August 30th, 2012

Mackenzie Valley Environmental Impact Review Board
#200 Scotia Centre
5102 – 50 Avenue
Yellowknife, NWT
X1A 2N7
Via email to: chubert@reviewboard.ca

**Re: Submission of Additional Information on Constructed Wetlands Treatment Systems (CWTS)**

Further to the request of Board Member James Wah-shee during the course of the public hearing Wednesday August 29th, please find attached a list of mines that have used constructed wetlands to treat constituents of concern (COCs).

CWTS have been used for many decades to treat effluents and seepage from mines around the world. Hundreds of human made wetlands have been used to treat mine waste waters for many years (MPERG Report 2010-4; Evaluation of the Effectiveness of Biological Treatment of Mine Waters by Laberge Environmental Services, [http://ygsftp.gov.yk.ca/publications/mperg/2010/MPERG2010-4.pdf](http://ygsftp.gov.yk.ca/publications/mperg/2010/MPERG2010-4.pdf)). This includes mining operations in North America and in cold climates. Some selected examples, along with references are provided in Table 1 (attached). Examples of scientific review articles and manuscripts discussing constructed wetlands for treatment of mine-related waters are provided below. Studies have also indicated that CWTS operate long-term and show improved function over time (example, Yang et al 2006, [http://www.ncbi.nlm.nih.gov/pubmed/16469422](http://www.ncbi.nlm.nih.gov/pubmed/16469422)).

FML has retained Contango Strategies Ltd and its partners to develop a plan for construction of a CWTS for demonstration and commissioning during operation at the NICO mine to be ready for implementation on closure. This is sufficiently early in the process to give us confidence in the ability to successfully design, test, and commission the system prior to closure. The design process for the greenhouse trials has already commenced.

We would like to stress that the function and design of the CWTS is not related to the activity generating the COC. It is the COC, its concentration, volume, and the water quality parameters that factor into the design and construction of a CWTS to remove particular COCs. The design of CWTS is not industry-specific, but contaminant and water parameter specific. Therefore, knowledge and experience in treatment of other types of produced waters can be applied to designing CWTS across industries if the contaminant in the water is the same. The contaminants and water parameters predicted for the co-disposal facility’s (CDF’s) post-closure seepage water quality are within the ranges of waters that have been effectively treated using CWTS. Selected examples of our group’s experience in designing and implementing CWTS are provided in Table 2 (attached).
Sincerely,

Contango Strategies Limited (in partnership with NPS/DUC, and Drs. Rodgers and Castle)

Monique Haakensen, PhD, PBiol
President and Principal Scientist

Additional examples of scientific review articles and manuscripts discussing constructed wetlands for treatment of mine-related waters.


Vesper, D.J. and Smilley, M.J. 2010 Attenuation and diel cycling of coal-mine drainage constituents in a passive treatment wetland: A case study from Lambert Run, West Virginia, USA. Applied Geochemistry, 25: 795-808.


Table 1: Examples of Constructed Wetlands

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Location</th>
<th>Treating for</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almonaster la Real</td>
<td>Monte Romero abandoned mine complex, southwestern Spain</td>
<td>Fe, Al, Cu Pb, As, ZN</td>
<td>Macías, F., Caraballo, M.A., Nieto, J.M., Rötting, T.S., Ayora, C. Natural pretreatment and passive remediation of highly polluted acid mine drainage. Journal of Environmental Management 104, pp. 93-100</td>
</tr>
<tr>
<td>Site Name</td>
<td>Location</td>
<td>Treating for</td>
<td>Reference</td>
</tr>
<tr>
<td>-----------------------------------</td>
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</tr>
<tr>
<td>Key Lake</td>
<td>Saskatchewan, Canada</td>
<td>As, Se, other</td>
<td>Personal communication</td>
</tr>
<tr>
<td>Unnamed uranium mines</td>
<td>Saskatchewan, Canada</td>
<td>multiple</td>
<td>Personal communication, natural and human assisted wetlands</td>
</tr>
</tbody>
</table>
Table 2: Examples of prior experience with design and implementation CWTS (Dr. John Rodgers)

<table>
<thead>
<tr>
<th>CWTS Owner</th>
<th>Location</th>
<th>Water Treated and Targeted Constituents</th>
<th>Scale (Full – Pilot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Paper</td>
<td>Tichonderoga, NY</td>
<td>Pulp Mill Wastewater (BOD, chlorinated organics, COD, etc.)</td>
<td>Pilot and Full</td>
</tr>
<tr>
<td>US Air Force</td>
<td>Anchorage, AK</td>
<td>Munitions wastewater</td>
<td>Pilot and Full</td>
</tr>
<tr>
<td>DOE/Produced Water Project; Diamond V Project</td>
<td>Clemson, SC</td>
<td>Simulated Produced Water; Energy derived water</td>
<td>Pilot</td>
</tr>
<tr>
<td>DOE / Chevron</td>
<td>Near Berry, AL</td>
<td>Coal Bed Methane Produced Water (Se, organics,</td>
<td>Pilot / Demonstration</td>
</tr>
<tr>
<td>DOE/ Savannah River Site</td>
<td>New Ellenton, SC</td>
<td>Process Water and Industrial Runoff (Cu, Hg, organics)</td>
<td>Pilot and Full</td>
</tr>
<tr>
<td>Duke Energy</td>
<td>Mooresville, NC</td>
<td>Flue gas desulfurization water (metals, organics)</td>
<td>Pilot and Full</td>
</tr>
<tr>
<td>Progress Energy</td>
<td>Asheville, NC</td>
<td>Flue gas desulfurization water (metals, organics)</td>
<td>Pilot and Full</td>
</tr>
<tr>
<td>Shell</td>
<td>Norco, LA</td>
<td>Refinery wastewater (organics, naphthenic acids, metals)</td>
<td>Pilot and Full</td>
</tr>
<tr>
<td>Chevron</td>
<td>Richmond, CA</td>
<td>Refinery wastewater</td>
<td>Pilot</td>
</tr>
<tr>
<td>Chevron</td>
<td>KS</td>
<td>Refinery wastewater</td>
<td>Pilot and Full</td>
</tr>
<tr>
<td>Chevron, Petronas, Exxon</td>
<td>Kome Field, Chad, Africa</td>
<td>Oil field Produced Water</td>
<td>Pilot</td>
</tr>
<tr>
<td>DOE</td>
<td>WV</td>
<td>Natural gas storage produced water</td>
<td>Pilot and Full (Demonstration)</td>
</tr>
<tr>
<td>DOE</td>
<td>SC</td>
<td>Fresh Oilfield Produced Water</td>
<td>Pilot</td>
</tr>
<tr>
<td>International Paper</td>
<td>Mansfield, LA</td>
<td>Pulp and Paper Mill Wastewater</td>
<td>Pilot and Full</td>
</tr>
<tr>
<td>Solutia, Inc.</td>
<td>Columbia, TN</td>
<td>Munitions and Industrial Wastewater</td>
<td>Pilot and Full</td>
</tr>
</tbody>
</table>