3.0 PROJECT DESCRIPTION

3.1 Geographic Location

The property is located at 326039 E 5589610 N (Zone 15) on National Topographic System map sheet 52 L (Figure 1.1).

3.2 Mineral Surface Rights

TANCO currently holds 13 surface leases (Figure 2.3):

- M-126 to M-130, inclusive (dated April 2, 1968);
- M-145 to M-149, inclusive (dated April 7, 1971);
- SL-1 (dated September 8, 1992);
- SL-3 (dated October 16, 1995); and,
- SL-11 (dated July 23, 2008, and held by Coltan Mines Ltd., a subsidiary of TANCO).

TANCO currently holds 3 mineral leases including (Figure 3.1):

- ML-04 to ML-06, inclusive (dated April 1, 1992).

The TANCO Mine road is on Crown Land, and extends outside the boundaries of the surface leases. Crown Land permit #GP 0000208 allows TANCO to maintain and/or operate the all weather road from PR # 315 to Bernic Lake.

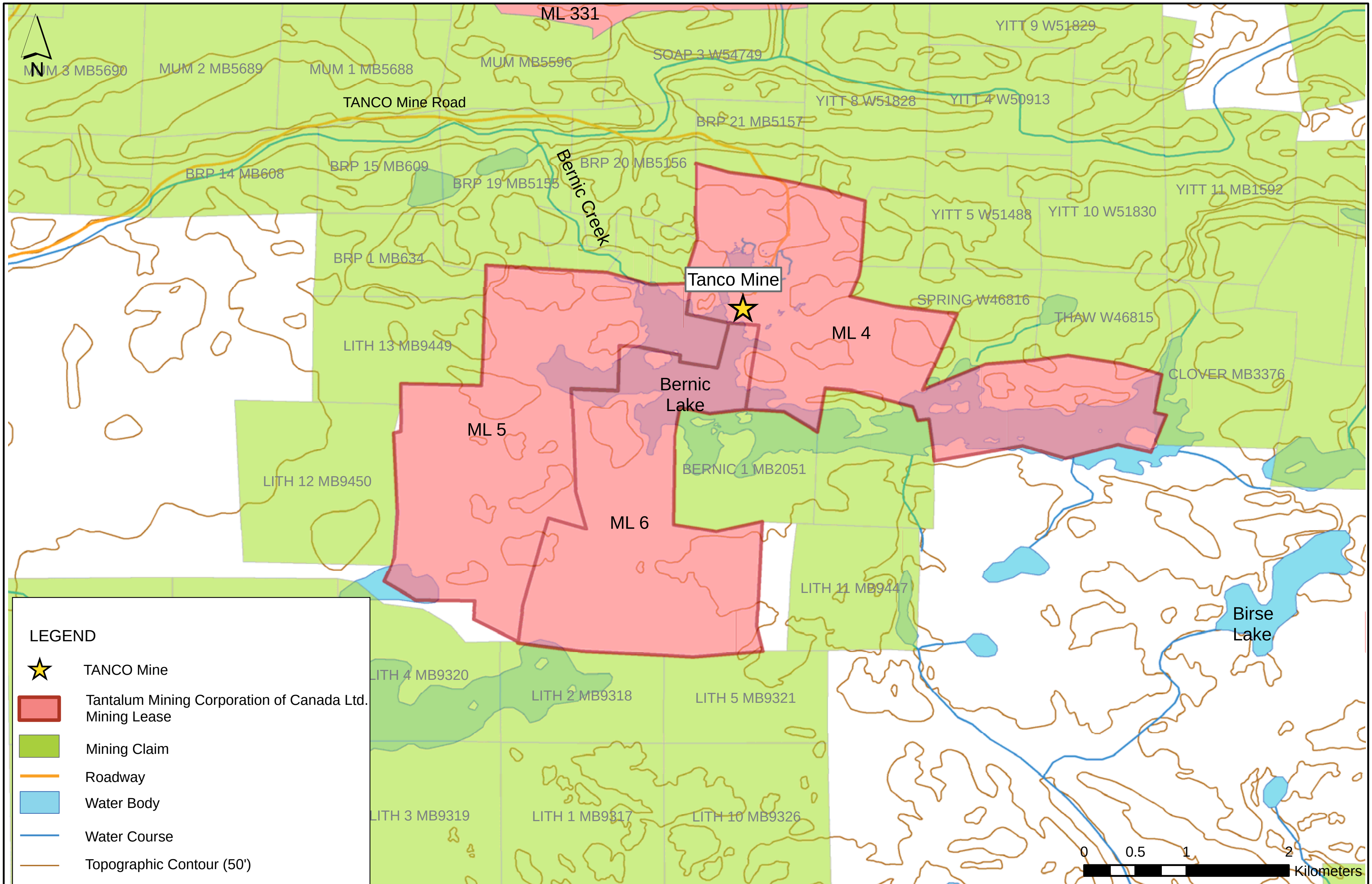

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FIGURE 3.1
MINERAL LEASES

3.3 MINERAL RESERVE AND MINE LIFE

3.3.1 TANTALUM

Since 1969, 4,595,675 tonnes of tantalum ore have been mined at an average feedgrade of 0.106%. Production of tantalum was suspended on May 15, 2009 and is scheduled to re-start in November 2011. Remaining reserves are:

- Proven – 414,521 tonnes at an average feedgrade of 0.073%;
- Indicated – 1,019,680 tonnes at an average feedgrade of 0.076%; and
- Inferred – 519,848 tonnes at an average feedgrade of 0.080%.

3.3.2 SPODUMENE

Spodumene has been mined since 1984 with 1,836,243 tonnes mined to date at an average feedgrade of 2.76%. Spodumene production was suspended on September 3, 2009. Remaining reserves are as follows:

- Proven – 427,674 tonnes at an average feedgrade of 2.4%;
- Indicated – 1,303,232 tonnes at an average feedgrade of 2.7%; and
- Inferred – 657,694 tonnes at an average feedgrade of 2.6%.

3.3.3 POLLUCITE

Pollucite has been mined since 1997 with 205,180 tonnes mined to date at an average feedgrade of 13.27%. Production was suspended temporarily from May 13, 2009 to January 21, 2010. As of October 1, 2010 remaining pollucite reserves were 137,000 tonnes at an average feedgrade of 13.8%.

3.4 MINE LIFE

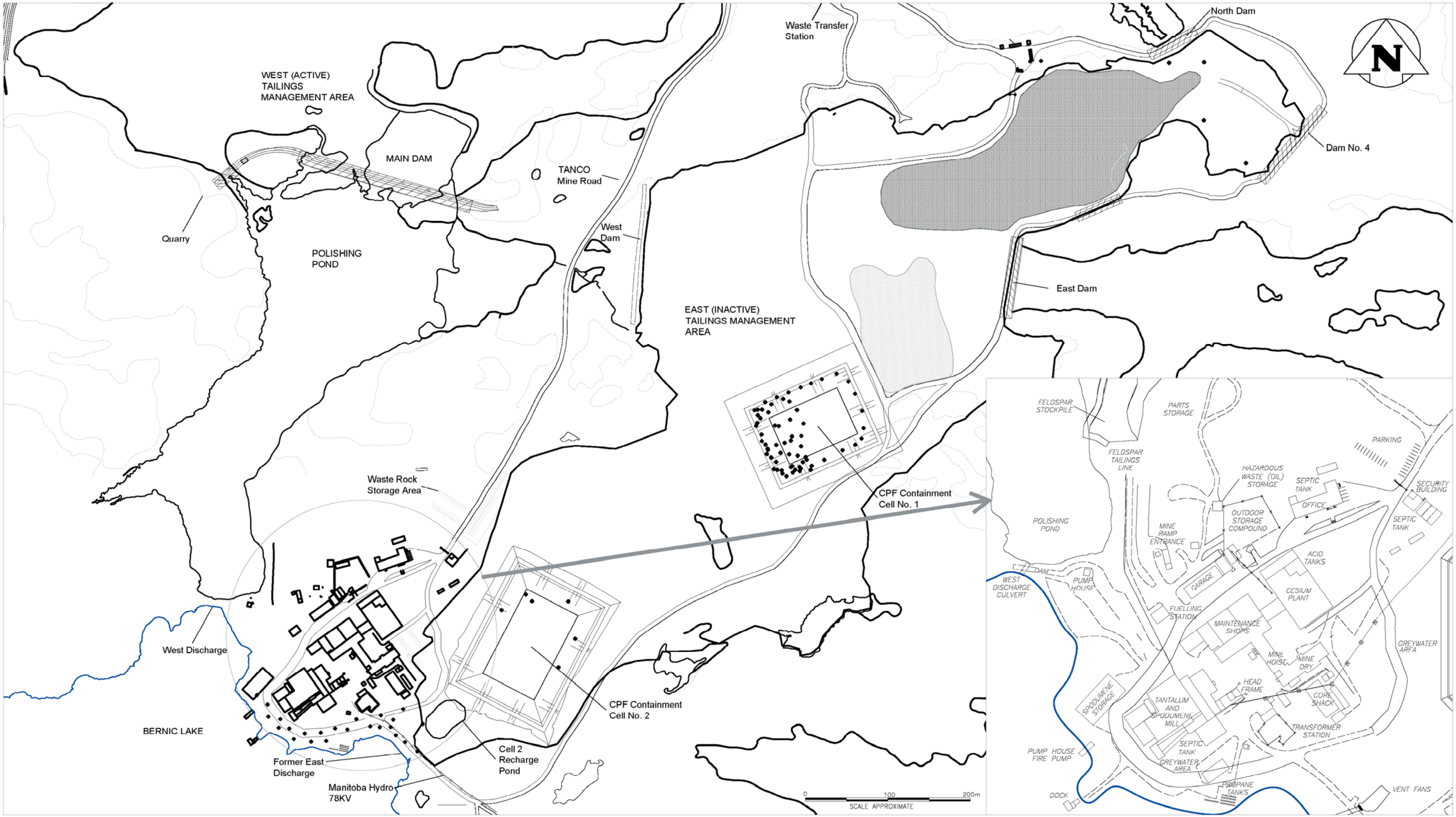
Operations at the mine are forecast to continue for a minimum of seven years, based on remaining mine reserves and current production rates (pollucite mining at 9% feedgrade). Planning to extend the pollucite mine life continues. Resumption of tantalum and/or spodumene production may also warrant extensions to the mine life.

3.5 SURFACE FACILITIES

3.5.1 TANCO MINE INFRASTRUCTURE

Infrastructure on the TANCO Project Site (i.e., the facility footprint) covers approximately 85 hectares. Surface infrastructure required to support mining includes (Figure 3.2):

- headframe and portal;
- tantalum/spodumene mill and dry grinding plant;
- warehouse/maintenance shop;
- mine dry;
- Cesium products facility (chemical plant);
- Cesium containment cells and residue stockpile;
- inactive and active tailings management areas;
- waste transfer station;
- transformer station;
- storage facilities;
- quarries;
- access road;
- parking lot;
- office facilities; and,
- security building.



LEGEND

- LIMITS OF TAILINGS MANAGEMENT AREA
- RESIDUE PLACEMENT AREA (2001–2010)
- RESIDUE PLACEMENT AREA (2007)

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FIGURE 3.2
MINESITE LAYOUT

3.5.1.1 HEAD FRAME AND PORTAL

The total height of the headframe is 33 m (Figure 3.2). The headframe houses an NO1780-B Ingersoll Rand hoist constructed by Hepburn that has the capacity to hoist 2 x 3.25 ton skips. The mine portal is 4 m x 4 m and the ramp has a slope of 20%.

3.5.1.2 MILL AND DRY GRINDING PLANT

The tantalum and spodumene concentrates are produced in the mill (Figure 3.2). The dry grinding plant processes the pollucite ore to a mesh size suitable for use in the chemical plant. The mill also houses offices, concentrate storage, and loading area. The tantalum/spodumene milling process is further described in Section 3.7.

3.5.1.3 CESIUM PRODUCTS FACILITY (CHEMICAL PLANT)

The Cesium Products Facility (CPF) was brought into production in 1997, and has the capacity to produce approximately 9,000 barrels per year of cesium formate drilling fluid and other cesium-based chemicals (Figure 3.2). Further information about the cesium process is provided in Section 3.9.

3.5.1.4 CPF RESIDUE CONTAINMENT CELLS AND RESIDUE STOCKPILE

Residue from the CPF process is pumped to one of two double-lined containment cells located in the inactive East TMA to allow the solids to settle out of the liquor (Figure 3.2). When a containment cell becomes full of residue, the residue is dewatered, the recovered liquid is returned to the CPF process, and the residue is removed to the East TMA for storage.

3.5.1.5 TAILINGS MANAGEMENT AREA

The facility has two Tailings Management Areas (TMA), the inactive East TMA and the active West TMA (Figure 3.2). Further information about tailings management is provided in Section 3.8.

3.5.1.6 WASTE TRANSFER STATION

The waste transfer station (Operating Permit RRR-108) is located approximately 1.5 km northeast of the mine (Figure 3.2). From 1968 to 2007 the area was used for solid waste disposal. In 2007, the facility was closed as per regulations, and the area is now used to collect solid waste before it is transported off-site to a licenced facility.

3.5.1.7 POWER TRANSMISSION AND TRANSFORMER STATION

Hydroelectric power is provided to the site via a 72 kV transmission line that originates at Pointe du Bois. The transmission line is owned and maintained by Manitoba Hydro. The approximate length of the line is 15 km. The line feeds into a TANCO owned and operated transformer station on site (Figure 3.2). The station is fenced to prevent unauthorized access. The transformer station houses four PCB-free transformers (Table 3.1). The transformers are maintained by TANCO maintenance personnel and inspected by the Mines Electrical Inspector. There is also an external contractor who performs annual inspections and maintenance of the transformers.

Table 3.1 Transformer voltage conversion and oil capacity.

Transformer	Voltage Conversion	Oil Capacity (L)
T1	72 kV to 600 V	3,670
T2	72 kV to 4.16 kV	4065
T3	72 kV to 4.16 kV	4700
T4	4.16 kV to 600 V	1690

3.5.1.8 Storage Facilities

Product

There are two on-site product storage facilities for tantalum and spodumene (Figure 3.2); spodumene and tantalum are both stored in the spodumene storage northwest of the mill, and spodumene is also stored in a structure attached to the southwest side of the mill (Figure 3.2). TANCO does not currently have any tantalum or spodumene stored on-site, and the spodumene storage facility is now being used for cesium products storage. Cesium product storage on-site is short-term, typically with fewer than 250 barrels of product onsite. The product is transported to a third-party warehouse in Winnipeg as it is produced.

TANCO has also constructed another small dome type storage facility near the spodumene shed to store shipping materials such as drums, bags, bulkheads, etc.

Outdoor Storage Areas

The outdoor storage area typically houses new oil, steel pipe and plates, various plastic pipe, consumables, new totes, etc (Figure 3.2). This area also contains the Hazardous Waste storage building.

Acid

There are two bulk storage acid tanks located adjacent to the CPF (Figure 3.2). Sulfuric acid bulk storage is in a 73,195 L carbon steel tank surrounded by an acid containment structure. Formic acid bulk storage is in a 46,170 L stainless steel tank surrounded by an acid containment structure. The containment structures contain 110% of the acid tank volumes to ensure adequate secondary containment in the event of a tank failure.

