

# Constructed Wetlands for Hydrocarbon Removal

## Project Update

Evaluate a man-made wetland as a cost-effective alternative to mechanical treatment for cleaning-up petroleum-contaminated water

ERAC - Environmental Research Advisory Council

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### What is the purpose of this project?

This project is based on the observed success of natural wetlands at reducing the mobility and concentration of petroleum hydrocarbon contamination. The question was then proposed – can a constructed, or engineered, wetland work in a similar fashion to treat hydrocarbon contaminated groundwater? If so, is it economical?

Mechanical treatment typically involves pumping petroleum-contaminated groundwater from extraction wells and then running it through an air stripper to remove the hydrocarbons. This stripping method can be expensive to operate and may require considerable maintenance because of iron and carbonate

build up. Finding an affordable alternative for treating the contaminated water is important because there is considerable groundwater contamination associated with oil and gas operations in Alberta. This is particularly true at older sites that must be properly cleaned up before they can be decommissioned. Typically the contaminants of concern are condensate (natural gas liquids), which migrate further and faster through groundwater than more viscous substances like crude oil.

Under this project, a pilot-scale constructed wetland has been operating since 1997 at Conoco Canada's Strachan Gas Plant, near Rocky Mountain House. In building and operating an artificial wetland, project researchers from Komex International sought to answer specific questions such as:

- What rates of contaminated water could the constructed wetland handle and to what extent would hydrocarbons biodegrade?
- How effective would planted vegetation, versus gravel, be at removing hydrocarbons?
- How well would the system work under summer and winter conditions?



*Constructed wetland research site*

### How was the project conducted?

The Strachan constructed wetland is a double-lined cell (50 metres long, 17 metres wide and 0.6 metres deep) filled with gravel and planted with reed grass and cattails; numerous other plant species have since grown in. Hydrocarbon-contaminated groundwater is pumped from recovery wells into this wetland and contamination removed through natural processes, principally volatilisation (evaporation) and biodegradation. During winter, the wetland subsurface was aerated to prevent freezing and increase the mass removal of hydrocarbons through evaporation.

The project has more recently focused on the effectiveness of the wetland's plants in removing hydrocarbons. Because a consistent assessment is difficult to achieve in wide-ranging field conditions, laboratory experiments at Utah State University were begun in 2000 to evaluate various plant-related processes.

ERAC was founded in the mid-1970s by the Canadian Association of Petroleum Producers (CAPP) to initiate research and technology development on environmental issues relating to the production of crude oil and natural gas in western Canada. In the past five years, direct and in-kind contributions to ERAC from CAPP, individual member companies, the Small Explorers and Producers Association of Canada (SEPAC), federal and provincial governments, academic institutions, and research groups have totaled over \$6 million.

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## What are the results?

The first two years of the project showed hydrocarbon removal was 100 per cent in summer and in winter, the latter with subsurface aeration. In spring and late fall, without aeration, treatment efficiency fell to 50 per cent, although the remaining hydrocarbons were removed by natural processes along the outflow channel. Further evaluation confirmed that oxygen needed to be added to the water before it entered the wetland to stimulate biodegradation processes.

Within the wetland, hydrocarbon removal was achieved mainly through volatilisation and to a lesser extent through biodegradation and dilution.

In the project's first two years, the plants were slow to establish strong roots and thus their ability to remove hydrocarbons had not been fully tested.

The 2001 fieldwork showed that even when they were better established, the plants did not uptake a significant amount of hydrocarbon compounds such as benzene, toluene and xylene. Thus the cost of establishing and maintaining plants in a constructed wetland may not be necessary, given that other natural processes are still removing the contaminants.

Overall, the project's preliminary indication is that an engineered wetland treatment system would have a similar capital cost but lower ongoing operating costs than conventional cleanup methods.

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## What happens next?

Since its 1997 start up, the constructed wetland has been effectively treating some 50 per cent of the Strachan site's extracted groundwater. In 2002, the project will go to full-scale treatment, run and funded by Keyspan Energy. To help treat all the water flowing through the wetland, baffles will be added to help mix lower, oxygen-less water with shallower, oxygen-rich water to stimulate biodegradation.

### Project Funding and In-Kind Support

This \$550,000 project has been funded by Gulf Canada Resources, Keyspan Energy Canada and Environment Canada, with in-kind funding from Komex International and Utah State University.

More information on ERAC is available on CAPP's web site: [www.capp.ca](http://www.capp.ca) (bookstore). To order the above materials, ERAC project updates, or technical reports, call the Petroleum Technology Alliance Canada (PTAC) at (403) 218-7703 or visit <http://www.ptac.org/techenvp.html>



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