

6.0 MONITORING PROGRAM

The TANCO facility is required to comply with the monitoring requirements incorporated in Manitoba Environment Act License No. 973 and in the various approvals of minor changes that have been issued since 1992. These requirements include weekly measurement of TSS and pH in the mine effluent and a groundwater monitoring program in the East TMA to monitor the effects of residue stockpiling and CPF Containment Cell operation on groundwater quality.

The TANCO facility also is required to comply with the *Metal Mining Effluent Regulations* (MMER), which came into effect on December 6, 2002 (Government of Canada 2002). These regulations require routine effluent quality monitoring for specific parameters, and periodic effluent characterisation, acute toxicity testing, chronic toxicity testing, receiving area and reference area water quality sampling, and Environmental Effects Monitoring (EEM). These can be broken down into four main monitoring components:

- Effluent sampling for deleterious substances and pH;
- Effluent characterization;
- Water quality monitoring in the receiving water body and in the reference water body; and
- Biological Studies.

This chapter outlines the required monitoring parameters and reporting requirements for the TANCO Mine, and what is proposed going forward.

6.1 MMER EFFLUENT SAMPLING FOR DELETERIOUS SUBSTANCES AND PH

The TANCO operation currently has one effluent discharge, the West Discharge (N50° 25' 44", W95° 27' 23"; Figure 4.9), releasing effluent from the mine's active West TMA into Bernic Lake. The West Discharge is the compliance point for the operation's existing Manitoba Environment Act Licence and is the final discharge point for the collection of all effluent samples.

The effluent is sampled for parameters listed in Table 6.1 at a frequency listed in Table 6.2.

TANCO is presently on a reduced sampling frequency on the basis of historical monitoring that demonstrated low concentrations of deleterious substances.

Changes to the mine operations that alter the effluent discharge quality, failure of an acute toxicity test, or a parameter concentration that exceeds the MMER authorized limits for deleterious substances may result in an immediate increase in the frequency of monitoring to once a month (Government of Canada 2002). This increased sampling frequency is maintained until the mine has 12 consecutive months of meeting the required standards and results for effluent quality and acute bioassays.

Quarterly electronic reports of the concentrations of deleterious substances, pH, monthly mean concentrations of deleterious substances, monthly effluent volume discharged, and quarterly acute toxicity results (reported in LC50 values) are entered and submitted using RISS (<https://www.riss-sitdr.ec.gc.ca>) within 45 days following the end of a calendar quarter. Monthly mass loadings of deleterious substances are automatically calculated in RISS. Weekly TSS, discharge volume and pH data are entered electronically in RISS.

An annual electronic report of these data is submitted via RISS before March 31 of the subsequent year.

A written annual report that includes these data was submitted to the Environment Canada authorization officer through the 2010 reporting periods. The written reports are no longer required by Environment Canada.

TANCO is required to sample and analyze effluent discharge based on their Environment Act Licence No. 973 (Appendix A). Monthly reports are submitted to Manitoba Conservation that include weekly TSS, pH, and monthly effluent discharge volumes.

Table 6.1 Effluent Sampling Parameters

Parameters
Effluent flow rate and calculation of the volume discharged
pH
Total Suspended Solids (TSS)
Concentrations of deleterious substances
Total Suspended Solids (TSS)
Total Arsenic (As)
Total Copper (Cu)
Total Lead (Pb)
Total Nickel (Ni)
Total Zinc (Zn)
Radium-226
Field Parameters
Temperature
Dissolved Oxygen
Conductivity
Acute toxicity testing (Rainbow trout 96h-LC50 and Daphnia magna 48h-LC50)

Table 6.2 Frequency of MMR sampling at the TANCO Mine.

Sample	Frequency
Effluent flow rate and calculation of the volume discharged	Weekly
pH	Weekly
Total Suspended Solids (TSS)	Weekly
Concentrations of deleterious substances	Quarterly
Acute toxicity testing*	Quarterly
Sub-lethal toxicity testing	Annually
Effluent characterisation	4 times a year
Environmental Effects Monitoring - Water Quality	4 times a year
Biological Studies	24 - 36 months

*A sample of effluent must be collected for acute toxicity testing in conjunction with the analysis for deleterious substances.

6.2 EEM: EFFLUENT CHARACTERIZATION AND WATER QUALITY MONITORING

The location of the West Discharge for effluent characterisation is described in Section 6.1.1 and Figure 4.9.

Exposure site water quality is sampled in Bernic Lake (N50° 25' 42", W95° 27' 23"), within 100 m of the effluent plume of the West Discharge (Figure 4.9). Reference site water quality is sampled in a bay of Tulabi Lake (N50° 29' 12", W95° 16' 10"), which is situated on the Bird River approximately 15.5 km northeast of Bernic Lake (Figure 4.10).

