



MONITORING AND SURVEILLANCE PLAN

QML-0009

November 2009

BELLEKENO PROJECT



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1.0 Introduction

This plan describes the environmental monitoring programs that will be carried out to ensure that the Bellekeno mine/mill development operations are conducted in a manner that provides human and environmental protection. These programs are designed to monitor:

- Potential effects to the receiving environment through scheduled sampling of water and aquatic resources, and inspection tours of the project components and receiving environment;
- Effluent discharge points and consequently operational treatment performance;
- Site facilities and incorporated design measures to ensure structural stability and prevent accidents and malfunctions;
- Mitigation success; and
- Adaptive management responses to improve procedure/process.

If monitoring indicates that physical structures, treatment systems or other mitigative measures are not performing, then maintenance measures or contingency plans can be implemented following an adaptive management approach as discussed in Section 12.

A number of monitoring programs and a surveillance network are already in place for care and maintenance activities and for advanced exploration and preliminary development activities at the Keno Hill Property. These programs include physical inspections, effluent treatment systems and flow monitoring, a water quality surveillance network, old mine workings monitoring, aquatic effects monitoring for benthic invertebrate populations, sediment monitoring, waste rock and mine wall sampling and/or the adaptive management plan. As discussed in Section 2, monitoring already occurs in the vicinity of Bellekeno, Onek and Christal Lake (previously old Mackeno mill). Existing and proposed monitoring stations near the potential mill and mine areas are discussed within the following sections.

2.0 Water Quality Surveillance Network

The existing water quality surveillance network at the Keno Hill Property includes surface receiving waters in the Bellekeno and Christal Lake area. Most of the monitoring stations have been sampled extensively in the past. Current water quality monitoring is required under Water Licence QZ06-074, Schedule A as well as under Water Licence QZ07-078, Schedule A (Flow Monitoring Plan).

Error! Reference source not found. outlines existing sampling frequency and schedule for internal and external lab analysis in the area of Bellekeno and Christal Lake. Table 2 outlines the proposed and edited/continued monitoring stations to track receiving water quality from the Bellekeno mine/mill development and operations program. **Error! Reference source not found.** shows the existing and proposed monitoring station locations.

Water stations will be sampled weekly, monthly and quarterly. This will include the following sites upstream of Christal Creek and upstream of Lightning Creek:

- KV-6 – Christal Creek at the Keno Highway to monitor down stream of the old Mackeno Mill and tailings location;
- KV-7 – Christal Creek at Hanson Road to monitor effects from the old Mackeno Mill;
- KV-41 - Lightning Creek at Keno City Road Crossing to monitor impacts from adit drainages and waste rock seepage reporting to this creek;
- KV-43 – Bellekeno 625 Treatment pond decant to monitor the impacts from the mine edited to be ongoing weekly sampling;
- KV-78 – Bellekeno Waste Rock Storage Facility;
- KV-52 or KV-80 – Potential mill water sources;
- KV-81 – Mill discharge (final discharge point) to monitor the mill impacts; and
- KV-2, KV-8, KV-38, KV-40, KV-42, KV-44, KV-45, KV-51, KV-65, KV-75, KV-76, KV-77 and KV-79 (refer to Table 2 for complete station descriptions) will also be included in the proposed water sampling stations.

Table 7-1 Current Monitoring Program Summary within the area of the Mill and Mine

Monitoring Station	Description	Licence	Internal Lab									External Lab												
			Inspect	Flow	pH	Temp.	Cond.	Total Zinc	Ammonia	Turbidity	Total ICP Metals	Dissolved ICP Metals	Ammonia	Hardness	pH	Cond.	TSS	LT50	Sediment	Benthic	Sub-Lethal Toxicity			
Required Monitoring under Current Water Licences																								
KV-1	South McQuesten River u/s Christal Creek	QZ06-074									Q	Q		Q	Q	Q	Q							
KV-2	South McQuesten River @ Pumphouse	QZ06-074									Q	Q		Q	Q	Q	Q							
KV-6	Christal Creek at Keno Highway	QZ06-074									M	M		M	M	M	M		BA	BA				
KV-7	Christal Creek @ Hanson Road	QZ06-074									M	M		M	M	M	M							
KV-8	Christal Creek @ Mouth	QZ06-074									M	M		M	M	M	M							
KV-16	Christal Creek 600 m d/s Silver Trail	Closure									Q	Q		Q	Q	Q	Q							
KV-29	Silver Trail Culvert #4	QZ06-074									M	M		M	M	M	M	M						
KV-30	Christal Creek 825m d/s Silver Trail	Closure									Q	Q		Q	Q	Q	Q							
KV-31	Galkeno 900 Adit	QZ06-074									M	M		M	M	M	M							
KV-32	Galkeno 900 treatment Pond Decant	QZ06-074	D		W	D		W	D		M	M		M	M	M	M	M						
KV-36	Bellekeno Mill Pond Discharge	QZ06-074									Q	Q		Q	Q	Q	Q							
KV-37	Lightning Creek u/s Hope Gulch	QZ06-074/QZ07-078		Q	Q		Q	Q			Q	Q		Q	Q	Q	Q							
KV-38*	Lightning Creek u/s Thunder Gulch	QZ06-074/QZ07-078		Q	Q		Q	Q			Q (Q)	Q (Q)		Q (Q)	Q (Q)	Q (Q)	Q (Q)		A					
KV-39	Hope Gulch u/s Lightning Creek	QZ06-074		Q	Q		Q	Q			Q	Q		Q	Q	Q	Q							
KV-40	Charity Gulch u/s Lightning Creek	Closure		Q	Q		Q	Q			Q	Q		Q	Q	Q	Q							
KV-41	Lightning Creek u/s bridge at Keno City	QZ06-074/QZ07-078		Q	Q		Q	Q			Q (Q)	Q (Q)		Q (Q)	Q (Q)	Q (Q)	Q (Q)		A					
KV-42	Bellekeno 625 Adit	QZ06-074/QZ07-078		C	D		D	D		D	M (W)	M (W)		M (W)	M (W)	M (W)	M (W)							
KV-43	Bellekeno 625 Treatment Pond Decant	QZ06-074/QZ07-078	D	D	D		D	D	D	D	M (W)	M (W)	M (W)	M (W)	M (W)	M (W)	M (W)	M						
KV-44	Bellekeno 625 Seep	Closure/QZ07-078		Ms	Ms		Ms	Ms			Q A (A)	Q A (A)		Q A (A)	Q A (A)	Q A (A)	Q A (A)							
KV-45	Onek Adit	QZ06-074/QZ07-078		Q	Q		Q	Q			Q (Q)	Q (Q)		Q (Q)	Q (Q)	Q (Q)	Q (Q)							
KV-49	Hinton Creek u/s Christal Creek	QZ06-074									Q	Q		Q	Q	Q	Q							
KV-50	Christal Creek u/s Hinton Creek	QZ06-074									Q	Q		Q	Q	Q	Q							
KV-51*	Christal Creek d/s Hinton Creek	QZ06-074									Q	Q		Q	Q	Q	Q							
KV-52	Natural Spring to Christal Lake at Old Mackeno pump house	QZ06-074		Q	Q		Q	Q			Q	Q		Q	Q	Q	Q							
KV-65	Thunder Gulch Upstream of Bellekeno	QZ06-074/QZ07-078		Q	Q		Q	Q			Q (M)	Q (M)	(M)	Q (M)	Q (M)	Q (M)	Q (M)							
KV-74	Bellekeno East – Decline	Closure/QZ07-078		C	D		D	D	D	D	M (W)	M (W)	M (W)	M (W)	M (W)	M (W)	M (W)							
KV-76	Thunder Gulch d/s of Bellekeno 625 adit	Closure/QZ07-078		Q	Q		Q	Q			Q (M)	Q (M)	Q (M)	Q (M)	Q (M)	Q (M)	Q (M)							
KV-77	Thunder Gulch upstream of Bellekeno East	Closure/QZ07-078		Q	Q		Q	Q			Q (Q)	Q (Q)		Q (Q)	Q (Q)	Q (Q)	Q (Q)							
KV-78	Bellekeno Waste Rock Storage Facility	Closure/QZ07-078			Ms		Ms	Ms			Q (Q)	Q (Q)		Q (Q)	Q (Q)	Q (Q)	Q (Q)							
KV-79	Christal Creek d/s MacKenno Tailings	Closure									Q	Q		Q	Q	Q	Q							
KV-80	Christal Lake u/s Mackeno Tailings	Closure									Q	Q		Q	Q	Q	Q							

Codes: C = Continuous Q = Quarterly red = not required under the Water Licence
D = Daily A = Annually () =
W = Weekly SA = Semi Annually monitor
M = Monthly BA = Bi Annually - every 2 Licence: QZ06-074 type B care and maintenance, QZ07-078 type B advanced exploration, Closure - closure plan monitoring
Ms = Monthly (May - Oct) * = Background

ICP Metals include: Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium
Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Molybdenum, Nickel, Potassium, Selenium
Silicon, Silver, Sodium, Strontium, Sulfur, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc and Zirconium

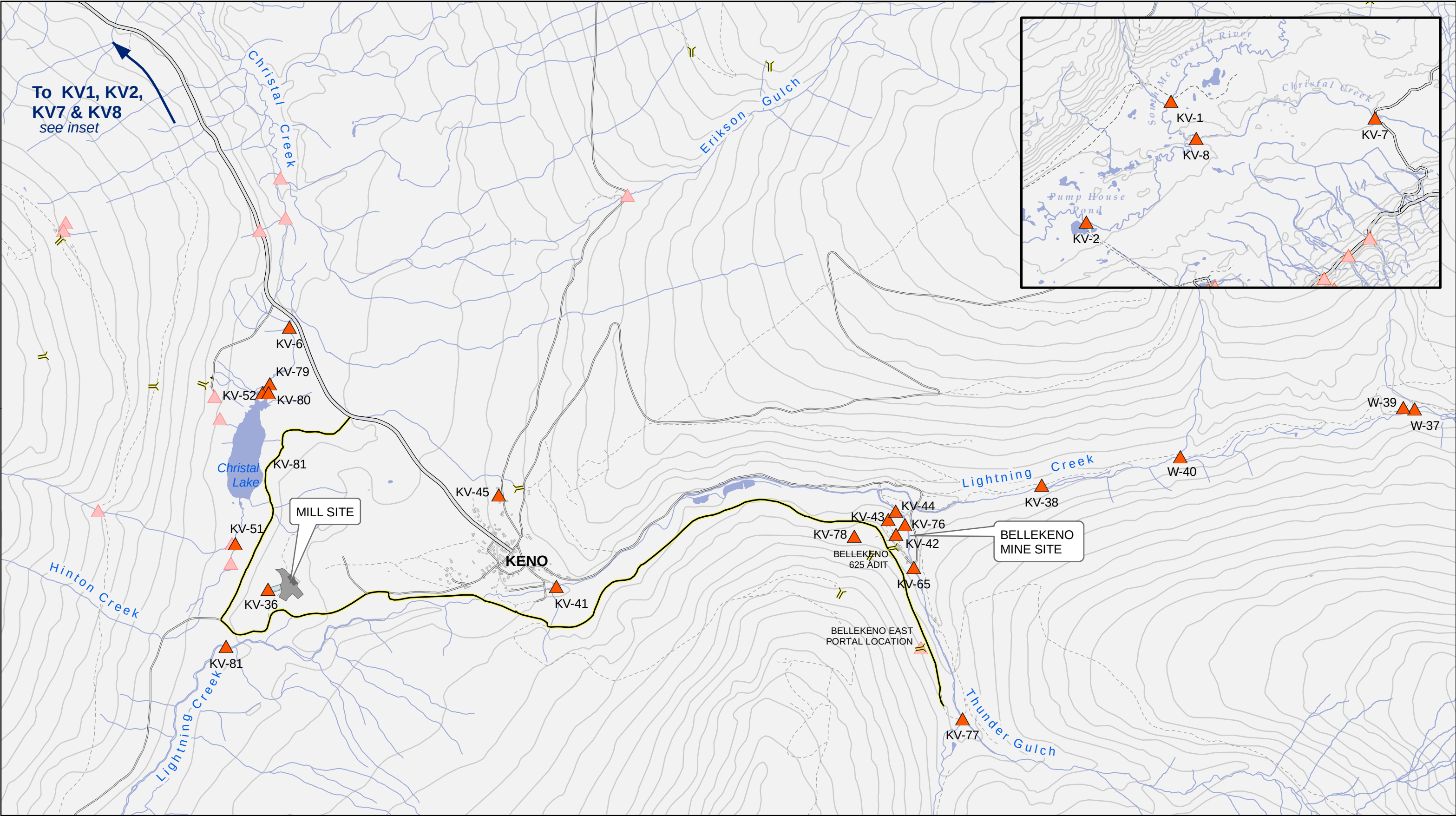
Table 7-2 Proposed Monitoring Program Summary Within the Area of the Mill and Mine

Monitoring Station	Easting	Northing	Description	Internal Lab							External Lab									EEM Program		
				Inspect	Flow	pH	Temp.	Cond.	Total Zinc	Ammonia	Turbidity	Total ICP Metals	Dissolved ICP Metals	Ammonia	Hardness	pH	Cond.	TSS	LT50	Sediment	Benthic	Sub-Lethal Toxicity
<u>Proposed Monitoring under new Type A Water Licence Application</u>																						
KV-1	4742790	7092790	South McQuesten River u/s Christal Creek		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-2	472076	7090036	South McQuesten River @ Pumphouse		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-6	483909	7088242	Christal Creek at Keno Highway		Q	Q	Q	Q				M	M		M	M	M	M		BA	BA	
KV-7	478657	7092413	Christal Creek at Hanson Road		M	M	M	M				M	M		M	M	M	M				
KV-8	465836	7088410	Christal Creek @ Mouth		Q	Q	Q	Q				M	M		M	M	M	M				
KV-37	490315	7087776	Lightning Creek u/s Hope Gulch		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-38*	488193	7087341	Lightning Creek u/s Thunder Gulch		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q		A		
KV-39	490252	7087783	Hope Gulch u/s Lightning Creek		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-40	488982	7087503	Charity Gulch u/s Lightning Creek		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-41	485429	7086764	Lightning Creek u/s bridge at Keno City		Q	Q	Q	Q				M	M		M	M	M	M		A		
KV-42	487363	7087062	Bellekeno 625 Adit		C	W	W	W	W	W	W	M	M	M	M	M	M	M				
KV-43	487318	7087147	Bellekeno 625 Treatment Pond Decant	D	D	D	D	D	D	D	D	W	W	W	W	W	W	W	M	A		SA
KV-44	487361	7087195	Bellekeno 625 Seep			Ms	Ms	Ms	Ms				Q	Q	Q	Q	Q	Q	Q			
KV-45	485101	7087288	Onok Adit		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-51*	483600	7087010	Christal Creek d/s Hinton Creek		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-52	483756	7087869	Mackeno Creek		M	M	M	M				M	M		M	M	M	M				
KV-65	487464	7086873	Thunder Gulch Upstream of Bellekeno		Q	Q	Q	Q				M	M	M	M	M	M	M				
KV-76	487414	7087118	Thunder Gulch d/s of Bellekeno 625 adit			Q	Q	Q	Q				M	M	M	M	M	M	M			
KV-77	487742	7086013	Thunder Gulch upstream of Bellekeno East		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-78	487126	7087052	Bellekeno Waste Rock Storage Facility			Ms	Ms	Ms				Q	Q		Q	Q	Q	Q				
KV-79	483796	7087919	Christal Creek d/s MacKeno Tailings		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-80	483790	7087869	Christal Lake u/s Mackeno Tailings		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-36	483787	7086750	Bellekeno Mill Pond Discharge	D	D	D	D	D	D	D	D	W	W	W	W	W	W	W	M	A		SA
KV-81	483548	7086423	Lightning Creek, South of Mill Site		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				

Codes:

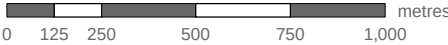
C = Continuous
D = Daily
W = Weekly
M = Monthly
Ms = Monthly (May - Oct)
Q = Quarterly
A = Annually
SA = Semi Annually
BA = Bi Annually - every 2 years
* = Background
**To Be Determined

ICP Metals include: Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium
Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Molybdenum, Nickel, Potassium, Selenium
Silicon, Silver, Sodium, Strontium, Sulfur, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc and Zirconium



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Datum: NAD 83
Projection: UTM Zone 8N



Adits



Proposed Bellekeno Project
Water Monitoring Station*



Other Water Monitoring Stations*

* Reference; Table 7-2

Haul Road

Silver Trail Highway

Secondary

Track,

Contours

Water Courses

Water Bodies

Structures



BELLEKENO MINE PROJECT
TYPE A WATER LICENSE APPLICATION

FIGURE 7-1
BELLEKENO SURFACE WATER
QUALITY MONITORING STATIONS

Drawn By: MD

AUGUST 2009

Verified by: RM

D:\Project\AllProjects\ALEX-05-01\Bellekeno\GIS\mxd\WUL_MLU_Applications\WUL_Aug_09\Fig_7_1_BKWQ_Stations.mxd

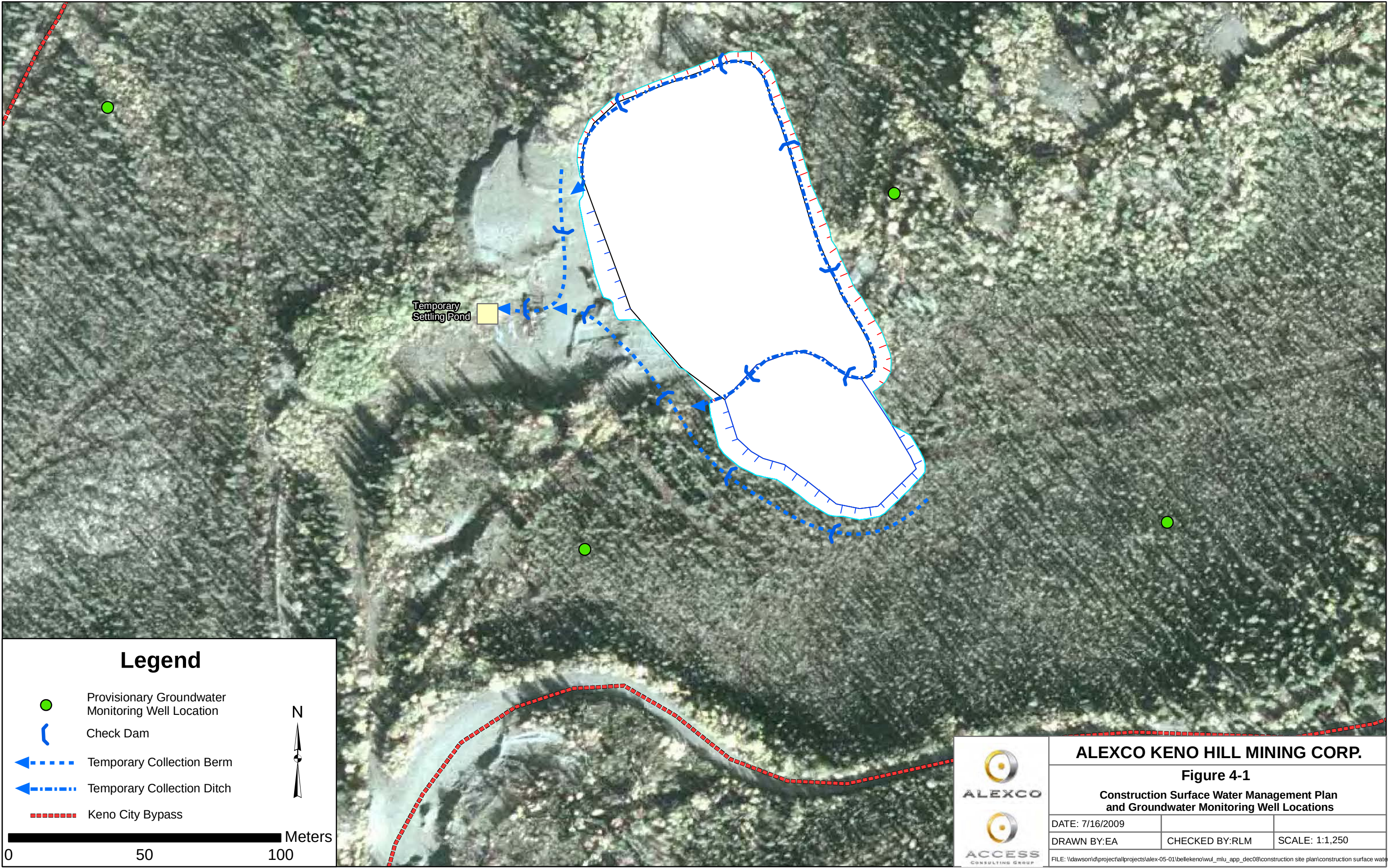
Currently at Bellekeno 625, treated water (KV-43) is monitored daily through internal analysis for pH, flow, total zinc, ammonia and turbidity with monthly samples sent to an external lab. Similar monitoring is conducted for the Bellekeno East portal, with treated water (KV-75) sampled and analyzed at the same frequencies if it is discharged. The mill and mine discharge will be monitored through stations KV-43 and KV-81.

3.0 Groundwater Surveillance Network

As part of the water licence application, Alexco has committed to the installation of groundwater monitoring wells around the mill and DSTF to determine local groundwater quality and flow paths. These monitoring wells will be installed prior to any operations or tailings deposition.

Monitoring wells will be positioned north, east, south and west of the mill and DSTF (see Figure 2). Each monitoring location will consist of a deep bedrock monitoring well and, if permeable sediments are encountered and the ground is not frozen, a shallow overburden monitoring well. The northern location will be north of the DSTF. The eastern monitoring location will be roughly between the mill and the Keno City solid waste disposal facility. For the southern location, shallow and deep monitoring will be separate. The deep monitoring well will be immediately south of the mill pond. The shallow monitoring well will be roughly southeast of the mill pond, along the current access road. The western well will be west of the DSTF. A second, shallow western monitoring point may be installed down gradient of the pond, within a test pit or excavation, if permeable sediments are identified and the ground is not frozen.

Also as part of the groundwater monitoring program, Alexco has also committed to doing regular testing of Keno City's municipal water source well.



Monitoring Schedule

Samples would be collected quarterly for first two years. Samples should be analyzed for dissolved metals and physical parameters, such as hardness, anions and pH, etc. Water levels would be collected monthly. After two years, sampling and water level collection may be allowed to decrease to twice annually, once during the wet season and once during a dry season, either winter or late summer. Following the initial year of monitoring and assessment will be completed for the program to verify flow paths and travel time.

Our proposed monitoring schedule is presented in the proposed Water Use Licence QZ09-092.

4.0 Permafrost Monitoring

Geotechnical programs have identified areas of permafrost within operational areas of the project. Specifically, some permafrost was encountered beneath the proposed non-AML Waste Rock Storage Area (WRSA) and under the easterly portion of the proposed Dry Stack Tailings Facility (DSTF). Ground temperature and permafrost monitoring is currently in place at these locations. Details on monitoring for the DSTF will be included in the DSTF OMS manual to be submitted as part of the DSTF Development and Operations Plan. Details on permafrost monitoring for the WRSA are included in the Mine Development and operations Plan.

5.0 Physical Inspection Plan

The purpose of the physical inspection is to observe and record sufficient information related to physical structures to permit development of a course of action; repair or rehabilitation if it is required. Physical inspections are currently areas inspected under Water Licence QZ07-078 on a weekly basis near the Bellekeno mine/mill development and operation include the Bellekeno 625 settling ponds, the Bellekeno East decline settling ponds, the Onek waste rock storage facility, surface pipelines between and near Bellekeno East decline and Bellekeno 625. During dewatering of the Bellekeno mine, the condition of the channel of Thunder Gulch and Lightning Creek downstream of Bellekeno 625 treatment plant will be physically inspected.

Type A Water Licence QZ09-092 to be issued for this proposed Bellekeno mine/mill development and operation will outline physical inspections required and will pertain to any new water retaining structures and water conveying structures. This may include but not limited to inspecting the waste rock storage area, the access road, dry stack tailings and the mill water and treatment ponds. The proposed physical inspections for mine production will be incorporated into the Water Licence QZ07-078 physical inspection plan and updated.

6.0 Weather Monitoring

6.1 Climate Overview

This section presents an overview of basic variables which affect the water balance at each of the three points of water use and discharge in this project. Data from two historical Environment Canada Atmospheric Environment Service weather stations in the Keno Hill area (Elsa townsite from 1948-1965, and 1974-1989; and Keno Hill from 1974-1982) were used to predict climatic parameters for the three site locations within the Bellekeno Mine and Mill development project.

The most important variables are average precipitation and average evaporation. These two parameters were considered the key parameters in developing the water balance for the Keno Hill area as a whole, see Section 2.1 of the Environmental Conditions Report (attached as Appendix C).

6.1.1 Precipitation and Evaporation

Two climatic variables were assessed to develop an overall water balance for the Keno Hill Silver District. The two variables are average precipitation and average evaporation. These two variables were considered the key parameters in developing the water balance for the site.

Data from various climate stations were used to characterize the climate of the Keno Hill Property. A discussion of this data including mean annual precipitation and rates of evaporation is provided in Section 2.1 of the Environmental Conditions Report (see Appendix C). This data was used to derive site hydrological conditions at the time; however, based on comparisons with the latest site data, the original techniques and hydrological inputs were deemed appropriate in deriving site hydrological conditions

(Clearwater Consultants Ltd, 2008; see Environmental Conditions Report). This climate data is therefore still considered valid and accurate.

Mean annual precipitation (MAP) has been shown within the Keno Hill Silver District to increase with increasing elevation. The significant relief over which the Keno Hill area spans is well represented by the two historical weather stations with Elsa at 814 m and the Keno Hill weather station at 1472 m. This spread facilitated derivation of the relationship between elevation and precipitation for the site. In combination with site evapotranspiration, calculations have been used to predict annual precipitation, evapotranspiration, and net precipitation for the Bellekeno Mine and Flame and Moth Mill (see **Error! Reference source not found.** below). The close proximity and similar elevation allow Elsa to be a proxy for the Flat Creek Camp.

Table 3 Precipitation and Evapotranspiration at Select Keno Hill District Locations

Site	Mean Annual Precipitation (mm)	Mean Annual Evapotranspiration (mm)	Annual Net Precipitation (mm)	Data Source
Keno Hill (1472 m Elevation)	585	205	380	AES Climate Station, UKHM Site Characterization Report, 1996
Elsa Townsite (814 m Elevation)	420	230	190	AES Climate Station, UKHM Site Characterization Report, 1996
Bellekeno Mine (1050 m Elevation)	479	221	258	Calculated based on site elevation-precipitation relationship
Flame and Moth mill site (901m Elevation)	443	227	215	Calculated based on site elevation-precipitation relationship

These precipitation and evapotranspiration estimates have been compared to recent work done by Clearwater Consultants Ltd. (CCL, 2008) on behalf of Alexco to update the 1996 study on Hydrology for the Keno Hill Silver district (CCL, 2008). CCL found that using the latest site flow data, hydrologic inputs for their new site-wide water balance could be estimated using the original techniques presented in the 1996 Hydrology Study, provided the influences of adit flows on local hydrology were accounted for. A direct comparison

between the annual net precipitation for the Flame and Moth Site (209 mm) with the 2004-2007 MAR of the Christal Creek catchment area based on KV-7 flow data (221 mm) shows close agreement. Comparison between the estimated Bellekeno Mine Site annual net precipitation and MAR from the Lightning Creek catchment area above KV-41 shows a considerable difference (258 mm vs. 344 mm, respectively). This can be explained in the fact that the Bellekeno Mine site is quite low within the Lightning Creek catchment, and therefore receives below average precipitation for the catchment area.

6.2 Climate Monitoring Stations

As part of closure planning studies, a meteorological station was established on Galena Hill in summer 2007 by Alexco. The station measures air temperature, relative humidity, barometric pressure, rainfall, wind speed and direction, solar radiation, and soil temperature. A second metrological station of the same type as that on Galena hill may be established at the Flame and Moth mill site. A Yukon Government monitored snow course station also exists in the area. These data will be used to update meteorological/hydrological information and water balances for the project area throughout operations and to better inform closure planning. This will include calculations of minimum and maximum for both wet and dry years.

7.0 Noise Impacts and Sound Monitoring

Noise Impacts and sound monitoring are discussed in the Noise Abatement Plan submitted under QML-0009.

8.0 Dust Abatement and Monitoring

Alexco commits to incorporate industry best management practices to minimize dust releases from its operations. The majority of public concerns expressed on this subject during YESAA assessment related to the potential for fugitive dust from the milling operation.

The single largest potential source of dust from a mining operation is the potential for windblown dust from tailings facilities. This has been a feature of slurry tailings deposits in past mining operations, where desiccated 'beaches' of tailings form above water line in large, valley fill tailings impoundments. The system proposed for the Bellekeno mill, however, is completely different from valley-fill slurry tailings deposits of the past. The Dry

Stack technology results in a filtered, moist tailings deposit that is placed and compacted in lifts to achieve certain design compaction levels. Also, with the added feature of progressive construct & progressive reclaim, only one year (approximately one hectare in surface area) will be exposed at any one time. Each year's dry stack after construction is covered with an evapotranspirative cover and revegetated.

Therefore, not only is the footprint minimized, but damp and compacted tails will not be subject to wind erosion. Should desiccation be observed to be occurring in summer months, the Operation, Maintenance and Surveillance Manual for the Day Stack Tailings Facility will dictate procedures to be undertaken for rewetting with spray bars or trucked water to maintain moist conditions prior to covering.

In addition to these mitigative dust control measures pertaining to the DSTF, Alexco will also follow a number of industry best management preventative practices for dust control for all aspects of the mine and mill operation including:

- If excess dust is produced by the crusher, dust screens will be installed around the crushing facility;
- Use of dust suppression techniques, such as the application of water as necessary, to the Dry Stack Tailing Facility, non-AML rock storage and the haul roads and mill site area, if and when dusting conditions occur;
- Under no circumstances will waste oil or other hydrocarbon product be used for dust suppression;
- Operational areas will be designed to minimize pollution from dust, taking account of prevailing wind conditions, and using enclosures for loadout areas, buildings as screens, etc.

During the YESAA assessment, the issue of dust was highlighted by assessors and reflected in the YG Decision Document issued July 10, 2009. The Decision Document calls for dust (TSP) monitoring to be conducted during operations.

Alexco commits to undertaking TSP monitoring, as per the requirements set out in the Decision Document. The TSP monitoring program will be comprised of two phases. First,

upon commencement of operations, a simple TSP air samplers will be installed at the edge of the mill site in between the mill and Keno City. If warranted by initial dustfall measurements indicating TSP concentrations in excess of 150 micrograms per cubic meter, a more extensive monitoring system will be put in place, and additional dust suppression measures will be undertaken in order to achieve the TSP objective of less than 150 micrograms per cubic meter.

9.0 Waste Rock Monitoring

All waste rock management facilities are subject to monitoring for physical and geochemical stability (acid rock drainage or metal leaching). A complete Waste Rock Management Plan was attached to the Construction Site Plan Revision 1 as Appendix B and includes detailed descriptions of waste rock monitoring.

10.0 Environmental Effects Monitoring (Under MMER)

The MMER, governed under the Fisheries Act, was annexed on June 6, 2002 and amended on October 2006. The Bellekeno mining operation will be subject to these regulations, as effluent discharge exceeds 50 m³ /day, which will authorize the deposit of a deleterious substance (allow the deposit of an effluent) from the mining and milling operation according to the following categories and conditions (MMER 2002, Metal Mining Guidance Document for Aquatic Environmental Effects Monitoring, June 2002):

10.1 Final Discharge Points

Bellekeno mine and mill operation will have two distinct discharge sites into two different receiving waters (mine operation effluent discharges to Lightning Creek; milling operation at Flame and Moth will discharge into Christal Creek and/or Christal Lake).

The final monitoring location selected will require a year-round accessible site where an accurate flow measuring device, according to Environment Canada specifications, can be constructed (Guidance Documents for the Sampling and Analysis of Metal Mining Effluents, Environment Canada, April 2001). This will also serve as the location where effluent sampling and monitoring will occur.

10.2 Effluent Monitoring

Monitoring at the above sites for discharge and water quality is required on a weekly basis and will be triggered at each respective location when mine and or mill construction commences. Acute lethal toxicity tests will be required monthly. In addition to criteria specified in the Type A water license, effluent must meet the following criteria (MMER 2004, Metal Mining Effluent Regulations, subsections 34(2), 36(5) and 38(9) of the *Fisheries Act*):

The concentration of the deleterious substance in the effluent does not exceed authorized limits as shown in Table 4:

Table 4 MMER Standards

Deleterious Substance	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized in a Grab Sample	Units
Arsenic	0.50	0.75	1.00	mg/l
Copper	0.30	0.45	0.60	mg/l
Cyanide	1.00	1.50	2.00	mg/l
Lead	0.20	0.30	0.40	mg/l
Nickel	0.50	0.75	1.00	mg/l
Zinc	0.50	0.75	1.00	mg/l
TSS	15.0	22.50	30.00	mg/l
Radium 226	0.37	0.74	1.11	Bq/l

*All concentrations are total values

The pH of the effluent is equal to or greater than 6.0 but is not greater than 9.5; and
The deleterious substance is not an acutely lethal effluent (trout and daphnia LT50)

10.3 Environmental Effects Monitoring (EEM) Program

Under MMER the Bellekeno operation will also be required to conduct an Environmental Effects Monitoring program. The sampling requirements under this program are as follows:

Part 1. Effluent and Water Quality Monitoring Studies

- a) Effluent Characterization: Quarterly sampling of extra parameters from final discharge point;
- b) Water Quality Monitoring: Quarterly sampling of sites within reference and exposure areas:
 - a. Reference Area: Water frequented by fish that is not exposed to effluent and that has fish habitat that, as far as is practicable is most similar to the exposure area.
 - b. Exposure Area: All fish habitat and waters frequented by fish that are exposed to effluent; and
- c) Sublethal Toxicity Testing: Semi-annual sampling required at each final discharge point and analysis of effects on reproduction or growth of a fish species, a plant species, an invertebrate species and an algal species as acceptable to MMER.

Part 2: Biological Monitoring Studies

A number of study cycles that each include:

- A study design (first study design to be submitted within 12 months of triggering MMER and includes a site characterization);
- Environment Canada and stakeholder review;
- A Field Sampling Program; and
- Submission of an Interpretive Report that indicates whether or not an effect is observed.

Within each cycle, studies are conducted to determine if the effluent is having an effect on the following biological components including:

- a) Fish Population: Studies conducted in exposure and reference areas
- b) Fish Tissue Studies: Only required if concentrations in effluent exceed is equal to or greater than 0.1 ug/l or ppb – as determined by the effluent characterization program)
- c) Benthic Invertebrate Community: Studies conducted in exposure and reference areas.

The first study cycle is 30 months in duration. The subsequent cycles are 24-72 months in duration, depending on previous results (i.e. if an effect is indicated). A final cycle is required if notification of mine closure is issued. In order to avoid redundancy in sampling sites and monitoring programs, final discharge points for MMER will be considered final discharge points under the proposed water licence for the Bellekeno mine/mill development and operations. All requirements and reports and data for the MMER EEM studies will be provided to the Yukon Water Board.

10.4 Christal Lake Characterization Study

To document local environmental conditions in Christal Lake an initial Characterization study will be conducted. The purpose of this study will be to document limnological characteristics of Christal Lake and will be undertaken during the first year of construction /operation. The program will involve the collection of lake sediments, phytoplankton, zooplankton and water quality using recognized guidance protocols. The program will be conducted three times during the open water season for phytoplankton only and one time sampling for other parameters. The results of this study will be considered as part of the MMER EEM program and the continuation of the Christal Lake Study will be integrated into the MMER EEM program as required.

11.0 Spill Contingency Plan

A Spill Contingency Plan is in place under the current Water Licence QZ07-078 for the purpose of advanced exploration and preliminary development activities at the Bellekeno Mine. The Spill Contingency Plan outlines that:

“The Licencee shall immediately contact the 24-hour Yukon Spill Report Centre, (867) 667-7244, and implement the Spill Contingency Plan should a spill or an unauthorized discharge occur. A detailed written report on any such event including, but not limited to, dates, quantities, parameters, causes and other relevant details and explanations, shall be submitted to the board not later than 10 days after the occurrence”;

“All personnel shall be trained in procedures to be followed and the equipment to be used in the containment of a spill”; and

“The Spill Contingency Plan shall be posted on site for the term of the Licence”.

For more details, see the Spill Contingency Plan and the Emergency Response Plan submitted for QML--0009. Incident reports will be forwarded to NNDFN.

12.0 Adaptive Management Plan (AMP) Overview

12.1 AMP Objectives

An adaptive management plan (AMP) is a management tool designed to guide responses to unforeseen or contingency events respecting for example, water quality and quantity and physical conditions of site workings and infrastructure. The adaptive management approach will provide for assessment of mitigation measures and their effectiveness, and guide the orderly implementation of responses. Since it is difficult to predict the specific environmental condition that may arise which requires a response from management, the AMP does not necessarily provide specific detailed descriptions of responses to a situation. The AMP provides a range of possible responses to use as a guide to respond to specific environmental conditions encountered. Management should use the information provided in the AMP and adapt the appropriate response from this guide, which is the sole purpose of an AMP.

The AMP framework encompassing active Company management includes:

- routine inspection and environmental monitoring, maintenance and reclamation;
- routine assessment of monitoring and performance data;
- performance thresholds for implementation of appropriate levels of responses for planned contingency measures; and
- reporting of monitoring results and actions.

Results of the current monitoring programs will be assessed on an ongoing basis to determine if any negative trends in water quality, quantity or other parameters are occurring. If the results indicate that there are no negative environmental impacts, then the frequency and length of monitoring and maintenance would continue as usual. Adaptive management will be implemented to respond to negative trends observed through the monitoring programs. The most current site wide Adaptive Management Plan is attached as Appendix B.

12.2 AMP Events Summary

A number of “events” have been identified which represent potential environmental conditions that would require a management response, if they were to occur:

1. Change in Water Quality or Quantity

- a. Significant Change in Water Quality
 - i. Water Treatment Facilities/ Licensed Effluent Discharges
 - ii. Adit Discharges
 - iii. Bellekeno Mine Water Quality Significantly Altered After Dewatering
 - iv. Receiving Water Quality Significantly Altered During or Subsequent to Dewatering Bellekeno Mine
- b. Significant Increase or Decrease in Monitored Flow Occurs
 - i. Bellekeno Mine Water Quantity Significantly Altered After Dewatering
- c. Currently Monitored Water Flow Stops
- d. New Water Flow is Observed
- e. Water Flow Path Changes

2. Waste Rock Seepage Exhibits AML

- a. Waste Rock Seepage/Run-Off Trending to AML Conditions

3. Sludge Storage Area Effectiveness Compromised

- a. Seepage Observed Near Sludge Storage Area
- b. Sludge Storage Area Approaching Capacity

4. Physical Instabilities

- a. Area of Significant Subsidence is Observed
- b. Rock Fall or Landslide Occurs Within a Monitored Area
- c. Structure Failure or Portal Collapse

5. Site Security Compromised

- a. Gate, Fence or Sign Damaged

The AMPs for each of these events are described individually in the District Wide Adaptive Management Program attached as Appendix B, while Table 5 provides a summary of the approach to AMP events. This table describes a narrative trigger, indicators and response thresholds, monitoring locations and parameters.

12.3 AMP Approach

For each AMP event a methodical approach is provided:

1. Description of the event and possible environmental consequences - Addresses issues or information that trigger the AMP;
2. Location of possible event occurrence – Identifies specific working site locations if applicable to event;
3. Monitoring requirements – Identifies the parameters to be monitored, frequency and means for monitoring each parameter;
4. Specific indicators and thresholds - Defines the conditions when management actions should be taken. There may be a series of indicators and staged thresholds for an individual event; and
5. Approach to responses –Description of the approach to responses including a simplified flow chart to guide the implementation process if any specific thresholds have been crossed.

Table 5 Overall AMP Summary

EVENT	NARRATIVE TRIGGER	INDICATORS	THRESHOLDS	MONITORING LOCATIONS	MONITORING PARAMETERS
1. CHANGE IN WATER QUALITY OR QUANTITY					
a. Significant change in water quality	<u>Water Treatment Facilities</u> Decline in effluent pH noted or effluent quality trending towards possible exceedance of standards or exceeds licensed standards.	pH, Total zinc, ammonia	Treated effluent: pH <8.0; OR Total Zinc > 0.40 mg/L and pH <6.5 for two consecutive days; OR Ammonia > 4.0 mg/L and pH > 9.0 for two consecutive days; OR Effluent quality standards exceeded.	Water Treatment Facilities	Routine in-situ, on-site total zinc, external multi-element ICP, hardness, pH, conductivity, TSS, ammonia (Bellekeno), LT50
	<u>Adit Discharges</u> Routine site inspections indicate noticeable change in water clarity or declining pH or increasing conductivity. Contaminant concentrations display a statistically significant sustained increase over historical water quality database.	Visual observation of clarity, in-situ pH & conductivity, total cadmium, total zinc	Site inspection: pH < 6.5 or conductivity >2,000 S/cm; OR Increase of 2X or more in total Cd/Zn load or conductivity when compared to the average for the previous 24 months	Adit Discharges	Routine in-situ, external multi-element ICP, hardness, pH, conductivity, TSS
b. Adit discharge or treated effluent, quantity increases or decreases	Observed or measured flows display a sustained and statistically significant increase or decrease over historical flow database	Flow and water quality (total zinc, pH and conductivity) and stream type - fish bearing	Increase/decrease in flow of 2X or more when compared to the average for the previous 24 months AND threshold for Event 1 a) or b) as applicable also exceeded	Site-wide flow monitoring	same as indicators

EVENT	NARRATIVE TRIGGER	INDICATORS	THRESHOLDS	MONITORING LOCATIONS	MONITORING PARAMETERS
c. Flow stops from adit discharge	Water flowing from historical workings stops	Flow, ice plug formation	25% of adit opening filled with ice	Adit and treatment locations	same as indicators
d. New water flow is observed	Previously dry site exhibits flow and effects down gradient water quality and loadings	Flow and water quality (Total zinc, pH and conductivity)	Adit flows for 30 l/s for 7 day period	Site-wide mine workings	same as indicators
e. Water flow path changes	Flow path of mine working discharge changes path from historically known channel and enters a new watercourse	Flow and water quality (Total zinc, pH and conductivity)	Flow path changed and enters a new watercourse	Adit and treatment locations	same as indicators
2. WASTE ROCK SEEPAGE EXHIBITS AML					
a. Waste rock seepage or run-off trending to AML conditions	Seepages from waste rock storage areas or from works constructed or upgraded with non AML material show significant decline in pH and/or an increase in conductivity OR approaching licensed discharge standards (where appropriate i.e. Onek)	pH, conductivity	Significant decline in pH between measurements or pH <7.0 and/or conductivity showing a significant increasing trend or >2000 S/cm; OR indicators approaching licensed standards for Onek waste rock storage area	Waste rock storage areas and works or upgrades constructed from non-AML material	Routine multi-element ICP
3. SLUDGE STORAGE AREA EFFECTIVENESS COMPROMISED					
a. Seepage observed near sludge storage areas	Routine inspection of sludge storage area shows seepage	Total zinc, pH	pH >8.5 and total zinc > 1.0 mg/L	Sime Pit, Sime Waste Dump, Valley Tailings sludge storage cell	Same as indicator
c. Sludge storage area approaching capacity	Sludge storage area approaching minimum freeboard of 1.0 meter below the decant point	Visual observation of freeboard	Freeboard is at 1.5 meter below decant point	Sime Pit, Sime Waste Dump, Valley Tailings sludge storage cell	Same as indicator

EVENT	NARRATIVE TRIGGER	INDICATORS	THRESHOLDS	MONITORING LOCATIONS	MONITORING PARAMETERS
4. PHYSICAL INSTABILITIES					
a. Area of significant surface subsidence has occurred	An observed subsidence has exposed an opening to surface or resulting in slope failure	Visible slope failure, ground subsidence or opening on surface	Opening to underground workings or area of subsidence effects public safety or down gradient environment	Site-wide	same as indicators
b. Rock fall or landslide is observed that effects road right-of-way or intrudes into stream	An observed rock fall or landslide effects a road right-of-way, infrastructure or intrudes into stream	Mine source material movement	Source material effects road or stream	Site-wide	same as indicators
c. Structure failure or portal collapse	A building, engineered structure or portal is seen to be failing (settling, excessive erosion)	Visual observation	Structure near public access	Site-wide	same as indicators
5. SITE SECURITY COMPROMISED					
a. Security gate, fence, sign damaged	Public health and wildlife safety measure damaged or removed	Sign, fence, gates, locks	Security feature damaged, removed, or compromised	Site-wide	same as indicators

13.0 Reporting

Reporting on water quality monitoring and management issues will be directed to the Yukon Water Board (YWB) and YG EMR in accordance with the requirements of the Water Licence. Monthly and annual reporting will be carried out during Bellekeno mine development activities and through the implementation of site decommissioning until it can be demonstrated through the monitoring results that the final closure reclamation objectives have been achieved.

Alexco also continues to liaise with the regulatory agencies, NNDFN, the Mayo RRC and the local community on environmental issues relating to the Bellekeno mine/mill development and operation program. For example all monthly and annual reports are provided to NNDFN.



ALEXCO KENO HILL MINING CORP.

QUARTZ MINING LICENCE

QML-0009

BELLEKENO MINE DEVELOPMENT

KENO HILL SILVER DISTRICT

YUKON

Appendix A

MSDS Sheets



Material Safety Data Sheet

Preparation Date: 16-Jun-2004

Revision Date: 30-Jul-2008

Revision Number: 1

SECTION 1 – PRODUCT AND COMPANY IDENTIFICATION

Supplier(s):

Orica Canada Inc.
Maple Street
Brownsburg, QC

For MSDS Requests: 1-450-533-4201

Orica USA Inc.

33101 E. Quincy Avenue
Watkins, CO 80137-9406

For MSDS Requests: 1-303-268-5000

Product Name:

Ammonium Nitrate Fuel Oil

Product Code:

125

Alternate Name(s):

AMEX™, AMEX HD™, ANFO

UN-No:

UN0331

Recommended Use:

A booster sensitive blasting agent.

Emergency Telephone Number: FOR CHEMICAL EMERGENCIES (24 HOUR) INVOLVING TRANSPORTATION, SPILL, LEAK, RELEASE, FIRE OR ACCIDENTS: **IN CANADA CALL:** THE ORICA TRANSPORTATION EMERGENCY RESPONSE SYSTEM AT 1-877-561-3636. **IN THE U.S. CALL: CHEMTREC 1-800-424-9300. IN THE U.S.:** FOR LOST, STOLEN, OR MISPLACED EXPLOSIVES CALL: BATF 1-800-800-3855. FORM ATF F 5400.0 MUST BE COMPLETED AND LOCAL AUTHORITIES (STATE/MUNICIPAL POLICE, ETC.) MUST BE ADVISED.

SECTION 2 – HAZARD IDENTIFICATION

Emergency Overview:

Risk of explosion by shock, fire of other sources of ignition. If misused or disposed of improperly, material could explode and cause death or serious injury. This product contains one or more substances, which are classified in the EU as carcinogenic, mutagenic and/ or reprotoxic. Irritating to eyes, respiratory system and skin. Harmful if swallowed. Oxidizing agent.

Appearance:

Off-white prills

Physical State:

Solid

Odor:

Diesel fuel oil

SECTION 3 – COMPOSITION/ INFORMATION ON INGREDIENTS

Chemical Name

Ammonium Nitrate
Fuels, Diesel, no. 2

CAS-No

6484-52-2
68476-34-6

Weight %

60-82
5-10

SECTION 4 – FIRST AID MEASURES

General Advice:

In case of accident or if you feel unwell, seek medical advice IMMEDIATELY (show the product label where possible).

Eye Contact:

Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Immediate medical attention is required.

Skin Contact:

Wash off immediately with soap and plenty of water, removing all contaminated clothes and shoes. If skin irritation persists, call a physician.

Inhalation:

Move victim to fresh air. Give artificial respiration ONLY if breathing has stopped. Give cardiopulmonary resuscitation (CPR) if there is no breathing AND no pulse. Obtain medical advice IMMEDIATELY.

Ingestion:

Immediate medical attention is required. Do not induce vomiting. Clean mouth with water and afterwards drink plenty of water. If spontaneous vomiting occurs, have victim lean forward with head positioned to avoid breathing in of vomitus, rinse mouth and administer more water. Never give anything by mouth to an unconscious person.

Notes to physician:

Symptomatic. Administer oxygen if there are signs of cyanosis. If clinical condition deteriorates, administer 10cc Methylene Blue intravenously. It is unlikely for this to be required with methemoglobin level of less than 40%.

SECTION 5 – FIRE-FIGHTING MEASURES

Flammable properties:	Not itself combustible but assists fire in burning materials. The product does not flash. Rate of burning: does not sustain burning at atmospheric pressure.
Suitable extinguishing media:	DO NOT FIGHT FIRES INVOLVING EXPLOSIVES. Evacuate surrounding areas. When controlling fire before involvement of explosives, fire-fighters should wear positive pressure self-containing breathing apparatus (SCBA) and full turnout gear. Water may be applied through fixed extinguishing system (sprinklers) as long as people need not be present for the system to operate.
Unsuitable extinguishing media:	DO NOT FIGHT FIRES INVOLVING EXPLOSIVES. Attempts to smother a fire involving this product will be ineffective as it is its own oxygen source. Smother this product could lead to decomposition and explosion. This product is more sensitive to detonation if contaminated with organic or oxidisable material or if heated while confined. Unless the mass of product on fire is flooded with water, re-ignition is possible.
Specific hazards arising from the chemical:	This product is a high explosive with mass detonation hazard. DO NOT FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS. Immediately evacuate all personnel from the area to a safe distance. Guard against re-entry. Thermal decomposition can lead to release of irritating gases and vapors.
Protective equipment and precautions for firefighters:	As in any fire, wear self-contained breathing apparatus pressure-demand, NIOSH approved (or equivalent) and full protective gear.

SECTION 6 – ACCIDENTAL RELEASE MEASURES

Methods for containment:	Avoid dust formation. Do not breathe dust.
Methods for cleaning up:	Avoid the use of metal tools containing iron and/or copper. Be careful to avoid shock, friction, and contact with grit. Collect product for recovery or disposal. For release to land, contain discharge by constructing dykes or applying inert absorbent; for release to water, utilize damming and/or water diversion to minimize the spread of contamination. Collect contaminated soil and water, and absorbent for proper disposal. Notify applicable government authority if release is reportable or could adversely affect the environment.
Other information:	Deactivating chemicals: Not applicable.

SECTION 7 – HANDLING AND STORAGE

Handling:	This product is an explosive and should only be used under the supervision of trained personnel. The use of coveralls is recommended. Use good industrial hygiene and housekeeping practices. Keep away from open flames, hot surfaces and sources of ignition.
Storage:	Store under moderate temperatures recommended by a technical services representative. Store under dry conditions in a well ventilated magazine that has been approved for either detonator storage or explosive storage. Do NOT store explosives in a detonator magazine or detonators in an explosive magazine. Keep away from heat, spark and flames. Keep containers closed. Explosives should be kept well away from initiating explosives; protected from physical damage; separated from oxidizing materials; combustibles, and sources of heat. Keep away from incompatibles. Ideal storage temperature is 10-27 °C (50-80 °F). Do not expose sealed containers to temperatures above 40 °C (104 °F).

SECTION 8 – EXPOSURE CONTROLS/PERSONAL PROTECTION

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Fuels, Diesel, no. 2	TWA: 100 mg/ m ³ Skin		

Other exposure guidelines:	Ammonium Nitrate: ORICA Guideline 5 mg/m ³ (internal TWA).
Engineering Measures:	No information available.
Personal Protective Equipment	
Eye/Face Protection:	Tightly fitting safety goggles.
Skin Protection:	User should verify impermeability under normal conditions of use prior to general use. Impervious butyl rubber gloves.
Respiratory Protection:	In case of insufficient ventilation wear suitable respiratory equipment. A NIOSH-approved respirator, if required.

Hygiene Measures: Handle in accordance with good industrial hygiene and safety practice. Recommendations listed in this section indicate the type of equipment, which will provide protection against over exposure to this product. Conditions of use, adequacy of engineering or other control measures, and actual exposures will dictate the need for specific protective devices at your workplace.

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Off-white prills	Odor:	Diesel fuel oil
Physical State:	Solid	Viscosity:	No information available
pH:	No data available	Flash Point:	52°C/ 126°F (Diesel fuel)
Autoignition Temperature:	230- 265°C	Boiling Point/Range:	None
Melting Point/Range:	170°C/ 338°F	Flammable Limits (Upper):	Not Applicable
Flammable Limits (Lower):	Not Applicable	Explosion Power:	350-400 kJ/ 100g
Specific Gravity:	No data available	Water Solubility:	Dissolves slowly with prolonged exposure to water
Other Solubility:	Not available	Vapor Pressure:	0.4 mmHg @ 20°C /68°F (diesel fuel oil)
Oxidizing Properties:	Oxidizer	Partition Coefficient (n-octanol/water):	No data available

SECTION 10 – STABILITY AND REACTIVITY

Stability: Stable under normal conditions. Decomposition Temperature: Ammonium Nitrate will spontaneously decompose at 210°C (410°F).

Conditions to avoid: Keep away from open flames, hot surfaces and sources of ignition. Not expected to be sensitive to static discharge. Not expected to be sensitive to mechanical impact.

Incompatible materials: Avoid oxidizable materials, metal powder, bronze & copper alloys, fuels (e.g. lubricants, machine oils), fluorocarbon lubricants, acids, corrosive liquids, chlorate, sulphur, sodium nitrite, charcoal, coke and other finely divided combustibles. Strong oxidizing and reducing agents.

Hazardous decomposition products: The following toxic decomposition products may be released. At temperatures above 210°C, decomposition may be explosive, especially if confined. Nitrogen oxides (NOx). Carbon oxide. Hydrocarbons.

Hazardous Polymerization: None under normal processing. Hazardous polymerization does not occur. Explosive material under shock conditions.

SECTION 11 – TOXICOLOGICAL INFORMATION

Acute Toxicity

Product Information: Irritating to eyes. May cause skin irritation. Harmful if swallowed.

Chemical name	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ammonium Nitrate	2217 mg/kg Rat	3000 mg/kg Rabbit	88.8 mg/L Rat 4 h
Fuels, Diesel, no. 2	>5000 mg/kg Rat	>5000 mg/kg Rabbit	

Subchronic Toxicity (28 Days): Ammonium Nitrate: Ingestion may cause methemoglobinemia. Initial manifestation of methemoglobinemia is cyanosis, characterized by navy lips, tongue and mucous membranes, with skin color being slate grey. Further manifestation is characterized by headache, weakness, dyspnea, dizziness, stupor, respiratory distress and death due to anoxia. If ingested, nitrates may be reduced to nitrites by bacteria in the digestive tract. Signs and symptoms of nitrite poisoning include methemoglobinemia, nausea, dizziness, increased heart rate, hypotension, fainting and, possibly shock.

Chronic Toxicity: May cause methemoglobinemia.
Carcinogenicity: The table below lists whether each agency has listed any ingredient as a carcinogen.

Chemical Name	ACGIH	IARC	NTP	OSHA
Fuels, Diesel, no. 2	A3			

Legend: A3: Confirmed animal carcinogen.
Mutagenic effects: There is no evidence of mutagenic potential.

Irritation: Irritating to eyes. May cause irritation of respiratory tract. May cause skin irritation in susceptible persons.
Reproductive effects: No information is available and no adverse reproductive effects are anticipated.
Developmental effects: No information is available and no adverse developmental effects are anticipated.
Target Organ: Eyes, skin, respiratory system, blood, kidney, liver, urinary tract, blood, endocrine system, immune system & gastrointestinal tract (GI).

SECTION 12 – ECOLOGICAL INFORMATION

Ecotoxicity effects: Dissolves slowly in water. Harmful to aquatic life at low concentrations.
Environmental Effects: Can be dangerous if allowed to enter drinking water intakes. Do not contaminate domestic or irrigation water supplies, lakes, streams, ponds, or rivers.

Persistence/Degradability: Some water resistance but soluble with extended time periods.

Mobility in Environmental media: Dissolves slowly in water.

SECTION 13 – DISPOSAL CONSIDERATIONS

Waste Disposal Method: Burn under supervision of an expert at an explosive burning ground or destroy by detonation in boreholes, in accordance with applicable local, provincial and federal regulations. Call upon the services of an Orica Technical Representative.

SECTION 14 – TRANSPORT INFORMATION

DOT Proper Shipping Name: Explosive, blasting type B
Hazard Class: 1.5D
UN-No: UN0331
Packing group: II

TDG Proper Shipping Name: Explosive, blasting type B
Hazard Class: 1.5D
UN-No: UN0331
Packing group: II

Transportation Emergency Telephone Number: 1-877-561-3636 or CHEMTREC: 1-800-424-9300

SECTION 15 – REGULATORY INFORMATION

CANADIAN CLASSIFICATION: This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and this MSDS contains all the information required by the CPR

WHMIS hazard class: This product is an explosive and is not regulated by WHMIS.

USA CLASSIFICATION:

SARA Regulations Sections 313 and 40 CFR 372: This product contains the following toxic chemical(s) subject to reporting requirements, Ammonium Nitrate (6484-52-2) & Fuels, Diesel no.2 (68476-34-6).

SARA 311/312 Hazardous Categorization

Acute Health Hazard: Yes
Chronic Health Hazard: Yes
Fire Hazard: Yes
Reactive Hazard: Yes
Sudden Release of Pressure Hazard: No

Ozone Protection and 40 CFR 42: No reportable quantities of ozone depleting agents

Other Regulations/Legislations which apply to this product: New Jersey Right-to-Know, Pennsylvania Right-to-Know, Massachusetts Right-to-Know, Rhode Island Right-to-Know, Florida, New Jersey Special Health Hazard Substance List, Minnesota Hazardous Substance List, California Director's List of Hazardous Substances, California Proposition 65.

TSCA: Complies

DSL: Complies

NDSL: Complies

The components in the product are on the following international inventory lists:

Chemical Name	TSCA	DSL	NDSL	ENCS	EINECS	ELINCS	CHINA	KECL	PICCS	AICS
Ammonium Nitrate	X	X	-	-	X	-	X	X	X	X
Fuels, Diesel, no. 2	X	X	-	X	X	-	X	X	X	X

Legend: X – Listed

SECTION 16 – OTHER INFORMATION

Prepared by: Safety Health & Environment
303-268-5000

Preparation Date: 16-Jun-2004

Revision Date: 30-Jul-2008

The information contained herein is offered only as guide to the handling of this specific material and has been prepared in good faith by technically knowledgeable personnel. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of any kind is given or implied and Orica will not be liable for any damages, losses, injuries or consequential damages which may result from the use of or reliance on any information contained herein.

End of MSDS



Material Safety Data Sheet

Preparation Date: 21-May-2005

Revision Date: 22-Oct-2008

Revision Number: 1

SECTION 1 – PRODUCT AND COMPANY IDENTIFICATION

Supplier(s):

Orica Canada Inc.
Maple Street
Brownsburg, QC

For MSDS Requests: 1-450-533-4201

Orica USA Inc.

33101 E. Quincy Avenue
Watkins, CO 80137-9406

For MSDS Requests: 1 303-268-5000

Product Name:

B-line™, Boostercord™, Cordtex™, Powercord™, Primaflex™

Product Code:

40040

Alternate Name(s):

Uniline, B-Line, Trunkline, Powercord 100, Powercord 150, Powercord 200, Powercord O 200, Boostercord, Primaflex, Anoline, X-245, X-247, Cordtex 7.5, Cordtex SHD, Cordtex 15, Cordtex LT, Cordtex AP, Cordtex 18, Cordtex 25, Cordtex Premium, Cordtex 40, Cordtex TL, Cordtex 50, Cordtex XTL, Cordtex 60, T-line, Special, 4400 M/S, Poly, Low Flash 25

UN-No:

UN0065

Recommended Use:

Used for initiation of explosive mixtures.

Emergency Telephone Number: FOR CHEMICAL EMERGENCIES (24 HOUR) INVOLVING TRANSPORTATION, SPILL, LEAK, RELEASE, FIRE OR ACCIDENTS: **IN CANADA CALL:** THE ORICA TRANSPORTATION EMERGENCY RESPONSE SYSTEM AT 1-877-561-3636. **IN THE U.S. CALL: CHEMTREC 1-800-424-9300. IN THE U.S.:** FOR LOST, STOLEN, OR MISPLACED EXPLOSIVES CALL: BATF 1-800-800-3855. FORM ATF F 5400.0 MUST BE COMPLETED AND LOCAL AUTHORITIES (STATE/MUNICIPAL POLICE, ETC.) MUST BE ADVISED.

SECTION 2 – HAZARD IDENTIFICATION

Emergency Overview:

Danger. Explosive. Risk of explosion by shock, friction, fire or other sources of ignition. This product is an article. No exposure to hazardous chemicals is expected to occur during intended product use. Misuse of the product may result in exposure to hazardous chemicals.

Appearance:

Cords covered with PVC or polyethylene plastic and/ or wax textiles

Physical State:

Solid

Odor:

Odorless

SECTION 3 – COMPOSITION/ INFORMATION ON INGREDIENTS

Chemical Name

Pentaerythritol Tetranitrate (PETN)

CAS-No

115-77-5

Weight %

60-100

SECTION 4 – FIRST AID MEASURES

General Advice:

Not applicable; this is a packaged product that will not result in exposure to the contents under normal conditions of use. In the event of contact, administer first aid appropriate for symptoms present.

Eye Contact:

Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Immediate medical attention is required.

Skin Contact:

Wash off immediately with soap and plenty of water, removing all contaminated clothes and shoes. If skin irritation persists, call a physician.

Inhalation:

Move victim to fresh air. Give artificial respiration ONLY if breathing has stopped. Give cardiopulmonary resuscitation (CPR) if there is not breathing AND no pulse. Obtain medical advice IMMEDIATELY.

Ingestion:

Immediate medical attention is required. Do not induce vomiting. Clean mouth with water and afterwards drink plenty of water. If spontaneous vomiting occurs, have victim lean forward with head positioned to avoid breathing in of vomitus, rinse mouth and administer more water. Never give anything by mouth to an unconscious person.

Notes to physician:	Symptomatic. Administer oxygen if there are signs of cyanosis. If clinical condition deteriorates, administer 10cc Methylene Blue intravenously. It is unlikely for this to be required with methemoglobin level of less than 40%.
SECTION 5 – FIRE-FIGHTING MEASURES	
Flammable properties:	Product burns if ignited, with possible transition to detonation. May ignite or explode if heated under confinement.
Suitable extinguishing media:	DO NOT FIGHT FIRES INVOLVING EXPLOSIVES. Evacuate surrounding areas. When controlling fire before involvement of explosives, fire-fighters should wear positive pressure self-containing breathing apparatus (SCBA) and full turnout gear. Water may be applied through fixed extinguishing system (sprinklers) as long as people need not be present for the system to operate.
Unsuitable extinguishing media:	DO NOT FIGHT FIRES INVOLVING EXPLOSIVES. Attempts to smother a fire involving this product will be ineffective as it is its own oxygen source. Smother this product could lead to decomposition and explosion. This product is more sensitive to detonation if contaminated with organic or oxidisable material or if heated while confined. Unless the mass of product on fire is flooded with water, re-ignition is possible.
Specific hazards arising from the chemical:	This product is a high explosive with mass detonation hazard. DO NOT FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS. Immediately evacuate all personnel from the area to a safe distance. Guard against re-entry. Thermal decomposition can lead to release of irritating gases and vapors.
Protective equipment and precautions for firefighters:	As in any fire, wear self-contained breathing apparatus pressure-demand, NIOSH approved (or equivalent) and full protective gear.

SECTION 6 – ACCIDENTAL RELEASE MEASURES

Methods for containment:	No information available.
Methods for cleaning up:	Review fire and explosion hazards before proceeding with clean up. Remove and protect ignition sources. Wear protective equipment during clean up. Mop up water using non-sparking tools. It is suggested that only personnel trained in Emergency Response should respond. Verify complete account of product(s). Notify authorities and follow applicable spill reporting requirements.

SECTION 7 – HANDLING AND STORAGE

Handling:	This product is an explosive and should only be used under the supervision of trained personnel. Protect containers from physical damage. Keep away from incompatible materials, heat, sparks, flames and other ignition sources. Avoid rough handling.
Storage:	Store under moderate temperatures recommended by a technical services representative. Store under dry conditions in a well ventilated magazine that has been approved for either detonator storage or explosive storage. Do NOT store explosives in a detonator magazine or detonators in an explosive magazine. Keep away from heat, sparks and flames. Keep containers closed. Explosives should be kept well away from initiating explosives; protected from physical damage; separated from oxidizing materials, combustibles, and sources of heat. Keep away from incompatibles.

SECTION 8 – EXPOSURE CONTROLS/ PERSONAL PROTECTION

Engineering Measures:	Full-handling precautions should be taken at all times.
Personal Protective Equipment	
Eye/Face Protection:	Tightly fitting safety goggles
Skin Protection:	Long sleeved clothing.
Respiratory Protection:	No special protective equipment required.
Hygiene Measures:	Handle in accordance with good industrial hygiene and safety practice.

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Cords covered with PVC or polyethylene plastic and/or wax and textiles	Odor:	None
Physical State:	Solid	Viscosity:	No information available
pH:	No data available	Flash Point:	Not applicable
Autoignition Temperature:	No data available	Boiling Point/Range:	Not applicable
Melting Point/Range:	No data available	Flammable Limits (Upper):	Not applicable
Flammable Limits (Lower):	Not applicable	Explosion Power:	No data available
Specific Gravity:	No data available	Water Solubility:	Negligible
Other Solubility:	Not applicable	Vapor Pressure:	No data available
Oxidizing Properties:	Not available	Partition Coefficient (n-octanol/water):	No data available

SECTION 10 – STABILITY AND REACTIVITY

Stability:	Can explode from impact, heat or friction. PETN explodes at 190 - 210 °C (374 - 410 °F). Stable up to approximately 70 °C.
Conditions to avoid:	Keep away from heat, impact, and friction. Some cords have limited tensile strength and abrasion resistance. Refer to the Product Bulletin for proper applications and use procedures. Damaged cords can lead to misfired holes - potentially, the most hazardous of all blasting situations. Avoid abrasion of cord on hole collars or casing pipes.
Incompatible materials:	Strong oxidizing agents, The PVC/polyethylene plastic or wax covering will, in time, be affected by diesel oil.
Hazardous decomposition products:	Carbon oxide. Nitrogen oxides (NOx). Hydrocarbons.

SECTION 11 – TOXICOLOGICAL INFORMATION

Acute Toxicity

Product Information:	Irritating to eyes. May cause skin irritation. Harmful if swallowed.
Chronic Toxicity:	Not available.
Carcinogenicity:	The ingredients of this product are not classified as carcinogenic by ACGIH (American Conference of Governmental Industrial Hygienists) or IARC (International Agency for Research on Cancer), not regulated as carcinogens by OSHA (Occupational Safety and Health Administration), and not listed as carcinogens by NTP (National Toxicology Program).
Mutagenic effects:	There is no evidence of mutagenic potential.
Irritation:	Irritating to eyes. May cause irritation of respiratory tract. May cause skin irritation in susceptible persons.
Reproductive effects:	No information is available and no adverse reproductive effects are anticipated.
Developmental effects:	No information is available and no adverse developmental effects are anticipated.
Target Organ:	Eyes, skin, respiratory system, blood, liver, urinary tract, gastrointestinal tract (GI), endocrine system, & immune system.

SECTION 12 – ECOLOGICAL INFORMATION

Ecotoxicity effects:	There is no known ecological information for this product.
Persistence/Degradability:	Not applicable.
Mobility in Environmental media:	Not applicable.

SECTION 13 – DISPOSAL CONSIDERATIONS

Waste Disposal Method:	Burn under supervision of an expert at an explosive burning ground or destroy by detonation in boreholes, in accordance with applicable local, provincial and federal regulations. Call upon the services of an Orica Technical Representative.

SECTION 14 – TRANSPORT INFORMATION

DOT Proper Shipping Name: Cord, Detonating
Hazard Class: 1.1D
UN-No: UN0065
Packing group: II
TDG Proper Shipping Name: Cord, Detonating
Hazard Class: 1.5D
UN-No: UN0065
Packing group: II

SECTION 15 – REGULATORY INFORMATION

CANADIAN CLASSIFICATION: This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and this MSDS contains all the information required by the CPR

WHMIS hazard class: This product is an explosive and is not regulated by WHMIS.

USA CLASSIFICATION:

SARA Regulations Sections 313 and 40 CFR 372: This product contains the following toxic chemical(s) subject to reporting requirements,

SARA 311/312 Hazardous Categorization

Acute Health Hazard: No
Chronic Health Hazard: No
Fire Hazard: No
Reactive Hazard: Yes
Sudden Release of Pressure Hazard: No

Ozone Protection and 40 CFR 42: No reportable quantities of ozone depleting agents

Other Regulations/Legislations which apply to this product: No information available.

TSCA: Complies

DSL: Complies

NDSL: Complies

SECTION 16 – OTHER INFORMATION

Prepared by: Safety Health & Environment
303-268-5000

Preparation Date: 21-May-2005
Revision Date: 22-Oct-2008

REFERENCES:

RTECS-Registry of Toxic Effects of Chemical Substances, CCINFODisc, Canadian Centre for Occupational Health and Safety, National Institute for Occupational Safety and Health, U.S. Dept. of Health & Human Services, Cincinnati, 1998.

Clayton, G.D. and Clayton, F.E., Eds., Patty's Industrial Hygiene and Toxicology, 3rd ed., Vol. IIA, B, C, John Wiley and Sons, New York, 1981.

Supplier's Material Safety Data Sheets.

CHEMINFO, HSDB, & NIOSH through "CCINFODisc", Canadian Centre for Occupational Health and Safety, Hamilton, Ontario, Canada, 1998.

"CHEMINFO", "CHRIS", "TOG", "DOT", through "CCINFODisc", Occupational Health and Safety, Hamilton, Ontario, Canada.

Documentation of the Threshold Limit Values and Biological Exposure Indices, 5th ed., American Conference of Governmental Industrial Hygienists Inc., Cincinnati, 1986.

Threshold Limit Values and Biological Exposure Indices for 1997, American Conference of Governmental Industrial Hygienists, Cincinnati, 1997.

Windholz, Martha, Ed., The Merck Index, 11 th ed., Merck and Co., Inc., Rahway, New Jersey, 1989

The information contained herein is offered only as guide to the handling of this specific material and has been prepared in good faith by technically knowledgeable personnel. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of any kind is given or implied and Orica will not be liable for any damages, losses, injuries or consequential damages which may result from the use of or reliance on any information contained herein.

End of MSDS



Material Safety Data Sheet

Preparation Date: 07-Nov-2005

Revision Date: 22-Oct-2008

Revision Number: 1

SECTION 1 – PRODUCT AND COMPANY INFORMATION

Supplier(s):

Orica Canada Inc.
Maple Street
Brownsburg, QC

For MSDS Requests: 1-450-533-4201

Orica USA Inc

33101 E Quincy Ave
Watkins, CO 80137-9406

For MSDS Requests: 1-303-268-5000

Product Name: ElectricCoal™, ElectricMS™, ElectricLP™, Electric Seismic, Electric Instant
Product Code: 20147
Alternate Name(s): Not available
UN-No: UN0255 or UN0030 (depending on packaging)
Recommended Use: Electric detonators and accessory products.

Emergency Telephone Number: FOR CHEMICAL EMERGENCIES (24 HOUR) INVOLVING TRANSPORTATION, SPILL, LEAK, RELEASE, FIRE OR ACCIDENTS: **IN CANADA CALL:** ORICA CANADA TRANSPORTATION EMERGENCY RESPONSE SYSTEM AT **1-877-561-3636**. **IN US CALL:** CHEMTREC **1-800-424-9300**. **IN THE U.S.** FOR LOST, STOLEN OR MISPLACED EXPLOSIVES CALL: BATF **1-800-800-3855**. FORM ATF F5400.0 MUST BE COMPLETED AND LOCAL AUTHORITIES (STATE/MUNICIPAL POLICE, ETC.) MUST BE ADVISED.

SECTION 2 – HAZARD IDENTIFICATION

Emergency Overview:

The following information is the potential hazards associated with the ingredient(s) in this product. It is our belief that, under conditions of normal occupational exposure, this product should pose no such hazards to the user. Main risk is that of explosion by shock, friction, fire or other sources of ignition. Read the entire MSDS for a more thorough evaluation of the hazards.

Appearance:

A metal cylinder with varying length attached plastic coated wires.

Physical State:

Solid

Odor:

None

SECTION 3 – COMPOSITION/ INFORMATION ON INGREDIENTS

Chemical Name	CAS-No	Weight %
Pentaerythritol Tetranitrate (PETN)	78-11-5	1-5
Barium	7440-39-3	1-5
Chromium	7440-47-3	1-5
Barium Chromate	10294-40-3	1-5

SECTION 4- FIRST AID MEASURES

General Advice:

General: Not applicable; this is a packaged product that will not result in exposure to the contents under normal conditions of use.
In the event of contact, administer first aid appropriate for burns, laceration and bruises. If detonation fumes are inhaled, remove to fresh air. Give artificial respiration ONLY if breathing has stopped. Give cardiopulmonary resuscitation (CPR) if there is no breathing AND no pulse. Oxygen administration may be beneficial in this situation, but should only be administered by personnel trained in its use. Obtain medical attention IMMEDIATELY.

Eye Contact:

No applicable information.

Skin Contact:

No applicable information.

Inhalation:

In the event those workers are overexposed to fumes and vapour resulting from detonation, remove victim from exposure and provide artificial respiration if not breathing.

Ingestion:

No applicable information.

Notes to Physician:

No applicable information.

SECTION 5 – FIRE-FIGHTING MEASURES

Flammable properties:	Product burns if ignited, with possible transition to detonation. May ignite or explode if heated under confinement.
Suitable extinguishing media:	DO NOT FIGHT FIRES INVOLVING EXPLOSIVES. Evacuate surrounding areas. When controlling fire before involvement of explosives, fire-fighters should wear positive pressure self-contained breathing apparatus (SCBA) and full turnout gear. Water may be applied through fixed extinguishing system (sprinklers) as long as people need not be present for the system to operate. Water may be used on small fires.
Unsuitable extinguishing media:	DO NOT FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS. Immediately evacuate all personnel from the area to a safe distance. Guard against re-entry. This product is a high explosive with a mass detonation hazard. Thermal decomposition can lead to release of irritating gases and vapors.
Protective equipment and precautions for fire fighters:	As in any fire, wear self-contained breathing apparatus pressure-demand, NIOSH approved (or equivalent) and full protective gear.

SECTION 6 – ACCIDENTAL RELEASE MESURES

Methods for containment:	No information available.
Methods for cleaning up:	Not required. If detonators are damaged, contact an Orica Canada Inc. or Orica USA Inc. Technical Representative. If detonators are broken, contact product advisor.

SECTION 7 - HANDLING AND STORAGE

Handling:	This product is an explosive and should only be used under the supervision of trained personnel. Protect containers from physical damage. Keep away from incompatible materials, heat, sparks, flames and other ignition sources. Avoid rough handling. Keep upwind of discharging unit. Post detonation: Avoid breathing post detonation residue; avoid getting into eyes or on skin. Utilize recommended exposure controls/protective clothing when working with post detonation residue or the contents of a damaged detonator.
Storage:	Store under moderate temperatures recommended by a technical services representative. Store under dry conditions in a well ventilated magazine that has been approved for either detonator storage or explosive storage. Do NOT store explosives in a detonator magazine or detonators in an explosive magazine. Keep away from heat, sparks and flames. Keep containers closed. Explosives should be kept well away from initiating explosives; protected from physical damage; separated from oxidizing materials, combustibles, and sources of heat. Keep away from incompatibles. Meet all legal requirements for shipping and magazinging.
Storage temperature:	It is recommended that detonators not be stored or used at temperatures exceeding 70°C (158°F) without approved procedures to address the elevated temperatures.

SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

Other exposure guidelines:	Recommendations listed in this section indicate the type of equipment that will provide protection against exposure to this product under normal conditions of use. Conditions of use, adequacy of engineering or other control measures, and actual exposure situations will dictate the need for specific protective devices at your workplace.
Engineering Measures:	Full-handling precautions should be taken at all times.
Personal Protective Equipment	
Eye/Face Protection:	Safety glasses with side-shields are recommended to prevent eye contact.
Skin Protection:	Gloves and protective clothing made from cotton should provide adequate protective.
Hygiene Measures:	Handle in accordance with good industrial hygiene and safety practice.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Metal cylinder with varying length of attached plastic coated wires	Odor:	None
Physical State:	Solid	Viscosity:	No information available
pH:	No data available	Melting Point/Range:	PETN melts @ 140 °C/ 284 °F
Flammable Limits (upper):	No data available	Flammable Limits (lower):	No data available
Explosion Power:	No data available	Specific Gravity:	Not available
		Oxidizing Properties:	No information available

Vapor Pressure: Not available

Partition Coefficient
(n-octanol/water): No data available

SECTION 10 - STABILITY AND REACTIVITY

Stability: Can explode from impact, heat or friction. If detonators are broken, contact product advisor. PETN explodes at 190 - 210 °C (374 - 410 °F).

Conditions to avoid: Impact or shock. Static discharge.

Incompatible materials: Acids, Bases.

Hazardous decomposition products: Thermal decomposition products are toxic and may include lead, hydrocarbons, oxides of carbon and nitrogen. To a lesser degree, decomposition products may include oxides of lead, chromium, barium, boron and hydrogen cyanide.

Hazardous Polymerization: None under normal processing.

SECTION 11 - TOXICOLOGICAL INFORMATION

Acute Toxicity

Product information: This product is an article. The following information is the potential hazards associated with the Ingredient(s) in this product. Under conditions of normal occupational exposure, this product should pose no such hazards to the user. Main risk is that of explosion by shock, friction, fire or other sources of ignition.

Subchronic Toxicity (28 days): Organic nitrates act as vasodilators; signs and symptoms of poisoning include headache, dizziness, increased heart rate, postural weakness and hypotension. Dermatitis or "drug rash" of the skin may also be observed.

Chronic toxicity: Contains a substance that is a known carcinogen. May cause cardiac effects.
Carcinogenicity: The table below indicates whether each agency has listed and ingredient as a carcinogen.

Chemical Name	ACGIH	IARC	NTP	OSHA
Barium Chromate	A1	Group 1	X	X

Legend: A1: Confirmed human carcinogen. Group 1: Some evidence of carcinogenicity was noted in humans. X: Acknowledged in NTP and OSHA carcinogen lists.

Mutagenic effects: Substances which should be regarded as being mutagenic to man. Lead.

Reproductive effects: It is our belief that under normal conditions of use, this product should pose no reproductive hazard to the worker. Lead exposure may cause reproductive effects based on studies in laboratory animals and on human epidemiological studies.

Developmental effects: It is our belief that under normal conditions of use, this product should pose no reproductive hazard to the worker. Lead has been shown to cause congenital abnormalities and behavioral deficits in experimental animals in addition to its ability to increase the number of miscarriages, stillbirths and abortions in lead-exposed women.

Target Organ: Eyes, Skin, Cardiovascular system, Immune system.

Other adverse effects: Prolonged or repeated exposure to organic nitrates may develop a tolerance due to chronic dilation of the blood vessels. This tolerance disappears rapidly after a few days away from exposure and withdrawal symptoms consisting of angina and heart attack have been reported in chronically exposed workers. Another type of tolerance loss is the "Monday morning disease", where workers experience headaches, dizziness, postural weakness and other symptoms.

SECTION 12 - ECOLOGICAL INFORMATION

Ecotoxicity effects: Contains no substances known to be hazardous to the environment or not degradable in waste water treatment plants.

SECTION 13 - DISPOSAL CONSIDERATIONS

Waste Disposal Method: Burn under supervision of an expert at a government-approved explosive burning ground or destroy, by detonation in boreholes, in accordance with applicable local, provincial and federal laws. Call upon the services of an Orica Canada Inc. or Orica USA Inc. technical representative.

SECTION 14 - TRANSPORT INFORMATION

DOT Proper Shipping Name:	Detonator, Electric
Hazard Class:	1.4B or 1.1 B (depending on packaging)
UN-No:	UN0255 or UN0030 (depending on packaging)
Packing Group:	II
TDG Proper Shipping Name:	Detonator, Electric
Hazard Class:	1.4B or 1.1 B (depending on packaging)
UN-No:	UN0255 or UN0030 (depending on packaging)
Packing Group:	II

SECTION 15 - REGULATORY INFORMATION

CANADIAN CLASSIFICATION: This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and this MSDS contains all the information required by the CPR

WHMIS hazard class: This product is an explosive and is not regulated by WHMIS.

