To the Editor:

This is an article from a series of monthly columns by Environmental Law Specialist Dianne Saxe, one of the top 25 environmental lawyers in the world. These articles are available for publishing at no charge, provided Dr. Saxe and Jackie Campbell are cited as the authors. Dr. Saxe can be contacted at (416) 962 5882 or admin@envirolaw.com. For more information, visit http://envirolaw.com.

Using Plants to Clean Contaminated Sites

There are an estimated 30,000 contaminated sites in Canada. These include properties like former gas stations, factories, or rail yards that are contaminated by heavy metals, organic compounds, or other toxins. Redevelopment of these sites, which are often found in prime downtown areas, is important to provincial and local governments.

Traditional remediation includes removal of contaminated soil or treatment with chemicals. These options have been criticized for several reasons, such as their high cost and destructiveness to sites. Plant-based remediation (phytoremediation) is a relatively inexpensive, low-tech approach that may lead to at least partial decontamination and restoration of contaminated sites. It takes advantage of the natural abilities of some plants to remove contaminants from the environment.

Plant roots absorb contaminants into their leaves, branches and/or stems, which are then harvested and removed, for destruction (usually incineration). The roots may also capture and prevent migration of soil contaminants. Plants may break down organic contaminants like petroleum products into less toxic compounds.

Phytoremediation works best on large sites where contaminants are located at a relatively shallow depth and at low concentrations. Several growing seasons may be needed to clean up a site. The technology is not suitable for some sites, such as those that are highly contaminated with metals, which may take decades to clean up.

Among the most critical considerations in selecting a plant species to use in phytoremediation are the following:

Does it work? Plants that are suited to remediation take up toxins into their leaves, stems and roots. A recent study of poplar and willow species that had been irrigated with leachate from landfill showed that selecting the right plant for a site is not a simple process. Poplars had better update of phosphorus, potassium, sulfur, copper and chloride, while willows absorbed more zinc, boron, iron and aluminum. Willow leaves had higher calcium and magnesium concentrations, as did poplar stems and roots. Poplar leaves and willow roots had higher manganese and sodium levels.

Typically, plant species are first tested at the remediation site. For example, an ongoing Chicago-area phytoremediation project began with testing of native trees, including black willow, to determine effectiveness in taking up metals and organic compounds from soil and groundwater.

Can it survive? Plants must be able to accumulate and tolerate contaminants, to adapt to the climate at the site, and be easy to maintain. They also have to tolerate stressors like pests and diseases, road salt or vehicle exhaust.

Effect on the ecosystem. Non-native plant species could thrive and ultimately threaten the local ecosystem if they escape from the remediation site.

Willows, which grow quickly and are known for their deep roots and ability to absorb large volumes of water, are among the most common tree species used. They remove a variety of organic and inorganic contaminants, as well as herbicides, pesticides and radionuclides. In Sweden, large-scale willow plantings are used to treat municipal wastewater, landfill leachate, and sewage sludge. Willow roots prevent spread of contaminated water, and the willow can be pruned back hard, yielding a significant amount of (contaminated) plant matter for disposal.

There are several drawbacks to phytoremediation. Some plants accumulate only certain elements, so the technology may not be applicable to sites where there are mixed contaminants. As well, with many plant species, there is simply not enough information available to conduct appropriate risk assessments.

There are many unknowns about the technology. For example, what is the risk to animals that eat contaminated plant materials? In some cases, plants may concentrate toxins, or convert contaminants into more toxic by-products. Are there health consequences when plants give off vapours that contain high concentrations of volatile substances? What about toxins in wood and leaves that are used for firewood or mulch?

These concerns and other practical considerations, such as whether the technology can achieve adequate site cleanup, how to monitor it, and even how to categorize the plant waste resulting from cleanup in order that it can be properly disposed of, make phytoremediation complex to regulate. As yet, standards have not been developed, and it is not clear how phytoremediation fits into the environmental regulatory framework.

On the other hand, phytoremediation may produce plant residues rich in metals that can be recycled. The vegetation reduces erosion by wind and water, and as ground cover, may decrease community exposure to certain contaminants, like lead. The plant residue that results from the process is much lighter and takes up significantly less space in landfills than does waste from other remediation methods, like excavated soils. The presence of trees and plants in an otherwise desolate landscape makes the sites more appealing and public acceptance has been high.

We are only just starting to understand how plants work to bring toxic sites back to life, and return the environment to its natural state.