Effective Management of a Recalcitrant Petroleum Hydrocarbon-Impacted Site by Phytoremediation

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Background/Objectives. Prior to its decommissioning in 1992, the former bulk petroleum plant located in a rural town in Manitoba, Canada consisted of five aboveground storage tanks with a typical loading rack, an oil shed, and two horizontal aboveground storage tanks (ASTs). Site investigations completed in the 1990s identified petroleum hydrocarbons (PHCs) exceeding Canadian Council of Ministers of the Environment guidelines. Following regulatory approval in 2012, a Phytoremediation Research Project was proposed. The purpose of the project was to evaluate the effectiveness of phytoremediation as a sustainable method to remediate former recalcitrant PHC impacted bulk plant sites. The findings of this study was used to evaluate phytoremediation as a sustainable remedial option at similar low value, low risk rural sites. The anticipated timeframe for this ongoing research program will be evaluated over a ten-year period, starting from the tree planting in 2012, as the full effectiveness of the phytoremediation program will increase as the trees mature and become established at the site. The remedial and hydraulic control effects of the trees will improve with time, and the anticipated lifespan of the selected poplar and willow varieties exceeds 50 years. This presentation reports the initiation of the project and the project status after a period of four years.

Approach/Activities. As part of the program, a number of research initiatives were implemented to assist in improving similar programs in future. The research initiatives included: 1) Soil mixing, 2) the use of a microbial root growth supplement, and 3) evaluation of cotoneasters as the preferred tree species. Soil mixing was completed to improve the subsurface conditions (namely distribution and addition of nitrogen fertilizer, oxygen and native microbial populations in low permeability soils), the reduction of concentrated PHC areas, and the removal of highly compacted surficial soils. These parameters are known to have a limiting effect on vegetation growth at other locations where phytoremediation was attempted. Trees were planted approximately 2.2 m apart. Myke® tree and shrub mycorrhizae, was used on approximately half the trees planted. While more typical poplar and willow species are commonly used for this phytoremedation practice, they pose a potential growth height issue in areas with overhead lines. The use of cotoneasters is not known to be documented in scientific literature for this specific use and their growth height may be effective in this situation. Seventeen of the 476 trees planted, were selected at random as representatives to assess the health of the trees and a monitoring well network was installed.

Results/Lessons Learned. The Myke® treated trees appeared to be in good health while the condition of the control trees was varied. While a few of the trees have died, the remaining poplars trees were in fair or good health with heights exceeding 5 m (in comparison to initial planting average of 1.6 m) and breast height diameters at approximately seven times the planting diameters. The sample willows were generally in good condition with heights at least double from original planting and breast height diameters three times the planting diameters. There appeared to be no appreciable growth of the cotoneaster representative trees. In addition to tree growth, the presence of a light non-aqueous phase product sheen was not detectable after four years and the concentrations of PHCs, namely BTEX compounds have decreased substantially by a factor of two to five. Groundwater elevation measurements

indicate the increasing depth to groundwater which supports the trees' increased water demand and an apparent draw down affect at the site.