USA CLASSIFICATION:

SARA Regulations Sections 313 and 40 CFR 372: This product contains the following toxic chemical(s) subject to reporting requirements, Barium Chromate (10294-40-3), Barium (7440-39-3), & Chromium (7440-47-3).

SARA 311/312 Hazardous Categorization

Acute Health Hazard:	No
Chronic Health Hazard:	No
Fire Hazard:	No
Reactive Hazard:	Yes
Sudden Release of Pressure Hazard:	No

Ozone Protection and 40 CFR 42: No reportable quantities of ozone depleting agents.

Other Regulations/Legislations which apply to this product: Massachusetts Right-to-Know, Pennsylvania Right-to-Know, New Jersey Right-to-Know, Rhode Island Right-to-Know.

TSCA: Complies

DSL: Complies

NDSL: Complies

SECTION 16 - OTHER INFORMATION

Prepared By: Safety, Health & Environment
303-268-5000

Preparation Date: 07-Nov-2005

Revision Date: 22-Oct-2008

The information contained herein is offered as a guide to the handling of this specific material and has been prepared in good faith by technically knowledgeable personnel. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of any kind is given or implied and Orica will not be liable for any damages, losses, injuries or consequential damages which may result from the use of or reliance on any information contained herein.

End of MSDS



Material Safety Data Sheet

Preparation Date: 19-Jul-2007

Revision Date: 22-Oct-2008

Revision Number: 1

SECTION 1 – PRODUCT AND COMPANY INFORMATION

Supplier(s):

Orica Canada Inc.
Maple Street
Brownsburg, QC

For MSDS Requests: 1-450-533-4201

Orica USA Inc

33101 E Quincy Ave
Watkins, CO 80137-9406

For MSDS Requests: 1-303-268-5000

Product Name:

Exel™ Detonator Assemblies Non-Electric

Product Code:

20080

Alternate Name(s):

Exel™ Constadet™, Exel™ Handidet™, Exel™ Handidet™ LP, Exel™ XE MS, Exel™ LP (W), Exel™ MS (W), Exel™ XT, & Exel™ T&D

UN-No:

UN0360 or UN 0361 (Depending on packaging)

Recommended Use:

Non-Electric detonators and accessory products.

Emergency Telephone Number: FOR CHEMICAL EMERGENCIES (24 HOUR) INVOLVING TRANSPORTATION, SPILL, LEAK, RELEASE, FIRE OR ACCIDENTS: **IN CANADA CALL:** ORICA CANADA TRANSPORTATION EMERGENCY RESPONSE SYSTEM AT **1-877-561-3636**. **IN US CALL:** CHEMTREC **1-800-424-9300**. **IN THE U.S.** FOR LOST, STOLEN OR MISPLACED EXPLOSIVES CALL: BATF **1-800-800-3855**. FORM ATF F5400.0 MUST BE COMPLETED AND LOCAL AUTHORITIES (STATE/MUNICIPAL POLICE, ETC.) MUST BE ADVISED.

SECTION 2 – HAZARD IDENTIFICATION

Emergency Overview:

The following information is the potential hazards associated with the ingredient(s) in this product. It is our belief that, under conditions of normal occupational exposure, this product should pose no such hazards to the user. Main risk is that of explosion by shock, friction, fire or other sources of ignition. Read the entire MSDS for a more thorough evaluation of the hazards.

Appearance:

A signal line (solid core/shock/tube) containing an explosive charge and a detonator.

Physical State:

Solid

Odor:

None

SECTION 3 – COMPOSITION/ INFORMATION ON INGREDIENTS

Chemical Name

CAS-No

Weight %

Pentaerythritol Tetranitrate (PETN)

78-11-5

0-10

Lead Azide

13424-46-9

0-5

Cyclotetramethylenetetranitramine (HMX)

2691-41-0

0.2 – 0.4

Aluminum

7429-90-5

<0.1

Also- may contain a lead sheathed delay element(s); may include a delay composition.

SECTION 4- FIRST AID MEASURES

General Advice:

General: Not applicable; this is a packaged product that will not result in exposure to the contents under normal conditions of use.

In the event of contact, administer first aid appropriate for burns, laceration and bruises. If detonation fumes are inhaled, remove to fresh air. Give artificial respiration ONLY if breathing has stopped. Give cardiopulmonary resuscitation (CPR) if there is no breathing AND no pulse. Oxygen administration may be beneficial in this situation, but should only be administered by personnel trained in its use. Obtain medical attention IMMEDIATELY.

Eye Contact:

No applicable information.

Skin Contact:

No applicable information.

Inhalation:

In the event those workers are overexposed to fumes and vapour resulting from detonation, remove victim from exposure and provide artificial respiration if not breathing.

Ingestion:

No applicable information.

Notes to Physician:

No applicable information.

20080- Exel™ Detonator Assemblies Non-Electric

SECTION 5 – FIRE-FIGHTING MEASURES

Flammable properties:	High explosive with mass detonation hazard. Expected to be sensitive to mechanical impact. Not expected to be sensitive to static discharge.
Suitable extinguishing media:	DO NOT FIGHT FIRES INVOLVING EXPLOSIVES. Evacuate surrounding areas. When controlling fire before involvement of explosives, fire-fighters should wear positive pressure self-contained breathing apparatus (SCBA) and full turnout gear. Water may be applied through fixed extinguishing system (sprinklers) as long as people need not be present for the system to operate. Water may be used on small fires.
Unsuitable extinguishing media:	DO NOT FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS. Immediately evacuate all personnel from the area to a safe distance. Guard against re-entry. This product is a high explosive with a mass detonation hazard. Thermal decomposition can lead to release of irritating gases and vapors.
Protective equipment and precautions for fire fighters:	As in any fire, wear self-contained breathing apparatus pressure-demand, NIOSH approved (or equivalent) and full protective gear.

SECTION 6 – ACCIDENTAL RELEASE MEASURES

Methods for containment:	No information available.
Methods for cleaning up:	Not required. If detonators are damaged, contact an Orica Canada Inc. or Orica USA Inc. technical representative. Deactivating Chemicals: Not required. If detonators are broken, contact product advisor.

SECTION 7 - HANDLING AND STORAGE

Handling:	This product is an explosive and should only be used under the supervision of trained personnel. Protect containers from physical damage. Keep away from incompatible materials, heat, sparks, flames and other ignition sources. Avoid rough handling.
Storage:	Store under moderate temperatures recommended by a technical services representative. Store under dry conditions in a well ventilated magazine that has been approved for either detonator storage or explosive storage. Do NOT store explosives in a detonator magazine or detonators in an explosive magazine. Keep away from heat, sparks and flames. Keep containers closed. Explosives should be kept well away from initiating explosives; protected from physical damage; separated from oxidizing materials, combustibles, and sources of heat. Keep away from incompatibles. Meet all legal requirements for shipping and magazing.
Storage Temperature:	It is recommended that detonators not be stored or used at temperatures exceeding 70°C (158°F) without approved procedures to address the elevated temperatures.

SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

Other exposure guidelines:	Recommendations listed in this section indicate the type of equipment that will provide protection against exposure to this product under normal conditions of use. Conditions of use, adequacy of engineering or other control measures, and actual exposure situations will dictate the need for specific protective devices at your workplace.
Engineering Measures:	Full-handling precautions should be taken at all times.
Personal Protective Equipment	
Eye/Face Protection:	Safety glasses with side-shields are recommended to prevent eye contact.
Skin Protection:	Gloves and protective clothing made from cotton should provide adequate protective.
Hygiene Measures:	Handle in accordance with good industrial hygiene and safety practice.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	A signal line (solid core/shock/tube) Containing an explosive charge and A detonator.	Odor:	None
Physical State:	Solid	Viscosity:	No Information Available
pH:	No data available	Melting Point/Range:	PETN melts at 140°C / 284°F
Flammable Limits (upper):	No data available	Flammable Limits (lower):	No data available

Explosion Power: No data available
Vapor Pressure: Not available
Partition Coefficient (n-octanol/water): No data available

Specific Gravity: Not available
Oxidizing Properties: No information available

SECTION 10 - STABILITY AND REACTIVITY

Stability: Can explode from impact, heat or friction. If detonators are broken, contact product advisor. PETN explodes at 190 - 210 °C (374 - 410 °F).
Conditions to avoid: Impact or shock. Static discharge.
Incompatible materials: Acids. Bases.
Hazardous decomposition products: Thermal decomposition products are toxic and may include lead, hydrocarbons, oxides of carbon and nitrogen. To a lesser degree, decomposition products may include oxides of lead, chromium, barium, boron and hydrogen cyanide.

SECTION 11 - TOXICOLOGICAL INFORMATION

Acute Toxicity

Subchronic Toxicity (28 days): Organic nitrates act as vasodilators; signs and symptoms of poisoning include headache, dizziness, increased heart rate, postural weakness and hypotension. Dermatitis or "drug rash" of the skin may also be observed.

Chronic toxicity: Contains no substance that is a known carcinogen.
Carcinogenicity: The ingredients of this product are not classified as carcinogenic by ACGIH (American Conference of Governmental Industrial Hygienists) or IARC (International Agency for Research on Cancer), not regulated as carcinogens by OSHA (occupational Safety and health Administration), and not listed as carcinogens by NTP (National Toxicology Program).

Reproductive effects: It is our belief that under normal conditions of use, this product should pose no reproductive hazard to the worker. Lead exposure may cause reproductive effects based on studies in laboratory animals and on human epidemiological studies.

Developmental effects: It is our belief that under normal conditions of use, this product should pose no reproductive hazard to the worker. Lead has been shown to cause congenital abnormalities and behavioral deficits in experimental animals in addition to its ability to increase the number of miscarriages, stillbirths and abortions in lead-exposed women.

Target Organ: Eyes, Skin, cardiovascular system, Immune system.

Other adverse effects: Prolonged or repeated exposure to organic nitrates may develop a tolerance due to chronic dilation of the blood vessels. This tolerance disappears rapidly after a few days away from exposure and withdrawal symptoms consisting of angina and heart attack have been reported in chronically exposed workers. Another type of tolerance loss is the "Monday morning disease", where workers experience headaches, dizziness, postural weakness and other symptoms.

SECTION 12 - ECOLOGICAL INFORMATION

Ecotoxicity effects: Contains no substances known to be hazardous to the environment or not degradable in waste water treatment plants.

SECTION 13 - DISPOSAL CONSIDERATIONS

Waste Disposal Method: Burn under supervision of an expert at a government-approved explosive burning ground or destroy, by detonation in boreholes, in accordance with applicable local, provincial and federal laws. Call upon the services of an Orica Canada Inc. or Orica USA Inc. technical representative.

SECTION 14 - TRANSPORT INFORMATION

DOT Proper Shipping Name: Detonator assemblies, Non-Electric
Hazard Class: 1.1B or 1.4B (depending on packaging)
UN-No: UN0360 or UN0361 (depending on packaging)
Packing Group: II

TDG Proper Shipping Name: Detonator assemblies, Non-Electric
Hazard Class: 1.1B or 1.4B (depending on packaging)
UN-No: UN0360 or UN0361 (depending on packaging)
Packing Group: II

SECTION 15 - REGULATORY INFORMATION

CANADIAN CLASSIFICATION: This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and this MSDS contains all the information required by the CPR

WHMIS hazard class: This product is an explosive and is not regulated by WHMIS.

USA CLASSIFICATION:

SARA Regulations Sections 313 and 40 CFR 372: This product contains the following toxic chemical(s) subject to reporting requirements,

SARA 311/312 Hazardous Categorization

Acute Health Hazard:	No
Chronic Health Hazard:	No
Fire Hazard:	No
Reactive Hazard:	Yes
Sudden Release of Pressure Hazard:	No

Ozone Protection and 40 CFR 42: No reportable quantities of ozone depleting agents

Other Regulations/Legislations which apply to this product: Massachusetts Right-to-Know, Pennsylvania Right-to-Know, New Jersey Right-to-Know, Rhode Island Right-to-Know.

TSCA: Complies

DSL: Complies

NDSL: Complies

SECTION 16 - OTHER INFORMATION

Prepared By: Safety, Health & Environment
303-268-5000

Preparation Date: 19-Jul-2007
Revision Date: 22-Oct-2008

The information contained herein is offered as a guide to the handling of this specific material and has been prepared in good faith by technically knowledgeable personnel. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of any kind is given or implied and Orica will not be liable for any damages, losses, injuries or consequential damages which may result from the use of or reliance on any information contained herein.

End of MSDS



Material Safety Data Sheet

Preparation Date: 22-Mar-2006

Revision Date: 28-Oct-2008

Revision Number: 1

SECTION 1 – PRODUCT AND COMPANY IDENTIFICATION

Supplier(s):

Orica Canada Inc.
Maple Street
Brownsburg, QC

For MSDS Requests: 450-533-4201

Orica USA Inc.

33101 E. Quincy Avenue
Watkins, CO 80137-9406

For MSDS Requests: 1 303-268-5000

Product Name:

POWERDITCH™ 1000, POWERPRO™, POWERFRAC™, GELDYN™, COALITE™ 8SU, DYNASHEAR™, GEL COALITE™ Z, & XACTEX™

Product Code:

40053

Alternate Name(s):

Not available

UN-No:

UN0081

Recommended Use:

A detonator-sensitive gelatin explosive.

Emergency Telephone Number: FOR CHEMICAL EMERGENCIES (24 HOUR) INVOLVING TRANSPORTATION, SPILL, LEAK, RELEASE, FIRE OR ACCIDENTS: **IN CANADA CALL:** THE ORICA TRANSPORTATION EMERGENCY RESPONSE SYSTEM AT 1-877-561-3636. **IN THE U.S. CALL: CHEMTREC 1-800-424-9300. IN THE U.S.:** FOR LOST, STOLEN, OR MISPLACED EXPLOSIVES CALL: BATF 1-800-800-3855. FORM ATF F 5400.0 MUST BE COMPLETED AND LOCAL AUTHORITIES (STATE/MUNICIPAL POLICE, ETC.) MUST BE ADVISED.

SECTION 2 – HAZARD IDENTIFICATION

Emergency Overview:

Risk of explosion by shock, fire of other sources of ignition. Very toxic if swallowed. Irritating to eyes, respiratory system and skin. Oxidizing agent.

Appearance:

Light pink

Physical State:

Semi-Solid

Odor:

Characteristic

SECTION 3 – COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No	Weight %
Ammonium Nitrate	6484-52-2	0-75
Sodium Nitrate	7631-99-4	0-50
Ethylene glycol, Dinitrate	628-96-6	8-76
Sulphur	7704-34-9	0-4
Nitroglycerin	55-63-0	1-20
Nitrocellulose	9004-70-0	0-6

SECTION 4 – FIRST AID MEASURES

General Advice:

In case of accident or if you feel unwell, seek medical advice IMMEDIATELY (show the product label where possible).

Eye Contact:

Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Immediate medical attention is required.

Skin Contact:

Wash off immediately with soap and plenty of water, removing all contaminated clothes and shoes. If skin irritation persists, call a physician.

Inhalation:

Move victim to fresh air. Give artificial respiration ONLY if breathing has stopped. Give cardiopulmonary resuscitation (CPR) if there is no breathing AND no pulse. Obtain medical advice IMMEDIATELY.

Ingestion:

Immediate medical attention is required. Do not induce vomiting. Clean mouth with water and afterwards drink plenty of water. If spontaneous vomiting occurs, have victim lean forward with head positioned to avoid breathing in of vomitus, rinse mouth and administer more water. Never give anything by mouth to an unconscious person.

Notes to physician:

Symptomatic. Administer oxygen if there are signs of cyanosis. If clinical condition deteriorates, administer 10cc Methylene Blue intravenously. It is unlikely for this to be required with methemoglobin level of less than 40%.

SECTION 5 – FIRE-FIGHTING MEASURES**Flammable properties:**

Not itself combustible but assists fire in burning materials. The product does not flash. Explosive power: 337 kJ/100 g.

Suitable extinguishing media:

DO NOT FIGHT FIRES INVOLVING EXPLOSIVES. Evacuate surrounding areas to a predetermined safe location no less than 2500 feet (800 meters) in all directions. When controlling fire before involvement of explosives, fire-fighters should wear positive pressure self-containing breathing apparatus (SCBA) and full turnout gear. Water may be applied through fixed extinguishing system (sprinklers) as long as people need not be present for the system to operate.

Unsuitable extinguishing media:

DO NOT FIGHT FIRES INVOLVING EXPLOSIVES. Attempts to smother a fire involving this product will be ineffective as it is its own oxygen source. Smother this product could lead to decomposition and explosion. This product is more sensitive to detonation if contaminated with organic or oxidisable material or if heated while confined. Unless the mass of product on fire is flooded with water, re-ignition is possible.

Specific hazards arising from the chemical:

This product is a high explosive with mass detonation hazard. DO NOT FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS. Immediately evacuate all personnel from the area to a safe distance. Guard against re-entry. Thermal decomposition can lead to release of irritating gases and vapors.

Protective equipment and precautions for firefighters:

As in any fire, wear self-contained breathing apparatus pressure-demand, NIOSH approved (or equivalent) and full protective gear.

SECTION 6 – ACCIDENTAL RELEASE MEASURES**Methods for containment:**

Contain or absorb leaking putty with sand or earth or other suitable substance.

Methods for cleaning up:

Avoid the use of metal tools containing iron and/or copper. Be careful to avoid shock, friction, and contact with grit. Collect product for recovery or disposal. For release to land, contain discharge by constructing dykes or applying inert absorbent; for release to water, utilize damming and/or water diversion to minimize the spread of contamination. Collect contaminated soil and water, and absorbent for proper disposal. Notify applicable government authority if release is reportable or could adversely affect the environment.

SECTION 7 – HANDLING AND STORAGE**Handling:**

This product is an explosive and should only be used under the supervision of trained personnel. The use of coveralls is recommended. Use good industrial hygiene and housekeeping practices. Keep away from open flames, hot surfaces and sources of ignition.

Storage:

Store under moderate temperatures recommended by a technical services representative. Store under dry conditions in a well ventilated magazine that has been approved for either detonator storage or explosive storage. Do NOT store explosives in a detonator magazine or detonators in an explosive magazine. Keep away from heat, spark and flames. Keep containers closed. Explosives should be kept well away from initiating explosives; protected from physical damage; separated from oxidizing materials; combustibles, and sources of heat. Keep away from incompatibles. Ideal storage temperature is 10-27 °C (50-80 °F). Do not expose sealed containers to temperatures above 40 °C (104 °F).

SECTION 8 – EXPOSURE CONTROLS/PERSONAL PROTECTION

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Sodium Nitrate	10 mg/cu m (nuisance dust)	NA	
Ethylene glycol, Dinitrate	TWA: 0.05 ppm Skin	Ceiling: 0.2 ppm Ceiling: 1 mg/ m ³ Skin	
Nitroglycerin	(TWA skin) 0.46 mg/ cu m	Ceiling: 0.2 ppm Ceiling: 2 mg/ m ³ Skin	

Other exposure guidelines:

Ammonium Nitrate: ORICA Guideline 5 mg/m³ (internal TWA)

Engineering Measures:	No information available.
Personal Protective Equipment	
Eye/Face Protection:	Face-shield. Tightly fitting safety goggles.
Skin Protection:	User should verify impermeability under normal conditions of use prior to general use. Impervious gloves. Nitrile Rubber.
Respiratory Protection:	In case of insufficient ventilation wear suitable respiratory equipment. A NIOSH-approved respirator, if required.
Hygiene Measures:	Handle in accordance with good industrial hygiene and safety practice. Recommendations listed in this section indicate the type of equipment, which will provide protection against over exposure to this product. Conditions of use, adequacy of engineering or other control measures, and actual exposures will dictate the need for specific protective devices at your workplace.

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Light pink	Odor:	Characteristic
Physical State:	Semi-Solid	Viscosity:	No information available
pH:	7	Flash Point:	> 100 °C
Autoignition Temperature:	-222 °C (liquid NG) >=100>=212	Boiling Point/Range:	Not available
Melting Point/Range:	Not available	Flammable Limits (Upper):	Not applicable
Flammable Limits (Lower):	Not applicable	Explosion Power:	No data available
Specific Gravity:	085- 1.48 g/cc	Water Solubility:	In soluble in water
Other Solubility:	Slightly soluble in standard organic solvents	Vapor Pressure:	Not applicable
Oxidizing Properties:	Oxidizer	Partition Coefficient (n-octanol/water):	No data available

SECTION 10 – STABILITY AND REACTIVITY

Stability:	Stable under normal conditions. Decomposition Temperature: Ammonium Nitrate will spontaneously decompose at 210 °C (410 °F). NG explodes at 222 °C (431.6 °F)
Conditions to avoid:	Keep away from open flames, hot surfaces and sources of ignition.
Incompatible materials:	Avoid oxidizable materials, metal powder, bronze & copper alloys, fuels (e.g. lubricants, machine oils), fluorocarbon lubricants, acids, corrosive liquids, chlorate, sulphur, sodium nitrite, charcoal, coke and other finely divided combustibles. Strong oxidizing and reducing agents.
Hazardous decomposition products:	The following toxic decomposition products may be released. At temperatures above 210 °C, decomposition may be explosive, especially if confined. Nitrogen oxides (NOx). Carbon oxide. Hydrocarbons.
Hazardous Polymerization:	None under normal processing. Hazardous polymerization does not occur. Explosive material under shock conditions.

SECTION 11 – TOXICOLOGICAL INFORMATION

Acute Toxicity

Product Information:	Irritating to eyes. May cause skin irritation. Harmful if swallowed.

Chemical name	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ammonium Nitrate	2217 mg/kg Rat	3000 mg/kg Rabbit	88.8 mg/L Rat 4 h
Sodium Nitrate	1267-4300 mg/kg Rat		
Ethylene glycol, Dinitrate	460 mg/ kg Rat 540 mg/ kg Mouse		
Nitroglycerin	105 mg/ kg Rat 115 mg/ kg Mouse	280 mg/ kg Rabbit	
Nitrocellulose	5 g/ kg Mouse 5 g/ kg Rat		

Subchronic Toxicity (28 Days):	Sodium Nitrate; Ammonium Nitrate: Ingestion may cause methemoglobinemia. Initial manifestation of methemoglobinemia is cyanosis, characterized by navy lips, tongue and mucous membranes, with skin color being slate grey. Further manifestation is characterized by headache, weakness, dyspnea, dizziness, stupor, respiratory distress and death due to anoxia. If ingested, nitrates may be reduced to nitrites by bacteria in the digestive tract. Signs and symptoms of nitrite poisoning include methemoglobinemia, nausea, dizziness, increased heart rate, hypotension, fainting and, possibly shock.

Chronic Toxicity: May cause methemoglobinemia.
Carcinogenicity: The ingredients of this product are not classified as carcinogenic by ACGIH (American Conference of Governmental Industrial Hygienists) or IARC (International Agency for Research on Cancer), not regulated as carcinogens by OSHA (Occupational Safety and Health Administration), and not listed as carcinogens by T\NTP (National Toxicology Program).
Mutagenic effects: There is no evidence of mutagenic potential.
Irritation: Irritating to eyes. May cause irritation of respiratory tract. May cause skin irritation in susceptible persons.
Reproductive effects: No information is available and no adverse reproductive effects are anticipated.
Developmental effects: No information is available and no adverse developmental effects are anticipated.
Target Organ: Eyes, skin, respiratory system, blood, liver urinary tract, & gastrointestinal tract (GI).
Other Adverse Effects: Prolonged or repeated exposure to organic nitrates may develop a tolerance due to chronic dilation of the blood vessels. This tolerance disappears rapidly after a few days away from exposure and withdrawal symptoms consisting of angina and heart attack have been reported in chronically exposed workers. Another type of tolerance loss is the "Monday morning disease", where workers experience headaches, dizziness, postural weakness and other symptoms.

SECTION 12 – ECOLOGICAL INFORMATION

Ecotoxicity effects: Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment

Chemical Name	Freshwater Algae Data	Freshwater Fish Species Data	Microtox Data	Water Flea Data	log Pow
Sodium Nitrate					-3.8

Persistence/Degradability: Nitroglycerin is water-insoluble and remains explosive.
Mobility in Environmental media: Dissolves slowly in water.

SECTION 13 – DISPOSAL CONSIDERATIONS

Waste Disposal Method: Burn under supervision of an expert at an explosive burning ground or destroy by detonation in boreholes, in accordance with applicable local, provincial and federal regulations. Call upon the services of an Orica Technical Representative.
US EPA Waste Number: No data available on product.

Chemical Name	RCRA	RCRA- Basis for listing	RCRA- D Series Wastes	RCRA- U Series Wastes
Nitroglycerin –55-63-0	Waste number P081			

SECTION 14 – TRANSPORT INFORMATION

DOT Proper Shipping Name: Explosive Blasting Type A
Hazard Class: 1.1D
UN-No: UN0081
Packing group: II
TDG Proper Shipping Name: Explosive Blasting Type A
Hazard Class: 1.1D
UN-No: UN0081
Packing group: II

Transportation Emergency Telephone Number: 1-877-561-3636 or CHEMTREC: 1-800-424-9300

SECTION 15 – REGULATORY INFORMATION

CANADIAN CLASSIFICATION: This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and this MSDS contains all the information required by the CPR

WHMIS hazard class: This product is an explosive and is not regulated by WHMIS.
USA CLASSIFICATION:

SARA Regulations Sections 313 and 40 CFR 372: This product contains the following toxic chemical(s) subject to reporting requirements, Ammonium Nitrate (6484-52-2), Sodium Nitrate (7631-99-4), Nitroglycerin (55-63-0), Nitrocellulose (9004-70-0), Sulphur (7704-34-9), & Ethylene Glycol, Dinitrate (628-96-6)

SARA 311/312 Hazardous Categorization

Acute Health Hazard: Yes

Chronic Health Hazard: Yes

Fire Hazard: Yes

Reactive Hazard: Yes

Sudden Release of Pressure Hazard: No

Ozone Protection and 40 CFR 42: No reportable quantities of ozone depleting agents

Other Regulations/Legislations which apply to this product: New Jersey Right-to-Know, Pennsylvania Right-to-Know, Massachusetts Right-to-Know, Rhode Island Right-to-Know, Florida, New Jersey Special Health Hazard Substance List, Minnesota Hazardous Substance List, California Director's List of Hazardous Substances, California Proposition 65.

TSCA: Complies

DSL: Complies

NDSL: Complies

The components in the product are on the following international inventory lists:

Chemical Name	TSCA	DSL	NDSL	ENCS	EINECS	ELINCS	CHINA	KECL	PICCS	AICS
Ammonium Nitrate	X	X	-	X	X	-	X	X	X	X
Sodium Nitrate	X	X	-	X	X	X	X	X	X	X
Ethylene Glycol, Dinitrate	X	X	-	-	X	-	-	X	-	X
Sulphur	X	X	-	X	X	X	X	X	X	X
Nitroglycerin	X	X	-	X	X	-	-	X	X	X
Nitrocellulose	X	X	-	X	-	-	X	X	X	X

Legend: X – Listed

SECTION 16 – OTHER INFORMATION

Prepared by: Safety Health & Environment
303-268-5000

Preparation Date: 22-Mar-2006

Revision Date: 28-Oct-2008

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End of MSDS

MATERIAL SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: XD-3 EXTRA ENGINE OIL 0W-30
Product Description: Synthetic Base Stocks and Additives
MSDS Number: 8044
Intended Use: Engine oil

COMPANY IDENTIFICATION

Supplier: Imperial Oil Products Division
240 4th Avenue
Calgary, ALBERTA. T2P 3M9 Canada
24 Hour Environmental / Health Emergency Telephone 519-339-2145
Transportation Emergency Phone Number 519-339-2145
Product Technical Information 1-800-268-3183
Supplier General Contact 1-800-567-3776

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

No Reportable Hazardous Substance(s) or Complex Substance(s).

SECTION 3 HAZARDS IDENTIFICATION

This material is not considered to be hazardous according to regulatory guidelines see Section 15.

HEALTH EFFECTS

Low order of toxicity. Excessive exposure may result in eye, skin, or respiratory irritation. High-pressure injection under skin may cause serious damage.

NFPA Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0
HMIS Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0

Note: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4 FIRST AID MEASURES

INHALATION

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

SECTION 5**FIRE FIGHTING MEASURES****EXTINGUISHING MEDIA**

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Hazardous Combustion Products: Smoke, Fume, Aldehydes, Sulphur Oxides, Oxides of carbon, Incomplete combustion products

FLAMMABILITY PROPERTIES

Flash Point [Method]: 210C (410F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: N/D

SECTION 6**ACCIDENTAL RELEASE MEASURES****NOTIFICATION PROCEDURES**

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

SPILL MANAGEMENT

Land Spill: Stop leak if you can do so without risk. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do so without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist

before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7 HANDLING AND STORAGE

HANDLING

Avoid contact with used product. Prevent small spills and leakage to avoid slip hazard.

Static Accumulator: This material is a static accumulator.

Storage

Do not store in open or unlabelled containers.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Substance Name	Form	Limit/Standard			Note	Source
Phosphorus		TWA	0.1 mg/m ³			ACGIH

Exposure limits/standards for materials that can be formed when handling this product: When mists / aerosols can occur, the following are recommended: 5 mg/m³ - ACGIH TLV, 10 mg/m³ - ACGIH STEL.

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

ENVIRONMENTAL CONTROLS

See Sections 6, 7, 12, 13.

SECTION 9	PHYSICAL AND CHEMICAL PROPERTIES

Typical physical and chemical properties are given below. Consult the Supplier in Section 1 for additional data.

GENERAL INFORMATION

Physical State: Liquid
Form: clear
Colour: Amber
Odour: Characteristic
Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15 C): 0.844
Flash Point [Method]: 210C (410F) [ASTM D-92]
Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0
Autoignition Temperature: N/D
Boiling Point / Range: > 316C (600F)
Vapour Density (Air = 1): > 2 at 101 kPa
Vapour Pressure: < 0.013 kPa (0.1 mm Hg) at 20°C
Evaporation Rate (N-Butyl Acetate = 1): < 0.1
pH: N/A
Log Pow (n-Octanol/Water Partition Coefficient): N/D
Solubility in Water: Negligible
Viscosity: [N/D at 40°C] | 11 cSt (11 mm²/sec) at 100C
Oxidizing properties: See Sections 3, 15, 16.

OTHER INFORMATION

Freezing Point: N/D
Melting Point: N/A
Pour Point: -48°C (-54°F)

SECTION 10	STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Excessive heat. High energy sources of ignition.

MATERIALS TO AVOID: Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11	TOXICOLOGICAL INFORMATION

Acute Toxicity

Route of Exposure	Conclusion / Remarks
INHALATION	
Toxicity (Rat): LC50 > 5000 mg/m ³	Minimally Toxic. Based on test data for structurally similar materials.
Irritation: No end point data.	Negligible hazard at ambient/normal handling temperatures. Based on assessment of the components.
INGESTION	
Toxicity (Rat): LD50 > 5000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Skin	
Toxicity (Rabbit): LD50 > 5000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Irritation (Rabbit): Data available.	Negligible irritation to skin at ambient temperatures. Based on test data for structurally similar materials.
Eye	
Irritation (Rabbit): Data available.	May cause mild, short-lasting discomfort to eyes. Based on test data for structurally similar materials.

CHRONIC/OTHER EFFECTS**For the product itself:**

Diesel engine oils: Not carcinogenic in animals tests. Used and unused diesel engine oils did not produce any carcinogenic effects in chronic mouse skin painting studies. Oils that are used in gasoline engines may become hazardous and display the following properties: Carcinogenic in animal tests. Caused mutations in vitro. Possible allergen and photoallergen. Contains polycyclic aromatic compounds (PAC) from combustion products of gasoline and/or thermal degradation products.

Contains:

Synthetic base oils: Not expected to cause significant health effects under conditions of normal use, based on laboratory studies with the same or similar materials. Not mutagenic or genotoxic. Not sensitising in test animals and humans.

Additional information is available by request.

CMR Status: None.

Chemical Name	CAS Number	List Citations
Phosphorus	7723-14-0	4

--REGULATORY LISTS SEARCHED--

1 = IARC 1
2 = IARC 2A

3 = IARC 2B
4 = ACGIH ALL

5 = ACGIH A1
6 = ACGIH A2

SECTION 12	ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Not expected to be harmful to aquatic organisms.

MOBILITY

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

SECTION 13	DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

REGULATORY DISPOSAL INFORMATION

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14	TRANSPORT INFORMATION

LAND (TDG) : Not Regulated for Land Transport

LAND (DOT) : Not Regulated for Land Transport

SEA (IMDG) : Not Regulated for Sea Transport according to IMDG-Code

AIR (IATA) : Not Regulated for Air Transport

SECTION 15	REGULATORY INFORMATION

WHMIS Classification: Not controlled

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations.

CEPA: All components of this material are either on the Canadian Domestic Substances List (DSL), exempt, or have been notified under CEPA.

NATIONAL CHEMICAL INVENTORY LISTING: DSL, TSCA

The Following Ingredients are Cited on the Lists Below: None.

--REGULATORY LISTS SEARCHED--

1 = TSCA 4
2 = TSCA 5a2

3 = TSCA 5e
4 = TSCA 6

5 = TSCA 12b
6 = NPRI

SECTION 16	OTHER INFORMATION

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

Revision Changes:

Section 05: Fire Fighting Measures - Fire Fighting Instruction was modified.

Section 06: Notification Procedures - Header was modified.

Section 13: Empty Container Warning was modified.

Section 09: Phys/Chem Properties Note was modified.

Section 09: Color was modified.

Section 09: Boiling Point C(F) was modified.

Section 08: Hand Protection was modified.

Section 07: Handling and Storage-Storage was modified.

Section 11: Dermal Lethality Test Data was modified.

Section 11: Oral Lethality Test Data was modified.

Section 06: Accidental Release- Spill Management- Water was modified.

Section 09: Relative Density - Header was modified.

Section 09: Flash Point C(F) was modified.

Section 09 Viscosity was modified.

Section 09: Relative Density was modified.

Section 15: List Citation Table - Header was modified.

Section 08: Exposure Limits Table was added.
Section 11: Chemical Name - Header was added.
Section 11: CAS Number - Header was added.
Section 11: List Citation - Header was added.
Section 11: Tox List Cited Table was added.
Composition: No components was added.
Section 08: OEL Table - Substance Name Column - Header was added.
Section 08: OEL Table - Form Column - Header was added.
Section 08: OEL Table - Limit Column - Header was added.
Section 08: OEL Table - Notation Column - Header was added.
Section 08: OEL Table - Source Column - Header was added.
Section 13: Regulatory Disposal Information - Header was added.
Section 13: Regulatory Disposal Information - Header was deleted.
Composition: No components was deleted.
Section 15: Canadian List Citations Table was deleted.
Section 15: Chemical Name - Header was deleted.
Section 15: CAS Number - Header was deleted.
Section 15: List Citations -Header was deleted.

WHMIS Classification: Not controlled

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DGN: 5006929 (1002607)

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Prepared By: Imperial Oil Limited, IH and Product Safety

MATERIAL SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: XD-3 EXTRA ENGINE OIL 10W
Product Description: Base Oil and Additives
MSDS Number: 8046
Intended Use: Engine oil

COMPANY IDENTIFICATION

Supplier: Imperial Oil Products Division
240 4th Avenue
Calgary, ALBERTA. T2P 3M9 Canada
24 Hour Environmental / Health Emergency Telephone 519-339-2145
Transportation Emergency Phone Number 519-339-2145
Product Technical Information 1-800-268-3183
Supplier General Contact 1-800-567-3776

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

No Reportable Hazardous Substance(s) or Complex Substance(s).

SECTION 3 HAZARDS IDENTIFICATION

This material is not considered to be hazardous according to regulatory guidelines see Section 15.

HEALTH EFFECTS

Low order of toxicity. Excessive exposure may result in eye, skin, or respiratory irritation. High-pressure injection under skin may cause serious damage.

NFPA Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0
HMIS Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0

Note: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4 FIRST AID MEASURES

INHALATION

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

SECTION 5

FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Hazardous Combustion Products: Smoke, Fume, Aldehydes, Sulphur Oxides, Oxides of carbon, Incomplete combustion products

FLAMMABILITY PROPERTIES

Flash Point [Method]: 230°C (446°F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: N/D

SECTION 6

ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

SPILL MANAGEMENT

Land Spill: Stop leak if you can do so without risk. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do so without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7

HANDLING AND STORAGE

HANDLING

Avoid contact with used product. Prevent small spills and leakage to avoid slip hazard.

Static Accumulator: This material is a static accumulator.

STORAGE

Do not store in open or unlabelled containers.

SECTION 8

EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure limits/standards for materials that can be formed when handling this product: When mists / aerosols can occur, the following are recommended: 5 mg/m³ - ACGIH TLV, 10 mg/m³ - ACGIH STEL.

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Work conditions can greatly effect glove durability; inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

ENVIRONMENTAL CONTROLS

See Sections 6, 7, 12, 13.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

Typical physical and chemical properties are given below. Consult the Supplier in Section 1 for additional data.

GENERAL INFORMATION

Physical State: Liquid

Colour: brown

Odour: Characteristic

Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15 °C): 0.876

Flash Point [Method]: 230°C (446°F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: N/D

Boiling Point / Range: N/D

Vapour Density (Air = 1): N/D

Vapour Pressure: [N/D at 20°C] | < 1 kPa (7.5 mm Hg) at 38°C

Evaporation Rate (N-Butyl Acetate = 1): < 1

pH: N/A

Log Pow (n-Octanol/Water Partition Coefficient): > 3.5

Solubility in Water: Negligible

Viscosity: [N/D at 40°C] | 6.5 cSt (6.5 mm²/sec) at 100°C

Oxidizing properties: See Sections 3, 15, 16.

OTHER INFORMATION

Freezing Point: N/D

Melting Point: N/A

Pour Point: -36°C (-33°F)

DMSO Extract (mineral oil only), IP-346: < 3 %wt

SECTION 10

STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Excessive heat. High energy sources of ignition.

MATERIALS TO AVOID: Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11	TOXICOLOGICAL INFORMATION

Acute Toxicity

Route of Exposure	Conclusion / Remarks
INHALATION	
Toxicity (Rat): LC50 > 5000 mg/m ³	Minimally Toxic. Based on test data for structurally similar materials.
Irritation: No end point data.	Negligible hazard at ambient/normal handling temperatures. Based on assessment of the components.
INGESTION	
Toxicity (Rat): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Skin	
Toxicity (Rabbit): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Irritation (Rabbit): Data available.	Negligible irritation to skin at ambient temperatures. Based on test data for structurally similar materials.
Eye	
Irritation (Rabbit): Data available.	May cause mild, short-lasting discomfort to eyes. Based on test data for structurally similar materials.

CHRONIC/OTHER EFFECTS

For the product itself:

Diesel engine oils: Not carcinogenic in animals tests. Used and unused diesel engine oils did not produce any carcinogenic effects in chronic mouse skin painting studies. Oils that are used in gasoline engines may become hazardous and display the following properties: Carcinogenic in animal tests. Caused mutations in vitro. Possible allergen and photoallergen. Contains polycyclic aromatic compounds (PAC) from combustion products of gasoline and/or thermal degradation products.

Contains:

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitising in test animals.

Additional information is available by request.

CMR Status:

--REGULATORY LISTS SEARCHED--

1 = IARC 1
2 = IARC 2A

3 = IARC 2B
4 = ACGIH ALL

5 = ACGIH A1
6 = ACGIH A2

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Not expected to be harmful to aquatic organisms.

MOBILITY

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Base oil component -- Expected to be inherently biodegradable

BIOACCUMULATION POTENTIAL

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

SECTION 13 DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

REGULATORY DISPOSAL INFORMATION

Empty Container Warning (where applicable): Empty containers may retain residue and can be dangerous. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Do not attempt to refill or clean container since residue is difficult to remove. Empty drums should be completely drained, properly bunged and promptly returned to a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations.

SECTION 14 TRANSPORT INFORMATION

LAND (TDG) : Not Regulated for Land Transport

LAND (DOT) : Not Regulated for Land Transport

SEA (IMDG) : Not Regulated for Sea Transport according to IMDG-Code

AIR (IATA) : Not Regulated for Air Transport

SECTION 15	REGULATORY INFORMATION

WHMIS Classification: Not controlled

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations.

CEPA: All components of this material are either on the Canadian Domestic Substances List (DSL), exempt, or have been notified under CEPA.

NATIONAL CHEMICAL INVENTORY LISTING: DSL, TSCA

The Following Ingredients are Cited on the Lists Below: None.

--REGULATORY LISTS SEARCHED--

1 = TSCA 4
2 = TSCA 5a2

3 = TSCA 5e
4 = TSCA 6

5 = TSCA 12b
6 = NPRI

SECTION 16	OTHER INFORMATION

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

No revision information is available.

WHMIS Classification: Not controlled

The information and recommendations contained herein are, to the best of Imperial Oil's knowledge and belief, accurate and reliable as of the date issued. Imperial Oil assumes no responsibility for accuracy of information unless the document is the most current available from an official Imperial Oil distribution system. The information and recommendations are offered for the user's consideration and examination, and it is the user's responsibility to satisfy itself that they are suitable and complete for its particular use. If buyer repackages this product, legal counsel should be consulted to insure proper health, safety and other necessary information is included on the container. Appropriate warnings and safe-handling procedures should be provided to handlers and users. Alteration of this document is strictly prohibited. Except to the extent required by law, republication or retransmission of this document, in whole or in part, is not permitted.

DGN: 5006930 (1012777)

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Prepared By: Imperial Oil Limited, IH and Product Safety

MATERIAL SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: XD-3 EXTRA ENGINE OIL 15W-40
Product Description: Base Oil and Additives
MSDS Number: 8043
Intended Use: Engine oil

COMPANY IDENTIFICATION

Supplier: Imperial Oil Products Division
240 4th Avenue
Calgary, ALBERTA. T2P 3M9 Canada
24 Hour Environmental / Health Emergency Telephone 519-339-2145
Transportation Emergency Phone Number 519-339-2145
Product Technical Information 1-800-268-3183
Supplier General Contact 1-800-567-3776

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

No Reportable Hazardous Substance(s) or Complex Substance(s).

SECTION 3 HAZARDS IDENTIFICATION

This material is not considered to be hazardous according to regulatory guidelines see Section 15.

HEALTH EFFECTS

Low order of toxicity. Excessive exposure may result in eye, skin, or respiratory irritation. High-pressure injection under skin may cause serious damage.

NFPA Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0
HMIS Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0

Note: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4 FIRST AID MEASURES

INHALATION

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

SECTION 5	FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Hazardous Combustion Products: Smoke, Fume, Aldehydes, Sulphur Oxides, Incomplete combustion products, Oxides of carbon

FLAMMABILITY PROPERTIES

Flash Point [Method]: 215C (419F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: 330°C (626°F)

SECTION 6	ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

SPILL MANAGEMENT

Land Spill: Stop leak if you can do so without risk. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do so without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist

before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7	HANDLING AND STORAGE

HANDLING

Avoid contact with used product. Prevent small spills and leakage to avoid slip hazard.

Static Accumulator: This material is a static accumulator.

STORAGE

Do not store in open or unlabelled containers.

SECTION 8	EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure limits/standards for materials that can be formed when handling this product: When mists / aerosols can occur, the following are recommended: 5 mg/m³ - ACGIH TLV, 10 mg/m³ - ACGIH STEL.

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

ENVIRONMENTAL CONTROLS

See Sections 6, 7, 12, 13.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

Typical physical and chemical properties are given below. Consult the Supplier in Section 1 for additional data.

GENERAL INFORMATION

Physical State: Liquid

Colour: dark brown

Odour: Characteristic

Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15 C): 0.87

Flash Point [Method]: 215C (419F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: 330°C (626°F)

Boiling Point / Range: 310C (590F) - 600C (1112F)

Vapour Density (Air = 1): N/D

VAPOUR PRESSURE: [N/D at 20°C] | < 1 kPa (7.5 mm Hg) at 38C

Evaporation Rate (N-Butyl Acetate = 1): < 0.1

pH: N/A

Log Pow (n-Octanol/Water Partition Coefficient): > 3.5

Solubility in Water: Negligible

Viscosity: [N/D at 40°C] | 15.4 cSt (15.4 mm²/sec) at 100C

Oxidizing properties: See Sections 3, 15, 16.

OTHER INFORMATION

Freezing Point: N/D

Melting Point: N/A

Pour Point: -27°C (-17°F)
DMSO Extract (mineral oil only), IP-346: < 3 %wt

SECTION 10	STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Excessive heat. High energy sources of ignition.

MATERIALS TO AVOID: Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11	TOXICOLOGICAL INFORMATION

Acute Toxicity

<u>Route of Exposure</u>	<u>Conclusion / Remarks</u>
INHALATION	
Toxicity (Rat): LC50 > 5000 mg/m ³	Minimally Toxic. Based on test data for structurally similar materials.
Irritation: No end point data.	Negligible hazard at ambient/normal handling temperatures. Based on assessment of the components.
INGESTION	
Toxicity (Rat): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Skin	
Toxicity (Rabbit): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Irritation (Rabbit): Data available.	Negligible irritation to skin at ambient temperatures. Based on test data for structurally similar materials.
Eye	
Irritation (Rabbit): Data available.	May cause mild, short-lasting discomfort to eyes. Based on test data for structurally similar materials.

CHRONIC/OTHER EFFECTS

For the product itself:

Diesel engine oils: Not carcinogenic in animals tests. Used and unused diesel engine oils did not produce any carcinogenic effects in chronic mouse skin painting studies. Oils that are used in gasoline engines may become hazardous and display the following properties: Carcinogenic in animal tests. Caused mutations in vitro. Possible allergen and photoallergen. Contains polycyclic aromatic compounds (PAC) from combustion products of gasoline and/or thermal degradation products.

Contains:

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitising in test animals.

Additional information is available by request.

CMR Status: None.

--REGULATORY LISTS SEARCHED--

1 = IARC 1
2 = IARC 2A

3 = IARC 2B
4 = ACGIH ALL

5 = ACGIH A1
6 = ACGIH A2

SECTION 12	ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Expected to be harmful to aquatic organisms. May cause long-term adverse effects in the aquatic environment.

MOBILITY

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Base oil component -- Expected to be inherently biodegradable

BIOACCUMULATION POTENTIAL

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

SECTION 13	DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

Regulatory Disposal Information

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14	TRANSPORT INFORMATION

LAND (TDG) : Not Regulated for Land Transport

LAND (DOT) : Not Regulated for Land Transport

SEA (IMDG) : Not Regulated for Sea Transport according to IMDG-Code

AIR (IATA) : Not Regulated for Air Transport

SECTION 15	REGULATORY INFORMATION

WHMIS Classification: Not controlled

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations.

CEPA: All components of this material are either on the Canadian Domestic Substances List (DSL), exempt, or have been notified under CEPA.

National Chemical Inventory Listing: DSL, TSCA

The Following Ingredients are Cited on the Lists Below: None.

--REGULATORY LISTS SEARCHED--

1 = TSCA 4
2 = TSCA 5a2

3 = TSCA 5e
4 = TSCA 6

5 = TSCA 12b
6 = NPRI

SECTION 16	OTHER INFORMATION

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

Revision Changes:

Section 05: Fire Fighting Measures - Fire Fighting Instruction was modified.

Section 06: Notification Procedures - Header was modified.

Section 13: Empty Container Warning was modified.

Section 09: Phys/Chem Properties Note was modified.

Section 09: Boiling Point C(F) was modified.

Section 08: Hand Protection was modified.

Section 09: Vapour Pressure was modified.

Section 09: Vapour Pressure - Header was modified.

Section 05: Hazardous Combustion Products was modified.

Section 06: Accidental Release- Spill Management- Water was modified.

Section 09: Relative Density - Header was modified.

Section 09: Flash Point C(F) was modified.

Section 09 Viscosity was modified.

Section 15: National Chemical Inventory Listing - Header was modified.

Section 09: Relative Density was modified.
Section 15: List Citation Table - Header was modified.
Section 12: Ecological Information - Acute Aquatic Toxicity was added.
Section 12: Ecological Information - Acute Aquatic Toxicity was added.
Section 11: Chronic Tox - Component - WHMIS was added.
Section 11: Chronic Tox - Component - Header was added.
Section 11: Other Health Effects Header was added.
Composition: No components was added.
Section 13: Regulatory Disposal Information - Header was added.
Section 13: Regulatory Disposal Information - Header was deleted.
Section 11: Other Health Effects Header was deleted.
Composition: No components was deleted.
Section 11: Chronic Tox - Component was deleted.
Section 11: Chronic Tox - Component - Header was deleted.
Section 12: Ecological Information - Acute Aquatic Toxicity was deleted.
Section 12: Ecological Information - Acute Aquatic Toxicity was deleted.
Section 15: Canadian List Citations Table was deleted.
Section 15: Chemical Name - Header was deleted.
Section 15: CAS Number - Header was deleted.
Section 15: List Citations -Header was deleted.
Section 09: Form - Header was deleted.
Section 09: Physical State was deleted.

WHMIS Classification: Not controlled

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Prepared By: Imperial Oil Limited, IH and Product Safety



MATERIAL SAFETY DATA SHEET

Date Prepared: November 08, 2003
Supersedes: January 25, 2001
MSDS Number: 8407

1. PRODUCT INFORMATION

Product Identifier: OBRA 30W

Application and Use:
Lubricating grease

Product Description:

A grease, a mixture of lubricating oil, soap and additives.

REGULATORY CLASSIFICATION

WHMIS:
Not a controlled product

CEPA: CANADIAN ENVIRONMENTAL PROTECTION ACT
All components of this product are either on the Domestic
Substances List (DSL) or are exempt.

TDG INFORMATION (RAIL/ROAD):
Not Regulated in Canada.

Please be aware that other regulations may apply.

TELEPHONE NUMBERS

Emergency 24 hr. (519) 339-2145
Technical Info. (800) 268-3183

MANUFACTURER/SUPPLIER:

IMPERIAL OIL
Products Division
240 4th Avenue S.W.
Calgary, Alberta
T2P 3M9

2. REGULATED COMPONENTS

The following components are defined in accordance with sub-paragraph 13(a) (i) to (iv) or paragraph 14(a) of the Hazardous Products Act:

NAME	%	CAS #
Not applicable		

3. TYPICAL PHYSICAL & CHEMICAL PROPERTIES

Physical State: Liquid
Specific gravity: not available
Viscosity: 30.40 cSt at 100 deg C
Vapour Density: not available
Boiling Point: not available
Evaporation rate: <1 (1= n-butylacetate)
Solubility in water: negligible
Freezing/Pour Point: 90 deg C DROP
Odour Threshold: not available
Vapour Pressure: <1 kPa at 38 deg C
Density: 0.94 g/cc at 15 deg C
Appearance/odour: White granules or prills, slight ammonia odor.

4. HEALTH HAZARD INFORMATION

NATURE OF HAZARD

INHALATION:

Negligible hazard at normal temperatures (up to 38 deg C).
Elevated temperatures or mechanical action may form vapours, mists or fumes which may be irritating to the eyes, nose, throat and lungs.
Avoid breathing vapours or mists.

EYE CONTACT:

Slightly irritating, but will not injure eye tissue.

SKIN CONTACT:

Low toxicity.
Frequent or prolonged contact may irritate the skin.
High pressure greasing equipment is capable of injecting grease under the skin which may have severe health consequences.

INGESTION:

Low toxicity.

ACUTE TOXICITY DATA:

Based on animal testing data from similar materials and products, the acute toxicity of this product is expected to be:

Oral : LD50 > 5000 mg/kg (Rat)
Dermal : LD50 > 3160 mg/kg (Rabbit)
Inhalation : LC50 > 5000 mg/m3 (Rat)

OCCUPATIONAL EXPOSURE LIMIT:

ACGIH recommends:

For oil mists, 5 mg/m3.

Local regulated limits may vary.

5. FIRST AID MEASURES

INHALATION:

In case of adverse exposure to vapours, mists and/or fumes formed at elevated temperature, or by mechanical action, immediately remove the affected victim from exposure. Administer artificial respiration if breathing has stopped. Keep at rest. Call for prompt medical attention.

EYE CONTACT:

Flush eyes with large amounts of water until irritation subsides. If irritation persists, get medical attention.

SKIN CONTACT:

Flush with large amounts of water. Use soap if available. Remove severely contaminated clothing (including shoes) and launder before reuse. If irritation persists, seek medical attention. Consult a physician immediately if the material is injected under the skin from the misuse of high pressure greasing equipment.

INGESTION:

If swallowed, DO NOT induce vomiting. Keep at rest. Get prompt medical attention.

6. PREVENTIVE AND CORRECTIVE MEASURES

PERSONAL PROTECTION:

The selection of personal protective equipment varies, depending upon conditions of use. In open systems where contact is likely, wear safety goggles, chemical-resistant overalls, and chemically impervious gloves. Where only incidental contact is likely, wear safety glasses with side shields. No other special precautions are necessary provided skin/eye

contact is avoided.

Where concentrations in air may exceed the occupational exposure limits given in Section 4 and where engineering, work practices or other means of exposure reduction are not adequate, approved respirators may be necessary to prevent overexposure by inhalation.

ENGINEERING CONTROLS:

The use of local exhaust ventilation is recommended to control emissions near the source. Laboratory samples should be handled in a fumehood. Provide mechanical ventilation of confined spaces.

HANDLING, STORAGE AND SHIPPING:

Keep containers closed. Handle and open containers with care. Store in a cool, well ventilated place away from incompatible materials. In keeping with good personal hygiene practices, wash hands thoroughly after handling the material. Store and load at normal (up to 38 deg C) temperature and at atmospheric pressure. Empty containers may contain product residue. Do not pressurize cut, heat, or weld empty containers. Do not reuse empty containers without commercial cleaning or reconditioning.

LAND SPILL:

Eliminate source of ignition. Keep public away. Prevent additional discharge of material, if possible to do so without hazard. Prevent spills from entering sewers, watercourses or low areas. Contain spilled liquid with sand or earth. Allow material to solidify and scrape up. Place material in suitable containers for recycle or disposal. Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately. Take all additional action necessary to prevent and remedy the adverse effects of the spill.

WATER SPILL:

Remove from surface by skimming or with suitable absorbents. If allowed by local authorities and environmental agencies, sinking and/or suitable dispersants may be used in unconfined waters. Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately. Take all additional action necessary to prevent and remedy the adverse effects of the spill.

7. FIRE AND EXPLOSION HAZARD

Flashpoint and method: 220 deg C COC ASTM D92

Autoignition: NA Flammable Limits: LEL: NA UEL: NA

GENERAL HAZARDS:

Low Hazard; liquids may burn upon heating to temperatures at or above the flash point.

Toxic gases will form upon combustion.

FIRE FIGHTING:

Use water spray to cool fire exposed surfaces and to protect personnel. Shut off fuel to fire.

Use foam, dry chemical or water spray to extinguish fire.

Respiratory and eye protection required for fire fighting personnel.

A self-contained breathing apparatus (SCBA) should be used for all indoor fires and any significant outdoor fires. For small outdoor fires, which may easily be extinguished with a portable fire extinguisher, use of an SCBA may not be required.

HAZARDOUS COMBUSTION PRODUCTS:

Smoke, carbon monoxide, carbon dioxide under thermal decomposition.

8. REACTIVITY DATA

STABILITY:

This product is stable. Hazardous polymerization will not occur.

INCOMPATIBLE MATERIALS AND CONDITIONS TO AVOID:

Strong oxidizing agents

HAZARDOUS DECOMPOSITION:

none

9. NOTES

All components of this product are listed on the U.S. TSCA inventory.

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REVISION SUMMARY:

Since 25 January 2001, this MSDS has been revised in Section(s):

3, 6, 7

10. PREPARATION

Date Prepared: November 08, 2003
Prepared by: Lubricants & Specialties
IMPERIAL OIL
Products Division
240 4th Avenue S.W.
Calgary, Alberta
T2P 3M9
(800) 268-3183

CAUTION: " The information contained herein relates only to this product or material and may not be valid when used in combination with any other product or material or in any process. If the product is not to be used for a purpose or under conditions which are normal or reasonably foreseeable, this information cannot be relied upon as complete or applicable. For greater certainty, uses other than those described in Section 1 must be reviewed with the supplier. The information contained herein is based on the information available at the indicated date of preparation. This MSDS is for the use of Imperial Oil customers and their employees and agents only. Any further distribution of this MSDS by Imperial Oil customers is prohibited without the written consent of Imperial Oil."

MATERIAL SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: ESSO GEAR OIL GX 75W-80W
Product Description: Base Oil and Additives
MSDS Number: 8063
Intended Use: Gear oil

COMPANY IDENTIFICATION

Supplier: Imperial Oil Products Division
240 4th Avenue
Calgary, ALBERTA. T2P 3M9 Canada
24 Hour Environmental / Health Emergency Telephone 519-339-2145
Transportation Emergency Phone Number 519-339-2145
Product Technical Information 1-800-268-3183
Supplier General Contact 1-800-567-3776

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

No Reportable Hazardous Substance(s) or Complex Substance(s).

SECTION 3 HAZARDS IDENTIFICATION

This material is not considered to be hazardous according to regulatory guidelines see Section 15.

HEALTH EFFECTS

Low order of toxicity. Excessive exposure may result in eye, skin, or respiratory irritation. High-pressure injection under skin may cause serious damage.

NFPA Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0
HMIS Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0

Note: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4 FIRST AID MEASURES

INHALATION

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

SECTION 5**FIRE FIGHTING MEASURES****EXTINGUISHING MEDIA**

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Hazardous Combustion Products: Sulphur Oxides, Aldehydes, Smoke, Fume, Oxides of carbon, Incomplete combustion products

FLAMMABILITY PROPERTIES

Flash Point [Method]: 160C (320F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: N/D

SECTION 6**ACCIDENTAL RELEASE MEASURES****NOTIFICATION PROCEDURES**

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

SPILL MANAGEMENT

Land Spill: Stop leak if you can do so without risk. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do so without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7

HANDLING AND STORAGE

HANDLING

Prevent small spills and leakage to avoid slip hazard.

Static Accumulator: This material is a static accumulator.

STORAGE

Do not store in open or unlabelled containers.

SECTION 8

EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure limits/standards for materials that can be formed when handling this product: When mists / aerosols can occur, the following are recommended: 5 mg/m³ - ACGIH TLV, 10 mg/m³ - ACGIH STEL.

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Work conditions can greatly affect glove durability; inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

ENVIRONMENTAL CONTROLS

See Sections 6, 7, 12, 13.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

Typical physical and chemical properties are given below. Consult the Supplier in Section 1 for additional data.

GENERAL INFORMATION

Physical State: Liquid

Colour: yellow

Odour: Characteristic

Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15 C): 0.856

Flash Point [Method]: 160C (320F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: N/D

Boiling Point / Range: 230C (446F) - 535C (995F)

Vapour Density (Air = 1): N/D

Vapour Pressure: [N/D at 20°C] | < 1 kPa (7.5 mm Hg) at 38C

Evaporation Rate (N-Butyl Acetate = 1): N/D

pH: N/A

Log Pow (n-Octanol/Water Partition Coefficient): > 3.5

Solubility in Water: Negligible

Viscosity: [N/D at 40°C] | 7.8 cSt (7.8 mm²/sec) at 100C

Oxidizing properties: See Sections 3, 15, 16.

OTHER INFORMATION

Freezing Point: N/D

Melting Point: N/A

Pour Point: -39°C (-38°F)

DMSO Extract (mineral oil only), IP-346: < 3 %wt

SECTION 10	STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Excessive heat. High energy sources of ignition.

MATERIALS TO AVOID: Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11	TOXICOLOGICAL INFORMATION

Acute Toxicity

Route of Exposure	Conclusion / Remarks
INHALATION	
Toxicity (Rat): LC50 > 5000 mg/m ³	Minimally Toxic. Based on test data for structurally similar materials.
Irritation: Data available.	Negligible hazard at ambient/normal handling temperatures. Based on assessment of the components.
INGESTION	
Toxicity (Rat): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Skin	
Toxicity (Rabbit): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Irritation (Rabbit): Data available.	Negligible irritation to skin at ambient temperatures. Based on test data for structurally similar materials.
Eye	
Irritation (Rabbit): Data available.	May cause mild, short-lasting discomfort to eyes. Based on test data for structurally similar materials.

CHRONIC/OTHER EFFECTS

For the product itself:

Repeated and/or prolonged exposure may cause irritation to the skin, eyes, or respiratory tract.

Contains:

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitising in test animals.

Additional information is available by request.

CMR Status:

--REGULATORY LISTS SEARCHED--

1 = IARC 1
2 = IARC 2A

3 = IARC 2B
4 = ACGIH ALL

5 = ACGIH A1
6 = ACGIH A2

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Not expected to be harmful to aquatic organisms.

MOBILITY

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Base oil component -- Expected to be inherently biodegradable

BIOACCUMULATION POTENTIAL

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

SECTION 13 DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

REGULATORY DISPOSAL INFORMATION

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14 TRANSPORT INFORMATION

LAND (TDG) : Not Regulated for Land Transport

LAND (DOT) : Not Regulated for Land Transport

SEA (IMDG) : Not Regulated for Sea Transport according to IMDG-Code

AIR (IATA) : Not Regulated for Air Transport

SECTION 15	REGULATORY INFORMATION

WHMIS Classification: Not controlled

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations.

CEPA: All components of this material are either on the Canadian Domestic Substances List (DSL), exempt, or have been notified under CEPA.

NATIONAL CHEMICAL INVENTORY LISTING: DSL, TSCA

The Following Ingredients are Cited on the Lists Below: None.

--REGULATORY LISTS SEARCHED--

1 = TSCA 4
2 = TSCA 5a2

3 = TSCA 5e
4 = TSCA 6

5 = TSCA 12b
6 = NPRI

SECTION 16	OTHER INFORMATION

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

Revision Changes: Not Applicable

WHMIS Classification: Not controlled

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Prepared By: Imperial Oil Limited, IH and Product Safety

MATERIAL SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: ESSO GEAR OIL GX 80W-90
Product Description: Base Oil and Additives
MSDS Number: 8064
Intended Use: Gear oil

COMPANY IDENTIFICATION

Supplier: Imperial Oil Products Division
240 4th Avenue
Calgary, ALBERTA. T2P 3M9 Canada
24 Hour Environmental / Health Emergency Telephone 519-339-2145
Transportation Emergency Phone Number 519-339-2145
Product Technical Information 1-800-268-3183
Supplier General Contact 1-800-567-3776

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

No Reportable Hazardous Substance(s) or Complex Substance(s).

SECTION 3 HAZARDS IDENTIFICATION

This material is not considered to be hazardous according to regulatory guidelines see Section 15.

HEALTH EFFECTS

Low order of toxicity. Excessive exposure may result in eye, skin, or respiratory irritation. High-pressure injection under skin may cause serious damage.

NFPA Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0
HMIS Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0

Note: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4 FIRST AID MEASURES

INHALATION

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

SECTION 5

FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Hazardous Combustion Products: Incomplete combustion products, Oxides of carbon, Sulphur Oxides, Smoke, Fume, Aldehydes

FLAMMABILITY PROPERTIES

Flash Point [Method]: 210°C (410°F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: N/D

SECTION 6

ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

SPILL MANAGEMENT

Land Spill: Stop leak if you can do so without risk. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do so without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7

HANDLING AND STORAGE

HANDLING

Prevent small spills and leakage to avoid slip hazard.

Static Accumulator: This material is a static accumulator.

STORAGE

Do not store in open or unlabelled containers.

SECTION 8

EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure limits/standards for materials that can be formed when handling this product: When mists / aerosols can occur, the following are recommended: 5 mg/m³ - ACGIH TLV, 10 mg/m³ - ACGIH STEL.

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Work conditions can greatly effect glove durability; inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

ENVIRONMENTAL CONTROLS

See Sections 6, 7, 12, 13.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

Typical physical and chemical properties are given below. Consult the Supplier in Section 1 for additional data.

GENERAL INFORMATION

Physical State: Liquid

Form: N/D

Colour: dark brown

Odour: Characteristic

Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15 °C): 0.885

Flash Point [Method]: 210°C (410°F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: N/D

Boiling Point / Range: N/D

Vapour Density (Air = 1): > 2 at 101 kPa

Vapour Pressure: < 0.013 kPa (0.1 mm Hg) at 20°C

Evaporation Rate (N-Butyl Acetate = 1): N/D

pH: N/A

Log Pow (n-Octanol/Water Partition Coefficient): > 3.5

Solubility in Water: Negligible

Viscosity: [N/D at 40°C] | 15 cSt (15 mm²/sec) at 100°C

Oxidizing properties: See Sections 3, 15, 16.

OTHER INFORMATION

Freezing Point: N/D

Melting Point: N/A

Pour Point: -24°C (-11°F)

DMSO Extract (mineral oil only), IP-346: < 3 %wt

SECTION 10	STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Excessive heat. High energy sources of ignition.

MATERIALS TO AVOID: Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11	TOXICOLOGICAL INFORMATION

Acute Toxicity

Route of Exposure	Conclusion / Remarks
INHALATION	
Toxicity (Rat): LC50 > 5000 mg/m ³	Minimally Toxic. Based on test data for structurally similar materials.
Irritation: Data available.	Elevated temperatures or mechanical action may form vapours, mist, or fumes which may be irritating to the eyes, nose, throat, or lungs. Based on assessment of the components.
INGESTION	
Toxicity (Rat): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Skin	
Toxicity (Rabbit): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Irritation (Rabbit): Data available.	Negligible irritation to skin at ambient temperatures. Based on test data for structurally similar materials.
Eye	
Irritation (Rabbit): Data available.	May cause mild, short-lasting discomfort to eyes. Based on test data for structurally similar materials.

CHRONIC/OTHER EFFECTS

For the product itself:

Repeated and/or prolonged exposure may cause irritation to the skin, eyes, or respiratory tract.

Contains:

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitising in test animals.

Additional information is available by request.

CMR Status: None.

--REGULATORY LISTS SEARCHED--

1 = IARC 1
2 = IARC 2A

3 = IARC 2B
4 = ACGIH ALL

5 = ACGIH A1
6 = ACGIH A2

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Not expected to be harmful to aquatic organisms.

MOBILITY

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Base oil component -- Expected to be inherently biodegradable

BIOACCUMULATION POTENTIAL

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

SECTION 13 DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

REGULATORY DISPOSAL INFORMATION

Empty Container Warning (where applicable): Empty containers may retain residue and can be dangerous. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Do not attempt to refill or clean container since residue is difficult to remove. Empty drums should be completely drained, properly bunged and promptly returned to a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations.

SECTION 14 TRANSPORT INFORMATION

LAND (TDG) : Not Regulated for Land Transport

LAND (DOT) : Not Regulated for Land Transport

SEA (IMDG) : Not Regulated for Sea Transport according to IMDG-Code

AIR (IATA) : Not Regulated for Air Transport

SECTION 15	REGULATORY INFORMATION

WHMIS Classification: Not controlled

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations.

CEPA: All components of this material are either on the Canadian Domestic Substances List (DSL), exempt, or have been notified under CEPA.

NATIONAL CHEMICAL INVENTORY LISTING: DSL, TSCA

The Following Ingredients are Cited on the Lists Below: None.

--REGULATORY LISTS SEARCHED--

1 = TSCA 4
2 = TSCA 5a2

3 = TSCA 5e
4 = TSCA 6

5 = TSCA 12b
6 = NPRI

SECTION 16	OTHER INFORMATION

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

No revision information is available.

WHMIS Classification: Not controlled

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DGN: 5006956 (547465)

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MATERIAL SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: AROX EP 100
Product Description: Base Oil and Additives
MSDS Number: 8296
Intended Use: Lubricant

COMPANY IDENTIFICATION

Supplier: Imperial Oil Products Division
240 4th Avenue
Calgary, ALBERTA. T2P 3M9 Canada
24 Hour Environmental / Health Emergency Telephone 519-339-2145
Transportation Emergency Phone Number 519-339-2145
Product Technical Information 1-800-268-3183
Supplier General Contact 1-800-567-3776

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

No Reportable Hazardous Substance(s) or Complex Substance(s).

SECTION 3 HAZARDS IDENTIFICATION

This material is not considered to be hazardous according to regulatory guidelines see Section 15.

HEALTH EFFECTS

This product may be used in certain applications where misting can occur. Excessive exposure to liquids and mists may cause skin and eye irritation. In addition, excessive exposure to mists may cause respiratory irritation and damage and aggravate pre-existing emphysema or asthma. Low order of toxicity. High-pressure injection under skin may cause serious damage.

NFPA Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0
HMIS Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0

Note: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4 FIRST AID MEASURES

INHALATION

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek

immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Unusual Fire Hazards: Pressurised mists may form a flammable mixture.

Hazardous Combustion Products: Smoke, Fume, Sulphur Oxides, Aldehydes, Oxides of carbon, Incomplete combustion products

FLAMMABILITY PROPERTIES

Flash Point [Method]: 230C (446F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: N/D

SECTION 6 ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

SPILL MANAGEMENT

Land Spill: Stop leak if you can do so without risk. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do so without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7

HANDLING AND STORAGE

HANDLING

Avoid breathing mists or vapour. Prevent small spills and leakage to avoid slip hazard.

Static Accumulator: This material is a static accumulator.

STORAGE

Do not store in open or unlabelled containers.

SECTION 8

EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure limits/standards for materials that can be formed when handling this product: When mists / aerosols can occur, the following are recommended: 5 mg/m³ - ACGIH TLV, 10 mg/m³ - ACGIH STEL.

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

Particulate air-purifying respirator approved for dust or oil mist is recommended.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Work conditions can greatly effect glove durability; inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended. Chemical-type goggles should be worn during misting operations.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

ENVIRONMENTAL CONTROLS

See Sections 6, 7, 12, 13.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

Typical physical and chemical properties are given below. Consult the Supplier in Section 1 for additional data.

GENERAL INFORMATION

Physical State: Liquid

Colour: Amber

Odour: Characteristic

Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density: 0.89

Flash Point [Method]: 230C (446F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: N/D

Boiling Point / Range: > 316C (600F)

Vapour Density (Air = 1): N/D

Vapour Pressure: [N/D at 20°C] | < 1 kPa (7.5 mm Hg) at 38C

Evaporation Rate (N-Butyl Acetate = 1): < 1

pH: N/A

Log Pow (n-Octanol/Water Partition Coefficient): N/D

Solubility in Water: Negligible

Viscosity: 100 cSt (100 mm²/sec) at 40°C

Oxidizing properties: See Sections 3, 15, 16.

OTHER INFORMATION

Freezing Point: N/D
Melting Point: N/A
Pour Point: -6°C (21°F)
DMSO Extract (mineral oil only), IP-346: < 3 %wt

SECTION 10	STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Excessive heat. High energy sources of ignition.

MATERIALS TO AVOID: Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11	TOXICOLOGICAL INFORMATION

Acute Toxicity

Route of Exposure	Conclusion / Remarks
INHALATION	
Toxicity (Rat): LC50 > 5000 mg/m ³	Minimally Toxic. Based on test data for structurally similar materials.
Irritation: No end point data.	Elevated temperatures or mechanical action may form vapours, mist, or fumes which may be irritating to the eyes, nose, throat, or lungs. Based on assessment of the components.
INGESTION	
Toxicity (Rat): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Skin	
Toxicity (Rabbit): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Irritation (Rabbit): Data available.	Negligible irritation to skin at ambient temperatures. Based on test data for structurally similar materials.
Eye	
Irritation (Rabbit): Data available.	May cause mild, short-lasting discomfort to eyes. Based on test data for structurally similar materials.

CHRONIC/OTHER EFFECTS

For the product itself:

Oil Mist (highly refined oils): Animals exposed to high concentrations of mist developed oil retention, inflammation, and oil granulomas in the respiratory tract. Oils exposed to high temperatures, cracking conditions, or mixing with tramp / used oils may introduce polycyclic aromatic compounds or microbial contaminants that could result in cancer or severe respiratory hazards.

Contains:

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitising in test animals.

Additional information is available by request.

CMR Status: None.

--REGULATORY LISTS SEARCHED--

1 = IARC 1
2 = IARC 2A

3 = IARC 2B
4 = ACGIH ALL

5 = ACGIH A1
6 = ACGIH A2

SECTION 12

ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Not expected to be harmful to aquatic organisms.

MOBILITY

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Base oil component -- Expected to be inherently biodegradable

BIOACCUMULATION POTENTIAL

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

SECTION 13

DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

REGULATORY DISPOSAL INFORMATION

Empty Container Warning (where applicable): Empty containers may retain residue and can be dangerous. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Do not attempt to refill or clean container since residue is difficult to remove. Empty drums should be completely drained, properly bunged and promptly returned to a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations.

SECTION 14

TRANSPORT INFORMATION

LAND (TDG) : Not Regulated for Land Transport

LAND (DOT) : Not Regulated for Land Transport

SEA (IMDG) : Not Regulated for Sea Transport according to IMDG-Code

AIR (IATA) : Not Regulated for Air Transport

SECTION 15	REGULATORY INFORMATION

WHMIS Classification: Not controlled

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations.

CEPA: All components of this material are either on the Canadian Domestic Substances List (DSL), exempt, or have been notified under CEPA.

NATIONAL CHEMICAL INVENTORY LISTING: DSL, TSCA

The Following Ingredients are Cited on the Lists Below: None.

--REGULATORY LISTS SEARCHED--

1 = TSCA 4
2 = TSCA 5a2

3 = TSCA 5e
4 = TSCA 6

5 = TSCA 12b
6 = NPRI

SECTION 16	OTHER INFORMATION

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

Revision Changes:

Section 05: Fire Fighting Measures - Fire Fighting Instruction was modified.

Section 09: Phys/Chem Properties Note was modified.

Section 09: Color was modified.

Section 09: Boiling Point C(F) was modified.

Section 09: Vapour Pressure was modified.

Section 03: Health Hazards was modified.

Section 06: Accidental Release- Spill Management- Water was modified.

Section 09: Flash Point C(F) was modified.

WHMIS Classification: Not controlled

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DGN: 5007243 (1012879)

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Prepared By: Imperial Oil Limited, IH and Product Safety



MATERIAL SAFETY DATA SHEET

Date Prepared: August 28, 2003
Supersedes: May 24, 2000
MSDS Number: 8388

1. PRODUCT INFORMATION

Product Identifier: ARGON EP 1 GREASE

Application and Use:
Lubricating grease

Product Description:

A grease, a mixture of lubricating oil, soap and additives.

REGULATORY CLASSIFICATION

WHMIS:
Not a controlled product

CEPA: CANADIAN ENVIRONMENTAL PROTECTION ACT
All components of this product are either on the Domestic
Substances List (DSL) or are exempt.

TDG INFORMATION (RAIL/ROAD):
Not Regulated in Canada.

Please be aware that other regulations may apply.

TELEPHONE NUMBERS

Emergency 24 hr. (519) 339-2145
Technical Info. (800) 268-3183

MANUFACTURER/SUPPLIER:

IMPERIAL OIL
Products Division
240 4th Avenue S.W.
Calgary, Alberta
T2P 3M9

2. REGULATED COMPONENTS

The following components are defined in accordance with sub-paragraph 13(a) (i) to (iv) or paragraph 14(a) of the Hazardous Products Act:

NAME	%	CAS #
Not applicable		

3. TYPICAL PHYSICAL & CHEMICAL PROPERTIES

Physical State: Liquid
 Specific gravity: 0.920 at 15.6 deg C/15.6 deg C
 Viscosity: 175.00 cSt at 40 deg C
 Vapour Density: not available
 Boiling Point: not available
 Evaporation rate: < 0.01 (1= n-butylacetate)
 Solubility in water: negligible
 Freezing/Pour Point: 130 deg C DROP
 Odour Threshold: not available
 Vapour Pressure: <0.01 kPa at 20 deg C
 Appearance/odour: Brown paste, petroleum odour

4. HEALTH HAZARD INFORMATION

NATURE OF HAZARD

INHALATION:

Negligible hazard at normal temperatures (up to 38 deg C).
 Elevated temperatures or mechanical action may form vapours, mists or fumes which may be irritating to the eyes, nose, throat and lungs.
 Avoid breathing vapours or mists.

EYE CONTACT:

Slightly irritating, but will not injure eye tissue.

SKIN CONTACT:

Low toxicity.
 Frequent or prolonged contact may irritate the skin.
 High pressure greasing equipment is capable of injecting grease under the skin which may have severe health consequences.

INGESTION:

Low toxicity.

ACUTE TOXICITY DATA:

Based on animal testing data from similar materials and products,

the acute toxicity of this product is expected to be:

Oral : LD50 > 5000 mg/kg (Rat)
Dermal : LD50 > 3160 mg/kg (Rabbit)
Inhalation : LC50 > 5000 mg/m3 (Rat)

OCCUPATIONAL EXPOSURE LIMIT:

ACGIH recommends:

For oil mists, 5 mg/m3.

Local regulated limits may vary.

5. FIRST AID MEASURES

INHALATION:

In case of adverse exposure to vapours, mists and/or fumes formed at elevated temperature, or by mechanical action, immediately remove the affected victim from exposure. Administer artificial respiration if breathing has stopped. Keep at rest. Call for prompt medical attention.

EYE CONTACT:

Flush eyes with large amounts of water until irritation subsides. If irritation persists, get medical attention.

SKIN CONTACT:

Flush with large amounts of water. Use soap if available.
Remove severely contaminated clothing (including shoes) and launder before reuse.
If irritation persists, seek medical attention.
Consult a physician immediately if the material is injected under the skin from the misuse of high pressure greasing equipment.

INGESTION:

If swallowed, DO NOT induce vomiting. Keep at rest. Get prompt medical attention.

6. PREVENTIVE AND CORRECTIVE MEASURES

PERSONAL PROTECTION:

The selection of personal protective equipment varies, depending upon conditions of use.
In open systems where contact is likely, wear safety goggles, chemical-resistant overalls, and chemically impervious gloves.
Where only incidental contact is likely, wear safety glasses with side shields. No other special precautions are necessary provided skin/eye contact is avoided.

Where concentrations in air may exceed the occupational exposure limits given in Section 4 and where engineering, work practices or other means of exposure reduction are not adequate, approved respirators may be necessary to prevent overexposure by inhalation.

ENGINEERING CONTROLS:

The use of local exhaust ventilation is recommended to control emissions near the source. Laboratory samples should be handled in a fumehood. Provide mechanical ventilation of confined spaces.

HANDLING, STORAGE AND SHIPPING:

Keep containers closed. Handle and open containers with care. Store in a cool, well ventilated place away from incompatible materials. In keeping with good personal hygiene practices, wash hands thoroughly after handling the material. Do not handle or store near an open flame, sources of heat, or sources of ignition. Empty containers may contain product residue. Do not pressurize cut, heat, or weld empty containers. Do not reuse empty containers without commercial cleaning or reconditioning.

LAND SPILL:

Eliminate source of ignition. Keep public away. Prevent additional discharge of material, if possible to do so without hazard. Prevent spills from entering sewers, watercourses or low areas. Contain spilled liquid with sand or earth. Allow material to solidify and scrape up. Place material in suitable containers for recycle or disposal. If liquid is too viscous for pumping, scrape up. Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately. Take all additional action necessary to prevent and remedy the adverse effects of the spill.

WATER SPILL:

Remove from surface by skimming or with suitable absorbents. If allowed by local authorities and environmental agencies, sinking and/or suitable dispersants may be used in unconfined waters. Consult an expert on disposal of recovered material. Ensure disposal in compliance with government requirements and ensure conformity to local disposal regulations. Notify the appropriate authorities immediately. Take all additional action necessary to prevent and remedy the adverse effects of the spill.

7. FIRE AND EXPLOSION HAZARD

Flashpoint and method: 180 deg C COC ASTM D92, BASEOIL

Autoignition: NA Flammable Limits: LEL: NA UEL: NA

GENERAL HAZARDS:

Low Hazard; liquids may burn upon heating to temperatures at or above the flash point.

Toxic gases will form upon combustion.

FIRE FIGHTING:

Use water spray to cool fire exposed surfaces and to protect personnel.
Shut off fuel to fire.

Use foam, dry chemical or water spray to extinguish fire.

Respiratory and eye protection required for fire fighting personnel.

A self-contained breathing apparatus (SCBA) should be used for all indoor fires and any significant outdoor fires. For small outdoor fires, which may easily be extinguished with a portable fire extinguisher, use of an SCBA may not be required.

HAZARDOUS COMBUSTION PRODUCTS:

Fumes, smoke, carbon monoxide, sulfur oxides, nitrogen oxides, phosphorus oxides, aldehydes and other decomposition products, in the case of incomplete combustion

Various metal oxides

8. REACTIVITY DATA

STABILITY:

This product is stable. Hazardous polymerization will not occur.

INCOMPATIBLE MATERIALS AND CONDITIONS TO AVOID:

Avoid contact with strong oxidants such as liquid chlorine, concentrated oxygen, sodium hypochlorite, calcium hypochlorite, etc., as this presents a serious explosion hazard.

HAZARDOUS DECOMPOSITION:

none

9. NOTES

All components of this product are listed on the U.S. TSCA inventory.