Parameters for effluent characterization from the West Discharge and water quality monitoring from the exposure and reference areas are included in Table 6.3.

Sub-lethal toxicity testing of samples from the West Discharge including IC50 and IC25 bioassays for:

- Aquatic invertebrates fecundity (*Ceriodaphnia dubia*);
- Fish growth inhibition (*Pimephales promelas* – fathead minnow);
- Microphytic aquatic plant growth inhibition (*Pseudokirchneriella subcapitata* formerly *Selenastrum capricornutum*); and
- Macrophytic aquatic plant fecundity and growth inhibition (*Lemna minor*, frond number and biomass).

Effluent characterization and water quality are sampled four times per year not less than one month apart (Table 6.2). These samples are typically collected during the May through October open water season. Chronic (sub-lethal) toxicity bioassays are sampled once annually on a date coinciding with a scheduled effluent characterization sampling.

An annual electronic report is submitted via RISS before March 31 of the subsequent year.

A written report was submitted to the Environment Canada Regional Director and Authorization Officer through the 2010 reporting periods. The written reports are no longer required by Environment Canada.

Table 6.3 Parameters measured for effluent characterisation and water quality analyses.

Parameters	
Field Parameters	Biological
Temperature	Chlorophyll a
Dissolved Oxygen (DO)	Radiochemical
Conductance	Radium-226 (Bq/L)
Total Dissolved Solids (TDS)	Total and Dissolved Metals
Secchi disc transparency	Aluminum (Al)
pH	Antimony (Sb)
Physicochemical	Arsenic (As)
pH (pH units)	Barium (Ba)
Hydroxide	Beryllium (Be)
Conductance (µS/cm)	Bismuth (Bi)
Specific Conductance (µS/cm @ 25°C)	Boron (B)
Total Dissolved Solids	Cadmium (Cd)
Hardness, dissolved	Calcium (Ca)
Hardness, total	Cesium (Cs)
Alkalinity (PP as CaCO ₃)	Chromium (Cr)
Alkalinity (Total as CaCO ₃)	Cobalt (Co)
Bicarbonate (HCO ₃)	Copper (Cu)
Carbonate (CO ₃)	Iron (Fe)
Total Suspended Solids	Lead (Pb)
Turbidity (NTU)	Lithium (Li)
True Colour (TCU)	Magnesium (Mg)
Major Ions	Manganese (Mn)
Potassium, dissolved	Mercury (Hg)
Sodium, dissolved	Molybdenum (Mo)
Calcium, dissolved	Nickel (Ni)
Magnesium, dissolved	Phosphorus (P)
Chloride, dissolved	Potassium (K)
Fluoride, dissolved	Rubidium (Rb)
Sulphate, dissolved	Selenium (Se)
Nutrients	Silicon (Si)
Organic Carbon, dissolved	Silver (Ag)
Organic Carbon, total	Sodium (Na)
Nitrite	Strontium (Sr)
Nitrate	Sulphur (S)
Nitrate_Nitrite	Thallium (Th)
Ammonia	Tin (Sn)
Total Kjeldahl Nitrogen	Titanium (Ti)
Total Nitrogen	Uranium (U)
Phosphorus, total dissolved	Vanadium (V)
Phosphorus, total	Zinc (Zn)
	Zirconium (Zr)

6.3 EEM: BIOLOGICAL STUDIES

Discharge of a metal mining effluent to the aquatic environment requires the conduct of periodic biological monitoring studies as stated in Schedule 5, Part 2 of the MMER (Government of Canada 2002). The monitoring studies normally consist of the following parts:

- Site characterization;
- A study of the benthic invertebrate community;
- A study of fish tissue, and
- A study of the fish population.

The TANCO Mine discharge has an effluent dilution greater than 99% within 250 m of the discharge point (Wardrop 2006), and the concentration of total mercury in the effluent is consistently $<0.10 \mu\text{g/L}$. Consequently, TANCO is not required to undertake fish studies (Government of Canada 2002). However, changes to the mine operations that alter the effluent discharge quality or any recorded concentration that exceeds the MMER limits may result in changes to the components of future biological monitoring studies.

Biological studies usually occur every 24 to 36 months (Table 6.2). To date, an effect of the TANCO effluent on the benthic invertebrate community has been confirmed by a 2005 study (Wardrop 2006), a Periodic Monitoring Surveillance study in 2008 (Wardrop 2009a), and an Investigation of Cause study in 2011 (Tetra Tech 2011b).

The Investigation of Cause study report was submitted to the authorisation officer in June 2011.