Propane Storage

Propane storage tanks are located in three different locations to fuel ventilation air heaters for the underground and to supply the mill and chemical plant (Table 3.2).

Table 3.2 Propane capacity by storage location.

Location	No of Tanks	Tank Capacity (USG)	Location Capacity (USG)	Location Propane Capacity (kg)	Maximum Location Capacity* (kg)
Main Site	5	2,400	12,000	23,255	18,600
East Fan	4	2,460	9840	19,100	15,260
Chemical Plant*	1	30,000	30,000	58,138	46,500
Total					**80,360**

* Maximum allowable fill capacity is 80% of the tank capacity.

Explosives Magazine

The explosives and detonators magazines are owned by Orica Limited and are operated by TANCO (Figure 3.2). Both magazines are constantly monitored by a remote security system

Fuel

Two double walled fuel storage tanks are installed at the TANCO facility: one each for diesel fuel and gasoline (Figure 3.2). The diesel tank capacity is 10,000 litres and the gasoline tank capacity is 4,500 litres. Petroleum Storage Permit #AG-23433 is valid until December 31, 2015.

Drill Core

The drill core stored on-site dates to the 1920s (Figure 3.2). There are two general areas for core storage. One is located on-site and consists of a number of small buildings. Another core storage building is located south of the site adjacent to the power line.

Waste Rock

A small (<5,000 tonnes) waste rock stockpile is located north of the parking lot (Figure 3.2). Waste rock (amphibolite, quartz, feldspar, granite, etc.) is generally managed underground – a small stockpile of non-acid generating waste rock is maintained on surface for use in dam construction, road maintenance, etc.

3.5.1.9 Quarries

Two quarries are actively used at TANCO, mainly for use in TMA dyke construction (Figure 3.2). The main quarry is adjacent to the main West TMA dam. The second quarry is located north of the perimeter dam of the West TMA.

3.5.1.10 Access Road and Parking Lot

Access to the minesite is via a 10 km long, gravel road (i.e., the TANCO Mine Road; Figure 3.2). The road is marked at the junction with Provincial Highway 315. All maintenance of the road is the responsibility of TANCO. The mine road crosses the Bird River at km 7 via a large (approximately 6 metres wide and 20 metres long) culvert. A gravel vehicle parking lot for employees and visitors is located at the end of the TANCO Mine Road.

3.5.1.11 Office, Warehouse and Mine Dry

The office building is a wood-frame structure on a foundation of wooden blocking material (Figure 3.2). The facility services building consists of a spare parts warehouse and maintenance shop (welding, electrical, heavy duty mechanic, service mechanic, etc.). The mine dry contains locker rooms, showers, and a lunch room.

3.5.1.12 Security Building

Site security is maintained at the main entrance to the minesite by a contracted security service (Figure 3.2). All contractors and visitors must sign in at the security building before entering or leaving the site.

3.5.2 Molson Loading Facility

The Molson Loading Facility is located adjacent to the Canadian Pacific Railway (CP) siding of the CP main rail line that passes through Molson, MB (Figure 2.1). The legal description of the Molson site is, “Part of the W ½ Section 21, Township 12, Range 9, EPM”. The land is leased from CP Rail with the building owned by TANCO. Upon surrender of the lease, TANCO will return the site to conditions acceptable to CP under Article 8.04 of the Lease Agreement.

The facility is used for transferring spodumene concentrate to rail cars or 20 foot ocean containers for transport to customers. Spodumene is transported in bulk by truck to the Molson facility where it is unloaded into the storage area. Facility capacity is approximately 2,000 metric tonnes. A system of conveyors is used to transfer the spodumene to railcars for shipments within North America or 20 foot ocean containers for shipment overseas. A Camco Industries dust collection system (1,000 cubic feet per minute and an effective filter area of 175 square feet) is operated in the building whenever product is being loaded or unloaded. Employees are required to wear respirators whenever product is being moved in the building.

3.6 Mining (Tantalum, Spodumene, and Pollucite)

The pegmatite is essentially a horizontal rock formation. Pollucite, spodumene, and tantalum are all located in separate zones of the formation. Mining activities historically often had to be planned to coordinate mining of one ore to obtain access to another product. Generally, the three product areas are now discrete so that mining of one product does not usually affect mining of the other products.

3.6.1 Mining Method and Production Rates

Mining is by the room and pillar method. At full production, the capacity of the mine is approximately 1,000 tonnes per day. Production from 2005 to 2011 is detailed in Table 3.3.

Table 3.3 TANCO production data for 2005 to 2011.

Year	Tantalum		Spodumene		Cesium Products	
	Ore Processed (tonnes)	Concentrate (tonnes)	Ore Processed (tonnes)	Final Product (tonnes)	Ore Processed (tonnes)	Cesium Product (barrels)
2005	162,874	71.688	74,358	11,485	21,674	9,447
2006	136,497	57.276	88,907	13,377	27,752	9,487
2007	133,323	52.447	95,930	12,977	28,726	8,813
2008	127,923	54.43	96,907	13,577	28,173	9,117
2009	86,993	32.325	63,237	8,335	17,461	6,012
2010	-	-	-	-	16,511	5,187
2011[a]	-	-	-	-	23,441	6,615

[a]January through July

3.6.2 Mine Openings and Ventilation

There are four mine openings: the main ramp, the shaft, and two vent raises (Figure 3.2). The vent raises are located 15 m east of the mill (Main Vent Fan) and approximately 450 m southeast of the mill (East Fan):

- The Main Vent Fan (Jack Nutt Shaft) is a 60” Joy Series 2000 Model 60-26 1/2-1170 with a capacity of 70,000 cubic feet per minute; and,
- The East Fan is a 60” Alphair Series 2000 Model 60-26-1170 with a capacity of 75,000 cubic feet per minute.

A 10 horsepower fan (installed at the Main Vent Fan), a GW Axial Model 19GRGK2 #D132S 1968, is used during shutdown periods (e.g., Christmas shutdown) to maintain sufficient pressure to prevent cold air from going underground.

3.6.3 Mine Equipment

Underground mining equipment:

- 1 stationary rockbreaker
- 2 mobile rockbreakers
- 2 twin boom jumbo drills
- 1 long hole drill
- 4 load, haul, dump units (scooptrams)
- 2 - 26 MT Wagner rock trucks
- 4 aerial lifts

- 2 locomotives
- 4 personnel carriers
- 1 fuel truck
- 1 hoist
- ventilation system

3.6.4 Underground Infrastructure

Blasted ore is mucked using load, haul, dump equipment (scooptrams) and/or 26 metric tonne ore trucks to move the ore to one of several ore passes (Figure 3.3). Rock breakers are used to break the rock to less than 7.5 cm and the rock is sent down the ore pass to the second level. A rail system, located on the second level, allows a locomotive to haul up to five full ore cars to the loading pocket where the ore is loaded into one of two 3 ton skips which are hoisted to surface via the shaft. At surface the skips are dumped into one of two coarse ore bins.

Also located underground are two refuge stations, one secured powder magazine, and one secured detonator magazine. In case of emergency, the mine is equipped with a stench gas system to warn personnel who are required to report to the refuge station. An underground communication system was installed in 2009 providing telephone access to most locations underground.

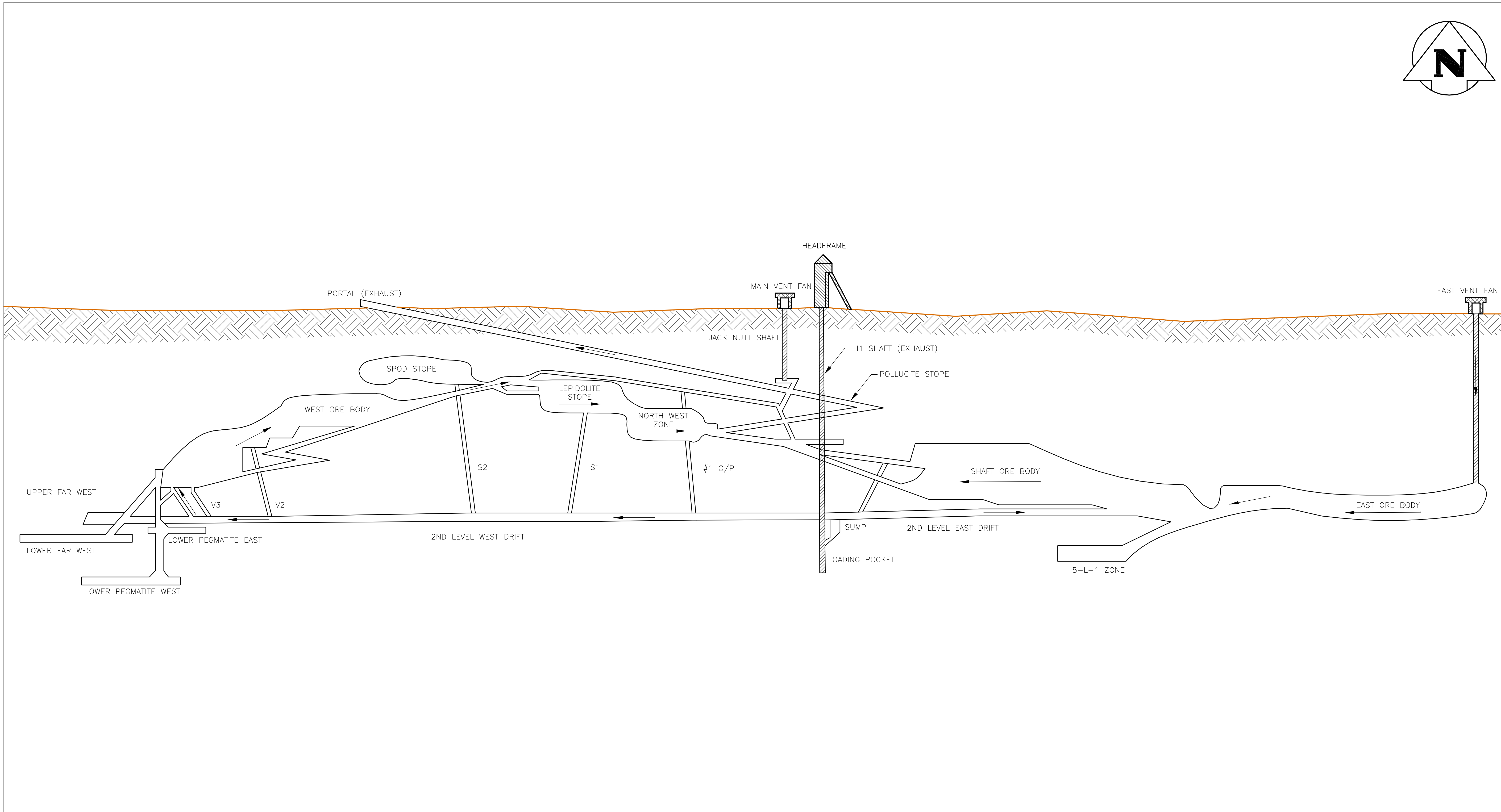

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FIGURE 3.3
IDEALIZED MINE CROSS-SECTION
LOOKING SOUTH WEST

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3.6.5 *Mine Water Management*

Water from the mine workings is routed to the underground sump. The actual routing varies based on the source of the water and flow rates (i.e., if minewater is at a higher level than the sump, the water can be directed with trenches or drilling, but if minewater is at a lower level than the sump, pumps are used to pump the water up to a level where it can drain into the main sump). Minewater is pumped from the sump to surface using an 8 stage horizontal ring section pump with a capacity of 1.25 m^3/minute. Minewater is then directed to the active West TMA via one of the tailings lines. Net water production from the underground is approximately 116,000 m^3 per year, with about 85% of this quantity derived from mine seepage and the balance being fresh water from Bernic Lake which is used for drilling and washing. The water is pumped intermittently; water flows underground can change based on rainfall or mining activities (e.g., access to a new fracture zone, sealing up a new fracture zone with grout). The main dewatering pump has a backup emergency power source in the event of a power failure, and there is a backup pump available in the event of a main pump failure.

3.6.6 *Mining Waste*

As required, up to 200 tonnes of waste rock per year are transported to the surface, mainly for immediate use on the mine road. The waste rock used to maintain the mine road has traditionally been feldspar, although more recently amphibolite has been used. The waste rock is non-acid generating, as shown by acid-base accounting (ABA) test results in the Mine Closure Plan (Appendix C).

3.6.7 *Crown Pillar Stability*

The current layout of pillars, taking into account their sizes and strengths as well as thickness of the crown pillar, indicates there will be no long-term stability issues with respect to overlying surface areas (Smith 1981, 1996 and 1998).

3.7 Milling (Tantalum, Spodumene, and Pollucite)

3.7.1 *Milling Process*

Tantalum ore is crushed and ground to minus 42 mesh, then concentrated using gravity separation methods (heavy media, hydrosizers, tables, and spirals). Spodumene ore is crushed and ground to minus 66 mesh, then concentrated using flotation methods to produce final concentrates. The tantalum and spodumene tailings are directed to the West Tailings Management Area.

Pollucite is crushed and ground to minus 200 mesh in the dry grinding plant and directed to the CPF for production of cesium products.

3.7.2 Milling Production Rate

TANCO's milling production capacities are approximately 1,000 tonnes/day with typical daily targets of 545 tonnes/day of tantalum, 300 tonnes/day of spodumene, and 100 tonnes/day of pollucite.

3.7.3 Milling Equipment

Equipment used in the milling process includes:

- Ball mills (4)
- Conveyors
- Screens
- Crushers
- Compressors
- Process tanks
- Flotation cells
- Material storage bins
- Dust collectors
- Ventilation Fans
- Pumps
- Hydrosizers

The Ball mills include the Marcy Mill and smaller regrind mill for tantalum, the spodumene ball mill and the dry grind ball mill. Simplified flowsheets for the milling processes are included in Appendix D.

3.7.4 Milling Reagents

The reagents used in the mill process and the quantities consumed from 2006 to 2008 are listed in Table 3.4. Reagent data for 2009 were not included since both tantalum and spodumene production were periodic rather than continuous and would not be indicative of reagent consumption at full production.

Table 3.4 **TANCO milling reagent use for 2006 to 2008 (units are kg).**

Reagent	CAS#	2006	2007	2008
Aristonate M	78330-12-8	13,736	13,877	14,615
Soda Ash	497-19.8	18,586	16,595	19,377
Starch	55963-33-2	3,402	2,974	2,565
Dowfroth 250	037286-64-9	532	583	678
Sulphuric Acid	7664-93-9	275,943	383,715	329,300
Acintol	61790-12-3	30,521	29,738	31,757
Drimax	577-11-7 & 57-55-6	1,431	1,037	4,789
Magnetite	1309-37-1 & 14808-60-7	19,250	14,778	21,429
Ferrosilicon	1309-37-1	11,750	11,500	11,500
Aero 3030	061790-60-1	2,632	1,739	2,518
Aero 845	64-17-5	6,820	8,152	7,925
Canpol	26-062-79-3	3,200	4,175	3,475

3.7.5 MILLING WASTE

Feldspar reject and process water resulting from the spodumene milling process, is pumped from the mill and deposited on the east shore of the polishing pond, approximately 100 m from the West Discharge (TANCO's regulatory compliance point for effluent discharge into Bernic Lake). Daily production (only when producing spodumene) is on the order of 100 tonnes. The tantalum and spodumene tailings are directed to the West Tailings Management Area by separate tailings pipelines.

