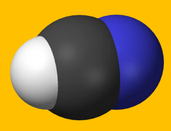
PORCUPINE GOLD MINES
CYANIDE IN THE ENVIRONMENT

Cyanide Chemistry

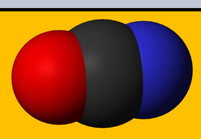
The term **cyanide** refers to a singularly charged anion consisting of one carbon atom and one nitrogen atom joined with a triple bond, CN^-. The most toxic form of cyanide is free cyanide, which includes the cyanide anion itself and **hydrogen cyanide**, HCN, either in a gaseous or aqueous state. At a pH of 9.3 - 9.5, CN^- and HCN are in equilibrium, with equal amounts of each present. At a pH of 11, over 99% of the cyanide remains in solution as CN^-, while at pH 7, over 99% of the cyanide will exist as HCN. Although HCN is highly soluble in water, its solubility decreases with increased temperature and under highly saline conditions. HCN gas and liquid are colorless and have the odor of bitter almonds, although not all individuals can detect the odor.

Cyanide forms complexes with gold, mercury, cobalt and iron that are very stable even under mildly acidic conditions. However, both **ferro-** and **ferricyanides** decompose to release free cyanide when exposed to direct ultraviolet light in aqueous solutions. This decomposition process is reversed in the dark. The stability of cyanide salts and complexes is pH dependent, and therefore, their potential environmental impacts and interactions (i.e. their acute or chronic effects, attenuation and re-release) can vary.The oxidation of cyanide, either by natural processes or from the treatment of effluents containing cyanide, can produce cyanate, OCN^-. **Cyanate** is less toxic than HCN, and readily hydrolyzes to ammonia and carbon dioxide.

Cyanide – Carbon, Nitrogen



Hydrogen Cyanide – Hydrogen, Carbon, Nitrogen



Cyanate – Oxygen, Carbon, Nitrogen

Exterior Hydrogen Cyanide Monitoring

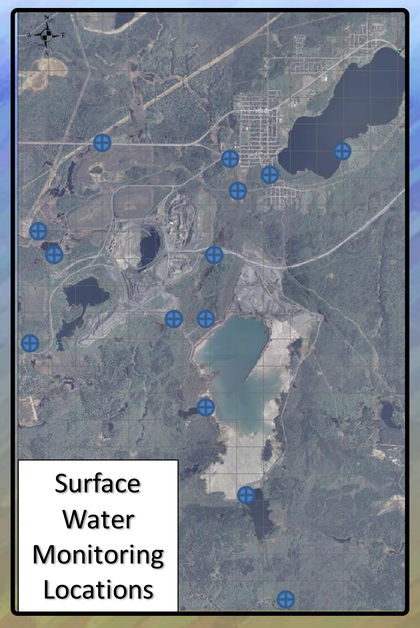
PGM monitors for the release of hydrogen cyanide (HCN) on an annual basis from the Dome Operations. A regulatory developed software program (AERMOD) is utilized for the contaminant level determination. In the near future, PGM will also be performing stack testing on the cyanide related air discharges. This testing will provide more accurate data on the quantity of HCN being emitted. These levels are reported to the provincial and federal government on an annual basis.

Interior Hydrogen Cyanide Monitoring

The mill complex is equipped with numerous HCN monitors. The monitors are located in strategic locations around the plant to measure HCN levels and trigger an evacuation alarm should the levels elevate to 4 parts per million. Portable HCN monitors are also used for confined space related work or for general monitoring during times of possible HCN generation.

