**Ecosystem Type: WETLANDS**

**Category: Clean and Plentiful Waters**

1. **Materials**

***Supplier*** – Wetlands supply water and oxygen for clean and plentiful waters. Wetland plants work as natural water budget regulators because of their ability to store and replenish water (Mikutta, and Rothwell, 2016; Gala, and Young, 2015; United States Geological Survey, 2013). In fact, in some locations wetlands have the ability to recharge groundwater at rates ranging from 0.03 to 1.1 centimeters per day (Gala and Young, 2015). Research has also found that wetland plants can release oxygen into water because these species can transfer oxygen from the atmosphere through their stems down to the roots (Zhan, Hu, Liang, and Fan, 2014). A steady supply of oxygen keeps the water clean because the presence of oxygen removes contaminants.

***Driver*** – no literature review available at this time

***Demander*** – no literature review available at this time

1. **Nutrition**

***Supplier*** –not applicable

***Driver*** -not applicable

***Demander*** - not applicable

1. **Energy**

***Supplier*** –not applicable

***Driver*** -not applicable

***Demander*** - not applicable

1. **Mediation of Waste, Toxics, and Other Nuisances**

***Supplier*** – Wetlands supply plant and animal species that filter wastes and adsorb pollutants to ensure clean and plentiful waters. The species available and its effectiveness depends on its location, such as whether it lives in a buffer versus living in an entire wetland ecosystem like an emergent herbaceous wetland (e.g., marshes, meadows). Terrestrial and aquatic wetland species can trap nutrients, salts and bacteria found in water (Qasaimeh, AlSharie, and Masoud, 2015; Westbrook, Brunet, Phillips, and Davies, 2011; Functions and Values of Wetlands, n.d.). Further, these species can remove metals from water through plant uptake or adsorption onto sediments (Qasaimeh, AlSharie, and Masoud, 2015; Functions and Values of Wetlands, n.d.). For example, duckweed, an aquatic plant, can remove uranium and arsenic from mine drainage and pharmaceuticals from wastewater (Ross, 2016).

***Driver*** – Land cover affects the ability of wetland plants and animals to filter and adsorb pollutants for clean and plentiful waters. Downstream loads of nutrients, salts and bacteria increase when humans alter wetlands for development purposes and agricultural purposes (Westbrook et al., 2011). Actions such as digging ditches to drain wetlands for agriculture decreases the capture of water provided by these ecosystems (Westbrook et al., 2011). Consequentially, the water will not have an opportunity to filter through the wetland to improve its quality.

***Demander*** – not applicable

1. **Mediation of Flows**

***Supplier*** – Wetlands supply terrestrial and aquatic species to control the flow of water and sediment loads for clean and plentiful waters. Wetlands are suppliers of water because they slow down the resource and in some cases, provide the baseline flow for surface and groundwater. Simultaneously, wetlands capture the sediment from the water that filters through its system. Sediment particles stay behind because the wetland slows the water down enough to allow the particle to settle. This improves the overall water quality of the river or stream that flows through the wetland.

***Driver*** – Transforming wetlands into agricultural and development lands decreases the ability for wetland species to control the flow of water and sediment loads. Actions such as digging ditches to drain wetlands for agriculture increases the downstream flow of water (Westbrook et al., 2011). Consequentially, the water that would have otherwise filtered through an upstream wetland misses an opportunity for particle settling. This results in lower water quality.

***Demander*** – no literature review available at this time

1. **Maintenance of Physical, Chemical, and Biological Indicators**

***Supplier*** – Wetlands supply terrestrial and aquatic species that filter water and trap nutrients, such as nitrogen, phosphorous, and dissolved organic carbon (Ross, 2016; Qasaimeh, AlSharie, and Masoud, 2015; Westbrook, Brunet, Phillips, and Davies, 2011; Functions and Values of Wetlands, n.d.). These nutrients decrease the health and quality of the water. With a wetlands help, studies find that water from sewage and swine can be treated naturally, improving the water quality (Dutta, Choudhary, and Mitra, 2017; Ross, 2016).

***Driver*** – Wetland functions change when land use changes around them. These functions include their ability to improve water quality through the maintenance of chemical and biological conditions of a water body. For example, one study found that drainage ditches affected the water levels of depressional wetlands (e.g., prairie potholes) by increasing the volume of water flowing into the ecosystem. Depressional wetlands are ecosystems where surface water accumulates (United States Environmental Protection Agency, 2002). When the water levels get too high in these type of wetlands, the ability for the wetland to fix nutrients from the water into the soil is impaired. These wetlands depend on a fluctuating hydrology to transform nutrients that can improve the water quality (McCauley, L.A. et al., 2015).

