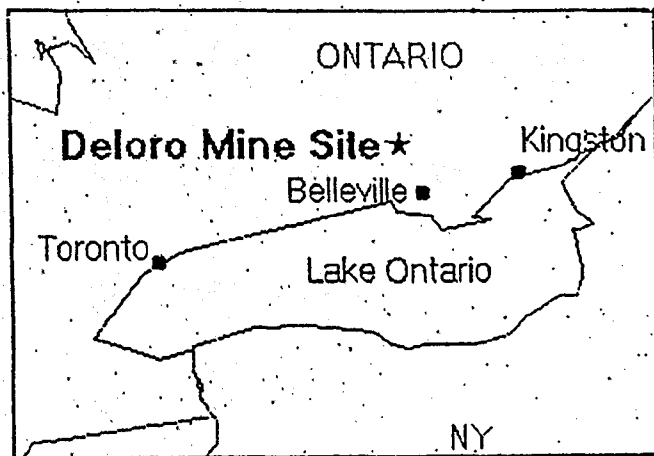


# Deloro Mine Site Rehabilitation *Background*

The Deloro mine site is located on the Moira River in Hastings County, about eight kilometres east of Marmora. Situated where the Canadian Shield intersects the Great Lakes Lowlands, the area is rich in mineral deposits.



## The Mining and Refining Years

Mining and refining began at the Deloro site in the 1860s and continued until 1961. Historical records show that gold was discovered at nearby Eldorado in 1866 and at Deloro sometime before 1871. Several mining operations extracted gold-bearing ore in the early years, and by 1871 about 25 shallow shafts had been sunk at the Deloro site. The high arsenic content of the ores made the recovery of gold difficult and hazardous, but a series of technical developments in mineral processing made it possible.

The gold mines closed in the early 1900s and the site, with its smelter was used to process arsenic-bearing silver and cobalt ores from mines at Cobalt and GowGanda in Northern Ontario.

Deloro boasted the first plant in the world to produce cobalt commercially, and was also a leading producer of stellite, a cobalt-chromium-tungsten alloy highly valued during the war years. Ores from all over the world, including Northern Rhodesia, Morocco and the Belgian Congo were processed at Deloro during the life of the smelting operations.

In the 1930s, 1940s and 1950s, concentrates were brought from Eldorado Nuclear Limited in Port Hope for further refinement.

Arsenic-based pesticides were produced from the arsenic by-products of the smelting operations, and continued as a main activity at the site until the market gave way to organic pesticides in the late 1950s.



## Safety and Environmental Hazards

A century of handling of hazardous materials and chemicals has left the Deloro site with massive safety and environmental problems. Large quantities of refining slag, mine tailings, calcium arsenite, and arsenical pesticides remained at the site. Fuels, chemicals and raw materials such as sulphuric acid, coke, lime, soda ash, caustic soda, liquid chlorine, salt, scrap iron, sodium chlorate and fuel oil were handled and deposited. Radioactive material brought from Eldorado Nuclear remained as radioactive slag spread over areas of the site.

## Government Involvement

In the early 1960s the Ontario government began monitoring arsenic levels in the Moira River. In 1978 the Ministry of Environment ordered the site owner, Erickson Construction Company Limited, to take steps to control the discharge of arsenic to the river. The company failed to comply with the Order issued under the Environmental Protection Act, and in 1978 declared a lack of operating funds. In 1979 the Ministry took over control of the abandoned site and the existing arsenic treatment plant.

## Rehabilitation Activities

### *Arsenic Treatment and Monitoring*

In 1982 the Ministry renovated the former research laboratory building on the site and constructed a new arsenic treatment plant. Early 1983 saw the start-up of the plant, which collects, stores, and treats arsenic-contaminated groundwater. Groundwater, including water diverted by an 80 metre long dike along the Moira River, is pumped from six pumping stations to a storage basin. The arsenic concentrations, which can range from 50 mg. per litre to 1500 mg. per litre, are equalized in the storage basin for more efficient treatment.