The waste feldspar is used for a variety of construction purposes, including surfacing of the mine road and as an erosion resistant cover for CPF residues placed in the East TMA.

3.7.6 PRODUCT STORAGE AND TRANSPORTATION

A spodumene/tantalum storage warehouse is located on-site next to the milling facility. The capacity of the warehouse is approximately 200 tonnes. Spodumene is stored in 25 kg sacks or 1 tonne Supersacks. Tantalum is stored in drums containing approximately 225 kg of tantalite ore.

Most of the spodumene is handled in bulk and is stored at the TANCO Mine in three 150 tonne storage bins. The contents of any of the bins can be transferred to a load out bin for loading into a covered hopper truck. The product is transported to the Molson Loadout Facility. Product handling at the Molson Facility is described in Section 3.5.2.

3.8 TAILINGS MANAGEMENT

The facility has two tailings management areas (TMA), the now inactive East TMA and the active West TMA. The history of operation of these TMAs is detailed below. The general composition of the tailings is a combination of tantalum and spodumene gangue consisting of various feldspars, quartz, amphiboles, gabbro, unrecovered tantalum and lithium minerals, and other minor pegmatite minerals. A 1992 study of ore samples determined that the pegmatite is acid-consuming rather than acid-generating (Appendix C).

3.8.1 *East TMA*

Approval for development of the East TMA was granted in 1969 by Order-in-Council No. 232/69. Development of the TMA was initiated in 1969 by constructing a dyke (the Main Dam) across the mouth of Beryl Bay. Additional containment dykes were subsequently constructed as required to contain the tailings. The TMA initially received tailings only from the tantalum concentration process. With completion of the spodumene concentrator in 1986, both tantalum and spodumene tails were deposited. The TMA was filled to capacity in 1992. The East TMA covers approximately 32 hectares and contains approximately three million tonnes of tailings.

In the 1980s and 1990s, TANCO occasionally mined and reprocessed surficial (above the tailings porewater surface) tailings deposits in the southern half of the East TMA for recovery of residual tantalum. TANCO has no plans to pursue this in the future.

The East TMA is contained by natural topography and four dams (Figure 3.2). Precipitation runoff from the East TMA is directed to the phreatic ditch which runs under CPF Containment Cell No. 2 to the Surge Pond, from which the runoff is then pumped to the West TMA. Prior to 2004, East TMA runoff flowed directly into Bernic Lake through a culvert in the Main Dam.

3.8.2 *West TMA*

Development of the West TMA was approved in 1991 through an alteration of *Environment Act* Licence No. 973. Placement of tailings in the West TMA started in 1991 and has continued to the present, with approximately three million tonnes deposited to date. Tailings are transported from the mill to the TMA in three 150 mm trestle-supported Certa Lok Yelomine pipelines (two for tantalum, and one for spodumene) and are placed in the TMA by end-of-pipe discharge. The West TMA consists of the primary tailings pond and a secondary polishing pond (Figure 3.2). The polishing pond was originally developed in the mid-1980s to manage the feldspar waste from the spodumene process and tailings wastewater from the, then-active East TMA.

The ultimate capacity of the West TMA at the maximum design dyke height of 321.6 masl (metres above sea level) is six million tonnes. Total capacity at the current dyke height of 320.1 masl is 3.73 million tonnes, with 3 million tonnes already in place. The current management and development plan for the West TMA indicates the TMA has capacity for 10 more years of operation at full production. The need for additional dyke raises will be determined by the timing of any resumption of tantalum and/or spodumene production. Provision of this capacity will involve the staged raising of containment dykes and dams from the current elevation to the final elevation of 321.6 m. At the final dyke elevation, the West TMA will cover approximately 40 ha at the end of mine life.

Approximately 13 ppm by weight of flocculent, either Canpol or Magnafloc 368, typically has been added to the tailings stream to promote settling of suspended solids in the primary pond. The flocculent addition was discontinued on May 9, 2010, but would resume with the resumption of tantalum and/or spodumene mining.

Excess water in the primary pond is decanted to the polishing pond through a control weir for clarification and pH adjustment prior to release via the West Discharge. Management of pH in the polishing pond is necessary to counter the effects of photosynthetically elevated pH that occurs as a result of algal photosynthesis during the open water season. The effluent pH is adjusted to an approximate range of 8.5 to 9.1 with the addition of sulphuric acid to the polishing pond upstream of the West Discharge. Acid (10% sulphuric acid) is pumped into a U-shaped discharge manifold floated upstream of the discharge (Figure 3.4). Acid is pumped to the manifold using a peristaltic pump. The rate of acid addition is managed by monitoring the pH of the discharge at two hour intervals during acid application and the monitoring results are used to adjust the pumping rate and maintain the target pH range. Effluent pH is measured every 4 hours when acid is not being applied. The pH adjustment system was first installed April 2010 and removed in October 2010 before the establishment of winter ice cover to avoid damage by the ice. The system is installed in the polishing pond each year after spring ice out and is in use from April to September when elevated polishing pond pH occurs.

Figure 3.4 Photograph showing the pH adjustment system at the West Discharge.

3.8.2.1 *Dams and Control Structures*

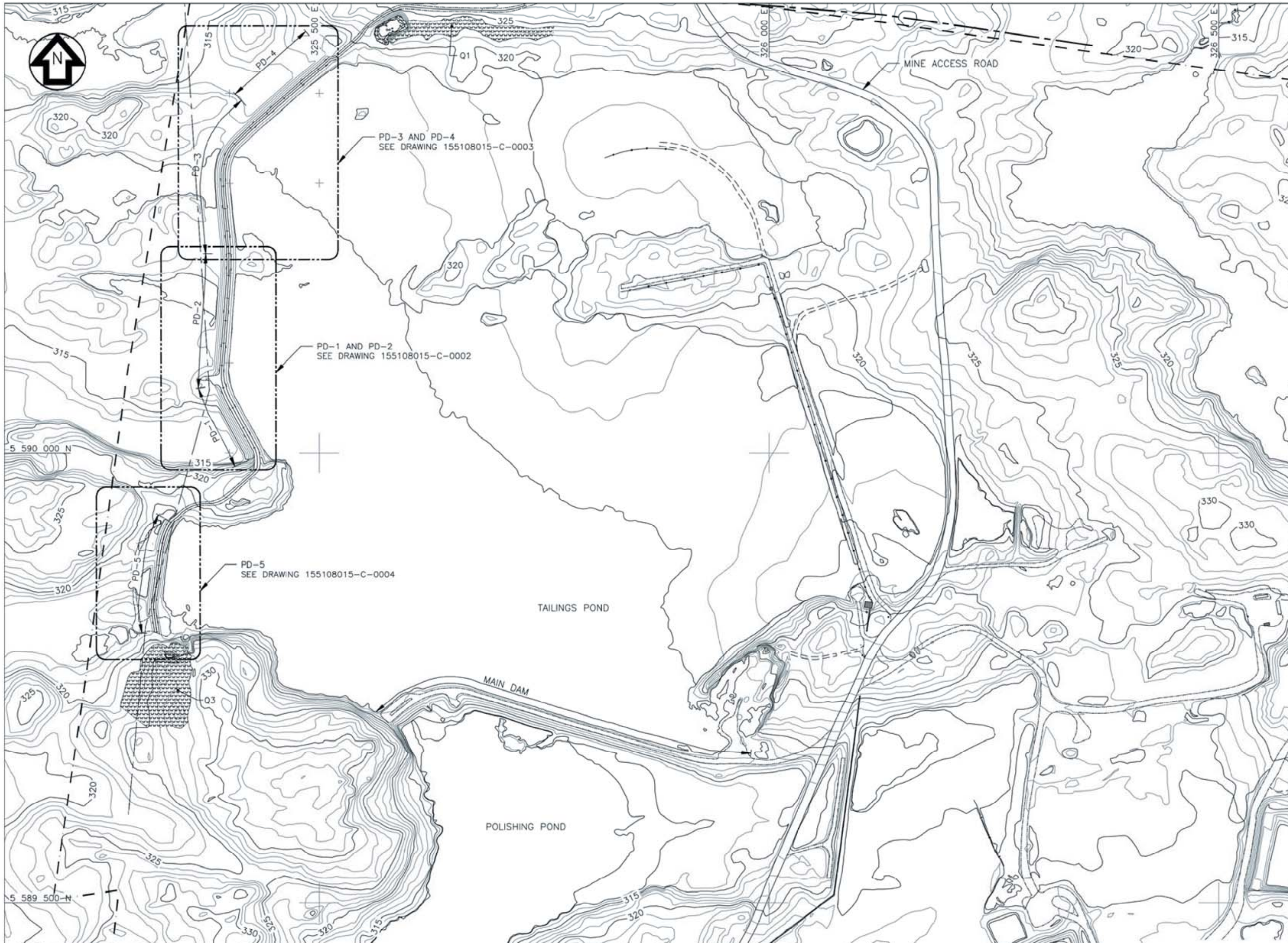
The earthfill structures that contain the two ponds of the active West TMA consist of a Main Dam (designated MD-1), a dam at the West Discharge Compliance Point (designated CPD), and five perimeter dykes (designated PD-1 through PD-5, Figure 3.5).

The Main Dam and Perimeter Dykes have a geomembrane liner (composed of 60 mil PVC) incorporated into their structure to mitigate against fluid loss (Hatch 2009; Appendix E). The initial stages of the Main Dam consist of a rock fill embankment with an upstream impervious blanket (composed of a combination of bedrock, clay, till and the geomembrane liner), whereas Perimeter Dykes PD-1 through PD-4 were initially comprised of a clay core and an outer rockfill shell. Both the Main Dam and Perimeter Dykes have been raised several times:

- Perimeter Dams 1 through 4 were raised to 334.7 metres in 2004
- Main Dam was raised to 334.7 metres and Perimeter 5 Dam was built to 334.7 metres in 2005
- All dams were raised to 336.2 metres in 2008

In 2004 and subsequent lifts, the elevation of the dykes was raised with the use of a geomembrane liner tied into the existing clay core or impervious blanket. In 2005 a similar design was completed on the Main Dam when the crest of the dam was raised, using a geomembrane liner tied into the upstream impervious blanket. During the 2005 construction season, Perimeter Dyke PD-5 was also built. The new dyke was constructed on clay sediment, with a rockfill base and a geomembrane liner within the upstream face of the structure to provide fluid retention. The liner was tied into the foundation with a key trench into the clay. Perimeter Dykes PD-1 to PD-5 and the Main Dam were raised again in 2008 using a geomembrane liner tied into the liner installed in 2004/2005. For both the Main Dam and Perimeter Dykes, granular fill was placed on either side of the liner and within the core of the structures, with a layer of rockfill placed on the upstream and downstream slopes to minimize erosion. No detailed information is available on the cross section of the Compliance Point Dam.

Earth dams and control structures are inspected annually by Hatch and remedial work is implemented as per the inspection reports. In September 2009 seven structures within the TMA were inspected: the Main Dam (MD-1), the Compliance Point Dam (CPD), and five perimeter dykes (PD-1 through PD-5) (Hatch 2009). Although some erosion and seepage was noted, the structures were found to be in satisfactory condition.



LEGEND:

- SHORELINE
- GROUND SURFACE ELEVATION CONTOUR (315)
- GROUND SURFACE CONTOUR
- TRACK
- DAM/DYKE CREST
- BUILDING
- PIPELINE
- FENCE
- COORDINATE GRID MARKER
- NEW DYKE CREST
- POTENTIAL QUARRY EXPANSION
- TANCO 2004 MINERAL LEASE BOUNDARY
- TANCO 2006 MINERAL LEASE BOUNDARY

NOTES:

1) CONTOUR INTERVAL IS I METRE.
2) SURFACE CONTOURS ARE BASED ON AERIAL PHOTOGRAPHY BY ATLIS GEOMATICS, PERFORMED ON JUNE 3, 2006 AT A SCALE OF 1:8000.
3) ALL CONTOURS AND ELEVATIONS GIVEN IN SECTION ARE IN UTM COORDINATES. TO CONVERT TO TANCO ELEVATIONS USE THE FOLLOWING EQUATION:

   TANCO FT = (UTM/0.3048)+52.84

4) COORDINATES, ELEVATIONS AND DIMENSIONS ARE IN METRES, UNLESS OTHERWISE NOTED.

SCALE 1:2000 — 50 0 50 100 150 200 METRES

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FIGURE 3.5
MAIN DAM AND PERIMETER DYKES

3.9 Cesium Products Facility

TANCO produces a number of cesium-based products from pollucite ore in the Cesium Products Facility (CPF). The CPF was initially developed in 1997 as a pilot plant to test a process for the production of a cesium formate drilling fluid. The pilot facility was converted to a production plant in 1999, producing approximately 6,000 barrels of cesium formate drilling fluid per annum. By 2004, production capacity was increased to 8,400 barrels of cesium formate drilling fluid per annum. TANCO's parent company, Cabot Speciality Fluids, relocated their entire cesium products manufacturing (cesium sulphate, cesium hydroxide, and cesium carbonate) program from their facilities in Revere, Pennsylvania, USA to the CPF in 2002. Over the past three years, annual production of other cesium products has ranged from 403 to 538 equivalent barrels.

3.9.1 Chemical Plant Equipment

Equipment used in the chemical plant includes:

- Process tanks
- Evaporators
- Conveyors (belt and screw)
- Boiler
- Pumps
- Heat exchangers
- Agitators
- Belt filter
- Material storage bins
- Ventilation fans
- Filter Presses

3.9.2 Product Storage and Transportation

The liquid cesium products (formate) are placed in high density polyethylene totes as they are produced. The totes have a volume of one cubic metre and are filled with 1,860 kg of formate. The density of the formate varies from 2.2 g/cm^3 in the summer to 2.15 g/cm^3 in the winter and fills 81% to 87% of each tote. Totes are shipped in batches of 10, via truck, to a third-party warehouse in Winnipeg for storage prior to shipment to the customer.

3.10 CPF Residue Management

3.10.1 Current Residue Management

Two process byproduct cells (CPF Cell No. 1 and CPF Cell No. 2) are located in the inactive East TMA (Figure 3.2). The containment cells are used for recovery of the process liquor for recycle back to the CPF process. Solids (primarily ore gangue, calcium sulphate, barium sulphate and aluminum hydroxides) from the chemical plant are retained in the containment cells. Cell No. 1 capacity is 54,600 m^3 and Cell No. 2 capacity is 98,500 m^3.

The cells are used alternately, with one cell filled with residue and then the residue is removed while the other cell is filled. The solid residue from the CPF process is slurried in the plant and pumped into one of the cells. The cell retains the slurry, allowing the suspended solids and liquid (the decant) to separate by gravity settling. The decant is pumped back to the chemical plant for use in the process while the solids remain in the cell. The cells each have a double HDPE liner to provide containment of the residue. The outer liner creates an inter-liner space that allows for monitoring of inner liner leakage through pump-ports installed between the liners.

Once a cell is filled with residue solids, the residue is dewatered, removed, and dry-stacked in the designated residue placement area in the East TMA. The chronology of cell dewatering and residue removal is detailed in Table 3.6.

