructed wetlands a popular wastewater treatment device for village scale wastewater treatment.





HORIZONTAL FLOW WETLAND WATER TREATMENT SYSTEMS CASE STUDIES

Cedar Grove FWS Wetland and Environment Center



The Cedar Grove Constructed Wetland is a 7.25 ha FWS wetland, in southeast Queensland approximately 18 km North of Beaudesert, within the Logan Shire Council area. It has been fully operational since 2020. Flow is split at the site into 3 wetlands operating in parallel with 2-3 cells in series (8 cells in total). The wetland is the first stage of a two staged wetland system designed to receive up to 3.3 ML or 20,000 EP from the Membrane Bioreactor (MBR) Wastewater Treatment Plant (WWTP) or 3.3 ML

by 2025. Because of its proximity within a drinking water catchment, the wetland was mandated by the Environmental Authority to operate under the strictest licence concentration discharge limits in Australia (Total Nitrogen <1 mg/L and Total Phosphorus <0.5 mg/L). Additionally, the wetland is required to capture and treat inflow from the Q200 24-hour rainfall event on the site as well as 6.5 times average dry weather flow volumes from the WWTP. During the initial three years of operation, the wetland has consistently conformed with its license discharge limits and a 1 in 200-year flood event in 2022.

The wetland forms part of the Cedar Grove Environment Centre which promotes sustainability and habitat restoration within the area. Surrounding the wetland 37,000 trees have been planted to restore habitat to the area and provide amenities to the local community. The project has an objective to achieve net environmental benefits.





Jubullum Hybrid Village Constructed Wetland

The Jubullum constructed wetland treats effluent from the Jubullum Aboriginal Community which is situated approximately 60 km west of Casino and 130 km west of Byron Bay in Northern NSW.



The Jubullum WWTP treats approximately 60 kL per day. Sewage is pre-treated by septic tanks from each household before entering an oxidation pond. The constructed wetland provided additional tertiary treatment following the oxidation pond before reuse within a citrus orchard. The constructed wetland consists of a 500 m² FWS wetland followed by a 300 m² HSSF wetland.

The hybrid system provides advanced treatment which utilises an aerated free water zone followed by a more anaerobic zone providing advanced BOD and TSS treatment. The wetland system can easily be maintained and provides aesthetic and habitat values to the local community.





West Byron FWS Wetland and Integrated Management Reserve

The West Byron FWS wetland is a 6 ha portion of a 40 ha Integrated Water Management Reserve, which treats water from the Byron Shire Council area in Northern NSW before release into Belongil Creek.



The wetland receives around 5 ML/day from an advanced activated sludge sewage treatment system. A portion of effluent is discharged into a 24 ha Melaleuca wetland which captures

nutrients and maintains the water table and therefore limits acid sulphate soil oxidation.

The wetland treatment system provides green space and habitat for the shire and offers a major carbon and environmental offset to the Byron Shire Council. The site is an important bird habitat area attracting over 200 species of birds. This has made the site a tourist attraction for bird watches.





Malabugilmah HSSF Village Constructed Wetland



Malabugilmah is an Aboriginal community located in the Clarence Valley in Northern New South Wales.

Seven HSSF constructed wetlands were built to treat village effluent for reuse onto a football field. The wetlands were designed and constructed to treat 36 kL/day of primary treated effluent to a secondary level TSS < 30 mg/L, BOD < 20 mg/L and achieve >50% Total Nitrogen reduction, no net Total Phosphorus export and $\geq 99.9\%$ Faecal Coliform (FC) reduction. The wetland cell configuration allowed the wetlands to be located on steeper terrain, enabling effluent to be treated to a secondary level without the use of pumps. In addition to the water quality targets the wetlands

were designed and constructed to satisfy environmental, economic and social needs of the community. The wetland systems were planted with a local Australian wetland tree, reed and rush species which have become well established.

The community was engaged at all stages of planning and design, with fourteen community members employed which received on-the-job training during construction.

Community members continue to be trained and employed to operate and maintain the sewerage treatment system.





Brisbane Airport Leachate Treatment Wetland

During construction of Brisbane Airports parallel runway, an opportunity was identified to produce topsoil for the new airfield from the vegetation cleared from the 360-hectare site. The cleared vegetation was mulched, blended with other topsoil from site and stored in stockpiles to allow the material to decompose into a nutrient rich topsoil product to aid in grass establishment for the new airfield.



Ecoteam was engaged to design a leachate management system to treat stormwater runoff from the mulch stockpiles, whilst the decomposition processes occurred over a 3-year period. The site experiences constraints with acid sulfate soils and tidal influences.

The stormwater treatment system designed for Brisbane Airport consists of a series of treatment swales and planted wetlands to ensure suspended solids and nutrients are captured and reduced to suitable levels for release to local sensitive waterways and Moreton Bay.

The system was designed using Water Sensitive Urban Design (WSUD) principles and MUSIC modelling. Monitoring conducted at the site concluded that the system is working effectively and exceeding treatment expectations.





Corindi Hybrid Stormwater Wetlands

The Corindi Stormwater wetland is located on the east-coast of Australia, close to Coffs Harbour. The wetland was designed to treat stormwater for a 50-lot subdivision. The design included a FWS macrophyte zones, melaleuca HSSF gravel beds, and an ecological cell, all integrated to protect a sensitive SEPP 14 Wetlands and estuary downstream.

Berms within the wetland allow for optimal flow hydraulics. The project included full community consultation.



The design allowed for enhanced nutrient reduction for the sensitive receive environment as well as habitat creation, green spaces and recreational areas for the local community.