6.4 GROUNDWATER MONITORING

The current CPF Plant groundwater monitoring program includes 40 wells (Figure 4.3). Groundwater wells were installed in 2000, 2002 and 2008. Wells were installed as detailed in UMA (2001), SEACOR (2004), and Wardrop (2009b).

The program monitors the effects of the CPF residue leachate on groundwater quality in the TMA. Groundwater monitoring also monitors the containment cells for outer liner leakage. The progress of residue leachate movement through the East TMA groundwater system is best traced using the leachate signature, comprised of six key parameters (SEACOR 2004):

- conductivity;
- total cesium;

- total rubidium;
- dissolved calcium;
- dissolved strontium; and
- dissolved sulphate.

Surface water samples are collected immediately downstream of the North, East and West dams, if sufficient water is available, to determine if residue leachate components are migrating from the East TMA via these routes (Figure 4.3).

Groundwater wells are sampled for the parameters listed in Table 6.3. Additional field parameters include well water level, pH, conductance, specific conductance, and temperature.

Surface water is sampled for the parameters listed in Table 6.2. Additional field parameters include pH, conductance, specific conductance and temperature.

Groundwater and surface water sampling are completed twice each year, once in the spring (typically beginning of June) and once in the fall (typically end of September or beginning of October).

Table 6.4 Parameters for groundwater quality analyses.

Key Parameters	Dissolved Metals
pH (pH units)	Aluminum (Al)
Conductance ($\mu\text{S}/\text{cm}$)	Antimony (Sb)
Specific Conductance ($\mu\text{S}/\text{cm}$ @ 25°C)	Arsenic (As)
Total Dissolved Solids	Barium (Ba)
Calcium (Ca), dissolved	Beryllium (Be)
Sulphate (SO_4), dissolved	Bismuth (Bi)
Strontium (Sr), dissolved	Boron (B)
Sulphur (S), dissolved	Cadmium (Cd)
Cesium (Cs), total	Chromium (Cr)
Rubidium (Rb), total	Cobalt (Co)
Physico-chemical	Copper (Cu)
Alkalinity (Total as CaCO_3)	Iron (Fe)
Bicarbonate (HCO_3)	Lead (Pb)
Carbonate (CO_3)	Lithium (Li)
Hydroxide	Manganese (Mn)
Hardness	Molybdenum (Mo)
Major Ions	Nickel (Ni)
Magnesium (Mg), dissolved	Phosphorus (P)
Sodium (Na), dissolved	Selenium (Se)
Potassium (K), dissolved	Silicon (Si)
Chloride, dissolved	Silver (Ag)
Nutrients	Thallium (Th)
$\text{NO}_2 + \text{NO}_3$	Tin (Sn)
	Titanium (Ti)
	Vanadium (V)
	Zinc (Zn)

To date, two written annual reports including data and information collected during the CPF Plant monitoring program are submitted to the Director of Manitoba Conservation's Environmental Assessment and Licensing Branch. The CPF Residue Placement Report addressed the effects of residue placement on the groundwater, whereas the CPF Containment Cell No.1 Report monitored for leakage of the Cell No.1's outer liner. TANCO is proposing to combine the two reports into a single annual report that addresses the effects of residue placement on groundwater along with monitoring for leakage in the outer liner of both Cell No.1 and 2.

6.5 NATIONAL POLLUTANT RELEASE INVENTORY

TANCO is required to report releases to the environment through the National Pollutant Release Inventory (NPRI). NPRI is Canada's legislated, publicly accessible inventory of pollutant releases to air, water and land, as well as disposals and transfers for recycling (NPRI 2009). The NPRI is managed by Environment Canada and currently tracks over 300 substances or groups of substances, listed in five different parts. Reporting to the NPRI is a legal requirement mandatory under the authority of *Canadian Environmental Protection Act (CEPA)* for facilities that meet published reporting requirements. Owners or operators of facilities are required to report their pollutant releases, disposals and transfers for recycling annually to the NPRI if they manufacture, process or otherwise use or release one or more of the NPRI substances and the total number of hours worked at the facility exceeded 20,000 hours (approximately 10 full-time employees).

TANCO reports the following releases to air on an annual basis: formic acid, sulphuric acid, total particulate matter (PM), PM₁₀, and PM_{2.5}. Releases to air reported to NPRI from 2000 to 2010 are provided in Section 3.15.1.

New reporting requirements for tailings and waste rock were implemented in December 2009. TANCO is now required to annually report quantities and concentrations of NPRI substances in waste rock and tailings placed disposed of on land. This requirement is retroactive to 2006. Refer to Section 3.15.2 for more details on quantities and composition of tailings.