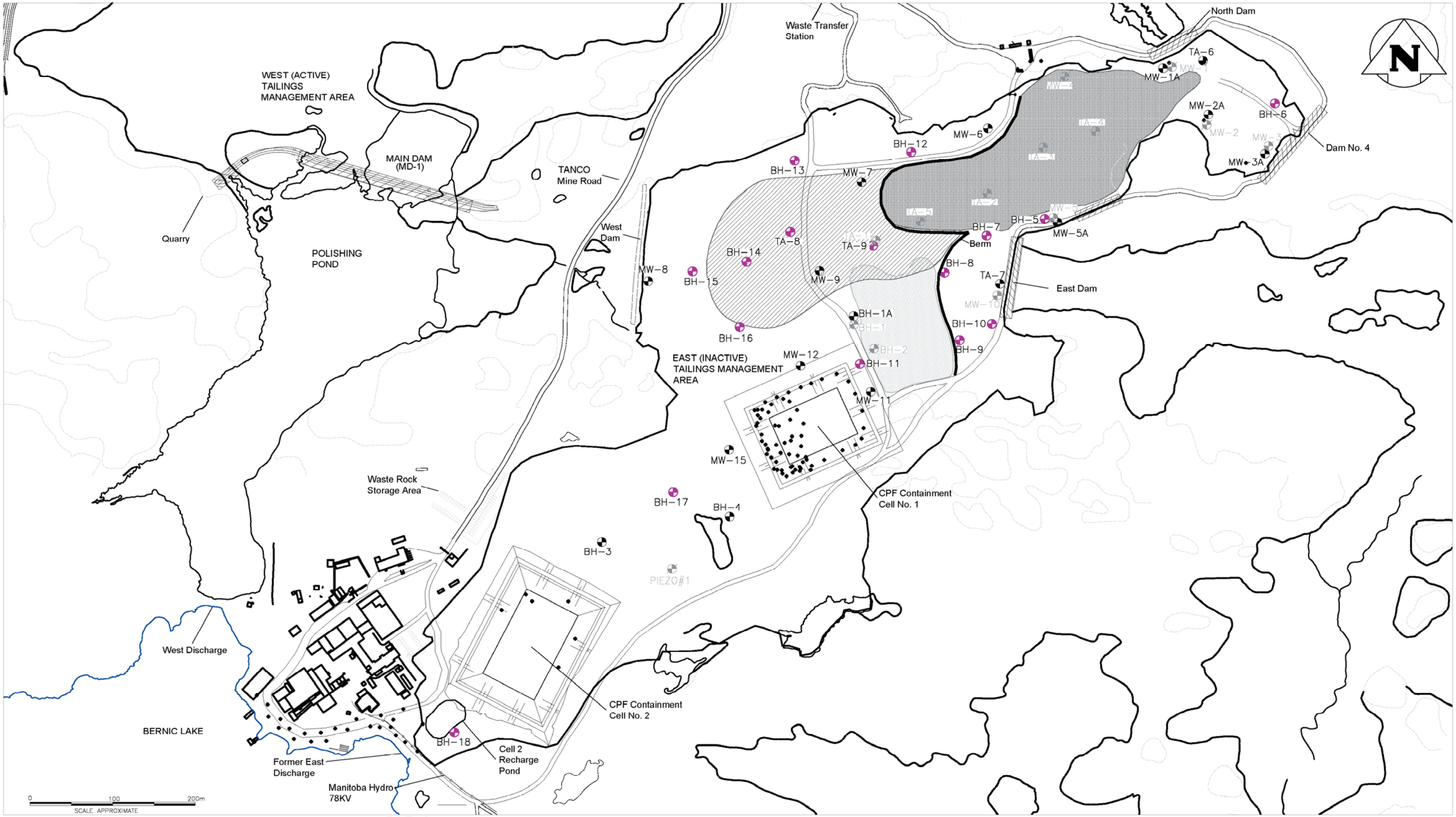
The primary consideration in locating the CPF residue drystack was groundwater travel time to the points of tailings porewater discharge to the receiving environment (i.e., at the four constructed dams). The guiding principles in TANCO's residue management approach include:

- minimization of the footprint of the residue stockpile;
- maximizing distance from the stockpile to any discharge points, and,
- ensuring that the height of the pile remains below the surrounding tree line (351.7 masl)

Residue quantities removed to the drystack since 2001 and estimated quantities to end of mine life are detailed in Table 3.6. The final footprint of the residue drystack at end of mine life is shown in Figure 3.6. Approximately 140,000 m^3 of residue will be left in the containment cells at the end of mine life for a total residue quantity on surface of 1,170,000 m^3 at mine closure. The residue management plan at closure is discussed in Section 3.21.2.

Table 3.5 Chronology of CPF cell dewatering and residue removal from 2001 to 2011 (volumes are +/- 10%); and estimated residue removal from 2011 to 2017.

Cell No.	Year	Residue Removed (m^3)
1	2001	50,000
2	2002	90,000
1	2004	50,000
2	2005	90,000
1	2006	50,000
2	2007	90,000
1	2008	50,000
2	2009	90,000
1	2011	74,000
Subtotal 2001 - 20011		**634,000**
2	2012	90,000
1	2013	50,000
2	2014	90,000
1	2015	50,000
2	2016	90,000
1	2017	50,000
Subtotal 2012 - 2017		**420,000**
Total 2001 - 2017		**1,054,000**



LEGEND

- MONITOR WELL (INSTALLED BY WARDROP 2008)
- MONITOR WELL (INSTALLED BY OTHERS)
- MONITOR WELL (DESTROYED)
- LIMITS OF TAILINGS MANAGEMENT AREA
- RESIDUE PLACEMENT AREA (2001–2010)
- RESIDUE PLACEMENT AREA (2007)
- RESIDUE PLACEMENT AREA (2011–2017)

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FIGURE 3.6
ESTIMATED RESIDUE FOOTPRINT AT END OF MINE LIFE

3.11 WATER USE AND MANAGEMENT

The TANCO operation draws water from two sources, fresh water from Bernic Lake and recycled water from the West TMA polishing pond. The total annual water requirement is in the range of 3.15 to 3.25 million m^3, with approximately 55% drawn from Bernic Lake and the balance reclaimed from the polishing pond. All withdrawals from Bernic Lake are subject to the conditions of Water Rights Act Licence No. 92-125 (expires October 28, 2012), which sets the maximum withdrawal rate at 0.113 m^3/sec and the maximum annual withdrawal at 3,700.5 cubic decametres (3,700,500 m^3). There are a total of six intakes which all meet the DFO minimum design requirements (DFO 1995; Table 3.7).

TANCO has not developed a site wide water balance. The following is drawn from a number of facility records for the period from 2005 to 2010 to provide an overview of water withdrawals, uses, and discharges at the facility.

The conventional milling process uses all of the recycled water and approximately 55% of the Bernic Lake water. Approximately 40% of the Bernic Lake water goes to the CPF for cooling, and, with the exception of evaporative losses, is returned to the polishing pond. Small quantities of fresh water are directed to the mine for drilling and washdown (<1%), to the CPF process (2%), and for domestic uses (2%) in the office, mill, warehouse, and mine dry. Water for domestic use is passed through a sand bed filter and is chlorinated prior to distribution for domestic uses other than drinking (Table 3.7).

The combined total annual water discharge from the mine and mill to the West TMA is 2,400,000 m^3 (maximum); note, this is less than water volume drawn into the mill because some water is evaporated off during drying of final product for both tantalum and spodumene. The annual discharge from the West Discharge (compliance point) of the polishing pond is approximately 3,000,000 m^3 when the mine is in full production.

Table 3.6 Water intake screen specifications.

Intake	Spodumene	Fire Pump Electric	Fire Pump Diesel	Cesium (8")	Cesium (6")	Domestic Water
Line Diameter (cm)	20	20	20	20	15	10
Maximum Flow (US gpm)	1000	500	500	450	450	50
Maximum Flow (L/s)	63	32	32	28	28	3
Open Screen Area (m^2)						
Subcarangiform	0.60	0.30	0.30	0.26	0.26	0.05
Anguilliform	1.70	0.84	0.84	0.73	0.73	0.13
Effective Screen Area (m^2)						
Subcarangiform	0.96	0.48	0.48	0.416	0.416	0.08
Anguilliform	2.72	1.344	1.344	1.168	1.168	0.208
Mesh (mm)	2.54	2.54	2.54	2.54	2.54	2.54
Open Area	0.625	0.625	0.625	0.625	0.625	0.625
Diameter (m)	1.270	0.762	0.762	0.711	0.711	0.305
Length (m)	1.270	0.762	0.762	0.711	0.711	0.305
Area						
Cylinder (m)	5.07	1.82	1.82	1.59	1.59	0.29
Ends (m)	1.27	0.46	0.46	0.40	0.40	0.07
Total Area (m^2)	6.33	2.28	2.28	1.99	1.99	0.37
Minimum Difference	3.61	0.94	0.94	0.82	0.82	0.16
Effective Screen Area/Total Area	232.9%	169.7%	169.7%	170.0%	170.0%	175.6%

3.12 SITE RUNOFF MANAGEMENT

The majority of the minesite runoff drains into either the active West TMA or inactive East TMA. The active TMA drains through a polishing pond to the lake via an engineered control structure, which is referred to as the West Discharge. This constitutes the only mine effluent discharge to Bernic Lake. Until June 2004, surface runoff and tailings porewater from the inactive East TMA drained to Bernic Lake via the East Discharge; a culvert installed in the main dam of the east TMA. The East Discharge was discontinued in June 2004 when the culvert was removed and all runoff accumulation was directed to the West TMA.

Surface runoff and tailings porewater from the East TMA drains to the phreatic ditch, which flows under CPF Containment Cell No.2 to the Surge Pond, and is then pumped to the West TMA via the tailings lines.

Direct runoff to Bernic Lake from the minesite is limited to the southern margins of the site, outside of the perimeter minesite road. All site roads have been contoured to direct runoff to the Surge Pond, the polishing pond, the East TMA, or the West TMA.

Cooling water from the CPF is discharged into the polishing pond approximately 50 m east of the West Discharge. Boiler blowdown water from the CPF is added to this stream and is diluted by the cooling water flow. The annual discharge of boiler blowdown water is 136.5 cubic metres and contains small quantities of additives required to condition the boiler water (Table 3.8). Water used for cooling in the CPF has no contact with any products or reagents.

Table 3.7 Boiler water treatment chemicals.

Chemical	Function	Quantity (litres)	Frequency
Cortrol IS 1050	oxygen scavenger	0.25 - 5.0	every 3-4 days
Optisperse PQ4684	internal treatment	0.5 - 1.0	every 5-6 days
Optisperse ADJ5050	alkalinity adjustment	1	1-2 times/year
Steamate NA5640	condensate treatment	0.5 - 1.0	every 4-5 days

3.13 WASTE MANAGEMENT

3.13.1 *SOLID WASTE*

Solid waste produced at the facility is collected at the waste transfer station where it is held until it is transported to a licenced facility. The waste transfer area is underlain by clay and glacial till from 0 to 15 m thick over granite bedrock and the few aquifers in the area are confined to gravel and sand lenses in or below the till and fracture zones in the bedrock.

Two bins are located at the waste transfer station: one for the collection of rubber and the other for general garbage and lunchroom waste. The general garbage bin is collected by a contractor approximately every two weeks. The rubber bin is collected quarterly.

3.13.2 Sanitary Waste

Sanitary waste is produced from washroom facilities in the mill and mine dry. At full workforce (150 people), the volume of wastewater produced is approximately 21,900 m^3/year to 27,375 m^3/year, based on the normal wastewater production of about 400 to 500 litres per person per day.

There are two sewage ejector systems at the facility: one system to service the main office and the other to service the mill and mine dry buildings. Sewage from the systems' service area drains into a septic tank where the liquid effluent is decanted, leaving solids in the tank. The liquid effluent is pumped from the septic tanks to a designated grey water discharge area, located north of the main office complex on the east side of the mine road between the road and the West dam of the East TMA (Figure 3.2). The solids are periodically pumped out of the tank by a local septic tank contractor. TANCO has an approval for variance of the Regulation for the sewage ejector system that services the mine dry and licence #95-EIL-80 applies to the main office ejector system.

3.13.3 Hazardous Waste

TANCO is registered as a Hazardous Waste Generator with Manitoba Conservation (Registration #MBG01598). Waste materials classified as hazardous under the Manitoba regulations are collected in UN designated containers and stored on-site in a contained storage building (Table 3.9). Weekly inspections are conducted to ensure the integrity of the storage area. The accumulated wastes are shipped using licenced carriers to licenced disposal facilities. Five part manifests are used to trace the shipment of the wastes to ensure that they arrive at the specified destination. Applicable regulations are:

- Manitoba Regulation 282/87 – Classification Criteria for Products, Substances and Organisms Regulation;
- Manitoba Regulation 175/87 – Generator Registration and Carrier Licensing Regulation; and,
- Manitoba Regulation 139/88 – Manifest Regulation.

In addition, other non-regulated wastes that are of an environmental concern, such as fluorescent light bulbs, used antifreeze, and electronic waste are handled and disposed of as if they were hazardous waste.

Scrap steel, rubber, and paper are recycled, and non-recyclable wastes are sent to the Class 1 landfill operated by the Rural Municipality of St. Clements in Libau, Manitoba.

Table 3.8 Hazardous Waste quantities generated and registered with the Province of Manitoba.

Waste	Physical State	Shipping Name	UN #	TDG Class	Packing Group	Provincial Waste Class	Quantity Generated per Month	Frequency of Generation	Treatment Disposal Code
Used Lubricating Oil	L	Waste Environmentally Hazardous Substance, Liquid, N.O.S. (Lead)				252	1800 L	C	X
Used Oil Filters (uncrushed)	S	Waste Environmentally Hazardous Substance, Solid, N.O.S. (Lead)				252	50 kg	C	X
Lead-Acid Batteries	S	Waste Batteries, Wet, Filled with Acid	2794	8	III	114	50 kg	R	X
Used Varsol Solvent	L	Waste Petroleum Distillates N.O.S.	1268	3	III	213	35 L	C	X
Used Aerosol Cans	S	Waste Aerosols, flammable	1950	2.1		212	5 kg	R	X
Waste Oil-based Paint	L	Waste Paint	1263	3	III	145	5 kg	R	X
Hydrochloric Acid	L	Waste Hydrochloric Acid	1789	8	II	114	1890 L	O	X
Asbestos Containing Waste	S	Waste Asbestos, White	2590	9	III		5 kg	R	X
NiCad, NiMH & Alkaline Batteries	S	Waste Batteries, dry, containing potassium hydroxide solid	3028	8	III		5 kg	R	X

C – continuous

L – liquid

O – one-time

R – random

S – solid

X – waste transported off-site by a waste carrier or disposal company

3.14 NOISE MANAGEMENT

Noise levels are regularly monitored inside the operating facilities as required by the Manitoba Workplace Safety and Health Act and Regulations. Monitoring results are posted on bulletin boards throughout the minesite. The areas where noise exceeds the regulatory limit of 80 dBA are identified with signs indicating that hearing protection is required. All employees are provided with a selection of hearing protectors (ear muffs, plugs). A noise survey was conducted on the ventilation raises on June 16, 2011. The Jack Nutt shaft ventilation raise and East End ventilation raise have noise levels exceeding 80 dB at the source (95.5 and 93.0 dBA, respectively), but are < 80 dB at distances of > 20 m away. All employees have an annual audiogram, with unusual results being flagged for follow up. The results are submitted to the Manitoba Workplace Safety and Health Division. The aggregated results are reviewed by the site Workplace Safety and Health Committee.