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REVISION SUMMARY:

Since 24 May 2000, this MSDS has been revised in Section(s):

3, 6, 7

10. PREPARATION

Date Prepared: August 28, 2003
Prepared by: Lubricants & Specialties
IMPERIAL OIL
Products Division
240 4th Avenue S.W.
Calgary, Alberta
T2P 3M9
(800) 268-3183

CAUTION: " The information contained herein relates only to this product or material and may not be valid when used in combination with any other product or material or in any process. If the product is not to be used for a purpose or under conditions which are normal or reasonably foreseeable, this information cannot be relied upon as complete or applicable. For greater certainty, uses other than those described in Section 1 must be reviewed with the supplier. The information contained herein is based on the information available at the indicated date of preparation. This MSDS is for the use of Imperial Oil customers and their employees and agents only. Any further distribution of this MSDS by Imperial Oil customers is prohibited without the written consent of Imperial Oil."

MATERIAL SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: UNIREX EP 2
Product Description: Base Oil and Additives
MSDS Number: 8382
Intended Use: Grease

COMPANY IDENTIFICATION

Supplier: Imperial Oil Products Division
240 4th Avenue
Calgary, ALBERTA. T2P 3M9 Canada
24 Hour Environmental / Health Emergency Telephone 519-339-2145
Transportation Emergency Phone Number 519-339-2145
Product Technical Information 1-800-268-3183
Supplier General Contact 1-800-567-3776

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

No Reportable Hazardous Substance(s) or Complex Substance(s).

SECTION 3 HAZARDS IDENTIFICATION

This material is not considered to be hazardous according to regulatory guidelines see Section 15.

HEALTH EFFECTS

Low order of toxicity. Excessive exposure may result in eye, skin, or respiratory irritation. High-pressure injection under skin may cause serious damage.

NFPA Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0
HMIS Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0

Note: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4 FIRST AID MEASURES

INHALATION

Under normal conditions of intended use, this material is not expected to be an inhalation hazard.

SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the

body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Hazardous Combustion Products: Aldehydes, Oxides of carbon, Smoke, Fume, Sulphur Oxides, Incomplete combustion products

FLAMMABILITY PROPERTIES

Flash Point [Method]: >200C (392F) [EST. FOR OIL, ASTM D-92 (COC)]

Flammable Limits (Approximate volume % in air): LEL: N/D UEL: N/D

Autoignition Temperature: N/D

SECTION 6 ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

SPILL MANAGEMENT

Land Spill: Allow spilled material to solidify and shovel it up into a suitable container for recycle or disposal. Scrape up spilled material with shovels into a suitable container for recycle or disposal.

Water Spill: Stop leak if you can do so without risk. Confine the spill immediately with booms. Skim from surface

Water spill and land spill recommendations are based on the most likely spill scenario for this material;

however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7	HANDLING AND STORAGE

HANDLING

Prevent small spills and leakage to avoid slip hazard.

Static Accumulator: This material is not a static accumulator.

STORAGE

Do not store in open or unlabelled containers.

SECTION 8	EXPOSURE CONTROLS / PERSONAL PROTECTION

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No protection is ordinarily required under normal conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

ENVIRONMENTAL CONTROLS

See Sections 6, 7, 12, 13.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

Typical physical and chemical properties are given below. Consult the Supplier in Section 1 for additional data.

GENERAL INFORMATION

Physical State: Solid

Form: semi-fluid

Colour: dark green

Odour: Characteristic

Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density: 0.89

Flash Point [Method]: >200C (392F) [EST. FOR OIL, ASTM D-92 (COC)]

Flammable Limits (Approximate volume % in air): LEL: N/D UEL: N/D

Autoignition Temperature: N/D

Boiling Point / Range: N/D

Vapour Density (Air = 1): N/D

Vapour Pressure: < 0.01 kPa (0.08 mm Hg) at 20°C

Evaporation Rate (N-Butyl Acetate = 1): N/D

pH: N/A

Log Pow (n-Octanol/Water Partition Coefficient): > 3.5

Solubility in Water: Negligible

Viscosity: 220 cSt (220 mm²/sec) at 40°C | 18.5 cSt (18.5 mm²/sec) at 100C

Oxidizing properties: See Sections 3, 15, 16.

OTHER INFORMATION

Freezing Point: N/D

Melting Point: >260°C (500°F)

DMSO Extract (mineral oil only), IP-346: < 3 %wt

Note: Most physical properties above are for the oil component in the material.

SECTION 10	STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Excessive heat. High energy sources of ignition.

MATERIALS TO AVOID: Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11	TOXICOLOGICAL INFORMATION

Acute Toxicity

Route of Exposure	Conclusion / Remarks
INHALATION	
Toxicity (Rat): LC50 > 5000 mg/m ³	Minimally Toxic. Based on assessment of the components.
Irritation: No end point data.	Negligible hazard at ambient/normal handling temperatures. Based on assessment of the components.
INGESTION	
Toxicity (Rat): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Skin	
Toxicity (Rabbit): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Irritation (Rabbit): Data available.	Negligible irritation to skin at ambient temperatures. Based on assessment of the components.
Eye	
Irritation (Rabbit): Data available.	May cause mild, short-lasting discomfort to eyes. Based on assessment of the components.

CHRONIC/OTHER EFFECTS

Contains:

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitising in test animals.

Additional information is available by request.

CMR Status: None.

--REGULATORY LISTS SEARCHED--

1 = IARC 1
2 = IARC 2A

3 = IARC 2B
4 = ACGIH ALL

5 = ACGIH A1
6 = ACGIH A2

SECTION 12	ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Expected to be harmful to aquatic organisms. May cause long-term adverse effects in the aquatic environment.

MOBILITY

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Base oil component -- Expected to be inherently biodegradable

BIOACCUMULATION POTENTIAL

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

SECTION 13	DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Suitable routes of disposal are supervised incineration, preferentially with energy recovery, or appropriate recycling methods in accordance with applicable regulations and material characteristics at the time of disposal.

REGULATORY DISPOSAL INFORMATION

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14	TRANSPORT INFORMATION

LAND (TDG) : Not Regulated for Land Transport

LAND (DOT) : Not Regulated for Land Transport

SEA (IMDG) : Not Regulated for Sea Transport according to IMDG-Code

AIR (IATA) : Not Regulated for Air Transport

SECTION 15	REGULATORY INFORMATION

WHMIS Classification: Not controlled

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations.

CEPA: All components of this material are either on the Canadian Domestic Substances List (DSL), exempt, or have been notified under CEPA.

NATIONAL CHEMICAL INVENTORY LISTING: TSCA, EINECS, DSL

The Following Ingredients are Cited on the Lists Below:

Chemical Name	CAS Number	List Citations
DIPHENYLAMINE	122-39-4	1
ZINC DIALKYL DITHIOPHOSPHATE	68457-79-4	6

--REGULATORY LISTS SEARCHED--

1 = TSCA 4
2 = TSCA 5a2

3 = TSCA 5e
4 = TSCA 6

5 = TSCA 12b
6 = NPRI

SECTION 16	OTHER INFORMATION

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

Revision Changes:

Section 05: Fire Fighting Measures - Fire Fighting Instruction was modified.

Section 06: Notification Procedures - Header was modified.

Section 13: Empty Container Warning was modified.

Section 09: Phys/Chem Properties Note was modified.

Section 08: Hand Protection was modified.

Section 06: Accidental Release- Spill Management- Water was modified.

Section 09: Flash Point C(F) was modified.

Section 09 Viscosity was modified.

Section 15: National Chemical Inventory Listing was modified.

Section 15: Canadian List Citations Table was modified.

Section 11: Chronic Tox - Component - WHMIS was added.

Section 11: Chronic Tox - Component - Header was added.

Section 11: Other Health Effects Header was added.

Composition: No components was added.

Section 13: Regulatory Disposal Information - Header was added.

Section 13: Regulatory Disposal Information - Header was deleted.

Section 11: Other Health Effects Header was deleted.

Composition: No components was deleted.

Section 15: Special Cases - Header was deleted.

Section 15: Special Cases Table was deleted.
Section 15: Inventory - Header was deleted.
Section 15: Status - Header was deleted.
Section 11: Chronic Tox - Component was deleted.
Section 11: Chronic Tox - Component - Header was deleted.
Section 11: Chemical Name - Header was deleted.
Section 11: CAS Number - Header was deleted.
Section 11: List Citation - Header was deleted.
Section 11: Tox List Cited Table was deleted.

WHMIS Classification: Not controlled

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Prepared By: Imperial Oil Limited, IH and Product Safety

MATERIAL SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: ESSO HD ANTIFREEZE 60/40 PREMIX
Product Description: Glycol
MSDS Number: 8514
Intended Use: Antifreeze/coolant

COMPANY IDENTIFICATION

Supplier: Imperial Oil Products Division
240 4th Avenue
Calgary, ALBERTA. T2P 3M9 Canada
24 Hour Environmental / Health Emergency Telephone 519-339-2145
Transportation Emergency Phone Number 519-339-2145
Product Technical Information 1-800-268-3183
Supplier General Contact 1-800-567-3776

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

Reportable Hazardous Substance(s) or Complex Substance(s)

Name	CAS#	Concentration*	Acute Toxicity
Ethylene Glycol	107-21-1	55 - 65%	Dermal Lethality: LD50 9.53 g/kg (Rabbit); Inhalation Lethality: LC50 4300 ppm (Rat); Oral Lethality: LD50 4.70 g/kg (Rat)

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

SECTION 3 HAZARDS IDENTIFICATION

This material is considered to be hazardous according to regulatory guidelines (see (M)SDS Section 15).

HEALTH EFFECTS

May cause harm to the unborn child. Ingestion of ethylene glycol may result in nausea, vomiting, abdominal cramps, blindness, liver damage, irritation, reproductive effects, nerve damage, convulsions, edema of the lung, cardiopulmonary effects (metabolic acidosis), pneumonia and kidney failure which could result in death. The single lethal dose for humans is about 100 ml. Inhalation of high levels of vapour or mists for prolonged periods of time may also result in toxic effects. Excessive exposure may result in eye, skin, or respiratory irritation. High-pressure injection under skin may cause serious damage.

Target Organs: Kidney | Reproductive system |

NFPA Hazard ID: Health: 1 Flammability: 0 Reactivity: 0
HMIS Hazard ID: Health: 2* Flammability: 0 Reactivity: 0

Note: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4 FIRST AID MEASURES

INHALATION

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

Seek immediate medical attention.

NOTE TO PHYSICIAN

This product contains ethylene and/or diethylene glycol which, if ingested, is metabolised to toxic metabolites by the enzyme alcohol dehydrogenase, for which ethanol and 4-methylpyrazole {US drug name Fomepizole, trade name Antizol} are antagonists. Administration of oral or intravenous ethanol or intravenous 4-methylpyrazole may arrest further metabolism of this material and thereby ameliorate the toxicity. Use of ethanol or 4-methylpyrazole does not affect toxic metabolites that are already present and is not a substitute for haemodialysis.

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, alcohol-resistant foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water or standard foam

FIRE FIGHTING

Fire Fighting Instructions: Material will not burn. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply.

Hazardous Combustion Products: Incomplete combustion products, Oxides of carbon, Smoke, Fume, Aldehydes

FLAMMABILITY PROPERTIES

Flash Point [Method]: N/A

Flammable Limits (Approximate volume % in air): LEL: N/A UEL: N/A

Autoignition Temperature: N/D

SECTION 6

ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

SPILL MANAGEMENT

Land Spill: Stop leak if you can do so without risk. Do not touch or walk through spilled material. Small Spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do so without risk. Consult an expert. Warn other shipping. Material will sink. Remove material, as much as possible, using mechanical equipment.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Remove debris in path of spill and remove contaminated debris from shoreline and water surface. Dispose of according to local regulations. Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7

HANDLING AND STORAGE

HANDLING

Avoid breathing mists or vapour. Avoid contact with skin. Prevent small spills and leakage to avoid slip hazard.

Static Accumulator: This material is not a static accumulator.

STORAGE

Do not store in open or unlabelled containers.

SECTION 8

EXPOSURE CONTROLS / PERSONAL PROTECTION

Substance Name	Form	Limit/Standard			Note	Source
Ethylene Glycol	Aerosol.	Ceiling	100 mg/m3			ACGIH

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No protection is ordinarily required under normal conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Work conditions can greatly affect glove durability; inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

If prolonged or repeated contact is likely, chemical-resistant gloves are recommended. If contact with forearms is likely, wear gauntlet-style gloves.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

If prolonged or repeated contact is likely, chemical, and oil resistant clothing is recommended.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

ENVIRONMENTAL CONTROLS

See Sections 6, 7, 12, 13.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

Typical physical and chemical properties are given below. Consult the Supplier in Section 1 for additional data.

GENERAL INFORMATION

Physical State: Liquid

Form: clear

Colour: green

Odour: Characteristic

Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 16 C): 1.07 - 1.08
Flash Point [Method]: N/A
Flammable Limits (Approximate volume % in air): LEL: N/A UEL: N/A
Autoignition Temperature: N/D
Boiling Point / Range: 132C (270F)
Vapour Density (Air = 1): 2.1 at 101 kPa
Vapour Pressure: 0.008 kPa (0.06 mm Hg) at 20°C
Evaporation Rate (N-Butyl Acetate = 1): 0.01
pH: 9 - 11
Log Pow (n-Octanol/Water Partition Coefficient): < 2
Solubility in Water: Complete
Viscosity: [N/D at 40°C]
Oxidizing properties: See Sections 3, 15, 16.

OTHER INFORMATION

Freezing Point: N/D
Melting Point: N/D
Pour Point: -52°C (-62°F)

SECTION 10 STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: High energy sources of ignition.

MATERIALS TO AVOID: Strong oxidizers, Acids, Alkalies

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

Acute Toxicity

Route of Exposure	Conclusion / Remarks
INHALATION	
Toxicity (Rat): LC50 > 5000 mg/m ³	Minimally Toxic. Based on test data for structurally similar materials.
Irritation: Data available.	Negligible hazard at ambient/normal handling temperatures. Based on test data for structurally similar materials.
INGESTION	
Toxicity (Human): LDLo 100 ml	Minimally Toxic. Based on test data for structurally similar materials.
Skin	
Toxicity (Rabbit): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Irritation (Rabbit): Data available.	Negligible irritation to skin at ambient temperatures. Based on test data for structurally similar materials.
Eye	

Irritation (Rabbit): Data available.	May cause mild, short-lasting discomfort to eyes. Based on test data for structurally similar materials.

CHRONIC/OTHER EFFECTS**Contains:**

ETHYLENE GLYCOL (EG): Repeated high oral exposure has caused kidney damage, neurological effects, degeneration of the liver and changes in blood chemistry and circulating blood cells in laboratory animals. Repeated overexposure has the potential to cause similar toxic effects in humans. EG causes developmental and reproductive effects at high dose levels in laboratory animals. The relevance of these findings to humans is uncertain. However, as a precaution, avoid exposure during pregnancy.

Additional information is available by request.

CMR Status: None.

Chemical Name	CAS Number	List Citations
Ethylene Glycol	107-21-1	4

--REGULATORY LISTS SEARCHED--

1 = IARC 1
2 = IARC 2A

3 = IARC 2B
4 = ACGIH ALL

5 = ACGIH A1
6 = ACGIH A2

SECTION 12	ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Not expected to be harmful to aquatic organisms.

MOBILITY

Material -- Expected to remain in water or migrate through soil.

PERSISTENCE AND DEGRADABILITY**Biodegradation:**

Material -- Expected to be readily biodegradable.

Atmospheric Oxidation:

Material -- Expected to degrade rapidly in air

BIOACCUMULATION POTENTIAL

Material -- Potential to bioaccumulate is low.

SECTION 13	DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Even though this product is readily biodegradable, it must not be indiscriminately discarded into the

environment. Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

REGULATORY DISPOSAL INFORMATION

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14

TRANSPORT INFORMATION

LAND (TDG) : Not Regulated for Land Transport

LAND (DOT)

Proper Shipping Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCES, LIQUID, N.O.S. (Ethylene Glycol)

Hazard Class & Division: 9

ID Number: 3082

Packing Group: III

ERG Number: 171

Label(s): 9

Transport Document Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCES, LIQUID, N.O.S., 9, UN3082, PG III, RQ (ETHYLENE GLYCOL)

SEA (IMDG) : Not Regulated for Sea Transport according to IMDG-Code

AIR (IATA) : Not Regulated for Air Transport

SECTION 15

REGULATORY INFORMATION

WHMIS Classification: Class D, Division 2, Subdivision A: Very Toxic Material

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations.

CEPA: All components of this material are either on the Canadian Domestic Substances List (DSL), exempt, or have been notified under CEPA.

NATIONAL CHEMICAL INVENTORY LISTING: DSL, TSCA

The Following Ingredients are Cited on the Lists Below: None.

--REGULATORY LISTS SEARCHED--

1 = TSCA 4

3 = TSCA 5e

5 = TSCA 12b

2 = TSCA 5a2

4 = TSCA 6

6 = NPRI

SECTION 16

OTHER INFORMATION

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

Revision Changes:

Section 13: Empty Container Warning was modified.

Section 09: Phys/Chem Properties Note was modified.

Section 09: Boiling Point C(F) was modified.

Section 08: Hand Protection was modified.

Section 11: Oral Lethality Test Data was modified.

Section 06: Accidental Release-Spill Management-Land was modified.

Section 06: Accidental Release- Spill Management- Water was modified.

Section 09: Relative Density - Header was modified.

Hazard Identification: Health Hazards was modified.

Hazard Identification: Emergency Overview Target Organs was modified.

Section 16: Health Hazards was modified.

Section 16: Target Organs was modified.

Section 16: Land Spill was modified.

Section 16: Water Spill was modified.

Section 16: Fire Fighting Media - Header was added.

Section 16: Fire Fighting Media - Header was added.

Section 16: Precautions was added.

Section 16: Precautions - Header was added.

Section 11: Chronic Tox - Component - WHMIS was added.

Section 11: Chronic Tox - Component - Header was added.

Section 11: Other Health Effects Header was added.

Section 11: Other Health Effects Header was deleted.

Section 11: Chronic Tox - Component was deleted.

Section 11: Chronic Tox - Component - Header was deleted.

Precautionary Label Text:

WHMIS Classification: Class D, Division 2, Subdivision A: Very Toxic Material

HEALTH HAZARDS

Danger of serious damage to health by prolonged exposure. May cause harm to the unborn child.

Target Organs: Kidney | Reproductive system |

PRECAUTIONS

Avoid breathing mists or vapour. Avoid contact with skin.

FIRST AID

INHALATION: Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

Eye: Flush thoroughly with water. If irritation occurs, get medical assistance.

Oral: Seek immediate medical attention.

Skin: Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

FIRE FIGHTING MEDIA

Use water fog, alcohol-resistant foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

SPILL/LEAK

Land Spill: Stop leak if you can do so without risk. Small Spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Recover by pumping or with suitable absorbent. Do not touch or walk through spilled material.

Water Spill: Stop leak if you can do so without risk. Report spills as required to appropriate authorities. Material will sink. This product emulsifies, disperses or is miscible in water. Consult an expert.

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Prepared By: Imperial Oil Limited, IH and Product Safety

MATERIAL SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: HYDRAUL 56
Product Description: Base Oil and Additives
MSDS Number: 8058
Intended Use: Hydraulic fluid

COMPANY IDENTIFICATION

Supplier: Imperial Oil Products Division
240 4th Avenue
Calgary, ALBERTA. T2P 3M9 Canada
24 Hour Environmental / Health Emergency Telephone 519-339-2145
Transportation Emergency Phone Number 519-339-2145
Product Technical Information 1-800-268-3183
Supplier General Contact 1-800-567-3776

SECTION 2 COMPOSITION / INFORMATION ON INGREDIENTS

No Reportable Hazardous Substance(s) or Complex Substance(s).

SECTION 3 HAZARDS IDENTIFICATION

This material is not considered to be hazardous according to regulatory guidelines see Section 15.

HEALTH EFFECTS

Low order of toxicity. Excessive exposure may result in eye, skin, or respiratory irritation. High-pressure injection under skin may cause serious damage.

NFPA Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0
HMIS Hazard ID:	Health: 0	Flammability: 1	Reactivity: 0

Note: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4 FIRST AID MEASURES

INHALATION

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

SECTION 5	FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Unusual Fire Hazards: Pressurised mists may form a flammable mixture.

Hazardous Combustion Products: Smoke, Fume, Aldehydes, Oxides of carbon, Incomplete combustion products, Sulphur Oxides

FLAMMABILITY PROPERTIES

Flash Point [Method]: 220C (428F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: 330°C (626°F)

SECTION 6	ACCIDENTAL RELEASE MEASURES

Notification Procedures

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

SPILL MANAGEMENT

Land Spill: Stop leak if you can do so without risk. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do so without risk. Confine the spill immediately with booms. Warn other

shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7 HANDLING AND STORAGE

HANDLING

Prevent small spills and leakage to avoid slip hazard.

Static Accumulator: This material is a static accumulator.

STORAGE

Do not store in open or unlabelled containers.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure limits/standards for materials that can be formed when handling this product: When mists / aerosols can occur, the following are recommended: 5 mg/m³ - ACGIH TLV, 10 mg/m³ - ACGIH STEL.

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

Personal Protection

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate,

gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

ENVIRONMENTAL CONTROLS

See Sections 6, 7, 12, 13.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

Typical physical and chemical properties are given below. Consult the Supplier in Section 1 for additional data.

GENERAL INFORMATION

Physical State: Liquid

Colour: Amber

Odour: Characteristic

Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15 C): 0.885

Flash Point [Method]: 220C (428F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: 330°C (626°F)

Boiling Point / Range: > 322C (612F)

Vapour Density (Air = 1): > 2 at 101 kPa

Vapour Pressure: < 0.013 kPa (0.1 mm Hg) at 20°C

Evaporation Rate (N-Butyl Acetate = 1): N/D

pH: N/A

Log Pow (n-Octanol/Water Partition Coefficient): > 3.5

Solubility in Water: Negligible

Viscosity: [N/D at 40°C] | 9.9 cSt (9.9 mm²/sec) at 100C

Oxidizing properties: See Sections 3, 15, 16.

OTHER INFORMATION

Freezing Point: N/D

Melting Point: N/A
Pour Point: -36°C (-33°F)
DMSO Extract (mineral oil only), IP-346: < 3 %wt

SECTION 10	STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Excessive heat. High energy sources of ignition.

MATERIALS TO AVOID: Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11	TOXICOLOGICAL INFORMATION

Acute Toxicity

Route of Exposure	Conclusion / Remarks
INHALATION	
Toxicity (Rat): LC50 > 5000 mg/m ³	Minimally Toxic. Based on assessment of the components.
Irritation: No end point data.	Negligible hazard at ambient/normal handling temperatures. Based on assessment of the components.
INGESTION	
Toxicity (Rat): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Skin	
Toxicity (Rabbit): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Irritation (Rabbit): Data available.	Negligible irritation to skin at ambient temperatures. Based on assessment of the components.
Eye	
Irritation (Rabbit): Data available.	May cause mild, short-lasting discomfort to eyes. Based on assessment of the components.

CHRONIC/OTHER EFFECTS

Contains:

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitising in test animals.

Additional information is available by request.

CMR Status: None.

--REGULATORY LISTS SEARCHED--

1 = IARC 1
2 = IARC 2A

3 = IARC 2B
4 = ACGIH ALL

5 = ACGIH A1
6 = ACGIH A2

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Not expected to be harmful to aquatic organisms.

MOBILITY

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Base oil component -- Expected to be inherently biodegradable

BIOACCUMULATION POTENTIAL

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

SECTION 13 DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

REGULATORY DISPOSAL INFORMATION

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14 TRANSPORT INFORMATION

LAND (TDG) : Not Regulated for Land Transport

LAND (DOT) : Not Regulated for Land Transport

SEA (IMDG) : Not Regulated for Sea Transport according to IMDG-Code

AIR (IATA) : Not Regulated for Air Transport

SECTION 15	REGULATORY INFORMATION

WHMIS Classification: Not controlled

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations.

CEPA: All components of this material are either on the Canadian Domestic Substances List (DSL), exempt, or have been notified under CEPA.

National Chemical Inventory Listing: DSL, TSCA

The Following Ingredients are Cited on the Lists Below:

Chemical Name	CAS Number	List Citations
ZINC C1-C14 ALKYLDITHIOPHOSPHATE	68649-42-3	6

--REGULATORY LISTS SEARCHED--

1 = TSCA 4
2 = TSCA 5a2

3 = TSCA 5e
4 = TSCA 6

5 = TSCA 12b
6 = NPRI

SECTION 16	OTHER INFORMATION

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

Revision Changes:

Section 05: Fire Fighting Measures - Fire Fighting Instruction was modified.

Section 06: Notification Procedures - Header was modified.

Section 13: Empty Container Warning was modified.

Section 09: Phys/Chem Properties Note was modified.

Section 09: Boiling Point C(F) was modified.

Section 08: Personal Protection - Header was modified.

Section 08: Hand Protection was modified.

Section 05: Hazardous Combustion Products was modified.

Section 06: Accidental Release- Spill Management- Water was modified.

Section 09: Relative Density - Header was modified.

Section 09: Flash Point C(F) was modified.

Section 09: Viscosity was modified.

Section 15: National Chemical Inventory Listing - Header was modified.

Section 09: Relative Density was modified.

Section 16: MSN,MAT ID was modified.

Section 15: List Citation Table - Header was modified.

Section 15: Canadian List Citations Table was added.

Section 15: Chemical Name - Header was added.

Section 15: CAS Number - Header was added.
Section 15: List Citations -Header was added.
Section 11: Chronic Tox - Component - WHMIS was added.
Section 11: Chronic Tox - Component - Header was added.
Section 11: Other Health Effects Header was added.
Composition: No components was added.
Section 11: Other Health Effects Header was deleted.
Composition: No components was deleted.
Section 11: Chronic Tox - Component was deleted.
Section 11: Chronic Tox - Component - Header was deleted.
Section 09: Form - Header was deleted.
Section 09: Physical State was deleted.

WHMIS Classification: Not controlled

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Prepared By: Imperial Oil Limited, IH and Product Safety

**MATERIAL SAFETY DATA**

MSDS No: 01787
CAS No: 013360-78-6
Date: 03/13/2001
Supersedes: 10/14/1997

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: **AEROPHINE® 3418A Promoter**

SYNONYMS: Sodium diisobutylidithiophosphinate, 50% aqueous solution

CHEMICAL FAMILY: Dithiophosphinate

MOLECULAR FORMULA: C₈H₁₈PS₂.Na

MOLECULAR WGT: 232

CYTEC INDUSTRIES INC., FIVE GARRET MOUNTAIN PLAZA, WEST PATERSON, NEW JERSEY 07424, USA

For Product Information call 1-800/652-6013. Outside the USA and Canada call 1-973/357-3193.

EMERGENCY PHONE: For emergency involving spill, leak, fire, exposure or accident call CHEMTREC: 1-800/424-9300. Outside the USA and Canada call 1-703/527-3887.

2. COMPOSITION/INFORMATION ON INGREDIENTS**OSHA REGULATED COMPONENTS**

COMPONENT	CAS. NO.	%	TWA/CEILING	REFERENCE
Sodium diisobutyl-di thiophosphinate	013360-78-6	50-52	not established	

3. HAZARDS IDENTIFICATION**EMERGENCY OVERVIEW**

APPEARANCE AND ODOR: Colorless to light yellow mobile liquid; odorless

STATEMENTS OF HAZARD:

WARNING! CAUSES EYE IRRITATION
MAY CAUSE SKIN IRRITATION

POTENTIAL HEALTH EFFECTS**EFFECTS OF OVEREXPOSURE:**

The acute oral (rat) and acute dermal (rabbit) LD₅₀ values for this material are 3.35 g/kg and greater than 5.0 g/kg, respectively. Mild skin and moderate eye irritation were produced during primary irritation studies in rabbits. Skin irritation was increased after repeated exposures in rabbit studies.

4. FIRST AID MEASURES

If quantities greater than 15 cc are swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth or induce vomiting in an unconscious person.

In case of skin contact, immediately wash affected areas with soap and plenty of water. Remove contaminated clothing and shoes. Obtain medical attention. Destroy or thoroughly clean shoes before reuse. Do not reuse contaminated clothing without laundering.

In case of eye contact, immediately irrigate with plenty of water for 15 minutes. Obtain medical attention if irritation persists or if otherwise necessary.

Material is not expected to be harmful if inhaled. If inhaled, remove to fresh air.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT: >200 F; 93 C

METHOD: Pensky-Martens Closed Cup

FLAMMABLE LIMITS

(% BY VOL): Not applicable

AUTOIGNITION TEMP: 819 F; 437 C

DECOMPOSITION TEMP: >662 F; 350C

EXTINGUISHING MEDIA AND FIRE FIGHTING INSTRUCTIONS

Use water spray, carbon dioxide or dry chemical to extinguish fires. Use water to keep containers cool.

Wear self-contained, positive pressure breathing apparatus and full fire-fighting protective clothing. See Section 8 (Exposure Controls/Personal Protection) for special protective clothing.

6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Where exposure level is not known, wear NIOSH approved, positive pressure, self-contained respirator. Where exposure level is known, wear NIOSH approved respirator suitable for level of exposure. In addition to the protective clothing/equipment in Section 8 (Exposure Controls/Personal Protection), wear impervious boots. Cover spills with some inert absorbent material; sweep up and place in a waste disposal container. Flush area with water.

7. HANDLING AND STORAGE

Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT (PPE)

Where this material is not used in a closed system, good enclosure and local exhaust ventilation should be provided to control exposure. Food, beverages, and tobacco products should not be carried, stored, or consumed where this material is in use. Before eating, drinking, or smoking, wash face and hands with soap and water. Avoid skin contact. Protective clothing such as impervious gloves, apron, workpants, long sleeve work shirt, or disposable coveralls are recommended to prevent skin contact. For operations where eye or face contact can occur, wear eye protection such as chemical splash proof goggles or face shield. Eyewash equipment and safety shower should be provided in areas of potential exposure. For operations where inhalation exposure can occur, a NIOSH approved respirator recommended by an industrial hygienist may be necessary. A full facepiece respirator also provides eye and face protection.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR: Colorless to light yellow mobile liquid; odorless

BOILING POINT: 223 F; 106 C

MELTING POINT: 23-32 F; -5-0 C; (crystallization point)

VAPOR PRESSURE: 17.5 mm Hg @ 20 C; (value for water)

SPECIFIC GRAVITY: 1.14 @ 24 C

VAPOR DENSITY: Not applicable

% VOLATILE (BY WT): ~50; (water)

pH: Slightly alkaline

SATURATION IN AIR (% BY VOL): Not applicable

EVAPORATION RATE: Not applicable

SOLUBILITY IN WATER: Complete

10. STABILITY AND REACTIVITY

STABILITY: Stable

CONDITIONS TO AVOID: None known

POLYMERIZATION: Will Not Occur

CONDITIONS TO AVOID: None known

INCOMPATIBLE MATERIALS: Strong mineral acids and strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS: oxides of carbon; oxides of phosphorus; oxides of sulfur (includes sulfur di and tri oxides)

11. TOXICOLOGICAL INFORMATION

Toxicological information for the product is found under Section 3. HAZARDS IDENTIFICATION. Toxicological information on the OSHA regulated components of this product is as follows:

Sodium diisobutyldithiophosphinate causes moderate eye and mild skin irritation.

12. ECOLOGICAL INFORMATION

Algae (*Selenastrum capricornutum*), 96 hr EbC50 = 35.1 mg/L; 96 hr ErC50 = 115 mg/L

LC50

BLUEGILL, 96 HOUR: 375 mg/L

DAPHNIA, 48 HOUR: 149 mg/L

BOD

28 Day: 78.8 %

OCTANOL/H₂O PARTITION COEF.: Not applicable

13. DISPOSAL CONSIDERATIONS

The information on RCRA waste classification and disposal methodology provided below applies only to the Cytec product, as supplied. If the material has been altered or contaminated, or it has exceeded its recommended shelf life, the guidance may be inapplicable. Hazardous waste classification under federal regulations (40 CFR Part 261 et seq) is dependent upon whether a material is a RCRA "listed hazardous waste" or has any of the four RCRA "hazardous waste characteristics." Refer to 40 CFR Part 261.33 to determine if a given material to be disposed of is a RCRA "listed hazardous waste"; information contained in Section 15 of this MSDS is not intended to indicate if the product is a "listed hazardous waste." RCRA Hazardous Waste Characteristics: There are four characteristics defined in 40 CFR Section 261.21-61.24: Ignitability, Corrosivity, Reactivity, and Toxicity. To determine Ignitability, see Section 5 of this MSDS (flash point). For Corrosivity, see Sections 9 and 14 (pH and DOT corrosivity). For Reactivity, see Section 10 (incompatible materials). For Toxicity, see Section 2 (composition). Federal regulations are subject to change. State and local requirements, which may differ from or be more stringent than the federal regulations, may also apply to the classification of the material if it is to be disposed. Cytec encourages the recycle, recovery and reuse of materials, where permitted, as an alternate to disposal as a waste. Cytec recommends that organic materials classified as RCRA hazardous wastes be disposed of by thermal treatment or incineration at EPA approved facilities. Cytec has provided the foregoing for information only; the person generating the waste is responsible for determining the waste classification and disposal method.

14. TRANSPORT INFORMATION

This section provides basic shipping classification information. Refer to appropriate transportation regulations for specific requirements.

D.O.T. SHIPPING INFORMATION		IMO SHIPPING INFORMATION
SHIPPING NAME:	NOT APPLICABLE/NOT REGULATED	NOT APPLICABLE/NOT REGULATED
HAZARD CLASS/ PACKING GROUP:	Not Applicable	Not Applicable
UN NUMBER:	Not Applicable	Not Applicable
IMDG PAGE:	Not Applicable	Not Applicable
D.O.T. HAZARDOUS SUBSTANCES:	(PRODUCT REPORTABLE QUANTITY) Not Applicable	Not Applicable
TRANSPORT LABEL REQUIRED:	None Required	None Required
ICAO/IATA		TRANSPORT CANADA
SHIPPING NAME:	NOT APPLICABLE/NOT REGULATED	NOT APPLICABLE/NOT REGULATED
HAZARD CLASS:	Not Applicable	Not Applicable
SUBSIDIARY CLASS:	Not Applicable	Not Applicable
UN / ID NUMBER:	Not Applicable	Not Applicable
PACKING GROUP:	Not Applicable	Not Applicable
TRANSPORT LABEL REQUIRED:	None Required	None Required
PACKING INSTR:	PASSENGER Not Applicable CARGO Not Applicable	Not Applicable
MAX NET QTY:	PASSENGER Not Applicable CARGO Not Applicable	Not Applicable
ADDITIONAL TRANSPORT INFORMATION		
TECHNICAL NAME (N.O.S.):	Not Applicable	

15. REGULATORY INFORMATION

INVENTORY INFORMATION

- US TSCA: All components of this product are included on the TSCA Inventory in compliance with the Toxic Substances Control Act, 15 U. S. C. 2601 et. seq.
- CANADA DSL: Components of this product have been reported to Environment Canada in accordance with subsection 25 of the Canadian Environmental Protection Act and are included on the Domestic Substances List.

EEC EINECS: All components of this product are included in the European Inventory of Existing Chemical Substances (EINECS) in compliance with Council Directive 67/548/EEC and its amendments.

**OTHER
ENVIRONMENTAL
INFORMATION**

The following components of this product may be subject to reporting requirements pursuant to Section 313 of CERCLA (40 CFR 372), Section 12(b) of TSCA, or may be subject to release reporting requirements (40 CFR 307, 40 CFR 311, etc.) See Section 13 for information on waste classification and waste disposal of this product.

COMPONENT	CAS. NO.	%	TPQ(lbs)	RQ(lbs)	S313	TSCA 12B

This product does not contain any components regulated under these sections of the EPA

PRODUCT CLASSIFICATION UNDER SECTION 311 OF SARA				
ACUTE (Y)	CHRONIC (N)	FIRE (N)	REACTIVE (N)	PRESSURE (N)

16. OTHER INFORMATION

NFPA HAZARD RATING (National Fire Protection Association)

Fire	FIRE: Materials that must be preheated before ignition can occur.
1	HEALTH: Materials that, under emergency conditions, can cause temporary
Health 2	incapacitation or residual injury.
0 Reactivity	REACTIVITY: Materials that in themselves are normally stable, even under fire
—	exposure conditions.
Special	

REASON FOR ISSUE:

Revised Section 15

Randy Deskin, Ph.D., DABT

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**OLD BRIDGE CHEMICALS, INC.
OLD WATERWORKS ROAD
OLD BRIDGE, NJ 08857**

Telephone: 732-727-2225

Facsimile: 732-727-2653

info@oldbridgechem.com

www.oldbridgechem.com

MATERIAL SAFETY DATA SHEET

October 25, 2006

Page 1 of 6

Product Name: COPPER SULFATE CRYSTALS

Manufacturer: Old Bridge Chemicals, Inc.
P.O. Box 194
Old Bridge, New Jersey 08857

Telephone: (732) 727-2225
Emergency Telephone: (800) 275-3924
24-hour Emergency Telephone: (800) 424-9300 Chemtrec

HAZARD CLASSIFICATION: NFPA: Health-3 / Fire-0 / Reactivity-0
HMIS: Health-3 / Fire-0 / Reactivity-0

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200).

SECTION I. MATERIAL IDENTIFICATION

Common Name: Copper Sulfate
Synonyms: Blue Vitrol, Bluestone, Cupric Sulfate
Molecular Formula: $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
EPA Reg. Number: 46923-4
EPA Signal Word: **DANGER**
CAS Number: 7758-99-8
SIC Number: 28199 C 29

SECTION II. COMPOSITION/INFORMATION ON INGREDIENTS

Exposure Limits: ACGIH TLV TWA: 1.0 mg/m³ (as copper dust/mist)
OSHA PEL TWA: 1.0 mg/m³ (as copper dust/mist)

SECTION III. HAZARD INFORMATION

Emergency overview: Odorless blue crystals. Can cause irreversible eye damage and severe skin irritation. Harmful if swallowed or absorbed through the skin. Avoid

breathing dust or mist. Avoid contact with the skin, eyes or clothes. May cause skin sensitization in certain individuals.

Swallowing:	Toxic orally in accordance with FHSLA regulations. Acute oral LD50 (male rats) = 472 mg/Kg. Can cause irritation to the digestive tract and abdominal pain.
Skin :	Slight skin irritant. Excessive exposure may cause skin irritation. Repeated exposure may cause allergic dermatitis. May cause irritation or burns on wet skin.
Eyes:	Can cause severe eye irritation and may result in irreversible eye damage.
Inhalation:	Inhalation of dust may cause irritation to the mucous membranes and upper respiratory tract
Carcinogenicity:	None as per NTP, OSHA, and IARC.

SECTION IV. FIRST AID PROCEDURES

Ingestion:	Give large amounts of milk, egg white, gelatin solution, or if they are not available, large quantities of water. Do not induce vomiting or give anything to an unconscious person. Avoid alcohol. Call Poison Control Center or a physician.
Skin:	Wash thoroughly with soap and water. Remove and wash contaminated clothing before reuse.
Eyes:	Immediately flush eyes with plenty of water for 15 minutes. Hold eyelids apart during irrigation. Call a physician.
Inhalation:	Remove person to fresh air. If not breathing, administer artificial respiration. Get medical attention.
Carcinogenicity:	None.

SECTION V. FIRE AND EXPLOSION DATA

Flash Point:	Not applicable.
Flammable Limits:	Not flammable. If heated above 400° C it can decompose to emit toxic fumes of oxide and sulfur.
Auto Ignition Temperature:	Not determined.
Extinguishing Media:	Copper Sulfate does not burn nor will it support combustion. If stored with other combustible products use water, CO ₂ or dry chemical.
Special Fire Fighting Instructions:	If dry heated above 600° C, SO ₂ is evolved. If water is used it will solubilize the Copper Sulfate and care should be taken to keep such water out of streams or other water bodies.
Fire Fighting Equipment:	Wear self-contained breathing apparatus.

Fire and Explosion Hazards: None.

SECTION VI. ACCIDENTAL RELEASE MEASURES

Use clean-up measures that avoid dust generation. Wear NIOSH or MSHA approved respirator if dust will be generated. Cover spill with absorbent material such as seeping compound or lime. Sweep up and put into an appropriate container for proper disposal in an approved method. Prevent accidental entry of solution into streams or other bodies of water. Shovel spills into plastic bags and seal with tape.

SECTION VII. HANDLING AND STORAGE

Signal Word:

DANGER

Handling Information:

Avoid breathing dust or mist. Sweep up crystals. Eye wash stations should be available in work areas. Users should wash hands before eating, drinking, smoking or using the toilet. Remove PPE immediately after handling this product. Wash outside of gloves before removing. Wash and change into clean clothing as soon as possible. Store in closed containers in a cool, dry, well-ventilated area away from heat sources and reducing agents. Store in original containers. Keep away from galvanized pipe, aluminum and nylon. Place damaged containers in plastic bags.

Storage Information:

SECTION VIII. EXPOSURE CONTROLS/PERSONAL PROTECTION

Ventilation:

TWA = 1 mg/l. for Copper Sulfate. When TWA exceeds this limit in the workplace, provide appropriate ventilation.

Respiratory Protection:

Wear an approved respirator for dusts or mists: MSHA/NIOSH approved number prefix TC-21C, or a NIOSH approved respirator with any R, P or HE filter. Alternatively, provide respiratory protection equipment in accordance with Paragraph 1910.134 of Title 29 of the Code of Federal Regulations.

Eye Protection:

Use safety glasses with side shields or goggles.

Skin Protection:

Applicators and other handlers should wear long-sleeved shirts and long pants, waterproof gloves, shoes plus socks and protective eyewear. Discard clothing and other absorbent materials that have been drenched or heavily contaminated with product's concentrate. Do not reuse them. Keep and wash PPE separately from other laundry.

SECTION IX. PHYSICAL DATA

Physical State:

Blue crystals or powder

Boiling Point:

NA

Melting Point:	Decomposition above 110°C with $-4\text{H}_2\text{O}$
Vapor Density:	NA
Specific Gravity:	2.284
Solubility in H_2O :	22.37% @ 0°C 117.95% @ 100°C
Solubility in Other Solvents:	Soluble in methanol, glycerol and slightly soluble in ethanol.
Molecular Weight:	249.68
Appearance:	Transparent blue crystals
Odor:	Odorless

SECTION X. REACTIVITY DATA

Stability:	Stable
Conditions to Avoid:	Product is highly soluble, but does not react with water.
Incompatibility:	Solutions are mildly corrosive to steel. Store solutions in plastic or rubber or 304, 347 or 316 stainless steel. Iron and moisture should be avoided. Store in a dry area. Incompatible with aluminum powder, acetylene gas, hydroxylamine, magnesium and moisture. Contact with magnesium can generate dangerous levels of hydrogen gas. With exposure to air it will oxidize and turn whitish.
Hazardous Decomposition Products:	None at normal production temperatures and pressures. If dry heated above 600°C toxic sulfur may evolve.
Polymerization:	Will not occur.

SECTION XI. TOXICOLOGICAL INFORMATION

Inhalation:	$\text{LC}_{50} > 2.95 \text{ mg/L}$ (rat) Inhalation of dust can result in irritation of nasal mucous membranes and sometimes of the pharynx, on occasion ulceration with perforation of the nasal septum.
Skin:	$\text{LD}_{50} > 8.0 \text{ g/kg}$ (rabbit)
Ingestion:	$\text{LD}_{50} > 472.5 \text{ mg/kg}$ (rat)
Primary Eye Irritation:	Corrosive, irreversible eye damage.
Primary Skin Irritation:	No skin irritation.

Note to Physician: Probable mucosal damage may contraindicate the use of gastric lavage. Measures against circulatory shock, respiratory depression and convulsions may be needed. Wilson's disease can be aggravated by excessive exposure. Symptoms include nausea, vomiting, epigastria pain, diarrhea, dizziness, jaundice, and general debility.

SECTION XII. ENVIRONMENTAL AND DISPOSAL INFORMATION

Aquatic LC_{50} :	Daphnia magna 0.182 mg/L.

	Rainbow Trout 0.17 mg/L. Blue Gill 1.5 mg/L.
Spills and Leaks:	All values are expressed as Copper Sulfate Pentahydrate. Test water was soft. Period 24 hours. Comply with Federal, State and local regulations on reporting spills. Do not wash away crystals or powder. Recover dry if possible. If product is in a confined solution, react with soda ash to form an insoluble Copper Carbonate solid that can be scooped up.
Waste Disposal:	Do not reuse container. Comply with Federal, State and local environmental control regulations. Sweep up crystals, powder or insoluble Copper Carbonate and dispose of in an approved landfill.
Environmental Effects:	May be dangerous if it enters the public water systems. Follow local regulation. Toxic to fish and plants. Fish toxicity critical concentration is 235 mg/l. and plant toxicity is 25 mg/l.

SECTION XIII. REGULATORY INFORMATION

NOTICE: The information herein is presented in good faith and believed to be accurate. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another. It is the buyer's responsibility to ensure that its activities comply with Federal, State, and local laws.

SARA 313 Information; This product contains the following substance subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372: COPPER COMPOUND > 1.0%

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following category:

ACUTE HEALTH HAZARD

OSHA: This product is considered hazardous under the OSHA Hazardous Communication Standard (29 CFR 1910.1200).

TSCA: Listed on the Chemical Inventory

CERCLA Hazardous Substances: RQ is not assigned to the broad class of copper compounds.

RCRA: When discarding this material as supplied, it does not meet RCRA characteristic definition if ignitability, corrosiveness, reactivity, and is not listed in 40CFR 261.33.

This product contains Copper Sulfate and is subject to the reporting requirements of Section 13 of the Emergency Planning and Community-Right-to-Know-Act of 1986 (40CFR372).

SECTION XIV. SHIPPING INFORMATION

DOT Shipping Name RQ, Environmentally Hazardous Substance, Solid, NOS, (CUPRIC SULFATE), 9, UN3077, PGIII, ERG 171

Reportable Quantity (RQ): 10 pounds (4.54 kg)

Not hazardous when shipping less than 10 pounds

Note: Marine pollutant

SECTION XV. MISCELLANEOUS INFORMATION

This is an NSF Certified Product to ANSI/NSF 60. Maximum use in potable water is not to exceed 2 mg. per liter.

SECTION XVI. MSDS PREPARATION INFORMATION

Prepared By: Joel L. Goldschmidt
Vice President



MATERIAL SAFETY DATASHEET
BULLETIN DE SÉCURITÉ DU PRODUIT

IN CASE OF EMERGENCY / EN CAS D'URGENCE: SARNIA (519)339-3711 - FORT SASKATCHEWAN (780)998-8282 - VARENNES (450)652-1000

PREPARATION INFORMATION / RENSEIGNEMENTS SUR LA PRÉPARATION:

Prepared for use in Canada by: / Pour utilisation au Canada, préparé par:
EH&S Product Regulatory Management Department
Dow Chemical Canada Inc. P.O. Box 1012, Sarnia, Ontario N7T 7K7 (800) 363-3500 EXT.2241

M A T E R I A L S A F E T Y D A T A S H E E T

1. CHEMICAL PRODUCT & COMPANY IDENTIFICATION

Page: 1

IN CASE OF EMERGENCY: Fort Saskatchewan, Alberta: (780) 998-8282
Sarnia, Ontario: (519) 339-3711
Varenes, Quebec: (450) 652-1000

Product: DOWFROTH* 250 FLOTATION FROTHER

Product Code: 23586

Effective Date: 01/15/99 Date Printed: 07/17/00 MSD: 002010

Dow Chemical Canada Inc.
P.O. Box 1012, Sarnia, Ontario N7T 7K7

Prepared for use in Canada by the EH&S Product Regulatory
Management Department; Phone: (800) 363-3500 EXT. 2241

2. COMPOSITION/INFORMATION ON INGREDIENTS

Propylene oxide methanol adduct	CAS# 037286-64-9	99%
Potassium hydroxide	CAS# 001310-58-3	1%

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

*
* Yellow to dark brown liquid. Low odor. Causes eye burns.
*

POTENTIAL HEALTH EFFECTS (See Section 11 for toxicological data.)

(Continued on page 2)

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

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EYE: Due to the pH of the material, it is assumed that exposure may cause severe irritation with corneal injury which may result in permanent impairment of vision, even blindness.

SKIN: Short single exposure not likely to cause significant skin irritation. Prolonged or repeated exposure may cause moderate skin irritation. May cause more severe response if confined to skin or skin is abraded (scratched or cut). Prolonged or repeated exposure to very large amounts of component(s) in this mixture may cause narcosis (drowsiness).

INGESTION: Single dose oral toxicity is considered to be low. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; swallowing amounts larger than that may cause injury. Observations in animals include tremors and convulsions.

INHALATION: At room temperature, vapors are minimal due to physical properties; a single exposure is not likely to be hazardous. If material is heated or mist is produced, concentrations may be attained that are sufficient to cause respiratory irritation and other effects. Signs and symptoms of excessive exposure may be anesthetic or narcotic effects.

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: Signs and symptoms of excessive exposure may be anesthetic or narcotic effects.

TERATOLOGY (BIRTH DEFECTS): Contains component(s) which did not cause birth defects in laboratory animals.

4. FIRST AID

(Continued on page 3)

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EYE: Wash eyes immediately and continuously for 30 minutes. Seek medical attention immediately. Wash eyes enroute if possible.

SKIN: Wash off in flowing water or shower.

INGESTION: If swallowed, seek medical attention. Do not induce vomiting unless directed to do so by medical personnel.

INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, oxygen should be administered by qualified personnel. Call a physician or transport to a medical facility.

NOTE TO PHYSICIAN: Eye irrigation may be necessary for an extended period of time to remove as much caustic as possible. Duration of irrigation and treatment is at the discretion of medical personnel. No specific antidote. Supportive care. Treatment based on judgment of the physician in response to reactions of the patient.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT: 300F, 149C

METHOD USED: Setaflash

AUTOIGNITION TEMPERATURE: Not determined.

FLAMMABILITY LIMITS

LFL: Not determined.

UFL: Not determined.

(Continued on page 4)

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HAZARDOUS COMBUSTION PRODUCTS: Under fire conditions polymers decompose. The smoke may contain polymer fragments of varying compositions in addition to unidentified toxic and/or irritating compounds. Hazardous combustion products may include and are not limited to: carbon monoxide and carbon dioxide.

OTHER FLAMMABILITY INFORMATION: Violent steam generation or eruption may occur upon application of direct water stream to hot liquids. Spills of these organic liquids on hot fibrous insulations may lead to lowering of the autoignition temperatures possibly resulting in spontaneous combustion.

EXTINGUISHING MEDIA: Water fog or fine spray, carbon dioxide, dry chemical, foam. Alcohol resistant foams (ATC type) are preferred if available. General purpose synthetic foams (including AFFF) or protein foams may function, but much less effectively. Do not use direct water stream. Will spread fire.

MEDIA TO BE AVOIDED: Do not use direct water stream.

FIRE FIGHTING INSTRUCTIONS: Keep people away. Isolate fire area and deny unnecessary entry. Burning liquids may be moved by flushing with water to protect personnel and minimize property damage. Burning liquids may be extinguished by dilution with water. Do not use direct water stream. May spread fire.

PROTECTIVE EQUIPMENT FOR FIRE FIGHTERS: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, pants, boots, and gloves). If protective equipment is not available or not used, fight fire from a protected location or safe distance.

6. ACCIDENTAL RELEASE MEASURES (See Section 15 for Regulatory Information)

(Continued on page 5)

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PROTECT PEOPLE: Clear non-emergency personnel from area.

PROTECT THE ENVIRONMENT: Contain liquid to prevent contamination of soil, surface water or ground water.

CLEANUP: Soak up with suitable, non-reactive absorbent material. Collect into suitable containers for disposal.

7. HANDLING AND STORAGE

HANDLING: Avoid contact with vapors from head space of containers.

STORAGE: To avoid uncontrolled emissions vent vapor from container to storage tank.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guideline.

PERSONAL PROTECTIVE EQUIPMENT

EYE/FACE PROTECTION: Use chemical goggles. Eye wash fountain should be located in immediate work area.

SKIN PROTECTION: When prolonged or frequently repeated contact could occur, use protective clothing impervious to this material. Selection of specific items such as faceshield,

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gloves, boots, apron, or full-body suit will depend on operation. If hands are cut or scratched, use gloves impervious to this material even for brief exposures.

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guideline. For most conditions, no respiratory protection should be needed; however, if material is heated or sprayed, use an approved air-purifying respirator.

EXPOSURE GUIDELINE(S): Dipropylene glycol methyl ether: ACGIH TLV and OSHA PEL are 100 ppm TWA, 150 ppm STEL.

Potassium hydroxide: ACGIH TLV and OSHA PEL are 2 mg/m³ Ceiling.

PELs are in accord with those recommended by OSHA, as in the 1989 revision of PELs.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Yellow to dark brown liquid.
ODOR: Not available.
VAPOR PRESSURE: <0.01 mmHg @ 20C
VAPOR DENSITY: Low
BOILING POINT: 473F, 245C
SOLUBILITY IN WATER: Completely miscible.
SPECIFIC GRAVITY: 0.98 25/25

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable under recommended storage conditions.
See Storage Section.

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CONDITIONS TO AVOID: None known.

INCOMPATIBILITY WITH OTHER MATERIALS: Avoid contact with
oxidizing materials.

HAZARDOUS DECOMPOSITION PRODUCTS: None known.

HAZARDOUS POLYMERIZATION: Will not occur.

11. TOXICOLOGICAL INFORMATION (See Section 3 for Potential Health Effects. For detailed toxicological data, write or call the address or non-emergency number shown in Section 1)

SKIN: The dermal LD50 has not been determined.

INGESTION: The oral LD50 for rats is between 1260 - 2520 mg/kg.

MUTAGENICITY: In vitro mutagenicity studies were negative for component(s) tested.

12. ECOLOGICAL INFORMATION (For detailed Ecological data, write or call the address or non-emergency number shown in Section 1)

ENVIRONMENTAL FATE

MOVEMENT & PARTITIONING: Log octanol/water partition coefficient (log Pow) is estimated to be low. Based largely or completely on information for similar material.

DEGRADATION & PERSISTENCE: 20-Day biochemical oxygen demand

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(BOD20) is 0.18 p/p. Biodegradation under aerobic static laboratory conditions is low (BOD20 or BOD28/ThOD between 2.5 and 10%)

ECOTOXICITY: Acute LC50 for fathead minnow (*Pimephales promelas*) is > 100 mg/L. Material is practically non-toxic to fish on an acute basis (LC50 greater than 100 mg/L).

13. DISPOSAL CONSIDERATIONS (See Section 15 for Regulatory Information)

DISPOSAL: DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. All disposal methods must be in compliance with all Federal, State/Provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator. THE DOW CHEMICAL COMPANY HAS NO CONTROL OVER THE MANAGEMENT PRACTICES OR MANUFACTURING PROCESSES OF PARTIES HANDLING OR USING THIS MATERIAL. THE INFORMATION PRESENTED HERE PERTAINS ONLY TO THE PRODUCT AS SHIPPED IN ITS INTENDED CONDITION AS DESCRIBED IN MSDS SECTION 2 (Composition/Information On Ingredients).

FOR UNUSED & UNCONTAMINATED PRODUCT, the preferred options include sending to a licensed, permitted: recycler, reclaimer, incinerator or other thermal destruction device.

As a service to its customers, Dow can provide names of information resources to help identify waste management companies and other facilities which recycle, reprocess or manage chemicals or plastics, and that manage used drums. Telephone Dow's Customer Information Center at 800-258-2436 or 517-832-1556 for further details.

14. TRANSPORT INFORMATION

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DEPARTMENT OF TRANSPORTATION (D.O.T.): For DOT regulatory information, if required, consult transportation regulations, product shipping papers, or your Dow representative.

CANADIAN TDG INFORMATION: For TDG regulatory information, if required, consult transportation regulations, product shipping papers, or your Dow representative.

15. REGULATORY INFORMATION (Not meant to be all-inclusive--selected regulations represented)

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations. See other sections for health and safety information.

CANADIAN REGULATIONS

=====

WHMIS INFORMATION: The Canadian Workplace Hazardous Materials Information System (WHMIS) Classification for this product is:

E - corrosive to metal or skin
 Refer elsewhere in the MSDS for specific warnings and safe handling information. Refer to the employer's workplace education program.

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REGULATORY INFORMATION (CONTINUED)

- - - - -
CPR STATEMENT: This product has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

- - - - -
HAZARDOUS PRODUCTS ACT INFORMATION: This product contains the following ingredients which are Controlled Products and/or on the Ingredient Disclosure List (Canadian HPA section 13 and 14):

COMPONENTS:	CAS #	AMOUNT(%w/w)
Polypropylene glycol methyl ether	CAS# 037286-64-9	98%
Potassium hydroxide	CAS# 001310-58-3	1%

U.S. REGULATIONS

=====

SARA 313 INFORMATION: To the best of our knowledge, this product contains no chemical subject to SARA Title III Section 313 supplier notification requirements.

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard
A delayed health hazard

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REGULATORY INFORMATION (CONTINUED)

TOXIC SUBSTANCES CONTROL ACT (TSCA):

All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

STATE RIGHT-TO-KNOW: The following product components are cited on certain state lists as mentioned. Non-listed components may be shown in the composition section of the MSDS.

CHEMICAL NAME	CAS NUMBER	LIST
POTASSIUM HYDROXIDE	001310-58-3	NJ1 NJ3 PA1 PA3
DIPROPYLENE GLYCOL METHYL ETHER	034590-94-8	NJ3 PA1

NJ1=New Jersey Special Health Hazard Substance (present at greater than or equal to 0.1%).

NJ3=New Jersey Workplace Hazardous Substance (present at greater than or equal to 1.0%).

PA1=Pennsylvania Hazardous Substance (present at greater than or equal to 1.0%).

PA3=Pennsylvania Environmental Hazardous Substance (present at greater than or equal to 1.0%).

STATE RIGHT-TO-KNOW: This product is not known to contain any

(Continued on page 12)

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REGULATORY INFORMATION (CONTINUED)

substances subject to the disclosure requirements of

New Jersey
Pennsylvania

OSHA HAZARD COMMUNICATION STANDARD:

This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

16. OTHER INFORMATION

MSDS STATUS: Revised Sections 3, 4, 8, 11, 12, 13, 15.
Canadian regulatory information revised.

(R) Indicates a Trademark of The Dow Chemical Company
The Information Herein Is Given In Good Faith, But No Warranty,
Express Or Implied, Is Made. Consult The Dow Chemical Company
For Further Information.

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades

MSDS No. 9950

EMERGENCY OVERVIEW

DANGER!

**EXTREMELY FLAMMABLE - EYE AND MUCOUS MEMBRANE IRRITANT
- EFFECTS CENTRAL NERVOUS SYSTEM - HARMFUL OR FATAL IF
SWALLOWED - ASPIRATION HAZARD**



NFPA 704 (Section 16)

High fire hazard. Keep away from heat, spark, open flame, and other ignition sources.

If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs). Contact may cause eye, skin and mucous membrane irritation. Harmful if absorbed through the skin. Avoid prolonged breathing of vapors or mists. Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headache, intoxication), and respiratory system effects.

Long-term exposure may cause effects to specific organs, such as to the liver, kidneys, blood, nervous system, and skin. Contains benzene, which can cause blood disease, including anemia and leukemia.

1. CHEMICAL PRODUCT and COMPANY INFORMATION (rev. Jan-04)

Amerada Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs):
COMPANY CONTACT (business hours):
MSDS Internet Website

CHEMTREC (800)424-9300
Corporate Safety (732)750-6000
www.hess.com/about/envIRON.html

SYNONYMS: Hess Conventional (Oxygenated and Non-oxygenated) Gasoline; Reformulated Gasoline (RFG); Reformulated Gasoline Blendstock for Oxygenate Blending (RBOB); Unleaded Motor or Automotive Gasoline

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and INFORMATION ON INGREDIENTS * (rev. Jan-04)

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Gasoline (86290-81-5)	100
Benzene (71-43-2)	0.1 - 4.9 (0.1 - 1.3 reformulated gasoline)
n-Butane (106-97-8)	< 10
Ethyl Alcohol (Ethanol) (64-17-5)	0 - 10
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Tertiary-amyl methyl ether (TAME) (994-05-8)	0 to 17.2
Toluene (108-88-3)	1 - 25
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 - 15

A complex blend of petroleum-derived normal and branched-chain alkane, cycloalkane, alkene, and aromatic hydrocarbons. May contain antioxidant and multifunctional additives. Non-oxygenated Conventional Gasoline and RBOB do not have oxygenates (Ethanol or MTBE and/or TAME). Oxygenated Conventional and Reformulated Gasoline will have oxygenates for octane enhancement or as legally required.

AMERADAHESSE CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades

MSDS No. 9950

3. HAZARDS IDENTIFICATION (rev. Dec-97)

EYES

Moderate irritant. Contact with liquid or vapor may cause irritation.

SKIN

Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

INGESTION

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

INHALATION

Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY

Contains benzene, a regulated human carcinogen. Benzene has the potential to cause anemia and other blood diseases, including leukemia, after repeated and prolonged exposure. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with systemic toxicity. See also Section 11 - Toxicological Information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash). Chronic respiratory disease, liver or kidney dysfunction, or pre-existing central nervous system disorders may be aggravated by exposure.

4. FIRST AID MEASURES (rev. Dec-97)

EYES

In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION

Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

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Gasoline, All Grades

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5. FIRE FIGHTING MEASURES (rev. Dec-97)

FLAMMABLE PROPERTIES:

FLASH POINT: -45 °F (-43°C)
AUTOIGNITION TEMPERATURE: highly variable; > 530 °F (>280 °C)
OSHA/NFPA FLAMMABILITY CLASS: 1A (flammable liquid)
LOWER EXPLOSIVE LIMIT (%): 1.4%
UPPER EXPLOSIVE LIMIT (%): 7.6%

FIRE AND EXPLOSION HAZARDS

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO₂, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

During certain times of the year and/or in certain geographical locations, gasoline may contain MTBE and/or TAME. Firefighting foam suitable for polar solvents is recommended for fuel with greater than 10% oxygenate concentration - refer to NFPA 11 "Low Expansion Foam - 1994 Edition."

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES (rev. Dec-97)

ACTIVATE FACILITY SPILL CONTINGENCY or EMERGENCY PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product

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vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE (rev. Dec-97)

HANDLING PRECAUTIONS

*****USE ONLY AS A MOTOR FUEL*****

*****DO NOT SIPHON BY MOUTH*****

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION (rev. Jan-04)

EXPOSURE LIMITS

Component (CAS No.)	Source	TWA (ppm)	STEL (ppm)	Exposure Limits	Note
Gasoline (86290-81-5)	ACGIH	300	500	A3	
Benzene (71-43-2)	OSHA	1	5	Carcinogen	
	ACGIH	0.5	2.5	A1, skin	
	USCG	1	5		
n-Butane (106-97-8)	ACGIH	800	--	2003 NOIC: 1000 ppm (TWA) Aliphatic Hydrocarbon Gases Alkane (C1-C4)	
Ethyl Alcohol (ethanol) (64-17-5)	OSHA	1000	--		
	ACGIH	1000	--	A4	
Ethyl benzene (100-41-4)	OSHA	100	--		
	ACGIH	100	125	A3	

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Component (CAS No.)	Source	TWA (ppm)	STEL (ppm)	Exposure Limits	Note
n-Hexane (110-54-3)	OSHA	500	--		
	ACGIH	50	--	skin	
Methyl-tertiary butyl ether [MTBE] (1634-04-4)	ACGIH	50		A3	
Tertiary-amyl methyl ether [TAME] (994-05-8)				None established	
Toluene (108-88-3)	OSHA	200		Ceiling: 300 ppm; Peak: 500 ppm (10 min.)	
	ACGIH	50	--	A4 (skin)	
1,2,4-Trimethylbenzene (95-63-6)	ACGIH	25	--		
Xylene, mixed isomers (1330-20-7)	OSHA	100	--		
	ACGIH	100	150	A4	

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile or neoprene are recommended. Chemical protective clothing such as that made of of E.I. DuPont Tychem®, products or equivalent is recommended based on degree of exposure.

Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION

A NIOSH-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection and limitations.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES (rev. Jan-04)

APPEARANCE

A translucent, straw-colored or light yellow liquid

ODOR

A strong, characteristic aromatic hydrocarbon odor. Oxygenated gasoline with MTBE and/or TAME may have a sweet, ether-like odor and is detectable at a lower concentration than non-oxygenated gasoline.

ODOR THRESHOLD

	<u>Odor Detection</u>	<u>Odor Recognition</u>
Non-oxygenated gasoline:	0.5 - 0.6 ppm	0.8 - 1.1 ppm
Gasoline with 15% MTBE:	0.2 - 0.3 ppm	0.4 - 0.7 ppm
Gasoline with 15% TAME:	0.1 ppm	0.2 ppm

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	85 to 437 °F (39 to 200 °C)
VAPOR PRESSURE:	6.4 - 15 RVP @ 100 °F (38 °C) (275-475 mm Hg @ 68 °F (20 °C)
VAPOR DENSITY (air = 1):	AP 3 to 4
SPECIFIC GRAVITY (H ₂ O = 1):	0.70 - 0.78
EVAPORATION RATE:	10-11 (n-butyl acetate = 1)
PERCENT VOLATILES:	100 %

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SOLUBILITY (H₂O):

Non-oxygenated gasoline - negligible (< 0.1% @ 77 °F). Gasoline with 15% MTBE - slight (0.1 - 3% @ 77 °F); ethanol is readily soluble in water

10. STABILITY and REACTIVITY (rev. Dec-94)

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources

INCOMPATIBLE MATERIALS

Keep away from strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

11. TOXICOLOGICAL PROPERTIES (rev. Dec-97)

ACUTE TOXICITY

Acute Dermal LD50 (rabbits): > 5 ml/kg

Acute Oral LD50 (rat): 18.75 ml/kg

Primary dermal irritation (rabbits): slightly irritating

Draize eye irritation (rabbits): non-irritating

Guinea pig sensitization: negative

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenicity: OSHA: NO IARC: YES - 2B NTP: NO ACGIH: YES (A3)

IARC has determined that gasoline and gasoline exhaust are possibly carcinogenic in humans. Inhalation exposure to completely vaporized unleaded gasoline caused kidney cancers in male rats and liver tumors in female mice. The U.S. EPA has determined that the male kidney tumors are species-specific and are irrelevant for human health risk assessment. The significance of the tumors seen in female mice is not known. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with effects to the central and peripheral nervous systems, liver, and kidneys. The significance of these animal models to predict similar human response to gasoline is uncertain.

This product contains benzene. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

This product may contain methyl tertiary butyl ether (MTBE): animal and human health effects studies indicate that MTBE may cause eye, skin, and respiratory tract irritation, central nervous system depression and neurotoxicity. MTBE is classified as an animal carcinogen (A3) by the ACGIH.

12. ECOLOGICAL INFORMATION (rev. Jan-04)

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations. If released, oxygenates such as ethers and alcohols will be expected to exhibit fairly high mobility in soil, and therefore may leach into groundwater. The API (www.api.org) provides a number of useful references addressing petroleum and oxygenate contamination of groundwater.

13. DISPOSAL CONSIDERATIONS (rev. Dec-97)

Consult federal, state and local waste regulations to determine appropriate disposal options.

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14. TRANSPORTATION INFORMATION (rev. Jan-04)

DOT PROPER SHIPPING NAME: Gasoline
 DOT HAZARD CLASS and PACKING GROUP: 3, PG II
 DOT IDENTIFICATION NUMBER: UN 1203
 DOT SHIPPING LABEL: FLAMMABLE LIQUID

PLACARD:



15. REGULATORY INFORMATION (rev. Jan-04)

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other federal, state, or local regulations; consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow-up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a "petroleum exclusion" clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

<u>ACUTE HEALTH</u>	<u>CHRONIC HEALTH</u>	<u>FIRE</u>	<u>SUDDEN RELEASE OF PRESSURE</u>	<u>REACTIVE</u>
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION WT. PERCENT
Benzene (71-43-2)	0.1 to 4.9 (0.1 to 1.3 for reformulated gasoline)
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Toluene (108-88-3)	1 to 15
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 to 15

US EPA guidance documents (www.epa.gov/tri) for reporting Persistent Bioaccumulating Toxics (PBTs) indicate this product may contain the following deminimis levels of toxic chemicals subject to Section 313 reporting:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION - Parts per million (ppm) by weight
Polycyclic aromatic compounds (PACs)	17
Benzo (g,h,i) perylene (191-24-2)	2.55
Lead (7439-92-1)	0.079

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CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 2 (Flammable Liquid)

Class D, Division 2A (Very toxic by other means) and Class D, Division 2B (Toxic by other means)

16. OTHER INFORMATION (rev. Jan-04)

NFPA® HAZARD RATING

HEALTH:	1	Slight
FIRE:	3	Serious
REACTIVITY:	0	Minimal

HMIS® HAZARD RATING

HEALTH:	1 *	Slight
FIRE:	3	Serious
REACTIVITY:	0	Minimal

* CHRONIC

SUPERSEDES MSDS DATED: 12/30/97

ABBREVIATIONS:

AP = Approximately < = Less than > = Greater than
 N/A = Not Applicable N/D = Not Determined ppm = parts per million

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists	NTP	National Toxicology Program
AIHA	American Industrial Hygiene Association	OPA	Oil Pollution Act of 1990
ANSI	American National Standards Institute (212)642-4900	OSHA	U.S. Occupational Safety & Health Administration
API	American Petroleum Institute (202)682-8000	PEL	Permissible Exposure Limit (OSHA)
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act	RCRA	Resource Conservation and Recovery Act
DOT	U.S. Department of Transportation [General Info: (800)467-4922]	REL	Recommended Exposure Limit (NIOSH)
EPA	U.S. Environmental Protection Agency	SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
HMIS	Hazardous Materials Information System	SCBA	Self-Contained Breathing Apparatus
IARC	International Agency For Research On Cancer	SPCC	Spill Prevention, Control, and Countermeasures
MSHA	Mine Safety and Health Administration	STEL	Short-Term Exposure Limit (generally 15 minutes)
NFPA	National Fire Protection Association (617)770-3000	TLV	Threshold Limit Value (ACGIH)
NIOSH	National Institute of Occupational Safety and Health	TSCA	Toxic Substances Control Act
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)	TWA	Time Weighted Average (8 hr.)
		WEEL	Workplace Environmental Exposure Level (AIHA)
		WHMIS	Workplace Hazardous Materials Information System (Canada)

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

Material Safety Data Sheet



First choice when
quality counts.

308166

Rev. D
Updated: 5/02



This Data Sheet contains important
information.
READ AND KEEP FOR REFERENCE.

INSTRUCTIONS

IMPORTANT: Read this MSDS before handling or disposing of this product and pass this information on to employees, customers and users of this product.

Emergency Overview

Physical State Liquid.
Color Clear to light amber. **Odor** Mild petroleum odor

WARNING!

Oil injected into the skin from high-pressure leaks in hydraulic systems can cause severe injury.

Most damage occurs during the first few hours.

Seek medical attention immediately.

Surgical removal of oil may be necessary.

Spills may create a slipping hazard.

Hazard Rankings

	HMIS	NFPA
Health Hazard	1	0
Fire Hazard	1	1
Reactivity	0	0

* = Chronic Health Hazard

Protective Equipment

Minimum Requirements
See Section 8 for Details



1.0 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Hydraulic Fluid

Chemical Name: Industrial Oils

Graco Inc.

P.O. Box 1441

60 11th Ave. NE

Minneapolis, MN 55440-1441

Part Number(s): 218-797

Use: Hydraulic Fluid used in PT2500 electric driver hydraulic pump.

Emergency Information

Health Emergency (RMPC): (303)- 623-5716

Chemical Spills (Chemtrec): (800)- 424-9300

2.0 COMPOSITION / INFORMATION ON INGREDIENTS

Component %	CAS#	% by Weight
1)Distillates, petroleum, solvent-refined light paraffinic	64741-89-5	30 – 50
2)Distillates, petroleum, solvent-refined heavy paraffinic	64741-89-5	40 – 60
3) Proprietary Ingredients	Proprietary Mixture	0 – 2
4) Zinc alkyldithiophosphate	68649-42-3	0 - 1

For exposure data, see **8.0, Exposure Controls / Personal Protection.**

3.0 HAZARDS IDENTIFICATION

Emergency Overview: **Physical State:** Liquid **Odor:** Mild petroleum odor **Color:** Clear to light amber

Potential Health Effects:

Eye Contact	This product can cause transient mild eye irritation with short-term contact with liquid sprays or mists
Skin Contact	This material can cause mild skin irritation from prolonged or repeated skin contact. Injection under the skin can cause inflammation, swelling and mild central nervous system depression. Injection of pressurized hydrocarbons can cause severe, permanent tissue damage. Initial symptoms may be minor. Injection of petroleum hydrocarbons requires immediate medical attention.
Inhalation	At elevated temperatures or in enclosed spaces, product mist or vapors may irritate the mucous membranes of the nose, the throat, bronchi, and lungs
Ingestion	If swallowed, large volumes of material can cause generalized depression, headache, drowsiness, nausea, vomiting and diarrhea. Smaller doses can cause a laxative effect. If aspirated into the lungs, liquid can cause lung damage.
Chronic Health Effects Summary	Contains a petroleum-based mineral oil. Prolonged or repeated skin contact can cause mild irritation and inflammation characterized by drying, cracking, (dermatitis) or oil acne. Repeated or prolonged inhalation of petroleum-based mineral oil mists at concentrations above applicable workplace exposure levels can cause respiratory irritation or other pulmonary effects.
Conditions Aggravated by Exposure	Medical conditions aggravated by exposure to this material may include pre-existing skin disorders.
Target Organs	This material may cause damage to the following organs: skin.
Carcinogenic Potential	This product does not contain any components at concentrations above 0.1% which are considered carcinogenic by OSHA, IARC or NTP.

OSHA Hazard Classification is indicated by an "X" in the box adjacent to the hazard title. If no "X" is present, the product does not exhibit the hazard as defined in the OSHA Hazard Communication Standard (29 CFR 1910.1200).

OSHA Health Hazard Classification				OSHA Physical Hazard Classification					
Irritant	☐	Toxic	☐	Combustible	☐	Explosive	☐	Pyrophoric	☐
Sensitizer	☐	Highly Toxic	☐	Flammable	☐	Oxidizer	☐	Water-reactive	☐
Corrosive	☐	Carcinogenic	☐	Compressed Gas	☐	Organic Peroxide	☐	Unstable	☐

4.0 FIRST AID MEASURES

Take proper precautions to ensure your own health and safety before attempting rescue or providing first aid. For more specific information, refer to Exposure Controls and Personal Protection in Section 8 of this MSDS.

Eye	Check for and remove contact lenses. Flush eyes with cool, clean, low-pressure water while occasionally lifting and lowering eyelids. Seek medical attention if excessive tearing, redness, or pain persists.
Skin	Remove contaminated shoes and clothing. Wipe off excess material. Wash exposed skin with mild soap and water. Seek medical attention if tissue appears damaged or if pain or irritation persists. Thoroughly clean contaminated clothing before reuse. Discard contaminated leather goods. If material is injected under the skin, seek medical attention immediately.
Inhalation	Move victim to fresh air. If victim is not breathing, immediately begin rescue breathing. If breathing is difficult, 100 percent humidified oxygen should be administered by a qualified individual. Seek medical attention immediately. Keep the affected individual warm and at rest.
Ingestion	Do not induce vomiting unless directed to by a physician. Do not give anything to drink unless directed to by a physician. Never give anything by mouth to a person who is not fully conscious. Seek medical attention immediately.
Notes to Physician	In the event of injection in underlying tissue, immediate treatment should include extensive incision, debridement and saline irrigation. Inadequate treatment can result in ischemia and gangrene. Early symptoms may be minimal.

. **NOTES:** NA = Not Applicable;

NE = Not Established;

UN = Unavailable

5.0 FIREFIGHTING MEASURES

Flashpoint	OPEN CUP: 212°C (414°F) (Cleveland.).
UFL	No Data
LFL	No Data
Autoignition Temperature	Not Available
Flammability Classification	NFPA Class-IIIB combustible material. Slightly combustible!
Extinguishing Media	Use dry chemical, foam, Carbon Dioxide or water fog
Special Properties	This material can burn but will not readily ignite. This material will release vapors when heated above the flash point temperature that can ignite when exposed to a source of ignition. In enclosed spaces, heated vapor can ignite with explosive force. Mists or sprays may burn at temperatures below the flash point.
Firefighting Equipment	Firefighters must use full bunker gear including NIOSH-approved positive pressure self-contained breathing apparatus to protect against potential hazardous combustion or decomposition products and oxygen deficiencies.
Hazardous Combustion Products	Carbon dioxide, carbon monoxide, smoke, fumes, unburned hydrocarbons and trace oxides of sulfur, phosphorus, zinc and/or nitrogen.

6.0 ACCIDENTAL RELEASE MEASURES

Take proper precautions to ensure your own health and safety before attempting spill control or clean-up. For more specific information, refer to the Emergency Overview on Page 1, Exposure Controls and Personal Protection in Section 8 and Disposal Considerations in Section 13 of this MSDS.

Do not touch damaged containers or spilled material unless wearing appropriate protective equipment. Slipping hazard; do not walk through spilled material. Stop leak if you can do so without risk. For small spills, absorb or cover with dry earth, sand, or other inert non-combustible absorbent material and place into waste containers for later disposal. Contain large spills to maximize product recovery or disposal. Prevent entry into waterways or sewers. In urban area, cleanup spill as soon as possible. In natural environments, seek cleanup advice from specialists to minimize physical habitat damage. This material will float on water. Absorbent pads and similar materials can be used. Comply with all laws and regulations.

7.0 HANDLING AND STORAGE

Handling	Avoid water contamination and extreme temperatures to minimize product degradation. Empty containers may contain product residues that can ignite with explosive force. Do not pressurize, cut, weld, braze solder, drill, grind or expose containers to flames, sparks, heat or other potential ignition sources. Consult appropriate federal, state and local authorities before reusing, reconditioning, reclaiming, recycling or disposing of empty containers and/or waste residues of this product
Storage	Keep container closed. Do not store with strong oxidizing agents. Do not store at temperatures above 120° F or in direct sunlight for extended periods of time. Consult appropriate federal, state and local authorities before reusing, reconditioning, reclaiming, recycling or disposing of empty containers or waste residues of this product.

8.0 EXPOSURE CONTROLS / PERSONAL PROTECTION

Eye	Safety glasses equipped with side shields should be adequate protection under most conditions of use. Wear goggles and/or face shield if splashing or spraying is anticipated. Wear goggles and face shield if material is heated above 125°F (51°C). Have suitable eye wash water available	
Personal Protective Equipment	Personal protective equipment should be selected based upon the conditions under which this material is used. A hazard assessment of the work area for PPE requirements should be conducted by a qualified professional pursuant to OSHA regulations. The following pictograms represent the minimum requirements for personal protective equipment. For certain operations, additional PPE may be required. 	
Hand Protection	Use gloves constructed of chemical resistant materials such as neoprene or heavy nitrile rubber if frequent or prolonged contact is expected. Use heat-protective gloves when handling product at elevated temperatures.	
Body Protection	Use clean and impervious protective clothing (e.g., neoprene or Tyvek ®) if splashing or spraying conditions are present. Protective clothing may include long-sleeve outer garment, apron, or lab coat. If significant contact occurs, remove oil-contaminated clothing as soon as possible and promptly shower. Launder contaminated before reuse or discard. Wear heat protective boots and protective clothing when handling material at elevated temperatures	
Engineering Controls	Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of mists and/or vapors below the recommended exposure limits (see below). An eye wash station and safety shower should be located near the work-station	
Respiratory Protection	Vaporization is not expected at ambient temperatures. Therefore, the need for respiratory protection is not anticipated under normal use conditions and with adequate ventilation. If elevated airborne concentrations above applicable workplace exposure levels are anticipated, a NIOSH-approved organic vapor respirator equipped with a dust/mist prefilter should be used. Protection factors vary depending upon the type of respirator used. Respirators should be used in accordance with OSHA requirements (29 CFR 1910.134).	
General Comments	Use good personal hygiene practices. Wash hands and other exposed skin areas with plenty of mild soap and water before eating, drinking, smoking, use of toilet facilities, or leaving work. DO NOT use gasoline, kerosene, solvents or harsh abrasives as skin cleaners. Since specific exposure standards/control limits have not been established for this product, the "Oil Mist, Mineral" exposure limits shown below are suggested as minimum control guidelines.	
Occupational Exposure Guidelines	Substance 1) Oil Mist, Mineral	Applicable Workplace Exposure Levels ACGIH (United States). TWA: 5 mg/m ³ STEL: 10 mg/m ³ OSHA (United States). TWA: 5 mg/m ³

9.0 CHEMICAL AND PHYSICAL PROPERTIES

Appearance and Odor	Mild petroleum odor
pH	Not Applicable
Vapor Pressure (mm Hg)	<0.001 kPa (<0.01 mmHg) (at 20°C)
Vapor Density (Air = 1)	>1 (Air = 1)
Boiling Point	Not available
Melting Point	Not available
Solubility in Water	Insoluble in cold water.
Specific Gravity (Water = 1)	0.87 (Water = 1)
Physical State	Liquid
Color	Clear to light amber
Viscosity (cST @ 40°C)	33
Volatile Characteristics	Negligible volatility
Additional Properties	Gravity, °API (ASTM D287) = 31.3 @ 60° F Density = 7.42 Lbs/gal. Viscosity (ASTM D2161) = 170 SUS @ 100° F

10.0 STABILITY AND REACTIVITY

Stability	Stable.
Conditions to Avoid	Keep away from extreme heat, sparks, open flame, and strongly oxidizing conditions.
Materials to Avoid	Strong oxidizers.
Hazardous Decomposition	No additional hazardous decomposition products were identified other than the combustion products identified in Section 5 of this MSDS
Hazardous Polymerization	Not expected to occur

11.0 TOXICOLOGICAL INFORMATION

For other health-related information, refer to the Emergency Overview on Page 1 of the Hazards Identification in Section 3 of this MSDS.

