

## Constructed Wetlands for the Remediation of Contaminated Waters

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### **ABSTRACT**

Constructed wetlands have become popular options for the treatment of domestic wastewater, agricultural wastewaters and stormwater. They represent sustainable, low maintenance and low cost alternatives for the removal of sediment and nutrients from the waste stream. With proper consideration for ecological and hydrological factors, these systems are also able to remediate a wide range of waters impacted with recalcitrant contaminants. Constructed wetlands utilize ecologically engineered systems that take advantage of natural processes to transform, degrade and/or attenuate many different types of contaminants. These contaminants include petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs) and heavy metals. Wetlands can be constructed to meet almost any scale of impairment and are flexible in their construction to accommodate a variety of applications from urban to rural to industrial.

Constructed wetlands are currently being used as a sustainable option for contaminated groundwater treatment across North America. Utilization of a constructed wetland for groundwater remediation, like any groundwater remedial system, is a technology with specific applications. However, in situations where a conventional groundwater pump and treat or other conventional treatment system could be used, a constructed wetland can typically replace most remedial functions often at lower net life-cycle cost and at a much lower O&M cost. Due to the body of evidence, treatment wetlands have become widely accepted by the public, regulators and some legislators. A major benefit to constructed wetlands is that they may be integrated as a functional landscape feature providing social and wildlife benefits.

Constructed wetland systems are scaleable to meet the demands of many sources of environmental impairment, they can be modular to address multiple contaminants through multiple processes, and they can be constructed as surface or subsurface flow, horizontal and/or vertical flow systems to meet site space availability. Functioning constructed treatment wetlands have been integrated into park areas, golf courses, residential communities and natural landscapes and with proper design considerations they have the potential to remain in place as wetland habitat long after site closure. Projects undertaken by CH2M HILL highlighted in the presentation include constructed

wetlands treating: landfill leachates in Indiana and Alaska; landfill stormwater runoff in Calgary; de-icing fluid runoff at an airport in Washington D.C. and the integration of a constructed wetland into the remedial design of a groundwater treatment system at a Superfund site in Oakland, California. Contaminants addressed within these and other projects include VOCs, PCBs, heavy metals, ethylene glycol and various nutrients. Implementation of a constructed wetland project requires a comprehensive understanding of site water quality, hydrogeology, hydrology, climate and regulatory discharge requirements.

## **SHORT BIOGRAPHY**

**Chad Brassard** is an Environmental Scientist with CH2M HILL Canada Ltd. He has more than 8 years experience conducting research and consulting in the arenas of agriculture and the environment. Mr. Brassard obtained his Bachelor of Science and Master of Science Degrees in Agro-Environmental Science from Dalhousie University in Halifax, NS. His areas of expertise include site assessment and remediation, bio/phytoremediation, wastewater management and treatment and constructed wetland systems.

**Robert Tossell** is a Principal Technologist at CH2M HILL with expertise in the development of strategies for site remediation including solvent bioremediation, phytoremediation, treatment wetland design, biotreatment technology development, and in situ remediation technology design and evaluation. He has experience with management of site contaminated with hydrocarbons (production refinery), chlorinated solvents, metals (chromium and arsenic) and perchlorate. Mr. Tossell was a past co-chair of the RTDF, Phytoremediation of Chlorinated Solvents Workgroup which is a consortium of partners from industry, government, and academia who coordinate research and development of innovative remediation/restoration technologies.