3.15 OPERATION EMISSIONS AND MANAGEMENT

3.15.1 AIR

The facility produces the following emissions to air which are estimated and reported annually to the National Pollutant Release Inventory (Table 3.10 and 3.11):

- Formic acid;
- Sulphuric acid;
- Particulate matter (PM_{10} and $PM_{2.5}$); and
- Dust (from roads).

Formic acid vapour is emitted during truck unloading into the formic acid bulk storage tank. Sulphuric acid mist and vapour are emitted from the digester in the chemical plant where the pollucite ore is dissolved.

Air quality during normal operations of the CPF was modeled using the U.S. Environmental Protection Agency SCREEN3 computer model (Appendix F; TetrES 1997). The air-dispersion modeling indicated that ground-level concentrations of all pollutants would not exceed the Manitoba Maximum Acceptable Level Concentrations (MAL) and air quality objectives at the property boundary. The same holds true today when compared against the updated MAL guidelines.

A dust survey conducted in 2007 determined that the Cesium Products Facility (CPF) residue stockpile does not represent a significant source of airborne dust when covered with the feldspar waste rock cap (Appendix G).

TANCO operates 11 baghouses and dust collectors in place to control emissions of fine host mineral particles (Table 3.12).

Table 3.9 Summary of historic substance releases to air from the TANCO Mine (2000 – 2010), NPRI ID 2278, note all sulphuric acid is released as stack or point released to air (from NPRI).

CAS Number	Substance	Units	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
64-18-6	Formic acid	tonnes	-	-	-	-	-	-	0.085	0.085	0.083	0.025	0.0363
7664-93-9	Sulphuric acid	tonnes	0.071	0.117	0.103	0.111	0.146	0.146	1.454	1.386	1.386	0.544	1.175
NA-M08	Total PM	tonnes	-	-	-	-	-	-	-	98.046	36.332	140.263	23.177
NA-M09	PM_{10}	tonnes	-	-	-	-	-	-	-	30.295	11.031	36.000	7.130
NA-M10	$PM_{2.5}$	tonnes	-	-	-	-	-	-	1.345	4.487	2.190	4.800	1.342

Table 3.10 Summary breakdown of Particulate Matter (PM) releases to air (2006 - 2010); note that the significant increase PM releases beginning in 2007 as a result of the addition of road dust to the reporting requirements.

	$PM_{2.5}$	Total PM	PM_{10}	$PM_{2.5}$	Total PM	PM_{10}	$PM_{2.5}$	Total PM	PM_{10}	$PM_{2.5}$	Total PM	PM_{10}	$PM_{2.5}$
Release (tonnes)	**2006**		**2007**			**2008**			**2009**			**2010**	
Stack or Point Release	0.31	0.301	0.301	0.301	0.117	0.117	0.117	0.07	0.07	0.07	0.06	0.06	0.06
Fugitive Releases	1.035	1.578	1.578	1.361	1.471	1.471	1.068	0.957	0.957	0.631	0.822	0.822	0.628
Sub-total	1.345	1.879	1.879	1.662	1.588	1.588	1.185	1.027	1.027	0.701	0.882	0.882	0.688
Road Dust	-	96.167	28.416	2.825	34.744	9.443	1.005	139.236	35.408	4.084	22.295	6.248	0.654
Total Releases	1.345	98.046	30.295	4.487	36.332	11.031	2.19	140.263	36.435	4.785	23.177	7.13	1.342

Table 3.11 TANCO Baghouses and Dust Collectors.

Air Source	Baghouse	Equipment #	Airflow (cfm)
Spod Pneumatics Blower (either to storage bin or loadout bin)	Spod Storage Bin Baghouse	LD8285	1200
Spod Pneumatics Blower (either to storage bin or loadout bin)	Spod Loadout Bin Baghouse	LD8286	1200
Spod Baggin Area Dust Collector Fan	Spod Bagging Area Baghouse	LD8306	1500
Main Crushing House Dust Collector Fan	Main Crushing House D/C Baghouse	LD6023	15100
Transfer Tower Dust Collector Fan	Transfer Tower D/C Baghouse	LD6029	5000
Fine Ore Bin Dust Collector Fan	Fine Ore Bin D/C Baghouse	LD6046	5900
Dry Grind Plant Dust Collector Fan	Dry Grind Dust Collector	LD4700	5025
Dry Grind FK Pump Compressor	Chem Plant Ore Silo Baghouse	LDF6	2000
Pneumatic Truck Blower	Lime Silo Baghouse	LDF7	
Floveyor Baghouse Fan	Floveyor Baghouse	LD8287	640
Tantalum Drier Dust Collector Fan	Tantalum Drier Dust Collector	LD6434	1200

3.15.1.1 Greenhouse Gas Emissions

Approximately 87% of recent project-related greenhouse gas (GHG) emissions originate from the combustion of propane for process steam production in the chemical plant, process and space heating for most on-site buildings, and heating the underground mine workings during the winter months (Tables 3.13 and 3.14). Heating of the ventilation air that goes underground during the winter months occurs at the vent fans. A further 10% of GHG emissions originate from the combustion of fuels in mobile equipment operation on surface and underground.

Table 3.12 TANCO greenhouse gas emissions (2008).

	Emissions factor (lbs/1000 USG)	Emission (kg)	Global Warming Potential	CO_2 Equivalent (tonnes)	%
Carbon Dioxide (CO_2)	12,500.0	7,288,111.80	1	7,288.1	84.28
Methane (CH_4)	0.2	116.6	21	2.4	0.03
Nitrous Oxide (N_2O)	0.9	524.7	310	162.7	1.88
Total (Propane)				**7,453.2**	**86.19**
Diesel				809.4	9.36
Gasoline				48.7	0.56
Barium Carbonate				328.3	3.80
Soda Ash				8	0.09
Total Equivalent CO_2				**8,647.7**	**100.00**

Table 3.13 TANCO greenhouse gas emissions (2009).

	Emissions factor (lbs/1000 USG)	Emission (kg)	Global Warming Potential	CO_2 Equivalent (tonnes)	%
Carbon Dioxide (CO_2)	12,500.0	4,325,649.8	1	4,325.6	85.93
Methane (CH_4)	0.2	69.2	21	1.5	0.03
Nitrous Oxide (N_2O)	0.9	311.4	310	96.5	1.92
Total (Propane)				**4,423.7**	**87.88**
Diesel				465.9	9.26
Gasoline				34.4	0.68
Barium Carbonate				109.9	2.18
Soda Ash				0.0	0.00
Total Equivalent CO_2				**5,033.8**	**100.00**

3.15.2 Land

Emissions to land include placement of mill tailings and CPF residue in designated tailings disposal areas on-site.

Contaminant emissions to the active Tailings Management Area, and for the waste rock used for road maintenance, are reportable under the requirements of the National Pollutant Release Inventory if they contain arsenic (As), chromium (Cr), cadmium (Cd), lead, (Pb), or Mercury (Hg). Tailings composition and annual emission quantities are detailed in Tables 3.15 and 3.16.

Table 3.14 Tailings composition.

Units	g/t
Antimony (Sb)	1.85
Arsenic (As)	< 10
Cadmium (Cd)	0.25
Chromium (Cr)	127
Cobalt (Co)	0.875
Copper (Cu)	10.1
Lead (Pb)	5.07
Manganese (Mn)	670
Mercury (Hg)	< 0.3
Nickel (Ni)	3.75
Phosphorus (P)	3100
Selenium (Se)	< 10
Silver (Ag)	< 2
Vanadium (V)	< 4
Zinc (Zn)	30.25

Table 3.15 Annual conventional tailings production (2005 to 2010).

Year	Total Volume of Tailings (tonnes)
2006	188,926
2007	178,725
2008	175,056
2009	71,280
2010	nil

3.15.3 WATER

As detailed in Sections 3.8.1 and 3.8.2, the primary discharge from the mine is the West Discharge, which reports to Bernic Lake. The only other source of discharge to water is local runoff from the mine road, which reports to the Bird River over much of the length of the road. Within the mine site surface runoff is directed to the tailings management areas. Only the westernmost margin of the mine site, outside the perimeter road, drains to Bernic Lake. Only the West Discharge is monitored for quality and quantity. Local runoff is not monitored for quality or quantity.

Monitoring of West Discharge quality has been conducted since the discharge was first established in 1996. The water quality monitoring required under Environment Act License No. 973 is limited to monthly measurements of pH and total suspended solids (TSS). More detailed characterization of the West Discharge was voluntarily initiated in

1997 by TANCO in anticipation of the requirement to comply with the Metal Mining Effluent Regulations, which ultimately came into effect in December 2002. The MMER requires weekly monitoring of pH and TSS and routine monitoring of what are termed deleterious substances (total As, Cu, Pb, Ni, Zn, and Ra^{226}) and acute toxicity to rainbow trout (48 hr LC50) and Daphnia magna (96 hr LC50). Monitoring frequency for deleterious substances and toxicity was initially monthly but was reduced to quarterly in 2005 on the basis of consistently low measured values over the first two years in accordance with the MMER. The occurrence of an acute toxicity failure in April 2006 required a return to monthly sampling for a minimum 12 month period, with the quarterly sampling implemented once again in May 2007 and continuing to the present. Monthly mean concentrations of deleterious substances, pH range, effluent discharge volumes, and acute toxicity test results from the West Discharge are presented in Table 3.17.

The effluent characterization data were compared to the Manitoba Water Quality Standards Objectives and Guidelines (MWQSOG; Williamson 2002) for the protection of aquatic life to provide an initial identification of parameters with the potential to adversely affect water quality or ecology in Bernic Lake. The MWQSOG are structured in three tiers. Tier I standards are applied to a particular effluent or waterbody and the specific standards vary with the particular project and the relevant issues. In the case of a metal mine the applicable standards are the allowable concentrations of deleterious substances under the Metal Mining Effluent Regulations. The Tier I standards are the least flexible of the three tiers and, in the case of the MMER effluent quality limits, must be complied with by the operation. Tier II Objectives are receiving water quality criteria that have been developed specifically for application in Manitoba. Tier III Guidelines are taken from the Canadian Council of Ministers of the Environment (CCME) water quality, sediment quality, and fish tissue quality guidelines. Tier II Objectives and Tier III Guidelines are applied to receiving waters and not to effluents and strict compliance is not required. The Tier II and III criteria provide overall guidance for the management of surface water quality in Manitoba. The occurrence of a parameter concentration in excess of a Tier II Objective or Tier III Guideline does not automatically infer an adverse effect, that is determined on the basis of site specific considerations, but the consistent occurrence of a parameter below the criterion can be taken to indicate no adverse effect associated with that parameter.

Mean total phosphorus concentrations exceeded the Tier III MWQSOG of 0.025 mg/L for all years sampled (Table 3.18). Mean nitrite concentrations exceeded the Tier III MWQSOG of 0.06 mg/L only in 2005 and 2006.

The mean total aluminum concentration also was greater than the Tier III MWQSOG of 0.100 mg/L (for pH $\geq$ 6.5) in 1997 to 2002, 2003, 2004, 2005 and 2007. Mean total iron exceeded the Tier III MWQSOG of 0.300 mg/L in 2004, 2006 and 2007.

Annual mean values of three parameters, total selenium, total silver, and total thallium appeared to exceed the Tier III MWQSOG from 1997 through 2002 (Table 3.18). These apparent exceedences disappeared in 2003 when analytical detection limits were lowered and have not returned since, indicating the exceedences were an artefact of the detection limits employed.

The Tier II MWQSOG for metals applies to the dissolved fraction. Analysis of dissolved metals for effluent characterisation was initiated in 2005. Mean annual concentrations of metals were below the applicable Tier II MWQSOG for all years (Table 3.18).

Effluent discharge volume at the West Discharge ranged from 2.33 million m^3/year to 2.95 million m^3/year between 2003 and 2009 (Table 3.17). Effluent discharge volume is not a direct function of ore production because TANCO pumps water to maintain flows in the absence of tailings deposition.

However, mine productivity does indirectly influence the amount of effluent discharged as evidenced by a record low discharge volume which coincided with a substantial decline in production at the TANCO Mine. The processing of tantalum and spodumene ore ceased in May and August of 2009, respectively, and the lowest annual volume of effluent was discharged to Bernic Lake in 7 years (2,334,912 m^3; Table 3.17). The highest concentrations of total suspended solids occurred during years of the lowest discharge volumes (2003 and 2009; Table 3.17), while pH ranges were similar among all years monitored. There was no evidence of temporal trends in the concentrations of deleterious substances.

Table 3.16 Monthly mean concentrations of deleterious substances, pH range, total monthly effluent volumes and acute toxicity test results in the West Discharge; 2003-2010. Units are mg/L unless otherwise noted. Values in italics exceed the authorized limits under MMER Schedule 4 but were within the limits of the transitional authorization provided to TANCO during the first year of MMER implementation. Shaded values exceed the authorized limits under Schedule 4 of the MMER.

Month	As	Cu	Pb	Ni	Zn	TSS	Ra (Bq/L)	Lowest pH	Highest pH	Effluent volume (m^3/mth)	Rainbow Trout 96h LC50	Daphnia magna 48h LC50
Jan-03	0.0056	0.0024	0.0002	0.0038	0.0170	7.0	<0.01	na	na	124,738	>100%	>100%
Feb-03	0.0049	0.0035	0.0003	0.0039	0.0190	5.0	<0.01	na	na	78,463	>100%	>100%
Mar-03	0.0074	0.0025	0.0003	0.0051	0.0140	3.0	<0.01	na	na	178,390	>100%	>100%
Apr-03	0.0074	0.0050	0.0009	0.0091	0.0260	10.0	NMR	na	na	216,270	>100%	>100%
May-03	0.0065	0.0040	0.0005	0.0063	<0.004	10.0	NMR	na	na	223,898	>100%	>100%
Jun-03	0.0102	0.0020	0.0004	0.0038	0.0050	***20.0***	<0.01	na	na	568,019	>100%	>100%
Jul-03	0.0116	0.0020	0.0004	0.0029	0.0040	***17.0***	NMR	na	na	154,423	>100%	>100%
Aug-03	0.0120	<0.004	0.0004	0.0031	0.0050	***18.0***	NMR	na	na	190,022	>100%	>100%
Sep-03	0.0098	0.0010	0.0004	0.0024	0.0030	***21.0***	<0.01	na	na	160,590	>100%	>100%
Oct-03	0.0068	<0.002	0.0005	0.0034	<0.004	***21.0***	NMR	na	na	168,231	>100%	>100%
Nov-03	0.0054	<0.002	0.0004	0.0046	0.0040	<7	NMR	na	na	157,192	>100%	>100%
Dec-03	0.0042	<0.002	<0.0002	0.0050	0.0070	<7	<0.01	na	na	177,289	NMR	NMR
Mean	**0.0077**	**0.0023**	**0.0004**	**0.0045**	**0.0090**	**11.6**	**<0.01**	**Min --**	**Max --**	**Total (2003) 2,397,525**		
Jan-04	0.0047	0.001	0.0003	0.0097	0.01	5	<0.01	7.0	7.3	181,241	>100%	>100%
Feb-04	0.0047	0.001	0.0003	0.0097	0.01	6	<0.01	7.0	7.2	188,609	NMR	NMR
Mar-04	0.0047	0.001	0.0003	0.0097	0.01	7	<0.01	6.0	7.1	196,453	>100%	>100%
Apr-04	0.0072	0.002	0.0005	0.0138	0.009	15	<0.01	6.8	7.1	287,640	>100%	>100%
May-04	0.0072	0.002	0.0005	0.0138	0.009	<11	<0.01	7.3	9.1	288,106	NMR	NMR
Jun-04	0.0072	0.002	0.0005	0.0138	0.009	9	<0.01	7.7	9.1	225,216	>100%	>100%
Jul-04	0.0054	0.001	0.0002	0.0051	0.003	11	<0.01	8.5	9.0	274,210	NMR	NMR
Aug-04	0.0054	0.001	0.0002	0.0051	0.003	11	<0.01	8.1	9.1	361,623	NMR	NMR
Sep-04	0.0054	0.001	0.0002	0.0051	0.003	<9	<0.01	7.3	7.7	--	>100%	>100%
Oct-04	0.0036	0.002	0.0002	0.0113	0.009	10	<0.01	7.5	8.2	484,336	NMR	NMR
Nov-04	0.0036	0.002	0.0002	0.0113	0.009	12	<0.01	7.6	8.2	145,734	NMR	NMR
Dec-04	0.0036	0.002	0.0002	0.0113	0.009	5	<0.01	7.0	7.4	144,607	>100%	>100%
Mean	**0.0052**	**0.0015**	**0.0003**	**0.0100**	**0.0078**	**8.4**	**<0.01**	**Min 6.0**	**Max 9.1**	**Total (2004) 2,777,775**		