***Demander*** – not applicable

1. **Spiritual, Symbolic, Religious, and Social Experiences**

***Supplier*** – Wetlands supply clean and plentiful waters for cultural and social experiences. Aboriginal cultures connect to water because they use it in many roles, such as healing and sustenance activities (Pritchard, 2011). These activities include fishing, hunting, gathering, and spiritual practices, which all rely on the presence of water (Pritchard, 2011). Other communities connect their legends to water and build their lives around these resources. Not only do wetlands play a part in providing water for these communities, they improve the overall quality of the water used during these activities (Dutta, Choudhary, and Mitra, 2017; Ross, 2016; Mikutta, and Rothwell, 2016; Gala, and Young, 2015; Qasaimeh, AlSharie, and Masoud, 2015; United States Geological Survey, 2013; Westbrook, Brunet, Phillips, and Davies, 2011; Functions and Values of Wetlands, n.d.).

***Driver*** – Land use changes affect the way that wetlands can provide clean and plentiful waters for cultural and social experiences. Draining wetlands, adding nutrients, and developing on top of these ecosystems changes the way that wetland plants and animals can remove nutrients, metals, and other toxics from water that flow through them (Dutta, Choudhary, and Mitra, 2017; Ross, 2016; Mikutta, and Rothwell, 2016; Gala, and Young, 2015; Qasaimeh, AlSharie, and Masoud, 2015; Westbrook, Brunet, Phillips, and Davies, 2011; Functions and Values of Wetlands, n.d.).

***Demander*** – not applicable

1. **Physical and Intellectual Interactions w/ Biota, Ecosystems, and Land/Seascapes**

***Supplier*** – not applicable

***Driver*** -not applicable

***Demander*** - not applicable

**Sources:**

Anthonj, C., Rechenburg, A., Kistemann, T. (2016). Water, sanitation and hygiene in wetlands. A case study from the Ewaso Naroke Swamp, Kenya. *International Journal of Hygiene and Environmental Health, 219*(7 Part A), 606-616. <https://doi.org/10.1016/j.ijheh.2016.06.006>.

Dutta, J., Choudhary, G.R., Mitra, A. (2017). Bioaccumulation of Toxic Heavy Metals in the Edible Fishes of Eastern Kolkata Wetlands (EKW), the Designated Ramsar Site of West Bengal, India. *International Journal of Aquaculture and Fishery Sciences, 3*(1), 018-021. doi: 10.17352/2455-8400.000023.

Functions and Values of Wetlands. (n.d.). Retrieved from <http://www.ecy.wa.gov/programs/sea/wetlands/functions.html>.

Gala, T. S., & Young, D. (2015). Geographically Isolated Depressional Wetlands – Hydrodynamics, Ecosystem Functions and Conditions. *Applied Ecology and Environmental Sciences, 3*(4), 108-116. doi: 10.12691/aees-3-4-3.

McCauley, L.A., Anteau, M.J., van der Burg, M.P., Wiltermuth, M.T. (2015). Land use and wetland drainage affect water levels and dynamics of remaining wetlands. *Ecosphere, 6*(6), 1-22. doi: 10.1890/ES14-00494.1.

Mikutta, C., Rothwell, J.J. (2016). Peat Bogs as Hotspots for Organoarsenical Formation and Persistence. *Environmental Science & Technology, 50*(8), 4314-4323. doi: 10.1021/acs.est.5b06182.

Pritchard, G. (2011). *Aboriginal Peoples, Water, and Health & Well-Being.* (thesis) Dalhousie University, Halifax, Nova Scotia.

Qasaimeh, A., AlSharie, H., Masoud, T. (2015). A Review on Constructed Wetlands Components and Heavy Metal Removal from Wastewater. *Journal of Environmental Protection, 6*(7), 710-718. doi: 10.4236/jep.2015.67064.

Ross, A. (2016). Wetland Plant Series: Common Duckweed. Retrieved from <http://phinizycenter.org/wetland-plant-series-common-duckweed/>.

United States Environmental Protection Agency. (2002). *Methods for Evaluating Wetland Condition. #7 Wetlands Classification* (EPA-822-R-02-017). Washington, DCD: United States. EPA.

United States Geological Survey. (2013). *Evapotranspiration from Wetland and Open-Water Sites at Upper Klamath Lake, Oregon, 2008-2010.* (USGS Publication No. 2013-5014). Washington, DC: U.S. Government Printing Office.

Westbrook, C.J., Brunet, N., Phillips, I., Davies, J.M. (2011). *Wetland Drainage Effects on Prairie Water Quality Final Report* (Report No. 9). Saskatoon, SK: Saskatchewan Watershed Authority and Centre for Hydrology, University of Saskatchewan.

Zhang, J., Hu, Z., Liang, S., Fan, J. (2014). Examination of oxygen release from plants in constructed wetlands in different stages of wetland plant life cycle. *Environmental Science and Pollution Research, 21*(16), 9709-9716. doi: 10.1007/s11356-014-2905-9