Distillates, petroleum, solvent-refined light paraffinic:

ORAL (LD50): Acute: >5000 mg/kg [Rat].

DERMAL (LD50): Acute: >2000 mg/kg [Rabbit].

Distillates, petroleum, solvent-refined heavy paraffinic:

ORAL (LD50): Acute: >5000 mg/kg [Rat].

DERMAL (LD50): Acute: >2000 mg/kg [Rabbit].

Distillates, petroleum, solvent-refined light paraffinic:

Mineral oil mists derived from highly refined oils are reported to have low acute and sub-acute toxicities in animals. Effects from single and short-term repeated exposures to high concentrations of mineral oil mists well above applicable workplace exposure levels include lung inflammatory reaction, lipoid granuloma formation and lipoid pneumonia. In acute and sub-acute studies involving exposures to lower concentrations of mineral oil mists at or near current work place exposure levels produced no significant toxicological effects. In long term studies (up to two years) no carcinogenic effects have been reported in any animal species tested.

Distillates, petroleum, solvent-refined heavy paraffinic:

Mineral oil mists derived from highly refined oils are reported to have low acute and sub-acute toxicities in animals. Effects from single and short-term repeated exposures to high concentrations of mineral oil mists well above applicable workplace exposure levels include lung inflammatory reaction, lipoid granuloma formation and lipoid pneumonia. In acute and sub-acute studies involving exposures to lower concentrations of mineral oil mists at or near current work place exposure levels produced no significant toxicological effects. In long term studies (up to two years) no carcinogenic effects have been reported in any animal species tested.

Hydraulic Oils:

Repeated or prolonged skin contact with certain hydraulic oils can cause mild skin irritation characterized by drying, cracking (dermatitis) or oil acne. Injection under the skin, in muscle or into the blood stream can cause irritation, inflammation, swelling, fever, and systemic effects, including mild central nervous system depression. Injection of pressurized hydrocarbons can cause severe, permanent tissue damage.

12.0 ECOLOGICAL INFORMATION

Ecotoxicity

Analysis for ecological effects has not been conducted on this product. However, if spilled, this product and any contaminated soil or water may be harmful to human, animal, and aquatic life. Also, the coating action associated with petroleum and petroleum products can be harmful or fatal to aquatic life and waterfowl.

Environmental Fate

An environmental fate analysis has not been conducted on this specific product. Plants and animals may experience harmful or fatal effects when coated with petroleum-based products. Petroleum-based (mineral) lube oils will normally float on water. In stagnant or slow-flowing waterways, an oil layer can cover a large surface area. As a result, this oil layer might limit or eliminate natural atmospheric oxygen transport into the water. With time, if not removed, oxygen depletion in the waterway can result in a loss of marine life or create an anaerobic environment. This material contains phosphorus which is a controlled element for disposal in effluent waters in most sections of North America. Phosphorus is known to enhance the formation of algae. Severe algae growth can reduce oxygen content in the water possibly below levels necessary to support marine life.

13.0 DISPOSAL INFORMATION

Hazard characteristic and regulatory waste stream classification can change with product use. Accordingly, it is the responsibility of the user to determine the proper storage, transportation, treatment and/or disposal methodologies for spent materials and residues at the time of disposition.

Conditions of use may cause this material to become a "hazardous waste", as defined by federal or state regulations. It is the responsibility of the user to determine if the material is a "hazardous waste" at the time of disposal. Transportation, treatment, storage, and disposal of waste material must be conducted in accordance with RCRA regulations (see 40 CFR 260 through 40 CFR 271). State and/or local regulations may be more restrictive. Contact the RCRA/Superfund Hotline at (800) 424-9346 or your regional US EPA office for guidance concerning case specific disposal issues. Empty drums and pails retain residue. DO NOT pressurize, cut, weld, braze, solder, drill, grind, or expose this product's empty container to heat, flame, or other ignition sources. DO NOT attempt to clean it. Empty drums and pails should be drained completely, properly bunged or sealed, and promptly sent to a reconditioner.

14.0 TRANSPORTATION INFORMATION

U.S. Dept. of Transportation: Not a US Department of Transportation regulated material.

Hazard Class - Not regulated

Packing Group(s) – Not applicable

UN/NA ID – Not regulated

Reportable Quantity – A Reportable Quantity (RQ) has not been established for this material.

Placards



Emergency Response Guide No. Not applicable

Hazmat STCC No. – Not assigned

MARPOL III Status – Not a DOT “Marine

Pollutant” Per 49 CFR 171.8

15.0 REGULATORY INFORMATION

CERCLA Sections 102A/103 Hazardous Substances (40 CFR Part 302.4)	The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) requires notification of the National Response Center concerning release of quantities of "hazardous substances" equal to or greater than the reportable quantities (RQ's) listed in 40 CFR 302.4. As defined by CERCLA, the term "hazardous substance" does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically designated in 40 CFR 302.4. Chemical substances present in this product or refinery stream that may be subject to this statute are: Zinc and Zinc Compounds, Concentration: 0 - 1%
SARA Title III Section 302 Extremely Hazardous Substances (40 CFR Part 355)	The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires facilities subject to Subparts 302 and 304 to submit emergency planning and notification information based on Threshold Planning Quantities (TPQs) and Reportable Quantities (RQs) for "Extremely Hazardous Substances" listed in 40 CFR 302.4 and 40 CFR 355. No components were identified
SARA Title III Section 311/312 Hazardous Categorization (40 CFR Part 370)	The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires facilities subject to this subpart to submit aggregate information on chemicals by "Hazard Category" as defined in 40 CFR 370.2. This material would be classified under the following hazard categories: No SARA 311/312 hazard categories identified.
SARA Title III Sections 313 (40 CFR Part 372)	This product contains the following components in concentrations above de minimis levels that are listed as toxic chemicals in 40 CFR Part 372 pursuant to the requirements of Section 313 of SARA: No components were identified.
U.S. Inventory (TSCA)	This product and/or its components are listed on the Toxic Substances Control Act (TSCA) inventory.
CWA	This material is classified as an oil under Section 311 of the Clean Water Act (CWA) and the Oil Pollution Act of 1990 (OPA). Discharges or spills which produce a visible sheen on waters of the United States, their adjoining shorelines, or into conduits leading to surface waters must be reported to the EPA's National Response Center at (800) 424-8802.
California Proposition 65	This material may contain the following components which are known to the State of California to cause cancer, birth defects or other reproductive harm, and may be subject to the requirements of California Proposition 65 (CA Health & Safety Code Section 25249.5): Toluene: 0.001%
New Jersey Right-to-Know Label	Petroleum Oil (Hydraulic Fluid)
Additional Regulatory Remarks	No additional regulatory remarks

16.0 OTHER INFORMATION

Refer to the top of Page 1 for the HMIS and NFPA Hazard Ratings for this product.

ABBREVIATIONS

AP = Approximately, EQ = Equal, > = Greater Than, < = Less Than, NA = Not Applicable, ND = No Data, NE = Not Established

ACGIH = American Conference of Governmental Industrial Hygienists

IARC = International Agency for Research on Cancer

NIOSH = National Institute of Occupational Safety and Health

NPCA = National Paint and Coating Manufacturers Association

NFPA = National Fire Protection Association

AIHA = American Industrial Hygiene Association

NTP = National Toxicology Program

OSHA = Occupational Safety and Health Administration

HMIS = Hazardous Materials Information System

EPA = Environmental Protection Agency

Prepared By	Graco, Inc.

This Material Safety Data Sheet and the information it contains is offered to you in good faith as accurate. We have reviewed any information contained in this data sheet which we have received from sources outside our company. We believe that information to be correct, but cannot guarantee its accuracy or completeness. Health and safety precautions in this Data Sheet may not be adequate for all individuals and/or situations. It is the users' obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. No statement made in this data sheet shall be construed as a permission or recommendation for the use of any product in a manner that might infringe existing patents. No warranty is made, either express or implied.

NOTES: NA = Not Applicable; NE = Not Established; UN = Unavailable

All written and visual data contained in this document reflects the latest product information available at the time of publication.

Graco reserves the right to make changes at any time without notice.

Sales Offices: Minneapolis, Detroit,

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**MATERIAL SAFETY DATA SHEET****Hydrochloric Acid****Section 01 - Chemical And Product And Company Information**

Product Identifier Hydrochloric acid, inhibited hydrochloric acid

Product Use Acidizing (activation) of petroleum wells, scale removal, ore reduction, metal cleaning, pH adjustment, industrial acidizing, generation of chlorine dioxide, regeneration of ion exchange resins.

Supplier Name..... ClearTech Industries Inc.
2302 Hanselman Avenue
Saskatoon, SK. Canada
S7L 5Z3

Prepared By..... ClearTech Industries Inc. Technical Department
Phone: (306)664-2522

Preparation Date..... May 5, 2008

24-Hour Emergency Phone..... 306-664-2522

**Section 02 - Composition / Information on Ingredients**

Hazardous Ingredients..... Hydrochloric Acid 15-40%

CAS Number..... Hydrochloric Acid 7647-01-0

Synonym (s)..... Aqueous hydrogen chloride, muriatic acid



Section 03 - Hazard Identification

- Inhalation**..... Vapour or mist can cause irritation to nose, throat, and upper respiratory tract. Symptoms include: coughing, choking, and bleeding of the nose and gums. Severe exposure can result in pulmonary edema and corrosion of tissues in the nose and throat.
- Skin Contact / Absorption**..... Contact may produce severe irritation or corrosive skin damage, depending upon length of contact and amount of acid. Effects range from dermatitis, photo sensitization, redness, swelling, pain, permanent scarring, to death.
- Eye Contact**..... Low concentrations of vapour or mist can be irritating, causing redness. Concentrated vapour, mist or splashed liquid can cause severe irritation, burns and permanent blindness.
- Ingestion**..... Causes severe burns of the mouth, esophagus, and stomach, with consequent pain, nausea, vomiting, diarrhea, circulatory collapse, and possibly death.
- Exposure Limits**..... ACGIH/PEL= 5ppm (hydrochloric acid)

Section 04 - First Aid Measures

- Inhalation**..... Remove victim to fresh air. Give artificial respiration only if breathing has stopped. If breathing is difficult, give oxygen. Seek immediate medical attention.
- Skin Contact / Absorption**..... Remove contaminated clothing. Wash affected area with lukewarm water for 20-30 minutes. Seek medical attention immediately.
- Eye Contact**..... Flush immediately with lukewarm water for at least 20 minutes. Forcibly hold eyelids apart to ensure complete irrigation of eye tissue. Seek immediate medical attention.
- Ingestion**..... Do not induce vomiting. If vomiting occurs, lean victim forward to prevent breathing in vomitus. Rinse mouth out with water. If the victim can swallow, give 1 cup of water or milk to dilute. If vomiting occurs, rinse the mouth out and give another cup of water. Do not give anything by mouth to an unconscious or convulsing person. Seek immediate medical attention.
- Additional Information**..... Not available



Section 05 - Fire Fighting

- Conditions of Flammability**..... Non-flammable
- Means of Extinction**..... Product does not burn. Where fire is involved, use any fire fighting agent appropriate for surrounding material; use water spray to cool fire-exposed surfaces.
- Flash Point**..... Not applicable
- Auto-ignition Temperature**..... Not applicable
- Upper Flammable Limit** Not applicable
- Lower Flammable Limit**..... Not applicable
- Hazardous Combustible Products**... Hydrogen and chlorine gas formed at temperatures over 1500°C.
- Special Fire Fighting Procedures**..... Wear NIOSH-approved self-contained breathing apparatus and protective clothing.
- Explosion Hazards**..... Normally none, but when in contact with metals explosive hydrogen gas may be evolved.

Section 06 - Accidental Release Measures

- Leak / Spill**..... Wear appropriate personal protective equipment. Ventilate area. Restrict access to area until clean up is complete. Stop or reduce leak if safe to do so. Prevent material from entering sewers.
- Deactivating Materials**..... Soda ash, lime, limestone

Section 07 - Handling and Storage

- Handling Procedures**..... Use proper equipment for lifting and transporting all containers. Use sensible industrial hygiene and housekeeping practices. Wash thoroughly after handling. Avoid all situations that could lead to harmful exposure.
- Storage Requirements**..... Store in a cool, dry, well-ventilated place. Keep container tightly closed, and away from incompatible materials. Store away from incompatible materials such as oxidizing materials, reducing materials and strong bases.



Section 08 - Personal Protection and Exposure Controls

Protective Equipment

- Eyes**..... Chemical goggles, full-face shield, or a full-face respirator is to be worn at all times when product is handled. Contact lenses should not be worn; they may contribute to severe eye injury.
- Respiratory**..... At concentrations up to 50 ppm, chemical charge respirator or air-purifying respirator is recommended. Above this level, a self-contained breathing apparatus is required.
- Gloves**..... Impervious gloves of chemically resistant material (rubber or PVC) should be worn at all times. Wash contaminated clothing with soap and water, dry thoroughly before reuse.
- Clothing**..... Body suits, aprons, and/or coveralls of chemical resistant material should be worn at all times. Wash contaminated clothing with soap and water, dry thoroughly before reuse.
- Footwear**..... Impervious boots of chemically resistant material should be worn at all times.

Engineering Controls

- Ventilation Requirements**..... Mechanical ventilation (dilution or local exhaust), process or personnel enclosure and control of process conditions should be provided. Supply sufficient replacement air to make up for air removed by exhaust systems.
- Other**..... Emergency shower and eyewash should be in close proximity.

Section 09 - Physical and Chemical Properties

- Physical State**..... Liquid
- Odor and Appearance**..... Colourless or slightly yellow, fuming liquid with a pungent odour.
- Odor Threshold**..... Detectable at 1-5ppm
- Specific Gravity (Water=1)**..... 1.16-1.19 (30-35%); 1.08 (15%)
- Vapor Pressure (mm Hg, 20C)**..... 100mm Hg at 20°C (35%)
- Vapor Density (Air=1)**..... 1.268
- Evaporation Rate**..... < 1



Boiling Point..... 90°C (30%), 83°C (31%)

Freeze/Melting Point..... -35°C (35%)

pH..... < 1

Water/Oil Distribution Coefficient.... < 1

Bulk Density..... Not available

% Volatiles by Volume..... 100%

Solubility in Water..... Completely miscible

Molecular Formula..... HCl

Molecular Weight..... 36.46

Section 10 - Stability and Reactivity

Stability..... Stable, heat and contamination could cause decomposition.

Incompatibility..... Incompatible with strong bases, metals, phosphines, acetylides, borides, carbides, silicides, vinyl acetate, formaldehyde, hypochlorites, cyanides, sulphides.

Hazardous Products of Decomposition.. Contact with hypochlorites liberates chlorine gas. May react violently with incompatible substances. May release toxic and/or flammable gases such as hydrogen and phosphine gas. Considerable amounts of heat may be evolved.

Polymerization..... Will not occur.

Section 11 - Toxicological Information

Irritancy..... Severe irritant, corrosive to eyes and skin.

Sensitization..... Not available

Chronic/Acute Effects..... Prolonged exposure can cause erosion and discolouration of teeth and chronic inflammation of nose, throat, and airways. Repeated or prolonged contact to dilute solutions can cause dermatitis.

Synergistic Materials..... Not available



Animal Toxicity Data..... LC₅₀(inhalation,mouse,4 hour)= 757ppm
LD₅₀(oral,rabbit)= 900mg/kg

Carcinogenicity..... Not considered to be carcinogenic by IARC, NTP and ACGIH.

Reproductive Toxicity..... Not available

Teratogenicity..... Not available

Mutagenicity..... Not available

Section 12 - Ecological Information

Fish Toxicity..... Not available

Biodegradability..... When released into the soil, this material is not expected to biodegrade.

Environmental Effects..... Extremely toxic to aquatic life by lowering the pH below 5.5. When released into the soil, this material may leach into groundwater.

Section 13 - Disposal Consideration

Waste Disposal..... Dispose in accordance with all federal, provincial, and/or local regulations including the Canadian Environmental Protection Act.

Section 14 - Transportation Information

TDG Classification

Class..... 8

Group..... II

PIN Number..... UN1789

Other..... Secure containers (full and/or empty) with suitable hold down devices during shipment.

Section 15 - Regulatory Information

WHMIS Classification.....D1, E



NOTE: THE PRODUCT LISTED ON THIS MSDS HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE HAZARD CRITERIA OF THE CANADIAN CONTROLLED PRODUCTS REGULATIONS. THIS MSDS CONTAINS ALL INFORMATION REQUIRED BY THOSE REGULATIONS.

NSF Certification.....Product is certified under ANSI/NSF Standard 60 for scale control and pH adjustment at a maximum dosage for the following:

31% hydrochloric acid: 45mg/L

35% hydrochloric acid: 40mg/L

Section 16 - Other Information

Note: The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment. The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations.

Attention: Receiver of the chemical goods / MSDS coordinator

As part of our commitment to the Canadian Association of Chemical Distributors (CACD) Responsible Distribution® initiative, ClearTech Industries Inc. and its associated companies require, as a condition of sale, that you forward the attached Material Safety Data Sheet(s) to all affected employees, customers, and end-users. ClearTech will send any available supplementary handling, health, and safety information to you at your request.

If you have any questions or concerns please call our customer service or technical service department.

ClearTech Industries Inc. - Locations

Corporate Head Office: 2302 Hanselman Avenue, Saskatoon, SK, S7L 5Z3

Phone: 306-664-2522

Fax: 306-665-6216

www.ClearTech.ca

Location	Address	Postal Code	Phone Number	Fax Number
Richmond, B.C.	12431 Horseshoe Way	V7A 4X6	604-272-4000	604-272-4596
Calgary, AB.	5516E - 40 th St. S.E.	T2C 2A1	403-279-1096	403-236-0989
Edmonton, AB.	11750 - 180 th Street	T5S 1N7	780-452-6000	780-452-4600
Saskatoon, SK.	2302 Hanselman Avenue	S7L 5Z3	306-933-0177	306-933-3282
Regina, SK.	555 Henderson Drive	S42 5X2	306-721-7737	306-721-8611
Winnipeg, MB.	340 Saulteaux Crescent	R3J 3T2	204-987-9777	204-987-9770
Mississauga, ON.	7480 Bath Road	L4T 1L2	905-612-0566	905-612-0575

24 Hour Emergency Number - All Locations - 306-664-2522

Material Safety Data Sheet

WHMIS / ANSI Z400.1-2004 Compliant



Date / Revised: 04-17-2007

Release: 1.0

Product: MAGNAFLOC 10

1. Identification of the Substance/Preparation and of the Company/Undertaking

Company Information

Company: Ciba Canada Ltd.
2626 Argentia Road
Mississauga, Ontario L5N 5N2
Canada
Customer Service / Product Information: 1-866-679-2422

Emergency information

Emergency 24-Hour Health/Environmental Phone: +1-800-873-1138
CANUTEC: (613) 996-6666 (24hrs)

Product information

Product: MAGNAFLOC 10
Use: flocculation agent

2. Hazards Identification

Emergency overview

Signal word: CAUTION: !
Colour: off-white
Appearance: powder
State of matter: solid
Odour: odourless
Health: This product has no known adverse effect on human health.
Physical/Chemical hazards: Organic powders may be capable of generating static discharges and creating explosive mixtures in air. Handle with caution., Slip hazard when wet.

Potential health effects

Primary routes of entry:

Eyes, Skin, Inhalation, Ingestion

Chronic exposure:

Eye contact may cause slight irritation and/or redness. Repeated or prolonged exposure may cause slight skin irritation.
Inhaled dust may cause respiratory irritation.

3. Composition/Information on Ingredients

This material does not contain any hazardous components that are reportable according to WHMIS criteria.

Material Safety Data Sheet

WHMIS / ANSI Z400.1-2004 Compliant



Date / Revised: 04-17-2007

Release: 1.0

Product: MAGNAFLOC 10

4. First-aid Measures

Inhalation:

Remove to fresh air, if not breathing give artificial respiration. If breathing is difficult, give oxygen and get immediate medical attention.

Skin:

After contact with skin, wash immediately with plenty of water and soap.
Get medical attention if irritation occurs.
If clothing is contaminated, remove and launder before reuse.

Eyes:

In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

Ingestion:

Do not induce vomiting. If vomiting occurs naturally, have casualty lean forward to reduce the risk of aspiration.
Seek medical attention immediately.

5. Fire-fighting Measures

Suitable extinguishing media:

carbon dioxide, dry powder, foam

Unsuitable Extinguishing Media:

If water is used, restrict pedestrian and vehicular traffic in areas where slip hazard may exist.

Hazardous combustion products:

Carbon and nitrogen oxides.

Hazards during fire-fighting:

Standard procedure for chemical fires.
The product becomes slippery when wet. Restrict pedestrian and vehicular traffic in areas where slip hazard may exist.
Dust in sufficient concentration can result in an explosive mixture in air. Handle to minimize dusting and eliminate open flame and other sources of ignition.

Protective equipment for fire-fighting:

Wear self-contained breathing apparatus and chemical-protective clothing.

6. Accidental Release Measures

Cleanup:

Sweep up and shovel into suitable containers for disposal.
Avoid raising dust.
Wear suitable protective equipment.
Should not be released into the environment.

7. Handling and Storage

Handling

General advice:

As with all industrial chemicals, use good industrial practices when handling. Avoid eye, skin, and clothing contact. Do not inhale. Do not taste or swallow. Use only with adequate ventilation.

Protection against fire and explosion:

Avoid creating dusty conditions. Risk of explosion if an air-dust mixture forms.

Storage

General advice:

Keep container tightly closed in a dry, cool and well-ventilated place.

Material Safety Data Sheet

WHMIS / ANSI Z400.1-2004 Compliant



Date / Revised: 04-17-2007

Release: 1.0

Product: MAGNAFLOC 10

> for industrial use only <

8. Exposure Controls and Personal Protection

Engineering Controls:

Work in well ventilated areas. Do not breathe dust.
Ensure good ventilation and local exhaust.

Personal protective equipment

Respiratory protection:

Wear a NIOSH-certified respirator as necessary.

Eye protection:

Wear safety goggles (chemical goggles) if there is potential for airborne dust exposures.

Body protection:

Wear chemical resistant gloves and protective clothing.

General safety and hygiene measures:

There are no OSHA or ACGIH exposure guidelines available for component(s) in this product.

9. Physical and Chemical Properties

Colour:	off-white	
Form:	powder	
State of matter:	solid	
Odour:	odourless	
pH value:	5 - 7	1% solution
Evaporation rate:		Not tested
Flash point:		Not applicable
Melting point:		Not applicable
Boiling point:		Not applicable
Vapour pressure:		Not tested
Density:		Not applicable
Bulk density:	0.8 g/cm3	
Vapour density:		Not tested
Partitioning coefficient n-octanol/water (log Pow):		Not applicable
Viscosity, dynamic:		Not tested
% Volatiles:		not determined
Solubility in water:		Forms a viscous solution
Solubility in other solvents:		Not tested

10. Stability and Reactivity

Stability:

Stable.

Conditions to avoid: Avoid temperature extremes. Avoid humidity.

Substances to avoid: Strong oxidizing agents., (may degrade polymer)

Possibility of Hazardous Reactions: No hazardous reactions known.

Hazardous decomposition products: No decomposition expected under normal storage conditions.

11. Toxicological Information

Acute oral toxicity:

Material Safety Data Sheet

WHMIS / ANSI Z400.1-2004 Compliant



Date / Revised: 04-17-2007

Release: 1.0

Product: MAGNAFLOC 10

LD50 / oral / rat: > 2,000 mg/kg

Acute inhalation toxicity:

Not determined.

Acute dermal toxicity:

dermal:

Not determined.

Skin irritation:

not determined

Eye irritation:

Not determined.

Skin Sensitization:

Not tested

Chronic toxicity:

not determined

Subacute Toxicity:

not determined

Subchronic Toxicity:

not determined

Genetic toxicity:

Not expected to be mutagenic

Carcinogenicity:

None of the components in this product at concentrations greater than 0.1% are listed by IARC; NTP, OSHA or ACGIH as a carcinogen.

Reproductive toxicity:

No data for product. No effects anticipated

Developmental toxicity/teratogenicity:

No data for product. No effects anticipated.

12. Ecological Information

Toxicity to fish:

Brachydanio rerio/96 h/LC50: 357 mg/l (OECD 203; ISO 7346; 92/69/EEC, C.1)

From tests on a product range

Toxicity to aquatic invertebrates:

Daphnia magna/48 h/EC50: 212 mg/l (OECD 202/EC C.2)

From tests on a product range

Toxicity to aquatic plants:

Chlorella vulgaris/72 h/EC50: > 1,000 mg/l (OECD 201/EC C. 3)

From tests on a product range

Toxicity to microorganisms:

Pseudomonas putida/24 h/EC50: 892 mg/l

From tests on a product range

Material Safety Data Sheet

WHMIS / ANSI Z400.1-2004 Compliant



Date / Revised: 04-17-2007

Release: 1.0

Product: MAGNAFLOC 10

Biodegradation:

Not tested

13. Disposal Considerations

Waste disposal of substance:

Dispose of in accordance with national, state and local regulations.

14. Transport Information

TDG (Canada) Road transport

Special shipping information: Not classified as a dangerous good under transport regulations.

International Air Transport Association (IATA)

Special shipping information: Not classified as a dangerous good under transport regulations.

International Maritime Dangerous Goods Code (IMDG)

Special shipping information: Not classified as a dangerous good under transport regulations.

15. Regulatory Information

US: Toxic Substances Control Act (TSCA):

All component(s) comprising this product are either exempt or listed on the TSCA inventory

Canada: Domestic Substances List (DSL):

All components either exempt or listed on the DSL

Canada Regulations

Workplace Hazardous Materials Information System (WHMIS Classification):

This product is not WHMIS controlled.

Significant New Activity Conditions (SNAC):

This product does not contain any components subject to a SNAC Notice.

International Regulations

Chemical Weapons Convention:

This product does not contain any component(s) listed under the Chemical Weapons Convention Schedule of Chemicals.

16. Other Information

Product Safety Contact:

Prepared by: Ginette Rambié (905) 812-7280

Phone number of preparer:

Date / Revised: 04-17-2007

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

Disclaimer:

The information contained herein is based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to such data or information. The user is responsible for determining whether the product is suitable for its intended conditions of use.



SYSTEM FLOC-360™

Flocculant

Description SYSTEM FLOC-360™ polymeric flocculant is used to flocculate clays and shales encountered in drilling operations and facilitate disposal of water-based drilling fluids.

Applications/Functions

- Can flocculate and settle out dispersed formation solids in clear fluids and conventional drilling fluids

Advantages

- Product addition creates aggressive water/solids separation
- Residual fluids after treatment have improved clarity
- Effective in low to moderate concentrations

Typical Properties

• Appearance	Amber Liquid
• Specific gravity	1.14- 1.18
• Freeze point, °F, (°C)	20°F (-7°C)
• pH of 1% aqueous solution @ 25°C	5.5-6.5
• Viscosity* @ 25°C (*Brookfield LVT, 30 rpm, Spindle #1)	80-120 cP
• Solubility in water	100% miscible

Recommended Treatment

For flocculation treatment of fluid systems containing PHPA polymer:

- Recommended treatment concentration is between 1.0 - 2.0 % by volume
- Final product concentration can be influenced by method of introduction and efficiency of reaction created.
- SYSTEM FLOC-360 flocculant should be introduced with agitation to optimize speed and efficiency of reaction.
- Disposal of solids and water phase should always be done in accordance with all applicable federal, state and local regulations.
- Responsible handling and disposal of drilling fluids, water phase effluent and produced solids require that these materials should not be allowed to gain entry into any stream, waterway or body of water.

For clean-out of Drilled Shafts using PHPA polymers:

- Using the diameter of the drilled shaft calculate the volume of a 1-2 foot interval of the open hole.
- Add SYSTEM FLOC-360 flocculant at a concentration of 0.5 - 1.0 % by volume and place directly to the bottom of the shaft. Based on calculated volumes, the appropriate amount of SYSTEM FLOC-360 flocculant can be placed in collapsible bags allowing delivery to the bottom of the shaft or material can be tremied into place.
- After proper placement, use of the auger flights to create agitation is necessary for effective dispersion of the SYSTEM FLOC-360 flocculant and incorporation with existing solids.
- Crosslinked polymer and drilled solids can be removed using a vented clean-out bucket

Packaging	SYSTEM FLOC-360 flocculant is packaged in 55-gallon (208.2 L) non-returnable steel-drums and 5-gallon (18.9 L) resealable plastic containers.

Availability	SYSTEM FLOC-360 flocculant can be purchased through any Baroid Industrial Drilling Products Retailer. To locate the Baroid IDP retailer nearest you contact the Customer Service Department in Houston or your area IDP Sales Representative.

Baroid Industrial Drilling Products

Product Service Line, Halliburton

3000 N. Sam Houston Pkwy E.

Houston, TX 77032

Customer Service	(800) 735-6075 Toll Free	(281) 871-4612
Technical Service	(877) 379-7412 Toll Free	(281) 871-4613

MATERIAL SAFETY DATA SHEET

Product Trade Name: System Floc-360™

Revision Date: 08-Aug-2007

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: System Floc-360™
Synonyms: None
Chemical Family: Polymer in Aqueous Solution
Application: Flocculent
Manufacturer/Supplier: Baroid Fluid Services
a Product Service Line of Halliburton Energy Services, Inc.
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000
Prepared By: Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Contains no hazardous substances	Mixture	60 - 100%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye irritation.

4. FIRST AID MEASURES

Inhalation If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	> 200
Flash Point/Range (C):	> 100
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media	All standard firefighting media.
Special Exposure Hazards	Spills produce extremely slippery surfaces.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.
NFPA Ratings:	Health 1, Flammability 0, Reactivity 0
HMIS Ratings:	Health 1, Flammability 0, Physical Hazard 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Material is slippery underfoot.
Storage Information	Store in a cool, dry location. Keep container closed when not in use. Store at temperatures between 50 and 100 F (10 and 37.8 C). Do not freeze. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Clear amber
Odor:	Odorless
pH:	4.8-6.5 (1%)
Specific Gravity @ 20 C (Water=1):	1.14-1.18
Density @ 20 C (lbs./gallon):	9.5-9.8
Bulk Density @ 20 C (lbs/ft3):	Not Determined
Boiling Point/Range (F):	> 212
Boiling Point/Range (C):	> 100
Freezing Point/Range (F):	20
Freezing Point/Range (C):	-7
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	80-85
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	80-120 (25C)
Viscosity, Kinematic @ 20 C (centistokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	None known.
Hazardous Decomposition Products	Hydrogen chloride. Carbon monoxide and carbon dioxide. Oxides of nitrogen.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhalation of mist or heated vapors may cause respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	In normal industrial use, ingestion is not considered a probable route of exposure.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	Not determined
Other Information	None known.
Toxicity Tests	

Oral Toxicity:	LD50: > 2000 mg/kg (Rat)
Dermal Toxicity:	LD50: > 2000 mg/kg (Rat)
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Ames test: negative
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not readily biodegradable.
Bio-accumulation	Not expected to bioaccumulate.

Ecotoxicological Information

Acute Fish Toxicity:	LC50:(96 hour) >10 mg/l (Brachidanio rerio)
Acute Crustaceans Toxicity:	EC50(48): > 50 mg/l (Daphnia magna)
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS

Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

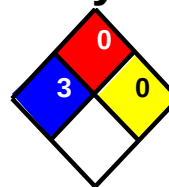
Disclaimer Statement

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Copper Sulfate Pentahydrate

Date Prepared: May 17, 2002



NFPA RATING

HEALTH	3
FLAMMABILITY	0
REACTIVITY	0
PROTECTIVE EQUIPMENT	

HMIS RATING

MATERIAL SAFETY DATA SHEET

SECTION I. PRODUCT IDENTIFICATION

Product Name: Copper Sulfate Pentahydrate

Synonyms: Triangle Brand Copper Sulfate; Triangle Brand Copper Sulfate Crystal; Triangle Brand Copper Sulfate Instant Powder; Triangle Brand Copper Sulfate Pentahydrate; Triangle Brand Cupric Sulfate Pentahydrate Technical; Phelps Dodge Copper Sulfate; Phelps Dodge Refining Corporation Triangle Brand Copper Sulfate; Phelps Dodge El Paso Triangle Brand; Cupric Sulfate; Copper Sulfate; Copper Sulfate Pentahydrate; Blue Vitriol; Triangle Brand Cupric Sulphate Pentahydrate Technical; Triangle Brand Copper Sulphate Instant Powder; Triangle Brand Copper Sulphate Crystal

Product Use: Industrial manufacturing, animal feed, algicide, fungicide, herbicide, pesticide or as a fertilizer.

Manufacturer/Vendor Information: PHELPS DODGE REFINING CORP.
P.O. Box 20001
El Paso, Texas

Chemtrec 24-Hour Emergency Phone:
In USA or Canada (800)424-9300
Other Information Phone: (915)778-9881

SECTION II. COMPOSITION / INFORMATION ON INGREDIENTS

CAS No.	Chemical Name	Exposure Limits	% by wt.
7758-99-8	Copper sulfate pentahydrate (CuSO ₄ •5H ₂ O), (Cupric sulfate), (Blue Vitriol), (Bluestone)	ACGIH TLV TWA: 1.0 mg/m ³ (as copper dust/mist) OSHA PEL TWA: 1.0 mg/m ³ (as copper dust/mist)	99
	Anhydrous Cupric Sulfate (CAS# 7758-98-7)	Phelps Dodge Triangle Brand Copper Sulfate Copper Sulfate Pentahydrate (CAS 7758-99-8) Contains anhydrous copper sulfate Contains water of crystallization Metallic copper equivalent	=99% =63.3% =35.7% =25.2%

SECTION III. HAZARDS IDENTIFICATION

Emergency Overview: Odorless, transparent blue crystals, granules or powder. Can cause irreversible eye damage and slight skin irritation. Harmful if swallowed. Avoid breathing mist or dust and contact with skin, eyes or clothing.

Route(s) of Entry: Inhalation, eye contact, skin contact and ingestion.

Acute Exposure: Can cause skin, eye and respiratory irritation.

Chronic Exposure: Prolonged or repeated skin contact may cause dermatitis. Prolonged or repeated eye contact may cause conjunctivitis. Prolonged excessive inhalation of mists containing copper sulfate may cause adverse effects on the liver and kidneys.

Carcinogenicity (NTP) (IARC) (OSHA) (ACGIH): Not listed

Eye: Corrosive and may result in irreversible eye damage.

Skin Contact: Can cause slight skin irritation. May cause localized discoloration of the skin. Product specific tests in accordance with USEPA standards do not indicate skin sensitization is likely to occur.

Inhalation: Can result in irritation of the upper respiratory tract and in excessive quantities may cause ulceration and perforation of the nasal septum.

Ingestion: Can result in digestive tract irritation, nausea, vomiting, diarrhea and abdominal pain.

SECTION IV. FIRST AID MEASURES

Eyes: Immediately flush eyes with plenty of water. Hold eye open and rinse slowly and gently for at least 15-20 minutes. Contact physician for treatment advice.

Skin: Wash skin with soap and plenty of water. If irritation persists contact a physician.

SECTION IV. FIRST AID MEASURES (Continued)

Ingestion: Contact a poison control center or physician for treatment advice. Have person sip a glass of water if able to swallow. Do not give anything by mouth to an unconscious person. Do not induce vomiting unless told to do so by the poison control center or physician. If vomiting occurs spontaneously, avoid aspiration.

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get immediate medical attention.

SECTION V. FIRE FIGHTING MEASURES

Flash Pt: Not applicable
Flammable Limits in Air-Lower: Not applicable
Flammable Limits in Air – Upper: Not applicable
Auto Ignition Temperature: Not applicable
Fire Fighting Extinguishing Media: Does not burn or support combustion. Use extinguishing media appropriate for surrounding fire (CO₂, dry chemical or water).
Fire Fighting Equipment: As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.
Fire Fighting Instructions: Evacuate area and fight fire from a safe distance.
Fire and Explosion Hazards: Sealed containers may rupture when heated due to release of water from crystals.
Hazardous Combustion Products: Not applicable
Explosion Data - Mechanical Impact / Static Discharge: Not available
Unusual Hazards: Material is acidic when dissolved in water, contact with magnesium metal may evolve hydrogen gas. Anhydrous cupric sulfate formed on water loss (white color). Anhydrous salt will ignite hydroxylamine, if present.

SECTION VI. ACCIDENTAL RELEASE MEASURES

Accidental Release Measures: Use clean-up methods that avoid dust generation (vacuum, wet). Wear a NIOSH approved respirator if dust will be generated in clean-up. Use protective clothing if skin contact is likely. If material is diluted in a water solution, and a spill occurs in a confined area, introduce lime or soda ash to form insoluble copper salts and dispose of by approved method. Prevent accidental entry of solution into streams and other water bodies. Shovel any spills into plastic bags and seal with tape. Copper sulfate solution may deteriorate concrete.

SECTION VII. HANDLING AND STORAGE

Signal Word: Danger.

Handling Information: Avoid breathing dust or solution mist. Sweep up crystals or powder, vacuum is preferred. Eye wash stations should be available in work areas. Users should wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

Storage Information: Store in closed containers in a cool, dry, well-ventilated area away from heat sources and reducing agents. Store copper sulfate in stainless steel, fiberglass, polypropylene, PVC's or plastic equipment. Keep away from galvanized pipe and nylon equipment. If container or bag is damaged, place the container or bag in a plastic bag. Use good housekeeping practices to prevent dust accumulation.

SECTION VIII. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls: Use adequate general or local ventilation to keep airborne concentrations below the exposure limits.

Eye Protection: Use protective goggles or a face-shield.

Skin Protection: Use protective clothing to prevent repeated or prolonged skin contact. Applicators and other handlers must wear long-sleeved shirt and long pants, waterproof gloves, shoes plus socks, and protective eyewear. Discard clothing and other absorbent materials that have been drenched or heavily contaminated with product's concentrate. Do not reuse them. Keep and wash PPE separately from other laundry.

SECTION VIII. EXPOSURE CONTROLS / PERSONAL PROTECTION (Continued)

Respiratory Protection: A respiratory protection program that meets OSHA 29 CFR 1910.134 requirements must be followed whenever workplace conditions warrant respirator use. For concentrations up to 10 times the exposure limit, use NIOSH approved half- or full-face, air-purifying respirator. For higher concentrations, consult a professional industrial hygienist.

SECTION IX. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Transparent blue crystals, granules or powder.
Melting Point:	Not available
Boiling Point:	-5H ₂ O @ 150 °C (760 mmHg)
Decomposition Temperature:	Decomposition above 110 °C with -4 H ₂ O
Density/Specific Gravity:	2.284 @ 15.6 °C
Odor/Odor Threshold:	Not available
Evaporation rate:	Not applicable
pH:	Not available
Coefficient of water/oil distribution:	Not available
Vapor Pressure:	Not applicable
Vapor Density:	Not applicable
Solubility in Water:	83.1 g/100 cc water @ 30 °C
Molecular Weight:	249.68

SECTION X. STABILITY AND REACTIVITY

Stability: Stable.

Incompatibility: Acetylene gas, aluminum powder, hydroxylamine, magnesium, moist air. Contact with magnesium metal can generate dangerous levels of hydrogen gas.

Conditions under which product is chemically unstable: Not applicable

Hazardous decomposition products: At temperatures >600 °C material decomposes to cupric oxide and sulfur dioxide.

Conditions of reactivity: Not applicable

Hazardous Polymerization: Will not occur.

SECTION XI. TOXICOLOGICAL INFORMATION**Toxicology Tests: (Triangle Brand Copper Sulfate Crystal)**

Test : 1

LD/LC : LD₅₀

Test Type : Acute

Test Route : Dermal

Test Species : Rabbit

Results Amounts : >5050 mg/kg

Test : 3

LD/LC : LC₅₀

Test Type : Acute, 4 hr

Test Route : Inhalation

Test Species : Rats

Results Amounts : >2.95 mg/L

Test : 2

LD/LC : LD₅₀

Test Type : Acute

Test Route : Oral

Test Species : Rat

Results Amounts : 352 mg/kg*

*Results based on toxicity evaluation of this product.

Primary Eye Irritation: Corrosive, irreversible eye damage

Primary Skin Irritation: Slightly irritating.

Skin Sensitization: Product-specific tests in accordance with USEPA standards did not indicate that this product would cause skin sensitization.

Respiratory Tract Sensitization: Not available.

Carcinogenicity: Not listed as a carcinogen by NTP, IARC, OSHA, or ACGIH.

SECTION XI. TOXICOLOGICAL INFORMATION (Continued)

Mutagenicity: A study performed with copper sulphate on mice showed mutagenicity in a chromosomal aberration test; however, the route of exposure (*i.e.*, intraperitoneal) is not likely to be applicable to workplace use of this product.

Reproductive Toxicity: No reproductive effects were shown in a feeding test performed with copper sulphate on rats and mice.

Teratogenicity: Embryotoxicity was not seen at non-maternally toxic doses of copper sulphate in the relevant studies reviewed.

Toxicologically Synergistic Materials: Not available.

Other Chronic Effects: Long term inhalation of copper sulfate containing mists (*i.e.*, Bordeaux mixture) may cause adverse effects to the liver and kidneys. A sub-chronic test performed on rats and mice showed that at high exposure levels in feed (>4000 ppm) cupric sulfate is toxic to the liver and kidneys.

Additional Information: Inhalation of dust and mists of copper salts can result in irritation of nasal mucous membranes, sometimes of the pharynx and, on occasion ulceration with perforation of the nasal septum. Exposure to copper dust causes discoloration of the skin.

Note to Physician: Probable mucosal damage may contraindicate the use of gastric lavage. Measures against circulatory shock, respiratory depression and convulsions may be needed. Wilson's disease or G6PD deficiency (individual who absorbs, retains and stores copper) can be aggravated by excessive exposure. Symptoms may include nausea, vomiting, epigastric pain, diarrhea, dizziness, jaundice, and general debility.

SECTION XII. ECOLOGICAL INFORMATION

Subacute dietary LC₅₀: >10,000 ppm (quail and duck).

96 hr acute toxicity LC₅₀: 0.65 ppm (bluegill), 0.056 ppm (trout), 16 ppm (pink shrimp)

48 hr EC₅₀: 54 ppb (eastern oysters)

48 hr LC₅₀: 17 ppm (pink shrimp), 600 ppb (daphnia)

24 hr LC₅₀: 6.9 ppm (blue crab), 600 ppb (daphnia)

Bioaccumulation: Not available

Biodegradability: Not applicable

SECTION XIII. DISPOSAL CONSIDERATIONS

Waste Disposal Method: Waste must be disposed of in accordance with federal, state/provincial and local environmental control regulations. Improper disposal is a violation of law. Do not reuse empty container. If allowed by federal, state/provincial and local authorities, dispose of container in a sanitary landfill or by incineration.

SECTION XIV. TRANSPORT INFORMATION

	Proper Shipping Name:	Technical Name (If N.O.S.):	Hazard Class:	ID:	PG:
DOT:	<i>Environmentally Hazardous Substance, Solid, n.o.s., (Cupric Sulfate)*</i>		9	UN3077	III

Reportable Quantity (RQ) = 10 pounds (4.54 kg).

*Applicable when product is shipped in packaging of 10 pounds or greater.

SECTION XV. REGULATORY INFORMATION**US Federal**

Federal Drinking Water Standards: (*Copper*) EPA 1300µg/L (action level), 1000 µg/L

Clean Water Act: This product contains compounds identified in 40 CFR 116.4.

TSCA: Listed

EPCRA, SARA Title III, Section 313 (40 CFR 372) Chemicals subject to reporting requirements (see Section II for CAS number and percentage in mixture): Section 312 and/or 313 reporting may be required for this product, depending of the amount used and/or stored on site.

CERCLA Hazardous Substances: RQ is not assigned to the broad class of copper compounds.

DOT: RQ 10 pounds (4.54 kg), See Section XIV TRANSPORT INFORMATION

Canada

This product has been classified in accordance with the hazard criteria of the *Controlled Products Regulations* and the MSDS contains all of the information required by the *Controlled Products Regulations*.

SECTION XVI. OTHER INFORMATION

Prepared By:	Phelps Dodge Corporation Department of Occupational Health and Safety One North Central Avenue Phoenix, AZ 85004 Telephone number (602.366.8398)
Reason for Revision:	Added use statement in Section I. Revised Section III and XI to reflect recent toxicity tests, Updated/revised information in other Sections with addition of Section XII in accordance with WHMIS.

Disclaimer: This information is based on available scientific evidence known to the Phelps Dodge Corporation. The information contained in the MSDS is being disclosed as required pursuant to applicable law. However, Phelps Dodge does not guarantee its accuracy or completeness. Health and safety precautions in this data sheet may not be adequate for all individuals and/or situations. It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. This information is furnished without warranty, expressed or implicit.

MATERIAL SAFETY DATA SHEET

Date Printed: 07/09/2004

Date Updated: 03/07/2004

Version 1.2

Section 1 - Product and Company Information

Product Name	DEXTRIN
Product Number	260754
Brand	ALDRICH
Company	Sigma-Aldrich
Street Address	3050 Spruce Street
City, State, Zip, Country	SAINT LOUIS MO 63103 US
Technical Phone:	314 771 5765
Emergency Phone:	414 273 3850 Ext. 5996
Fax:	800 325 5052

Section 2 - Composition/Information on Ingredient

Substance Name	CAS #	SARA 313
DEXTRIN	9004-53-9	No
Formula	C6H12O6	
RTECS Number:	HH9450000	

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Caution: Avoid contact and inhalation.

For additional information on toxicity, please refer to Section 11.

Section 4 - First Aid Measures

ORAL EXPOSURE

If swallowed, wash out mouth with water provided person is conscious. Call a physician.

INHALATION EXPOSURE

If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen.

DERMAL EXPOSURE

In case of contact, immediately wash skin with soap and copious amounts of water.

EYE EXPOSURE

In case of contact, immediately flush eyes with copious amounts of water for at least 15 minutes.

Section 5 - Fire Fighting Measures

FLASH POINT

N/A

AUTOIGNITION TEMP

N/A

FLAMMABILITY

N/A

EXTINGUISHING MEDIA

Suitable: Water spray. Carbon dioxide, dry chemical powder, or appropriate foam.

FIREFIGHTING

Protective Equipment: Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.
Specific Hazard(s): Emits toxic fumes under fire conditions.

Section 6 - Accidental Release Measures

PROCEDURE(S) OF PERSONAL PRECAUTION(S)

Wear respirator, chemical safety goggles, rubber boots, and heavy rubber gloves.

METHODS FOR CLEANING UP

Sweep up, place in a bag and hold for waste disposal. Avoid raising dust. Ventilate area and wash spill site after material pickup is complete.

Section 7 - Handling and Storage

HANDLING

User Exposure: Avoid breathing dust. Avoid contact with eyes, skin, and clothing.

STORAGE

Suitable: Keep container closed. Store in a cool dry place.

SPECIAL REQUIREMENTS

Hygroscopic.

Section 8 - Exposure Controls / PPE

ENGINEERING CONTROLS

Mechanical exhaust required.

PERSONAL PROTECTIVE EQUIPMENT

Respiratory: Government approved respirator.
Hand: Compatible chemical-resistant gloves.
Eye: Chemical safety goggles.

GENERAL HYGIENE MEASURES

Wash thoroughly after handling. Wash contaminated clothing before reuse.

Section 9 - Physical/Chemical Properties

Appearance

Color: Faintly yellow
Form: Powder

Property

Value

At Temperature or Pressure

Molecular Weight

N/A

pH

N/A

BP/BP Range

N/A

MP/MP Range

N/A

Freezing Point	N/A
Vapor Pressure	N/A
Vapor Density	N/A
Saturated Vapor Conc.	N/A
SG/Density	N/A
Bulk Density	N/A
Odor Threshold	N/A
Volatile%	N/A
VOC Content	N/A
Water Content	N/A
Solvent Content	N/A
Evaporation Rate	N/A
Viscosity	N/A
Surface Tension	N/A
Partition Coefficient	N/A
Decomposition Temp.	N/A
Flash Point	N/A
Explosion Limits	N/A
Flammability	N/A
Autoignition Temp	N/A
Refractive Index	N/A
Optical Rotation	N/A
Miscellaneous Data	N/A
Solubility	N/A

N/A = not available

Section 10 - Stability and Reactivity

STABILITY

Conditions of Instability: Protect from moisture.

Conditions to Avoid: Protect from moisture.

Materials to Avoid: Strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS

Hazardous Decomposition Products: Carbon monoxide, Carbon dioxide.

Section 11 - Toxicological Information

ROUTE OF EXPOSURE

Multiple Routes: May be harmful by inhalation, ingestion, or skin absorption. May cause irritation.

SIGNS AND SYMPTOMS OF EXPOSURE

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

TOXICITY DATA

Intravenous
 Mouse
 350 MG(FE)/KG
 LD50

Section 12 - Ecological Information

No data available.

Section 13 - Disposal Considerations

APPROPRIATE METHOD OF DISPOSAL OF SUBSTANCE OR PREPARATION

Dissolve or mix the material with a combustible solvent and burn

in a chemical incinerator equipped with an afterburner and scrubber. Observe all federal, state, and local environmental regulations.

Section 14 - Transport Information

DOT

Proper Shipping Name: None
Non-Hazardous for Transport: This substance is considered to be non-hazardous for transport.

IATA

Non-Hazardous for Air Transport: Non-hazardous for air transport.

Section 15 - Regulatory Information

US CLASSIFICATION AND LABEL TEXT

US Statements: Caution: Avoid contact and inhalation.

UNITED STATES REGULATORY INFORMATION

SARA LISTED: No
TSCA INVENTORY ITEM: Yes

CANADA REGULATORY INFORMATION

WHMIS Classification: This product has been classified in accordance with the hazard criteria of the CPR, and the MSDS contains all the information required by the CPR.
DSL: Yes
NDSL: No

Section 16 - Other Information

DISCLAIMER

For R&D use only. Not for drug, household or other uses.

WARRANTY

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Inc., shall not be held liable for any damage resulting from handling or from contact with the above product. See reverse side of invoice or packing slip for additional terms and conditions of sale. Copyright 2004 Sigma-Aldrich Co. License granted to make unlimited paper copies for internal use only.

MATERIAL SAFETY DATA SHEET

For Emergency Assistance
Involving Chemicals Call CHEMTREC
(800) 424-9300

WHMIS (Classification)
CLASS B-3: Combustible liquid with
a flash point between 37.8°C
(100°F) and 93.3°C (200°F).
CLASS D-2B: Material causing other
toxic effects (TOXIC).

Section I. Chemical Product Identification

Distributed by:
Univar Canada Ltd.
9800 Van Horne Way
Richmond, BC
V6X 1W5

Product Name	Methyl Isobutyl Carbinol	Code	LA1277
		CAS#	000108112
Synonym	Methyl Amyl Alcohol MIBC 2-Pentanol-4-Methyl		
		DSL	On the DSL list.
Chemical Name	dimethyl-1,3 butanol-1		
		CI#	Not available.
Chemical Family	Not available.		
Chemical Formula	C6H14O		
Material Uses	Industrial applications: Organic solvent		

Section II. Composition and Information on Ingredients

Name	CAS #	% by Weight	LC50/LD50
Methyl Isobutyl Carbinol	000108112	100	ORAL (LD50): Acute: >2590 mg/kg [Rat]. DERMAL (LD50): Acute: >3.5 mL/kg [Rabbit]. VAPOR (LC50): Acute: >2000 ppm 4 hours [Rat].

Section III. Hazards Identification

Potential Acute Very hazardous in case of ingestion. Hazardous in case of
Health Effects skin contact (irritant), of eye contact (irritant), of
inhalation.

Potential Chronic Health Effects	CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

****Section IV. First Aid Measures****

Eye Contact	IMMEDIATELY flush eyes with running water for at least 15 minutes, keeping eyelids open. Seek medical attention.
Skin Contact	Flush affected skin with gently flowing lukewarm water for at least 20 minutes and remove contaminated clothing while rinsing. Wash contaminated skin with mild soap and water for 15 minutes. If irritation occurs and persists, obtain medical attention.
Hazardous Skin Contact	Flush affected skin with gently flowing lukewarm water for at least 20 minutes and remove contaminated clothing while rinsing. Wash contaminated skin with mild soap and water for 15 minutes. If irritation occurs and persists, obtain medical attention.
Inhalation	If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Hazardous Inhalation	Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.
Ingestion	Do not induce vomiting. Do not give anything by mouth to an unconscious person. Guard against aspiration into lungs by having the individual turn on to their left side. If vomiting occurs spontaneously keep head below hips to prevent aspiration of liquid into the lungs. Obtain medical attention immediately.
Hazardous Ingestion	Not available.

****Section V. Fire and Explosion Data****

The Product is: Flammable.

Auto-Ignition Temperature	338°C (640.4°F)

Flash Points	CLOSED CUP: 44°C (111.2°F). (TAG) OPEN CUP: 51.7°C (125.1°F) (Cleveland).

Flammable Limits LOWER: 1% UPPER: 5.5%

Products of Combustion	Carbon monoxide and carbon dioxide are produced on combustion.

Fire Hazards in Presence of Various Substances	Flammable in presence of open flames and sparks, of heat, of oxidizing materials.
Explosion Hazards in Presence of Various Substances	Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive in presence of oxidizing materials.
Fire Fighting Media and Instructions	Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.
Special Remarks on Fire Hazards	Vapour forms a flammable/explosive mixture with air between upper and lower flammable limits. Do not enter confined fire space without adequate protective clothing and an approved positive pressure self-contained breathing apparatus. Containers exposed to intense heat from fires should be cooled with water to prevent vapour pressure buildup which could result in container rupture. Product will float and can be reignited on surface of water. Container areas exposed to direct flame contact should be cooled with large quantities of water as needed to prevent weakening of container structure. Caution - Combustible.
Special Remarks on Explosion Hazards	Not available.

****Section VI. Accidental Release Measures****

Small Spill	Absorb with an inert material and put the spilled material in an appropriate waste disposal.
Large Spill	Issue warning "Combustible". Eliminate all ignition sources. Handling equipment must be grounded. Isolate hazard area and restrict access. Try to work upwind of spill. Avoid direct contact with material. Wear appropriate breathing apparatus (if applicable) and protective clothing. Stop leak only if safe to do so. Dike and contain land spills; contain water spills by booming. Use water fog to knock down vapours; contain runoff. For large spills remove by mechanical means and place in containers. Absorb residue or small spills with absorbent material and remove to non-leaking containers for disposal. Recommended materials: Clay or Sand Flush area with water to remove trace residue. Dispose of recovered material as noted under Disposal Considerations. Notify appropriate environmental agency(ies).

****Section VII. Handling and Storage****

Precautions	Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. DO NOT ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the

label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids. Hot surfaces may be sufficient to ignite liquid even in the absence of sparks or flames. Extinguish pilot lights, cigarettes and turn off other sources of ignition prior to use and until all vapours are gone. Vapours may accumulate and travel to distant ignition sources and flashback. Empty containers may contain hazardous product residues. Do not pressurize drum containers to empty them. Fixed equipment as well as transfer containers and equipment should be grounded to prevent accumulation of static charge. Do not cut, drill, grind, weld or perform similar operations on or near containers. Air-dry contaminated clothing in a well ventilated area before laundering. Launder contaminated clothing prior to reuse. Use good personal hygiene.

Storage	Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Use explosion-proof ventilation to prevent vapour accumulation.

****Section VIII. Exposure Controls/Personal Protection****

Engineering Controls	Make up air should always be supplied to balance air exhausted (either generally or locally). Local ventilation recommended where mechanical ventilation is ineffective in controlling airborne concentrations below the recommended occupational exposure limit. Concentrations in air should be maintained below the recommended threshold limit value if unprotected personnel are involved. For personnel entry into confined spaces (i.e. bulk storage tanks) a proper confined space entry procedure must be followed including ventilation and testing of tank atmosphere. Electrical and mechanical equipment should be explosion-proof. Mechanical ventilation is recommended for all indoor situations to control fugitive emissions. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection	Chemical safety goggles and/or full face shield to protect eyes and face, if product is handled such that it could be splashed into eyes. Impervious gloves (neoprene) should be worn at all times when handling this product. Impervious clothing (apron, coveralls) should also be worn in confined workspaces or where the risk of skin exposure is much higher. Safety showers should be available for emergency use. If exposure exceeds occupational exposure limits, use an appropriate NIOSH-approved respirator. Use a NIOSH-approved chemical cartridge respirator with organic vapour cartridges or use a NIOSH-approved supplied-air respirator. For high airborne concentrations, use a NIOSH-approved supplied-air respirator, either self-contained or airline breathing apparatus, operated in positive pressure mode.

Personal Protection in Case of a Large Spill	Chemical safety goggles and/or full face shield to protect eyes and face, if product is handled such that it could be splashed into eyes. Impervious gloves (neoprene) should be worn at all times when handling this product. Impervious clothing (apron, coveralls) should also be worn in confined workspaces or where the risk of skin exposure is much higher. Safety showers should be available for emergency

use. If exposure exceeds occupational exposure limits, use an appropriate NIOSH-approved respirator. Use a NIOSH-approved chemical cartridge respirator with organic vapour cartridges or use a NIOSH-approved supplied-air respirator. For high airborne concentrations, use a NIOSH-approved supplied-air respirator, either self-contained or airline breathing apparatus, operated in positive pressure mode.

Exposure Limits TWA: 104 STEL: 167 (mg/m³) from ACGIH (TLV) [United States] SKIN
TWA: 25 STEL: 40 (ppm) from ACGIH (TLV) [United States] SKIN

Consult local authorities for acceptable exposure limits.

Section IX. Physical and Chemical Properties

Physical State and Appearance	Liquid.	Odor	Sweetish. Alcohol like.
		Taste	Not available.
Molecular Weight	102.17 g/mole		
pH (1% soln/water)	Not available.	Color	Colorless.
Boiling Point	130°C - 133°C (266°F - 271.4°F)		
Melting Point	-90°C (-130°F)		
Critical Temperature	Not available.		
Specific Gravity	0.808 (Water = 1)		
Vapor Pressure	>0.4 kPa (@ 20°C)		
Vapor Density	3.5 (Air = 1)		
Volatility	Not available.		
Odor Threshold	Not available.		
Evaporation rate	0.27		
Viscosity	Not available.		
Water/Oil Dist. Coeff.	The product is more soluble in oil; log(oil/water) = 26.9		
Ionicity (in Water)	Not available.		
Dispersion Properties	Not available.		
Solubility	Very slightly soluble in cold water, hot water. Soluble in Other Solvents: Alcohol, Ether, Organic Solvents		

Section X. Stability and Reactivity Data

Stability	The product is stable.
Instability Temperature	Not available.
Conditions of Instability	Do not use with aluminum equipment at temperatures above 49 degrees Celsius. Avoid excessive heat, open flames and all ignition sources.
Incompatibility with various substances	Reactive with oxidizing agents, acids.
Corrosivity	Not available.
Special Remarks on Reactivity	Not available.
Special Remarks on Corrosivity	Not available.
Hazardous Polymerization	Will not occur.

****Section XI. Toxicological Information****

Routes of Entry	Absorbed through skin. Eye contact. Inhalation. Ingestion.
Toxicity to Animals	Acute oral toxicity (LD50): >2590 mg/kg [Rat]. Acute dermal toxicity (LD50): >3.5 mL/kg [Rabbit]. Acute toxicity of the vapor (LC50): >2000 ppm 4 hours [Rat].
Chronic Effects on Humans	CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.
Other Toxic Effects on Humans	Very hazardous in case of ingestion. Hazardous in case of skin contact (irritant), of eye contact (irritant), of inhalation.
Special Remarks on Toxicity to Animals	Not available.
Special Remarks on Chronic Effects on Humans	Prolonged and repeated contact with skin can cause defatting and drying of the skin resulting in skin irritation and dermatitis. Prolonged exposure to high vapour concentration can cause headache, dizziness, nausea, blurred vision and central nervous system depression. Pre-existing Conditions: Pre-existing eye, skin and respiratory disorders may be aggravated by exposure to this product.
Special Remarks	Vapours are moderately irritating to the respiratory

on	passages.
Other Toxic	Ingestion of this product may cause headache, dizziness,
Effects on Humans	fatigue and central nervous system depression. Vapours are moderately irritating to the eyes.

****Section XII. Ecological Information****

Ecotoxicity	Do not allow product or runoff from fire control to enter storm or sanitary sewers, lakes, rivers, streams, or public waterways. Block off drains and ditches. Provincial regulations require and federal regulations may require that environmental and/or other agencies be notified of a spill incident. Spill area must be cleaned and restored to original condition or to the satisfaction of authorities. MIBC is practically non-toxic to aquatic organisms and is expected to be slightly toxic to mammalian wildlife. MIBC may deoxygenate surface waters.

BOD5 and COD	Not available.

Products of Biodegradation	Biodegradable. Not likely to bioaccumulate.

Toxicity of the Products of Biodegradation	Not available.

Special Remarks on the Products of Biodegradation	Not available.

****Section XIII. Disposal Considerations****

Waste Disposal	Waste management priorities (depending on volumes and concentration of waste) are: 1. recycle (reprocess), 2. energy recovery (cement kilns, thermal power generation), 3. incineration, 4. disposal at a licenced waste disposal facility. Do not attempt to combust waste on-site. Incinerate at a licenced waste disposal site with approval of environmental authority.

****Section XIV. Transport Information****

TDG Classification	Class 3: Flammable liquid.

Shipping name	Methyl isobutyl carbinol

PIN	UN2053

Packing Group	III

Special Provisions for Transport	Not regulated under the Transportation of Dangerous Goods Act when transported by road or rail in packagings or containers of 454 L or less (waste excluded).

****Section XV. Other Regulatory Information****

Other Regulations	OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

****Section XVI. Other Information****

References -Manufacturer's Material Safety Data Sheet.

Other Special Not available.
Considerations

Validated by Hardev Bendick on 12/7/2000. Verified by Hardev Bendick.

Tel. number for non-emergency questions concerning MSDS: 1-866-686-4827

Notice to Reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Univar Canada Ltd. expressly disclaims all expressed or implied warranties of merchantability and fitness for a particular purpose with respect to the product provided.**

===== END OF MSDS =====



Material Safety Data Sheet

acc. to OSHA and ANSI

Printing date 02/03/2003

Reviewed on 11/01/2002

• **1 Identification of substance:**

○ **Product details:**

○ **Product name:** Potassium ethyl xanthate

○ **Stock number:** A11450

○ **Manufacturer/Supplier:**

Alfa Aesar, A Johnson Matthey Company
Johnson Matthey Catalog Company, Inc.
30 Bond Street
Ward Hill, MA 01835-8099
Emergency Phone: (978) 521-6300
CHEMTREC: (800) 424-9300
Web Site: www.alfa.com

○ **Information Department:** Health, Safety and Environmental Department

○ **Emergency information:**

During normal hours the Health, Safety and Environmental Department. After normal hours call Chemtrec at (800) 424-9300.

• **2 Composition/Data on components:**

○ **Chemical characterization:**

Description: (CAS#)

Potassium ethyl xanthate (CAS# 140-89-6): 100%

○ **Identification number(s):**

○ **EINECS Number:** 205-439-3

• **3 Hazards identification**

○ **Hazard description:** Xn Harmful

○ **Information pertaining to particular dangers for man and environment**

R 22 Harmful if swallowed.

R 36/37/38 Irritating to eyes, respiratory system and skin.

○ **Classification system**

○ **HMIS ratings (scale 0-4)**

(Hazardous Materials Identification System)

Health (acute effects) = 1

Flammability = 1

Reactivity = 1

- **4 First aid measures**

- **After inhalation**
Supply fresh air. If required, provide artificial respiration. Keep patient warm. Seek immediate medical advice.
- **After skin contact**
Immediately wash with water and soap and rinse thoroughly. Seek immediate medical advice.
- **After eye contact**
Rinse opened eye for several minutes under running water. Then consult a doctor.
- **After swallowing** Seek immediate medical advice.

- **5 Fire fighting measures**

- **Suitable extinguishing agents**
Carbon dioxide, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
- **Special hazards caused by the material, its products of combustion or resulting gases:**
In case of fire, the following can be released:
Carbon monoxide and carbon dioxide
Sulfur oxides (SO_x)
- **Protective equipment:**
Wear self-contained respirator.
Wear fully protective impervious suit.

- **6 Accidental release measures**

- **Person-related safety precautions:**
Wear protective equipment. Keep unprotected persons away.
Ensure adequate ventilation
- **Measures for environmental protection:**
Do not allow material to be released to the environment without proper governmental permits.
- **Measures for cleaning/collecting:**
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.
- **Additional information:**
See Section 7 for information on safe handling
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

- **7 Handling and storage**

- **Handling**
- **Information for safe handling:**
Keep container tightly sealed.
Store in cool, dry place in tightly closed containers.
Ensure good ventilation at the workplace.
- **Information about protection against explosions and fires:**
Keep ignition sources away.
- **Storage**
- **Requirements to be met by storerooms and receptacles:**
No special requirements.
- **Information about storage in one common storage facility:**
Store away from oxidizing agents.

- **Further information about storage conditions:**
Keep container tightly sealed.
Store in cool, dry conditions in well sealed containers.

• **8 Exposure controls and personal protection**

- **Additional information about design of technical systems:**
Properly operating chemical fume hood designed for hazardous chemicals and having an average face velocity of at least 100 feet per minute.
- **Components with limit values that require monitoring at the workplace:**
Not required.
- **Additional information:** No data
- **Personal protective equipment**
- **General protective and hygienic measures**
The usual precautionary measures for handling chemicals should be followed.
Keep away from foodstuffs, beverages and feed.
Remove all soiled and contaminated clothing immediately.
Wash hands before breaks and at the end of work.
Avoid contact with the eyes and skin.
- **Breathing equipment:**
Use suitable respirator when high concentrations are present.
- **Protection of hands:**
Impervious gloves
Check protective gloves prior to each use for their proper condition.
- **Material of gloves**
The selection of suitable gloves not only depends on the material, but also on quality. Quality will vary from manufacturer to manufacturer.
- **Eye protection:** Safety glasses
- **Body protection:** Protective work clothing.

• **9 Physical and chemical properties:**

○ **General Information**

- **Form:** Powder
- **Color:** Light yellow
- **Odor:** Not determined

	<u>Value/Range</u>	<u>Unit</u>	<u>Method</u>
○ Change in condition			
○ Melting point/Melting range:	213	° C	dec
○ Boiling point/Boiling range:	Not determined		
○ Sublimation temperature / start:	Not determined		
○ Ignition temperature:	Not determined		
○ Decomposition temperature:	Not determined		
○ Danger of explosion: Product does not present an explosion hazard.			
○ Explosion limits:			
○ Lower:	Not determined		
○ Upper:	Not determined		
○ Vapor pressure:	Not determined		

- **Density:** Not determined
- **Solubility in / Miscibility with**
- **Water:** Not determined

• **10 Stability and reactivity**

- **Thermal decomposition / conditions to be avoided:**
Decomposition will not occur if used and stored according to specifications.
- **Materials to be avoided:** Oxidizing agents
- **Dangerous reactions** No dangerous reactions known
- **Dangerous products of decomposition:**
Carbon monoxide and carbon dioxide
Sulfur oxides (SO_x)

• **11 Toxicological information**

- **Acute toxicity:**
LD/LC50 values that are relevant for classification:
Oral: LD50: 308 mg/kg (mus)
LD50: 1700 mg/kg (rat)
- **Primary irritant effect:**
- **on the skin:** Irritant to skin and mucous membranes.
- **on the eye:** Irritating effect.
- **Sensitization:** No sensitizing effects known.
- **Subacute to chronic toxicity:**
- **Subacute to chronic toxicity:**
The Registry of Toxic Effects of Chemical Substances (RTECS) reports the following effects in laboratory animals:
Behavioral - excitement.
Behavioral - muscle contraction or spasticity.
Behavioral - antipsychotic.
Behavioral - somnolence (general depressed activity).
Lungs, Thorax, or Respiration - respiratory depression
Blood - changes in erythrocyte (RBC) count.
Biochemical - Enzyme inhibition, induction, or change in blood or tissue levels - catalases.
Biochemical - Enzyme inhibition, induction, or change in blood or tissue levels - other enzymes.
- **Additional toxicological information:**
To the best of our knowledge the acute and chronic toxicity of this substance is not fully known.
No classification data on carcinogenic properties of this material is available from the EPA, IARC, NTP, OSHA or ACGIH.

• **12 Ecological information:**

- **General notes:**
Do not allow material to be released to the environment without proper governmental permits.

• **13 Disposal considerations**

- **Product:**
- **Recommendation**
Consult state, local or national regulations to ensure proper disposal.
- **Uncleaned packagings:**

- **Recommendation:**
Disposal must be made according to official regulations.

- **14 Transport information**

Not a hazardous material for transportation.

- **DOT regulations:**
- **Hazard class:** None
- **Land transport ADR/RID (cross-border)**
- **ADR/RID class:** None
- **Maritime transport IMDG:**
- **IMDG Class:** None
- **Air transport ICAO-TI and IATA-DGR:**
- **ICAO/IATA Class:** None
- **Transport/Additional information:**
Not dangerous according to the above specifications.

- **15 Regulations**

- **Product related hazard informations:**
- **Hazard symbols:** Xn Harmful
- **Risk phrases:**
22 Harmful if swallowed.
36/37/38 Irritating to eyes, respiratory system and skin.
- **Safety phrases:**
26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
36/37 Wear suitable protective clothing and gloves.
- **National regulations**
All components of this product are listed in the U.S. Environmental Agency Toxic Substances Control Act Chemical substance Inventory.
- **Information about limitation of use:**
For use only by technically qualified individuals.

- **16 Other information:**

Employers should use this information only as a supplement to other information gathered by them, and should make independent judgement of suitability of this information to ensure proper use and protect the health and safety of employees. This information is furnished without warranty, and any use of the product not in conformance with this Material Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

- **Department issuing MSDS:** Health, Safety and Environmental Department.
- **Contact:** Darrell R. Sanders

Technical Service: 1-800-343-7276
Bulk/Specialty Sales: 1-888-343-8025

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-----EMERGENCY ASSISTANCE-----

FOR EMERGENCY ASSISTANCE INVOLVING CHEMICALS CALL CHEMTREC (800)424-9300

-----FOR PRODUCT AND SALES INFORMATION-----

CONTACT YOUR LOCAL VAN WATERS & ROGERS BRANCH OFFICE

-----PRODUCT IDENTIFICATION-----

PRODUCT NAME: SODIUM ETHYL XANTHATE CAS NO.: UNASSIGNED
COMMON NAMES/SYNONYMS: AERO(R) 325 VW&R CODE: T1791

FORMULA: ROCS(S) NA OR ROCS(S) K DATE ISSUED: 08/89
HAZARD RATING (MANUFACTURER) SUPERCEDES: 10/87

HEALTH: 1
FIRE: 0
REACTIVITY: 0
SPECIAL: NONE

HAZARD RATING SCALE:
0=MINIMAL 3=SERIOUS
1=SLIGHT 4=SEVERE
2=MODERATE

-----HAZARDOUS INGREDIENTS-----

COMPONENT	CAS NO.	%	EXPOSURE LIMITS, PPM			
			OSHA PEL	ACGIH TLV	OTHER LIMIT	HAZARD
SODIUM ETHYL XANTHATE	UNREPORTED	UNKNOWN	NONE	NONE	NONE	NONE
ETHANOL	64-17-5	0.5-1	1000	1000	NONE	FLAMMABLE

(R) TRADEMARK OF AMERICAN CYANIMID COMPANY.

-----PHYSICAL PROPERTIES-----

BOILING POINT, DEG F: N/A VAPOR PRESSURE, MM HG/20 DEG C: N/A
MELTING POINT, DEG F: 360-493 VAPOR DENSITY (AIR=1): N/A
SPECIFIC GRAVITY (WATER=1): N/A WATER SOLUBILITY, %: APPRECIABLE
APPEARANCE AND ODOR: N/A EVAPORATION RATE (BUTYL ACETATE=1): NIL

-----FIRST AID MEASURES-----

IF INHALED: REMOVE TO FRESH AIR. GIVE ARTIFICIAL RESPIRATION IF NOT BREATHING. GET IMMEDIATE MEDICAL ATTENTION.

IN CASE OF EYE CONTACT: IMMEDIATELY FLUSH EYES WITH LOTS OF RUNNING WATER FOR 15 MINUTES, LIFTING THE UPPER AND LOWER EYELIDS OCCASIONALLY. GET IMMEDIATE MEDICAL ATTENTION.

IN CASE OF SKIN CONTACT: IMMEDIATELY WASH SKIN WITH LOTS OF SOAP AND WATER. REMOVE CONTAMINATED CLOTHING AND SHOES; WASH BEFORE REUSE. GET MEDICAL ATTENTION IF IRRITATION PERSISTS AFTER WASHING.

IF SWALLOWED: IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING BY GIVING 2 GLASSES OF WATER AND STICKING A FINGER DOWN THE THROAT. GET IMMEDIATE

MEDICAL ATTENTION. DO NOT GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS OR CONVULSING PERSON.

-----HEALTH HAZARD INFORMATION-----

PRIMARY ROUTES OF EXPOSURE: INHALATION, SKIN OR EYE CONTACT.

SIGNS AND SYMPTOMS OF EXPOSURE

INHALATION: BREATHING DUST MAY IRRITATE THE NOSE AND THROAT AND CAUSE COUGHING AND CHEST DISCOMFORT.

EYE CONTACT: DUSTS MAY IRRITATE THE EYES.

SKIN CONTACT: PROLONGED OR REPEATED CONTACT WITH THE DUST MAY IRRITATE THE SKIN.

SWALLOWED: NONE CURRENTLY KNOWN.

CHRONIC EFFECTS OF EXPOSURE: NO SPECIFIC INFORMATION AVAILABLE.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: NONE REPORTED.

-----TOXICITY DATA-----

ORAL: NO DATA FOUND.

DERMAL: NO DATA FOUND.

INHALATION: NO DATA FOUND.

CARCINOGENICITY: THIS MATERIAL IS NOT CONSIDERED TO BE A CARCINOGEN BY THE NATIONAL TOXICOLOGY PROGRAM, THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER, OR THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

OTHER DATA: NONE

-----PERSONAL PROTECTION-----

VENTILATION: LOCAL MECHANICAL EXHAUST VENTILATION CAPABLE OF MINIMIZING DUST EMISSIONS AT THE POINT OF USE.

RESPIRATORY PROTECTION: IF USE CONDITIONS GENERATE VAPORS OR MISTS, WEAR A NIOSH-APPROVED RESPIRATOR APPROPRIATE FOR THOSE EMISSION LEVELS. APPROPRIATE RESPIRATORS MAY BE A FULL FACEPIECE OR A HALF MASK AIR-PURIFYING CARTRIDGE RESPIRATOR EQUIPPED FOR ORGANIC VAPORS/MISTS, A SELF-CONTAINED BREATHING APPARATUS IN THE PRESSURE DEMAND MODE, OR A SUPPLIED-AIR RESPIRATOR.

EYE PROTECTION: CHEMICAL GOGGLES. IT IS GENERALLY RECOGNIZED THAT CONTACT LENSES SHOULD NOT BE WORN WHEN WORKING WITH CHEMICALS BECAUSE CONTACT LENSES MAY CONTRIBUTE TO THE SEVERITY OF AN EYE INJURY.

PROTECTIVE CLOTHING: LONG-SLEEVED SHIRT, TROUSERS, SAFETY SHOES, AND GLOVES.

OTHER PROTECTIVE MEASURES: AN EYEWASH AND SAFETY SHOWER SHOULD BE NEARBY AND READY FOR USE.

FLASH POINT, DEG F: N/A FLAMMABLE LIMITS IN AIR, %
METHOD USED: N/A LOWER: N/A UPPER: N/A
EXTINGUISHING MEDIA: USE WATER SPRAY, DRY CHEMICAL, CO2, OR ALCOHOL
FOAM.

UNUSUAL FIRE AND EXPLOSION HAZARDS: NONE.

HAZARDOUS DECOMPOSITION PRODUCTS: CARBON DISULFIDE.

NOTE: EMPTY CONTAINERS CAN HAVE RESIDUES, GASES AND MISTS AND ARE SUBJECT TO PROPER WASTE DISPOSAL, AS ABOVE.

OTHER PRECAUTIONS: CONTAINERS, EVEN THOSE THAT HAVE BEEN EMPTIED, WILL RETAIN PRODUCT RESIDUE AND VAPORS. ALWAYS OBEY HAZARD WARNINGS AND HANDLE EMPTY CONTAINERS AS IF THEY WERE FULL.

-----FOR ADDITIONAL INFORMATION-----

CONTACT MSDS COORDINATOR, VAN WATERS & ROGERS INC.
DURING BUSINESS HOURS, PACIFIC TIME (408)435-8700

-----NOTICE-----

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-----REVISION-----

08/89: CHANGED HEADING AND CONTACT INFORMATION.



Material Safety Data Sheet

ORFOM ® SIPX (SODIUM ISOPROPYL XANTHATE)

September 30, 2001

MSDS #: 28990

Revision #0

CHEVRON PHILLIPS CHEMICAL COMPANY LP
10001 Six Pines Drive
The Woodlands, TX 77380

PHONE NUMBERS

HEALTH:

Chevron Phillips Emergency
Information Center 866.442.9628
(North America) and
1.832.813.4984(International)

TRANSPORTATION:

North America: CHEMTREC 800.424.9300
or 703.527.3887

ASIA: 1.703.527.3887

EUROPE: BIG .32.14.584545 (phone)
or .32.14.583516 (telefax)

SOUTH AMERICA SOS-Cotec

Inside Brazil: 0800.111.767

Outside Brazil: 55.19.3467.1600

Technical Services: (832) 813-4862

For Additional MSDSs: (800) 852-5530

A. Product Identification

Synonyms: Not Established

Chemical Name: Sodium Isopropyl Xanthate

Chemical Family: Dithiocarbonate

Chemical Formula: C₄H₇OS₂Na

CAS Reg. No.: 140-93-2

Product No.: Not Established

Product and/or Components Entered on EPA's TSCA Inventory: YES

This product is in U.S. commerce, and is listed in the Toxic Substances Control Act (TSCA) Inventory of Chemicals; hence, it may be subject to applicable TSCA provisions and restrictions.

Canadian Inventory Listing Status: DSL

All ingredients are listed in the Domestic Substances List (DSL).

Impurities are exempt in accordance with Section 3 of the Canadian Environmental Protection Act (CEPA).

B. Components

Ingredients	CAS Number	% By Wt.	OSHA PEL	ACGIH TLV
Sodium Isopropyl Xanthate	140-93-2	>84.0	NE	NE
Sodium Hydroxide	1310-73-2	< 3.0	2 mg/m ³	2 mg/m ³ (C)
Water	7732-18-5	Reminder	NE	NE

C. Personal Protection Information

Ventilation: Use adequate ventilation to control exposure below recommended level.

Respiratory Protection: Not generally required unless needed to prevent respiratory irritation.

Eye Protection: Use safety glasses with side shields.

Skin Protection: No special garments required. Avoid unnecessary skin contamination. Use impervious rubber gloves.

NOTE: Personal protection information shown in Section C is based upon general information as to normal uses and conditions. Where special or unusual uses or conditions exist, it is suggested that the expert assistance of an industrial hygienist or other qualified professional be sought.

D. Handling and Storage Precautions

Do not get in eyes, on skin or on clothing. Do not breathe vapors, mist, fume or dust. Wear protective equipment and/or garments described above if exposure conditions warrant. Wash thoroughly after handling. Launder contaminated clothing before reuse. Use only with adequate ventilation.

Store in a closed containers. Store in cool, well-ventilated area away from ignition sources. Protect from moisture and oxidants.

E. Reactivity Data

Stability: Stable
Conditions to Avoid: Acid; ignition sources.

Incompatibility (Materials to Avoid): Oxidants, organic or inorganic acids

Hazardous Polymerization: Will Not Occur

Conditions to Avoid: Not Applicable

Hazardous Decomposition Products: Sulfur oxides and carbon disulfides released on heating.

