# QUESTIONS AND ANSWERS ABOUT CONSTRUCTED WETLANDS

## *How do Constructed Wetlands work?*

$$\text{Organic Pollutants} + \text{Oxygen} \xrightarrow[\text{water, saturated soils, oxic and anoxic conditions}]{\text{microbes + plants}} CO_2 + H_2O + \text{Heat} + \text{Biomass}$$

## *What are the advantages of Constructed Wetlands?*

- **Low capital, operating and maintenance costs**
- **Effective on low strength pollutants (<100 PPM) such as from wastewater, animal containment facilities, stormwater, and other similar sources.**
- **Removes biological oxygen demand (BOD), suspended solids (TSS) very well. If so designed nutrient removal (nitrogen and phosphorus), as well as pathogenic bacteria and virus -- to tertiary quality.**
- **Degrades most all organic compounds to lesser or greater degrees**
- **Precipitates heavy metals into insoluble compounds**
- **Treats substances that we are *not* looking for as well those we are such as hormone disrupters**
- **Can provide a plethora of additional benefits such as wildlife habitat, public recreational opportunities, environmental education, and receiving water flow equalization or ground water recharge**

## *What are the disadvantages of Constructed Wetlands?*

- **Land intensive**
- **Highly toxic materials can have an adverse impact on wetlands activity**
- **Medium and high concentrations of pollutants require pretreatment**
- **Not capable of degrading all pollutants such as certain recalcitrant organic molecules and some salts**

## *How do Constructed Wetlands differ from natural wetlands?*

**Water flows are uncontrolled in natural wetlands. Channels often move up to 90% of the water, thus reducing contact time. Constructed wetlands are specifically designed to avoid short-circuiting and dead spots with little circulation so make better use of the available area. Oftentimes three or more wetland cells are linked in series so as to mix and remix the flows.**

## *What types of plants are used in Constructed Wetlands?*

**A wide variety of marshland plants are used depending up design purpose, water depth, and climate. The five most significant plant groups are cattails *Typha latifolia*, bulrushes *Scipus spp*., pondweeds *Potamogeton spp*, duckweed *Lemna minor,* and wetland grasses. Generally a few species native to the area are planted, and many others find their way in naturally.**

## *What is the optimum temperature for Constructed Wetlands?*

**It depends upon the pollutant, and wetland type. A wide range of temperatures can be effective, from well below freezing to tropical. While biological productivity is oftentimes higher in warmer waters, microbial abundance is still very high even under the ice of winter. In North America CW are found from semi-tropical Florida to the NW Territories.**

## *What can water emerging from a Constructed Wetland be used for?*

**Depending upon the design of the CW, most anything any other surface water can be used for, as the BOD and TSS present are wetland derived, not wastewater. All surface water must be assumed to contain microbes and other organisms associated with wildlife so requires further treatment before suitable for potable supplies. Ground water recharge, low flow augmentation of surface waters for the benefit of wildlife, irrigation, fish culture ponds or other aquatic life are a few of the uses thus far employed. Generally speaking, emergent vegetation keeps water temperatures about 4- 6°C cooler than open water would be during the summer and somewhat warmer during fall and spring. During winter less temperature variation is noted. Some are used for salmon culture.**

## *Do Constructed Wetlands work in subzero temperatures?*

**Yes, South Dakota has more free water surface Constructed Wetlands than any other political jurisdiction in North America. They work well despite very cold winter temperatures. The mechanisms of winter operation are not quite the same as summer. In near freezing water temperatures pollutants still adsorb into the biofilm surrounding plant parts, even though the above water plant portions are senescent and microbial activity is lower. As soon as temperatures become more favorable, microbial activity increases to the point of consuming the pollutants as usual. In below freezing temperatures CW act as a stripper, physically trapping**

**particles and molecules, again awaiting more suitable temperatures. Denitrification proceeds in anaerobic areas but nitrification may be slowed due to light limitation caused by ice cover and short day length. The evidence suggests they actually work better under a cover of ice to sequester nutrients than in more ice-free temperate climates.**

## *What pH does Constructed Wetlands require?*

**No definite limits established. The large quantities of organic material offer a buffering capacity from the carbonate-bicarbonate cycle. The discharge pH is typically at or near neutral - 6.5 - 7.5 irrespective of influent pH.**

## *Are there differing types of Constructed Wetlands?*

**Yes. Virtually all are unique depending upon objectives. Some (subsurface flow) are virtually horizontal-flow submerged trickling filters. The most effective type has been found to be free surface water CW. They have 60% or more of the surface area as water too deep for rooted emergent vegetation to thrive. An abundance of oxygen is typically found in the deep-water areas, especially near the surface. Nitrification occurs here, with denitrification occurring in anoxic zones of emergent vegetation.**

## *Can Constructed Wetlands remove heavy metals?*

**Yes. Particulate matter is quickly filtered out. Dissolved metals are removed as well. In the anaerobic areas, such as sediments and near the bottom in deeper water as well as in dense stands of vegetation microbes abound which reduce sulfate ($SO_4^{--}$) to hydrogen sulfide ($H_2S$). The reaction is:**

$$CH_3COOH + SO_4^{--} \rightarrow H_2S + 2\ HCO_3^-$$

**Many dissolved metals, including zinc, lead, copper, and several others react with sulfide to form highly insoluble compounds. Such compounds are retained permanently - and harmlessly - in the wetland sediments.**

## *What about mosquitoes?*

**Mosquitoes are typically found in still waters, usually temporary. A hollow tree trunk that retains rain water for a few days, a puddle, a discarded tire, an old paint can, a low spot in rain gutters on roofs are the most likely breading grounds of mosquitoes. The air breathing larval form are large, and poor swimmers.**

**Predacious insects such as dragon and damsel fly nymphs, as well as most any small fish without specialized mouthparts feed readily on mosquito larvae. With proper system design and operation mosquito populations can be controlled and managed to avoid problems.**