Air

Surface Water

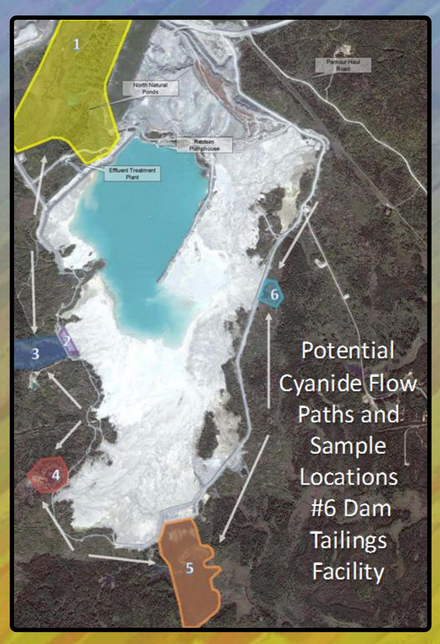


Soil Program

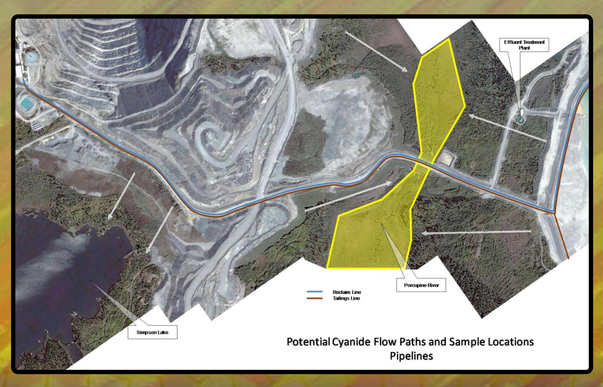
PGM has a spill response plan dedicated to the release of cyanide. Any contaminated soil would be excavated and hauled to the tailings facility. Sampling protocols and remediation end points have been established to ensure there is no future contamination. All cyanide related facilities are situated within the confines of cement containment berms to minimize the risk of release to ground. PGM has also determined potential cyanide release flowpaths based on an evaluation of cyanide transportation and processes. Sampling locations based on the evaluation have been established to monitor near field and far field conditions.

PGM Surface Water Monitoring Program

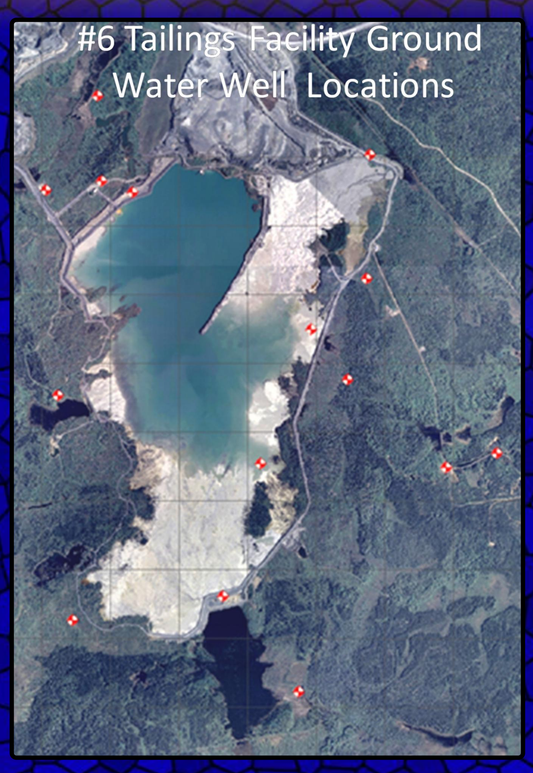
PGM has two regulated effluent water discharge points and two regulated surface water locations for the Dome Mine Site. In addition, PGM has established numerous surface water sampling locations throughout the mine site and town of South Porcupine. These stations exist to establish a baseline for water quality, and to determine if there are any downstream effects from the mine sites effluent water discharges. PGM environmental personnel sample these stations on a quarterly basis. Surface water samples are analyzed for various elements that include Total and WAD Cyanide and Thiocyanate.



Soil

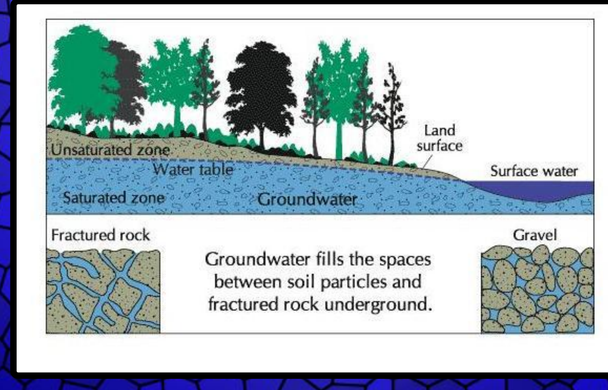


Ground Water



Groundwater

Groundwater is water located beneath the ground surface in soil pore spaces and in the fractures of bedrock formations. A unit of rock or an unconsolidated deposit is called an aquifer when it can yield a usable quantity of water. The depth at which soil pore spaces or fractures and voids in rock become completely saturated with water is called the water table. Groundwater is naturally recharged from, and eventually flows to, the surface naturally; natural discharge often occurs at springs and seeps, and can form oases or wetlands.



#6 Dam Tailings Facility Groundwater Monitoring Program

Groundwater monitoring wells are installed at strategic locations around #6 Dam Tailings Facility. These monitoring wells exist for the purposes of sampling groundwater for contaminant analysis, determining groundwater levels and/or determining the direction of groundwater flow. These measurements are important for site monitoring and remediation. PGM environmental personnel sample and monitor the water levels in each well twice per year. Ground water samples are analyzed for various elements that include Total and WAD Cyanide and Thiocyanate.