F. Health Hazard Data

Recommended Exposure Limits:

Control as Particulate Not Otherwise Classified (PNOC) or Regulated:

	OSHA PEL	ACGIH TLV*
Respirable Fraction	5 mg/m ³	3 mg/m ³
Total Dust	15 mg/m ³	10 mg/m ³

* The value is for inhalable (total) particulate matter containing no asbestos and

Acute Effects of Overexposure:

Eye: Irritation possible.

Skin: Mild irritation. Dermatitis may be possible with prolonged contact.

Inhalation: Dust may cause irritation to the nose, throat, and upper respiratory tract.

Ingestion: Low to moderate toxicity possible.

Subchronic and Chronic Effects of Overexposure:

Xanthates can decompose to release carbon disulfide (CAS # 75-15-0) which may cause dizziness, headache, fatigue, nervousness, loss of appetite, psychosis and nerve, heart, kidney or liver changes.

Other Health Effects:

No known applicable information.

Health Hazard Categories:

Animal Human

Animal Human

Known Carcinogen	___	___	Toxic	___	___
Suspect Carcinogen	___	___	Corrosive	___	___
Mutagen	___	___	Irritant	___	___
Teratogen	___	___	Target Organ Toxin	<u>X</u>	<u>X</u>
Allergic Sensitizer	___	___	Specify - Liver, Kidney, Heart &		
Highly Toxic	___	___	Nerve Toxin		

Canadian WHIMS:

CLASS D: POISONOUS AND INFECTIOUS MATERIAL CATEGORIES

1. Materials Causing Immediate and Serious Toxic Effects

- A. Very Toxic _____
 B. Toxic _____

2. Materials Causing Other Toxic Effects

A. Very Toxic

1. Chronic Toxic Effects	_____
2. Teratogen/Embryo Toxin	_____
3. Carcinogen	_____
4. Reproductive Toxin	_____
5. Respiratory Tract Sensitizer	_____
6. Mutagen	_____

B. Toxic

1. Chronic Toxic Effects	<u>X</u>
2. Skin or Eye Irritant	_____
3. Skin Sensitizer	_____
4. Mutagen	_____

Specify: Liver - Toxin; Kidney - Toxin; Heart - Toxin; Nerve - Toxin.

First Aid and Emergency Procedures:

Eye: Flush eyes with running water for at least fifteen minutes. If irritation or adverse symptoms develop, seek medical attention.

Skin: Wash skin with soap and water for at least fifteen minutes. If irritation or adverse symptoms develop, seek medical attention.

Inhalation: Remove from exposure. If breathing is difficult, give oxygen. If breathing ceases, administer artificial respiration followed by oxygen. Seek immediate medical attention.

Ingestion: Give two glasses of water and induce vomiting, only if subject is conscious. Seek medical attention.

G. Physical Data

Appearance: Yellowish Powder or Pellets
Odor: Slight
Boiling Point: Not Applicable
Vapor Pressure: Not Applicable
Vapor Density (Air = 1): Not Applicable
Solubility in Water: Appreciable
Specific Gravity (H₂O = 1): Not Established
Percent Volatile by Volume: 14 maximum
Evaporation Rate (Butyl Acetate = 1): Not Applicable
Viscosity: Not Applicable

H. Fire and Explosion Data

Flash Point (Method Used): Not Applicable (solid or powder)
Flammable Limits (% by Volume in Air): LEL - Not Applicable
UEL - Not Applicable

Fire Extinguishing Media: Dry chemical, foam or carbon dioxide (CO₂)

Special Fire Fighting Procedures: Evacuate area of all unnecessary personnel. Shut off source, if possible. Use NIOSH/MSHA approved self-contained breathing apparatus and other protective equipment and/or garments described in Section C if conditions warrant. Water fog or spray may be used to cool exposed containers and equipment.

Fire and Explosion Hazards: Sulfur oxides and carbon disulfide released upon heating.

I. Spill, Leak and Disposal Procedures

Precautions Required if Material is Released or Spilled:

Evacuate area of all unnecessary personnel. Wear protective equipment and/or garments described in Section C if exposure conditions warrant. Shut off source, if possible and contain spill. Protect from ignition. Keep out of water sources and sewers. Follow normal clean-up procedures for solid spills. Control dust. Avoid breathing dust. Avoid contact with skin and eyes.

Waste Disposal (Insure Conformity with all Applicable Disposal Regulations):
Incinerate or place in permitted waste management facility.

J. DOT Transportation

Shipping Name: Self-heating, solid, organic, n.o.s., (Sodium isopropyl xanthate)
Hazard Class: 4.2
ID Number: UN 3088
Packing Group: II
Marking: Self-heating, solid, organic, n.o.s., (Sodium isopropyl xanthate), UN 3088
Label: Spontaneously combustible
Placard: Spontaneously combustible/3088
Hazardous Substance/RQ: Not Applicable
Shipping Description: Self-heating, solid, organic, n.o.s., (Sodium isopropyl xanthate), 4.2, UN 3088, PG II
Packaging References: 49 CFR 173.212, 173.241

K. RCRA Classification - Unadulterated Product as a Waste

Reactive (D003)

Prior to disposal, consult your environmental contact to determine if the TCLP (Toxicity Characteristic Leaching Procedure, EPA Test Method 1311) is required. Reference 40 CFR Part 261.

L. Protection Required for Work on Contaminated Equipment

Contact immediate supervisor for specific instructions before work is initiated. Wear protective equipment and/or garments described in Section C if exposure conditions warrant. Use NIOSH/MSHA approved respiratory protection, such as air-supplied mask, in confined spaces or other poorly ventilated areas.

M. Hazard Classification

☒ This product meets the following hazard definition(s) as defined by the Occupational Safety and Health Hazard Communication Standard (29 CFR Section 1910.1200):

☐ Combustible Liquid	☐ Flammable Aerosol	☐ Oxidizer
☐ Compressed Gas	☐ Explosive	☐ Pyrophoric
☐ Flammable Gas	☒ Health Hazard (Section F)	☐ Unstable
☐ Flammable Liquid	☐ Organic Peroxide	☐ Water Reactive
☐ Flammable Solid		

— Based on information presently available, this product does not meet any of the hazard definitions of 29 CFR Section 1910.1200.

Canadian WHIMS:

Class D: Poisonous and Infectious Material
Division 2. Materials Causing Other Toxic Effects

N. Additional Comments

SARA 313

This product contains the following chemical or chemicals subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
(See Section B).

Sodium Hydroxide
Carbon Disulfide

NFPA 704 Hazard Codes - - - - - Signals

Health	: 1	Least	- 0
Flammability:	0	Slight	- 1
Reactivity	: 0	Moderate	- 2
Special Haz.:	-	High	- 3
		Extreme	- 4

Prepared according to the OSHA Hazard Communication Standard (29 CFR 1910.1200) and the ANSI MSDS Standard (Z400.1) by EHS Product Stewardship Group, Chevron Phillips Chemical Company LP, 10001 Six Pines Drive, The Woodlands, TX 77380

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

Material Safety Data Sheet

HYDRATED LIME

Rev. Date:5/1/2008

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

Product Name:		Hi-Cal Hydrate	
Synonym/s:		Hydrate, High Calcium Hydrated Lime, Type N Hydrated Lime, HL	
Manufacturer:	US Operations: Chemical Lime Co. 3700 Hulen St. Fort Worth, TX 76107 817-732-8164	Canadian Operations: Chemical Lime Co. of Canada Inc. 20302-102B Ave. Langley, BC V1M 3H1 604-888-4333	
Emergency Phone:		Chemtrec 1-800-424-9300	
Chemical Name:	Calcium Hydroxide	WHMIS Classification: D2A, E	
Chemical Family:	Alkaline Earth Hydroxide		
Chemical Formula:	Ca(OH) ₂		
Product Use/s:		Water treatment, pH adjustment, FGT, Construction, Pulp/Paper	
Prepared By:		Chemical Lime Co. R&D/Technical Services, KSA	

SECTION 2: COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient	CAS	OSHA PEL, TWA 8/40h (mg/m3)	ACGIH TLV, TWA 8/40h (mg/m3)	NIOSH REL, TWA 8/40h (mg/m3)	NIOSH IDLH (mg/m3)	Conc. (%)
Calcium Hydroxide, Ca(OH) ₂ (Hydrated Lime)	1305-62-0	15 (total dust) 5 (respirable)	5	5	N.A.	> 90
Magnesium Hydroxide, Mg(OH) ₂ (Brucite)	1309-42-8	N.A.	N.A.	N.A.	N.A.	< 5
Magnesium Oxide, MgO (Periclase)	1309-48-4	10	10	N.A.	N.A.	< 5
Calcium Carbonate, CaCO ₃ (Limestone)	1317-65-3 (471-34-1)	15 (total dust) 5 (respirable)	10	10 (total dust) 5 (respirable)	N.A.	< 3
Crystalline Silica, SiO ₂ (Quartz)	14808-60-7	10/(SiO ₂ % + 2) (respirable)	0.025 (respirable)	0.05 (respirable)	50	< 2

OSHA Regulatory Status: This material is subject to 29 CFR 1910.1200 (Hazard Communication).

Material Safety Data Sheet

HYDRATED LIME

Rev. Date:5/1/2008

SECTION 3: HAZARDS IDENTIFICATION

Emergency Overview: Hydrate is an odorless white or grayish-white powder. Contact can cause irritation to eyes, skin, respiratory system, and gastrointestinal tract.

Potential Health Effects

Eyes: Contact can cause severe irritation or burning of eyes, including permanent damage.

Skin: Contact can cause irritation of skin.

Ingestion: This product can cause severe irritation of gastrointestinal tract if swallowed.

Inhalation: This product can cause severe irritation of the respiratory system. Long-term exposure may cause permanent damage. Hydrate is not listed by MSHA, OSHA, or IARC as a carcinogen. However, this product may contain trace amounts of crystalline silica in the form of quartz or cristobalite, which has been classified by IARC as a Group I carcinogen to humans when inhaled. Inhalation of silica can also cause a chronic lung disorder, silicosis.

Medical

Conditions Aggravated

by Exposure: Contact may aggravate disorders of the eyes, skin, gastrointestinal tract, and respiratory system.

Potential

Environmental Effects: This material is alkaline and if released into water or moist soil will cause an increase in pH.

SECTION 4: FIRST AID MEASURES

Eyes: Immediately flush eyes with generous amounts of water or eye wash solution if water is unavailable. Pull back eyelid while flushing to ensure that all lime dust has been washed out. Seek medical attention promptly if the initial flushing of the eyes does not remove the irritant. Do not rub eyes.

Skin: Brush off or remove as much dry lime as possible. Wash exposed area with large amounts of water. If irritation persists, seek medical attention promptly.

Inhalation: Move victim to fresh air. Seek medical attention. If breathing has stopped, give artificial respiration.

Ingestion: Do not induce vomiting. Seek medical attention immediately. Never give anything by mouth unless instructed to do so by medical personnel.

Material Safety Data Sheet

HYDRATED LIME

Rev. Date:5/1/2008

SECTION 5: FIRE FIGHTING MEASURES

Fire Hazards:	Hydrate is not combustible or flammable. However, hydrate reacts vigorously with acids, and may release heat sufficient to ignite combustible materials in specific instances. Hydrate is not considered to be an explosion hazard, although reaction with acids or other incompatible materials may rupture containers.
Hazardous Combustion Products:	None
Extinguishing Media:	Use dry chemical fire extinguisher. Do not use water or halogenated compounds, except that large amounts of water may be used to deluge small quantities of hydrate.
Fire Fighting Instructions:	Keep personnel away from and upwind of fire. Avoid skin contact or inhalation of dust. Wear full fire-fighting turn-out gear (full Bunker gear), and respiratory protection (SCBA).

SECTION 6: ACCIDENTAL RELEASE MEASURES

Spill / Leak Procedures:	Do Not use water on bulk material spills. Use proper protective equipment.
Small Spills:	Use dry methods to collect spilled materials. Avoid generating dust. Do not clean up with compressed air. Store collected materials in dry, sealed plastic or non-aluminum metal containers. Residue on surfaces may be water washed.
Large Spills:	Use dry methods to collect spilled materials. Evacuate area downwind of clean-up operations to minimize dust exposure. Store spilled materials in dry, sealed plastic or non-aluminum metal containers.
Containment:	Minimize dust generation and prevent bulk release to sewers or waterways.
Clean-up:	Residual amounts of material can be flushed with large amounts of water. Equipment can be washed with either a mild vinegar and water solution, or detergent and water.

SECTION 7: HANDLING AND STORAGE

Handling:	Keep in tightly closed plastic or non-aluminum metal containers. Protect containers from physical damage. Avoid direct skin contact with the material.
Storage:	Store in a cool, dry, and well-ventilated location. Do not store near acids or other incompatible materials. Keep away from moisture. Do not store or ship in aluminum containers.

Material Safety Data Sheet

HYDRATED LIME

Rev. Date:5/1/2008

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls:	Provide ventilation adequate to maintain PELs.
Respiratory Protection:	Use NIOSH/MSHA approved respirators if airborne concentration exceeds PELs.
Skin Protection:	Use appropriate gloves and footwear to prevent skin contact. Clothing should fully cover arms and legs. Should lime get inside clothing or gloves, remove the clothing and the lime promptly.
Eye Protection:	Use safety glasses with side shields or safety goggles. Contact lenses should not be worn when working with lime products.
Other:	Eye wash fountain/stations and emergency showers should be available.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance: White or grayish-white powder	Odor: Odorless	Physical State: Solid
Boiling Point (°C/°F): 2850 / 5162	Melting Point (°C/°F): dec 580 / 1076	Specific Gravity (Apparent) g/cc: 0.4 - 0.55 (True) g/cc: 2.2 - 2.4
Vapor Pressure (mm Hg): N.A.	Vapor Density: N.A.	Evaporation Rate: N.A.
Solubility in Water Slightly soluble in water.	pH (25°C/77°F): 12.4	

SECTION 10: STABILITY AND REACTIVITY

Stability:	Chemically stable, but slowly reacts with carbon dioxide to form calcium carbonate. See also Incompatibility below.								
Incompatibility/ Conditions to Avoid:	Hydrate should not be mixed or stored with the following materials, due to the potential for vigorous reaction and release of heat: <table><tr><td>Acids (unless in a controlled process)</td><td>Organic Acid Anhydrides</td></tr><tr><td>Reactive Fluoridated Compounds</td><td>Nitro-Organic Compounds</td></tr><tr><td>Reactive Brominated Compounds</td><td>Reactive Phosphorous Compounds</td></tr><tr><td>Reactive Powdered Metals</td><td>Interhalogenated Compounds</td></tr></table>	Acids (unless in a controlled process)	Organic Acid Anhydrides	Reactive Fluoridated Compounds	Nitro-Organic Compounds	Reactive Brominated Compounds	Reactive Phosphorous Compounds	Reactive Powdered Metals	Interhalogenated Compounds
Acids (unless in a controlled process)	Organic Acid Anhydrides								
Reactive Fluoridated Compounds	Nitro-Organic Compounds								
Reactive Brominated Compounds	Reactive Phosphorous Compounds								
Reactive Powdered Metals	Interhalogenated Compounds								
Hazardous Decomposition Products:	None								
Hazardous Polymerization:	None								

SECTION 11: TOXICOLOGICAL INFORMATION

ORL-RAT LD50: 7,340 MG/KG
ORL-MUS LD50: 7,300 MG/KG

Hydrated Lime is not listed by MSHA, OSHA, or IARC as a carcinogen, but this product may contain trace amounts of crystalline silica, which has been classified by IARC as carcinogenic to humans when inhaled in the form of quartz or cristobalite.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity: Because of the high pH of this product, it would be expected to produce significant ecotoxicity upon exposure to aquatic organisms and aquatic systems in high concentrations.

Environmental Fate: This material shows no bioaccumulation effect or food chain concentration toxicity.

SECTION 13: DISPOSAL CONSIDERATIONS

Dispose of in accordance with all applicable federal, state, and local environmental regulations. If this product as supplied, and unmixed, becomes a waste, it will not meet the criteria of a hazardous waste as defined under the U.S. Resource Conservation and Recovery Act (RCRA).

SECTION 14: TRANSPORTATION INFORMATION

Hydrate is not classified as a hazardous material by US DOT and is not regulated by the Transportation of Dangerous Goods (TDG) when shipped by any mode of transport.

Material Safety Data Sheet

HYDRATED LIME

Rev. Date:5/1/2008

SECTION 15: REGULATORY INFORMATION

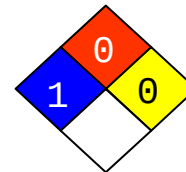
U.S. EPA Regulations: RCRA Hazardous Waste Number (40 CFR 261.33): not listed
RCRA Hazardous Waste Classification (40 CFR 261): not classified
CERCLA Hazardous Substance (40 CFR 302.4) unlisted specific per RCRA, Sec. 3001;
CWA, Sec. 311(b)(4); CWA, Sec. 307(a), CAA, Sec. 112
CERCLA Reportable Quantity (RQ), not listed
SARA 311/312 Codes: not listed
SARA Toxic Chemical (40 CFR 372.65): not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): not listed, Threshold
Planning Quantity (TPQ): not listed
All chemical ingredients are listed on the USEPA TSCA Inventory List.

OSHA/MSHA Regulations: Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): 5mg/M³ TWA-8
MSHA: not listed
OSHA Specifically Regulated Substance (29 CFR 1910): not listed

State Regulations: Consult state and local authorities for guidance. Components found in this product may contain trace amounts of inherent naturally occurring elements (such as, but not limited to arsenic and cadmium) that may be regulated.

Canada: WHMIS Classification: "D2A" Materials Causing Other Toxic Effects
WHMIS Classification: "E" Corrosive Materials (listed due to corrosive effect on aluminum)
Canada DSL: Listed

NFPA Hazard Class: Health: 1 Flammability: 0 Reactivity: 0
HMIS Hazard Class: Health: 1 Flammability: 0 Reactivity: 0 Personal Protection: E



SECTION 16: OTHER INFORMATION

Prepared By: Chemical Lime Company, R&D/Technical Services, KSA

Chemical Lime Company provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person. Individuals receiving this information must consult their own technical and legal advisors and/ or exercise their own judgment in determining its appropriateness for a particular purpose. Chemical Lime Company makes no representations or warranties, either express or implied, including without limitation and warranties of merchantability or fitness for a particular purpose with respect to the information set forth herein or the product(s) to which the information refers. Accordingly, Chemical Lime Company will not be responsible or liable for any claims, losses or damages resulting from the use of or reliance upon or failure to use this information.



Cutler-Magner Company
12th Avenue West and Waterfront
P.O. Box 16807
Duluth, Minnesota 55816-0807

Material Safety Data Sheet

PRODUCT IDENTIFICATION

**CALCIUM OXIDE -
Quicklime**

CHEMICAL ABSTRACT NO.

CAS No. 1305-78-8

DATE REVISED

01/03/2006

Section I

MANUFACTURER

Cutler-Magner Company
Foot of Hill Avenue
Superior, WI 54880

24 Hour Emergency Contact
Number: (715) 392-5146
Ask for Supervisor On Call

Telephone Number for
Information: (800) 232-1302

HMIS II SAFETY RATING

Health - **3**
Flammability - **0**
Physical Hazard - **2**
Personal Protective Equip - **E**

Other Common Names: Pebble Lime, Unslaked Lime
Trade Names: Rockport

Section II – Hazardous Ingredients / Identity Information

Specific Chemical Identity; Common Names	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (Optional)
Calcium Oxide; Lime; Quicklime	5 mg/m ³	2 mg/m ³		
Crystalline Silica (Quartz)	0.1 mg/m ³	0.05 mg/m ³	Respirable	0.1 to 0.3 %

Calcium oxide is not listed on the NTP, IARC, or OSHA lists of carcinogens. Crystalline silica, a component of this product, is listed by IARC and NTP but not by OSHA. In 1997, IARC determined that "crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1). OSHA requires that products containing 0.1% of a known carcinogen must be labeled. NTP states that "silica, crystalline (respirable)" may reasonably be anticipated to be a carcinogen (1991). Cutler-Magner Company recommends using personal protection equipment when handling this product.

Section III – Physical / Chemical Characteristics

Boiling Point (Calcium Oxide)	2850 °C	Specific Gravity (H ₂ O=1)	3.2-3.4
Vapor Pressure (mm Hg)	NA	Melting Point	2570 °C
Vapor Density (Air = 1)	NA	Evaporation Rate	NA
Solubility in Water	Reacts to form calcium hydroxide		
Appearance and Color	White to gray lumps, pebbles, granules, powder; faint earthy odor		

Section IV – Fire and Explosion Hazard Data

Flash Point	NA	Flammable Limits – NA
Extinguishing Method	NA	
Special Fire Fighting Procedures	Reaction with water may produce enough heat to ignite combustible material.	
Unusual Fire and Explosion Hazards	Material is an explosion hazard when wet and confined.	

Section V – Reactivity Data

Stability	Unstable		Conditions to Avoid – NA
	Stable	X	
Incompatibility (Materials to Avoid)		Water, Acid, Interhalogen, Phosphorus (V) Oxide	
Hazardous Decomposition or Byproducts		None	
Hazardous Polymerization	May Occur		Conditions to Avoid – NA
	Will Not Occur	X	

Section VI – Health Hazard Data

Route(s) of Entry	Inhalation? - YES	Absorption Through Skin? – YES	Ingestion (swallowing)? - YES
Health Hazards	Acute	Causes irritation and inflammation to mucous membrane and respiratory passages.	
	Chronic	Long-term exposure can cause irritation, ulceration and perforation of nasal septum.	
Toxicological Information	No LD50 / LC50 have been identified for this product. Quicklime is not listed by MSHA, OSHA, or IARC as a carcinogen, but this product may contain trace amounts of crystalline silica, which has been classified by IARC as (Group 1) carcinogenic to humans when inhaled in the form of quartz or cristobalite.		
Signs and Symptoms of Exposure		Irritation of skin, eyes, and respiratory tract.	
Medical Conditions Generally Aggravated by Exposure		Respiratory disease, skin condition.	
Emergency and First Aid Procedures		Remove to fresh air. Wash dust with soap and water. Flush out eyes with generous amounts of water. Drink plenty of water if swallowed. See Physician.	

Section VII – Precautions for Safe Handling

Steps to Be Taken in Case Material is Released or Spilled	Normal clean-up procedures. Care should be taken to avoid causing dust to become airborne. Vacuum cleaning systems are recommended.		
Waste Disposal Method	Dispose of product in accordance with Federal, State and Local regulations.		
Precautions to Be Taken in Handling	Store away from water and acids.		
Other Precautions	Waste should not be discarded with combustible material where the possibility exists of getting the mixture wet – FIRE HAZARD!		

Section VIII – Control Measures

Respiratory Protection - Dust filter mask is recommended as minimal protection		
Ventilation	Local Exhaust – To maintain TLV and PEL Mechanical – To maintain TLV' and PEL	Special – None Other – None
Protective Gloves – Cloth or leather gloves will protect skin		
Eye Protection – Fitted goggles will reduce eye injury		
Other Protective Clothing – Long sleeve shirts and pants		
Work / Hygienic Practices – Maintain dust exposure limits below TLV and PEL. If not possible – use respiratory protection		

Section IX – Ecological Information

Ecotoxicity: Because of the high pH of this product, in high concentrations it would be expected to produce significant ecotoxicity upon exposure to aquatic organisms and aquatic systems.

Environmental Fate: This material shows no bioaccumulation effect or food chain toxicity.

Section X – Regulatory Information

EPA

RCRA Hazardous Waste Classification (40 CFR 261): Not Listed
RCRA Hazardous Waste Number (40 CFR 261.33): Not Listed
ERCLA Hazardous Substance (40 CFR 302.4): Unlisted specific per RCRA,
Sec. 3001; CWA, Sec.311 (b)(4); CWA, Sec. 307(a), CAA, Sec. 112
CERCLA Reportable Quantity (RQ): Not Listed
SARA 311/312 Codes: Not Listed
SARA Toxic Chemical (40 CFR 372.65): Not Listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not Listed;
Threshold Planning Quantity (TPQ): Not Listed
All chemical ingredients are listed on the USEPA TSCA Inventory List

OSHA / MSHA

Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): 5 mg/M³ TWA-8
MSHA: Not Listed
OSHA Specifically Regulated Substance (29 CFR 1910): Not Listed

Canada

WHIMS Classification: "E" Corrosive Materials (Listed due to corrosive effect of aluminum)
WHIMS Classification: "D2A" Materials Causing Other Toxic Effects
CANADA DSL: Listed

State Regulations

Consult state and local authorities for guidance

Other

HMIS: Health Risk 3, Flammability 0, Reactivity 1, Personal Protection E
NFPA: Health Hazard 3, Fire Hazard 0, Reactivity 1
DOT: For aircraft transport only, Calcium Oxide is classified as Hazard Class 8
– Corrosive, UN 1910, Packing Group 3

The above information is believed to be correct as of the date hereof. However, no warranty of merchantability, fitness for any use, or any other warranty is expressed or is to be implied regarding the accuracy of these data, the results to be obtained from the use of the material, or the hazards connected with such use. Since the information contained herein may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the data hereof may suggest modification of the information, we do not assume responsibility for the results of its use. This information is furnished on the condition that the person(s) receiving it shall make their own determination as to the suitability of the material for their particular purpose and on the condition that they assume the risk of use thereof.

**MATERIAL SAFETY DATA SHEET****Sodium Sulphide****Section 01 - Chemical And Product And Company Information**

Product Identifier Sodium Sulphide

Product Use Depilatory for hides and skins, manufacture of rubber, sulphur dyes, rayon denitrating, paper pulp, ore floatation, metal refining, cotton printing, as chemical intermediate and laboratory reagent.

Supplier Name ClearTech Industries Inc.
2303 Hanselman Avenue
Saskatoon SK S7I 5Z3
Canada

Prepared By ClearTech Industries Inc. Technical Department
Phone: (306)664-2522

Preparation Date 10/25/04

24-Hour Emergency Phone 306-664-2522

**Section 02 - Composition / Information on Ingredients**

Hazardous Ingredients Sodium Sulfide 59-62%

CAS Number Sodium Sulfide 1313-82-2

Synonym (s) Sodium Monosulfide; Sulfur Compounds; Na₂S



Section 03 - Hazard Identification

- Inhalation**..... Hazard is highly toxic (50-100 ppm in air) hydrogen sulfide which may accumulate in confined spaces due to the decomposition of sodium sulfide or from its reaction with acids. Symptoms include painful conjunctivitis, headache, nausea, dizziness, coughing and, in extreme cases, pulmonary edema and possible death.
- Skin Contact / Absorption**..... Contact with skin can produce serious caustic burns with painful inflammation and possible destruction of tissue. May cause irritation, severe burns and corrosion to the skin. This material may be absorbed through the skin producing toxicity typical of hydrogen sulfide poisoning.
- Eye Contact**..... Inflammation, tearing and pain may be expected. Severe contact can cause destruction of tissue. This product has similar effects as alkalies following direct exposure to the eye and can cause lacrimation, sensitivity to light, tearing and irreversible damage, including blindness.
- Ingestion**..... Sodium sulfide is a strong base and can cause severe burns on the mucous membrane. Hydrolysis by gastric fluids releases toxic hydrogen sulfide. The symptoms and effects are similar to those under inhalation, above.
- Exposure Limits**..... No occupational exposure limits have been established by OSHA & ACGIH for this product. The limits for hydrogen sulphide have been established:
- OSHA/TWA: 10ppm
OSHA/STEL: 15ppm
ACGIH/TWA: 10ppm
OSHA/STEL: 15ppm

Section 04 - First Aid Measures

- Inhalation**..... Hydrogen sulfide has a characteristic "rotten egg" odor. Remove victim to fresh air. Give artificial respiration only if breathing has stopped. If breathing is difficult, give oxygen. Seek immediate medical attention.
- Skin Contact / Absorption**..... Remove contaminated clothing. Wash affected area with soap and water. Contact a poison control center, emergency room or physician right away as further treatment will be necessary.
- Eye Contact**..... Flush immediately with water for at least 20 minutes. Forcibly hold eyelids apart to ensure complete irrigation of eye tissue. Seek immediate medical attention as further treatment will be necessary.
- Ingestion**..... Gently wipe or rinse the inside of the mouth with water. Sips of water may be given if person is fully conscious. Never give anything by mouth to an unconscious or convulsing person. Do not induce vomiting. Contact a poison control center, emergency room or physician right away as further treatment will be necessary.



Additional Information..... Contact with acid and excessive heat liberates flammable and poisonous hydrogen sulfide gas.

Section 05 - Fire Fighting

Conditions of Flammability..... Non-flammable

Means of Extinction..... Not available

Flash Point..... Not available

Auto-ignition Temperature..... 260°C

Upper Flammable Limit Not available

Lower Flammable Limit..... Not available

Hazardous Combustible Products... Contact with all acids or excessive heat will liberate poisonous, flammable hydrogen sulfide gas.

Special Fire Fighting Procedures..... Wear NIOSH-approved self-contained breathing apparatus and protective clothing. Fire-fighters must wear NIOSH approved, pressure demand, self-contained breathing apparatus with full face piece for possible exposure to hazardous gases. Hydrogen sulfide vapors are heavier than air and may travel a considerable distance to source of ignition and flash back.

Explosion Hazards..... Not available



Section 06 - Accidental Release Measures

- Leak / Spill**..... Immediately evacuate the area. Remove sources of ignition. Provide maximum ventilation. Unprotected personnel should move upwind of spill. Only personnel equipped with proper respiratory and eye/skin protection should be permitted in the area. Carefully shovel or sweep up spilled material and place into closed containers. Spilled material should be reclaimed if possible. Product must not come in contact with acids. After all visible traces have been removed, thoroughly wet vacuum the area. Do not flush to sewer. At the first sign of a hydrogen sulfide leak, a planned emergency program should be put into operation. Emergency drills should be made periodically. If a hydrogen sulfide leak occurs, all persons must promptly leave the area. A wind sock or other wind direction indicator should be within sight. Move crossways to the wind from the contaminated area. Insure that the entire area is evacuated. Only persons wearing NIOSH approved self-contained breathing apparatus or full facepiece airline respirators with auxiliary SCBA's operated in the pressure/demand mode and eye/skin protection should be permitted in area. Each hydrogen sulfide leak should be dealt with immediately. Lead acetate strips or portable monitoring instruments can be used to locate a hydrogen sulfide leak. If hydrogen sulfide is leaking, the lead acetate paper will turn brown. When working on a leak, employees should take a position so that escaping hydrogen sulfide moves away from them. Supplied air equipment must be working no matter how small the leak.
- Deactivating Materials**..... Not available

Section 07 - Handling and Storage

- Handling Procedures**..... Use proper equipment for lifting and transporting all containers. Use sensible industrial hygiene and housekeeping practices. Wash thoroughly after handling. Avoid all situations that could lead to harmful exposure.
- Storage Requirements**..... Store away from strong oxidizing agents. Do not allow contact with acids and excessive heat. Will liberate poisonous, flammable hydrogen sulfide gas. Do not store in zinc, aluminum or copper containers. Wear respiratory protection whenever exposure to vapor is likely. Wear appropriate personal protective equipment when handling this product. Store in a cool, dry, well-ventilated place. Store only in closed, properly labeled containers. Keep container closed when not in use.

Section 08 - Personal Protection and Exposure Controls

Protective Equipment

- Eyes**..... Chemical goggles, full-face shield, or a full-face respirator is to be worn at all times when product is handled. Contact lenses should not be worn; they may contribute to severe eye injury.



- Respiratory**..... If exposure of hydrogen sulfide gas could exceed the exposure limits, use NIOSH approved full face airline and/or self-contained breathing apparatus operated in a positive pressure demand mode. The respiratory use limitations made by NIOSH or the manufacturer must be observed. Respiratory protection programs must be in accordance with 29 CFR 1910.134.
- Gloves**..... Impervious gloves of chemically resistant material (rubber or PVC) should be worn at all times. Wash contaminated clothing with soap and water, dry thoroughly before reuse.
- Clothing**..... Body suits, aprons, and/or coveralls of chemical resistant material should be worn at all times. Wash contaminated clothing with soap and water, dry thoroughly before reuse.
- Footwear**..... Impervious boots of chemically resistant material should be worn at all times

Engineering Controls

- Ventilation Requirements**..... Mechanical ventilation (dilution or local exhaust), process or personnel enclosure, and control of process conditions. Supply sufficient replacement air to make up for air removed by exhaust systems.
- Other**..... Use local exhaust or general room/dilution ventilation as appropriate to control employee exposures in the work place.

Section 09 - Physical and Chemical Properties

- Physical State**..... Flakes
- Odor and Appearance**..... Slight rotten egg, white to yellow.
- Odor Threshold**..... 1-5 ppm for hydrogen sulfide.
- Specific Gravity (Water=1)**..... 1.858 (flake)
- Vapor Pressure (mm Hg, 20C)**..... Not available
- Vapor Density (Air=1)**..... Not available
- Evaporation Rate**..... Not available
- Boiling Point**..... 174°C
- Freeze/Melting Point**..... 92°C
- pH**..... Strongly alkaline



Water/Oil Distribution Coefficient.... Not available

Bulk Density..... 40 lbs/ft³(flake)

% Volatiles by Volume..... Very low

Solubility in Water..... 15% @ 20°C

Molecular Formula..... Na₂S

Molecular Weight..... 78.04

Section 10 - Stability and Reactivity

Stability..... Stable

Incompatibility..... Avoid contact with strong oxidizing agents and acids. Avoid concentrating solutions, could cause spontaneous ignition. Solutions attack zinc, copper, aluminum and alloys of these metals. Avoid heat, flames, sparks and other sources of ignition.

Hazardous Products of Decomposition.. Oxides of sulfur, oxides of sodium, hydrogen sulfide.

Polymerization..... Will not occur

Section 11 - Toxicological Information

Irritancy..... Strong irritant, corrosive.

Sensitization..... Not available



Chronic/Acute Effects..... ACUTE: Irritation of mucous membranes, eyes, and respiratory tract is possible following exposure to the decomposition product, hydrogen sulfide gas, which is potentially lethal.

CHRONIC: The effects of long-term, low level exposures to this product have not been determined. Safe handling of this material on a long-term basis should emphasize the prevention of all contact with this material to avoid any effects from repetitive acute exposures.

Hydrogen sulfide is a toxic and irritant gas whose effects are exerted on the respiratory system, gastrointestinal tract, eyes and central nervous system. Acute effects on the respiratory system, in order of increasing severity, can be a runny nose with anosmia (loss of the sense of smell), tracheobronchitis with pain, cough, pulmonary edema with dyspnea (shortness of breath), delayed bronchopneumonia, respiratory paralysis and terminal asphyxial convulsion. Acute effects may occur without warning as a result of olfactory fatigue. While the odor of hydrogen sulfide is distinct at 0.3ppm, olfactory fatigue occurs rapidly with continuous inhalation. Gastrointestinal effects can be profuse salivation, nausea, vomiting or diarrhea. Nervous system effects may be giddiness, headache, vomiting, vertigo, amnesia, confusion and unconsciousness. Eye irritation is the most common low exposure effect of hydrogen sulfide and is characterized by irritation of the conjunctiva with photophobia to severe conjunctivitis with keratitis. A possible warning sign of eye exposure is the appearance of halos around light sources and increased sensitivity to light.

Synergistic Materials..... Not available

Animal Toxicity Data..... LD₅₀(Oral, Rat)= 200mg/kg
LD₅₀(Dermal, Rabbit)= 177.8mg/kg

Carcinogenicity..... This product is NOT listed as a carcinogen or suspected carcinogen by NTP, IARC, or OSHA.

Reproductive Toxicity..... Not available

Teratogenicity..... Not available

Mutagenicity..... Not available

Section 12 - Ecological Information

Fish Toxicity..... LC50(48 hrs, Bluegill Sunfish)= 61ppm

Biodegradability..... Not available

Environmental Effects..... This product is highly toxic to aquatic life.



Section 13 - Disposal Consideration

Waste Disposal.....Dispose in accordance with all federal, provincial, and/or local regulations including the Canadian Environmental Protection Act.

Section 14 - Transportation Information

TDG Classification

Class..... 8

Group..... II

PIN Number..... UN 1849

Other..... Secure containers (full and/or empty) with suitable hold down devices during shipment.

Section 15 - Regulatory Information

WHMIS Classification.....E, D1A

NOTE: THE PRODUCT LISTED ON THIS MSDS HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE HAZARD CRITERIA OF THE CANADIAN CONTROLLED PRODUCTS REGULATIONS. THIS MSDS CONTAINS ALL INFORMATION REQUIRED BY THOSE REGULATIONS

Section 16 - Other Information

Note: The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment. The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations.

ClearTech Industries Inc. - Locations

Corporate Head Office: 2302 Hanselman Avenue, Saskatoon, SK, S7L 5Z3

Phone: 306-664-2522

Fax: 306-665-6216

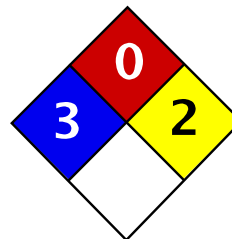
www.ClearTech.ca

Location	Address	Postal Code	Phone Number	Fax Number
Richmond BC	12431 Horseshoe way	V7A 4X6	604-272-4000	604-272-4596
Calgary AB	5516E - 40 th St. S.E.	T2C 2A1	403-279-1096	403-236-0989
Edmonton AB	11750 - 180 th Street	T5S 1N7	780-452-6000	780-452-4600
Saskatoon SK	2302 Hanselman Avenue	S7L 5Z3	306-933-0177	306-933-3282



Regina SK	555 Henderson Drive	S42 5X2	306-721-7737	306-721-8611
Winnipeg MB	340 Saulteaux Crescent	R3J 3T2	204-987-9777	204-987-9770
Mississauga ON	7480 Bath Road	L4T 1L2	905-612-0566	905-612-0575

24 Hour Emergency Number - All Locations - 306-664-2522



Health	3
Fire	0
Reactivity	2
Personal Protection	

Material Safety Data Sheet

Sulfuric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sulfuric acid

Catalog Codes: SLS2539, SLS1741, SLS3166, SLS2371, SLS3793

CAS#: 7664-93-9

RTECS: WS5600000

TSCA: TSCA 8(b) inventory: Sulfuric acid

CI#: Not applicable.

Synonym: Oil of Vitriol; Sulfuric Acid

Chemical Name: Hydrogen sulfate

Chemical Formula: H₂-SO₄

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sulfuric acid	7664-93-9	95 - 98

Toxicological Data on Ingredients: Sulfuric acid: ORAL (LD₅₀): Acute: 2140 mg/kg [Rat.]. VAPOR (LC₅₀): Acute: 510 mg/m 2 hours [Rat]. 320 mg/m 2 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:

Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, of inhalation. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, + (Proven.) by OSHA. Classified A2 (Suspected for human.) by ACGIH.

MUTAGENIC EFFECTS: Not available.

TERATOGENIC EFFECTS: Not available.

DEVELOPMENTAL TOXICITY: Not available.

The substance may be toxic to kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes, teeth. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion:

Products of combustion are not available since material is non-flammable. However, products of decomposition include fumes of oxides of sulfur. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas. Reacts with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.

Fire Hazards in Presence of Various Substances: Combustible materials

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available.

Risks of explosion of the product in presence of static discharge: Not available.

Slightly explosive in presence of oxidizing materials.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:

Metal acetylides (Monocesium and Monorubidium), and carbides ignite with concentrated sulfuric acid.

White Phosphorous + boiling Sulfuric acid or its vapor ignites on contact.

May ignite other combustible materials.

May cause fire when sulfuric acid is mixed with Cyclopentadiene, cyclopentanone oxime, nitroaryl amines, hexalithium disilicide, phosphorous (III) oxide, and oxidizing agents such as chlorates, halogens, permanganates.

Special Remarks on Explosion Hazards:

Mixtures of sulfuric acid and any of the following can explode: p-nitrotoluene, pentasilver

trihydroxydiaminophosphate, perchlorates, alcohols with strong hydrogen peroxide, ammonium tetraperoxychromate, mercuric nitrite, potassium chlorate, potassium permanganate with potassium chloride, carbides, nitro compounds, nitrates, carbides, phosphorous, iodides, picrates, fulminates, dienes, alcohols (when heated)

Nitramide decomposes explosively on contact with concentrated sulfuric acid.

1,3,5-Trinitrosohexahydro-1,3,5-triazine + sulfuric acid causes explosive decomposition.

Section 6: Accidental Release Measures

Small Spill:

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:

Corrosive liquid. Poisonous liquid.

Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture.

May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage:

Hygroscopic. Reacts. violently with water. Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 1 STEL: 3 (mg/m³) [Australia] Inhalation

TWA: 1 (mg/m³) from OSHA (PEL) [United States] Inhalation

TWA: 1 STEL: 3 (mg/m³) from ACGIH (TLV) [United States] [1999] Inhalation

TWA: 1 (mg/m³) from NIOSH [United States] Inhalation

TWA: 1 (mg/m³) [United Kingdom (UK)] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Thick oily liquid.)

Odor: Odorless, but has a choking odor when hot.

Taste: Marked acid taste. (Strong.)

Molecular Weight: 98.08 g/mole

Color: Colorless.

pH (1% soln/water): Acidic.

Boiling Point:

270°C (518°F) - 340 deg. C

Decomposes at 340 deg. C

Melting Point: -35°C (-31°F) to 10.36 deg. C (93% to 100% purity)

Critical Temperature: Not available.

Specific Gravity: 1.84 (Water = 1)

Vapor Pressure: Not available.

Vapor Density: 3.4 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:

Easily soluble in cold water.

Sulfuric is soluble in water with liberation of much heat.

Soluble in ethyl alcohol.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability:

Conditions to Avoid: Incompatible materials, excess heat, combustible material materials, organic materials, exposure to moist air or water, oxidizers, amines, bases.

Always add the acid to water, never the reverse.

Incompatibility with various substances:

Reactive with oxidizing agents, reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture.

Corrosivity:

Extremely corrosive in presence of aluminum, of copper, of stainless steel(316).

Highly corrosive in presence of stainless steel(304).

Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Hygroscopic. Strong oxidizer. Reacts violently with water and alcohol especially when water is added to the product.

Incompatible (can react explosively or dangerously) with the following: ACETIC ACID, ACRYLIC ACID, AMMONIUM HYDROXIDE, CRESOL, CUMENE, DICHLOROETHYL ETHER, ETHYLENE CYANOHYDRIN, ETHYLENEIMINE, NITRIC ACID, 2-NITROPROPANE, PROPYLENE OXIDE, SULFOLANE, VINYLIDENE CHLORIDE, DIETHYLENE GLYCOL MONOMETHYL ETHER, ETHYL ACETATE, ETHYLENE CYANOHYDRIN, ETHYLENE GLYCOL MONOETHYL ETHER ACETATE, GLYOXAL, METHYL ETHYL KETONE, dehydrating agents, organic materials, moisture (water), Acetic anhydride, Acetone, cyanohydrin, Acetone+nitric acid, Acetone + potassium dichromate, Acetonitrile, Acrolein, Acrylonitrile, Acrylonitrile+water, Alcohols + hydrogen peroxide, ally compounds such as Allyl alcohol, and Allyl Chloride, 2-Aminoethanol, Ammonium hydroxide, Ammonium triperchromate, Aniline, Bromate + metals, Bromine pentafluoride, n-Butyraldehyde, Carbides, Cesium acetylene carbide, Chlorates, Cyclopentanone oxime, chlorinates, Chlorates + metals, Chlorine trifluoride, Chlorosulfonic acid, 2-cyano-4-nitrobenzenediazonium hydrogen sulfate, Cuprous nitride, p-chloronitrobenzene, 1,5-Dinitronaphthlene + sulfur, Diisobutylene, p-dimethylaminobenzaldehyde, 1,3-Diazidobenzene, Dimethylbenzylcarbinol + hydrogen peroxide, Epichlorohydrin, Ethyl alcohol + hydrogen peroxide, Ethylene diamine, Ethylene glycol and other glycols, , Ethylenimine, Fulminates, hydrogen peroxide, Hydrochloric acid, Hydrofluoric acid, Iodine heptafluoride, Indane + nitric acid, Iron, Isoprene, Lithium silicide, Mercuric nitride, Mesityl oxide, Mercury nitride, Metals (powdered), Nitromethane, Nitric acid + glycerides, p-Nitrotoluene, Pentasilver trihydroxydiaminophosphate, Perchlorates, Perchloric acid, Permanganates + benzene, 1-Phenyl-2-methylpropyl alcohol + hydrogen peroxide, Phosphorus, Phosphorus isocyanate, Picrates, Potassium tert-butoxide, Potassium chlorate, Potassium Permanganate and other permanganates, halogens, amines, Potassium Permanganate + Potassium chloride, Potassium Permanganate + water, Propiolactone (beta)-, Pyridine, Rubidium acetylene carbide, Silver permanganate, Sodium, Sodium carbonate, sodium hydroxide, Steel, styrene monomer, toluene + nitric acid, Vinyl acetate, Thallium (I) azidodithiocarbonate, Zinc chlorate, Zinc iodide, azides, carbonates, cyanides, sulfides, sulfites, alkali hydrides, carboxylic acid anhydrides, nitriles, olefinic organics, aqueous acids, cyclopentadiene, cyano-alcohols, metal acetylides, Hydrogen gas is generated by the action of the acid on most metals (i.e. lead, copper, tin, zinc, aluminum, etc.). Concentrated sulfuric acid oxidizes, dehydrates, or sulfonates most organic compounds.

Special Remarks on Corrosivity:

Non-corrosive to lead and mild steel, but dilute acid attacks most metals.

Attacks many metals releasing hydrogen.

Minor corrosive effect on bronze.

No corrosion data on brass or zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.

Acute oral toxicity (LD50): 2140 mg/kg [Rat.].

Acute toxicity of the vapor (LC50): 320 mg/m³ 2 hours [Mouse].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, + (Proven.) by OSHA. Classified A2 (Suspected for human.) by ACGIH.

May cause damage to the following organs: kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes, teeth.

Other Toxic Effects on Humans:

Extremely hazardous in case of inhalation (lung corrosive).

Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion, .

Special Remarks on Toxicity to Animals: Not available.**Special Remarks on Chronic Effects on Humans:**

Mutagenicity: Cytogenetic Analysis: Hamster, ovary = 4mmol/L

Reproductive effects: May cause adverse reproductive effects based on animal data. Developmental abnormalities (musculoskeletal) in rabbits at a dose of 20 mg/m³ for 7 hrs.(RTECS)

Teratogenecity: neither embryotoxic, fetotoxic, nor teratogenetic in mice or rabbits at inhaled doses producing some maternal toxicity

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects:

Skin: Causes severe skin irritation and burns. Continued contact can cause tissue necrosis.

Eye: Causes severe eye irritation and burns. May cause irreversible eye injury.

Ingestion: Harmful if swallowed. May cause permanent damage to the digestive tract. Causes gastrointestinal tract burns. May cause perforation of the stomach, GI bleeding, edema of the glottis, necrosis and scarring, and sudden circulatory collapse(similar to acute inhalation). It may also cause systemic toxicity with acidosis.

Inhalation: May cause severe irritation of the respiratory tract and mucous membranes with sore throat, coughing, shortness of breath, and delayed lung edema. Causes chemical burns to the respiratory tract. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Cause corrosive action on mucous membranes. May affect cardiovascular system (hypotension, depressed cardiac output, bradycardia). Circulatory collapse with clammy skin, weak and rapid pulse, shallow respiration, and scanty urine may follow. Circulatory shock is often the immediate cause of death. May also affect teeth(changes in teeth and supporting structures - erosion, discoloration).

Chronic Potential Health Effects:

Inhalation: Prolonged or repeated inhalation may affect behavior (muscle contraction or spasticity), urinary system (kidney damage), and cardiovascular system, heart (ischemic heart leisons), and respiratory system/lungs(pulmonary edema, lung damage), teeth (dental discoloration, erosion).

Skin: Prolonged or repeated skin contact may cause dermatitis, an allergic skin reaction.

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 49 mg/l 48 hours [bluegill/sunfish].

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Sulfuric acid may be placed in sealed container or absorbed in vermiculite, dry sand, earth, or a similar material. It may also be diluted and neutralized. Be sure to consult with local or regional authorities (waste regulators) prior to any disposal. Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Sulfuric acid UNNA: 1830 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information**Federal and State Regulations:**

Illinois toxic substances disclosure to employee act: Sulfuric acid
New York release reporting list: Sulfuric acid
Rhode Island RTK hazardous substances: Sulfuric acid
Pennsylvania RTK: Sulfuric acid
Minnesota: Sulfuric acid
Massachusetts RTK: Sulfuric acid
New Jersey: Sulfuric acid
California Director's List of Hazardous Substances (8 CCR 339): Sulfuric acid
Tennessee RTK: Sulfuric acid
TSCA 8(b) inventory: Sulfuric acid
SARA 302/304/311/312 extremely hazardous substances: Sulfuric acid
SARA 313 toxic chemical notification and release reporting: Sulfuric acid
CERCLA: Hazardous substances.: Sulfuric acid: 1000 lbs. (453.6 kg)

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:**WHMIS (Canada):**

CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS E: Corrosive liquid.

DSCL (EEC):

R35- Causes severe burns.
S2- Keep out of the reach of children.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S30- Never add water to this product.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 2

Personal Protection:**National Fire Protection Association (U.S.A.):****Health:** 3**Flammability:** 0**Reactivity:** 2**Specific hazard:****Protective Equipment:**

Gloves.

Full suit.

Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.

Face shield.

Section 16: Other Information**References:**

- Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
- The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
- Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.

Other Special Considerations: Not available.**Created:** 10/09/2005 11:58 PM**Last Updated:** 11/06/2008 12:00 PM

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info@oldbridgechem.com

www.oldbridgechem.com

MATERIAL SAFETY DATA SHEET

October 25, 2006

Page 1 of 4

Common Name: ZINC SULFATE

Manufacturer: Madison Industries, Inc.
P.O. Box 175
Old Bridge, New Jersey 08857

Telephone: 732-727-2225
Emergency Telephone: 800-275-3924
24 Hour Emergency Telephone: 800-424-9300 (Chemtrec)

HAZARDOUS CLSSIFICATION: NFPA: Health-2 / Fire-0 / Reactivity-0
HMIS: Health-2 / Fire-0 / Reactivity-0

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200).

ATTENTION: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

SECTION I. MATERIAL IDENTIFICATION

Common Name: Zinc Sulfate
Trade Name: Zinc Sulfate Monohydrate
Molecular Formula: $\text{ZnSO}_4 \cdot \text{H}_2\text{O}$
Molecular Weight: 179
CAS Number: 7446-19-7

SECTION II. HAZARDS

This material or the components of this material are included in the Toxic Chemical Inventory as required in Section 8 (b) of the Toxic Substance Control Act (Public Law 94-469) and is codified in 40 CR 720.

Superfund Amendments & Reauthorization Act - Title III Applicability Section 312 40 CFR 370.40:

Health X Acute
Hazard X Chronic

Section 313 Zinc Compounds 40 CFR 372-85

SECTION III. PHYSICAL DATA

Physical State:	White powder or granules
Boiling Point:	NA
Melting Point:	No data
Crystallization Point:	70°F
Vapor Density:	0 (water = 1)
Specific Gravity:	3.28
Solubility in H ₂ O:	30% at 70°F
Appearance:	White powder or granules
Evaporation Rate:	NA

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point:	Not flammable.
Extinguishing Media:	Dry chemical, Carbon Dioxide or Foam. Water may be ineffective, but water spray or fog may be used as a cooling agent.
Fire and Explosion Hazards:	May release toxic Oxides of Zinc and Sulfur in a fire.

SECTION V. REACTIVITY DATA

Stability:	Stable at normal temperatures and pressures.
Thermal Decomposition:	May release toxic and hazardous Oxides of Zinc and Sulfur.
Polymerization:	Will not occur.

SECTION VI. HEALTH AND HAZARD INFORMATION

Route of Entry:	Ingestion or inhalation.
Target Organs:	Respiratory system, eyes and skin.
Acute Exposure:	May cause skin irritation. May cause eye irritation, possible corneal burn. May cause gastrointestinal disturbance. May cause irritation to nose and throat.
Chronic Exposure:	May cause skin dermatitis. May cause eye conjunctivitis. No known ingestion reaction anticipated. May cause inhalation reflex bronchial constriction.

SECTION VII. FIRST AID PROCEDURES

Swallowing:	If person is conscious induce vomiting. Call Poison Control Center or a physician. Do not give anything by mouth to an unconscious person.
Skin:	Immediately wash skin with soap and plenty of water. Remove contaminated clothing and shoes. Call a physician. Wash contaminated clothing before reuse.
Eyes:	Immediately flush eyes with plenty of water for 15 minutes. Hold eyelids apart during irrigation. Call a physician.
Inhalation:	Immediately remove person to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped administer artificial respiration. Keep person warm and calm. Call a physician.
Carcinogenicity:	None

SECTION VIII. HANDLING PRECAUTIONS

Personal Protective Equipment:	Respirators - If exposure cannot be maintained at or below established OSHA guidelines, respiratory protection must be provided in accordance with 29 CFR 1910.134 requirements. Skin Protection - Wear appropriate protective clothing and chemical resistant gloves as needed to prevent skin contact. Consult manufacturer to determine appropriate type of gloves or clothing for your particular application. Clean contaminated clothing and protective equipment before reuse. Wash thoroughly after handling material. Eye Protection - Wear splash proof or dust proof safety goggles wherever there is a potential for eye contact.
Ventilation:	Provide local exhaust or process enclosing ventilation to maintain exposures below OSHA guidelines 29 CFR 1910.1000 subpart 7.

SECTION IX. SPILL OR LEAK PROCEDURES

Spills or Leaks:	Comply with Federal, State and Local regulations on reporting spills. Flush with plenty of water to an approved chemical sewer.
Waste Disposal:	Comply with Federal, State and Local regulations. Zinc Sulfate can be carefully reacted with Sodium Carbonate to form an insoluble Zinc Carbonate solid that can be scooped up and sent to a disposal contractor.

SECTION X. SPECIAL PRECAUTIONS

Storage:	Heated storage is necessary to prevent crystallization. Keep containers closed.
Other Precautions:	Do not take internally.

SECTION XI. REGULATORY INFORMATION

NOTICE: The information herein is presented in good faith and believed to be accurate. However, no warranty, expressed or implied, is given. Regulatory requirements are subject to change and may differ from one location to another. It is the buyer's responsibility to ensure that its activities comply with Federal, State and local laws.

U.S. REGULATIONS: SARA 313 Information; this product contains the following substance subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372: **Zinc Compound 40.5%**

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following category:

AN IMMEDIATE HEALTH HAZARD

SECTION XII. SHIPPING INFORMATION

QUANTITIES OF 1000 POUNDS OR MORE: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, NOS, (Zinc Sulfate) 9, UN3082, PGIII, RQ, ERG 171

QUANTITIES OF LESS THAN 1000 POUNDS: NON-HAZARDOUS AND NON-REGULATED IN THAT PACKAGE

SECTION XIII. MSDS PREPARATION INFORMATION

Prepared by: Joel L. Goldschmidt
Vice President

Material Safety Data Sheet

Material Name: **Low Sulfur Diesel-S15**

MSDS ID: NOVA-0034

Section 1 - Product and Company Identification

Synonyms: Ultra-low sulphur diesel, diesel oil, fuel distillate, hydrodesulfurized kerosene

Chemical Name: Kerosine, petroleum, hydrodesulfurized

Chemical Family: Kerosene

Material Use: Fuel for home heating; also for marine and on-road diesel engines

Chemical Formula: Not available; complex mixture

NOVA Chemicals
P.O. Box 2518, Station M
Calgary, Alberta, Canada T2P 5C6

Product Information: 1-412-490-4063

MSDS Information Email:
msdsemail@novachem.com

EMERGENCY Telephone Numbers:

North America (Canada and US):

1-800-561-6682, 1-403-314-8767 (NOVA Chemicals) (24 hours)

1-800-424-9300 (CHEMTREC-USA) (24 hours)

1-613-996-6666 (Canutec-Canada) (24 hours)

Mexico and South America: +44 208 762 8322 (NCEC) (24 hours)

General Comments

This product is a complex mixture of aliphatic, olefinic, naphthenic and aromatic hydrocarbons having a variable boiling range of 160°C to 370°C (320°F to 698°F).

Section 2 - Hazards Identification

HMIS Ratings: Health: 1* Fire: 2 Physical Hazard: 0 Personal Protection: chemical goggles, gloves, respirator

*Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic hazard*

NFPA Ratings: Health: 1 Fire: 2 Reactivity: 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

Emergency Overview

WARNING! COMBUSTIBLE. Product is an amber oily liquid with a kerosene-like odor. This product burns readily when heated to high temperatures, giving off combustible and toxic vapors. This product is harmful and possibly fatal if swallowed. Small amounts of this product, if aspirated into the lungs, may cause mild to severe injury. This product is irritating to the eyes and skin. Ingestion or excessive inhalation of this product may result in headache, sleepiness, dizziness, nausea, loss of coordination, and in extreme conditions coma and possibly death. Contains trace components that may cause cancer. Avoid contact. Pre-existing medical conditions may be aggravated by exposure. Prevent entry into ditches, sewers, and waterways.

Potential Health Effects: Eyes

This product is irritating to the eyes. Pre-existing medical conditions are aggravated by exposure.

Potential Health Effects: Skin

Prolonged and/or repeated skin contact with this product may cause irritation, blistering and severe dermatitis. Product may be partially absorbed through intact skin. Prolonged or repeated contact with this product may cause allergic-like skin reactions and over time may possibly cause skin cancer. Pre-existing medical conditions are aggravated by exposure.

Potential Health Effects: Ingestion

This product is harmful or fatal if swallowed. Ingestion causes gastrointestinal irritation, nausea, vomiting, and cramping; depression of the central nervous system. May also cause central nervous system effects including headache, sleepiness, dizziness, nausea, loss of coordination, and in extreme conditions coma and possibly death. Ingestion may cause kidney and liver damage and blood disorders. Small amounts of this product, if aspirated into the lungs, may cause mild to severe pulmonary injury.

Potential Health Effects: Inhalation

This product may be harmful by inhalation. Pre-existing medical conditions are aggravated by exposure. Excessive inhalation of this material may result in heartbeat irregularities and central nervous system effects including headache, sleepiness, dizziness, nausea, loss of coordination, and in extreme conditions respiratory failure, coma and possibly death. Small amounts of this product, if aspirated into the lungs, may cause mild to severe pulmonary injury.

Material Safety Data Sheet

Material Name: **Low Sulfur Diesel-S15**

MSDS ID: NOVA-0034

Section 3 - Composition / Information on Ingredients

CAS #	Component	Percent by Wt.
64742-81-0	Kerosine, petroleum, hydrodesulfurized	≥99.5
7704-34-9	Sulfur	0-0.0015

Additional Information

This product is considered to be hazardous under 29 CFR 1910.1200 (Hazard Communication).

This material is a controlled product under Canadian WHMIS regulations.

This material is regulated as a hazardous material/dangerous goods for transportation.

See Section 8 for applicable exposure limits. See Section 11 for applicable toxicity data.

Section 4 - First Aid Measures

First Aid: Eyes

Remove contact lenses, if it can be done safely. Immediately flush eyes with water for at least 15 minutes, while holding eyelids open. Seek medical attention if symptoms develop or persist.

First Aid: Skin

For skin contact, wash immediately with soap and water for at least 15 minutes. Seek medical attention if symptoms develop or persist. Completely decontaminate clothing, shoes and other protective equipment before reuse or discard.

First Aid: Inhalation

Move affected individual to non-contaminated air. Loosen tight clothing such as a collar, tie, belt or waistband to facilitate breathing. Seek immediate medical attention if the individual is not breathing, is unconscious or if any other symptoms persist. WARNING: Contact through mouth-to-mouth resuscitation may pose a secondary risk to the rescuer. Avoid mouth-to-mouth contact by using a mouth shield or guard to perform artificial respiration.

First Aid: Ingestion

DO NOT INDUCE VOMITING. Loosen tight clothing such as a collar, tie, belt or waistband. Seek immediate medical attention. Small amounts which accidentally enter the mouth should be rinsed out until taste is gone.

First Aid: Notes to Physician

For more detailed medical emergency support information call 1-800-561-6682 or 1-403-314-8767 (24 hours, NOVA Chemicals Emergency Response). Ensure thorough eye and skin decontamination. Treat unconsciousness, nausea, hypotension, seizures and cardiac arrhythmias in the conventional manner. Aspiration of this product during induced emesis can result in lung injury. If evacuation of stomach contents is considered necessary, use the method least likely to cause aspiration, such as gastric lavage after protecting the airway. Observe hospitalized patients for delayed chemical pneumonia, acute tubular necrosis, encephalopathy and dysrhythmias. Monitor for urinary phenol within 72 hours of acute exposure.

Section 5 - Fire Fighting Measures

See Section 9: Physical Properties for flammability limits, flash point and autoignition information.

General Fire Hazards

Fire and container explosion hazards are serious when this product is exposed to heat, flame or oxidizing materials. Empty containers when heated may pose a fire risk. Vapors are heavier than air and may travel along the ground to some distant source of ignition and flash back. Consider need for immediate emergency isolation and evacuation.

Explosion Hazards

Vapors may form explosive mixture with air. Keep containers away from source of heat, fire or oxidizing materials.

Hazardous Combustion Products

Upon decomposition, this product emits carbon monoxide, carbon dioxide, low molecular weight hydrocarbons, acidic gases, nitrogen oxides, sulfur oxides, and other toxic contaminants.

Extinguishing Media

Dry chemical, foam, carbon dioxide, and water fog. Water may be an ineffective extinguishing medium and increase spread of flames. Use water spray to cool fire-exposed containers and to protect personnel. Monitor water run-off for flammability, and prevent from entering drains and sewers, or other confined or underground spaces.

Material Safety Data Sheet

Material Name: **Low Sulfur Diesel-S15**

MSDS ID: NOVA-0034

Fire Fighting Equipment/Instructions

Reference 2004 Emergency Response Guidebook, Guide No. 128 for additional details and instructions. Position upwind. Keep unnecessary personnel away. Move containers from fire area if you can do so without risk. Fight fire from maximum distance or use unmanned holders or monitor nozzles. Immediately withdraw in case of fire and tank venting or heat discoloration of a tank. If container, rail car or tank truck is involved in a fire, isolate for 800 meters (1/2 mile) in all directions, also consider initial evacuation for 800 meters (1/2 mile) in all directions. Fire fighters should wear full-face, self-contained breathing apparatus and thermal protective clothing. Avoid inhaling any smoke and combustion products. Remove and clean or destroy any contaminated clothing. Cool containers with water spray until well after the fire is out. Control runoff waters to prevent entry into sewers, drains, underground or confined spaces and waterways.

Section 6 - Accidental Release Measures

Evacuation Procedures

Isolate area. Keep unnecessary personnel away. Alert stand-by emergency and fire fighting personnel. Monitor surrounding area for build-up of flammable air concentrations.

Spills

Small spill or leak area should be isolated immediately for at least 50 meters (164 feet) in all directions. Eliminate ignition sources. Large spills, isolate and consider downwind evacuation for 300 meters (984 feet). Keep upwind and out of low areas. Stop discharge if safe to do so. Contain discharge by booming on water or diking on ground. Remove liquid material with non-sparking approved pumps, skimmers or vacuum equipment. Absorb with DRY earth, sand or other non-combustible material. Soil remediation may be required. Prevent entry into sewers, drains, underground or confined spaces, water intakes and waterways.

Special Procedures

Contact local police/emergency services and appropriate emergency telephone numbers provided in Section 1. Ensure that statutory and regulatory reporting requirements in the applicable jurisdiction are met. Wear appropriate protective equipment and clothing during cleanup. Individuals without appropriate protective equipment should be excluded from area of spill until cleanup has been completed

See Section 8 for recommended Personal Protective Equipment and see Section 13 for waste disposal considerations.

Section 7 - Handling and Storage

Handling Procedures

Keep locked up or secured. Handle in fully grounded, properly designed and approved equipment systems that are suitable for flammable liquids. Use with adequate ventilation. Do not ingest or inhale. Keep away from heat and ignition sources. No smoking or open flames permitted in storage, use or handling areas. Dissipate static electricity during transfer by grounding and bonding containers and equipment. An anti-static agent may be added to storage tanks to reduce static charge build-up during loading. Take special precautions when cold cutting or breaking into lines, or when cleaning and disposing of empty containers. Do not breathe gas, fumes, vapor or spray. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately. Avoid contact with skin and eyes. Keep away from incompatible materials such as oxidizing agents. After handling, always wash hands thoroughly with soap and water.

Storage Procedures

Storage area should be clearly identified, well-illuminated, clear of obstruction and accessible only to trained and authorized personnel. Adequate security must be provided so that unauthorized personnel do not have access to product. Store in grounded, properly designed and approved vessels and away from incompatible materials. Store and use away from heat, sparks, open flame, or any other ignition source. An anti-static agent may be added to storage tanks to reduce static charge build-up during loading. Keep absorbents for leaks and spills readily available. Store according to applicable regulations. Have appropriate extinguishing capability in storage area (e.g. sprinkler system, portable fire extinguishers) and flammable gas detectors. Inspect vents during winter conditions for vapor ice build-up.

See Section 8: Exposure Controls/Personal Protection for appropriate Personal Protective Equipment. See Section 10 for information on incompatibilities.

Material Safety Data Sheet

Material Name: **Low Sulfur Diesel-S15**

MSDS ID: NOVA-0034

Section 8 - Exposure Controls / Personal Protection

Exposure Guidelines

A: General Product Information

Refer to published exposure limits - use effective control measures and PPE to maintain worker exposure to concentrations that are below these limits. Ensure that eyewash stations and safety showers are proximal to work locations.

B: Component Exposure Limits

ACGIH, OSHA, NIOSH, EPA, Alberta, and Ontario exposure limit lists have been checked for major components listed with CAS registry numbers. Other exposure limits may apply, check with proper authorities.

Kerosine, petroleum, hydrodesulfurized (64742-81-0)

ACGIH: 200 mg/m³ TWA (as total hydrocarbon vapor) (application restricted to conditions in which there are negligible aerosol exposures)

Skin - potential significant contribution to overall exposure by the cutaneous route.

Ontario: 200 mg/m³ TWAEV (as total hydrocarbon vapor) (application restricted to conditions in which there are negligible aerosol exposures)

Absorption through skin, eyes, or mucous membranes

Sulfur (7704-34-9)

Alberta: 10 mg/m³ TWA

ENGINEERING CONTROLS

Engineering methods to reduce hazardous exposure are preferred controls. Methods include mechanical ventilation (dilution and local exhaust) process or personal enclosure, remote and automated operation, control of process conditions, leak detection and repair systems, and other process modifications. Ensure all exhaust ventilation systems are discharged to outdoors, away from air intakes and ignition sources. Supply sufficient replacement air to make up for air removed by exhaust systems. Administrative (procedure) controls and use of personal protective equipment may also be required.

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment: Eyes/Face

Wear safety glasses; chemical goggles are recommended if splashing is possible, or to prevent eye irritation from vapors.

Personal Protective Equipment: Skin/Hands/Feet

Use impervious gloves. Wear chemical-resistant safety footwear with good traction to prevent slipping. Work clothing that sufficiently prevents skin contact should be worn, such as coveralls and long sleeves. Fire resistant (i.e., Nomex) or natural fiber clothing (i.e., cotton or wool) is recommended. Synthetic clothing can generate static electricity and is not recommended where flammable vapor releases may occur.

Personal Protective Equipment: Respiratory

If engineering controls and ventilation is not sufficient to prevent buildup of aerosols or vapors, appropriate NIOSH/MSHA approved air-purifying respirators or self-contained breathing apparatus (SCBA) appropriate for exposure potential should be used. Air supplied breathing apparatus must be used when oxygen concentrations are low or if airborne concentrations exceed the limits of the air-purifying respirators.

Personal Protective Equipment: General

Personal protective equipment (PPE) should not be considered a long-term solution to exposure control. Employer programs to properly select, fit, maintain, and train employees to use equipment must accompany PPE. Consult a competent industrial hygiene resource, the PPE manufacturer's recommendation, and/or applicable regulations to determine hazard potential and ensure adequate protection.

Material Safety Data Sheet

Material Name: **Low Sulfur Diesel-S15**

MSDS ID: NOVA-0034

Section 9 - Physical & Chemical Properties

Physical State and Appearance:	Oily liquid	Color:	Amber
Odor:	Kerosene-like; can be detected at low ppm levels	pH:	Not available
Vapor Pressure:	1.50 mm Hg at 20°C (68°F)	Vapor Density @ 0°C (Air=1):	8
Boiling Point:	Range: 160°C-370°C (320°F-698 °F)	Melting Point:	Not applicable
Solubility (H2O):	Insoluble	Specific Gravity (Water=1):	≤ 0.881
Freezing Point:	Range: -36°C - 0°C (-32.8°F - 32°F)	Dispersion Properties:	Not available
Evaporation Rate (Ethyl Ether):	600	Viscosity:	Range: 1.30 -4.10 cSt at 40°C (104°F)
Percent Volatile:	100%	Auto Ignition:	257°C (494.6°F)
Flash Point:	≥40°C (≥104°F)	Flash Point Method:	Pensky-Martens
Upper Flammable Limit (UFL):	Not available	Lower Flammable Limit (LFL):	Not available
Flammability Classification:	Combustible		

Section 10 - Stability & Reactivity Information

Chemical Stability

This product is stable under normal use conditions for shock, vibration, pressure, or temperature.

Instability

Not applicable

Chemical Stability: Conditions to Avoid

Keep away from heat, sparks, or open flame.

Incompatibility

May react with oxidizing agents. Slightly reactive with metals. Heated vapors or mists may form explosive mixture with air.

Hazardous Polymerization

Not likely to occur.

Corrosivity

Not considered to be corrosive.

Hazardous Decomposition

Upon decomposition, this product emits carbon monoxide, carbon dioxide, low molecular weight hydrocarbons, acidic gases, nitrogen oxides, sulfur oxides, and other toxic contaminants.

Section 11 - Toxicological Information

A: Acute Toxicity - General Product Information

Similar fuel oil mixtures have been tested under the EPA's High Production Volume (HPV) program for the Kerosenes/Jet Fuel Category. Kerosene is not considered acutely toxic. Animal tests have produced moderate to severe skin irritation and eye irritation. Eye irritation generally resolved within one to 7 days. Kerosenes did not produce sensitization when tested in guinea pigs. Sulfur component may cause sensitization.

B: Acute Toxicity - LD50/LC50

Kerosene, petroleum, hydrodesulfurized (64742-81-0)

Inhalation LC50 Rat: >5.2 mg/L/4H; Oral LD50 Rat: >5000 mg/kg; Dermal LD50 Rabbit: >2000 mg/kg

Sulfur (7704-34-9)

Inhalation LC50 Rat: >6.23 mg/L/4H; Oral LD50 Rat: >3000 mg/kg; Dermal LD50 Rabbit: >2000 mg/kg

Material Safety Data Sheet

Material Name: **Low Sulfur Diesel-S15**

MSDS ID: NOVA-0034

C: Chronic Toxicity - General Product Information

Similar fuel oil mixtures have been tested under the EPA's High Production Volume (HPV) program for the Kerosenes/Jet Fuel Category. Chronic skin exposure causes dermatitis and slight to moderate skin irritation in rabbits. Some animal studies have indicated damage to the heart and spleen. No tests have shown evidence of mutagenicity or teratogenicity. In carcinogenicity tests, kerosene was not an initiator but did show evidence of tumor promoting activity.

D: Chronic Toxicity - Carcinogenic Effects

ACGIH, EPA, IARC, OSHA, and NTP carcinogen lists have been checked for selected similar materials or those components with CAS registry numbers.

Kerosene, petroleum, hydrodesulfurized (64742-81-0)

ACGIH: A3 - Confirmed animal carcinogen with unknown relevance to humans (as total hydrocarbon vapor)

IARC: Monograph 45, 1989 (related to Jet Fuel) (Group 3 (not classifiable))

Section 12 - Ecological Information

Ecotoxicity

A: General Product Information

Similar fuel oil mixtures have been tested under the EPA's High Production Volume (HPV) program for the Kerosenes/Jet Fuel Category. Product is largely insoluble in water. Under ambient conditions, this product absorbs quickly in soil. Kerosene shows moderate toxicity to aquatic organisms.

B: Component Analysis - Ecotoxicity - Aquatic/Terrestrial Toxicity

Kerosene, petroleum, hydrodesulfurized (64742-81-0)

96 Hr LC50 Pimephales promelas: 45 mg/L [flow-through]; 96 Hr LC50 Lepomis macrochirus: 1740 mg/L [static]

96 Hr LC50 Dendronereides heteropoda: 4720 mg/L

Sulfur (7704-34-9)

96 Hr LC50 Brachydanio rerio: 866 mg/L [static]

Environmental Fate/Mobility

Kerosene is not subject to hydrolysis. Partitioning to water is <10% at equilibrium, while partitioning to sediment is 2% and to biota (fish) is 0.1%

Persistence/Degradability

This material is considered biodegradable. Some components biodegrade quickly while other higher molecular weight components will degrade more slowly. Atmospheric half-lives of 0.2 to 1.5 days have been calculated for representative C9 and C16 hydrocarbon components of kerosenes.

Bioaccumulation/Accumulation

Lower molecular-weight, normal hydrocarbons are most readily biodegraded but tend to partition to air rather than water, while more complex, higher molecular weight polynuclear aromatics and substituted aromatics tend to sorb to soil or sediment; both processes limit bioavailability and can slow biodegradation. The hydrocarbons in kerosenes are generally not inhibitory to microbial activity though changes in microbial community composition may occur in spill or impacted areas due to the proliferation of species that can biodegrade the compounds.

Section 13 - Disposal Considerations

U.S./Canadian Waste Number & Descriptions

A: General Product Information

This product may be known to be a hazardous waste according to US and Canadian regulations. The use, mixing or processing of this product may alter this product. Contact federal, provincial/state and local authorities in order to generate or ship a waste material associated with this product to ensure materials are handled appropriately and meet all criteria for disposal of hazardous waste. **DO NOT ATTEMPT TO DISPOSE OF BY UNCONTROLLED IGNITION.** Since emptied containers retain product residue, follow safe handling/label warnings even after container is emptied.

See Section 7: Handling and Storage and Section 8: Exposure Controls/Personal Protection for additional handling information that may be applicable for safe handling and the protection of employees.

Material Safety Data Sheet

Material Name: **Low Sulfur Diesel-S15**

MSDS ID: NOVA-0034

Waste generator is advised to carefully consider hazardous properties and control measures needed for other materials that may be found in the waste

B: Component Waste Numbers

No EPA Waste Numbers are applicable for this product's components.

Section 14 - Transportation Information

US DOT Information

Shipping Name: DIESEL FUEL

UN/NA #: NA1993 Hazard Class: 3 Packing Group: III

Required Label(s): None

Additional Info.: 2004 Emergency Guidebook, Guide #128.

This classification applies to US domestic shipments only.

This product meets the conditions of 49 CFR 173.120 (b)(2) and may be reclassified as a combustible liquid for shipments within the U.S..

Canadian TDG Information

Shipping Name: DIESEL FUEL

UN #: UN1202 Hazard Class: 3 Packing Group: III

Required Label(s): FLAMMABLE LIQUID

Additional Info.: 2004 Emergency Guidebook, Guide #128.

International Air Transport Association (IATA) and ICAO Information

Shipping Name: DIESEL FUEL

UN #: UN1202 Hazard Class: 3 Packing Group: III

Required Label(s): FLAMMABLE LIQUID

International Maritime Dangerous Goods (IMDG) Code

Shipping Name: DIESEL FUEL

UN #: UN1202 Hazard Class: 3 Packing Group: III

Required Label(s): FLAMMABLE LIQUID

Additional Info.: EmS Code: F-E, S-E

Marine Pollutant: No

Section 15 - Regulatory Information

A: International Regulations

Component Analysis - International Inventory Status

Component	CAS #	US - TSCA	CANADA - DSL	EU - EINECS
Kerosine, petroleum, hydrodesulfurized	64742-81-0	Yes	Yes	Yes
Sulfur	7704-34-9	Yes	Yes	Yes

B: USA Federal & State Regulations

Ongoing occupational hygiene, medical surveillance programs, or site emission or spill reporting may be required by Federal or State regulations. Check for applicable regulations.

USA OSHA Hazard Communication Class

This product/material is considered hazardous under 29 CFR 1910.1200 (Hazard Communication). HCS

Classes:

HCS CLASS: Combustible liquid having a flash point between 37.8°C (100°F) and 93.3°C (200°F).

HCS CLASS: Irritating substance.

HCS CLASS: Target organ effects.

USA Right-to-Know - Federal

None of this product's components are listed under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), or CERCLA (40 CFR 302.4).

USA Right-to-Know - State

The following components appear on one or more of the following state hazardous substances lists. Some components (including those present only in trace quantities, and therefore not listed in this document) may be included on the Right-To-Know lists of other U.S. states. The reader is therefore cautioned to contact his or her

Material Safety Data Sheet

Material Name: **Low Sulfur Diesel-S15**

MSDS ID: NOVA-0034

NOVA Chemicals' representative or NOVA Chemicals' Product Integrity group for further U.S. State Right-To-Know information.

Component	CAS	NJ	PA
Sulfur	7704-34-9	Yes	Yes

C: Canadian Regulations - Federal and Provincial

WHMIS Ingredient Disclosure List (IDL)

No components are listed in the WHMIS Ingredient Disclosure List (IDL).

WHMIS Classification

Workplace Hazardous Materials Information System (WHMIS): This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and the MSDS contains all the information required by the CPR.

WHMIS CLASS B3: Combustible liquid with a flash point between 37.8°C (100°F) and 93.3°C (200°F).

WHMIS CLASS D2A: Material causing other toxic effects, very toxic material.

WHMIS CLASS D2B: Material causing other toxic effects, toxic material.

Other Regulations

Ongoing occupational hygiene, medical surveillance programs, or site emission or spill reporting may be required by Federal or Provincial regulations. Check for applicable regulations.

Section 16 - Other Information

Label Information

WARNING COMBUSTIBLE Product is an amber oily liquid with a kerosene-like odor. This product burns readily when heated to high temperatures, giving off combustible and toxic vapors. This product is harmful and possibly fatal if swallowed. Small amounts of this product, if aspirated into the lungs, may cause mild to severe injury. This product is irritating to the eyes and skin. Ingestion or excessive inhalation of this product may result in headache, sleepiness, dizziness, nausea, loss of coordination, and in extreme conditions coma and possibly death. Contains trace components that may cause cancer. Avoid contact. Pre-existing medical conditions are aggravated by exposure. Prevent entry into ditches, sewers, and waterways.

FIRST AID:

SKIN: For skin contact, wash immediately with soap and water for at least 15 minutes. Seek medical attention if symptoms develop or persist. Completely decontaminate clothing, shoes and other protective equipment before reuse or discard.

EYES: Remove contact lenses, if it can be done safely. Immediately flush eyes with water for at least 15 minutes, while holding eyelids open. Seek medical attention if symptoms develop or persist.

INHALATION: Move affected individual to non-contaminated air. Loosen tight clothing such as a collar, tie, belt or waistband to facilitate breathing. Seek immediate medical attention if the individual is not breathing, is unconscious or if any other symptoms persist.

WARNING: Contact through mouth-to-mouth resuscitation may pose a secondary risk to the rescuer. Avoid mouth-to-mouth contact by using a mouth shield or guard to perform artificial respiration.

INGESTION: DO NOT INDUCE VOMITING. Loosen tight clothing such as a collar, tie, belt or waistband. Seek immediate medical attention. Small amounts which accidentally enter the mouth should be rinsed out until taste is gone.

IN CASE OF A LARGE SPILL: Consider downwind evacuation for 300 meters (984 feet). Stop discharge if safe to do so. Eliminate ignition sources. Keep upwind and out of low areas. Isolate, contain, and attempt to recover. Absorb with DRY earth, sand or other non-combustible material. Remove material with non-sparking approved pumps, skimmers or vacuum equipment. Soil remediation may be required. Prevent entry into sewers, drains, underground or confined spaces, water intakes and waterways.

References

Available on request.

Special Considerations

The International Agency for Research on Cancer (IARC) has categorized diesel exhaust as carcinogenic to humans (Class 2A).

Diesel exhaust particulates

NTP: Reasonably Anticipated to be a Human Carcinogen (related to Diesel exhaust particulates)

IARC: Monograph 46, 1989 (related to Diesel engine exhaust) (Group 2A (probably carcinogenic to humans))

For additional information on equipment bonding and grounding, refer to the American Petroleum Institute (API) Recommended Practice 2003, "Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents" or National Fire Protection Association (NFPA) 77, "Recommended Practice on Static Electricity".