Table 3.16 (cont'd) **Monthly mean concentrations of deleterious substances, pH range, total monthly effluent volumes and acute toxicity test results in the West Discharge; 2003-2010. Units are mg/L unless otherwise noted. Values in italics exceed the authorized limits under MMER Schedule 4 but were within the limits of the transitional authorization provided to TANCO during the first year of MMER implementation. Shaded values exceed the authorized limits under Schedule 4 of the MMER.**

Month	As	Cu	Pb	Ni	Zn	TSS	Ra (Bq/L)	Lowest pH	Highest pH	Effluent volume (m^3/mth)	Rainbow Trout 96h LC50	Daphnia magna 48h LC50
Jan-05	NMR	NMR	NMR	NMR	NMR	8.0	NMR	6.9	7.3	207,312	NMR	NMR
Feb-05	NMR	NMR	NMR	NMR	NMR	8.8	NMR	6.5	6.8	193,424	NMR	NMR
Mar-05	0.0095	0.0038	0.00062	0.0323	0.0071	10.2	<0.01	6.5	6.7	167,822	>100%	>100%
Apr-05	NMR	NMR	NMR	NMR	NMR	15.5	NMR	6.6	7.5	245,655	NMR	NMR
May-05	0.0049	0.0017	0.00025	0.0147	0.0028	13.0	<0.01	8.0	9.0	242,910	>100%	>100%
Jun-05	NMR	NMR	NMR	NMR	NMR	11.9	NMR	7.4	8.6	297,495	NMR	NMR
Jul-05	0.0076	0.0015	0.00018	0.0039	0.0031	7.5	<0.01	7.9	9.5	371,690	>100%	>100%
Aug-05	NMR	NMR	NMR	NMR	NMR	12.7	NMR	8.0	9.5	303,688	NMR	NMR
Sep-05	NMR	NMR	NMR	NMR	NMR	15.0	NMR	8.5	9.3	196,958	NMR	NMR
Oct-05	0.007	0.0012	0.00027	0.0053	0.0016	14.3	<0.01	7.5	8.2	227,609	>100%	>100%
Nov-05	NMR	NMR	NMR	NMR	NMR	9.0	NMR	7.0	8.0	151,275	NMR	NMR
Dec-05	NMR	NMR	NMR	NMR	NMR	6.8	NMR	7.0	7.8	146,952	NMR	NMR
Mean	**0.0073**	**0.0021**	**0.0003**	**0.0141**	**0.0037**	**11.0**	**<0.01**	**Min 6.5**	**Max 9.5**	**Total (2005) 2,752,790**		
Jan-06	NMR	NMR	NMR	NMR	NMR	5.0	NMR	6.5	6.9	221,297	NMR	NMR
Feb-06	NMR	NMR	NMR	NMR	NMR	4.0	NMR	6.6	6.7	174,720	NMR	NMR
Mar-06	0.0062	0.0021	0.0004	0.0154	0.0075	4.2	<0.01	6.6	6.8	210,304	85.7	>100%
Apr-06	0.0042	0.0021	0.0004	0.0121	0.0061	9.0	<0.01	6.7	8.0	248,467	>100%	>100%
May-06	0.0041	0.0015	0.0001	0.0086	0.0071	12.8	<0.01	7.7	9.5	213,317	>100%	>100%
Jun-06	0.0046	0.0022	0.0012	0.0054	0.0058	14.2	<0.01	7.3	9.4	174,870	>100%	>100%
Jul-06	0.0075	0.0003	0.0001	0.0032	0.0013	12.3	<0.01	8.4	9.2	210,320	>100%	>100%
Aug-06	0.0091	0.0009	0.0001	0.0026	0.0003	14.4	<0.01	8.9	9.5	216,820	>100%	>100%
Sep-06	0.0069	0.0009	0.0002	0.0034	0.0014	12.5	<0.01	8.1	9.5	203,535	>100%	>100%
Oct-06	0.0052	0.0009	0.00021	0.0040	0.0043	9.2	<0.01	7.7	8.0	218,649	>100%	>100%
Nov-06	0.0044	0.0012	0.00028	0.0052	0.0043	5.8	<0.01	7.3	8.8	218,855	>100%	>100%
Dec-06	0.0029	0.0010	0.00009	0.0053	0.0034	3.5	0.007 [a]	7.3	7.8	304,955	>100%	>100%
Mean	**0.0055**	**0.0013**	**0.0003**	**0.0065**	**0.0041**	**8.9**	**<0.01**	**Min 6.5**	**Max 9.5**	**Total (2006) 2,616,109**		

Table 3.16 (cont'd) **Monthly mean concentrations of deleterious substances, pH range, total monthly effluent volumes and acute toxicity test results in the West Discharge; 2003-2010. Units are mg/L unless otherwise noted. Values in italics exceed the authorized limits under MMER Schedule 4 but were within the limits of the transitional authorization provided to TANCO during the first year of MMER implementation. Shaded values exceed the authorized limits under Schedule 4 of the MMER.**

Month	As	Cu	Pb	Ni	Zn	TSS	Ra (Bq/L)	Lowest pH	Highest pH	Effluent volume (m^3/mth)	Rainbow Trout 96h LC50	Daphnia magna 48h LC50
Jan-07	0.0036	0.0013	0.00022	0.0076	0.0073	4.8	0.006	6.67	7.28	295,041	>100%	>100%
Feb-07	0.0044	0.0021	0.00026	0.0109	0.0054	4.2	0.009	6.95	7.52	199,799	>100%	>100%
Mar-07	0.0061	0.0028	0.00045	0.0182	0.0075	7.3	0.010	6.84	7.10	273,474	>100%	>100%
Apr-07	0.0056	0.0022	0.00058	0.0215	0.0110	8.2	0.020	6.87	9.36	315,103	>100%	>100%
May-07 [b]	NMR	NMR	NMR	NMR	NMR	7.5	NMR	8.51	9.36	201,432	NMR	NMR
Jun-07	NMR	NMR	NMR	NMR	NMR	9.3	NMR	6.65	9.56	264,600	NMR	NMR
Jul-07	0.0038	0.0011	0.00008	0.0030	0.0068	10.6	0.003	8.90	9.74	254,256	>100%	>100%
Aug-07	0.0049	0.0008	0.00016	0.0035	0.0060	11.5	0.009	8.20	9.50	281,201	>100%	>100%
Sep-07	NMR	NMR	NMR	NMR	NMR	10.0	NMR	7.70	8.90	172,883	NMR	NMR
Oct-07	0.0040	0.0017	0.00024	0.0051	0.0066	8.8	0.003	7.60	8.20	256,510	>100%	>100%
Nov-07	NMR	NMR	NMR	NMR	NMR	8.2	NMR	7.40	7.90	202,482	NMR	NMR
Dec-07	0.00234 [a]	0.00118 [a]	0.000099 [a]	0.00620 [a]	0.0040	6.0	0.010	7.00	7.50	210,657	>100%	>100%
Mean	**0.0046**	**0.0017**	**0.0003**	**0.0100**	**0.0068**	**8.0**	**0.009**	**Min 6.65**	**Max 9.70**	**Total (2007) 2,927,436**		
Jan-08	NMR	NMR	NMR	NMR	NMR	7.8	NMR	6.58	7.09	212,319	NMR	NMR
Feb-08	0.00337	0.00233	0.000274	0.0181	0.012	4.8	0.009	6.58	6.97	189,793	>100%	>100%
Mar-08	NMR	NMR	NMR	NMR	NMR	3.5	NMR	6.80	7.03	169,423	NMR	NMR
Apr-08	0.0041	0.0022	0.00022	0.0234	0.0176	7.0	0.020	6.53	6.75	280,845	>100%	>100%
May-08	NMR	NMR	NMR	NMR	NMR	9.0	NMR	6.96	9.07	250,356	NMR	NMR
Jun-08	NMR	NMR	NMR	NMR	NMR	10.4	NMR	7.51	8.96	308,844	NMR	NMR
Jul-08	0.0043	0.0011	0.00012	0.0060	0.0018	9.2	0.008	7.36	9.33	379,789	>100%	>100%
Aug-08	NMR	NMR	NMR	NMR	NMR	8.0	NMR	7.82	9.06	242,994	NMR	NMR
Sep-08	NMR	NMR	NMR	NMR	NMR	9.5	NMR	7.36	8.02	198,135	NMR	NMR
Oct-08	0.0044	0.0011	0.000233	0.0073	0.0029	13.5	0.003	7.47	7.95	261,807	>100%	>100%
Nov-08	NMR	NMR	NMR	NMR	NMR	10.5	NMR	7.66	7.93	293,753	NMR	NMR
Dec-08	NMR	NMR	NMR	NMR	NMR	8.8	NMR	7.18	7.38	161,944	NMR	NMR
Mean	**0.0041**	**0.0017**	**0.0002**	**0.0137**	**0.0086**	**8.5**	**0.010**	**Min 6.53**	**Max 9.33**	**Total (2008) 2,950,002**		

Table 3.16 (cont'd) **Monthly mean concentrations of deleterious substances, pH range, total monthly effluent volumes and acute toxicity test results in the West Discharge; 2003-2010. Units are mg/L unless otherwise noted. Values in italics exceed the authorized limits under MMER Schedule 4 but were within the limits of the transitional authorization provided to TANCO during the first year of MMER implementation. Shaded values exceed the authorized limits under Schedule 4 of the MMER.**

Month	As	Cu	Pb	Ni	Zn	TSS	Ra (Bq/L)	Lowest pH	Highest pH	Effluent volume (m^3/mth)	Rainbow Trout 96h LC50	Daphnia magna 48h LC50
Jan-09	0.00363	0.00196	0.000381	0.00637	0.011	8.3	0.005	7.05	7.28	138,159	>100%	>100%
Feb-09	NMR	NMR	NMR	NMR	NMR	7.0	NMR	6.90	7.19	194,502	NMR	NMR
Mar-09	NMR	NMR	NMR	NMR	NMR	8.5	NMR	6.85	7.10	181,970	NMR	NMR
Apr-09	0.0048	0.0022	0.00075	0.0089	0.0111	22.6	0.010	6.94	7.26	285,408	>100%	>100%
May-09	NMR	NMR	NMR	NMR	NMR	9.3	NMR	7.51	9.19	262,748	NMR	NMR
Jun-09	NMR	NMR	NMR	NMR	NMR	10.0	NMR	7.69	9.41	272,046	NMR	NMR
Jul-09	0.0060	0.0020	0.00012	0.0053	0.0040	13.8	0.005	8.80	9.40	203,957	>100%	>100%
Aug-09	NMR	NMR	NMR	NMR	NMR	12.8	NMR	8.50	9.36	203,957	NMR	NMR
Sep-09	NMR	NMR	NMR	NMR	NMR	21.0	NMR	8.85	9.46	165,840	NMR	NMR
Oct-09	0.0124	0.0006	0.00012	0.0020	0.0013	13.8	0.008	7.70	8.95	164,653	>100%	>100%
Nov-09	NMR	NMR	NMR	NMR	NMR	6.6	NMR	7.86	8.07	125,388	NMR	NMR
Dec-09	NMR	NMR	NMR	NMR	NMR	6.0	NMR	7.04	7.50	136,284	NMR	NMR
Mean	**0.0067**	**0.0017**	**0.0003**	**0.0056**	**0.0069**	**11.6**	**0.007**	**Min 6.85**	**Max 9.46**	**Total (2009) 2,334,912**		
Jan-10	0.0076	0.0014	0.00036	0.0032	0.0043	4.8	0.01	6.98	7.30	151,869	>100%	>100%
Feb-10	NMR	NMR	NMR	NMR	NMR	3.8	NMR	7.07	7.33	136,402	NMR	NMR
Mar-10	NMR	NMR	NMR	NMR	NMR	2.0	NMR	7.16	7.42	171,368	NMR	NMR
Apr-10	0.0048	0.0012	0.00010	0.0015	0.0083	6.0	0.003	8.45	9.48	256,620	>100%	>100%
May-10	NMR	NMR	NMR	NMR	NMR	8.8	NMR	7.46	9.23	179,366	NMR	NMR
Jun-10	NMR	NMR	NMR	NMR	NMR	10.0	NMR	7.22	8.29	105,833	NMR	NMR
Jul-10	0.0173	0.0010	0.00015	0.0019	0.0019	15.0	0.007	7.60	9.35	170,500	>100%	>100%
Aug-10	NMR	NMR	NMR	NMR	NMR	10.3	NMR	7.16	8.16	59,528	NMR	NMR
Sep-10	NMR	NMR	NMR	NMR	NMR	11.4	NMR	7.44	8.03	87,864	NMR	NMR
Oct-10	0.0086	0.0007	0.00020	0.0035	0.0029	14.2	0.010	7.64	7.88	136,648	>100%	>100%
Nov-10	NMR	NMR	NMR	NMR	NMR	11.2	NMR	7.51	7.91	128,916	NMR	NMR
Dec-10	NMR	NMR	NMR	NMR	NMR	4.8	NMR	7.33	7.60	86,521	NMR	NMR
Mean	**0.0096**	**0.0011**	**0.0002**	**0.0025**	**0.0044**	**8.5125**	**0.0074**	**Min 6.98**	**Max 9.48**	**Total (2010) 1,671,435**		

NMR - no measurement required.

[a] new detection limit.

[b] mine shutdown due to flood warning.

