FREE WATER SURFACE TREATMENT WETLAND

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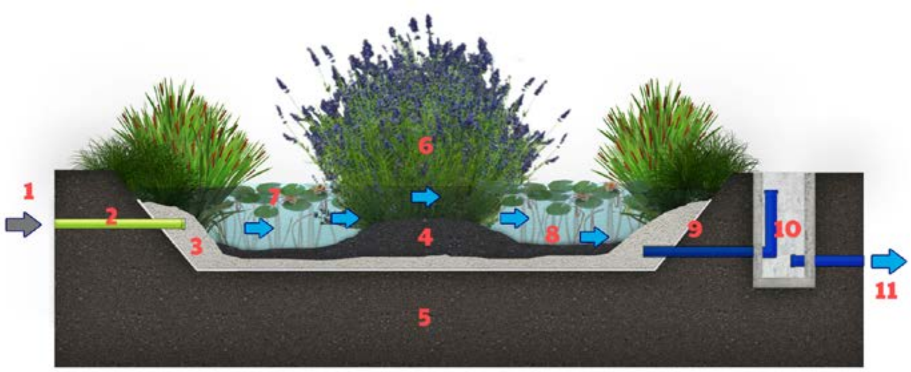

1 - Inlet
2 - Feeding system
3 - Porous media
4 - Rooting media
5 - Original soil
6 - Different water plants corresponding to different water levels
7 - Water level
8 - Deep zone
9 - Waterproof layer (liner or compact clay)
10 - Regulation manhole
11 - Outlet

Description

A free water surface (FWS) treatment wetland (TW) is most like a natural wetland and is characterized by a volume of water 0.5–1 meter deep. Various types of aquatic and wetland plant (floating, emergent, and submerged) can be used in combination with areas of open water. The structure of the various plants serves as physical substrate for biofilm while the plants themselves incorporate ammonia nitrogen and phosphorus. A significant portion of the plant biomass is in the rhizosphere. With plant senescence, detritus and litter are accumulated on the bottom, forming a mat on the surface, and affect the internal cycling of substances.

Advantages	Disadvantages
• Low energy usage possible (feeding by gravity) • Robust against load fluctuations • Operation in separate and combined sewer systems possible • Lower construction price than subsurface flow treatment wetlands	• Potential mosquito habitat • Seasonal treatment variability

Co-benefits

High	Biodiversity (flora)	Biodiversity (fauna)	Biomass production	Aesthetic value	Water reuse
Medium	Flood mitigation	Carbon sequestration	Recreation	Pollination	
Low	Temperature regulation				

Notes:

More details and additional co-benefits

- Water reuse: indirect domestic
- Agricultural and aquaculture reuse
- Environmental education
- Passive recreation
- Freshwater migrating waterfowl
- Groundwater recharge

Compatibilities with Other NBSs

FWS wetlands can be used after all other types of treatment wetland, waste stabilization pond, and lagoon. As a terminal process in water treatment they also serve as a public perception buffer of the role of natural systems.

Case Studies

In publication

- Free water surface treatment wetland in Arcata, California, USA
- Two free surface flow wetlands for post-tertiary treatment of wastewater in Sweden
- Free water surface system for tertiary treatment in Jesi, Italy

Other

- Blue Heron Reclamation and Wetland Area, Titus Ville, Florida, USA
- City of Arcata, California, USA
- Fernhill Wetlands, Oregon, USA
- Chain of Wetlands, Trinity River, Dallas, Texas, USA
- East Fork Wetland Project, John Bunker Wetland Center, Dallas, Texas, USA

Operation and Maintenance

Monthly

Only requirements are sampling and weir cleaning. Weir adjustment may be required in periods of maximum flows and/or rain if necessary

Yearly

- Selected vegetation removal and/or replanting
- Mosquito management
- Weir inspection

Extraordinary: troubleshooting

Vector outbreak

- Utilize integrated best management practices

The excess material has to be removed and, if needed, the wetland should be replanted in the case of the following:

- Accumulation of settled/flocculated total suspended solids
- Accumulation of detrital and senescent vegetation
- Weir head loss due to detritus and plant material

Literature

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Kadlac, R. (2009). Comparison of free surface wetlands and horizontal wetlands. Ecological Engineering, 35, 159-174.

NBS Technical Details

Type of influent

- Secondary treated wastewater
- Greywater

Treatment efficiency

• COD	41–90%
• BOD_5	~54%
• TN	30–80%
• NH_4-N	~73%
• TP	27–60%

Requirements

- Net area requirements 3–5 m^2 per capita
- Electrical needs: can be operated by gravity flow, otherwise energy for pumps required. Machine fuel is needed during the following:
- Vegetation management: 2–3 weeks/year
- Solids removal: every 10–15 years

Design criteria

- Use of P-k-C* approach for target pollutants (e.g. BOD_5, TN, TP)
  (see, for example, Kadlec and Wallace, 2009)
- For tertiary treatment a hydraulic retention time between 12 and 24 hours should be targeted
- Earth moving, aquatic vegetation planting, concrete forming, minor piping-hydraulic controls

Possible configurations

- Septic tank STEP followed by a series of FWS wetlands
- Oxidation ponds followed by a series of FWS wetlands
- Oxidation ditch/aerated lagoon followed by a series of FWS wetlands
- Multiple cells with variations in open water and vegetated areas; important in layout

Climatic conditions

- FWS treatment wetlands are found in most climate conditions (cold weather, desert, moderate rainfall, etc.)
- High rainfall conditions over 1,200 mm/year limitation

Literature

Kadlec, R. H. and Wallace, S. (2009). Treatment Wetlands. CRC Press, Boca Raton, Florida, USA.

Ynoussa, M., et al. (2017). HomeGlobal Water Pathogen Project. Part Four. Management of Risk from Excreta and Wastewater Sanitation System Technologies. Pathogen Reduction in Sewered System Technologies, UNESCO