Material Safety Data Sheet

Material Name: **Low Sulfur Diesel-S15**

MSDS ID: NOVA-0034

Key/Legend

ACGIH = American Conference of Governmental Industrial Hygienists; BLEVE = Boiling Liquid Expanding Vapor Explosion; BOD = Biochemical Oxygen Demand; CAS = Chemical Abstracts Service; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; CPR = Controlled Products Regulations; DOT = Department of Transportation; DSL = Domestic Substances List; EINECS = European Inventory of Existing Commercial Substances; EPA = Environmental Protection Agency; EU = European Union; FDA = Food and Drug Administration; IARC = International Agency for Research on Cancer; IDL = Ingredient Disclosure List; Kow = Octanol/water partition coefficient; LEL = Lower Explosive Limit; NIOSH = National Institute for Occupational Safety and Health; NJTSR = New Jersey Trade Secret Registry; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; RCRA = Resource Conservation and Recovery Act; SARA = Superfund Amendments and Reauthorization Act; TDG = Transportation of Dangerous Goods; TSCA = Toxic Substances Control Act.

MSDS Prepared by: NOVA Chemicals

MSDS Information Phone Number: 1-412-490-4063

Other Information

Notice to Reader:

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This is the end of MSDS # NOVA-0034.



MATERIAL SAFETY DATA SHEET

Section 1 - IDENTIFICATION

Product Name: Portland Cements

CAS Reg. No.: 65997-15-1

Chemical Name and Synonyms: Portland Cement, Cement, Hydraulic Cement

Trade Names: Portland Cement – Types I, IA, II, III, IIIA; SAYLOR'S® Portland Types: I, IA, II, III; PRONTO®, Flamingo Brixment® White Portland Cement

MSDS Information: This MSDS supersedes prior MSDS's for the products noted above. This MSDS covers a number of products with similar applications and occupational exposure hazards. Specific constituents and methods of preparation for these products will vary. The term "Portland Cement", used in the text of this MSDS, refers to the above named products collectively.

Chemical Family: Calcium silicate compounds; calcium compounds containing iron and aluminum; and gypsum are the primary constituents of these products.

Informational Phone Numbers: (800) 437-7762 Customer Service - Nazareth, PA
(800) 336-0366 Customer Service - Speed, IN
(800) 624-8986 Customer Service - Martinsburg, WV
(800) 386-2111 Customer Service - Mississauga, ONT

Emergency Contact Information: (800)-424-9300 Chemtrec

MSDS Prepared by: Essroc MSDS Development Committee - (610) 837-6725 – April 2009

Section 2 - COMPONENTS

Hazardous Ingredients:

Component	CAS No.	OSHA PEL (8-hour TWA)	ACGIH TLV	Other Information
Portland Cement	65997-15-1	15 mg total dust/m ³ 5 mg respirable dust/m ³	10 mg/m ³	IDLH: 5000 mg/m ³ LD ₅₀ : No Data
Gypsum	13397-24-5	15 mg total dust/m ³ 5 mg respirable dust/m ³	10 mg/m ³	IDLH: Not Determined LD ₅₀ : No Data
Limestone	1317-65-3	15 mg total dust/m ³ 5 mg respirable dust/m ³	10 mg/m ³	IDLH: Not Determined LD ₅₀ : No Data
Crystalline Silica (< 0.3%)	14808-60-7	For mineral dusts containing crystalline silica: (10 mg respirable dust/m ³)/(%SiO ₂ +2) (30 mg total dust/m ³)/(%SiO ₂ + 2)	0.025 mg/m ³	IDLH: 50 mg/m ³ (tw) LD ₅₀ : ipr rat LD Lo 400 mg/kg

Notes:

Trace Elements: Portland cement is made from materials mined from the earth and processed using energy provided by fuels. Trace amounts of naturally occurring, potentially harmful chemicals might be detected during chemical analysis. Trace constituents may include calcium oxide (also known as free lime or quick lime), free magnesium oxide, potassium and sodium sulfate compounds, chromium compounds, and nickel compounds.

Section 3 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

Portland Cement is a powder that poses little immediate hazard. A single short-term exposure to the dry powder is not likely to cause serious harm. However, exposure of sufficient duration to wet Portland Cement can cause serious, potentially irreversible tissue (skin or eye) destruction in the form of chemical (caustic) burns, including third degree burns. The same type of tissue destruction can occur if wet or moist areas of the body are exposed for sufficient duration to dry Portland Cement.

POTENTIAL HEALTH EFFECTS

Relevant Routes of Exposure: Eye contact, skin contact, inhalation and ingestion.

Effects resulting from eye contact: Exposure to airborne dust may cause immediate or delayed irritation or inflammation.

Eye contact by larger amounts of dry powder or splashes of wet Portland Cement may cause effects ranging from moderate eye irritation to chemical burns and blindness. Such exposures require immediate first aid (see Section 4) and medical attention to prevent significant damage to the eye.

Effects resulting from skin contact: Discomfort or pain cannot be relied upon to alert a person to hazardous skin exposure. Consequently, the only effective means of avoiding skin injury or illness involves minimizing skin contact, particularly contact with wet Portland Cement. Exposed persons may not feel discomfort until hours after the exposure has ended and significant injury has occurred.

Exposure to dry Portland Cement may cause drying of the skin with consequent mild irritation or more significant effects attributable to aggravation of other conditions. Dry Portland Cement contacting wet skin or exposure to moist or wet Portland Cement may cause more severe skin effects including thickening, cracking, or fissuring of the skin. Prolonged exposure can cause severe skin damage in the form of (caustic) chemical burns.

Some individuals may exhibit an allergic response upon exposure to Portland Cement, possibly due to trace amounts of chromium. The response may appear in a variety of forms ranging from a mild rash to severe skin ulcers. Persons already sensitized may react to their first contact with the product. Other persons may first experience this effect after years of contact with Portland Cement products.

Effects resulting from inhalation: Portland Cement may contain free crystalline silica. Prolonged exposure to airborne free crystalline silica may cause delayed lung injury including silicosis, a disabling and potentially fatal lung disease, and/or other diseases. (also see "Carcinogenic potential" below.)

Inhalation may also aggravate other lung conditions. Exposure to Portland Cement may cause irritation to the moist mucous membranes of the nose, throat, and upper respiratory system. It may also leave unpleasant deposits in the nose.

Effects resulting from ingestion: Although ingestion of small quantities of Portland Cement is not known to be harmful, ill effects are possible especially if larger quantities are consumed. Portland Cement should not be eaten.

Carcinogenic potential: Portland Cement is not listed as a carcinogen by the National Toxicology Program (NTP), International Agency for Research (IARC) or the Occupational Safety and Health Administration (OSHA). It may, however, contain trace amounts of substances listed as carcinogens by these organizations.

Portland Cement may contain crystalline silica. Crystalline silica is classified by the IARC as a known human carcinogen. Some human studies indicate potential for lung cancer from crystalline silica exposure. Risk depends on duration and level of exposure.

Medical conditions which may be aggravated by inhalation or dermal exposure:

Pre-existing upper respiratory and lung diseases.

Unusual (hyper) sensitivity to hexavalent chromium (chromium⁺⁶) salts.

Section 4 - FIRST AID

Eyes: Immediate flush eyes thoroughly with water. Continue flushing eye for at least 15 minutes including under lids, to remove all particles. Call physician immediately.

Skin: Wash skin with cool water and pH-neutral soap or a mild detergent intended for use on skin. Seek medical treatment in all cases of prolonged exposure to wet cement, cement mixtures, liquids from fresh cement products, or prolonged wet skin exposure to dry cement.

Inhalation of Airborne Dust: Remove to fresh air. Seek medical help if coughing and other symptoms do not subside. ("Inhalation" of gross amounts of Portland Cement requires immediate medical attention.)

Ingestion: Do not induce vomiting. If conscious, have the victim drink plenty of water and call a physician immediately.

Section 5 - FIRE AND EXPLOSION DATA

Portland Cement is not combustible.

Flash Point:	Not applicable	Upper Explosive Limit:	Not applicable
Auto ignition temperature:	Not applicable	Lower Explosive Limit:	Not applicable
Auto ignition temperature:	Not applicable	Extinguishing media:	Not applicable
Hazardous combustion products:	Not applicable	Unusual fire and explosion hazards:	None
Special fire fighting procedures:	Portland Cement poses no fire-related hazards. Self-contained breathing apparatus is recommended to limit exposure to combustion products when fighting any fire.		

Section 6 - ACCIDENTAL RELEASE MEASURES

Collect dry material using a scoop. Avoid actions that cause dust to become airborne. Avoid inhalation of dust and contact with skin. Wear appropriate personal protective equipment as described in Section 8.

Scrape up wet material and place in appropriate container. Allow the material to "dry" before disposal. Do not attempt to wash Portland Cement down drains.

Dispose of waste material according to local, state, and federal regulations.

Section 7 - HANDLING AND STORAGE

Keep Portland Cement dry until used. Normal temperatures and pressures do not affect the material. Promptly remove dusty clothing or clothing which is wet with cement fluids and launder before reuse. Wash thoroughly after exposure to dust or wet cement mixtures or fluids.

Section 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

Skin protection: Prevention is essential to avoid potentially severe skin injury. Avoid contact with unhardened (wet) Portland Cement products. If contact occurs, promptly wash affected area with soap and water. Where prolonged exposure to unhardened Portland Cement products might occur, wear impervious clothing and gloves to eliminate skin contact. Where required, wear boots that are impervious to water to eliminate foot and ankle exposure.

Do not rely on barrier creams. Barrier creams should not be used in place of gloves.

Periodically wash areas contacted by dry Portland Cement or by wet cement or fluids with a pH neutral soap. Wash again at the end of the work. If irritation occurs, immediately wash the affected area and seek treatment. If clothing becomes saturated with wet cement, it should be removed and replaced with clean dry clothing.

Respiratory protection: Avoid actions that cause dust to become airborne. Use local or general ventilation to control exposures below applicable exposure limits.

Use NIOSH/MSHA-approved (under 30 CFR 11) or NIOSH-approved (under 42 CFR 84) respirators in poorly ventilated areas, if an applicable exposure limit is exceeded, or when dust causes discomfort or irritation.

Ventilation: Use local exhaust or general dilution ventilation to control exposure within applicable limits.

Eye protection: When engaged in activities where cement dust or wet cement could contact the eye, wear safety glasses with side shields or goggles. In extremely dusty environments and unpredictable environments, wear unvented or indirectly vented goggles to avoid eye irritation or injury. Contact lenses should not be worn when working with Portland Cement or fresh cement products.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Grey, white powder	Odor:	No distinct odor
Physical state:	Solid (powder)	pH (in water):	12 to 13
Solubility in water:	Slightly soluble (0.1 to 1.0%)	Vapor pressure:	Not applicable
Vapor density:	Not applicable	Boiling point:	Not applicable (>1000° C)
Melting point:	Not applicable	Specific gravity (H ₂ O=1.0):	2.80 - 3.00
Evaporation Rate:	Not applicable	Coefficient of oil to water distribution:	Not applicable

Section 10 - STABILITY AND REACTIVITY

Stability: Stable

Conditions to avoid: Unintentional contact with water.

Incompatibility: Wet Portland Cement is alkaline. As such it is incompatible with acids, ammonium salts and aluminum metal.

Hazardous decomposition: Will not spontaneously occur. Adding water results in hydration and produces (caustic) calcium hydroxide.

Hazardous polymerization: Will not occur.

Section 11 - TOXICOLOGICAL INFORMATION

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Reproductive Toxicity.....	Not Applicable
Teratogenicity.....	Not Applicable
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For a description of available, more detailed toxicological information, call one of the informational phone numbers listed at the end of Section 1.

Section 12 - ECOLOGICAL INFORMATION

Ecotoxicity: No recognized unusual toxicity to plants or animals.

Relevant physical and chemical properties: See sections 9 and 10.

Section 13 - DISPOSAL

Dispose of waste material according to local, state, and federal regulations. (Since Portland Cement is stable, uncontaminated material may be saved for future use.)

Dispose of bags in an approved landfill or incinerator.

Section 14 - TRANSPORTATION DATA

Hazardous materials description/proper shipping name: Portland Cement is not hazardous under U.S. Department of Transportation (DOT) regulations.

Hazard class: Not applicable.

Identification number: Not applicable

Required label text: Not applicable.

Hazardous substances/reportable quantities (RQ): Not applicable

Section 15 - OTHER REGULATORY INFORMATION

Status under USDOL-OSHA & MSHA Hazard Communication Standards (29CFR 1910.1200 & 30CFR Part 47): Portland Cement is considered a "hazardous chemical" under these regulations, and should be part of any hazard communication program.

Status under CERCLA/Superfund, 40 CFR 117 and 302: Not Listed

Hazard Category under SARA TITLE III, Sections 311- 312: Portland Cement qualifies as a "hazardous substance" with delayed health effects.

Status under SARA Title III, Section 313: This product contains NONE of the substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372 in concentrations above de minimis levels.

Toxic Substance Control Act (TSCA): Some substances in Portland Cement are on the TSCA inventory list.

Status under the Federal Hazardous Substances Act: Portland Cement is a "hazardous substance" subject to statutes promulgated under the subject act.

Status under Canadian Environmental Protection Act: Not listed.

Status under WHMIS: Portland Cement is considered to be a hazardous material under the Hazardous Products Act as defined by the Controlled Products Regulations (Class D2A – Materials causing other toxic effects and Class E - Corrosive material) and is therefore subject to the labeling and MSDS requirements of the Workplace Hazardous Materials Information System (WHMIS).

SECTION 16 - OTHER INFORMATION

Abbreviations:

ACGIH	American Conference of Government Industrial Hygienists
ASTM	American Society of Testing Materials
CAS	Chemical Abstract Service
CFR	Code of Federal Regulations
DOT	Department of Transportation
IARC	International Agency for Research
IDLH	Immediately dangerous to life and health (NIOSH).
m ³	cubic meter
mg	Milligram
mm	millimeter
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
NIOSH	National Institute for Occupational Safety and Health
NTP	National Toxicity Program
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
RQ	Reportable Quantities
SARA	Superfund Amendments and Reauthorization Act
TLV	Threshold Limit Value
TWA	Time Weighted Average
URT	Upper Respiratory Tract
WHMIS	Workplace Hazardous Material Information System

Other important information:

Portland Cement should only be used by knowledgeable persons. A key to using the product safely requires the user to recognize that Portland Cement chemically reacts with water, and that some of the intermediate products of this reaction (that is, those present while Portland Cement is "setting") pose a far more severe hazard than does Portland Cement itself.

While the information provided in this material safety data sheet is believed to provide a useful summary of the hazards of Portland Cement as it is commonly used, the sheet cannot anticipate and provide all of the information that might be needed in every situation. Inexperienced product users should obtain proper training before using this product.

In particular, the data furnished in this sheet do not address hazards that may be posed by other materials mixed with Portland Cement to produce Portland Cement products. Users should review other relevant material safety data sheets before working with this Portland Cement or working on Portland Cement products, for example, Portland Cement concrete.

SELLER MAKES NO WARRANTY, EXPRESSED OR IMPLIED, CONCERNING THE PRODUCT OR THE MERCHANTABILITY OR FITNESS THEREOF FOR ANY PURPOSE OR CONCERNING THE ACCURACY OF ANY INFORMATION PROVIDED BY ESSROC CEMENT CORP., except that the product shall conform to contracted specifications. The information provided herein was believed by Essroc Cement Corp. to be accurate at the time of preparation or prepared from sources believed to be reliable, but it is the responsibility of the user to investigate and understand other pertinent sources of information to comply with all laws and procedures applicable to the safe handling and use of the product and to determine the suitability of the product for its intended use. Buyer's exclusive remedy shall be for damages and no claim of any kind, whether as to product delivered or for non-delivery of product, and whether based on contract, breach or warranty, negligence, or otherwise shall be greater in amount than the purchase price of the quantity of product in respect of which damages are claimed. In no event Seller be liable for incidental or consequential damages, whether Buyer's claim is based on contract, breach of warranty, negligence or otherwise.



ALEXCO KENO HILL MINING CORP.

QUARTZ MINING LICENCE

QML-0009

BELLEKENO MINE DEVELOPMENT

KENO HILL SILVER DISTRICT

YUKON

Appendix B

Adaptive Management Plan



KENO HILL SILVER DISTRICT

ADAPTIVE MANAGEMENT PLAN – 2009 UPDATE

PREPARED BY:



FEBRUARY 2009

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Appendix A	Environmental Monitoring Program

1. INTRODUCTION

1.1 BACKGROUND

The Keno Hill Silver District, inclusive of Galena Hill, Sourdough Hill, and Keno Hill, is located in the vicinity of Elsa and Keno City, Yukon, approximately 354 km due north of Whitehorse (please see Figure 1-1). From the first discovery of silver in July, 1903 extensive exploration and prospecting led to numerous commercial open pits and underground mining operations throughout the property; however, due to falling silver prices, commercial production of the property was suspended on January 9, 1989.

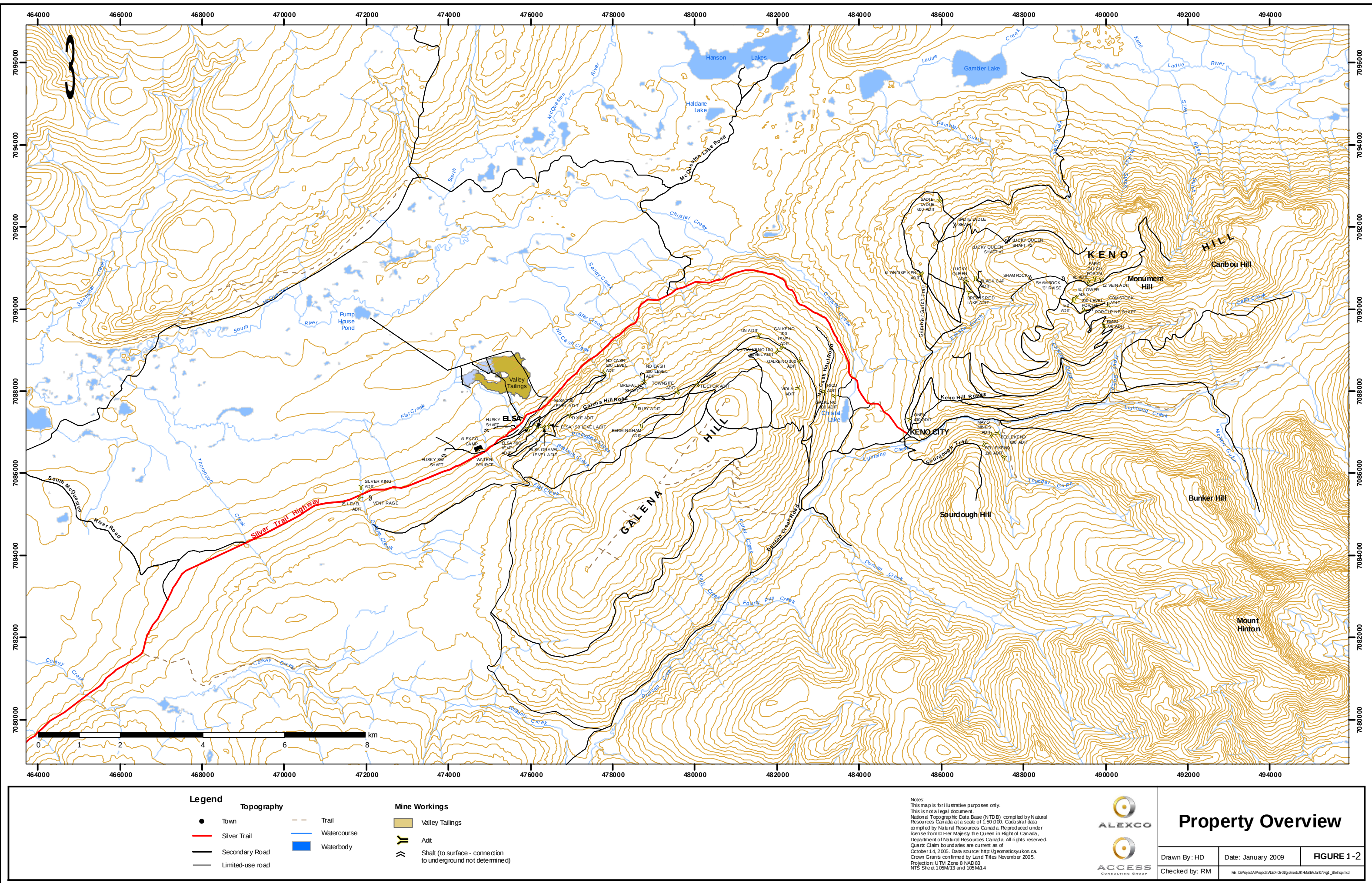
Two companies, AMT Canada Inc. and Nevada Pacific Gold, respectively, attempted to commence operations on the property since that time. However, each company ceased to be involved with the project and, as such, the Court appointed PricewaterhouseCoopers Inc. as Interim Receiver and Receiver-Manager of United Keno Hill Mines Limited and UKH Minerals Limited (collectively known as "UKHM") on April 6, 2004. Subsequently, through a selection process Alexco Resource Corp. (Alexco) became the preferred purchaser of the UKHM assets (June 24, 2005). In February 2006, following negotiation of a Subsidiary Agreement between the Government of Canada, the Government of Yukon and the Company, the Supreme Court of Yukon approved the purchase of the assets of UKHM by Alexco through its wholly owned subsidiary, Elsa Reclamation & Development Company Ltd. (ERDC). In December, 2007, Alexco registered the vesting order at the Mayo Mining Recorder Office, the Yukon Land Title Office and the Yukon Lands Branch. This action brought to "Final Close" the acquisition by ERDC of the assets of UKHM, and followed the granting of Water Use Licence QZ06-074 to ERDC by the Yukon Water Board on November 14, 2007. WUL QZ06-074 specifically addresses environmental care and maintenance activities in the district.

In January 2008, Alexco Resource Corp. applied for a Water Use Licence and a Class 4 Mining Land Use Approval to authorize advanced exploration activities in the Keno Hill Silver District. The Class 4 Approval (LQ00240) was issued on June 17, 2008 followed by Water Use Licence QZ07-078 on October 3, 2008 which addresses water usage for the purpose of advanced exploration and preliminary development activities at the Bellekeno Mine in the Keno Hill Silver District.

1.2 HISTORIC MINE WORKINGS

Historic mine workings are routinely inspected to ensure public health and safety and continued site security; monitored for site changes or damage; and sampled periodically for flow and water quality. Older mine workings are monitored on a weekly basis during open water season with results of inspections documented and corrective action taken if required. Winter inspections are limited to accessible sites. The site inspection checklists are provided within the Environmental Monitoring Program in Appendix A. Figure 1-2 shows an overview of the property with the mine workings.

The Keno Hill Silver District has a rich and detailed history with many of the older workings dating back to the early 1920's. A complete description of site workings is provided in the report entitled, "UKHM Site Characterization Report", (Access Mining Consultants Ltd., 1996). Chapter 5 – Site Description, of this report provides a detailed description of the entire Keno Hill Silver District mine site developments, including history, type of development and infrastructure, and site plans and figures. The reader is referred to this report for a complete description of development activities undertaken at the old mine workings located on the property. A summary of historic development at each of the mines at the Keno Hill Silver District is provided in Table 1-1.



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Table 1-1 Summary of Historic Development

Summary of Development								
Mine	Open Pit	Underground # levels	Shafts, Raises Portals, Adits	Bldgs and Equip.	Rock Piles waste, ore	Mill Tailings	Other	Adit Discharge & Drainage
Galena Hill								
Birmingham	2 178,512 t mined	3 for 250 ft depth 7,754 t mined	8 shaft 1 adit	3 bldg @adit	3 continuous 1,000,000t@pit 7,000@adit			KV-18 No Cash Creek drainage
Calumet	3 108,547 t mined	1300 ft depth extensive UG, many lev,2.6Mt	1 shaft 1 adit	none	3@pits,1@adit 1,110,000@pits 198,000t@adit		head of tramway town removed	No discharge
C-structure	1 2,392 t	0			1 28,000 t			No discharge
Dixie		1 23,872 t	1 adit 1 shaft	1 bldg	1 @ adit 19,800 t			No discharge
Elsa		7@+50,100,200 200,400,525,650 &775; 491,009t	6 adits 1 internal shaft >2 raises		3 51,650 t	mill & dams existing + old tlgs	existing town	No discharge
Galkeno		6@100,200,300 400,500,900	5 adits 2 internal shaft 1 external shaft	old bldgs	4 total 171,400t	3,000 to 5,000 t old mill removed	treatment plus ponds 900 level	KV-27 Galkeno 300 level Adit Christal Creek and Lake KV-31 Galkeno 900 level Adit Christal Creek and Lake
Husky		4@125, 250,375 &450; 429,367 t	1 shaft	H.frame	1WR 4,600 t			
Husky SW		3 @ 250, 400, &530; 10,461 t	1shaft	H.frame, blast.	1WR, 1Ore 17,000 t			KV-17 Husky SW Adit No discharge
Miller	1 9,263 t	1 in open pit minimal prdn.	1 old shaft (open pitted)		1 @ pit 63,000 t			
No Cash		4@100,200,300 300 & 500 levels 166,530 t mined	1 raise, 1 shaft 2 adits	h. frame, bldg	1 138,100@500L 6,500 @ 100 L		tram station	KV-20 No Cash 500 level Adit
Ruby		1 @400 level 40,652 t mined	1 raise, 1 adit	1 bldg	1 WR, cribbing 29,800 t		power, tracks	KV-19 Ruby Adit
Silver King	1 6,631 t mined	3 for 325 ft 200,982 t mined	2 shafts, 4 adits 3 raises		2 rock, 1 ore 43,000t@adit 120,000t@pit		treatment plus ponds	KV-13 Silver King Adit Flat Creek drainage
Sime	3 47,304 t	0 (see Galkeno)			3 450,000 t			
Townsite		1 adit 18,570 t	1 adit 1 raise	1 bldg	1 14,300 t		cribbing one bldg	Seasonal discharge
UN		1 adit (no ore mined)	1A		1 3,200 t			Seasonal discharge

Table 1-1 Summary of Historic Development (Continued)

Summary of Development								
Mine	Open Pit	Underground # levels	Shafts, Raises Portals, Adits	Bldgs and Equip.	Rock Piles waste, ore	Mill Tailings	Other	Adit Discharge & Drainage
Sourdough Hill								
Bellekeno		9 40,502 t mined	4 adits	@625 portal	4 63,950 t		treatment	KV-42 Bellekeno 600 Adit Lightning Creek drainage
Keno Hill								
Black Cap	1 47,497 t	2 ? 1,079 t	2 adits		1 390,000 t @ pit			
Flame & Moth	1 1,590 t	1 (small)	1 adit		1 small		remaining reserves	KV-36 Flame & Moth No discharge
Comstock-Keno Porcupine	1 4,253 t	3 22,863 t ?	3 adits 1 raise	2 @portals	2 1@pit, 1@UG 6,500 t			
Keno 700 & Shamrock "J"		8 283,517 t	4 adits, 2 shafts several raises	several	2 42,100 t total		several veins mined, old camp	KV-33 Keno 700 level Adit Lightning Creek drainage
Lucky Queen	1 (small pit)	4 123,530 t mined	1 shaft, 1 adit	1 @500 portal	2 66,900 t			KV-34 Lucky Queen Adit Cristal Creek drainage
Onok	1 62,254 t	4 for 400 ft 33,036 t	2 shafts 1 adit		3; 7,500 @ adit 600,000 t @ pit			KV-45 Adit flow to ground Cristal Creek drainage
Sadie Ladue		6 244,330 t mined	1 adit	1	2 44,000 t	1	loadout	KV-35 Sadie Ladue 600 level Adit
Shamrock	2	3 5,035 pit + UG	1 shaft 2 adits	shaft bldg	2 9,000 t			No discharge
Valley Tailings							3 ponds	KV-12 Pond #3 decant Flat Creek drainage

1.3 ALEXCO ACTIVITIES

Alexco's is undertaking care and maintenance, exploration and development, and closure studies in the Keno Hill Silver District which includes various activities:

Principal activities:

- surface drilling and advanced underground exploration with view to mine development;
- direct use of water for camp purposes and quartz mining undertakings;
- direct use of water and wastewater for lime mixing operations;
- deposit of waste into water and receiving environment;
- waste rock storage;
- construction and upgrades to access roads;
- operation and maintenance of existing five wastewater treatment facilities and associated settling ponds using lime treatment (Silver King 100, Galkeno 900, Galkeno 300 and Bellekeno 625 adits and the Valley Tailings Area);
- storage of wastewater in the treatment settling ponds and Valley Tailings Area; and
- maintenance of existing diversion channels (Porcupine Creek) and ditches.

Accessory activities:

- maintenance and operation of site infrastructure related to water treatment systems and access roads;
- site security and maintenance of site facilities and structures for public health and safety;
- transport of milk of lime solutions to treatment sites;
- periodic desludging of treatment settling ponds and transportation or pumping to sludge storage areas which are periodically decanted;
- mine dewatering to advance underground exploration or development;
- water sampling (effluent and receiving waters);
- waste rock analysis and classification;
- environmental monitoring, inspections and sample programs, including monitoring and inspection of physical structures;
- removal and clean up of infrastructure related to adits, adit structures and facilities;

- wastewater treatment studies and test programs related to potential closure design options; and
- operation, inspection and maintenance of the Valley Tailings Area.

1.4 PLANS IN PLACE

The Company recognizes that there are waters and physical workings at the Keno Hill Silver District that could potentially become an environmental risk or hazard that do not yet require immediate attention. The development of an Existing State of Mine Closure Plan is intended to address these water discharges and workings which require further intervention over the long term.

Several plans are currently in place pursuant to the existing licences and approvals and are referenced throughout the AMP. A site-wide Environmental Monitoring Program has been compiled for the Keno Hill Silver District which incorporates monitoring associated with the various site activities that are taking place. The Environmental Monitoring Program (EMP) is contained in Appendix A as it provides a basis and grounding for the AMP, and coincides with licenced monitoring requirements. The EMP outlines monitoring plans for physical inspections, and water and aquatic resources.

Additional plans have been prepared pursuant to Water Licences QZ06-074 and QZ07-078, and the Class 4 Mining Land Use Approval to guide the management of activities and monitoring associated with site care and maintenance as well as advanced exploration and preliminary development:

- Waste Rock Management Plan (January 2008);
- Sludge Management Plan Revision No.1 (May 2008);
- Waste Rock Metals and Acid Base Accounting Testing Plan (October 2008);
- Physical Inspection and Reporting Plan (October 2008);
- Flow Monitoring Plan (October 2008); and
- Mine Wall Testing Plan (October 2008).

However, to address risks or hazards over the short term, an adaptive management strategy is required in the event conditions degrade to the point where management actions

are required. This document has therefore been developed and provides detailed AMP implementation protocol for the company's operations at the Keno Hill Silver District.

2. ADAPTIVE MANAGEMENT PLAN OVERVIEW

2.1 ADAPTIVE MANAGEMENT PLAN OBJECTIVES

An adaptive management plan (AMP) is a management tool designed to guide responses to unforeseen or contingency events respecting for example, water quality and quantity and physical conditions of site workings and infrastructure. The adaptive management approach will provide for assessment of mitigation measures and their effectiveness, and guide the orderly implementation of responses. Since it is difficult to predict the specific environmental condition that may arise which requires a response from management, the AMP does not necessarily provide specific detailed descriptions of responses to a situation. The AMP provides a range of possible responses to use as a guide to respond to specific environmental conditions encountered. Management should use the information provided in the AMP and adapt the appropriate response from this guide, which is the sole purpose of an AMP.

The AMP framework encompassing active Company management includes:

- routine inspection and environmental monitoring, maintenance and reclamation;
- routine assessment of monitoring and performance data;
- performance thresholds for implementation of appropriate levels of responses for planned contingency measures; and
- reporting of monitoring results and actions.

Results of the monitoring programs (Section 1.4 – Plans in Place), will be assessed on an ongoing basis to determine if any negative trends in water quality, quantity or other parameters are occurring. If the results indicate that there are no negative environmental impacts, then the frequency and length of monitoring and maintenance would continue as usual. Adaptive management will be implemented to respond to negative trends observed through the monitoring programs.

2.2 AMP EVENTS SUMMARY

A number of “events” have been identified which represent potential environmental conditions that would require a management response, if they were to occur:

1. Change in Water Quality or Quantity

- a. Significant Change in Water Quality
 - i. Water Treatment Facilities/ Licenced Effluent Discharges
 - ii. Adit Discharges
 - iii. Bellekeno Mine Water Quality Significantly Altered After Dewatering
 - iv. Receiving Water Quality Significantly Altered During or Subsequent to Dewatering Bellekeno Mine
- b. Significant Increase or Decrease in Monitored Flow Occurs
 - i. Bellekeno Mine Water Quantity Significantly Altered After Dewatering
- c. Currently Monitored Water Flow Stops
- d. New Water Flow is Observed
- e. Water Flow Path Changes

2. Waste Rock Seepage Exhibits AML

- a. Waste Rock Seepage/Run-Off Trending to AML Conditions

3. Sludge Storage Area Effectiveness Compromised

- a. Seepage Observed Near Sludge Storage Area
- b. Sludge Storage Area Approaching Capacity

4. Physical Instabilities

- a. Area of Significant Subsidence is Observed
- b. Rock Fall or Landslide Occurs Within a Monitored Area
- c. Structure Failure or Portal Collapse

5. Site Security Compromised

- a. Gate, Fence or Sign Damaged

The AMP's for each of these events are described individually in subsequent sections while Table 2-1 at the end of this section provides a summary of the approach to AMP events. This table describes a narrative trigger, indicators and response thresholds, monitoring locations and parameters.

2.3 AMP APPROACH

For each AMP event a methodical approach is provided:

1. Description of the event and possible environmental consequences - Addresses issues or information that trigger the AMP;
2. Location of possible event occurrence – Identifies specific working site locations if applicable to event;
3. Monitoring requirements – Identifies the parameters to be monitored, frequency and means for monitoring each parameter;
4. Specific indicators and thresholds - Defines the conditions when management actions should be taken. There may be a series of indicators and staged thresholds for an individual event; and
5. Approach to responses –Description of the approach to responses including a simplified flow chart to guide the implementation process if any specific thresholds have been crossed.

Table 2-1 Overall AMP Summary

EVENT	NARRATIVE TRIGGER	INDICATORS	THRESHOLDS	MONITORING LOCATIONS	MONITORING PARAMETERS
1. CHANGE IN WATER QUALITY OR QUANTITY					
a. Significant change in water quality	<u>Water Treatment Facilities</u> Decline in effluent pH noted or effluent quality trending towards possible exceedance of standards or exceeds licenced standards.	pH, Total zinc, ammonia	Treated effluent: pH <8.0; OR Total Zinc > 0.40 mg/L and pH <6.5 for two consecutive days; OR Ammonia > 4.0 mg/L and pH > 9.0 for two consecutive days; OR Effluent quality standards exceeded.	Water Treatment Facilities	Routine in-situ, on-site total zinc, external multi-element ICP, hardness, pH, conductivity, TSS, ammonia (Bellekeno), LT50
	<u>Adit Discharges</u> Routine site inspections indicate noticeable change in water clarity or declining pH or increasing conductivity. Contaminant concentrations display a statistically significant sustained increase over historical water quality database.	Visual observation of clarity, in-situ pH & conductivity, total cadmium, total zinc	Site inspection: pH < 6.5 or conductivity >2,000 µS/cm; OR Increase of 2X or more in total Cd/Zn load or conductivity when compared to the average for the previous 24 months	Adit Discharges	Routine in-situ, external multi-element ICP, hardness, pH, conductivity, TSS
b. Adit discharge or treated effluent, quantity increases or decreases	Observed or measured flows display a sustained and statistically significant increase or decrease over historical flow database	Flow and water quality (total zinc, pH and conductivity) and stream type - fish bearing	Increase/decrease in flow of 2X or more when compared to the average for the previous 24 months AND threshold for Event 1 a) or b) as applicable also exceeded	Site-wide flow monitoring	same as indicators
c. Flow stops from adit discharge	Water flowing from historical workings stops	Flow, ice plug formation	25% of adit opening filled with ice	Adit and treatment locations	same as indicators
d. New water flow is observed	Previously dry site exhibits flow and effects down gradient water quality and loadings	Flow and water quality (Total zinc, pH and conductivity)	Adit flows for 30 l/s for 7 day period	Site-wide mine workings	same as indicators
e. Water flow path changes	Flow path of mine working discharge changes path from historically known channel and enters a new watercourse	Flow and water quality (Total zinc, pH and conductivity)	Flow path changed and enters a new watercourse	Adit and treatment locations	same as indicators

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EVENT	NARRATIVE TRIGGER	INDICATORS	THRESHOLDS	MONITORING LOCATIONS	MONITORING PARAMETERS
2. WASTE ROCK SEEPAGE EXHIBITS AML					
a. Waste rock seepage or run-off trending to AML conditions	Seepages from waste rock storage areas or from works constructed or upgraded with non AML material show significant decline in pH and/or an increase in conductivity OR approaching licenced discharge standards (where appropriate ie. Onek)	pH, conductivity	Significant decline in pH between measurements or pH <7.0 and/or conductivity showing a significant increasing trend or >2000 µS/cm; OR indicators approaching licenced standards for Onek waste rock storage area	Waste rock storage areas and works or upgrades constructed from non-AML material	Routine multi-element ICP
3. SLUDGE STORAGE AREA EFFECTIVENESS COMPROMISED					
a. Seepage observed near sludge storage areas	Routine inspection of sludge storage area shows seepage	Total zinc, pH	pH >8.5 and total zinc > 1.0 mg/L	Sime Pit, Sime Waste Dump, Valley Tailings sludge storage cell	Same as indicator
c. Sludge storage area approaching capacity	Sludge storage area approaching minimum freeboard of 1.0 meter below the decant point	Visual observation of freeboard	Freeboard is at 1.5 meter below decant point	Sime Pit, Sime Waste Dump, Valley Tailings sludge storage cell	Same as indicator
4. PHYSICAL INSTABILITIES					
a. Area of significant surface subsidence has occurred	An observed subsidence has exposed an opening to surface or resulting in slope failure	Visible slope failure, ground subsidence or opening on surface	Opening to underground workings or area of subsidence effects public safety or down gradient environment	Site-wide	same as indicators
b. Rock fall or landslide is observed that effects road right-of-way or intrudes into stream	An observed rock fall or landslide effects a road right-of-way, infrastructure or intrudes into stream	Mine source material movement	Source material effects road or stream	Site-wide	same as indicators
c. Structure failure or portal collapse	A building, engineered structure or portal is seen to be failing (settling, excessive erosion)	Visual observation	Structure near public access	Site-wide	same as indicators
5. SITE SECURITY COMPROMISED					
a. Security gate, fence, sign damaged	Public health and wildlife safety measure damaged or removed	Sign, fence, gates, locks	Security feature damaged, removed, or compromised	Site-wide	same as indicators

3. CHANGE IN WATER QUALITY OR QUANTITY

Results of water quality and quantity monitoring are assessed on an ongoing basis to determine if significant changes are occurring and an adaptive management response is required. The following sections describe what constitutes a significant change to water quality or quantity and associated responses that would be implemented.

3.1 SIGNIFICANT CHANGE IN WATER QUALITY

3.1.1 Description

All data for current water sample stations in the Keno Hill Silver District are stored in an EQWin database that allows water quality to be tracked at each site such that conditions can be identified at any point in the season. In this way parameters can be seen to be fluctuating from the normal, and reaching levels where management is required to respond. Set point triggers can be placed in the database so that response parameters are flagged for notification and action.

3.1.2 Locations

Water quality is monitored from discharging adits and water treatment facilities for potential effects to the receiving environment including loading of down gradient waters. These sites are listed below and shown in Figure 3-1 of the Environmental Monitoring Program in Appendix A.

Water Treatment Facilities:

- KV12 - Valley Tailings Pond #3 Decant;
- KV14 - Silver King Treatment Pond #2 Decant;
- KV28 - Galkeno 300 Treatment Pond Decant;
- KV32 - Galkeno 900 Treatment Pond Decant; and
- KV43 - Bellekeno 625 Treatment Pond Decant.

Adits:

- KV17 - Husky South West;
- KV18 - Bermingham Adit;

- KV19 - Ruby Adit;
- KV20 - No Cash 500 Adit;
- KV33 - Keno 700 Adit;
- KV34 - Lucky Queen Adit;
- KV35 - Sadie Ladue Adit;
- KV36 - Flame and Moth Adit;
- KV45 - Onek Adit;
- KV53 - UN Adit;
- KV66 - Klondike Keno Adit;
- KV67 - Keno 200 Adit;
- KV68 - Brewis Red Lake Adit; and
- KV74 - Bellekeno East Adit.

3.1.3 Monitoring Requirements

Regular water sampling has been conducted at several sites in the Keno Hill Silver District where regular water flow is expected either continuously or at various times of the year. Sites monitored are summarized within the Environmental Monitoring Program (Table 3-1 of Appendix A). This monitoring program coincides with required monitoring under Water Licences QZ06-074 and QZ07-078.

Specific parameters monitored will be compared to specific thresholds to determine if they have been breached. Monitoring requirements will change should one of the AMP thresholds be triggered. This could include more frequent monitoring of grab samples at the station location as well as more frequent monitoring of the receiving environment, including down gradient receiving waters or down gradient piezometers located below the site or workings where the trigger was initiated.

3.1.4 Specific Thresholds

Specific thresholds for the different categories of monitoring stations that will initiate a response are provided in the following sections.

3.1.4.1 Water Treatment Facilities/ Licenced Effluent Discharges

Water quality data from treatment facilities and other effluent discharges (Bellekeno East decline or Onek Pit Waste Rock Storage Facility) will be assessed to determine if the following thresholds have been exceeded:

- Daily sampling result for pH less than 8.0 units at a water treatment facility decant;
- Daily sampling result for zinc or ammonia trending toward possible exceedance of discharge standard:
 - o Total zinc > 0.40 mg/l and pH < 6.5 units for two consecutive days; or
 - o Ammonia > 4.0 mg/l and pH > 9.0 for two consecutive days (applies to Bellekeno only).
- Sample result exceeds effluent quality standard (Table 3-1).

Table 3-1 Licenced Effluent Quality Standards

Parameter	Maximum Concentration in a Grab Sample (mg/L)
pH	6.5 to 9.5 pH Units
Suspended solids	25.0
Ammonia Nitrogen*	5.0
Arsenic (Total)	0.50
Cadmium (Total)	0.05
Copper (Total)	0.30
Lead (Total)	0.20
Nickel (Total)	0.50
Silver (Total)	0.10
Zinc (Total)	0.50

* Ammonia nitrogen standard applies to Water Licence QZ07-078 only (Bellekeno 625, Bellekeno East, Onek Pit Waste Rock Storage Facility)

3.1.4.2 Adit Discharge

Old mine workings adit discharge quality will be assessed to determine if thresholds are triggered indicating that a significant increase in metals loading or conductivity is occurring:

- Field measurements will be implemented during routine weekly site inspections (during open water season). The following represent thresholds for these inspections:

- o noticeable change in water clarity;
 - o pH appears to be significantly declining between measurements or dropping below 6.0; and
 - o conductivity shows a significant increasing trend or conductivity above 2,000 $\mu\text{S}/\text{cm}$.
- A monitoring result at an adit discharge sample location whereby there is an increase of two-times (2X) or more in metal load for total cadmium or total zinc when compared to the average loading for the previous 24-months' water quality data for that site, along with discharge concentrations for the site which are at or greater than those concentrations provided elsewhere on the property as licenced effluent quality standards. For example, if the load (kg/yr) for these parameters increases by two-times or more when compared to the average for the previous 24 months, but the data does not exceed licenced discharge standards, the AMP is not triggered. Similarly, if water quality data exceeds licenced effluent quality standards but does not result in an increase of two-times or more in metal load when compared to the average for the previous 24 months, the AMP is not triggered (See No Cash 500 Example below). Both conditions must be met for the AMP to be triggered;
- A monitoring result at an adit discharge sample location whereby there is an increase of two-times (2X) or more in conductivity (measured externally by an accredited lab) when compared to the average conductivity for the previous 24-months' water quality data for that site.

No Cash 500 Adit Cadmium, Zinc & Conductivity Examples

Using the No Cash 500 Adit (monitoring station KV-20) as an example, an average total cadmium concentration of 0.131 mg/L is calculated for 6 sample events during 2007 and 2008. At an observed average discharge of 7.3 L/s this computes to total cadmium loading of 29 kg/yr. Therefore, while licenced discharge standards provided elsewhere on the property for total cadmium are 0.05 mg/L, the AMP would only be triggered if the total cadmium also exceeded 29 kg/yr by two times or more (≥ 58 kg/yr).

Continuing with the No Cash 500 Adit as an example, an average total zinc concentration of 12.2 mg/L is calculated for the 6 sample events in 2007 and 2008. At an observed average discharge of 7.3 L/s this computes to a total zinc loading of 2,709 kg/yr. Therefore, while licenced discharge standards provided elsewhere on the property for total zinc are 0.50 mg/L, the AMP would only be triggered if total zinc also exceeded 2,709 kg/yr by two times or more ($\geq 5,418$ kg/yr).

At the No Cash 500 Adit, an average conductivity of 951 $\mu\text{S}/\text{cm}$ (external lab analyses) is calculated for 6 samples collected between October 24, 2006 and September 10, 2007. The AMP would therefore be triggered if conductivity exceeded the average of 895 $\mu\text{S}/\text{cm}$ by two times or more (≥ 1790 $\mu\text{S}/\text{cm}$).

3.1.4.3 Bellekeno Mine Water Quality Significantly Altered After Dewatering

The same thresholds provided for adit discharges (section 3.1.4.2) would apply to the Bellekeno 625 adit discharge (KV-42) to determine if mine water quality had been significantly altered after dewatering:

- A monitoring result whereby there is an increase of two-times (2X) or more in metal load for total cadmium or total zinc when compared to the average loading for the 24-months' water quality data prior to dewatering, along with discharge concentrations for the site which are at or greater than those concentrations provided elsewhere on the property as licenced effluent quality standards. Both conditions must be met for increased monitoring to be triggered; or
- A monitoring result whereby there is an increase of two-times (2X) or more in conductivity (measured externally by an accredited lab) when compared to the average conductivity for the previous 24-months' water quality data prior to dewatering.

3.1.4.4 Receiving Water Quality Significantly Altered During or Subsequent to Dewatering Bellekeno Mine

Receiving water quality down gradient of Bellekeno mine in Thunder Gulch and Lightning Creek will be assessed to determine if it has been significantly altered during or subsequent to dewatering Bellekeno mine. Water quality data from monitoring stations KV-41 (Lightning Creek u/s bridge at Keno City) and KV-76 (Thunder Gulch downstream of Bellekeno 625 Adit) will be used in this assessment. As with adit discharge thresholds, metals loading and conductivity will be tracked to determine if receiving water quality has been significantly altered:

- A monitoring result whereby there is an increase of two-times (2X) or more in metal load for total cadmium or total zinc when compared to the average loading for the 24-months' water quality data prior to dewatering; or
- A monitoring result whereby there is an increase of two-times (2X) or more in conductivity (measured externally by an accredited lab) when compared to the average conductivity for the previous 24-months' water quality data prior to dewatering.

3.1.5 Approach to Responses

As per the general approach to the AMP, a staged response to a change in water quality will be implemented if one of the thresholds is breached. Triggered responses are outlined below for the different types of monitoring stations and may be specific to the particular threshold that was breached. For example, an exceeded threshold could indicate the potential for a 'low risk' event or a 'high risk' event which in turn triggers an appropriate level of response.

3.1.5.1 Water Treatment Facilities/ Licenced Effluent Discharges

For water treatment facilities the following responses will occur if daily effluent sampling at the decant results in a pH less than 8.0 units OR an effluent quality standard for zinc or ammonia is near to exceedance;

- routine system monitoring and inspections;

- ensure system power and site operations;
- operate back up power if necessary;
- verify lime slurry tank volumes and flow rate;
- adjust lime addition rate;
- verify system pH;
- verify internal sampling and analytical results;
- re-sample and analyze;
- replace or repair system equipment;
- review need for settling pond desludging and desludge pond;
- consider need to send samples for outside analyses and/or analytical equipment maintenance.

For water treatment facilities the following responses will occur if an effluent quality standard is exceeded;

- consider the need for capital improvements and implement.

Additional responses specific to the Tailings Dams:

- routine dam monitoring and inspections;
- ensure decants structure free flowing;
- daily water levels measured and verified;
- geotechnical inspection as appropriate; and
- structural repairs or maintenance identified and remedial action taken.

Response specific to Bellekeno East decline:

- direct discharge to Bellekeno 625 treatment facility.

Response specific to Onek Waste Rock Storage Facility

- no discharge from Onek Pit Waste Rock Storage Facility – run-off collected and transported to Bellekeno 625 treatment facility.

3.1.5.2 Adit Discharge

For adit discharges, initial responses can include a number of mitigative measures such as ditching, berming, or pumping water, or whatever alternative is needed as to not degrade the quality of water nearby. A comprehensive analysis will be performed by the laboratory to verify the accuracy of monitoring information. Additional samples will be sent to the lab to ensure quality control. Included in the lab testing will be a LT50 bioassay toxicity test for acute lethality.

The next step will be to document and re-affirm the flow path of the watercourse above where the sample was taken and the down gradient environment. This is to determine if the cause of the trigger is a variation in the flow path which has allowed water to flow through an area which could be the source of new metal loading. Areas that may be suspect to loading will be documented for further analysis.

The next step will be to perform a comprehensive analysis of samples taken at the sampling stations in the drainage area down gradient of the site in question. At certain old mine workings (No Cash 500 adit and Onek adit), down gradient piezometers have been installed to track effects to the local receiving environment. Additional drive point piezometers could be installed at other locations based on continued tracking of adit discharge flow paths. Results of 2007 monitoring of adit flow paths tracked most flows to receiving waters, however, if flow goes to ground and is not observed to enter receiving waters, additional piezometers may be installed. Results from piezometers would be analysed to determine the extent of the groundwater contamination, if any. The purpose of this analysis will be to aid in the identification of potential down gradient environmental effects. This will also allow a determination of the extent of the higher contamination levels and will dictate the extent of the response measures. If deemed necessary, monitoring frequency will be increased to help pinpoint the cause of the trigger in the effluent discharge and include additional groundwater, seepage or surface water sampling in the receiving environment.

Technical experts and regulatory agencies will be consulted to determine temporary mitigation measures which can be implemented to control the flow of contaminants, if occurring, into nearby watercourses or groundwater while a mitigation plan is developed. Once a mitigation or treatment plan is developed, construction of any required facilities and implementation of any required work plans will then proceed according to any directives returned by the Yukon Water Board. These plans should allow water quality to return to normal levels by securely preventing the noted contaminants from proceeding any further past the treatment point, much like the treatment sites at Galkeno 300 or Bellekeno 625. The water treatment plans will be designed such that treatment can proceed for an undetermined length of time until the final Closure Plan can be implemented.

3.1.5.3 Bellekeno Mine Water Quality Significantly Altered After Dewatering

Dewatering of the Bellekeno Mine is a licenced activity pursuant to Water Licence QZ07-078. Schedule A, Part V of the Water Licence provides a compliance monitoring schedule during and for 12 weeks following dewatering Bellekeno Mine. Should mine water quality (and/or quantity – see Section 3.2.5.3) be significantly altered after dewatering of the Bellekeno mine, the period of weekly monitoring outlined in the Water Licence for the Bellekeno 625 adit and treatment facility effluent (KV-42 and KV-43) as well as the Bellekeno East decline and pond decant (KV-74 and KV-75) would continue until water quality has stabilized.

If the mine water quality effects the water treatment facility performance and thresholds are being exceeded (Section 3.1.4.1) then dewatering can be reduced or shut down until modifications to the treatment facility are made (Section 3.1.5.1).

3.1.5.4 Receiving Water Quality Significantly Altered During or Subsequent to Dewatering Bellekeno Mine

Should water quality in Thunder Gulch and/or Lightning Creek be significantly altered during or subsequent to dewatering Bellekeno mine, the monitoring frequency of monitoring stations KV-37 (Lightning Creek upstream of Hope Gulch), KV-38 (Lightning Creek upstream of Thunder

Gulch), KV-41 (Lightning Creek u/s bridge at Keno City) and KV-77 (Thunder Gulch upstream of Bellekeno East) would increase from quarterly monitoring to monthly and then to weekly if the event were to persist. Water quality measurements and data analysis will be interpreted in an attempt to determine the cause of the altered receiving water quality in Thunder Gulch and Lightning Creek. Dewatering and treatment facility operations would be reviewed and treatment facility performance assessed.

Once water quality is no longer considered significantly altered from pre-dewatering conditions, water quality monitoring at quarterly intervals will be resumed.

3.1.6 Significant Change in Water Quality AMP Summary

Table 3-2 provides a summary of the AMP for a significant change in effluent quality from the water treatment facilities including specific thresholds and actions to be taken in order of priority. Table 3-3 provides the AMP summary for a significant change in adit discharge quality as well receiving water quality as a result of dewatering Bellekeno.

Table 3-2 Significant Change in Effluent Quality AMP Summary

SPECIFIC THRESHOLD	ACTIONS TAKEN IN ORDER OF PRIORITY
Daily sampling result pH < 8.0 at a water treatment facility decant; OR Total zinc > 0.40 mg/L and pH < 6.5 units for two consecutive days; OR Total ammonia > 4.0 mg/L and pH > 9.0 for two consecutive days (Bellekeno only); OR	Routine system monitoring and inspections; Ensure system power and site operations; Operate back up power if necessary; Verify lime slurry tank volumes and flow rate; Adjust lime addition rate; Verify system pH; Verify internal sampling and analytical results; Re-sample and analyze; Replace or repair system equipment; Review need for settling pond desludging and desludge pond; Consider need to send samples for outside analyses and/or analytical equipment
Sample result exceeds effluent quality standard.	Shut down mine de-watering (Bellekeno) Consider need for capital improvements and implement

Table 3-3 Significant Change in Adit Discharge/Receiving Water Quality AMP Summary

SPECIFIC THRESHOLD	ACTIONS TAKEN IN ORDER OF PRIORITY				
ADITS Field measurement during routine weekly site inspections: - noticeable change in water clarity; - pH appears to be significantly declining between measurements or drops below 6.0; - conductivity shows significant increasing trend or conductivity above 2,000 µS/cm. OR Increase of 2X or more in metal load for total zinc / cadmium when compared to the average loading for the previous 24 months, AND exceeds licenced discharge standards for the parameters provided elsewhere on the property; OR Increase of 2X or more in conductivity (lab measurement) when compared to average for previous 24 months.	Initial response if necessary to ditch/ berm/ pump water or take necessary measures to prevent degradation of nearby waters.				
	Additional sample sent to lab*				
	Re-affirm Flow Path	Flow path has changed	Document areas suspect to loading		
		Flow path has not changed			
			Analyze data	Implement mitigation or treatment plan	
	Sample downstream sites				
	Continue weekly dewatering monitoring for Bellekeno until water quality stabilizes	Reduce or shut down dewatering if Bellekeno water treatment facility affected	Make modifications to Bellekeno water treatment facility		
BELLEKENO RECEIVING WATER Increase of 2X or more in metal load for total zinc / cadmium when compared to the average loading for the previous 24 months prior to dewatering; OR Increase of 2X or more in conductivity (lab measurement) when compared to average for previous 24 months prior to dewatering.	Increase receiving water quality monitoring to monthly, then weekly if event persists				
	Analyze/interpret data to determine cause	Review dewatering and treatment facility operations/performance			

*Toxicity tests include acute toxicity testing.

3.2 SIGNIFICANT INCREASE OR DECREASE IN MONITORED FLOW OCCURS

3.2.1 Description

For every currently monitored site where water flow occurs, the volume of water flowing from the source is measured or estimated and compared with historical observations for that particular site. The flow data is recorded and maintained in the EQWin water quality database. Much like the responses for water flow ceasing completely, a significant increase or decrease in a monitored flow can be an indication of problems or issues further upstream. Therefore, responses should be in place for irregularities observed in flows with a reasonably predictable flow history.

3.2.2 Locations

Discharge from adits and water treatment facilities is measured to prevent significant adverse effects to the receiving environment including loading of down gradient waters. These sites are listed below and shown in Figure 3-1 of the Environmental Monitoring Program in Appendix A.

Water Treatment Facilities:

- KV14 - Silver King Treatment Pond #2 Decant;
- KV28 - Galkeno 300 Treatment Pond Decant;
- KV32 - Galkeno 900 Treatment Pond Decant; and
- KV43 - Bellekeno 625 Treatment Pond Decant.

Adits:

- KV17 - Husky South West;
- KV18 - Bermingham Adit;
- KV19 - Ruby Adit;
- KV20 - No Cash 500 Adit;
- KV33 - Keno 700 Adit;
- KV34 - Lucky Queen Adit;
- KV35 - Sadie Ladue Adit;
- KV36 - Flame and Moth Adit;
- KV45 - Onek Adit;

- KV53 - UN Adit;
- KV66 - Klondike Keno Adit;
- KV67 - Keno 200 Adit;
- KV68 - Brewis Red Lake Adit; and
- KV74 - Bellekeno East Adit.

3.2.3 Monitoring Requirements

All water treatment and old mine adits at the Keno Hill Silver District where regular water flow is expected are monitored either continuously or at various times of the year during water quality sampling events. These sites are listed in Appendix A with monitoring frequency for each site including receiving water monitoring sites. Monitoring schedules coincide with the requirements of the Water Licences and data necessary for closure planning.

3.2.4 Specific Thresholds

The specific thresholds that will indicate a significant change in discharge and initiate an adaptive management response are outlined below. For reference, average flow for each of the locations listed above is provided in the following Table 3-4.

Table 3-4 Average Flow for 2007 and 2008 – Treatment Sites Decants and Adit Discharge

Site	Description	2007 & 2008 Average Flow L/s	N (# samples)	Max	Min
<u>Water Treatment Facilities</u>					
KV14	Silver King Treatment Pond #2 Decant	6.4	390	13.0	2.5
KV28	Galkeno 300 Treatment Pond Decant	12.4	528	30.5	7.5
KV32	Galkeno 900 Treatment Pond Decant	3.1	392	8.0	1.8
KV43	Bellekeno 625 Treatment Pond Decant	2.1	457	10.0	0.0
<u>Adits</u>					
KV17	Husky South West	0.4	6	1.6	0.017
KV18	Birmingham Adit	4.2	4	9.7	1.5
KV19	Ruby Adit	1.0	6	2.0	0.3
KV20	No Cash 500 Adit	5.3	6	7.8	3.0
KV33	Keno 700 Adit	2.9	5	5.5	1.3
KV34	Lucky Queen	None	0		
KV35	Sadie Ladue Adit	4.5	6	10.0	0.5
KV36	Flame and Moth	None	0		
KV45	Onek Adit	2.3	6	5	0.8
KV53	UN Adit	None	1	0.75	0.75
KV66	Klondike Keno Adit	Dry	0		
KV67	Keno 200 Adit	0.3	2	0.4	0.3
KV68	Brewis Red Lake Adit	Dry	0		
KV74	Bellekeno East Adit	None	0		

3.2.4.1 Decrease in Discharge

- Noticeable decrease in adit discharge since last inspection.
- A monitoring result at a sampling site whereby there is a decrease of two-times (2X) or more in water flow when compared to the average flow for the previous 24-months' data for that site.

3.2.4.2 Increase in Discharge

- Noticeable increase in adit discharge since last inspection.
- A monitoring result at a sample site whereby there is an increase of two-times (2X) or more in water flow when compared to the average flow for the previous 24-months' data for that site; AND
- Average metal loading (total zinc/cadmium) has increased by two-times (2X) or more when compared to the average loading for the previous 24-month's water quality data for that site, along with discharge concentrations for the site which are at or greater than those concentration limits provided elsewhere on the property as licenced discharge standards (see Section 3.1 Significant Change in Water Quality); OR
- A monitoring result at a sampling site whereby there is an increase of two-times (2X) or more in conductivity (measured externally by the lab) when compared to the average conductivity for the previous 24-months' water quality data for that site (see Section 3.1 Significant Change in Water Quality).

3.2.5 Approaches to Responses

As per the general approach to the AMP, a staged response to a significant increase or decrease in an observed water flow will be implemented if a threshold is breached. For adit discharges, initial responses can include a number of mitigative measures such as ditching,

berming, or pumping water, or whatever alternative is needed as to not degrade the quality of water nearby and receiving environment.

3.2.5.1 Decrease in Discharge

The initial response to a significant decrease in flow rate will be to examine the flow path upstream from the observed location of the flow decrease. Normally, this will consist of examining the adit from where the water flow originates from. This will determine if the decrease in water flow is due to an ice plug forming or a cave-in has occurred that has blocked a portion of the flow. If the cause of the reduced flow is the formation of an ice plug in the adit, monitoring will be increased until such time as the flow returns to normal or until the ice plug causes the water flow to cease, at which time the AMP for flow stopping (Section 3.3) will be triggered.

If the reduced water flow is due to a cave-in either at the entrance of an adit or further into the adit, then regular monitoring will be implemented as removal of the material impeding on the flow may be difficult to removal due to safety or other concerns.

Depending on the nature of the flow reduction, inspection frequency may increase and water quality sampling may be conducted to assist with the assessment of the potential causes or implications of the decreased flow.

3.2.5.2 Increase in Discharge

The response to a significant increase in the flow rate will be to increase inspection frequency and to document the path of the water flow (photo's and GPS survey). It is entirely possible that the path of the water flow could have changed due to the increase of water flow, which may have caused the water to breach it's banks or to accelerate the erosion of certain portions of the side banks. Areas of particular concern when documenting the flow path should include flows through waste rock piles, flows into other underground mine workings, and flows into other watercourses or near site infrastructure. Documentation should be sufficient enough so that if the water flow has indeed changed course, it can be accurately displayed on a site map. Refer to Section 3.5 for a staged response to a change in flow path.

The next step of the response to a significant increase in water flow is to obtain a grab sample and to perform a comprehensive analysis of the water. This analysis is important as it will determine whether the increase in flow is also contributing to metals loading or contamination to a nearby watercourse or local groundwater levels, which will in turn determine the severity or impact the increased flow will have on the surrounding environment, and whether a mitigation program will have to be implemented at this location. If metal concentrations are found to be of concern, and the flow path does not intersect with a potential fish bearing stream, then the site will be subject to continual monitoring. Downstream or down gradient locations should be monitored to ensure that the flow path does not eventually reach fish bearing waters.

If the flow path does deposit loading into a fish bearing stream or creek, an assessment of mitigation or treatment options will be performed and an appropriate mitigation plan will be implemented after consultations with technical experts and regulatory agencies.

The next step of the response is to determine the physical stability of the environment along the flow path. The most common area to suffer physical instability due to water flows will be waste rock piles, followed by steep embankments with loose soil. If either short or long term stability is threatened, then mitigative measures will have to be addressed and could consist of redirection of the flow.

3.2.5.3 Bellekeno Mine Water Quantity Significantly Altered After Dewatering

Dewatering of the Bellekeno Mine is a licenced activity pursuant to Water Licence QZ07-078. Schedule A, Part V of the Water Licence provides a compliance monitoring schedule during and for 12 weeks following dewatering Bellekeno Mine. Should mine water quantity (and/or quality – see Section 3.1.4.3) be significantly altered after dewatering of the Bellekeno mine, the period of weekly monitoring outlined in the Water Licence for the Bellekeno 625 adit and treatment facility effluent (KV-42 and KV-43) as well as the Bellekeno East decline and pond decant (KV-74 and KV-75) would continue until water quantity has stabilized.

Water quality analysis would be conducted as per the Water Licence with continued daily flow monitoring to assess implications to the treatment facility. The treatment facility may require

modification to handle increased flows or dewatering may need to be stopped to ensure treatment facility performance and that effluent quality standards are achieved.

3.2.6 Significant Increase or Decrease in Flow AMP Summary

Table 3-5 provides a summary of this AMP event including specific thresholds and actions to be taken in order of priority.

Table 3-5 Significant Increase or Decrease in Monitored Flow AMP Summary

SPECIFIC THRESHOLD	ACTIONS TAKEN IN ORDER OF PRIORITY					
Noticeable increase/decrease in adit discharge since last routine weekly site inspection; Increase of 2X or more in water flow when compared to the average flow for the previous 24 months; AND Metal loading (total Zn/Cd) has increased by 2X or more when compared to average loading for the previous 24 months and discharge standards for these parameters at other locations on the property are exceeded; OR There is an increase of 2X or more in conductivity when compared to the average for the previous 24 months.	Initial response if necessary to ditch/ berm/ pump water or take necessary measures to prevent degradation of nearby waters and receiving environment.					
	Document flow path	Flow enters fish bearing waters	Initiate monitoring of water quality and flow	Water quality exceeds effluent regulations	Initiate mitigation or treatment plan	
				Water quality does not exceed effluent regulations		Continue monitoring of water quality and flow until regular flow resumes
		Flow does not enter fish bearing waters				Initiate monitoring of water quality and flow until regular flow resumes
		Flow poses risk to physical stability or infrastructure downstream or water treatment system		Complete mitigative design for areas of potential physical instability. Review and assess effects to water treatment facility. Revise dewatering strategy and/or treatment system		Implement physical instability preventative measures. Review treatment system performance and make adjustments to system
Decrease of 2X or more in water flow when compared to the average flow for the previous 24 months	Examine flow path upstream from observed area	Formation of ice plug evident				Increase monitoring of ice plug until AMP Event 2 (flow stops) triggered
		Evidence of cave-in or collapse		Immediate mitigative measures unnecessary		Increase monitoring for physical stability issues

3.3 CURRENTLY MONITORED WATER FLOW STOPS

3.3.1 Description

When the expected water flow is interrupted, this could be the result of a few situations. The interruption could be the result of low precipitation levels leading up to the observed event. An inlet for water hydraulically linked to the subject adit could have been intentionally or unintentionally sealed, an underground cave-in or subsidence could have occurred thereby stopping sufficient water from entering the workings to create the expected water flow.

Another situation could be the formation of an ice plug in the adit. The formation of an ice plug could result in a build-up of water pressure behind the plug. If the water pressure becomes too much for the ice plug, the plug may release water. This could lead to a release of water into the receiving environment.

Dewatering also can stop flows for a period of time, but is controlled by site personnel.

3.3.2 Locations

Water Treatment Facilities:

- KV14 - Silver King Treatment Pond #2 Decant;
- KV28 - Galkeno 300 Treatment Pond Decant;
- KV32 - Galkeno 900 Treatment Pond Decant; and
- KV43 - Bellekeno 625 Treatment Pond Decant.

Adits:

- KV17 - Husky South West;
- KV18 - Bermingham Adit;
- KV19 - Ruby Adit;
- KV20 - No Cash 500 Adit;
- KV33 - Keno 700 Adit;
- KV34 - Lucky Queen Adit;
- KV35 - Sadie Ladue Adit;

- KV36 - Flame and Moth Adit;
- KV45 - Onek Adit;
- KV53 - UN Adit;
- KV66 - Klondike Keno Adit;
- KV67 - Keno 200 Adit;
- KV68 - Brewis Red Lake Adit; and
- KV74 - Bellekeno East Adit.

3.3.3 Monitoring Requirements

All treated adit discharges and old mine workings at the Keno Hill Silver District where regular water flow is expected either continuously or at various times of the year are inspected and sampled (see Appendix A). These sites are listed in Appendix A and include the monitoring frequency for each site. Monitoring schedules coincide with the requirements of the Water Licences and reflect the data necessary for closure planning.

3.3.4 Specific Thresholds

The specific thresholds that will initiate the adaptive management response will be as follows:

- A currently monitored flow ceases or is reduced by more than 50% of the historical average flows during a period of the year when flow has been historically present.

3.3.5 Approach to Responses

As per the general approach to the AMP, a staged response to an interruption in the water flow at adits where flow should be observed will be implemented if this trigger is activated.

The initial response to the trigger will be a more thorough inspection of the adit. This may involve looking deeper into the adit, and looking for evidence of the formation of an ice plug or cave in. If physical inspection of the underground workings is not possible, then evidence of adit ice formation or cave in near surface will be conducted.

If an ice plug has formed and impeded the constant flow of water, the next step will be the determination of the extent of the ice plug. If the ice plug consumes less than 25% of the adit opening where it is located, then increased monitoring of the ice plug will be necessary to observe whether the ice plug develops into a larger plug or whether it has reached the extent of its formation and will recede once the seasonal increase in the temperature occurs. This inspection will also include linkages to other developments including vent raises and shafts and their status (i.e. are they closed to prevent air movement).

If the ice plug consumes more than 25% of the adit opening where it is located, then it has to be determined whether the adit contains or requires heat trace. If heat trace is present, then an inspection of the electrical system will be required as the presence of ice in this amount will likely be an indicator that the heat trace is not working. The first components to inspect are electrical connections making sure that all connections are clean and are firmly in contact. If all contacts are satisfactory, then the unit should be checked for external damage and any damaged parts should be replaced. If the electrical connections are all good and there is no evidence of external damage, arrangements should be made to have a qualified repair technician look at the unit and repair.

De-icing measures need to be implemented for adits with an ice plug forming in them in order to bring the ice formation under control whether or not the adit contains a heat trace. The process of de-icing will consist of utilizing a heated steam point to thaw a number of holes into the ice block that has formed in the adit. The holes should be sufficient to enable the establishment of adit flow. Once the holes are generated, steam pipes will operate until the ice blockage has been reduced to enable adit flows.

If the adit is not equipped with a heat trace, then heat trace could also be installed in order to prevent the long term build-up of another ice plug once the de-icing measures have been completed.

In both cases, the monitoring of these locations should be increased to ensure that the staged response has been adequate to mitigate the consequential effects of the event.

3.3.6 AMP Summary for Monitored Flow Stops

Table 3-6 provides a summary of this AMP event including specific thresholds and actions to be taken in order of priority.

Table 3-6 AMP Summary for Monitored Flow Stops

Specific Threshold	Actions Taken in Order of Priority			
Water flow from adit has stopped	Inspect adit	Ice plug formed; >25% of adit opening	Heat trace present	Check for electrical problems and repair
				Implement De-icing Measures Plan
				Increase monitoring until regular flow resumes
			No heat trace present	Implement De-icing Measures Plan
				Install heat trace
				Increase monitoring until regular flow resumes
		Ice plug formed; <25% of adit opening		
		Increase monitoring until regular flow resumes		
		No ice plug – cave in or subsidence	Inspect attached raises	Close any open raises

3.4 NEW WATER FLOW IS OBSERVED

3.4.1 Description

Although the site caretakers are aware of the majority of water flows exiting from the underground workings at the Keno Hill Silver District, there is always the possibility that a water flow can be generated from a previously dry location, or a location that was previously undisclosed or undiscovered.

The environmental consequences of a new water flow being generated on the property is the potential exposure of humans, wildlife or down gradient stream, including fish bearing streams to potentially increase levels of contaminants (metals, sediments) that could be contained in the flow. Another consideration is the affect of the water flow on physical characteristics of the environment, such as soil erosion or permafrost degradation, which could negatively impact the surrounding environment.

3.4.2 Locations

Site wide based on routine inspection throughout the property (See Appendix A).

3.4.3 Monitoring Requirements

Since it is impossible to predict where a new flow of water is going to be generated, there can be no specific monitoring requirements to observe new water flows prior to their existence. New water flows would be observed during routine monitoring of known sites, either during travels from site to site, or upon inspection of the sites themselves. Generally there is daily travel and site inspections from one end of the district to the other as part of the operation of the water treatment facilities.

3.4.4 Specific Thresholds

The specific thresholds that will initiate an adaptive management response will be as follows:

- A water flow is observed with a flow greater than 30 L/sec, persists for at least 7 days and is observed to influence other site workings, facilities, infrastructure or property, or drains to a downstream receiving water that is fish bearing. This flow is considered adequate as it

allows for the winter season when glaciation occurs at numerous locations and is a normal site occurrence.

3.4.5 Approach to Responses

As per the general approach to the AMP, a staged response to a sighting of a new water flow will be implemented if the trigger is activated.

The initial response to the trigger will be to document the path of the new water flow. Areas of particular concern when documenting the flow path should include flows through waste rock piles, flows into other underground mine workings, and flows into other watercourses. Documentation (photo's and GPS survey) should be sufficient enough so that the new water flow can be accurately displayed on a site map.

The next step of the response to a new water flow is to obtain a sample for water quality from the water flow and to perform a comprehensive analysis of the water. This analysis is important as it will determine whether the new flow will contribute high metal loading or contamination to a nearby watercourse or to the local groundwater levels, which will, in turn, determine the severity or impact the new water flow will have on the surrounding environment, and whether a specific mitigation treatment program will have to be implemented at this location. If metal concentrations are found to be of concern, and the flow path does not affect human resources or intersect with a potential fish bearing stream, then the site will be subject to continual monitoring. Downstream locations would be monitored to ensure that the flow path does not eventually reach fish bearing waters either through an unobserved flow or through groundwater.

If the flow path does deposit loading into a fish bearing stream or creek, an assessment of mitigation measures or water treatment options will be performed and an appropriate plan will be implemented after consultations with technical experts and regulatory agencies.

The next step of the response is to determine the physical stability of the environment along the new flow path. The most common area to suffer physical instability due to water flows will be waste rock piles, followed by steep embankments with loose soil. If either short or long term stability is threatened, then mitigative measures will have to be addressed and could consist of redirection of the flow.

3.4.6 AMP Summary for New Water Flow

Table 3-7 provides a summary of this AMP event including specific thresholds and actions to be taken in order of priority.

Table 3-7 AMP Summary for New Water Flow

SPECIFIC THRESHOLD	ACTIONS TAKEN IN ORDER OF PRIORITY			
Flowing water is observed at a previously dry site - >30 L/s for 7 days	Document the flow path	Identify areas of metal loading or physical instability (long or short term)	Complete mitigative design for areas of potential physical instability	Implement physical instability preventative measures
	Initiate monitoring of water quality and flow	Water quality does not exceed effluent guidelines		Continue regular monitoring of water quality
		Water quality exceeds effluent guidelines and does not enter fish bearing waters		Initiate monitoring of downstream sampling locations
		Water quality exceeds effluent guidelines and enters fish bearing stream		Implement mitigation or treatment program

3.5 WATER FLOW PATH CHANGES

3.5.1 Description

Although the flow path of most of the major water contributing adits are previously documented and rarely change their course, there is the possibility that, due to some unforeseen circumstances, such as an unusually large or long freshet period, above average precipitation, or the displacement of soil or rock due to landslides or rock falls, the flow path of any one of these sites could be altered.

An altered flow path may not have any affect on the surrounding environment other than the path's own displacement, but an altered flow path may also become a hazard if it causes physical instability of soil or rock due to erosion, interferes with property or public infrastructure such as roads or highways, or acts as a conduit for potential contaminants to be deposited in fish bearing creeks or streams. In these cases management will have to step in and intervene and respond in order to prevent a possible detrimental affect on the surrounding environment or infrastructure.

3.5.2 Locations

Water Treatment Facilities:

- KV12 - Valley Tailings Pond #3 Decant;
- KV14 - Silver King Treatment Pond #2 Decant;
- KV28 - Galkeno 300 Treatment Pond Decant;
- KV32 - Galkeno 900 Treatment Pond Decant; and
- KV43 - Bellekeno 625 Treatment Pond Decant.

Adits:

- KV17 - Husky South West;
- KV18 - Bermingham Adit;
- KV19 - Ruby Adit;
- KV20 - No Cash 500 Adit;
- KV33 - Keno 700 Adit;

- KV34 - Lucky Queen Adit;
- KV35 - Sadie Ladue Adit;
- KV36 - Flame and Moth Adit;
- KV45 - Onek Adit;
- KV53 - UN Adit;
- KV66 - Klondike Keno Adit;
- KV67 - Keno 200 Adit;
- KV68 - Brewis Red Lake Adit; and
- KV74 - Bellekeno East Adit.

3.5.3 Monitoring Requirements

Since it is almost impossible to predict when a change in the path of flow of water is going to occur, there can be no specific monitoring requirements to observe these changes prior to their existence. Change in flow paths will be observed during the routine monitoring of known sites, either during travels from site to site, or upon inspection of the sites themselves (see Appendix A).

3.5.4 Specific Thresholds

The specific thresholds that will initiate the action plan will be as follows:

- When the previously documented flow path is observed to have significantly deviated from this path and entered a stream.

3.5.5 Approach to Responses

As per the general approach to the AMP, a staged response to a change in a flow path will be implemented if one of the triggers is activated.

The initial response is to determine new sampling points along the flow path, which will be determined based on areas where it is possible for the new water path to collect and disperse contaminants. This phase of the response should also consider current sampling points that

may be affected, including downstream receiving water sites and down gradient piezometers. Once these points are chosen, grab samples will be taken at the appropriate sites and sent out for water quality analyses and possibly toxicity tests if entering fish bearing streams. If receiving water test results or piezometer water quality test results show high or unacceptable levels of loading, an assessment of mitigation or treatment options will be performed and an appropriate strategy will be implemented after consultations with technical experts and regulatory agencies.

Following this analysis, the next step will be to inspect the entire length of the flow path and to document this path (photographs and GPS survey) and any areas of significance, such as areas where physical stability may be of concern or areas where the path now intersects another watercourse or water body. This will help determine if the new path now presents metal loading potential to a stream whether fish bearing or not that was previously unaffected by this water flow.

After documenting the flow path, areas of instability will be investigated that may have been identified during the inspection of the new flow path. These areas may include waste rock piles or slopes with loose soil or gravel cover or effects to site infrastructure. An assessment of the possible long term effects of water flow through these areas of instability will be performed and, if necessary, temporary mitigative measures will be designed and implemented until the final Closure Plan can be implemented. Construction of any required facilities (ditches, berms, rip rap channels) and implementation of any required work plans will then proceed according to any directives returned by the Yukon Water Board.

3.5.6 AMP Summary for Change in Water Flow Path

Table 3-8 provides a summary of this AMP event including specific thresholds and actions to be taken in order of priority.

Table 3-8 AMP Summary for Change in Water Flow Path

SPECIFIC THRESHOLD	ACTIONS TAKEN IN ORDER OF PRIORITY			
Flow path change to a new stream	→ Document the entire flow path	→ Identify areas of metal loading or physical instability (long or short term)	→ Complete mitigative design for areas of potential physical instability	→ Implement physical instability preventative measures
	→ Determine new water sampling locations	→ Initiate monitoring of water quality and flow	→ Water quality does not exceed effluent guidelines	→ Continue regular monitoring of water quality
			→ Water quality exceeds effluent guidelines/does not enter fish bearing waters	→ Initiate monitoring of downstream sampling locations
			→ Water quality exceeds effluent guidelines/enters fish bearing stream	→ Implement mitigation or treatment program

4. WASTE ROCK SEEPAGE EXHIBITS AML

As mentioned previously in Section 1.4 (Plans in Place) a number of plans are in currently in place with respect to waste rock management and monitoring:

- Environmental Monitoring Program (February 2009);
- Waste Rock Management Plan (January 2008);
- Waste Rock Metals and Acid Base Accounting Testing Plan (October 2008); and
- Mine Wall Testing Plan (October 2008).

The following sections pertain to the potential for acidic or metal leachate (AML) to occur as a result of seepage or run-off through waste rock storage areas or areas where waste rock has been used as a construction material.

4.1 WASTE ROCK SEEPAGE/RUN-OFF TRENDING TO AML CONDITIONS

4.1.1 Description

Waste rock seeps/run-off will be monitored to determine if water quality is trending to AML conditions and an adaptive management response is required.

4.1.2 Locations

- An observed seep has historically been monitored below Bellekeno 625 (KV-44).
- A recently established water quality monitoring station exists at the Onek Waste Rock Storage Facility (KV-78) to monitor run-off.
- Any seepage from works constructed or upgraded with non-AML material, which currently includes Bellekeno East and Bellekeno powerline roads. Other Bellekeno East waste rock management areas as defined in the Waste Rock Management Plan are also monitored for drainage or seeps.

4.1.3 Monitoring Requirements

Specific monitoring requirements for the Bellekeno 625 seep (KV-44) and Onek Waste Rock Storage Facility (KV-78) are outlined in the EMP (Appendix A). Monthly field measurements of pH, temperature and conductivity in will be taken between May and October, and flow at KV-44 will also be estimated. Samples will also be collected on an annual basis for KV-44 and a quarterly basis for KV-78 and sent to an external laboratory for the full suite of water quality analyses.

As per the Waste Rock Management Plan, any waste rock drainage or seeps observed between May and October will be monitored for estimated flow volume and basic field parameters of pH and conductivity. Evidence of sulphide oxidation such as snow melt areas or the presence of oxidations products will also be noted.

One geomembrane-lined lysimeter $\geq 5\text{m}^3$ will be installed in both AML (Onek Waste Rock Storage Area) and non-AML storage areas (Bellekeno power line road). Drainage volume will be monitored, with field parameters (pH and conductivity) measured on a monthly basis from May to October. Providing there is sufficient quantity of drainage, a full suite of water quality analyses will be conducted at least twice per year.