Table 3.17 **Summary statistics of the TANCO Mine effluent characterization; 1997-2010. Units are mg/L unless otherwise noted. Shaded values exceed the applicable Manitoba Water Quality Standard, Objective or Guideline.**

Parameter	1997-2002		2003		2004		2005		2006		2007		2008		2009		2010		MWQSOG
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Physicochemical																			
pH (pH units)	8.13	0.89	9.20	1.04	7.63	0.6	7.0	0.5	8.0	0.6	7.6	0.3	7.5	0.2	7.9	0.4	7.82	0.13	6.5 - 9.0
Hydroxide (OH^-)	3.4	3.9	3	0	<5	--	<0.5	--	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Specific Conductance (µS/cm @ 25°C)	269	36	--	--	322	21	386	91	357	18	401	50	403	22	339	38	235	33	
Total Dissolved Solids	145	23	187	22	174	12	258	39	223	16	255	35	258	31	223	23	122	29	
Hardness, dissolved	--	--	--	--	72.6	6.0	89	21	76.0	6.0	94.2	10.8	91.7	4.6	86.6	6.4	62.7	8.7	
Hardness, total	54.8	5.6	73.8	6.5	--	--	--	--	83.4	9.8	94.1	11.8	93.1	6.8	84.9	7.1	62.4	7.3	
Alkalinity (PP as $CaCO_3$)	7	8	--	--	--	--	<0.5	--	2.3	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Alkalinity (Total as $CaCO_3$)	72	22	50	4	44	8	32.3	10.6	38.9	9.8	36.1	6.4	26.0	9.5	53.9	20.9	72.8	8.0	
Bicarbonate (HCO_3)	66	26	36	32	52	8	39.4	13.0	46.3	11.8	44.1	7.7	31.8	11.6	64.4	23.9	88.6	9.8	
Carbonate (CO_3)	12	18	12.25	13.79	<5	--	<0.5	--	2.8	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Total Suspended Solids	21	26	12	8	8	3	12	4	11	5	8	3	12	4	13	3	10	6	
Turbidity (NTU)	--	--	13.7	2.1	7.9	2.0	19.5	12.6	16.3	11.6	12.1	5.2	9.3	3.4	14.4	4.6	11.6	6.9	
True Colour (Col. Units)	--	--	23	1	21	3	35	30	16	9	12	8	14	5	21	10	25	7	
Major Ions																			
Potassium, dissolved	7.4	2.4	7.7	0.8	7.2	0.5	--	--	6.76	0.91	8.05	0.66	7.89	0.16	5.97	1.03	4.2	0.4	
Sodium, dissolved	22.44	4.51	22.5	1.1	20.3	1.4	23.9	3.9	23.03	2.01	23.50	2.74	20.45	0.44	18.06	3.04	14.7	2.2	
Calcium, dissolved	17.3	1.8	24.2	2.2	24.1	2.4	29.9	6.8	27.48	2.78	32.36	3.97	31.23	1.73	28.99	2.19	20.0	2.9	
Magnesium, dissolved	2.92	0.28	3.29	0.23	3.04	0.18	3.17	0.41	3.33	0.24	3.58	0.26	3.32	0.18	3.47	0.30	3.1	0.4	
Chloride, dissolved	12.0	2.5	14.0	1.9	12.4	0.8	12.7	2.8	12.2	0.9	12.1	3.3	9.1	1.3	9.2	1.4	8.5	1.2	
Fluoride, dissolved	--	--	0.91	0.04	0.78	0.07	0.89	0.27	0.93	0.18	0.78	0.11	0.81	0.09	0.65	0.06	0.46	0.07	
Sulphate, dissolved	38.0	13.7	84.8	18.0	81.6	5.5	106.9	43.8	95.0	12.0	109.3	15.0	118	5	77.4	20.6	29.6	8.3	
Nutrients																			
Organic Carbon, dissolved	--	--	13.0	0.5	10.8	0.4	9.9	1.2	10.9	0.8	9.9	1.0	8.7	0.6	9.6	1.7	10.2	0.9	
Organic Carbon, total	--	--	14.3	0.6	11.9	1.2	11	0	10.8	0.7	10.5	1.0	9.0	0.5	10.0	1.6	11.5	0.6	
Nitrite	0.034	0.079	--	--	--	--	0.077	0.077	0.146	0.355	0.031	0.015	0.050	0.027	0.020	0.018	0.004	0.003	0.06
Nitrate	1.20	0.64	0.600	0.060	1.46	0.35	2.80	1.64	1.69	1.06	2.49	1.32	2.49	1.15	1.690	1.710	0.382	0.566	
Nitrate_Nitrite	1.17	0.68	0.550	--	1.37	0.34	--	--	1.78	1.25	2.52	1.32	2.54	1.17	1.706	1.724	0.386	0.571	
Ammonia	0.3	0.3	--	--	0.59	0.68	0.55	0.84	0.398	0.530	0.649	0.698	0.20	0.23	0.36	0.53	0.097	0.085	
Total Kjeldahl Nitrogen	1.33	0.18	--	--	--	--	1.8	1.6	1.4	0.9	1.18	0.59	0.36	0.35	1.20	0.39	0.76	0.22	
Total Nitrogen	--	--	--	--	--	--	4.33	3.76	3.0	1.7	3.70	1.76	3.0	1.2	2.91	1.90	1.13	0.56	
Phosphorus, total dissolved	--	--	0.130	--	0.04	0.03	0.01	0.01	0.026	0.019	0.080	0.062	0.047	0.043	0.047	0.035	0.037	0.020	
Phosphorus, total	0.19	0.04	0.150	0.028	0.11	0.03	0.130	0.116	0.051	0.032	0.123	0.081	0.075	0.030	0.088	0.030	0.094	0.057	0.025
Biological																			
Chlorophyll a	0.060	0.049	0.018	0.025	--	--	0.0362	0.0097	0.0448	0.0182	0.0373	0.0184	0.033	0.004	0.0359	0.0266	0.0209	0.0204	
Radiochemical																			
Radium-226 (Bq/L)	--	--	0.01	0.00	<0.01	--	<0.01	--	0.01	--	0.008	0.005	0.005	0.003	0.007	0.003	0.010	0.006	

Table 3.17 (cont'd) **Summary statistics of the TANCO Mine effluent characterization; 1997-2010. Units are mg/L unless otherwise noted. Shaded values exceed the applicable Manitoba Water Quality Standard, Objective or Guideline.**

	1997-2002		2003		2004		2005		2006		2007		2008		2009		2010		
Parameter	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**MWQSOG**
Dissolved Metals																			
Aluminum (Al)	0.068	0.043	--	--	--	--	0.0303	0.0336	0.0166	0.0091	0.0167	0.0144	0.0097	0.0051	0.017	0.007	0.010	0.006	
Antimony (Sb)	0.0036	0.0031	--	--	--	--	0.00375	0.00027	0.00292	0.00032	0.00307	0.00076	0.00256	0.00020	0.00259	0.00079	0.00141	0.00035	
Arsenic (As)	0.0126	0.0083	--	--	--	--	0.0041	0.0021	0.0044	0.0023	0.00277	0.00094	0.00308	0.00070	0.00543	0.00345	0.00775	0.00474	0.15
Barium (Ba)	0.0051	0.0022	--	--	--	--	0.00304	0.00073	0.00398	0.00189	0.00487	0.00198	0.00212	0.00098	0.00538	0.00239	0.00486	0.00235	
Beryllium (Be)	0.0002	0.0001	--	--	--	--	0.00009	0.00013	<0.00005	--	0.00009	0.00007	0.00002	0.00002	<0.0001	<0.0001	0.00002	0.00001	
Bismuth (Bi)	0.0027	0.0019	--	--	--	--	<0.00005	---	<0.00005	--	<0.00005	<0.000005	<0.000005	<0.000005	<0.00005	<0.00005	<0.00005	<0.00005	
Boron (B)	0.087	0.016	--	--	--	--	0.090	0.014	0.085	0.009	0.080	0.011	0.07	0.03	<0.5	<0.5	0.11	0.06	
Cadmium (Cd)	0.0002	0.0001	--	--	--	--	0.00007	0.00004	0.00004	0.00002	0.00006	0.00003	0.000009	0.000003	<0.00005	<0.00005	<0.00003	<0.00003	0.00193 [a]
Cesium (Cs)	--	--	--	--	--	--	0.00100	0.00027	0.80914	0.14835	0.7043	0.1330	0.6453	0.1404	3.8306	2.7515	2.1780	0.5591	
Chromium (Cr)	0.0006	0.0003	--	--	--	--	0.0002	0.0003	<0.0002	--	0.0001	0.0001	<0.0001	<0.0001	<0.0005	<0.0005	0.0002	0.0001	0.06287 [a]
Cobalt (Co)	0.0003	0.0001	--	--	--	--	0.00072	0.00102	0.00016	0.00012	0.00037	0.00035	0.000132	0.000071	0.00024	0.00016	0.00006	0.00002	
Copper (Cu)	0.002	0.001	--	--	--	--	0.0013	0.0008	0.0009	0.0005	0.00123	0.00069	0.00075	0.00015	0.0012	0.0007	0.0007	0.0003	0.00754 [a]
Iron (Fe)	0.078	0.177	0.007	0.004	0.029	0.033	0.127	0.215	0.030	0.030	0.022	0.022	0.004	0.001	0.02	0.02	0.012	0.006	
Lead (Pb)	0.0007	0.0005	--	--	--	--	0.00002	0.00002	0.00010	0.00013	0.00005	0.00004	0.000034	0.000057	<0.00005	<0.00005	<0.000005	<0.000005	0.00202 [a]
Lithium (Li)	3.46	0.94	--	--	--	--	3.84	0.83	3.3414	0.4867	3.9211	0.5918	4.0875	0.0727	2.893	0.622	1.882	0.156	
Manganese (Mn)	0.194	0.326	0.0855	0.0332	0.682	0.789	1.654	2.165	0.47506	0.58649	1.22810	1.35878	0.21917	0.25364	0.4767	0.4388	0.0426	0.0919	
Mercury (Hg)	0.00005	--	--	--	--	--	<0.00005	--	<0.00005	--	<0.00005	<0.00005	<0.00001	<0.00001	<0.00005	<0.00005	<0.00005	<0.00005	
Molybdenum (Mo)	0.017	0.004	--	--	--	--	0.0169	0.0100	0.01454	0.00761	0.01662	0.00778	0.01679	0.00685	0.0141	0.0057	0.0113	0.0027	
Nickel (Ni)	0.0027	0.0015	--	--	--	--	0.0134	0.0142	0.0045	0.0034	0.00828	0.00673	0.00506	0.00174	0.0049	0.0030	0.0017	0.0007	0.04388 [a]
Rubidium (Rb)	--	--	--	--	--	--	0.0010	0.0003	0.87167	0.12320	0.8005	0.1499	0.7283	0.0816	0.6153	0.0797	0.4088	0.0749	
Selenium (Se)	0.002	0.003	--	--	--	--	0.1502	0.2999	<0.0005	--	<0.005	<0.005	0.00003	0.00002	<0.0004	<0.0004	0.00008	0.00003	
Silicon (Si)	3.07	0.60	--	--	--	--	--	--	3.65	0.44	3.14	1.82	3.35	0.65	3.8	0.8	3.7	0.6	
Silver (Ag)	0.0006	0.0007	--	--	--	--	<0.00001	--	<0.00001	--	<0.00001	<0.00001	<0.000005	<0.000005	<0.00005	<0.00005	<0.000005	<0.000005	
Strontium (Sr)	0.089	0.017	--	--	--	--	0.133	0.045	0.11363	0.01306	0.14800	0.02100	0.16400	0.00616	0.1177	0.0155	0.0839	0.0114	
Sulphur (S)	12.4	4.3	--	--	--	--	--	--	29.5	0.1	40.5	5.8	43	1	31	10	19	9	
Tantalum (Ta)	--	--	--	--	--	--	--	--	--	--	--	--	0.000007	--	--	--	0.00007	0.00003	
Thallium (Tl)	0.0016	0.0012	--	--	--	--	0.0430	0.0847	0.00029	0.00015	0.00043	0.00034	0.000239	0.000057	0.00024	0.00019	0.00002	0.00001	
Tin (Sn)	0.002	0.002	--	--	--	--	0.04259	0.08494	0.00008	0.00002	0.00011	0.00006	0.00006	0.00001	<0.0001	<0.0001	0.0010	0.0007	
Titanium (Ti)	0.0009	0.0019	--	--	--	--	<0.0005	--	0.0010	0.0005	0.0005	0.0005	<0.0005	<0.0005	<0.005	<0.005	0.00196	0.00042	
Uranium (U)	--	--	--	--	--	--	0.26046	0.51970	0.00125	0.00079	0.00081	0.00030	0.000781	0.000362	0.00205	0.00085	0.0003	0.0002	
Vanadium (V)	0.0007	0.0011	--	--	--	--	0.0351	0.0699	0.00013	0.00005	0.00007	0.00004	<0.0002	<0.0002	<0.002	<0.002	0.0007	0.0006	
Zinc (Zn)	0.003	0.003	--	--	--	--	0.0034	0.0050	0.0015	0.0011	0.0039	0.0038	0.0007	0.0002	0.0024	0.0035	0.0002	0.0001	0.09965 [a]
Zirconium (Zr)	--	--	--	--	--	--	<0.005	--	<0.005	--	<0.005	<0.005	<0.0001	<0.0001	<0.001	<0.001	0.0002	0.0001	

Table 3.17 (cont'd) **Summary statistics of the TANCO Mine effluent characterization; 1997-2010. Units are mg/L unless otherwise noted. Shaded values exceed the applicable Manitoba Water Quality Standard, Objective or Guideline.**