An iron/lime treatment process, which uses ferric chloride, lime and a polyelectrolyte, is used to treat the collected groundwater. Sludge from the process is dried in an underdrained lagoon and the treated effluent, with 99.5 to 99.9% of the arsenic removed, is returned to the Moira River.

Over 2,000 tonnes of sludge have been removed from the site in the past four years for disposal at hazardous waste landfill sites in Lambton County, Ontario and Blainville, Quebec.

An extensive program is in place to monitor surface and groundwater at the Deloro site. The program includes the monitoring of the treatment plant influent and effluent and the groundwater pumping stations. Two monitoring networks on the Moira River and Young's Creek provide information on surface water quality, and a series of monitoring wells is used to assess groundwater quality.

Sampling frequencies for arsenic and other heavy metals range from hourly at one of the surface water samplers, to monthly sampling of the groundwater under the site.

Although arsenic concentrations and loadings vary with the levels of flow in the Moira River, the ongoing monitoring shows that arsenic loadings and arsenic concentrations in the river have been substantially reduced. To illustrate, the average daily loading of arsenic in 1979 was 51.2 kg. per day, compared to 3.7 kg. per day in 1994. Similarly, the average annual arsenic concentrations dropped from 0.33 mg. per litre in 1979 to 0.03 mg. per litre in 1994.

### *Other Remediation*

In 1987, eight hectares of ferric hydroxide tailings (red mud) on the east side of the Moira River were covered with crushed limestone to prevent wind erosion and dust, to raise the pH level of the tailings, and to stabilize the containment dams.

Other measures undertaken to address on-site contaminants and safety hazards include the clean-up of contamination sources such as the pesticides building and the arsenic baghouse; the demolition of unsafe structures; and the removal of waste oil and pesticides.

## *Mine Closure Activities*

The abandoned mine workings, from the period of 1866 to 1904, remained as an ongoing threat to public and worker safety and restricted further environmental work at the site.

In May 1992 an engineering plan to address mine hazards at the Deloro site was developed with the Ontario Ministry of Northern Development and Mines. Work began in July on an in-depth review of the mine hazards, followed by a survey to pinpoint the location of all mine workings at the site.

The mine workings closure project was completed in phases over the next three years. The project, which totalled close to \$750,000, was funded by the Ministry of Environment and Energy, the Ministry of Northern Development and Mines, and Environment Canada, through the National Contaminated Sites Remediation Program. The federal program provided funding on a 50/50 cost-sharing basis until March 31, 1995.

Rehabilitation work in the mine areas included the backfilling of identified shafts, pits, stopes and adits; the blasting and elimination of weak crown pillars and unsafe ground; the plugging of narrow vein stopes and the capping of selected shafts. A monitoring program to assess the effectiveness of the closure measures is in progress.

## **Environmental Rehabilitation**

The Bay of Quinte Remedial Action Plan (RAP) identified the Deloro site as an ongoing source of arsenic to the Bay of Quinte watershed and the Stage 2 document, "Clean Up and Implementation Strategies", recommended the acceleration of the site rehabilitation program.

The elimination of the physical mine hazards at the site has paved the way for the next stages of this work.

A multi-phased plan has been developed for long-term rehabilitation of the Deloro site. The plan, which addresses health, safety, and environmental problems, includes upgrades to the arsenic treatment plant, further stabilization of the red mud tailings area, securement of the site wastes, and the demolition of the infrastructure associated with the smelting and refining plant site on the west side of the river.

Project implementation will involve a two-stage private sector services contract for the provision of project management and consulting engineering services. The first stage, which will position the project to proceed, includes the tendering of the contract. The second stage will require several years to complete, and will proceed in phases, subject to the availability of funds.

## **For More Information**

For more information on the history or ongoing rehabilitation of the Deloro site, contact:

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