4.1.4 Specific Thresholds

Field measurements of pH and conductivity will be monitored to determine if the following specific thresholds have been breached due to AML:

- pH significantly declining between measurements or dropping below 7.0; and/or
- conductivity showing a significant increasing trend or conductivity above 2,000 $\mu\text{S}/\text{cm}$.

As the Onek Waste Rock Storage Facility is a licenced effluent discharge point, specific thresholds and adaptive management responses are discussed in Section 3 – Significant Change in Water Quality or Quantity (Sec 3.1.4.1 and 3.1.5.1).

4.1.5 Approach to Responses

Initial responses to an observed waste rock seep or runoff trending to AML conditions can include further inspection of the waste rock source material to ensure that the rock types used for construction are acceptable and mitigative measures such as ditching, berming, or pumping water, rock removal or whatever alternative is required to not degrade the quality of water nearby. A full suite of water quality analysis will be performed by an external laboratory to verify the accuracy of field measurements.

The location of seepage or run-off will be documented with photos and GPS.

Downstream or down gradient locations should be monitored to ensure that AML run-off does not eventually reach fish bearing waters. If water quality analyses indicates run-off does deposit loading into a fish bearing stream or creek, the initial response of ditching, berming, or pumping or selective waste rock removal to prevent this would be implemented. Once the seepage/run-off is diverted or removed, measures would be taken to prevent the AML from occurring. This may include installing a cover or possibly collection and treatment of the run-off (i.e. Onek Waste Rock Storage Facility).

Weekly monitoring at the location trending to AML conditions would be implemented until seepage/run-off stops for two consecutive weeks or thresholds are not triggered for two consecutive months.

4.1.6 AMP Summary for Waste Rock Seepage/Run-Off Trending to AML Conditions

Table 4-1 provides a summary of this AMP event including specific thresholds and actions to be taken in order of priority.

Table 4-1 AMP Summary for Waste Rock Seepage Trending to AML Conditions

SPECIFIC THRESHOLD	ACTIONS TAKEN IN ORDER OF PRIORITY		
pH significantly declining between measurements or dropping below 7.0; and/or conductivity showing an increasing trend or conductivity above 2,000 µS/cm	Prevent degradation of surface waters	→ confirmatory sample to external Lab	→ downstream / down gradient monitoring
	Inspect rock types to ensure suitable for construction	→ document seepage with photos & GPS	→ Cover installation
			→ Selective waste rock removal
			→ Ditching and diverting seepages
			→ Collect & treat run-off

5. SLUDGE STORAGE AREA EFFECTIVENESS COMPROMISED

As mentioned previously in Section 1.4 (Plans in Place) a Sludge Management Plan Revision No.1 (May 2008) is currently in place. The following sections pertain to the potential for the effectiveness of sludge storage areas mentioned within this plan to become compromised.

5.1 SEEPAGE OBSERVED NEAR SLUDGE STORAGE AREA

5.1.1 Description

Any seepage observed in the vicinity of the sludge storage areas will be monitored to determine if it is resulting from sludge deposition.

5.1.2 Locations

Sludge storage areas will be routinely monitored for seepage:

- Sime Pit;
- Sime Waste Dump; and
- Valley Tailings Sludge Storage Cell.

5.1.3 Monitoring Requirements

Specific monitoring requirements for the Sime Pit are outlined within the Sludge Management Plan. Among these monitoring requirements are visual daily inspection reports of the facility and sludge status and inspection for seeps in the immediate vicinity of the Galkeno 300 treatment system, which could provide an indication of decant water from the Sime Pit.

Similarly, visual inspections will be conducted of the Sime Waste Dump and Valley Tailings Sludge Storage Cell when these facilities are in use.

5.1.4 Specific Thresholds

Any new identified seeps will be monitored and analyzed onsite for the pH and zinc thresholds:

- pH > 8.5 and zinc > 1.0 mg/L.

5.1.5 Approach to Responses

Seepage observed in the vicinity of the sludge storage areas will be documented with photos and monitored weekly for flow, field pH and zinc. A full suite of water quality analysis will be performed by an external laboratory to verify the accuracy of field measurements. The flow path will be documented and an assessment of the down gradient environment conducted to determine if flow is reaching surface waters and whether or not they are fish bearing. If seepage is depositing a load into a fish bearing stream or creek, ditching, berming or pumping may be implemented to prevent this. Alternative sludge storage area would be assessed and use of the current one would cease. Other pit locations could be investigated for potential sludge storage areas including the Upper Sime Pit and Hector Calumet Pits.

The Sludge Management Plan would be revised to incorporate any new sludge storage areas and implemented.

5.1.6 AMP Summary for Seepage Near a Sludge Storage Area

Table 5-1 provides a summary of this AMP event including specific thresholds and actions to be taken in order of priority.

Table 5-1 AMP Summary for Seepage Near a Sludge Storage Area

SPECIFIC THRESHOLD	ACTIONS TAKEN IN ORDER OF PRIORITY		
ph > 8.5 and zinc > 1.0 mg/L →	→ monitor weekly for flow, pH and zinc →	confirmatory sample to external Lab →	downstream / down gradient monitoring & photo documentation
			→ if depositing to fishing bearing waters - ditching /diverting seepage
			→ assess alternative locations
			→ cease use of sludge storage area
			→ Revise Sludge Management Plan & implement

5.2 SLUDGE STORAGE AREA APPROACHING CAPACITY

5.2.1 Description

Sludge storage areas will be monitored daily during use to ensure sufficient capacity.

5.2.2 Locations

Sludge storage locations are outlined in the Sludge Management Plan:

- Valley Tailings Area Sludge Storage Cells;
- Sime Waste Dump; and
- Sime Pit.

5.2.3 Monitoring Requirements

Visual inspection of freeboard in the sludge storage areas. Specific monitoring requirements for the Sime Pit are outlined within the Sludge Management Plan. Among these monitoring requirements are visual daily inspection reports of the facility and sludge status including freeboard.

Similarly, visual inspections will be conducted of the Sime Waste Dump and Valley Tailings Sludge Storage Cell when these facilities are in use.

5.2.4 Specific Thresholds

Freeboard is approaching capacity: 1.5 m. A minimum freeboard of 1.0 m below the decant point will be maintained.

5.2.5 Approach to Responses

Determine if there is seepage from the sludge storage area as per the visual inspection (Section 5.1).

An investigation would be conducted of the ability to increase the facility capacity by increasing berm height for example.

Alternative sludge storage area would be assessed and use of the current one would cease. Other pit locations could be investigated for potential sludge storage areas including the Upper Sime Pit and Hector Calumet Pits.

The Sludge Management Plan would be revised to incorporate any new sludge storage areas and implemented.

5.2.6 AMP Summary for Sludge Storage Area Approaching Capacity

Table 5-2 provides a summary of this AMP event including specific thresholds and actions to be taken in order of priority.

Table 5-2 AMP Summary for Sludge Storage Area Approaching Capacity

SPECIFIC THRESHOLD	ACTIONS TAKEN IN ORDER OF PRIORITY	
Freeboard approaching capacity = 1.5 m	→ check for seepage	
	→ Investigate ability to increase facility capacity	→ assess alternative locations
		→ cease use of sludge storage area
		→ Revise Sludge Management Plan & implement

6. PHYSICAL INSTABILITIES

The following sections pertain to potential physical instabilities that may be encountered in the Keno Hill Silver District.

6.1 AREA OF SIGNIFICANT SUBSIDENCE IS OBSERVED

6.1.1 Description

There are many documented cases of underground workings in the area, and even some underground workings that are undocumented. In a number of these workings, the stopes came very close to the surface of the ground, leaving a very thin crown pillar. Over time, some of these crown pillars started to weather and sag with age, creating instability on the surface. This aging of the crown pillar is usually defined by a large depression in the ground, and in some cases, can expose an opening leading to the underground workings.

These depressions do not have to be very deep in order to cause concern. Subsidence on the surface is an indicator that the crown pillar is failing, and there is no good way to determine what the risk is of that pillar catastrophically failing. The risk to human safety is magnified when the subsidence occurs in an area of human use or a right-of-way used by vehicles and equipment, which can accelerate the failure of the crown pillar.

Subsidence can also be observed as a result of slope failure or erosion, which could potentially effect the down gradient environment, particularly surface water. Slope failure could eventually result in a rock fall or landslide (Section 6.2) or lead to structure failure or portal collapse (Section 6.3).

6.1.2 Locations

Site wide based on routine inspection throughout the property and as outlined in the Physical Inspection and Reporting Plan (see Appendix A).

6.1.3 Monitoring Requirements

Since it is almost impossible to predict when or where surface subsidence will occur, there can be no specific monitoring requirements to observe these areas prior to their existence, therefore

any observations of subsidence throughout the Keno Hill Silver District will be noted. Maintenance personnel will routinely observe subsidence in the course of their daily site activities.

6.1.4 Specific Thresholds

The specific thresholds that will initiate an adaptive management response include:

- A depression with defined edges is noted in the ground with the potential to create a public safety concern;
- A cave-in has occurred allowing access to the underground workings of a mine site;
- Break in soil/ slope creep/ sediment transport observed from physical structure with perceived potential to effect nearby structures or down gradient surface water.

6.1.5 Approaches to Responses

As per the general approach to the adaptive management plan, a staged response to an observed area of subsidence will be implemented if the threshold is triggered.

The initial response to observing an area of subsidence will be to prevent a hazard to public health and safety and minimize sediment transport to surface waters. This could include installation of barriers such as dykes or silt fencing or construction of diversion ditches or berms. If necessary physical removal or physical repair of structure to remediate. Access to the area would be limited using fencing, barricades, or signage to alert the public and other maintenance personnel to the danger that may exist.

The next stage of the response will be to locate, if possible, diagrams or information pertaining to any underground workings in the area. This will help determine if the cause of subsidence is due to the collapse of a crown pillar or other underground workings.

If there are no underground workings in the area, then it is possible that the subsidence would be due to liquefaction of soil near the surface and may not be a cause for concern. The break or depression will be filled in with soil and monitored to see if the subsidence continues. If the depression continues to appear after soil mounding, then further investigation by a mining engineer may be warranted, particularly if there is a risk to the stability of a nearby structure.

If the subsidence can be attributed to underground workings, the next stage in the response will be to develop an adequate design to counter the negative effects of the subsidence. This will be done in consultation with a mining engineer. This design could include mounding and the use of certain layers of soil or aggregate of specific sizes or physically capping the area such as a shaft. Any physical repairs to slopes or embankments would involve an assessment in consultation with a mining engineer before hand.

This measure will also be implemented if the subsidence exposes an opening to the underground workings. Mining engineers will be consulted in order to devise a plan to adequately cover the opening to prevent access to the underground workings.

The final stage will be to implement the design at the area of the subsidence and to monitor the area to watch for signs of continued subsidence at or around the previously identified area of subsidence.

6.1.6 AMP Summary for Area of Significant Subsidence

Table 6-1 provides a summary of this AMP event including specific thresholds and actions to be taken in order of priority.

Table 6-1 AMP Summary for Area of Significant Subsidence

SPECIFIC THRESHOLD	ACTIONS TAKEN IN ORDER OF PRIORITY					
Area of subsidence has exposed opening to underground workings		Review available underground mine workings				
Area of subsidence effects public safety	Close off area around subsidence with delineating markers or fence	Review available underground mine workings	Underground mine workings confirmed	Design structurally sound cover for subsidence	Implement design	Continued monitoring
Break in soil/ slope creep/ sediment transport from physical structure	Prevent sediment transport to surface waters		No evidence of underground workings	Fill in depression and monitor for further subsidence	Subsidence continues	Consult with mining engineer

6.2 ROCK FALL OR LANDSLIDE OCCURS WITHIN MONITORED AREA

6.2.1 Description

There are a number of potentially unstable slope and rock/soil depositions throughout the Keno Hill Silver District generated by the numerous mine workings and associated activities that have occurred there over the past 100 years. Instabilities exist in places such as pit walls, many of which are in a state of ravelling. Trenching into steep slopes can often leave an unstable rock wall that could fail due to timely erosion. Waste rock piles can possibly shift due to changes in foundation conditions. Even access roads with sections that have been cut or blasted through rock can suffer wall failure given the right circumstances.

Most areas where there exists the possibility of a rock fall or landslide present minimum risk to human or equipment safety. Even though it is remote or unlikely, a significant amount of material can potentially block access to a site. Soil movement can also impede on certain water flows, thereby changing the flow path and initiating an event noted in Section 3.5 of this AMP - Water Flow Path Changes.

6.2.2 Locations

Site wide based on routine inspection throughout the property (See Appendix A).

6.2.3 Monitoring Requirements

Since it is almost impossible to predict when or where a rock fall or a landslide will occur, there can be no specific monitoring requirements to observe these areas prior to their existence. As with Section 6.1 (Area of Significant Subsidence), the monitoring information required is observations of instability or subsidence throughout the Keno Hill Silver District. Maintenance personnel will routinely observe soil or earth movement in the course of their daily site activities.

6.2.4 Specific Thresholds

The specific thresholds that will initiate an adaptive management response include:

- A rock fall or landslide has blocked access to a previously monitored site.

- A rock fall or landslide has blocked access to a roadway previously used by the public.
- A rock fall or landslide has blocked or re-directed the flow of water of a documented stream or watercourse.
- Liquefaction of a waste rock pile foundation has caused waste rock to migrate closer to a watercourse.

6.2.5 Approaches to Responses

As per the general approach to the adaptive management plan, a staged response to the presence of a rock fall or a landslide will be implemented if a threshold is breached.

The initial response to observing a rock fall or a landslide will be to determine if it impedes on a right-of-way or a water flow path. If the debris impedes on a right of way, access to the area will be limited using fencing, barricades, or signage to alert the public and other maintenance personnel to the debris' presence.

The next stage of the response will be to examine the area to assess the possibility of further erosion of the originating slope. This task may require the services of a registered engineer. If warranted, a plan will be developed to prevent future erosion in the area.

The final step in the response to debris from a rock fall or a landslide impeding on a right-of-way will be to remove the debris, likely with heavy machinery, and transporting it to an isolated waste pile where the debris will not affect any watercourse or physical stability.

If the rock fall or landslide debris enters a watercourse, then water quality testing will be implemented. This will be done to determine if the presence of the rock in the water is contributing any metal loading to the water. If the loading in the water is found to be effected by the source material, then a mitigation plan will be developed and implemented in consultation with technical experts and regulatory agencies until such time as the debris can be removed from the watercourse, and water levels return to their historical norm.

If the metal loading is determined to be not effected by the source material, then no mitigation treatment plan will be necessary, and the debris can be removed from the watercourse.

The final stage will be to continue monitoring water quality at that location for a period of time until it is determined that the rock fall or landslide had no lingering effects on the water quality.

6.2.6 AMP Summary for Rock Fall or Landslide

Table 6-2 provides a summary of this AMP event including specific thresholds and actions to be taken in order of priority.

Table 6-2 AMP Summary for Rock Fall or Landslide

SPECIFIC THRESHOLD	ACTIONS TAKEN IN ORDER OF PRIORITY					
Rock Fall or landslide is Observed	Rocks intrude on right-of-way	Post warning to local traffic	Explore possibility of future rock falls in the area	Implement preventative measures if warranted		Remove intruding rocks with heavy equipment
	Rocks intrude on water flow	Initiate monitoring of water quality and metal leachate testing	Metal loading in source material	Develop and initiate mitigation or treatment plan		
			Metal loading not in source material		Remove rocks or soil from stream or creek bed	Continue water quality monitoring of site

6.3 STRUCTURE FAILURE OR PORTAL COLLAPSE

6.3.1 Description

With advanced exploration and preliminary development taking place in the Keno Hill Silver District, new structures are constructed on site to support these activities. Additionally, the extensive amount of activity in the Keno Hill Silver District in the past century has left behind numerous buildings and mining related structures in various states of disrepair. Although many of these workings are in sparse areas, a number of structures and portals exist in areas where the public can access them easily. In some cases, local literature even encourages the public to attend these sites to observe their historical value.

It is therefore imperative that structures and buildings in those areas frequented by the public that are considered structurally unsafe be dismantled and demolished in an appropriate manner. This type of practice will ensure that the danger to public safety is eliminated.

6.3.2 Locations

Site-wide based on routine inspection throughout the property (See Appendix A) and specifically:

- Water treatment facility settling ponds and adits;
- Valley Tailings Area;
- New waste rock storages areas and road at Bellekeno;
- Historic mine workings and structures (waste rock load out dumps); and
- Old building and structures throughout the property.

6.3.3 Monitoring Requirements

The monitoring information required includes physical inspections of structures in the Keno Hill Silver District for failure or collapse. Maintenance personnel will routinely observe buildings of concern in the course of their site activities.

6.3.4 Specific Thresholds

The specific thresholds that will initiate the action plan will be as follows:

- Failure of engineered structure or mining component (i.e. water treatment facility settling ponds, Valley Tailings Area dams and decants structures, roads, waste rock dumps);
- A supported structure, building, or portal opening in the vicinity of a public access or point of interest that effects public safety partially collapses;
- A supported structure, building, or portal opening in the vicinity of a public access or point of interest that effects public safety collapses completely.

6.3.5 Approaches to Responses

As per the general approach to the adaptive management plan, a staged response to a structure or portal partially failing or collapsing will be implemented if the threshold is triggered.

The initial response to a building or structure partially failing or collapsing will be to limit access to the area using fencing, barricades, or signage to alert the public and other maintenance personnel to the danger that may exist. The structural failure will be documented and an assessment made of the potential effects to worker and public health and safety and the surrounding environment.

Investigation by a mining or geotechnical engineer may be warranted, particularly if an engineered mining component is at risk of failure (mine portal, tailings dam or settling pond). Recommendations from the engineers will be implemented as required and if warranted engineering plans or designs may be required and developed for implementation in consultation with regulatory authorities.

The response to failure of a historic structure will be to implement consultations with the local community, First Nation of Nacho N'yak Dun and the Heritage Resources Branch of the Yukon Government to determine if the structure should be preserved as an artifact or whether the structure can be torn down and disposed of to eliminate the hazard it poses. If it can be demonstrated that there is no public health and safety concern, Heritage Resources may

determine that the structure should be kept for historical purposes. Access to the area will continue to be limited until such time as the structure is returned to a physically stable state.

If authorisation is given to remove the structure, then a plan will be developed to ensure that the removal of the structure takes place without incident. This plan may include the use of an excavator to pick at the remains and filling any open portals with rock in accordance with *Mine Safety Regulations* to close off access to any underground workings.

6.3.6 AMP Summary for Structure Failure or Portal Collapse

Table 6-3 provides a summary of this AMP event including specific thresholds and actions to be taken in order of priority.

Table 6-3 AMP Summary for Structure Failure or Portal Collapse

SPECIFIC THRESHOLD	ACTIONS TAKEN IN ORDER OF PRIORITY				
Building structure near public access collapses →	Erect barriers to prevent public access →	For historic structures - consult with locals and YG for heritage value →	Request to keep structure for heritage values →		Keep barriers erected until heritage takes over responsibility
			No heritage value →	Design plan to remove structure and close portals →	Implement removal plan
Failure of engineered structure or mining component →	Erect barriers to prevent public access →	Assess potential effects to worker and public safety and environment →	Investigation by mining or geotechnical engineer may be warranted →	Implement recommendations from engineers as required	

7. SITE SECURITY COMPROMISED

7.1 GATE, FENCE OR SIGN DAMAGED

7.1.1 Description

Due to the vast history of mining in the Keno Hill Silver District, there exist a large number of mine workings where hazards to public safety exist. In order to alleviate these hazards, depending on the type of hazard and its accessibility, structures, gates, fences, or signs have been erected to prevent the public from entering these areas or draw their attention to the hazard.

Over the course of time, some of these deterrents may suffer damage or fatigue which impedes on their ability to perform as a safety deterrent. The most likely scenario is for the item to have fallen down, however, the items performance may have been degraded by weather erosion or possibly at the hands of vandals.

7.1.2 Locations

Site wide based on routine inspection throughout the property (See Appendix A).

7.1.3 Monitoring Requirements

Since it is almost impossible to predict when or where a gate, fence, or sign will be damaged, there can be no specific monitoring requirements to observe these circumstances prior to their existence. The monitoring information required is observations of damage to any of these safety features throughout the Keno Hill Silver District. Maintenance personnel will be familiar with the placement of gates, signs, and fences around the property and thus, during their routine site activities will be able to observe when one of these features requires attention.

7.1.4 Specific Thresholds

The specific thresholds that will initiate the action plan will be as follows:

- A gate is found open outside of a scheduled visit by authorised site personnel.

- A gate post is found to be damaged such that the gate is sufficiently disabled to prevent access to the site by authorised site personnel.
- A gate post is found to be damaged such that the gate no longer prevents unauthorised access to a site of concern.
- A fence is found to be damaged such that it no longer prevents unauthorised access to a site of concern.
- A fence or structure is found to be damaged such that it no longer prevents unauthorised access to a site of concern.
- The placard of a sign has been damaged either by environmental conditions or by vandalism such that the sign is no longer effective in relaying the information intended.
- A sign post has been damaged to an extent where the sign is in a position which renders it ineffective in relaying the information intended.

7.1.5 Approaches to Responses

As per the general approach to the adaptive management plan, a staged response to any one of the above circumstances will be implemented if the threshold is triggered.

The initial response to a gate being found open or a fence being damaged and allowing access to the site will first trigger an examination of the area in question in order to ascertain whether trespassers are in the vicinity and may have initiated the condition of the gate or fence. If trespassers are found and do not appear to impose a risk to the site personnel, they will be cordially escorted off the property and the gate will be locked. If site personnel feel that there may be a risk in confronting the trespassers, then the appropriate authorities will be contacted immediately and requested to attend to the situation. If the lock on the gate has been damaged or tampered with, it will be replaced in a timely fashion.

If the gate is found to be damaged such that it no longer prevents unauthorised personnel from accessing a site, then the same measures above will be implemented. Once the trespassers have been escorted off site or the area is deemed to not contain any trespassers, the gate will be repaired or replaced in a timely fashion to ensure it will prevent access to the site by unauthorised personnel.

If the placard of a sign has been damaged either by environmental conditions or by vandalism, or the sign post is broken such that the sign is no longer effective in relaying the information intended, then maintenance personnel should note this at the time of observation and this information should be passed on to the project manager.

7.1.6 AMP Summary for Damage to Gate, Fence or Sign

Table 7-1 provides a summary of this AMP event including specific thresholds and actions to be taken in order of priority.

Table 7-1 AMP Summary for Dame to Gate, Fence or Sign

SPECIFIC THRESHOLD	ACTIONS TAKEN IN ORDER OF PRIORITY					
Gate not closed. →	Examine area of concern for trespassers →	Trespassers found →	Escort off of property →	Examine gate →	Gate is not locked →	Lock gate.
		No trespassers found →			Gate structure is broken →	Repair gate
					Gate has fallen over →	Create more adequate foundation for gate.
Fence cut or knocked down →	Examine area of concern for trespassers →	Trespassers found →	Escort off of property →	Examine fence →	Fence is cut →	Repair or replace fence.
		No trespassers found →			Fence is knocked down →	Create more adequate base for fence poles.
Sign is not visible →	Examine sign →	Face of sign disfigured or faded →				Replace sign placard
		Sign post broken →				Replace sign post and remount sign placard.
		Sign post has come out of foundation →				Create more adequate foundation and replant sign.

8. REPORTING PROCEDURE

The Keno Hill Silver District Remediation Manager will be ultimately responsible for implementation of the AMP. Site personnel including the District Manager, Support Services Manager, Exploration Manager, First Aid Manager and Development Manager will also be aware of the AMP and monitoring and inspection requirements. Site treatment operations personnel who conduct the daily inspections will report directly to the Remediation Manager who will work with other site Managers as appropriate to implement the AMP responses. The Data Manager will report to the Environmental Services Manager and Remediation Manager who will support and work directly with site Managers. Should an AMP event be triggered Alexco Senior Management will be appraised and involved in AMP responses as appropriate.

AMP triggered events will be documented and responses reported as part of the monthly water licensing reports. Should an incident occur that triggers an AMP event, this will be reported to the Water Board within 10 days of the occurrence as required under the licences. Monthly reports are provided to the Water Board, YG EMR, Water Resources and the First Nation of Nacho N'yak Dun. The Annual Report will also summarize all AMP events and responses and any revisions to the AMP made as part of the AMP annual review.

9. CERTIFICATION

Should you have any questions regarding this report, or if you require further information, please contact the undersigned at Access Consulting Group in Whitehorse, Yukon, at (867) 668-6463.

Respectfully submitted,

ACCESS CONSULTING GROUP

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KENO HILL SILVER DISTRICT

ADAPTIVE MANAGEMENT PLAN – 2009 UPDATE

APPENDIX A

ENVIRONMENTAL MONITORING PROGRAM



KENO HILL SILVER DISTRICT

ENVIRONMENTAL MONITORING PROGRAM
2009 UPDATE

PREPARED BY:



FEBRUARY 2009

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1.0 INTRODUCTION

This document describes the environmental monitoring program (EMP) that will be carried out to ensure that activities throughout the Keno Hill Silver District are conducted in a manner that strives for overall human and environmental protection. The EMP includes monitoring of a number of components and a surveillance network which is currently in place and designed to monitor:

- potential effects to the receiving environment through scheduled monitoring of water and aquatic resources, terrestrial resources, climate, as well as inspection tours of project components and receiving environment;
- water treatment facilities effluent quality as well as any seepages or run-off from waste rock and sludge storage facilities and consequently operational performance;
- site security to ensure public health and safety;
- site facilities and operations as a preventative measure for accidents and malfunctions;
- stability of historic mine workings;
- mitigation success; and
- adaptive management responses to improve procedure/process.

Monitoring data will be used for site management and closure plan development and implementation as necessary. If monitoring indicates that treatment systems or project facilities are not performing or issues with mine components arise, then maintenance measures or contingency plans can be implemented following an adaptive management approach as discussed in the report entitled “Keno Hill Silver District Adaptive Management Plan – 2009 Update” prepared by Access Consulting Group.

1.1 SUPPORTING PLANS AND LICENCE REQUIREMENTS

In addition to providing a basis and grounding for the Adaptive Management Plan, this EMP has been prepared to coincide with licenced monitoring requirements pursuant to Water Licences QZ06-074 and QZ07-078, and the Class 4 Mining Land Use Approval,

which guide the management of activities and monitoring associated with site care and maintenance as well as advanced exploration and preliminary development. Other plans that have been prepared which contain environmental monitoring aspects are also implemented pursuant to these licences/approval and include:

- Waste Rock Management Plan (January 2008);
- Sludge Management Plan Revision No.1 (May 2008);
- Waste Rock Metals and Acid Base Accounting Testing Plan (October 2008);
- Physical Inspection and Reporting Plan (October 2008) – Appendix B;
- Flow Monitoring Plan – Appendix C; and
- Mine Wall Testing Plan (October 2008).

These documents should be referenced for details on these monitored components.

1.2 REPORTING AND ANNUAL REVIEW

As with the Adaptive Management Plan, an annual review will be completed that assesses monitoring data collected. Data and inspection reports will be compiled and reported each year such that the results can be included into the Annual Report as required by the Water Licence.

2.0 PHYSICAL INSPECTIONS

If structural failures or instabilities (subsidence, settling, excessive erosion) are identified during routine inspections of engineered structures, works and installations (e.g. tailings dams, settling ponds, spillways, diversion ditches, roads, portals, waste rock dumps) an inspection by a qualified geotechnical engineer may be undertaken for physical stability. Table 2-1 outlines the physical inspection monitoring program for the tailings impoundments, settling ponds and diversion ditches as outlined in Water Licence QZ06-074.

Table 2-1 Physical Inspections

Physical Inspection	Frequency
KV10 Tailing Dam No.1	D
KV11 Tailing Dam No.2	D
KV12 Tailing Dam No.3	D
Tailings Dam Crest Survey	A
KV47 Porcupine Diversion Ditch	Q
Treatment Site Settling Ponds	D

The annual inspection of the Valley Tailings Area dams will be carried out in accordance with the Dam Safety Guidelines by a Professional Engineer licenced to practice in Yukon. A report on the inspection prepared by the P.Eng. will document the inspection locations and methodologies, results, problems identified and remedial measures recommended. The status of any remedial measures recommended in the previous year's report will be appended to the report with an exploration regarding any recommendation not implemented. This report will be provided to Yukon Water Board as part of the annual report.

A number of historic mine sites are physically inspected on a monthly basis during the open water season to ensure public health and safety and environmental protection. Site personnel record observations on an inspection check list form (Appendix A), which is provided for review to management personnel for action as necessary.

A Physical Inspection and Reporting Plan is in place as per Water Licence QZ07-078 for water retaining and conveying structures and associated earthworks and is provided in Appendix B.

3.0 WATER RESOURCES

3.1 SURFACE WATER MONITORING NETWORK

A network of surface water monitoring sites is in place to monitor effluent discharges, surveillance sites including receiving waters, and adit discharges for quality control and environmental effects purposes. Many of the monitoring stations have been sampled extensively in the past. A complete description of the stations and historic water chemistry results is discussed in Access Mining Consultants Ltd., June 3, 1996, *United Keno Hill Mines Limited, and Report No. KH/96/01, Site Characterization* (Section 6).

Table 3-1 provides UTM coordinates for the network of numbered surface water sample station locations. External monitoring frequency and the associated water licence are also indicated. Figure 2-1 shows the surface water sample station locations.

There are differing monitoring and analytical requirements for the treatment sites /effluent discharges; surveillance sites including receiving waters; and adit discharges, which are outlined in Table 3-1 and presented in further detail within the following sections. A Flow Monitoring Plan has been prepared and is provided in Appendix C.

Water Licence QZ07-078 provides specific monitoring requirements pertaining to the period of time during and for twelve weeks after dewatering of Bellekeno Mine. The Water Licence should be referenced for these special conditions and monitoring requirements.

3.1.1 Sampling Protocol

Monitoring and sampling will be carried out in accordance with the procedures and standards described in:

- a) Guidance Document for the Sampling and Analysis of Metal Mining Effluents, April 2001, (Report: EPS 2/MM/5), Mineral and Metals Division, Environment Canada; and
- b) Guidance Document for Flow Measurement of Metal Mining Effluents, April 2001, (Report: EPS 2/MM/4), Minerals and Metals Division, Environment Canada.

Table 3-1 Surface Water Sample Station Locations Description and Coordinates

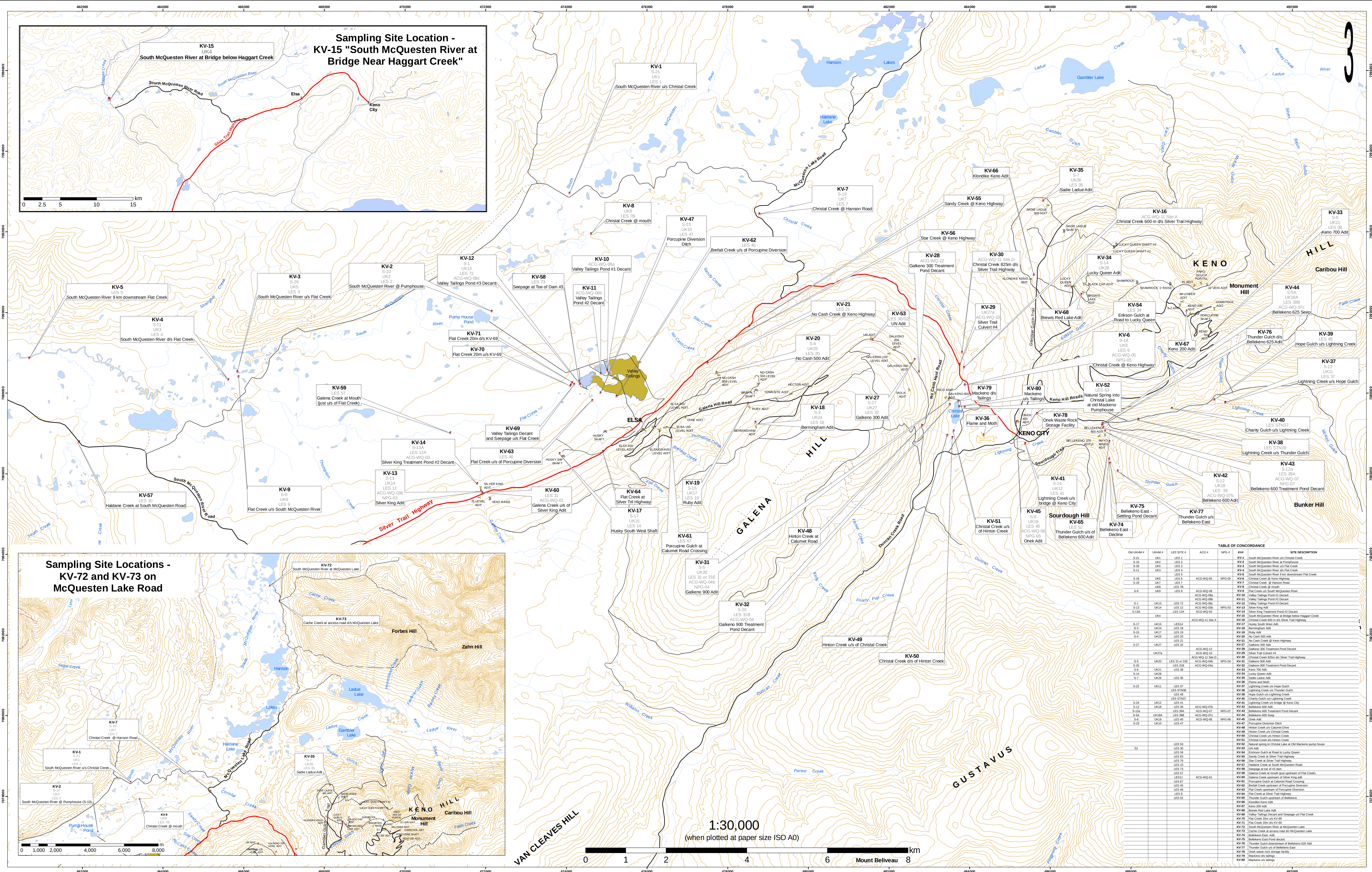
SITE	SITE DESCRIPTION	EXTERNAL MONITORING FREQUENCY	EASTING	NORTHING	WATER LICENCE
Treatment Sites					
KV12	Valley Tailings Pond #3 Decant	M	474310	7088278	QZ06-074
KV13	Silver King Adit	M	471887	7085572	QZ06-074
KV14	Silver King Treatment Pond #2 Decant	M	471797	7085755	QZ06-074
KV27	Galkeno 300 Adit	M	482636	7088837	QZ06-074
KV28	Galkeno 300 Treatment Pond Decant	M	482622	7088793	QZ06-074
KV31	Galkeno 900 Adit	M	483483	7087848	QZ06-074
KV32	Galkeno 900 Treatment Pond Decant	M	483512	7087719	QZ06-074
KV42	Bellekeno 625 Adit	M	487363	7087062	QZ06-074, QZ07-078
KV43	Bellekeno 625 Treatment Pond Decant	M	487318	7087147	QZ06-074, QZ07-078
KV74	Bellekeno East Decline	M	487505	7086415	QZ07-078
KV75	Bellekeno East Pond decant	M	487594	7086161	QZ07-078
Surveillance Sites & Receiving Waters					
KV1	South McQuesten River u/s Christal Creek	M	474008	7092790	QZ06-074
KV2	South McQuesten River at Pumphouse	Q	472076	7090036	QZ06-074
KV3	South McQuesten River u/s Flat Creek	Q	465846	7088534	QZ06-074
KV4	South McQuesten River 350 m d/s Flat Creek	Q	465618	7088335	QZ06-074
KV5	South McQuesten River 9 km downstream Flat Creek	Q	460691	7088873	QZ06-074
KV6	Christal Creek at Keno Highway	M	483909	7088242	QZ06-074
KV7	Christal Creek at Hanson Road	M	478657	7092413	QZ06-074
KV8	Christal Creek at mouth	M	474585	7091944	QZ06-074
KV9	Flat Creek u/s South McQuesten River	Q	465836	7088410	QZ06-074
KV10	Valley Tailings Pond #1 Decant	Q	475015	7088571	
KV11	Valley Tailings Pond #2 Decant	Q	474856	7088486	
KV15	South McQuesten River at Bridge below Haggart Creek	Q	449744	7085770	QZ06-074
KV16	Christal Creek 600 m d/s Silver Trail Highway	Q	483887	7088863	
KV21	No Cash Creek at Keno Highway	Q	477500	7088750	QZ06-074
KV29	Silver Trail Culvert #4	M	483740	7088792	QZ06-074
KV30	Christal Creek 825m d/s Silver Trail Highway	Q	483856	7089091	
KV37	Lightning Creek u/s Hope Gulch	Q	490315	7087776	QZ06-074, QZ07-078
KV38	Lightning Creek u/s Thunder Gulch	Q	488193	7087341	QZ06-074,

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SITE	SITE DESCRIPTION	EXTERNAL MONITORING FREQUENCY	EASTING	NORTHING	WATER LICENCE
					QZ07-078
KV39	Hope Gulch u/s Lightning Creek	Q	490252	7087783	QZ06-074
KV40	Charity Gulch u/s Lightning Creek	Q	488982	7087503	
KV41	Lightning Creek u/s bridge at Keno City	Q	485429	7086764	QZ06-074, QZ07-078
KV44	Bellekeno 625 Seep	A	487361	7087195	QZ07-078
KV47	Porcupine Diversion Ditch	Q	474516	7088026	QZ06-074
KV48	Hinton Creek u/s Calumet Drive	Q	482819	7087198	QZ06-074
KV49	Hinton Creek u/s Christal Creek	Q	483582	7087009	QZ06-074
KV50	Christal Creek u/s Hinton Creek	Q	483575	7086897	QZ06-074
KV51	Christal Creek d/s Hinton Creek	Q	483600	7087010	QZ06-074
KV52	Natural spring to Christal Lake at Old Mackeno pump house	Q	483756	7087869	QZ06-074
KV54	Erickson Gulch at Road to Lucky Queen	Q	485834	7088993	QZ06-074
KV55	Sandy Creek at Silver Trail Highway	Q	478532	7089677	QZ06-074
KV56	Star Creek at Silver Trail Highway	Q	478051	7089277	QZ06-074
KV57	Haldane Creek at South McQuesten Road	Q	461852	7086760	QZ06-074
KV58	Seepage at toe of #3 dam	Q	Unfixed	Unfixed	QZ06-074
KV59	Galena Creek at mouth (just u/s of Flat Creek)	Q	471126	7087018	QZ06-074
KV60	Galena Creek u/s of Silver King adit	Q	476604	7086892	QZ06-074
KV61	Porcupine Gulch at Calumet Road Crossing	Q	476607	7086895	QZ06-074
KV62	Brefalt Creek upstream of Porcupine Diversion	Q	476217	7086807	QZ06-074
KV63	Flat Creek upstream of Porcupine Diversion	Q	474644	7087814	QZ06-074
KV64	Flat Creek at Silver Trail Highway	Q	474906	7086535	QZ06-074
KV65	Thunder Gulch upstream of Bellekeno	Q	487464	7086873	QZ06-074, QZ07-078
KV69	Valley Tailings Decant and Seepage u/s Flat Creek	Q	474099	7088181	
KV70	Flat Creek 20m u/s KV69	Q	474140	7088260	
KV71	Flat Creek 20m d/s KV69	Q	474046	7088203	
KV72	South McQuesten River at McQuesten Lake	Q	482492	7104476	
KV73	Cache Creek at access road d/s McQuesten Lake	Q	482846	7103594	
KV76	Thunder Gulch d/s of Bellekeno 625 Adit	Q	487414	7087118	QZ07-078
KV77	Thunder Gulch u/s of Bellekeno East	Q	487742	7086013	QZ07-078
KV78	Onek Waste Rock Storage Facility	A	485726	7087518	QZ07-078
KV79	Christal Creek d/s of Mackeno Tailings	Q	483796	7087919	
KV80	Christal Creek u/s of Mackeno Tailings	Q	483790	7087869	

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SITE	SITE DESCRIPTION	EXTERNAL MONITORING FREQUENCY	EASTING	NORTHING	WATER LICENCE
Adit Discharges					
KV17	Husky South West Adit	Q	485332	7092431	QZ06-074
KV18	Birmingham Adit	Q	478689	7087226	QZ06-074
KV19	Ruby Adit	Q	478504	7087748	QZ06-074
KV20	No Cash 500 Adit	Q	477728	7088508	QZ06-074
KV33	Keno 700 Adit	Q	490000	7089499	QZ06-074
KV34	Lucky Queen Adit	Q	486456	7090518	QZ06-074
KV35	Sadie Ladue Adit	Q	485832	7092768	QZ06-074
KV36	Flame and Moth	Q	483836	7086820	QZ06-074
KV45	Onek Adit	Q	485101	7087288	QZ06-074, QZ07-078
KV53	UN Adit	Q	481595	7089322	QZ06-074
KV66	Klondike Keno Adit	Q	485599	7090833	QZ06-074
KV67	Keno 200 Adit	Q	489496	7089983	QZ06-074
KV68	Brewis Red Lake Adit	Q	486789	7090194	QZ06-074



ONUM #	UKR #	LES SITE #	ACG #	SITE #	KV #	SITE DESCRIPTION
S-10	UK1	LES 1			KV-1	South McQuesten River at Christal Creek
S-11	UK2	LES 2			KV-2	South McQuesten River at Pump House
S-12	UK3	LES 3			KV-3	South McQuesten River at Flat Creek
S-13	UK4	LES 4			KV-4	South McQuesten River at Flat Creek
S-14	UK5	LES 5			KV-5	South McQuesten River at Flat Creek
S-15	UK6	LES 6			KV-6	South McQuesten River at Flat Creek
S-16	UK7	LES 7			KV-7	South McQuesten River at Flat Creek
S-17	UK8	LES 8			KV-8	South McQuesten River at Flat Creek
S-18	UK9	LES 9			KV-9	South McQuesten River at Flat Creek
S-19	UK10	LES 10			KV-10	South McQuesten River at Flat Creek
S-20	UK11	LES 11			KV-11	South McQuesten River at Flat Creek
S-21	UK12	LES 12			KV-12	South McQuesten River at Flat Creek
S-22	UK13	LES 13			KV-13	South McQuesten River at Flat Creek
S-23	UK14	LES 14			KV-14	South McQuesten River at Flat Creek
S-24	UK15	LES 15			KV-15	South McQuesten River at Flat Creek
S-25	UK16	LES 16			KV-16	South McQuesten River at Flat Creek
S-26	UK17	LES 17			KV-17	South McQuesten River at Flat Creek
S-27	UK18	LES 18			KV-18	South McQuesten River at Flat Creek
S-28	UK19	LES 19			KV-19	South McQuesten River at Flat Creek
S-29	UK20	LES 20			KV-20	South McQuesten River at Flat Creek
S-30	UK21	LES 21			KV-21	South McQuesten River at Flat Creek
S-31	UK22	LES 22			KV-22	South McQuesten River at Flat Creek
S-32	UK23	LES 23			KV-23	South McQuesten River at Flat Creek
S-33	UK24	LES 24			KV-24	South McQuesten River at Flat Creek
S-34	UK25	LES 25			KV-25	South McQuesten River at Flat Creek
S-35	UK26	LES 26			KV-26	South McQuesten River at Flat Creek
S-36	UK27	LES 27			KV-27	South McQuesten River at Flat Creek
S-37	UK28	LES 28			KV-28	South McQuesten River at Flat Creek
S-38	UK29	LES 29			KV-29	South McQuesten River at Flat Creek
S-39	UK30	LES 30			KV-30	South McQuesten River at Flat Creek
S-40	UK31	LES 31			KV-31	South McQuesten River at Flat Creek
S-41	UK32	LES 32			KV-32	South McQuesten River at Flat Creek
S-42	UK33	LES 33			KV-33	South McQuesten River at Flat Creek
S-43	UK34	LES 34			KV-34	South McQuesten River at Flat Creek
S-44	UK35	LES 35			KV-35	South McQuesten River at Flat Creek
S-45	UK36	LES 36			KV-36	South McQuesten River at Flat Creek
S-46	UK37	LES 37			KV-37	South McQuesten River at Flat Creek
S-47	UK38	LES 38			KV-38	South McQuesten River at Flat Creek
S-48	UK39	LES 39			KV-39	South McQuesten River at Flat Creek
S-49	UK40	LES 40			KV-40	South McQuesten River at Flat Creek
S-50	UK41	LES 41			KV-41	South McQuesten River at Flat Creek
S-51	UK42	LES 42			KV-42	South McQuesten River at Flat Creek
S-52	UK43	LES 43			KV-43	South McQuesten River at Flat Creek
S-53	UK44	LES 44			KV-44	South McQuesten River at Flat Creek
S-54	UK45	LES 45			KV-45	South McQuesten River at Flat Creek
S-55	UK46	LES 46			KV-46	South McQuesten River at Flat Creek
S-56	UK47	LES 47			KV-47	South McQuesten River at Flat Creek
S-57	UK48	LES 48			KV-48	South McQuesten River at Flat Creek
S-58	UK49	LES 49			KV-49	South McQuesten River at Flat Creek
S-59	UK50	LES 50			KV-50	South McQuesten River at Flat Creek
S-60	UK51	LES 51			KV-51	South McQuesten River at Flat Creek
S-61	UK52	LES 52			KV-52	South McQuesten River at Flat Creek
S-62	UK53	LES 53			KV-53	South McQuesten River at Flat Creek
S-63	UK54	LES 54			KV-54	South McQuesten River at Flat Creek
S-64	UK55	LES 55			KV-55	South McQuesten River at Flat Creek
S-65	UK56	LES 56			KV-56	South McQuesten River at Flat Creek
S-66	UK57	LES 57			KV-57	South McQuesten River at Flat Creek
S-67	UK58	LES 58			KV-58	South McQuesten River at Flat Creek
S-68	UK59	LES 59			KV-59	South McQuesten River at Flat Creek
S-69	UK60	LES 60			KV-60	South McQuesten River at Flat Creek
S-70	UK61	LES 61			KV-61	South McQuesten River at Flat Creek
S-71	UK62	LES 62			KV-62	South McQuesten River at Flat Creek
S-72	UK63	LES 63			KV-63	South McQuesten River at Flat Creek
S-73	UK64	LES 64			KV-64	South McQuesten River at Flat Creek
S-74	UK65	LES 65			KV-65	South McQuesten River at Flat Creek
S-75	UK66	LES 66			KV-66	South McQuesten River at Flat Creek
S-76	UK67	LES 67			KV-67	South McQuesten River at Flat Creek
S-77	UK68	LES 68			KV-68	South McQuesten River at Flat Creek
S-78	UK69	LES 69			KV-69	South McQuesten River at Flat Creek
S-79	UK70	LES 70			KV-70	South McQuesten River at Flat Creek
S-80	UK71	LES 71			KV-71	South McQuesten River at Flat Creek
S-81	UK72	LES 72			KV-72	South McQuesten River at Flat Creek
S-82	UK73	LES 73			KV-73	South McQuesten River at Flat Creek
S-83	UK74	LES 74			KV-74	South McQuesten River at Flat Creek
S-84	UK75	LES 75			KV-75	South McQuesten River at Flat Creek
S-85	UK76	LES 76			KV-76	South McQuesten River at Flat Creek
S-86	UK77	LES 77			KV-77	South McQuesten River at Flat Creek
S-87	UK78	LES 78			KV-78	South McQuesten River at Flat Creek
S-88	UK79	LES 79			KV-79	South McQuesten River at Flat Creek
S-89	UK80	LES 80			KV-80	South McQuesten River at Flat Creek
S-90	UK81	LES 81			KV-81	South McQuesten River at Flat Creek
S-91	UK82	LES 82			KV-82	South McQuesten River at Flat Creek
S-92	UK83	LES 83			KV-83	South McQuesten River at Flat Creek
S-93	UK84	LES 84			KV-84	South McQuesten River at Flat Creek
S-94	UK85	LES 85			KV-85	South McQuesten River at Flat Creek
S-95	UK86	LES 86			KV-86	South McQuesten River at Flat Creek
S-96	UK87	LES 87			KV-87	South McQuesten River at Flat Creek
S-97	UK88	LES 88			KV-88	South McQuesten River at Flat Creek
S-98	UK89	LES 89			KV-89	South McQuesten River at Flat Creek
S-99	UK90	LES 90			KV-90	South McQuesten River at Flat Creek
S-100	UK91	LES 91			KV-91	South McQuesten River at Flat Creek
S-101	UK92	LES 92			KV-92	South McQuesten River at Flat Creek
S-102	UK93	LES 93			KV-93	South McQuesten River at Flat Creek
S-103	UK94	LES 94			KV-94	South McQuesten River at Flat Creek
S-104	UK95	LES 95			KV-95	South McQuesten River at Flat Creek
S-105	UK96	LES 96			KV-96	South McQuesten River at Flat Creek
S-106	UK97	LES 97			KV-97	South McQuesten River at Flat Creek
S-107	UK98	LES 98			KV-98	South McQuesten River at Flat Creek
S-108	UK99	LES 99			KV-99	South McQuesten River at Flat Creek
S-109	UK100	LES 100			KV-100	South McQuesten River at Flat Creek

3.2 TREATMENTS SITES /EFFLUENT DISCHARGES

Treatment sites include effluent discharge points which are intended to monitor individual effluent discharges associated with the water treatment facilities at Silver King 100, Bellekeno 625, Galkeno 900, Galkeno 300, and the Valley Tailings Area. Mine waters are treated using conventional lime treatment technology and settling ponds to precipitate metals and control solids release. Regular on-site monitoring of both the raw adit waters and treated effluent discharges will be conducted for controlling treatment processes and in accordance with Water Licences QZ06-074 and QZ07-078 (see Table 3-1). A summary of the monitoring program for treatment sites including both on-site measurements and external laboratory analysis is shown in Table 3-2. Figure 3-1 shows the locations for these sites.

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Table 3-2 Treatment Sites Monitoring Schedule

Site No.	Description	On-site								External Lab							
		Inspect	Flow	pH	Temp.	Cond.	Total Zinc	Ammonia	Turbidity	Total ICP Metals	Dissolved ICP Metals	Ammonia -N	Hardness	pH	Cond.	TSS	LT50
KV12	Valley Tailings Pond #3 Decant	D	D	D	D	D	D			M	M		M	M	M	M	M
KV13	Silver King Adit	D	D	D	D	D	D			M	M		M	M	M	M	
KV14	Silver King Treatment Pond #2 Decant	D	D	D	D	D	D			M	M		M	M	M	M	M
KV27	Galkeno 300 Adit	D	D	D	D	D	D			M	M		M	M	M	M	
KV28	Galkeno 300 Treatment Pond Decant	D	D	D	D	D	D			M	M		M	M	M	M	M
KV31	Galkeno 900 Adit	D	D	D	D	D	D			M	M		M	M	M	M	
KV32	Galkeno 900 Treatment Pond Decant	D	D	D	D	D	D			M	M		M	M	M	M	M
KV42	Bellekeno 625 Adit	D	D	D	D	D	D	D	D	M	M	M	M	M	M	M	
KV43	Bellekeno 625 Treatment Pond Decant	D	D	D	D	D	D	D	D	M	M	M	M	M	M	M	M
KV74	Bellekeno East Adit	D	C	D	D	D	D	D	D	M	M	M	M	M	M	M	
KV75	Bellekeno East Settling Pond Decant	D	D	D	D	D	D	D	D	M	M	M	M	M	M	M	M
Codes: D = Daily M = Monthly C = Continuous ICP Metals include: Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Molybdenum, Nickel, Potassium, Selenium Silicon, Silver, Sodium, Strontium, Sulfur, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc and Zirconium																	

3.3 SURVEILLANCE SITES

Surveillance sites include receiving waters and other locations within the background or receiving environment. Regular on-site monitoring of surveillance sites will be conducted to track water quality and quantity in accordance with Water Licences QZ06-074 and QZ07-078 (see Table 3-1). A summary of the monitoring program for surveillance sites including both on-site measurements and external laboratory analysis is shown in Table 3-3. Figure 3-1 shows the locations for these sites.

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Table 3-3 Surveillance Sites Monitoring Schedule

Site No.	Description	On-site					External Lab											Sediment Program	Benthic Program
		Inspect	Flow	pH	Temp.	Cond.	Total ICP Metals	Dissolved ICP Metals	Ammonia -N	Hardness	pH	Cond.	TSS	LT50					
KV1	South McQuesten River u/s Christal Creek	M	M	M	M	M	M	M		M	M	M	M			BA	BA		
KV2	South McQuesten River at Pumphouse	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV3	South McQuesten River u/s Flat Creek	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q			BA	BA		
KV4	South McQuesten River 350 m d/s Flat Creek	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q			BA	BA		
KV5	South McQuesten River 9 km d/s Flat Creek	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV6	Christal Creek at Keno Highway	M	M	M	M	M	M	M		M	M	M	M			BA	BA		
KV7	Christal Creek at Hanson Road	M	M	M	M	M	M	M		M	M	M	M						
KV8	Christal Creek at mouth	M	M	M	M	M	M	M		M	M	M	M						
KV9	Flat Creek u/s South McQuesten River	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q			BA	BA		
KV10	Valley Tailings Pond #1 Decant	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV11	Valley Tailings Pond #2 Decant	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV15	South McQuesten River at Bridge below Haggart Creek	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV16	Christal Creek 600 m d/s Silver Trail Highway	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV21	No Cash Creek at Keno Highway	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV29	Silver Trail Culvert #4	M	M	M	M	M		M		M	M	M	M	M					
KV30	Christal Creek 625 m d/s Silver Trail Highway	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV37	Lightning Creek u/s Hope Gulch	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV38	Lightning Creek u/s Thunder Gulch	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q			A			
KV39	Hope Gulch u/s Lightning Creek	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV40	Charity Gulch u/s Lightning Creek	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV41	Lightning Creek u/s bridge at Keno City	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q			A			
KV44	Bellekeno 625 Seep	Ms	Ms	Ms	Ms	Ms	A	A		A	A	A	A						
KV47	Porcupine Diversion Ditch	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV48	Hinton Creek u/s Calumet Drive	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV49	Hinton Creek u/s Christal Creek	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV50	Christal Creek u/s Hinton Creek	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV51	Christal Creek d/s Hinton Creek	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV52	Natural spring to Christal Lake at Old Mackeno pump house	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV54	Erickson Gulch at Road to Lucky Queen	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV55	Sandy Creek at Silver Trail Highway	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV56	Star Creek at Silver Trail Highway	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV57	Haldane Creek at South McQuesten Road	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV58	Seepage at toe of #3 dam	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV59	Galena Creek at mouth (just u/s of Flat Creek)	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV60	Galena Creek u/s of Silver King adit	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV61	Porcupine Gulch at Calumet Road Crossing	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV62	Brefalt Creek u/s of Porcupine Diversion	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV63	Flat Creek upstream of Porcupine Diversion	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV64	Flat Creek at Silver Trail Highway	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV65	Thunder Gulch upstream of Bellekeno	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV69	Valley Tailings Decant and Seepage u/s Flat Creek	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV70	Flat Creek 20 m u/s KV69	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV71	Flat Creek 20 m d/s KV69	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV72	South McQuesten River at McQuesten Lake	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV73	Cache Creek at access road d/s McQuesten Lake	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV76	Thunder Gulch d/s of Bellekeno 625 Adit	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q						
KV77	Thunder Gulch u/s of Bellekeno East	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV78	Onek Waste Rock Storage Facility	Ms	-	Ms	Ms	Ms	A	A		A	A	A	A						
KV79	Christal Creek d/s of Mackeno Tailings	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						
KV80	Christal Creek u/s of Mackeno Tailings	Q	Q	Q	Q	Q	Q	Q		Q	Q	Q	Q						

Codes:

BA - Every Second Year
A - Annually
Q = Four times a Year May/July/October/February
M= Monthly
Ms = Monthly from May to October

ICP Metals include: Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Molybdenum, Nickel, Potassium, Selenium, Silicon, Silver, Sodium, Strontium, Sulfur, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc and Zirconium

3.4 ADIT DISCHARGES

A number of historic mine workings exist on the property and are routinely inspected by site personnel for site security, physical stability and drainage. Observations are recorded on an inspection checklist provided in Appendix A.

Many of these adits drain directly to ground or to drainages that eventually report to ground. No known effects to final receiving waters have been identified from these drainages.

The older workings are monitored on a quarterly (May/July/October/February) basis to track the effluent quality and flows from these adits. The large water chemistry database already developed for these sites (see Access Mining Consultants Ltd., June 3, 1996. *United Keno Hill Mines Limited, Report No. UKH/96/01, Site Characterization*), has been updated and will continue to be maintained to monitor for changes in water chemistry. The information will be used for closure planning purposes and linked with future studies for closure (groundwater monitoring and rock characterization).

Regular on-site monitoring of adit discharges will be conducted to track changes in water quality or quantity and in accordance with Water Licence QZ06-074 (see Table 3-1). A summary of the monitoring program for adit discharges including both on-site measurements and external laboratory analysis is shown in Table 3-4. Figure 3-1 shows the locations for these adits.

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Table 3-4 Adit Discharges Monitoring Schedule

Site No.	Description	On-site				Cond.	External Lab					
		Inspect	Flow	pH Units	Temp.		Total ICP Metals	Dissolved ICP Metals	Hardness	pH Units	Cond.	TSS
KV17	Husky South West Adit	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV18	Birmingham Adit	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV19	Ruby Adit	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV20	No Cash 500 Adit	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV33	Keno 700 Adit	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV34	Lucky Queen Adit	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV35	Sadie Ladue Adit	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV36	Flame and Moth	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV45	Onek Adit	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV53	UN Adit	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV66	Klondike Keno Adit	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV67	Keno 200 Adit	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
KV68	Brewis Red Lake Adit	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
Codes: Q = Four times a Year May/July/October/February ICP Metals include: Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Molybdenum, Nickel, Potassium, Selenium Silicon, Silver, Sodium, Strontium, Sulfur, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc and Zirconium												

4.0 AQUATIC RESOURCES

4.1 CREEK SEDIMENTS

Sediment sampling occurs to monitor impacts from mine drainages on local stream sediments. Every two years during summer low flow five sites on the South McQuesten River, Christal and Flat Creeks are sampled for sediments in conjunction with a benthic invertebrate monitoring program. Additionally, sediment samples are collected annually from two sites in Lightning Creek. The sediment sampling program for these surveillance sites is outlined in Table 3-3. Results from this program will be reported in an Annual Report and include an evaluation against previously recorded stream sediment data.

4.1.1 Sampling Protocol

Sediment sampling will be carried out as follows:

- a) Sediment samples will be collected in replicates of three from the active channel, directly into high density plastic sample jars, using an aluminum or Teflon scoop;
- b) Samples will be dried and screened, using sieves at ASTM mesh numbers 10, 20, 40, 60, 100, 140 and 270 (ASTM -E11-61) and the fraction weights recorded;
- c) A sub-sample composed of material passing through the 100 mesh number sieve will be analyzed for metals by a 33 element ICP scan. Loss on ignition will also be determined by heating the sample to 600°C.

4.2 BENTHIC INVERTEBRATES

The benthic invertebrate program is performed in conjunction with the sediment sampling program every two years at five sites on the South McQuesten River, Christal and Flat Creeks (Table 3-3). Data will be analyzed using a variety of indices and compared with existing information and reported in the Annual Report.

4.2.1 Sampling Protocol

Benthic invertebrate sampling will be carried out as follows:

- a) Three replicate samples will be taken by a circular Hess sampler (0.0934 m²) or Waters and Knapp sampler (0.089 m²) equipped with a 250 µm mesh net;
- b) Samples will be preserved with 10% formalin solution, and identified to the lowest possible taxon (usually genus) and counted;
- c) Stream information collected at the time of the benthos collection will include velocity, depth, temperature, substrate conditions and riparian conditions.

5.0 METEROLOGICAL

An automated meteorological station was installed on Galena Hill above Hector adit in June 2007. The station measures air temperature, relative humidity, barometric pressure, rainfall, wind speed and direction, solar radiation, and soil temperature. A Yukon Government monitored snow course station also exists in the area.



KENO HILL SILVER DISTRICT

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APPENDIX A

INSPECTION CHECKLISTS

Weekly Site Inspection Checklist - Open Water Season

Keno Hill Silver District, Yukon

Inspection Conducted the Week of: _____

Site Name	Silver King Adit	Husky S.W. Adit	Elsa	Husky Mine	Valley Tailings	Pump House	Dixie Adit	Ruby Adit	No Cash 500 Adit	Hector Adit	Birmingham 100 Adit	Galkeno 300 Adit	Galkeno 900 Adit	Onek 400 Adit	Bellekeno 100 Adit	Bellekeno 625 Adit	Keno 700 Adit	Shamrock "J" Raise	Lucky Queen Adit	Wernecke Camp	Klondike Keno Adit	Keno 200 Adit	Brewis Red Lake Adit	
Number of Sites	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
KV Site Number	KV13	KV17						KV19	KV20		KV18	KV27	KV31	KV45		KV42	KV33		KV34		KV66	KV67	KV68	
A) Site Security & Public Safety																								
1) Are access points secure? - doors, grates, windows, fencing, etc.	Y	N	Y	N	Y	N	Y	N		Y	N	Y	N	Y	N	Y	N	Y	N				Y	N
2) Are gates locked?	Y	N	Y	N	Y	N	Y	N			Y	N					Y	N						
3) Are there any new holes?	Y	N	Y	N	Y	N	Y	N			Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
4) Has hole changed?	Y	N	Y	N	Y	N	Y	N			Y	N	Y	N	Y	N		Y	N		Y	N		
5) Checked signage?	Y	N	Y	N	Y	N	Y	N			Y	N	Y	N	Y	N	Y	N		Y	N	Y	N	
B) Water																								
1) Is there any water flow?	Y	N	Y	N	Y	N	Y	N	Y	N		Y	N	Y	N	Y	N	Y	N		Y	N	Y	N
2) Is there a noticeable change in flow (since last inspection)?	Y	N	Y	N	Y	N	Y	N			Y	N	Y	N	Y	N	Y	N		Y	N		Y	N
3) Do you observe an ice plug?	Y	N	Y	N	Y	N	Y	N			Y	N	Y	N	Y	N	Y	N		Y	N		Y	N
4) Water clarity - clean or dirty?	Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty
5) pH?																								
6) Conductivity?																								
C) Dams and Ponds																								
1) Is there any seepage along downstream side of structure?	Y	N					Y	N					Y	N	Y	N								
2) Checked culverts/decanats (free of blockages, damage, etc)?	Y	N					Y	N					Y	N	Y	N								
4) Is there evidence of up-welling downstream?	Y	N					Y	N					Y	N										
5) Are there any new slumps, cracks, etc.?	Y	N					Y	N					Y	N	Y	N								
D) Infrastructure																								
1) Are there any NEW damaged power poles/lines?	Y	N			Y	N							Y	N	Y	N	Y	N						
2) Is there evidence of forced entry to any structure?	Y	N	Y	N	Y	N	Y	N			Y	N	Y	N	Y	N		Y	N	Y	N		Y	N
3) Is there any new damage to building(s)?	Y	N	Y	N	Y	N	Y	N			Y	N	Y	N	Y	N		Y	N	Y	N		Y	N
E) Other																								
1) Pictures taken?	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
2) Date and Time of Inspection (am/pm).																								
3) Inspector to initial upon completion.																								

Note: Please Provide Comments/Concerns/Observed Changes, if Necessary:



Site Inspection Checklist - Winter Conditions **Keno Hill Silver District, Yukon**

Inspection Conducted the Week of: _____

Site Name	Silver King Adit		Elsa		Valley Tailings		Elsa Townsite Infrastructure		Dixie Adit		Ruby Adit		Hector Adit		Galkeno 300 Adit		Galkeno 900 Adit		Onek 400 Adit		Bellekeno 625 Adit			
Number of Sites	1		2		3		4		5		6		7		8		9		10		11			
KV Site Number	KV13										KV19				KV27		KV31		KV45		KV42			
A) Site Security & Public Safety																								
1) Are access points secure? - doors, grates, windows, fencing, etc.	Y	N	Y	N			Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N		
2) Are gates locked?	Y	N	Y	N			Y	N															Y	N
3) Are there any new holes?	Y	N	Y	N			Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
5) Checked signage?																								
B) Water																								
1) Is there any water flow?	Y	N	Y	N	Y	N			Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N		
2) Is there a noticeable change in flow (since last inspection)?	Y	N	Y	N	Y	N			Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
3) Do you observe an ice plug?	Y	N	Y	N					Y	N			Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
4) Water clarity - clean or dirty?	Clean	Dirty	Clean	Dirty					Clean	Dirty			Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty	Clean	Dirty		
5) pH?																								
6) Conductivity?																								
C) Dams and Ponds																								
1) Is there any seepage along downstream side of structure?	Y	N			Y	N									Y	N	Y	N			Y	N		
2) Checked culverts/decants (free of blockages, damage, etc)	Y	N			Y	N									Y	N	Y	N			Y	N		
4) Is there evidence of up-welling downstream?	Y	N			Y	N									Y	N	Y	N			Y	N		
5) Are there any new slumps, cracks, etc.?	Y	N			Y	N									Y	N	Y	N			Y	N		
D) Infrastructure																								
1) Are there any NEW damaged power poles/lines?	Y	N	Y	N			Y	N			Y	N					Y	N	Y	N	Y	N		
2) Is there evidence of forced entry to any structure?	Y	N	Y	N			Y	N			Y	N					Y	N	Y	N	Y	N	Y	N
3) Is there any new damage to building(s)?	Y	N	Y	N			Y	N											Y	N	Y	N		
E) Other																								
1) Pictures taken?	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N		
2) Date and Time of Inspection (am/pm).																								
3) Inspector to initial upon completion.																								

Note: Please Provide Comments/Concerns/Observed Changes, if Necessary:





KENO HILL SILVER DISTRICT

ENVIRONMENTAL MONITORING PROGRAM
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APPENDIX B

PHYSICAL INSPECTION AND REPORTING PLAN



Alexco Resource Canada Corp.

Physical Inspection and Reporting Plan

Water Use Licence QZ07-078

October 2008

Prepared by:



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APPENDICES

Appendix I Checklist Open Season

1.0 INTRODUCTION

1.1 Purpose of Plan

This plan is submitted to fulfill the condition set out in Part D Section 23 of Water Licence QZ07-078 issued to Alexco Resource Canada Corp on October 3, 2008:

“Within 30 days of the effective date of this licence, the licensee shall submit to the board a physical inspection and reporting plan for all water retaining structures and water conveying structures. The physical inspection and reporting plan shall include at a minimum, but necessarily be limited to, the following:

- a) The plan shall indicate, that at a minimum, the frequency of inspection and reporting will be conducted at least on a weekly basis for all water structures.*
- b) The plan shall include, but not necessarily be limited to, Bellekeno 625 settling ponds, Bellekeno East settling Ponds, Onek waste rock storage facility, and surface pipelines between and near Bellekeno East and Bellekeno 625.”*

This plan outlines the Physical Inspection and Reporting methodology that will be used during the advanced exploration and preliminary development activities at the Bellekeno Mine on the Keno Hill property.

2.0 MINE LOCATION AND DESCRIPTION

The Bellekeno mine area is located approximately 3 km east of Keno City within the Keno Hill Silver District. The Keno Hill Silver District is located in central Yukon Territory, 354 km (by air) due north of Whitehorse.

The portal at Bellekeno East is located on a steep slope above Thunder Gulch, a narrow tributary of Lightening Creek.

3.0 PHYSICAL INSPECTION LOCATIONS

As per Part D, Section 23b of the Water Licence QZ07-078, the areas to be inspected include:

- Bellekeno 625 settling ponds;
- Bellekeno East decline settling ponds;
- Onek waste rock storage facility; and
- Surface pipelines between and near Bellekeno East decline and Bellekeno 625.

Also, as per section 38 of the Water Licence QZ07-078:

“During Dewatering of Bellekeno mine, the Licensee shall, on a weekly basis, observe the condition of the channel of Thunder Gulch and Lightning Creek downstream of Bellekeno 625 treatment plant and provide a detailed report to the board identifying any physical issues relating to the dewatering flows”.

4.0 PHYSICAL INSPECTION SCHEDULE

The Physical inspection for the above structures will be conducted on a weekly basis.

5.0 PHYSICAL INSPECTION METHOD

The purpose of the physical inspection is to observe and record sufficient information to permit development of a course of action; repair or rehabilitation if it is required.

The Physical Inspection will comprise of completing visual inspection methods by competent field technicians on the Bellekeno 625 settling ponds, the Bellekeno east decline settling ponds, Onek Waste Rock Facility, and the surface pipelines between and near Bellekeno East decline and Bellekeno 625. During dewatering of Bellekeno mine, the condition of the channel of Thunder Gulch and Lightning Creek downstream of Bellekeno 625 treatment plant will be physically inspected. Inspection checklists will be filled out on a weekly basis to ensure structural integrity of mine components and that

runoff and discharge is being appropriately managed (see Appendix I). The following rating system will be used in the field reporting to evaluate the structural integrity of the areas to be physically inspected:

Excellent	“As New” Condition.
Good	System or element is sound and performing its function; although it shows signs of use and may require some minor repairs, mostly routine.
Fair	System or element is still performing adequately at this time, but needs “priority” and/or “routine” repair to prevent future deterioration and to restore it to good condition. A fair rating will be reported to site manager after the inspection.
Poor	System or element cannot be relied upon to continue to perform its original function without “immediate” and/or “priority” repairs. A poor rating will be reported to site manager after the inspection.

If issues are identified during the weekly inspections of structures, works and installations (e.g. waste rock storage area, overburden stockpiles, embankments, diversion ditches, sediment ponds, and pipelines) the site manager will be informed immediately and the appropriate mitigative measures will be implemented. An inspection by a qualified geotechnical engineer would be undertaken for physical stability if necessary. Additional erosion and sediment controls may need to be implemented as required.

If geotechnical inspections are required, they will be carried out during the summer months when the surface and sides of the various rock-fill structures are not obscured by snow.

6.0 REPORTING

As per Sections 18 and 19 of the Water Licence QZ07-078:

“18. Unless otherwise specified in this licence, all monitoring data, reports, plans, studies, study results, designs or manual shall be submitted to the Board in an unbound form that is reproducible by standard photocopier and shall be accompanied by 5 copies.”

And

“19. All monitoring data, reports, plans, studies, study results, designs or manuals shall be submitted in digital form on compact disk using an IBM compatible format that is readable using commonly available software”.

The results of the weekly physical inspections of the Bellekeno 625 settling ponds, the Bellekeno east decline settling ponds, Onek Waste Rock Facility, and the surface pipelines between and near Bellekeno East decline and Bellekeno 625, will be summarized and incorporated into the Water Licence QZ07-078 water quality annual reports (as per section 15 e of the licence). Requirements of the annual reports are outlined in sections 14 and 15 of the Water Licence QZ07-078. Section 37 of the Water Licence QZ07-078 requires *“Actions taken or planned in response to any identified issues and/or to prevent recurrence must be reported annually as part of the annual report”*.

The weekly physical inspection checklists will be kept on file internally for proof of inspections and for reference as required.

Section 38 of the water licence requires a detailed report submitted to the Yukon Water Board identifying any physical issues relating to the dewatering flows from the Bellekeno mine (Thunder Gulch and Lightning Creek channels downstream of Bellekeno 625 treatment plant). Section 38 also requires *“Any mitigative measures undertaken shall also be detailed in that report and submitted to the board following dewatering activities at Bellekeno mine. This report shall be provided to the board as part of the monthly report required by this licence”*. The monthly report required during dewatering of the

Bellekeno mine will be incorporated into the monthly water quality report required by this licence (QZ07-078). The monthly reporting requirements are outlined in section 16 and 17 of the Water Licence QZ07-078.

Alexco Resource Canada Corp.

Physical Inspection and Reporting Plan

Water Use Licence QZ07-078

Appendix I

Checklist Open Season

Checklist OPEN SEASON

Inspection Conducted the Week of: _____

	Bellekeno 625 Settling Ponds		Bellekeno East Decline Settling Ponds		Onek Waste Rock Storage Facility		Surface Pipelines between BK East and BK625		Thunder Gulch Channel During Dewatering		Lightning Creek Channel During Dewatering			
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
A Site Security and Public Safety														
1 Are access points (doors, grates, windows, fencing, etc.) ajar or insecure?														
2 Are any gates unlocked?														
3 Do access points have any new holes?														
4 Have any old holes changed?														
5 Has signage been removed/damaged?														
B Water														
1 Is there any water flow?														
2 Is there a noticeable change in flow (since last inspection)?														
3 Are there ice plugs?														
4 Any loose material or exposed liner?														
C Dams and Ponds Physical Inspection														
1 Is there any seepage along the downstream side of the structure?														
2 Do culverts and decants exhibit blockages, damage, etc?														
3 Is there evidence of upwelling downstream?														
4 Are there any new slumps, cracks, etc? any movement?														
5 Was the toe and crest of the pond checked?														
D Infrastructure														
1 Are there any newly damaged or signs of wear on poles, lines or pipelines?														
2 Any Pipeline Leaks?														
3 Is there evidence of forced entry to any structure?														
4 Is there new minor damage to any buildings?														
5 Have there been any structural failures or collapses?														
E Site Engineering/Geotechnical Stability														
1 Are there signs of ground subsidence in the surrounding area?														
2 Are there signs that a rockfall or landslide has occurred in the area?														
F Other														
1 Were pictures taken?														
2 Date and time of inspection														
3 Inspector initials														
F Overall Condition														
Excellent, Good, Fair or poor														

Provide, when applicable, comments, concerns and/or observed changes:



KENO HILL SILVER DISTRICT

ENVIRONMENTAL MONITORING PROGRAM
2009 UPDATE

APPENDIX C

FLOW MONITORING PLAN



Alexco Resource Canada Corp.

**Bellekeno Underground Development
Flow Monitoring Plan**

Water Use Licence QZ07-078

October 2008

Prepared by:



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1.0 INTRODUCTION

1.1 Purpose of Plan

This plan is submitted to fulfill the condition set out in Part D Section 26 of Water Licence QZ07-078 issued to Alexco Resource Canada Corp on October 3, 2008:

“The Licensee shall, within 30 days of the effective date of this licence, submit a plan for monitoring flows at monitoring stations described in this licence, which require flow measurement. At a minimum, the plan shall indicate the methodology to be used at each monitoring station.”

This plan outlines the flow monitoring methodology that will be used during the advanced exploration and preliminary development activities at the Bellekeno Mine on the Keno Hill property.

2.0 MINE LOCATION AND DESCRIPTION

The Bellekeno mine area is located approximately 3 km east of Keno City within the Keno Hill Silver District. The Keno Hill Silver District is located in central Yukon Territory, 354 km (by air) due north of Whitehorse.

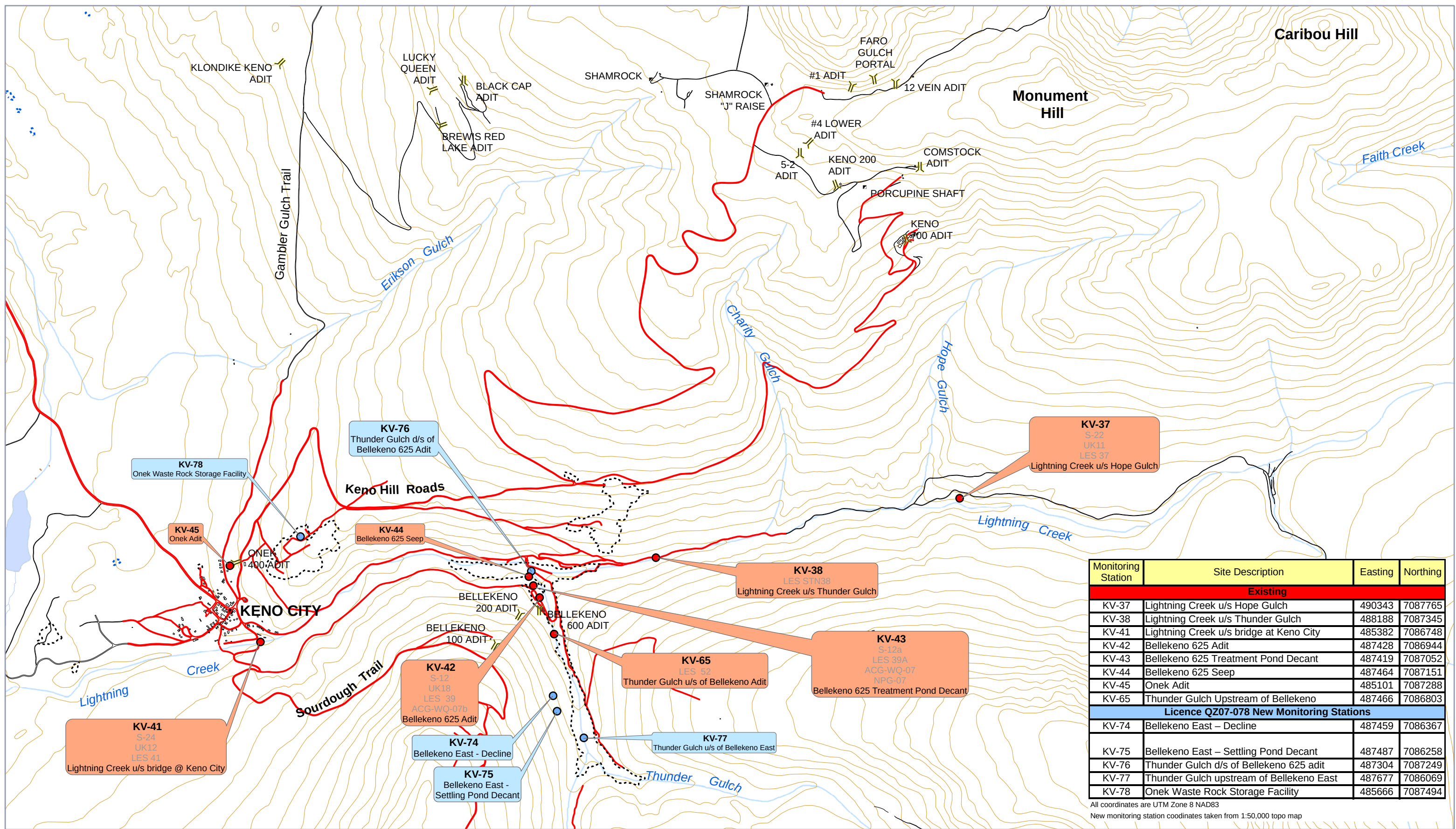
The portal at Bellekeno East is located on a steep slope above Thunder Gulch, a narrow tributary of Lightening Creek.

3.0 MONITORING STATION LOCATIONS

Schedule A, Part I of the Water Licence QZ07-078 identifies 13 specific water monitoring stations required for flow monitoring. Eight locations are being monitored for Water Quality under the Care & Maintenance Water Licence QZ07-074 (as denoted by an asterisk [*] on Table 1). Table 1 provides the site designations, descriptions and locations. Figure 1 illustrates the existing and new flow monitoring locations. (Please note that GPS Coordinates are approximate).

Table 1 Existing and New Flow Monitoring Locations under Water Licence QZ07-078

Monitoring Station	Site Description	Easting	Northing
Existing			
KV-37*	Lightning Creek u/s Hope Gulch	490343	7087765
KV-38*	Lightning Creek u/s Thunder Gulch	488188	7087345
KV-41*	Lightning Creek u/s bridge at Keno City	485382	7086748
KV-42*	Bellekeno 625 Adit	487428	7086944
KV-43*	Bellekeno 625 Treatment Pond Decant	487419	7087052
KV-44*	Bellekeno 625 Seep	487464	7087151
KV-45*	Onek Adit	485101	7087288
KV-65*	Thunder Gulch Upstream of Bellekeno	487466	7086803
Licence QZ07-078 New Monitoring Stations			
KV-74	Bellekeno East – Decline	487459	7086367
KV-75	Bellekeno East – Settling Pond Decant	487487	7086258
KV-76	Thunder Gulch d/s of Bellekeno 625 adit	487304	7087249
KV-77	Thunder Gulch upstream of Bellekeno East	487677	7086069
KV-78	Onek Waste Rock Storage Facility	485666	7087494



Monitoring Station	Site Description	Easting	Northing
Existing			
KV-37	Lightning Creek u/s Hope Gulch	490343	7087765
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KV-43	Bellekeno 625 Treatment Pond Decant	487419	7087052
KV-44	Bellekeno 625 Seep	487464	7087151
KV-45	Onek Adit	485101	7087288
KV-65	Thunder Gulch Upstream of Bellekeno	487466	7086803
Licence QZ07-078 New Monitoring Stations			
KV-74	Bellekeno East – Decline	487459	7086367
KV-75	Bellekeno East – Settling Pond Decant	487487	7086258
KV-76	Thunder Gulch d/s of Bellekeno 625 adit	487304	7087249
KV-77	Thunder Gulch upstream of Bellekeno East	487677	7086069
KV-78	Onek Waste Rock Storage Facility	485666	7087494

All coordinates are UTM Zone 8 NAD83
New monitoring station coordinates taken from 1:50,000 topo map

N

1:25,000
(when plotted on 11x17 inch sheet)

02505001,0001,5002,000m

Legend

Station Name

Site Description

Existing Flow Monitoring Location

Site Description

Proposed Flow Monitoring Location

Water Quality

Mine Workings

Topography

Notes:
This map is for illustrative purposes only.
This is not a legal document.
National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced under license from © Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.
Projection: UTM Zone 8 NAD83
NTS Sheet 105M/14

ALEXCO

ACCESS CONSULTING GROUP

FLOW MONITORING PLAN

EXISTING AND PROPOSED FLOW MONITORING LOCATIONS

Drawn By: HD

Date: October 2008

FIGURE 1

Checked by: KN

File: D:\Project\AIR\Projects\ALEX-05-01\Monitoring\Programs\FlowMonPlan\Oct08\Fig1_FlowMonPlan.mxd

4.0 MONITORING SCHEDULE

Throughout the term of the licence, the timeline for the monitoring of the flow stations will be conducted according to Schedule A, Part III, *On-site Monitoring Schedules of the Water Licence QZ07-078*. The flow monitoring program will consist of continuous, daily, monthly (May to October), and quarterly monitoring. The schedule will be as follows:

Continuous Monitoring:	KV-42 and KV-74
Daily Monitoring:	KV-43 and KV-75
Monthly (May to October) Monitoring:	KV-44
Quarterly Monitoring:	KV-37, KV-38, KV-41, KV-45, KV-65, KV-76 and KV-77
Not Specified in Schedule A, Part III:	KV-78

The culverts at KV-78 (the Onek Waste Rock Storage Facility) will be monitored monthly using a Heron Instruments Dipper-T probe to determine the accumulation amount of water within the storage facility. During pumping of clean, tested water from the Onek Waste Rock Storage Facility, the continuous flow will be calculated by monitoring the pump discharge rate, or if vacuum trucks are used to empty the culvert, the flow will be calculated on the basis of volume of solution removed by the trucks.