	1997-2002		2003		2004		2005		2006		2007		2008		2009		2010		
Parameter	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	MWQSOG
Total Metals																			
Aluminum (Al)	0.568	0.610	0.171	0.092	0.123	0.033	0.167	0.115	0.0990	0.0593	0.1691	0.1393	0.0458	0.0244	0.078	0.073	0.042	0.025	0.100 [b]
Antimony (Sb)	0.004	0.003	0.0038	0.0007	0.0029	0.0003	0.0040	0.0003	0.00315	0.00045	0.00305	0.00072	0.00265	0.00029	0.0026	0.0007	0.0015	0.0004	
Arsenic (As)	0.011	0.007	0.0080	0.0027	0.0048	0.0009	0.0073	0.0020	0.0054	0.0019	0.00442	0.00114	0.00397	0.00054	0.0072	0.0038	0.0105	0.0051	
Barium (Ba)	0.0078	0.0032	0.014	0.013	0.007	0.002	0.00461	0.00072	0.00625	0.00159	0.00613	0.00182	0.00463	0.00145	0.0089	0.0025	0.0103	0.0035	
Beryllium (Be)	0.0007	0.0008	0.0002	0.0002	0.0001	0.0001	0.00031	0.00033	0.00019	0.00014	0.00025	0.00026	0.00007	0.00007	0.0002	0.0002	0.00006	0.00003	
Bismuth (Bi)	0.0031	0.0015	0.0004	0.0003	<0.0005	--	0.00009	0.00008	0.00011	0.00004	0.00011	0.00008	0.000031	0.000016	<0.00005	<0.00005	0.000025	0.000017	
Boron (B)	0.0791	0.0191	0.103	0.025	0.088	0.007	0.0950	0.0130	0.090	0.011	0.081	0.010	0.07	0.03	<0.5	<0.5	0.09	0.07	
Cadmium (Cd)	0.0002	0.0001	0.00003	0.00005	0.00003	0.00003	0.0001	0.0001	0.00005	0.00002	0.00007	0.00003	0.000012	0.000002	<0.00005	<0.00005	0.00001	0.000002	
Calcium (Ca)	--	--	22.1	3.9	22.85	0.49	29.9	7.0	28.61	3.30	31.87	4.29	31.65	2.46	28.34	2.61	19.58	2.42	
Cesium (Cs)	0.867	0.789	--	--	--	--	0.00081	0.00048	0.85657	0.15112	0.7961	0.1198	0.7025	0.1281	4.0301	2.8430	2.2380	0.5488	
Chromium (Cr)	0.0004	0.0001	0.001	0.000	<0.0005	--	0.00063	0.00071	0.0005	0.0002	0.0006	0.0002	0.0001	0.0001	<0.001	<0.001	0.0002	0.0001	
Cobalt (Co)	0.0004	0.0002	0.0003	0.0002	0.0004	0.0002	0.00078	0.00094	0.00034	0.00027	0.00041	0.00034	0.000211	0.000082	0.00027	0.00017	0.00012	0.00003	
Copper (Cu)	0.002	0.001	0.002	0.002	0.001	0.001	0.0021	0.0012	0.0013	0.0006	0.0016	0.0007	0.00105	0.00011	0.0014	0.0007	0.0020	0.0020	
Iron (Fe)	0.299	0.255	0.274	0.200	0.4	0.3	--	--	0.322	0.306	0.598	0.676	0.190	0.173	0.30	0.27	0.262	0.130	0.3
Lead (Pb)	0.0009	0.0004	0.0009	0.0027	0.0003	0.0001	0.00033	0.00020	0.00030	0.00033	0.00025	0.00017	0.000143	0.000063	0.00025	0.00024	0.000260	0.000162	
Lithium (Li)	3.65	1.67	3.80	0.82	3.31	0.34	3.78	0.86	3.8788	0.3787	4.1433	0.5257	4.0900	0.2399	2.933	0.597	2.154	0.354	
Magnesium (Mg)	3.13	0.67	3.19	0.64	3.0	0.3	3.13	0.35	3.43	0.28	3.54	0.28	3.41	0.21	3.44	0.18	3.26	0.43	
Manganese (Mn)	0.294	0.284	0.587	0.412	0.808	0.667	1.830	1.929	1.00800	0.84852	1.40356	1.23949	0.70975	0.46341	0.737	0.304	0.4074	0.2347	
Mercury (Hg)	--	--	0.0001	0.0000	<0.00002	--	0.00005	0.00003	<0.00005	--	<0.00005	<0.00005	<0.00001	<0.00001	<0.0001	<0.0001	0.00002	0.00001	0.0001
Molybdenum (Mo)	0.015	0.005	0.016	0.004	0.018	0.009	0.0202	0.0091	0.01592	0.00764	0.01760	0.00779	0.01654	0.00641	0.0138	0.0056	0.0114	0.0033	0.073
Nickel (Ni)	0.003	0.002	0.0045	0.0024	0.0077	0.0033	0.0141	0.0131	0.0067	0.0041	0.00884	0.00675	0.00650	0.00242	0.0057	0.0027	0.00247	0.00085	
Potassium (K)	7.1	2.6	7.4	1.4	7.0	0.4	9	1	8.17	0.99	8.34	1.12	7.95	0.39	5.87	1.09	4.24	0.35	
Rubidium (Rb)	0.692	0.468	--	--	--	--	0.0007	0.0005	0.9325	0.1603	0.8483	0.1467	0.7903	0.0770	0.6633	0.1015	0.4370	0.0876	
Selenium (Se)	0.0029	0.0050	0.0002	0.0001	0.0002	0.0002	<0.0005	--	<0.0005	--	<0.0005	<0.0005	<0.00004	<0.00004	<0.0004	<0.0004	0.00008	0.00002	0.001
Silicon (Si)	4.52	2.42	3.14	1.09	2.91	0.93	5.58	--	3.58	0.82	3.60	1.97	3.58	1.06	4.1	1.1	3.9	0.3	
Silver (Ag)	0.0005	0.0004	0.0001	0.0001	0.0001	0.0000	<0.00001	--	0.00002	0.00002	<0.00001	<0.00001	<0.000005	<0.000005	<0.00005	<0.00005	<0.000005	<0.000005	0.0001
Sodium (Na)	22.370	6.401	22.8	3.9	19.9	1.6	23.0	2.7	23.65	2.43	23.14	3.23	20.53	1.09	18.00	2.40	15.2	2.3	
Strontium (Sr)	0.732	3.417	0.107	0.016	0.104	0.015	0.133	0.037	0.12273	0.01267	0.14989	0.02127	0.16350	0.00900	0.1153	0.0134	0.0835	0.0102	
Sulphur (S)	13.3	5.1	24.8	5.9	26.1	2.7	56.1	--	34.0	5.5	39.5	6.6	45	4	32	10	14	11	
Tantalum (Ta)	--	--	--	--	--	--	--	--	--	--	--	--	0.000019	--	--	--	--	--	
Thallium (Tl)	0.0029	0.0042	0.00032	0.00027	0.00033	0.00014	0.00060	0.00051	0.00040	0.00022	0.00051	0.00043	0.000279	0.000074	0.00025	0.00020	0.00008	0.00003	0.0008
Tin (Sn)	0.001	0.000	0.001	0.002	<0.001	--	0.00021	0.00005	0.00017	0.00007	0.00025	0.00009	0.00007	0.00001	0.0001	0.0001	0.00005	0.00003	
Titanium (Ti)	0.0011	0.0017	0.0025	0.0018	0.0018	0.0002	0.0007	0.0002	0.0010	0.0005	0.0010	0.0005	<0.0005	<0.0005	<0.005	<0.005	0.0017	0.0012	
Uranium (U)	0.0029	0.0008	0.001	0.001	0.0011	0.0005	0.00132	0.00017	0.00159	0.00083	0.00110	0.00020	0.000941	0.000285	0.00215	0.00075	0.00203	0.00068	
Vanadium (V)	0.0007	0.0007	0.0002	0.0002	0.0002	0.0001	0.00015	0.00016	0.00017	0.00006	0.00010	0.00003	<0.0002	<0.0002	<0.002	<0.002	0.0004	0.0002	
Zinc (Zn)	0.0062	0.0060	0.010	0.012	0.005	0.003	0.0037	0.0024	0.0048	0.0027	0.0066	0.0020	0.0021	0.0009	0.005	0.004	0.0041	0.0025	
Zirconium (Zr)	0.001	0.000	0.001	0.001	<0.001	--	--	--	<0.005	--	<0.005	<0.005	<0.0001	<0.0001	<0.001	<0.001	<0.0005	<0.0005	

[a] Calculated range based on average dissolved hardness (81.8 mg/L).

[b] Guideline based on pH ≥ 6.5.

3.16 Site Security

A security service is maintained at the main entrance to the minesite. All TANCO personnel must use ID tags to enter the site. All contractors and visitors must sign in at the security building before entering the site. The access roads to the tailings disposal area are located approximately 1 km and 2.5 km northeast respectively, from the security building off TANCO Road. Access to the tailings disposal area roads is restricted via a locked chain barricade across each of the roads. The access road to the waste disposal ground is locked with a chain barricade. Access to the powder magazine was modified in late-2002, such that all traffic now enters the site through the security service before accessing the road to the powder magazine. In addition, the entrance road to the powder magazine is locked with a chain barricade.

3.17 Malfunctions or Accidents

The TANCO Mine holds an exceptional environmental and safety record. With their “Drive to Zero” initiative, which is based on Cabot’s belief that all safety and environmental incidents are preventable, TANCO and Cabot have demonstrated they are committed to pursuing excellence with respect to minimizing the facility’s environmental footprint. Cabot invests significant capital in all their facilities’ process equipment and infrastructure to maintain regulatory compliance, increase energy efficiency, and minimize the company’s impact on the environment.

During the summer of 2006, a small fire started at the landfill and water bombers were dispatched to the mine by Manitoba Conservation.

On January 4, 2008, tailings process water leaked from a pump box and spilled out of the mill and onto the ice surface of Bernic Lake. The overflow consisted primarily of process water as tailings solids remained either in the pump box or in the overflow sump pit adjacent to the pump box. Manitoba Conservation was informed of the incident and a remediation plan was immediately established. The frozen material was recovered from the ice surface and placed into the West TMA. No other incidents of unplanned discharges to Bernic Lake have occurred at the TANCO Mine.

Exceedances of authorized effluent limits under the MMER are listed in Table 3.19. TANCO had a transitional authorization for TSS to exceed the monthly mean of 15 mg/L for this first year (2003). A sample of TANCO effluent collected March 31, 2006 was determined to be acutely lethal to Rainbow trout with an estimated 96h LC_{50} of 85.7%. The acute toxicity testing frequency was increased from quarterly to monthly for 12 months following this occurrence. The TANCO effluent passed all subsequent Rainbow trout toxicity tests to the present date.

Table 3.18 Exceedances of MMER authorized limits for deleterious substances in TANCO effluent (2003-2011).

Date	Measured value	MMER Limit	
April 2005	15.5 mg/L TSS	15.00 mg/L	monthly mean
June 25, 2007	9.56 pH units	9.50	single grab sample
July 5, 2007	9.74 pH units	9.50	single grab sample
July 30, 2007	9.52 pH units	9.50	single grab sample
April 16, 2009	37 mg/L TSS	30.00 mg/L	single grab sample
April 2009	22.6 mg/L TSS	15.00 mg/L	monthly mean
September 2009	21.0 mg/L TSS	15.00 mg/L	monthly mean
July 2011	17.0 mg/L TSS	15.00 mg/L	monthly mean

3.18 CONTINGENCY AND EMERGENCY RESPONSE PLANS

TANCO maintains a standard of emergency preparedness to provide timely and co-ordinated response to an emergency, in order to minimize the effects of the emergency or disaster on TANCO employees, the public, the minesite and the environment. TANCO recently completed a new Emergency Response Plan to conform with new Cabot Corporation Standards implemented in 2010 (Appendix H). The Emergency Response Plan outlines the actions to be taken by Response Groups and appropriate personnel. In the case of an emergency underground, the TANCO Mine Department will follow response procedures in compliance with Standard Mine Rescue Practice.

TANCO has also established an agreement with the RM of Alexander to provide fire/rescue emergency services to the mine if required. The agreement includes provisions to ensure that alternative resources would be available for the RM should they be responding to a call at the mine during a subsequent emergency.

3.19 HEALTH AND SAFETY

As a Cabot Corporation owned company, TANCO is committed to be a leader in Safety, Health and Environmental (SH&E) performance. TANCO is committed to integrating SH&E into their business activities to ensure the safety of their employees, contractors, visitors, the communities in which they operate, and the environment. SH&E excellence is a core value of Cabot Corporation and TANCO and we will meet or exceed all applicable SH&E laws and regulations. TANCO is also committed to continuous improvement of their SH&E performance.

The full text of Cabot Corporation's Safety, Health, and Environmental Policy can be found at: http://www.cabot-corp.com/Safety-Health-and-Environment/ShandE-Policy-and-Excellence.

3.20 SUSPENSION OF OPERATIONS

If temporary suspension of the operation is required, the facility will be placed under care and maintenance which involves continued environmental monitoring, operation of critical equipment, and site security. TANCO would continue to dewater the mine, continue to pump the phreatic ditch over to the active TMA, and ensure compliance with all environmental regulations. Equipment would be maintained to ensure the foregoing and all other equipment would be maintained to facilitate a restart. There would be no action required with regards to the containment cells although an election could be made to empty a cell, do repairs to the cell liners, and prepare the cell(s) for use upon a restart.

3.21 DECOMMISSIONING AND RECLAMATION

At project closure, the minesite will be returned to a state compatible with the surrounding natural environment. TANCO will follow the plans laid out in the facility's Closure Plan which was prepared in accordance with Manitoba Mine Closure Regulation (67/99). The complete closure plan has been included as Appendix C. The following sections provide an overview of the Closure Plan.

3.21.1 PLANNED DECOMMISSIONING ACTIVITIES

At closure, all moveable equipment will be removed from the mine, including all electrical equipment. The mine shaft and ventilation raises will be capped with engineered concrete plugs and the mine portal entrance will be filled with mine waste materials and capped with an engineered concrete plug. Once the openings are permanently capped, the mine will be allowed to naturally flood. This is estimated to take a nominal 28 years based on a seepage rate of 0.19 m^3/minute and a void space of 2,750,000 m^3.

Surface infrastructure including buildings and equipment will be demolished and/or removed from the minesite. Concrete foundations which are not removed during the demolition process will be demolished to grade, covered with overburden and graded appropriately. Surface areas shall be scarified to assist with natural re-vegetation. Utility providers will be notified of the mine closure and will be responsible for the removal of their service equipment. Roads currently maintained by TANCO to provide access to the mine will be maintained to allow access for post-closure monitoring. Once monitoring is complete, all roads will be decommissioned including the removal of water crossings, site prepared (as required), and seeded. Unless directed otherwise by regulatory agencies, road decommissioning will include the removal of the causeway at the Bird River. The shoreline, where it has been altered by road construction, will be re-contoured and established to a self-maintaining form with the aim of preventing un-natural erosion into the river.

Decommissioning of the active tailings management area will include draining the water and allowing surface tailings to dry. The control structures in the main dam and the polishing pond will be fully opened to allow for water bodies to equalize and allow for drainage of water from the main settling area. The stable dams will remain intact and any non-stable dams will be demolished to blend into the surrounding topography. The tailings will also be graded as necessary. Natural re-vegetation is proposed for both tailings management areas and has been demonstrated to be effective (Wardrop 2008). All other waste materials will be removed from the site.

3.21.2 CPF Residue Management at Closure

TANCO is currently examining alternative means of removing the CPF solids from the CPF liquor to eliminate a requirement for periodic removal of accumulated solids from the CPF containment cells. The current procedure, involving the use of heavy equipment within the containment cells, periodically causes damage to the cell liner and the subsequent repair can involve a significant labour effort and potentially may delay CPF plant operation. The alternative being considered by TANCO is filtering of the residue in the CPF plant to enhance Cs recovery and reduce the moisture content to match that of the residue removed from cells in the current manner. The belt filtered residue would then be placed directly on the drystack. The CPF containment cells would be retained, but would be used for process liquor storage.

The TANCO pollucite ore reserve is the single largest cesium reserve in the world. At the end of mine life, the CPF residue dry stack will then become the largest known cesium resource in the world. At current rates of cesium chemical production the end of mine life is estimated to be 2018 when the total quantity of CPF residue produced and dry stacked in the East TMA will be approximately 1,200,000 m^3 on the basis of residue production to date and the current ore reserve. The CPF residue is therefore a mineral resource and not simply a process waste product. TANCO has been exploring means of reprocessing the CPF residue to recover the residual cesium, rubidium, and gypsum. The process is technically successful but is not economic in current market conditions. The economics of residue reprocessing will be evaluated as the end of mine life is approached; however it is not possible to base the residue dry stack closure plan on reprocessing at this time.

Given the resource value in the CPF residue, TANCO plans to close out the residue dry stack in a manner that provides appropriate environmental controls but maintains accessibility for future processing.

3.21.3 Post-Closure Monitoring

The environmental monitoring schedule will follow MMER/EEM and Manitoba Environment Act Licence requirements up until three years after notification of closure. The monitoring will then continue to comply with the *Environment Act* Licence for a period of three years. Surface water quality, ground water quality, and re-vegetation monitoring are proposed during this time.