The Bellekeno East decline (KV-74) will not have a continuous flow. The decline will be inspected daily for flow and if any water is pumped from the Bellekeno East decline, the flow will be calculated by monitoring the pumping rate.

5.0 FLOW MONITORING METHODS

Flow monitoring will be conducted in accordance with the *Manual of Standard Operating Procedures for Hydrometric Surveys in British Columbia*, dated November 2, 1998. Depending on the flow condition (i.e. stream vs. adit piped flow), one of the following flow monitoring methods will be implemented at each monitoring station.

5.1 Current Meter

A current meter measures velocity at various points along the width of the stream. The manual of operation provided with the meter would be followed and the general current meter use and flow measurement procedure from this protocol would be followed.

Please note that text surrounded by quotation marks was taken from the “*Water Measurement Manual*” (U.S. Department of the Interior, 1984).

“*The essential features of conventional current meters are a wheel, which rotates when immersed in flowing water, and a device for determining the number of revolutions of the wheel.*” The relationship between the velocity of the water and number of revolutions of the wheel per unit time for various velocities would be provided by the manufacture of the device. The instrument would be calibrated by the manufacturer prior to its shipment.

The current meter would be calibrated every year prior to its use. As part of the calibration process, a relationship between the speed of rotation of the meter and the water velocity would be developed. The relationship is called a rating table. The relationship would be developed after each calibration and the curve is supplied with the meter. (a rating table from another current meter will not be used.)

Since there is a variety of equipment available to conduct flow measurements, it has been assumed that a Price-type current meter with top setting wading rod would be used to conduct the measurements. The Price-type current meter and top setting wading rod are commonly used in the Yukon. In addition, the following procedure would be for the “*sixth-tenths-depth*” measurements, in which the velocity at sixth-tenths of the stream depth is assumed to represent the average velocity through the vertical water column.

This procedure has been prepared under the assumption that a person wading across the stream would undertake the flow measurements. For detailed procedures on conducting flow measurements from a boat or bridge refer to the “*Water Measurement Manual*” published by the U.S. Department of the Interior (1984).

The flow measurement procedure would consist of the following steps:

- Locating the monitoring station, the stations would be clearly marked.
- The number of depth and velocity measurements would be determined to conduct across the stream or river. There would be at least 20 flow measurements across the channel. However, the number of measurements may be reduced for the very small streams if the distance between the measurements becomes less than 30 centimetres (U.S. Department of the Interior, 1984). There should be no flow measurement representing more than 10% of the overall channel flow. The width across the channel would be obtained by measuring from a fixed reference point on one bank to the other.
- A measuring tape or marked cable would be used to spread across the channel to outline the locations where depth and velocity measurements will be conducted.
- The water depth would be measured at each location using the wading rod. The rod would be graduated to 0.02 metres with the zero mark at the bottom of the rod. The depth is the point at which the level water surface intersects the rod. Observations would be made to the nearest 0.01 metre.
- Velocity would be measured at sixth-tenths (0.6) of the depth from the water surface. The height of the current meter would be adjusted to sixth-tenths of the depth. The manufacturer manual would be followed on how to adjust the current meter to the proper depth.
- The number of spins per unit time at each location would be measured. Either a set of headphones or a digital counter would be used to count the number of revolutions while timing is being conducted. The timing would be started immediately after the current meter has spun past the point where it records a complete revolution (i.e. a scratch sound using the earphones or number change on the digital reader). Also it would be ensured that the rotations are measured for a minimum of forty seconds.
- The location from the left bank (while facing upstream), depth and number of revolutions per unit time on a field data sheet (please refer to Appendix I for a blank field data sheet) would be recorded.
- The location of the person taking the flow measurements is important. They would face upstream and stand at least thirty centimetres downstream of the rod. The rod would be held vertically with the meter pointing in the direction of flow.

- The measurements would continue to be taken across the stream or river in equally spaced intervals until the right bank is reached.

5.2 V-notch Sharp Crested Weir

A V-notch sharp-crested weir measures volumetric flow rates of a stream. The weir would be designed and constructed to meet 2005 ASTM Standard D5242-92 – Standard Test Method for Open-Channel Flow Measurement of Water and Thin-Plate Weirs. Operation and installation of the weir would be in accordance with Environment Canada's *Guidance Document for Flow Measurement of Metal Mining Effluents* (EPS2/MM/4 – April, 2001). The purpose of the weir would be to calm creek waters and allow still water to be decanted through a specifically shaped notch within the weir. Water level-discharge relationships could then be applied to the specific shaped notch in order to calculate an instantaneous volumetric flow rate.

5.3 Bucket and Stop Watch

Volumetric analysis or the '*bucket and stopwatch method*' can be an extremely precise and accurate method that simply involves the collection of discharged water in a container of known volume for a measured period of time. This is a simple method for measuring small amounts of water where all of the flow can be concentrated (such as naturally within a rock cascade, a temporary dam with a pipe, or a discharge pipe from a settling pond). The method could also be used in larger streams which have flow concentrated or partitioned by culverts, pipes or weirs. A short, wide container is more suitable to fit under the falling water than a tall narrow one. The container volume should be such that it takes at least 3 seconds to fill. It is important that the bucket is held upright and that multiple (>3) readings are taken to reduce measurement error. An alternative approach is to hold down and open a heavy-gauge plastic garbage bag on the stream bed, time its filling, and empty the bag contents into a measuring container. The bag can also be weighed and the volume calculated if the density of the water is known.

Stream discharge (Q) in L/s would be calculated as:

$$Q = V/t \text{ where } V \text{ is the contained volume (L) during time } t \text{ (s).}$$

Reference: Hauer & Lamberti, 1996. Methods in stream ecology. Academic Press.

5.4 Continuous Flows

Continuous flows are required at the Bellekeno 625 Adit (KV-42) and the Bellekeno East Decline (KV-74). The decline will be inspected daily for flow and if any water is pumped from the Bellekeno East decline, the flow will be calculated by monitoring the pumping rate.

The Bellekeno 625 Adit (KV-42) discharge is currently being treated by lime in a treatment shed prior to entering the settling ponds. A calibrated digital flow meter would be installed in the line to give continuous flow measurements. A daily average would be reported as well as the flow during at the time of monitoring. The digital flow meter would be installed, calibrated, maintained and used as per the manufactures specifications.

5.5 Dipping Probe

As previously mentioned, the culverts at KV-78 (the Onek Waste Rock Storage Facility) will be monitored monthly using a Heron Instruments Dipper-T probe to determine the accumulation amount of water within the storage facility. The Heron probe gives a solid beep when water is encountered. The base of the culvert and the water level would be measured to a designated point at the top of the culvert. The increase and decrease in the water volume could be calculated using the height of the water column. During pumping of clean, tested water from the Onek Waste Rock Storage Facility, the continuous flow will be calculated by monitoring the pump discharge rate.

6.0 REPORTING

A daily field report form (see Appendix I) will be filled out by competent and qualified field technicians while completing the daily flow monitoring (KV-42, KV-43, KV-74 and KV-75) and daily water quality testing. The daily average and the flow at the time of monitoring will be reported for stations that require continuous flow monitoring. Sites that require quarterly flow monitoring (KV-37, KV-38, KV-41, KV-45, KV-65, KV-76 ANF KV-77) as

well as the stations that require monthly monitoring (KV-44 and KV-78) will be recorded in the field during the Water Quality sampling program.

As per Section 18 and 19 of the QZ07-078 Water Licence:

“18. Unless otherwise specified in this licence, all monitoring data, reports, plans, studies, study results, designs or manual shall be submitted to the Board in an unbound form that is reproducible by standard photocopier and shall be accompanied by 5 copies.”

And

“19. All monitoring data, reports, plans, studies, study results, designs or manuals shall be submitted in digital form on compact disk using an IBM compatible format that is readable using commonly available software”.

The flow monitoring data collected will be incorporated into the Water Licence QZ07-078 water quality monthly and annual reports. Requirements of the monthly and annual reports are outlined in Sections 14, 15, 16 and 17 of the Water Licence QZ07-078.

Alexco Resource Canada Corp.

**Bellekeno Underground Development
Flow Monitoring Plan**

Water Use Licence QZ07-078

APPENDIX I

Daily Field Report Form

Date: _____

Daily Field Report

Operator: _____

		KV-13	KV-14	KV-31	KV-32	KV-42	KV-43	KV-74	KV-75
Parameter	Units	Silver King 100 Adit	Silver King 100 Decant	Galkeno 900 Adit	Galkeno 900 Decant	Bellekeno 625 Adit	Bellekeno 625 Decant	Bellekeno East Decline	Bellekeno East Decant
Time	HH:MM (24h)								
Air Temperature	°C								
Water Temperature	°C								
pH	pH units								
Conductivity	µS								
Ammonia	mg/L								
Turbidity	NTU								
Flow Rate	sec/5 gal								
Lime Added - Flow Rate	sec/L								
Mix Tank Hz	Hz								
Mix Tank pH	pH								
Target pH	pH								
Lime Pump RPM	RPM								
Bioreactor Cell									
Freeboard	in								
Totalizer Reading	L/sec								
Water Temperature	°C								
Visual and smell impression in tank (sheen, odor, etc.)	G/B/U								
pH	pH units								
Conductivity	µS								
Dissolved Oxygen	mg/L								
Redox potential	V								

Comments:



ALEXCO KENO HILL MINING CORP.

QUARTZ MINING LICENCE

QML-0009

BELLEKENO MINE DEVELOPMENT

KENO HILL SILVER DISTRICT

YUKON

Appendix C

Environmental Conditions Report

ENVIRONMENTAL CONDITIONS REPORT

VERSION No.1

KENO HILL SILVER DISTRICT
YUKON

AUGUST 2009

Prepared by:



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1.0 INTRODUCTION

This Environmental Conditions Report provides a description of the regional setting for the Keno Hill Silver District with regards to the physical, biological and human environments. These descriptions are not intended to provide baseline environmental conditions prior to mining as the area has had nearly a century of mining activities. The collection of data to describe baseline environmental conditions was not even a consideration during early mining development; as such, very little to no baseline data has been documented.

It should also be recognized that over the course of time the local ecosystem has changed, and in some areas adjusted or even adapted to reflect the current mining activities in the area. This has complicated the establishment of “baseline” conditions necessary to measure and assess the impacts that have occurred. The regional setting for the area is therefore based on present environmental conditions.

1.1 KENO HILL SILVER DISTRICT LOCATION

The Keno Hill Silver District is located in the north-central Yukon Territory approximately 354 km due north of Whitehorse (see Figure 1-1 “General Location Map” and Figure 1-2 “Keno Hill Property Location Map”) and comprises approximately 827 mineral claims covering three adjacent mountains, Galena Hill, Keno Hill, and Sourdough Hill. The property covered by mining claims and leases is approximately 15,000 ha in a roughly east-west belt about 29 km long and up to 8 km wide.

Access to the district is provided by a two-lane paved road from Whitehorse to Mayo and an all weather gravel road running 45 km northeast from Mayo; a total distance of 452 km. The property lies along the broad McQuesten River valley and three prominent hills to the south of the valley. The elevation of the valley is about 700 m above sea level. Galena Hill, Keno Hill and Sourdough Hill rise to elevations of about 1,400 m, 1,825 m and 1,370 m, respectively.

Many buildings of the old Elsa townsite remain situated on the property. Facilities in Elsa include houses, bunkhouses, mine dry, offices, warehouse, transport shop,

machine shop, carpentry shop and assay laboratory. A 544 ton per day concentrator and small silver refinery are also located in Elsa. Hydropower is supplied from a Yukon Energy Corporation 5 megawatt facility located near Mayo.

All the silver deposits are located within a 20 km radius of Elsa. The Elsa and Keno City area were the focus of previous exploration and mining activity from the early 20th century through to United Keno Hill Mines Ltd (UKHM) closure in 1987, when many independent miners along with a number of corporations were prospecting the area for silver.

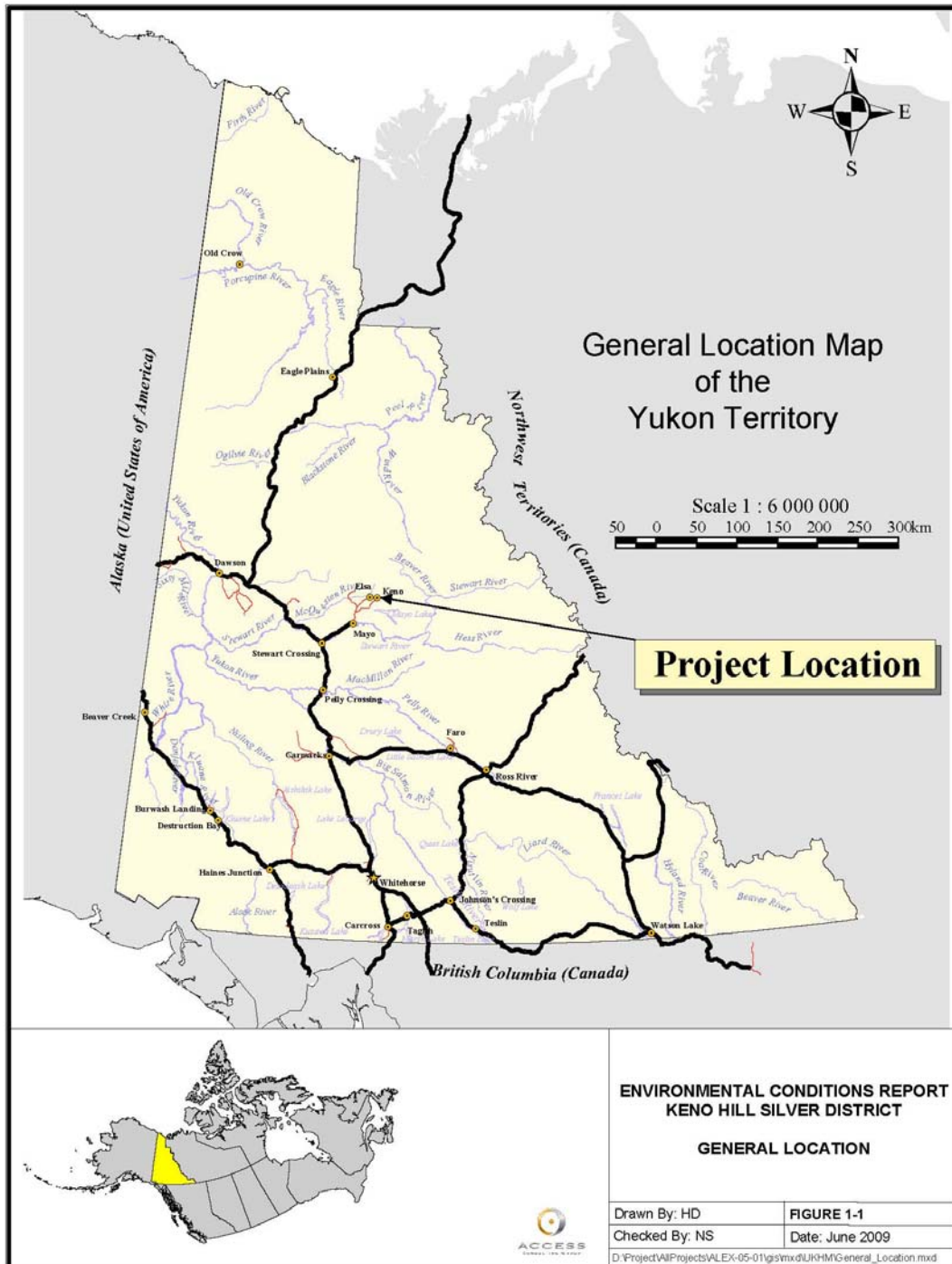
1.2 GENERAL DESCRIPTION OF AREA

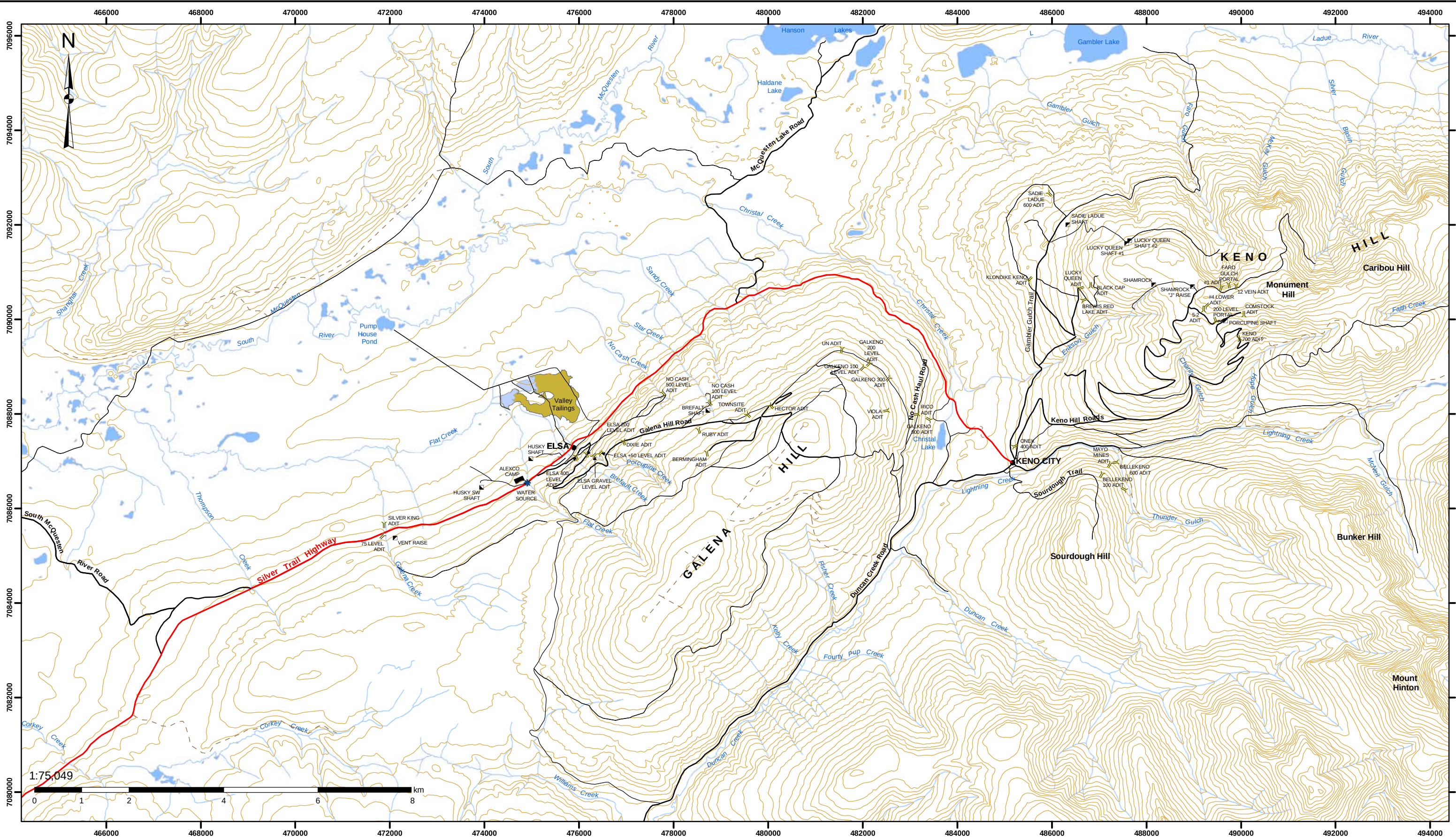
The Keno Hill Silver District lies within the Yukon Plateau, just south of the Wernecke Mountains. The terrain consists of concordant, rolling, upland areas separated by wide valleys. Alpine mountain peaks extend above the upland locally. Valley bottoms and slopes have dense boreal forest cover but the upland commonly extends above tree line and is tundra covered.

Geologically, the area is part of the Selwyn Basin and is characterized by late pre-Cambrian through Mississippian marine clastic meta-sedimentary rocks intruded by mid-Cretaceous granitic plutons. The meta-sediments are complexly deformed and thrust imbricated. Silver bearing veins are found along late brittle faults that cut the deformed package. The camp is at the western extent of the Cordilleran ice sheet thus a complex assemblage of glacial and peri-glacial landforms and deposits are present. Valley bottoms are broad and overburden covered, commonly boggy and contain thick peat deposits. Permafrost is widespread though discontinuous, and requires consideration for any development.

The Keno Hill Silver District is wholly contained within the catchment of the Stewart River. Drainage from the district enters the Stewart River at three different points due to the site straddling the drainage divides of three different tributaries of the Stewart River. Listed in the downstream order in which they enter the Stewart River, these tributaries are the Ladue River, the Mayo River, and the McQuesten River.

Figure 1-1 General Location Map





Notes:
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National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Reproduced under license from © Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.
Crown Grants confirmed by Land Titles November 2005.
Projection: UTM Zone 8 NAD83
NTS Sheet 105M/13 and 105M/14

Topography

- Town
- Silver Trail
- Secondary Road
- Limited-use road
- Trail
- Watercourse
- Waterbody

Mine Workings

- Valley Tailings
- Adit
- Shaft (to surface - connection to underground not determined)

ACCESS
CONSULTING GROUP

**ENVIRONMENTAL CONDITIONS REPORT
KENO HILL SILVER DISTRICT**

PROPERTY OVERVIEW

Drawn By: HD	June 2009	Figure 1 - 2
Checked by: NS	D:\Project\AllProjects\VAL-05-01\gis\mxd\UKH\Envr\mental_Conditions_Report\Fig_1_2_PropertyOverview.mxd	

The property location in the interior of Yukon, south of the Wernecke Mountains, results in the area being semi-arid but subject to occasional heavy rainstorms. Snow cover is light and blankets the area from October to May. Temperature extremes are characteristic of the area. Winters are long, cold and dark. Summers are mild to cool, often rainy and grey but occasionally interrupted by hot, dry, clear spells. Stream flows generally peak in May with the spring snow melt but heavy flows also occur in summer and fall during storm events. Long daylight hours in summer are conducive to lush plant growth but the short growing season limits the overall growth rate and size of most vegetation.

The area has experienced a long history of occupation and development thus its original wilderness character has changed considerably though the habitat remains generally healthy and productive. Hardrock mining has caused an influx of population but in itself has not caused a great deal of habitat destruction. Placer mining has profoundly changed some valley bottoms causing significant changes to stream beds. Logging, partly to support mining operations, has been carried out on a small scale in many valleys; however, re-growth is progressing well. Fish populations have declined due to a combination of off shore harvest and local habitat degradation, both chemical and physical, from hardrock and placer mining as well as other undertakings. The effects of local activities on habitat do not appear to be either irreversible or necessarily long term since, based on water quality and benthic invertebrate studies as well as observations of extensive re-vegetation, there has been considerable rejuvenation in the time frame of the area developments.

This report provides further detail on the climate, geology and soils, water quality and hydrology, aquatic resources (fisheries, benthic invertebrates, stream sediments), wildlife, and vegetation in the area. Heritage resources, land use patterns, and socio-economic conditions are also discussed.

Table 1-1 provides an overview of existing environmental conditions in the Keno Hill Silver District.

Table 1-1 Keno Hill Silver District Setting Summary

Region:	Yukon
Topographic Map Sheets:	NTS 105M/14 & 105M/13
Geographic Location Name Code:	Keno City
Latitude:	63° 54' 32" N
Longitude:	135° 19' 18" W
Drainage Region:	Stewart River drainage region
Significant Watersheds:	South McQuesten River, Lightning Creek
Nearest Communities:	Mayo, Keno City
Road Access:	Silver Trail Highway
First Nations Traditional Territory:	Nā-cho N'yak Dun
Surrounding Land Status:	YG Land
Special Designations:	None
Ecoregion:	Yukon Plateau (North)
Study Area Elevation:	945 m asl (Above Sea Level)
Vegetation Communities:	- Northern boreal forests occupy lower slopes and valley bottoms - spruce, pine and alder - Grasses and sedges, mosses occupy forest floor - Heavy moss and lichen growth resident as ground cover understory of shrub willow, - Open and forest fringe areas of willow and scrub birch, and various flowering plant species
Wildlife Species:	- Moose, dall sheep, grizzly and black bear, caribou, beaver, wolf, lynx, marten, wolverine, western tanager, magnolia warbler. - Various terrestrial bird species including ptarmigan, birds of prey, and migratory species, including various waterfowl species including snow geese; eagles, peregrine falcon, and gyrfalcon.
Fish Species:	Bering and Beaufort Sea salmonids and freshwater species, including: Arctic grayling, lake trout, lake whitefish, broad whitefish, burbot, inconnu, Arctic Cisco, Northern pike
Valued Components:	Water quality, Arctic grayling, Chinook salmon, moose, public health and safety, trapping, traditional harvesting, tourism.

2.0 PHYSICAL ENVIRONMENT

Chapter 2 of this Environmental Conditions Report summarizes the physical environment for the Keno Hill Silver District including climate (evaporation, precipitation), terrestrial resources (geology, physiography, soils), and water quality and hydrology for watercourses and discharging adits.

2.1 CLIMATE

2.1.1 General

An automated meteorological station (Calumet Weather Station) was installed on Galena Hill above Hector adit in June 2007. The location is shown on Figure 2-4 – Water Quality Sample Stations below in Section 2.3 (Water Quality and Hydrology). The station measures air temperature, relative humidity, barometric pressure, rainfall, wind speed and direction, solar radiation, and soil temperature. A Yukon Government monitored snow course station also exists in the area.

The following sections present the 1996 characterization of climate, which was in turn used to derive site hydrological conditions at the time. Based on comparisons with the latest site data, the original techniques and hydrological inputs were deemed appropriate in deriving site hydrological condition (Clearwater Consultants Ltd, 2008; Refer to Appendix A). The following information is therefore considered valid and accurate.

2.1.2 Available Data

The climate records from a total of eleven climate stations were assembled in 1996 to assist in characterizing the climate of the Keno Hill Silver District. Details of these stations are presented in Table 2-1. The table also identifies the type of climatic information each station provided for the study.

The region around the Keno Hill Silver District has been served by a network of climate monitoring stations. At least three climate stations have been operated within the boundaries of the silver district. Two of these stations were maintained by the Atmospheric Environment Service (AES) and were located at the Elsa townsite and on the southern flank of Keno Hill. The third station was operated on a seasonal basis by

DIAND at a site in the Flat Creek catchment near the Elsa townsite. In addition to these stations, the AES operate a principal climatological station at the Mayo Airport, located some 40 km southwest of Elsa. The data from the Mayo Airport can be combined with that of two discontinued stations in the near vicinity of the airport (i.e. Mayo Landing and Mayo) to construct a long-term climate record.

Table 2-1 Details of Regional Climate Stations

Station Name ³	Latitude		Longitude		Elevation (m.a.s.l.)	Period of Record	Mean Annual Precipitation (mm)	Information Applicable To This Study
	Deg.	Min.	Deg.	Min.				
AES¹								
Boundary/ Mile 34 Boundary Rd	64	14	140	21	1036	1967 - 1978	576	Precipitation
Clinton Creek	64	28	140	44	576	1964 - 1978	370	Precipitation
Dawson	64	3	139	26	320	1897 - 1979	306	Precipitation/ Humidity/ Temperature
Dawson Airport	64	3	139	8	369	1976 - 1995	340	Precipitation/ Humidity/ Temperature
Elsa	63	55	135	29	814	1948 - 1965, 1974 - 1989	413	Precipitation
Pelly Ranch/ Fort Selkirk	62	49	137	22	454	1954 - 1995	286	Precipitation/ Bright Sunshine
Keno Hill	63	56	135	12	1472	1974 - 1982	590	Precipitation
Klondike/ Dempster	64	27	138	13	960	1966 - 1995	469	Precipitation
Mayo Airport/ Mayo/ Mayo Landing	63	37	135	52	504	1924 - 1995	306	Precipitation/ Humidity/ Temperature
Snag Airport	62	22	140	24	587	1943 - 1966	339	Humidity/ Temperature
DIAND²								
Flat Creek	63	55	135	30	730 (approx.)	1992 - 1994 (summers only)	Not available	Humidity/ Temperature

Notes: 1. Environment Canada, Atmospheric Environment Service

2. Department of Indian Affairs and Northern Development, Fire Management Program

3. For some stations, more than one name is presented. Where this happens, the first name given is the current official designation of the station. Other names represent past designations of the station. Name changes appear to have most often been triggered by the slight relocation of the station.

2.1.3 Precipitation

Mean annual precipitation (MAP) within a mountainous region typically increases with increasing elevation. The region around the Keno Hill Silver District is no exception to this rule as illustrated by the graph of MAP versus elevation shown on Figure 2-1. The data points on this graph were obtained from the information assembled in Table 2-1 for the regional AES climate stations.

The Keno Hill Silver District is in an area of significant relief. Accordingly, MAP can be expected to vary considerably within the boundaries of the district. In order to quantify this variation, an empirical relationship was derived between MAP and elevation using the data from the two AES stations which were operated on the property, namely the Elsa and Keno Hill stations. These are suitable stations for deriving the relationship since their elevations are widely separated (i.e. 814 m versus 1472 m). Assuming a linear relationship between MAP and elevation, a line was fitted to the data of these two

stations (see Figure 2-1). The slope of this line indicates that MAP increases by an average of 27 mm for every 100 m of ascent, a value not too dissimilar from that observed in other regions of the Yukon interior.

The curve fitted exclusively to the Elsa and Keno Hill data seems to also explain much of the variation in MAP observed at the other regional AES climate stations. The scatter about the line drawn on Figure 2-1 can largely be attributed to a mild drying trend as one moves from the northwest to the southeast across the region. This drying trend is made apparent by noting where the individual climate stations are located in relation to the property. All stations plotting above the line are located north and west of the property. In contrast, the two stations plotting below the line are found south of the property.

The adopted empirical relationship shown on Figure 2-1 should be viewed as providing only approximate estimates of MAP for ungauged points within the district. Although elevation is the principal control, precipitation also varies according to other variables such as slope and aspect which are not explicitly accounted for in the empirical relationship.

Figure 2-2 was prepared to illustrate the seasonal distribution of precipitation at the property. As with MAP, the seasonal distribution is influenced by elevation. To demonstrate this influence, the seasonal distributions for Mayo Airport (504 m), Elsa (814 m), and Keno Hill (1472 m) have been plotted on Figure 2-2. The following observations can be drawn from examining these distributions:

- precipitation is common throughout the year;
- the wettest period is normally the summer months of July and August;
- the driest month of the year is typically April;
- the proportion of total precipitation which falls as rain decreases as elevation increases (60% of total precipitation at Mayo Airport, 53% at Elsa, and 41% at Keno Hill); and,
- the precipitation gradient during winter is steeper than that during summer (which suggests orographic effects are more pronounced during snowfall than during rainfall).

Figure 2-1 Mean Annual Precipitation as a Function of Elevation

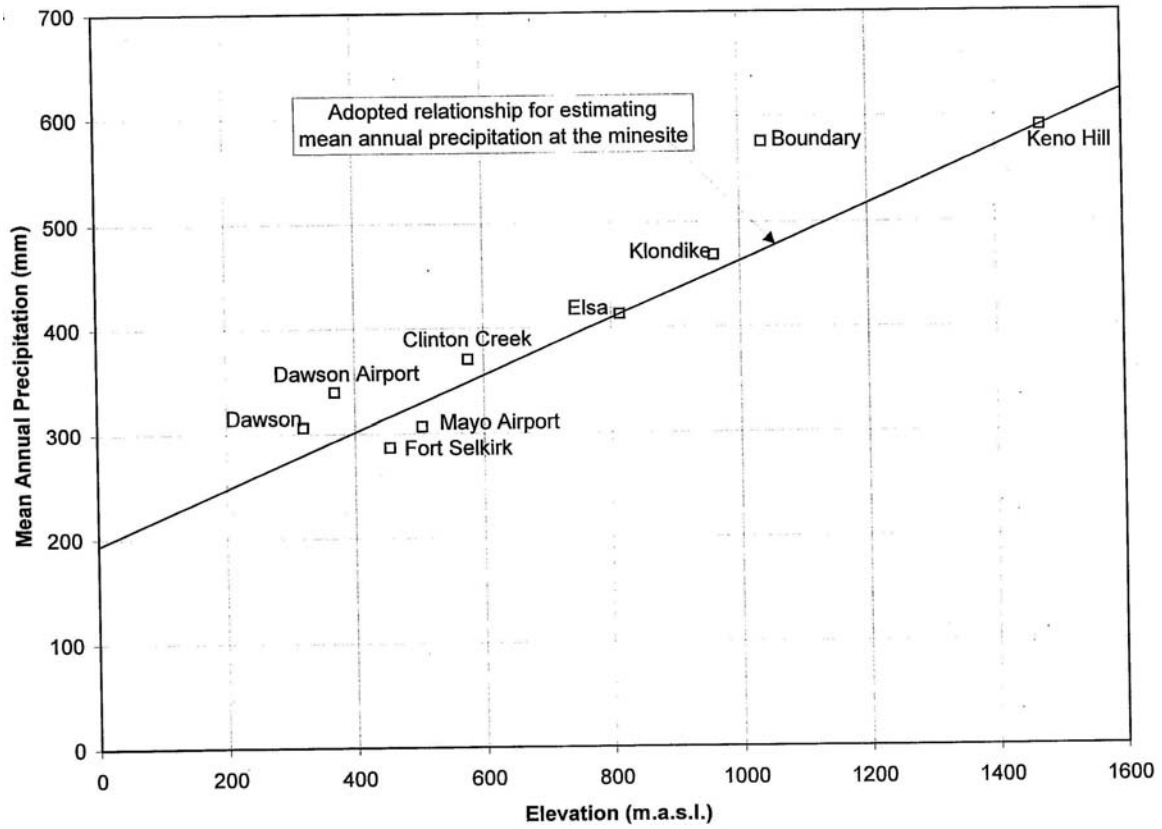
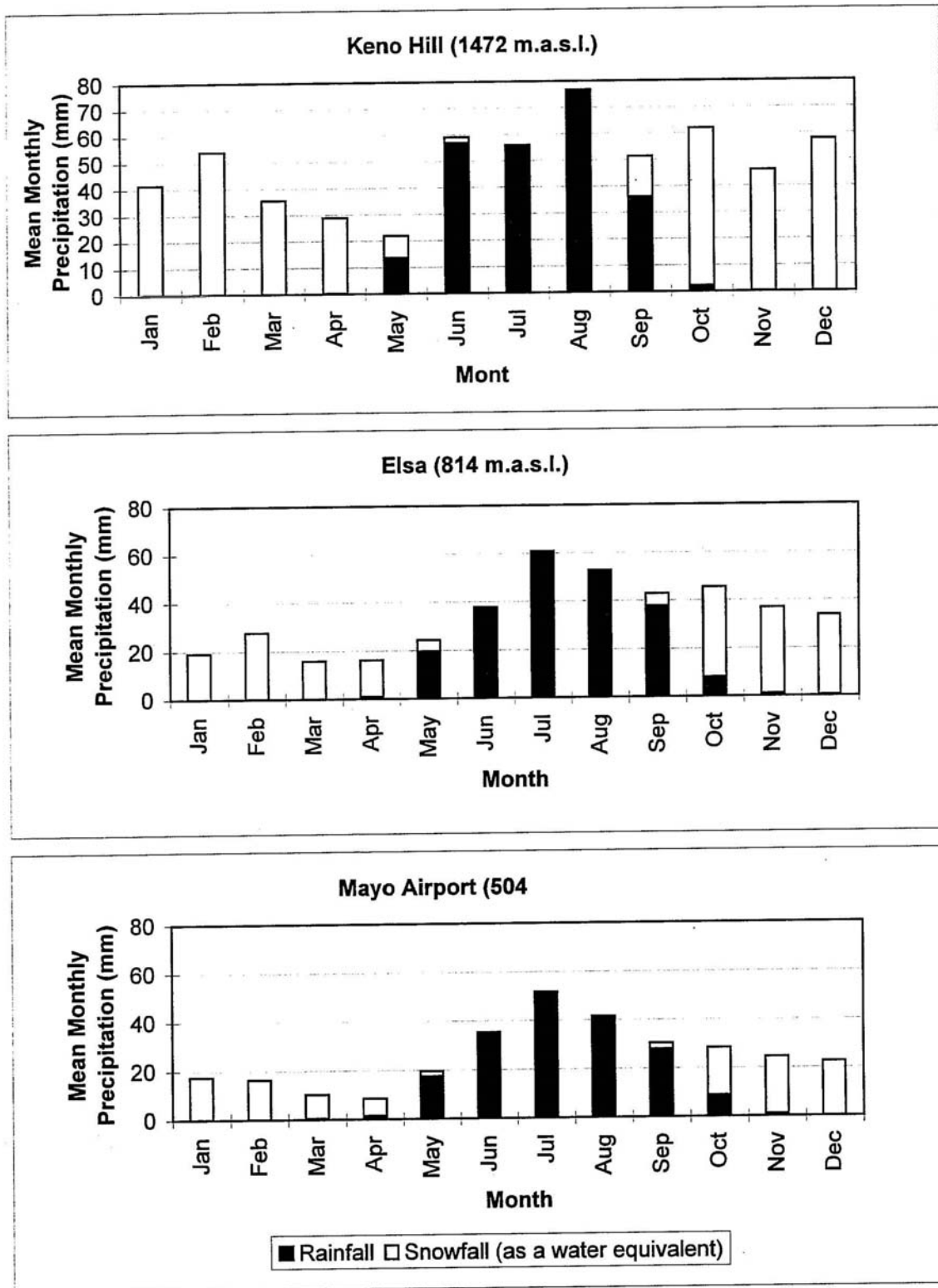


Figure 2-2 Mean Monthly Precipitation



2.1.4 Evaporation

Two rates of evaporation are of interest: lake evaporation and evapotranspiration. The former refers to evaporation from a free-water surface while the latter refers to evaporation from a land surface including transpiration from plants. Both rates were estimated from meteorological data using a computer program known as WREVAP which was developed by Environment Canada's National Hydrology Research Institute.

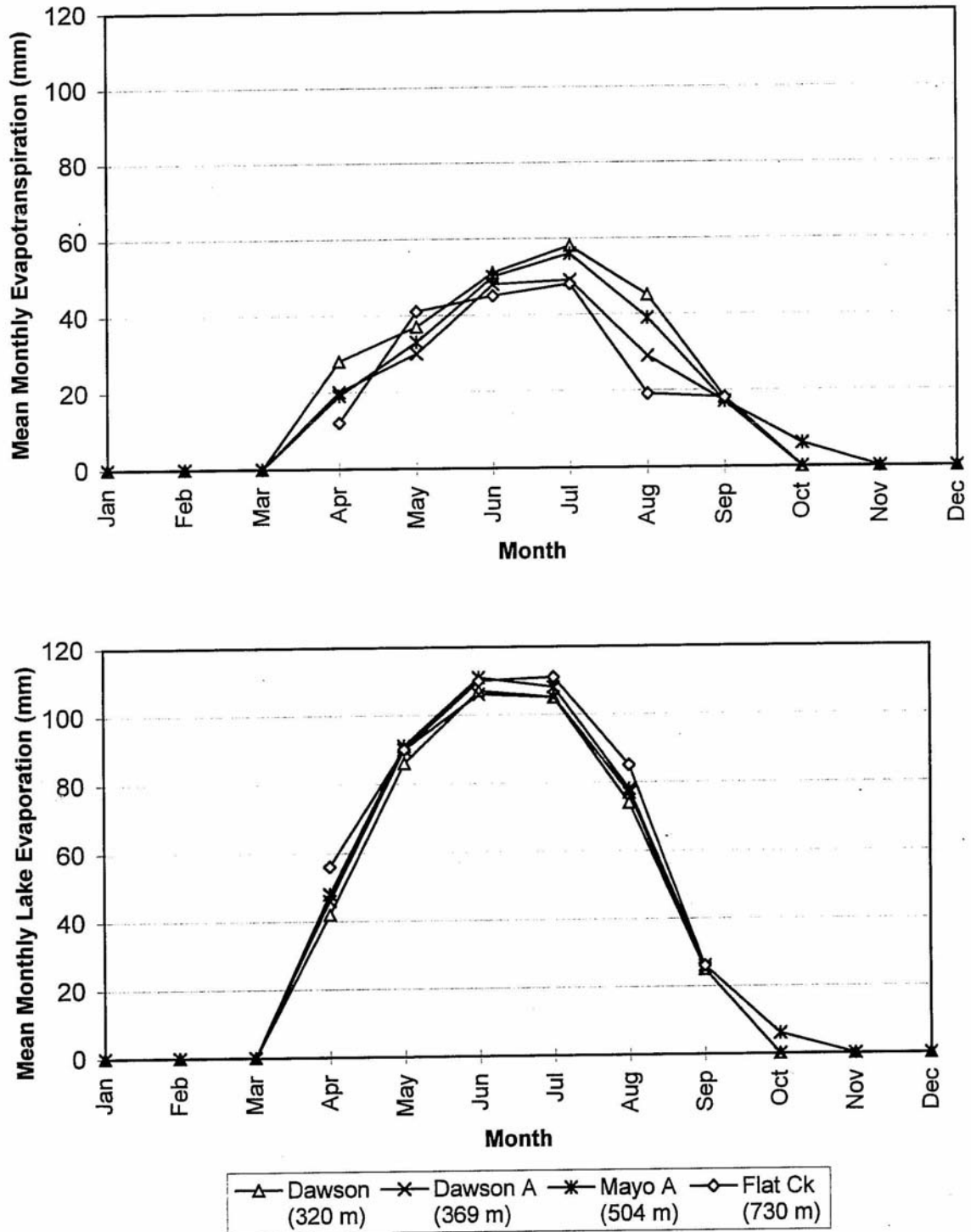
The meteorological inputs to the WREVAP model comprise humidity, temperature, and sunshine duration. In order to obtain valid estimates of evaporation, the model must be provided with accurate measurements of the first two climatic variables. Model results are less sensitive to the accuracy of the third input requirement (sunshine duration). Thus, the use of sunshine duration records from another nearby climate station provides adequate accuracy. With this in mind, a search was made for climate stations which met the following two criteria:

- the station experiences a comparable climate to the Keno Hill Silver District; and,
- as a minimum, the station monitors both humidity and air temperature.

Using these criteria, a total of four climate stations were selected for the evaporation modelling, one located on the property itself (Flat Creek) and three located in the general region (Dawson, Dawson Airport, and Mayo Airport). However sunshine duration has not been maintained at any of these locations. To obtain this additional information, reference was made to the closest climate station equipped to measure sunshine duration that being Pelly Ranch or, as it was formerly known, Fort Selkirk.

Figure 2-3 displays the results of applying the WREVAP model to the meteorological conditions at each of the four climate stations. The top graph shows estimates of mean monthly evapotranspiration while the bottom graph shows the monthly distribution of lake evaporation. As can be observed, all four stations experience similar rates of both lake evaporation and actual evapotranspiration. Based on this similarity, the average of the evaporation rates at the four stations was selected to represent the conditions at the property. The average annual lake evaporation is about 460 mm while the estimated actual evapotranspiration is about 200 mm per annum, or 43% of lake evaporation.

Figure 2-3 Mean Monthly Evaporation Data



2.2 TERRESTRIAL RESOURCES

The following subsections describe terrestrial resources including regional and district geology, physiography and surficial geology as well as local soils characterization.

2.2.1 Regional Geology

The Keno Hill Silver District is located in the western part of the Selwyn Basin in an area dominated by deformed and metamorphosed Upper Proterozoic to Mississippian sedimentary rocks formed at the edge of a continental margin. During the Jurassic and Cretaceous periods, the area was subjected to compressional tectonic forces producing two major thrust sheets (Robert Service and Tombstone) and widespread folding. Early large scale deformation produced recumbent folds, resulting in local structural thickening of strata. A second (and possibly third) deformational event produced gentle south westerly plunging syn- and antiform pairs.

The Robert Service Thrust Sheet in the south is composed of Late Proterozoic to Cambrian sandstone, locally with interbedded limestone and argillite, a Cambrian to Middle Devonian succession of siltstone, limestone and chert, and Upper Devonian argillite, chert, and chert pebble conglomerate. The latter unit unconformably overlies the lower units.

The Tombstone Thrust Sheet to the north consists of Devonian phyllite, felsic meta-tuffs and metaclastic rocks, overlain by Carboniferous quartzite. This latter rock unit is locally thickened due to folding and or thrusting and hosts the mineralization of the Keno Hill Silver District.

Intrusive rocks formed during four episodes of plutonism. Early Paleozoic fine-grained diabase occurs as metre-scale dikes and sills in the Upper Proterozoic to Lower Cambrian rocks. During the Mid-Triassic, gabbros to diorites formed pods of various sizes, primarily in the Devonian and Mississippian rocks of the Tombstone thrust sheet. A third phase of plutonism took place around ninety-two million years ago in the early Cretaceous and resulted in widespread and voluminous Tombstone intrusions of commonly granitic to granodioritic composition. The youngest magmatic activity

occurred around sixty-five million years ago in the Upper Cretaceous and resulted in the formation of peraluminous megacrystic potassium feldspar granite.

In addition to where polymetallic veins were exploited, the area hosts a number of occurrences, and showings of tungsten, copper, gold, lead, zinc, antimony and barite. Tin, tungsten, and molybdenite occurrences are possibly related to the suite of Cretaceous intrusion, whereas lead, zinc, and barite occur in stratiform calcareous sedimentary rocks of early to mid-Paleozoic age typical of sediment-hosted deposits.

2.2.2 Property Geology

The Keno Hill District is underlain primarily by Yukon Group metasedimentary rocks, locally divided into three formations; Upper Schist, Central Quartzite and Lower Schist. The Upper Schist (Hyland Group, pre-Cambrian to Cambrian age) overlies the quartzite in what is inferred to be a thrust contact (Robert Service Thrust) and consists of quartz-mica schist, quartzite, graphitic schist and minor limestone. The Central Quartzite (Keno Hill Quartzite, Mississippian age) contains thick and thin-bedded quartzite, massive quartzite, graphitic phyllite, graphitic schist, calcareous schist and minor Triassic greenstone. This unit is approximately 700 m thick and is host to most of the past producing ore bodies. Structurally juxtaposed below the quartzite is the Lower Schist which has been correlated with the Devonian-Mississippian Earn Group. The Lower Schist includes graphitic schist, argillite, thin-bedded quartzite, calcareous schist, phyllite, slate, sericite schist, minor thick-bedded quartzite and locally significant intervals of Triassic greenstone. The greenstone forms sills and / or boudins and consists of metadiorite and metagabbro. The sills and boudins form bodies up to one kilometre long and thirty metres thick. Regional, greenschist facies metamorphism of all units is believed to have occurred in the Middle Cretaceous, about 105 million years ago.

A number of quartz-feldspar porphyritic sills have intruded the stratigraphy parallel to schistosity. The sills are most common in the Lower and Upper Schists and can reach thicknesses of up to fifty metres; reports of occurrences in the Central Quartzite are inconclusive and vague. The quartz-porphyry sills are believed to be of Cretaceous age.

Structurally, the property is characterized by four sets of faults; many of which have been filled by hydrothermal minerals, forming veins. The oldest fault set consists of south dipping structures that are generally parallel to foliation and are apparently associated with the Tombstone Thrust Fault since movement was contemporaneous or slightly later. Locally, brittle deformation has been observed along these structures. A second fault set, known as “longitudinal veins” strikes north east to east northeast and dips steeply southeast. The latest movement along these faults is sinistral with offsets locally reaching more than 150 metres; however, more than one episode of movement commonly is indicated. Depending on the competency of the host rock, longitudinal veins can be up to thirty metres wide in an anastomosing system of sub-veins. Essentially all mineralized rock was mined from these longitudinal veins. A third set of faults, known as “transverse faults”, is north-west striking and dips steeply to the north. Transverse faults typically do not contain silver and lead mineralization but are commonly filled by quartz with trace to minor arsenopyrite, pyrite and jamesonite.

A younger set of faults, known as cross faults, strike north to north east with a dip of sixty degrees west to south west and offset vein or longitudinal faults by up to 2,000 metres. In the western part of the property, dextral movement is the most recent event along these structures, whereas in the eastern part of the property sinistral movement with less magnitude prevails.

At Keno Hill, the largest accumulation of ore minerals occurred in structurally prepared competent rocks, such as the Central Quartzite, resulting in areas of increased fluid flow. Incompetent rocks like phyllites tend to produce fewer and smaller, if any, open spaces, limiting fluid flow and resulting mineral precipitation.

Mineralization in the Keno Hill Silver District is of the polymetallic silver-lead-zinc vein type. In general, common gangue minerals include manganiferous siderite and to a lesser extent quartz and quartz breccia as well as calcite. Silver occurs in argentiferous galena and argentiferous tetrahedrite (freibergite). In supergene assemblages, silver is further found as native silver, in polybasite, stephanite, and pyrargyrite. Lead occurs in galena and zinc in sphalerite, which is iron-rich. Other sulphides include pyrite, arsenopyrite (locally gold-bearing) and chalcopyrite.

The veins of the Keno Hill Silver District display characteristics associated with both mesothermal and epithermal deposits and it is not clear if a continuum exists or if separate and distinct mineralizing events are involved. The most prominent examples of epithermal style mineralization are found in the western part of the district, although the Lucky Queen mine on Keno Hill produced native silver and ruby silver in quantity. Proximity to a magmatic heat source has often been called upon to explain the district zonation, though this is by no means a complete explanation.

Mineral zonation is common within base metal-rich veins (zinc-rich margin and silver/lead-rich center). Changes in mineralogy within individual oreshoots is less clearly documented, although there has long been a conviction that silver and lead rich zones occur higher in the veins while zinc becomes dominant at depth. Anecdotal evidence suggests that vertically stacked oreshoots may repeatedly show zoning of lead rich upper portions to zinc dominant roots, but data confirming this has not been found. In general, Pb-Zn mineralization appears to be nearly contemporaneous in age.

Mechanisms triggering deposition of ore and gangue minerals have been suggested by district wide studies of fluid inclusions and light stable isotopes. Fluid boiling appears to have been ubiquitous and some evidence exists for fluid mixing. The hydrothermal fluids responsible for mineral deposition contained significant quantities of CO₂ which may have “boiled” during abrupt changes in pressure produced during fluid movement from confined fractures to more open conduits formed in quartzite.

Irrespective of stratigraphic formations or regional map units only a few major rock types are commonly encountered in the area of the old mine workings. These are:

- schists and phyllites with variable carbon content;
- chloritic phyllites or schists;
- quartzites and phyllitic quartzites;
- sericite-quartz phyllites; and,
- greenstones.

2.2.3 Physiography and Surficial Geology

The Keno Hill Silver District lies within the northeastern part of the Yukon Plateau, and the terrain is mountainous with elevations ranging from 1,848 m (Summit of Keno Hill) to 610 m (McQuesten River valley). The area has been profoundly influenced by the latest glaciation but shows more subtle evidence of an earlier event as well.

The lower slopes of Galena Hill show clear evidence of ice marginal deposits such as kame terraces related to the glacial lobes occupying the major valley. The retreat of the Cordilleran ice sheet has had a major impact on the south McQuesten valley. Till blankets much of the valley and glacio-fluvial deposits are widespread. Glacio-lacustrine deposits formed in ice marginal lakes occur in the deeper part of the valley. Large meltwater streams have left huge meander scars. Boyle (1965) provides the following additional description of the physiography and glacial deposits in the area.

Galena Hill trends northeast between Duncan Creek and the McQuesten River valley. It has an elevation of 4,740 feet, a moderately steep southwestern slope, and steeper north, northwestern, and southeastern slopes. The terrain above 4,300 feet is relatively flat and rolling, and marked by several level grassy meadows. The north, northwestern, and southeastern slopes of the hill are crossed by several streams that have cut steep gulches into the rock strata. The principal streams responsible for these gulches are Galena, Flat, Brefalt, and Sandy Creeks and Porcupine Gulch on the northwestern slope and Hinton and Fisher Creeks on the eastern and southeastern slopes.

Keno Hill and Sourdough Hill are adjacent hills separated by Lightning Creek. Keno Hill trends northeast and lies between the Keno Ladue-McQuesten River valley and Allen, Faith, Lightning, and Christal Creeks. The hill has relatively gentle southern and southeastern slopes and a precipitous northern slope, marked by two cirques, Faro Gulch and Silver Basin Gulch. The terrain above 4,500 feet is relatively flat and rolling with five prominent rocky knolls known as Keno, Minto, Monument (the highest point on Keno Hill, elevation 6,065 feet), Caribou, and Beauvette. On the slopes of the hill several streams follow steep gulches in the rock strata, the principal ones being Gambler, Faro, McKay, and

Silver Basin on the northern slope, Faith, Hope, and Charity on the northeastern and southern slopes, and Erickson on the western slope.

Sourdough Hill (Pl. VI) lies southwest of Keno Hill and trends north between Thunder, Lightning, and Duncan Creeks. The part of the hill described in this report is on the northern and northwestern slopes, which are gentle up to 4,200 feet and from there rise abruptly to a steep rocky hogsback that trends southwest for some 6,000 feet.

Extensive rock outcrops are uncommon on Galena, Keno, and Sourdough Hills, and with the exception of the gulches and cirques where relatively good geological sections are present, detailed mapping can only be done by observing float. Below an elevation of 4,400 feet rock outcrops are sparse, and the slopes are covered with till, soil, rock debris, much, and muskeg, in which conifers, birch, aspen, Arctic black-birch, and other vegetation grow abundantly. Above this elevation the soil is thin, outcrops are more numerous, the ground is covered with local rock float, the terrain is treeless, and the vegetation is limited to alpine species and grassy meadows.

The lower slopes of the hills were severely glaciated during Pleistocene time by ice-sheets that spread, from the east, over the entire area. Glacial till, gravel, and other debris lie in a series of benches on the slopes of the hills and floor the valleys. The deposits are generally 5 to 20 feet thick, but in some areas as on the southern slope of Keno Hill facing Lightning Creek and north of Christal Lake, they are 30 to 50 feet thick or more.

The Keno Hill-Galena Hill area is in the region of permanently frozen ground. Wernecke (1932) has given an interesting account of the permafrost conditions, and the present investigation has added further data. The permafrost is irregularly distributed and its occurrence is dependent upon the elevation, hillside exposure, depth of overburden, amount of vegetative cover, and presence of flowing underground and surface water. At high elevations and on slopes with a northern exposure it is generally present. Thus, on Keno Hill, the mine workings on the top of the hill and on the northern slope encountered permafrost some 400

feet below the surface. On the northern slopes of Sourdough Hill and Galena Hill a similar situation prevails, and frost and ice lenses have been encountered at depths of 250 feet or more in the mine workings. On the lower southern slope of Keno Hill, however, the workings of the Onek and Mount Keno mines show little evidence of permafrost. In places where surface and underground water are flowing the permafrost has been thawed out and frostfree windows and strips are present. These provide access and egress for waters that are oxidizing the lodes.

The effects of frost action, soil creep, and slope wash are marked on the hills, particularly at the higher elevations. Frost action is responsible for features such as stone rings and stripes, and produces a general 'boiling action' that brings rock float, mineralized float, and soil from deeper layers to the surface, thus facilitating the mapping of both the underlying bedrock and the tracing of vein faults. On steep slopes, however, frost action and land creep have transported float downhill places, 100 feet or more, making the accurate mapping of contacts and vein faults difficult.

Glacial Deposits

The glacial deposits of the area were laid down during the advance and retreat of at least two ice-sheets that spread over the area from the east. The evidence for the first glaciation is rather meagre and is restricted to the presence of erratics above an elevation of 4,000 feet on Keno and Galena Hills and to an old till in the upper part of Dublin Gulch. The most distinctive deposits are those of the last glaciation.

These deposits floor the principal valleys and form benches on the lower slopes of the hills. They vary in thickness from a few feet to 50 feet or more and are composed mainly of till, glacio-fluvial deposits, glacio-lacustrine gravel, sand and silt, and layers of peat.

The tills, rarely more than a few feet thick, are absent in places. They are grey or greenish buff and consist of a heterogeneous mixture of fine sand, clay, small

particles of schist, quartzite, and greenstone, and variously sized stones and boulders. Carbonate, mostly in the cementing materials, is present in some tills.

The clay and sand fractions are composed principally of irregular grains and broken fragments of quartz, feldspar, mica minerals, and hornblende. Heavy mineral accessories as determined by X-ray are magnetite, ilmenite, rutile, sphene, leucoxene, zircon, staurolite, garnet, monazite, epidote, tourmaline, pyrite, and red and black jasper pebbles. The till minerals are generally angular and abraded, and look fresh with little visible evidence of chemical decomposition. Most tills give a neutral or slightly alkaline reaction (pH 7-7.5).

Most of the rock pebbles and fragments and the heavy minerals in the tills are probably derived locally. Some minerals such as garnet and staurolite and the jasper pebbles may, however, have travelled considerable distances, because these minerals are not plentiful in the rocks underlying Keno and Galena Hills.

Lenses of gravel and sand are common in some tills, and thin peat layers are present locally. The gravel and sand lenses generally contain the same mineral assemblage as the tills. The peat layers are composed essentially of brownish and brownish black decomposed plant remains and much brownish material (humus). A small amount of mineral matter, consisting of quartz, feldspar, mica flakes, and a suite of heavy accessory minerals similar to that in the tills, is present throughout the peat.

The glacio-fluvial deposits are as much as 50 feet or more thick and include poorly sorted gravels and sand deposits which occur in kames, eskers, and glacial benches. Most of the pebbles and stones are relatively well rounded to subangular and consists of quartzite, schist, greenstone, diorite, and granite, all mainly derived locally. The fine sandy fractions contain the same mineral assemblage as the tills.

The glacio-lacustrine deposits range from a few feet to tens of feet in thickness. In places they are stratified, in others they consist of unsorted, washed gravels containing sand lenses. The gravels contain well-rounded pebbles, stones, and

subangular schist fragments of local derivation. The mineral constitution of the sand lenses and fine fractions of the gravels is similar to that of the other glacial deposits described above.

2.2.4 Soils

The following description of soil is excerpted from Boyle's (1965) work:

Soil development has been affected by four principal factors: the variability of parent materials, the marked relief of the country, the climatic and vegetative forces under which the soil developed, and the presence of permafrost.

In the Keno Hill-Galena Hill area both bedrocks and glacial materials have served as parents for soil. The marked relief has had the effect of producing deeper soils in the valleys and on the lower slopes of the hills. The difference in the exposure of the hillsides has been responsible for the occurrence of greatly different soils within short distances. South-facing slopes are generally less densely wooded and freer from permafrost than north-facing slopes. On the former the soils are somewhat better developed; the latter are covered in most places by deposits of muck, peat, and half-bog soils.

Except for a few localized areas, the soils are not strongly weathered or deeply leached. They also exhibit a poor profile development, particularly those underlain by permafrost.

The soils in the area can be conveniently classified into two general types: (1) residual, and (2) muck peat, and half-bog.

The residual soils were formed principally from the weathering of the various types of bedrocks, or as is evident in some places, particularly in the vicinity of Dublin Gulch, from the decomposition of a till that predates the last glaciation.

The thickness of the residual soils varies, depending on the slope of the hills. On the tops of the hills they are rarely more than 3 feet thick and in places are

entirely absent; lower down on the slopes the soils, thickened by slope wash and land creep, may exceed 10 feet. In most areas they are highly disturbed by solifluction and frost-boiling, and their profile development is either immature or non-existent. In places the following generalized profile is present from the surface downward:

HORIZON	DESCRIPTION
Surface A ₀₀	Trees, Shrubs, grass, moss, loose leaves, etc.
A ₀	Undecomposed, partly matter organic layer consisting of roots, moss, woody fragments, humus, etc. - 3 to 6 inches thick - unfrozen during summer.
A ₁	Organic layer consisting of decomposed roots, moss, woody fragments, humus, clay, sand, etc. - 3 to 6 inches thick - generally unfrozen during summer. This layer is thin or absent in places.
B + C	Residual soil - 1 foot to 10 feet thick. Frozen except locally. The soil overlying quartzite and greenstone is light reddish and yellow brown and contains much fine sand, clay, and small amounts of humus. Because of frost action angular blocks of quartzite and greenstone are generally admixed with the soil in all areas. The principal mineral constituents are quartz, feldspar, micas, clay minerals, hornblende, and limonite. The common heavy minerals are zircon, rutile, sphene, ilmenite, magnetite, epidote, monazite, tourmaline, and garnet. The soils overlying greenstones carry much sphene and leucoxene and small amounts of chromite. In the vicinity of the siderite-galena-sphalerite and pyrite-arsenopyrite lodes cerussite, beudantite, scorodite, native gold, oxidized galena cubes, goethite and limonite particles, and oxidized pyrite nodules appear in the heavy fractions. Over parts of the Dublin Gulch granodiorite mass and in the vicinity of some skarn zones the soils are weathered residuum carry scheelite. The soil overlying schists is grey or black, depending upon the type of schist. Over graphitic schists the soil is black and contains much graphitic material. Small fragments and plates of schist are universally present. The principal mineral constituents are quartz, feldspar, micas, clay minerals, graphite, and limonite. The common heavy minerals are similar to those overlying quartzite. Near the cassiterite veins north of Dublin Gulch the soils overlying schists and quartzites carry small amounts of cassiterite and tourmaline.
Bedrock D	Quartzite, phyllite, greenstone, and schist.

Most residual soils are moderately well drained on the lower slopes of the hills, but poorly drained on the tops of the hills, where the upper layers of the soil are water-saturated all summer. The pH of most residual soils varies from 5.2 to 6.5.

The muck, peat, and half-bog soils are largely developed on the north slopes of the hills and on low-lying poorly drained ground. In most occurrences the profiles show the following sequence from the surface downwards:

HORIZON	DESCRIPTION
Surface A ₀₀	Trees, grasses, low shrubs, mosses, loose leaves, etc.
A ₀	Slightly compressed undecomposed organic matter consisting of woody fragments, roots, mosses, leaves, and minor amounts of mineral matter; 3 to 6 inches thick; unfrozen during summer.
A ₁	Muck composed of dark brown to black decomposed organic matter and humus with a slight admixture of clay, sand, etc.; 6 to 10 inches thick; generally permanently frozen below top few inches.
B + C (Residual Soils)	Residual soil or till, gravel, and sand; generally frozen; thickness varies.
D (Glacial Materials)	Thickness varies
Bedrock D	Quartzite, phyllite, greenstone, and schist.

The muck, peat, and half bog soils are very poorly drained and are watersaturated all summer. Their pH varies from 6.0 to 7.0.

2.2.4.1 Soils Characterization – Water Treatment Sites

A preliminary soil characterization study was carried out in 2007 for six locations currently undergoing water treatment or have the potential to require water treatment (Silver King, Valley Tailings Area, No Cash, Galkeno 300 and 900, Onek, and Bellekeno). Results and maps produced from this study are provided in the *Preliminary Soils Characterization Study Report* located in Appendix B.

Five boreholes were also drilled in 2006 in an effort to characterize soils and gravels and to assess permeability for possible in-situ treatment (Valley Tailings Area (3), Galkeno

900) as well as to determine a potential gravel borrow source (Hanson Lake Road). Results of this drilling exercise are provided in the *Soils Characterization and Drilling Report* located in Appendix C.

Six additional boreholes were completed along the crests of the Valley Tailings Dams #1, #2, and #3 while six more boreholes were completed within the tailings impoundments behind Dam #1 and Dam #3. Observations taken from the drill program show that the Valley Tailings Dams were constructed on top of peat and local deposits of tailings. No permafrost was found during this study however a previous study completed by EBA in 1982 did encounter permafrost indicating that permafrost degradation has occurred in disturbed areas. Soils stratigraphy for the crest boreholes were logged with results included in SRK Consulting's *2007 Geotechnical Closure Studies Report* located in Appendix D.

Soil samples have also been collected and analyzed as part of revegetation trials occurring on Galena Hill for the waste rock dumps. See Section 3.3.4 Revegetation Trails – Galena Hill Waste Rock Dumps.

Soil samples were also collected from nine test pits in the Valley Tailings Area in 2007.

2.3 SURFACE WATERS

The Keno Hill Silver District encompasses three separate drainages, two of which report to the South McQuesten River. They are Christal and Flat Creeks (both draining into the S. McQuesten) and Lightning Creek which drains into the Stewart River via Duncan Creek.

2.3.1 Surface Water Surveillance Network

Surface water quality in the Keno Hill Silver District is monitored to assess and track changes in the condition of waters within the various watersheds on the property. Through monitoring waters can be characterized and changes or trends identified in water quality over time. Specific existing or emerging water quality problems can be identified and determine whether goals, including compliance with regulations and

treatment objectives are being met. The data are useful for building site-wide and localized loading models and in identifying closure issues and in closure planning.

The water quality surveillance program is designed to effectively meet water quality monitoring objectives at the site. The program is comprehensive and covers all three watersheds on the site, and the Valley Tailings Area. The program is continuously being reassessed for its effectiveness at canvassing the site and for its ability to help plan site activities.

A number of watercourses and adits on the property are monitored for water quality and quantity. Sample sites are categorized as:

- treatment sites – locations where water treatment systems have been implemented;
- surveillance sites & receiving waters – watercourses downstream of the property including background stations; and
- adit discharges – old mine workings with discharge.

All surface water sample station locations and monitoring frequency are listed in Table 2-2. Figure 2-4 shows these station locations.

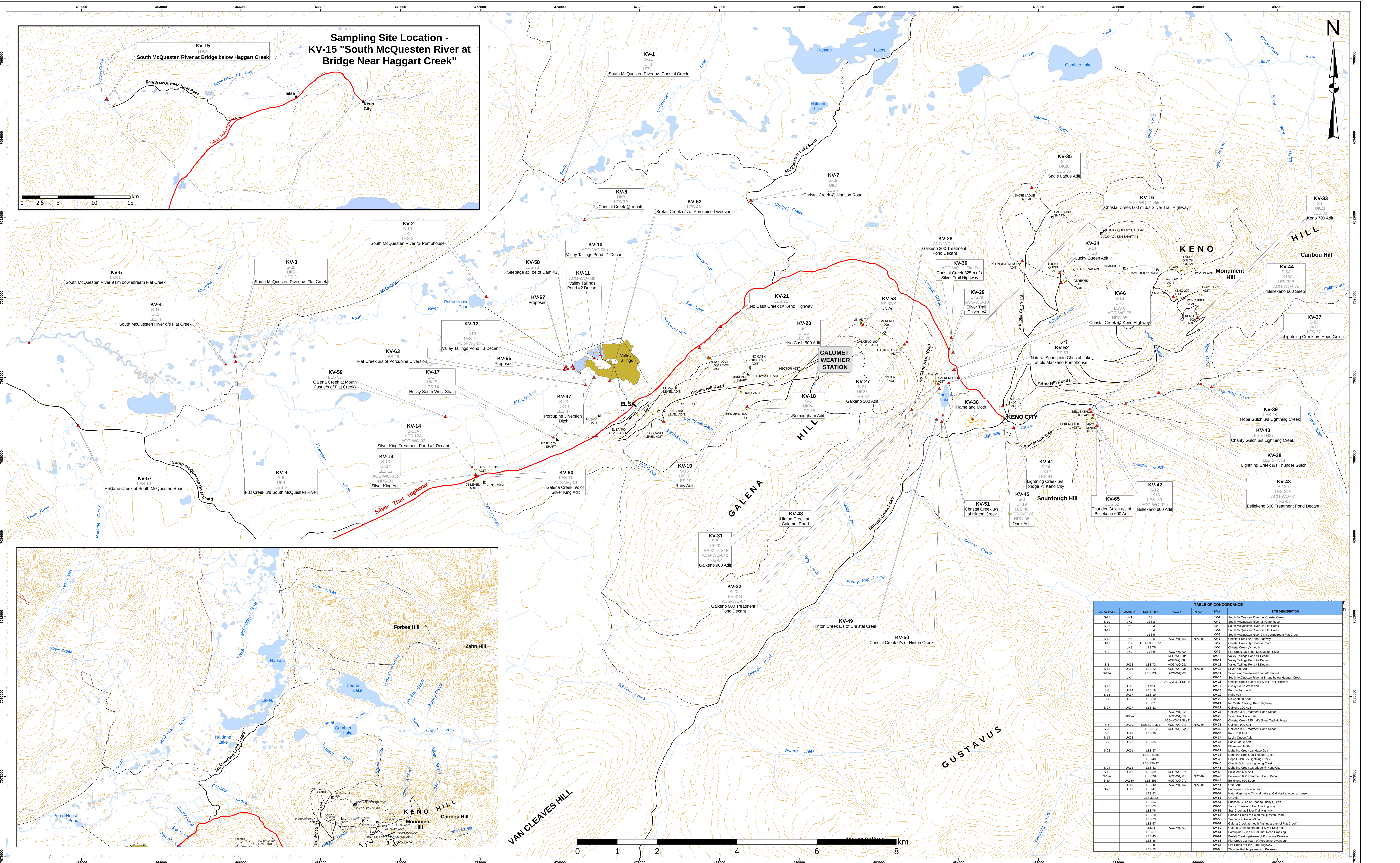
Table 2-2 Surface Water Sample Station Locations Description and Coordinates

SITE	SITE DESCRIPTION	EXTERNAL MONITORING FREQUENCY	EASTING	NORTHING	WATER LICENCE
Treatment Sites					
KV12	Valley Tailings Pond #3 Decant	M	474310	7088278	QZ06-074
KV13	Silver King Adit	M	471887	7085572	QZ06-074
KV14	Silver King Treatment Pond #2 Decant	M	471797	7085755	QZ06-074
KV27	Galkeno 300 Adit	M	482636	7088837	QZ06-074
KV28	Galkeno 300 Treatment Pond Decant	M	482622	7088793	QZ06-074
KV31	Galkeno 900 Adit	M	483483	7087848	QZ06-074
KV32	Galkeno 900 Treatment Pond Decant	M	483512	7087719	QZ06-074
KV42	Bellekeno 625 Adit	M	487363	7087062	QZ06-074, QZ07-078
KV43	Bellekeno 625 Treatment Pond Decant	M	487318	7087147	QZ06-074, QZ07-078
KV74	Bellekeno East Decline	M	487505	7086415	QZ07-078
KV75	Bellekeno East Pond decant	M	487594	7086161	QZ07-078
Surveillance Sites & Receiving Waters					
KV1	South McQuesten River u/s Christal Creek	M	474008	7092790	QZ06-074
KV2	South McQuesten River at Pumphouse	Q	472076	7090036	QZ06-074
KV3	South McQuesten River u/s Flat Creek	Q	465846	7088534	QZ06-074
KV4	South McQuesten River 350 m d/s Flat Creek	Q	465618	7088335	QZ06-074
KV5	South McQuesten River 9 km downstream Flat Creek	Q	460691	7088873	QZ06-074
KV6	Christal Creek at Keno Highway	M	483909	7088242	QZ06-074
KV7	Christal Creek at Hanson Road	M	478657	7092413	QZ06-074
KV8	Christal Creek at mouth	M	474585	7091944	QZ06-074
KV9	Flat Creek u/s South McQuesten River	Q	465836	7088410	QZ06-074
KV10	Valley Tailings Pond #1 Decant	Q	475015	7088571	
KV11	Valley Tailings Pond #2 Decant	Q	474856	7088486	
KV15	South McQuesten River at Bridge below Haggart Creek	Q	449744	7085770	QZ06-074
KV16	Christal Creek 600 m d/s Silver Trail Highway	Q	483887	7088863	
KV21	No Cash Creek at Keno Highway	Q	477500	7088750	QZ06-074
KV29	Silver Trail Culvert #4	M	483740	7088792	QZ06-074
KV30	Christal Creek 825m d/s Silver Trail Highway	Q	483856	7089091	
KV37	Lightning Creek u/s Hope Gulch	Q	490315	7087776	QZ06-074, QZ07-078
KV38	Lightning Creek u/s Thunder Gulch	Q	488193	7087341	QZ06-074, QZ07-078

SITE	SITE DESCRIPTION	EXTERNAL MONITORING FREQUENCY	EASTING	NORTHING	WATER LICENCE
KV39	Hope Gulch u/s Lightning Creek	Q	490252	7087783	QZ06-074
KV40	Charity Gulch u/s Lightning Creek	Q	488982	7087503	
KV41	Lightning Creek u/s bridge at Keno City	Q	485429	7086764	QZ06-074, QZ07-078
KV44	Bellekeno 625 Seep	A	487361	7087195	QZ07-078
KV47	Porcupine Diversion Ditch	Q	474516	7088026	QZ06-074
KV48	Hinton Creek u/s Calumet Drive	Q	482819	7087198	QZ06-074
KV49	Hinton Creek u/s Christal Creek	Q	483582	7087009	QZ06-074
KV50	Christal Creek u/s Hinton Creek	Q	483575	7086897	QZ06-074
KV51	Christal Creek d/s Hinton Creek	Q	483600	7087010	QZ06-074
KV52	Natural spring to Christal Lake at Old Mackeno pump house	Q	483756	7087869	QZ06-074
KV54	Erickson Gulch at Road to Lucky Queen	Q	485834	7088993	QZ06-074
KV55	Sandy Creek at Silver Trail Highway	Q	478532	7089677	QZ06-074
KV56	Star Creek at Silver Trail Highway	Q	478051	7089277	QZ06-074
KV57	Haldane Creek at South McQuesten Road	Q	461852	7086760	QZ06-074
KV58	Seepage at toe of #3 dam	Q	Unfixed	Unfixed	QZ06-074
KV59	Galena Creek at mouth (just u/s of Flat Creek)	Q	471126	7087018	QZ06-074
KV60	Galena Creek u/s of Silver King adit	Q	476604	7086892	QZ06-074
KV61	Porcupine Gulch at Calumet Road Crossing	Q	476607	7086895	QZ06-074
KV62	Brefalt Creek upstream of Porcupine Diversion	Q	476217	7086807	QZ06-074
KV63	Flat Creek upstream of Porcupine Diversion	Q	474644	7087814	QZ06-074
KV64	Flat Creek at Silver Trail Highway	Q	474906	7086535	QZ06-074
KV65	Thunder Gulch upstream of Bellekeno	Q	487464	7086873	QZ06-074, QZ07-078
KV69	Valley Tailings Decant and Seepage u/s Flat Creek	Q	474099	7088181	
KV70	Flat Creek 20m u/s KV69	Q	474140	7088260	
KV71	Flat Creek 20m d/s KV69	Q	474046	7088203	
KV72	South McQuesten River at McQuesten Lake	Q	482492	7104476	
KV73	Cache Creek at access road d/s McQuesten Lake	Q	482846	7103594	
KV76	Thunder Gulch d/s of Bellekeno 625 Adit	Q	487414	7087118	QZ07-078
KV77	Thunder Gulch u/s of Bellekeno East	Q	487742	7086013	QZ07-078
KV78	Onek Waste Rock Storage Facility	A	485726	7087518	QZ07-078
KV79	Christal Creek d/s of Mackeno Tailings	Q	483796	7087919	
KV80	Christal Creek u/s of Mackeno Tailings	Q	483790	7087869	

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SITE	SITE DESCRIPTION	EXTERNAL MONITORING FREQUENCY	EASTING	NORTHING	WATER LICENCE
Adit Discharges					
KV17	Husky South West Adit	Q	485332	7092431	QZ06-074
KV18	Birmingham Adit	Q	478689	7087226	QZ06-074
KV19	Ruby Adit	Q	478504	7087748	QZ06-074
KV20	No Cash 500 Adit	Q	477728	7088508	QZ06-074
KV33	Keno 700 Adit	Q	490000	7089499	QZ06-074
KV34	Lucky Queen Adit	Q	486456	7090518	QZ06-074
KV35	Sadie Ladue Adit	Q	485832	7092768	QZ06-074
KV36	Flame and Moth	Q	483836	7086820	QZ06-074
KV45	Onek Adit	Q	485101	7087288	QZ06-074, QZ07-078
KV53	UN Adit	Q	481595	7089322	QZ06-074
KV66	Klondike Keno Adit	Q	485599	7090833	QZ06-074
KV67	Keno 200 Adit	Q	489496	7089983	QZ06-074
KV68	Brewis Red Lake Adit	Q	486789	7090194	QZ06-074



Notes:
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Projection: UTM Zone 8 NAD83
Scale 1:30,000 when plotted at A0 page size.

Water Quality

Station Name
Historic Station Number
Site Description

Water Quality Station

Mine Workings

Adit
Shaft (to surface - connection to underground not determined)
Valley Tailings
Pit

Topography

Town
Silver Trail
Secondary Road
Limited-use road
Trail
Watercourse
Waterbody

TABLE OF CONCORDANCE					SITE DESCRIPTION
ON UTM #	UTM #	LES SITE #	ACG #	NPG #	
S-21	UK1	LES 1			KV-1 South McQuesten River u/s Christal Creek
S-10	UK2	LES 2			KV-2 South McQuesten River at Pump House
S-28	UK5	LES 3			KV-3 South McQuesten River u/s Flat Creek
S-11	UK3	LES 4			KV-4 South McQuesten River d/s Flat Creek
S-18	UK6	LES 5			KV-5 South McQuesten River 9 km downstream Flat Creek
S-19	UK7	LES 7 & LES 51	ACG-WQ-05	NPG-05	KV-6 Christal Creek @ Keno Highway
S-9	UK9	LES 9	ACG-WQ-09	NPG-09	KV-9 Flat Creek u/s South McQuesten River
S-1	UK13	LES 12	ACG-WQ-08	NPG-08	KV-8 Valley Tailings Pond #2 Decant
S-13	UK14	LES 12	ACG-WQ-08	NPG-08	KV-12 Valley Tailings Pond #3 Decant
S-13A	UK4	LES 12A	ACG-WQ-03	NPG-03	KV-13 Silver King Adit
S-17	UK15	LES 14	ACG-WQ-11 Site A		KV-14 Silver King Treatment Pond #2 Decant
S-3	UK24	LES 18			KV-18 Christal Creek 600 m d/s Silver Trail Highway
S-46	UK17	LES 19			KV-19 Husky South West Shaft
S-4	UK25	LES 20			KV-20 No Cash 500 Adit
S-27	UK27	LES 32			KV-27 Galkeno 300 Adit
S-5	UK30	LES 31 or S1E	ACG-WQ-11 Site D	NPG-04	KV-30 Christal Creek 825m d/s Silver Trail Highway
S-14	UK28	LES 38	ACG-WQ-04		KV-31 Galkeno 900 Adit
S-7	UK26	LES 35	ACG-WQ-04		KV-32 Galkeno 900 Treatment Pond Decant
S-22	UK11	LES 37			KV-37 Lightning Creek u/s Thunder Gulch
S-24	UK12	LES 41			KV-41 Lightning Creek u/s bridge @ Keno City
S-12	UK18	LES 39	ACG-WQ-07	NPG-07	KV-42 Bellekeno 600 Adit
S-1A	UK18A	LES 39B	ACG-WQ-07C	NPG-07C	KV-43 Bellekeno 600 Treatment Pond Decant
S-1	UK13	LES 47	ACG-WQ-06	NPG-06	KV-6 Christal Creek @ Keno Highway
S-23	UK10	LES 47			KV-47 Porcupine Diversion Ditch
S-12	LES 39B2	LES 34			KV-34 Lucky Queen Shaft #2
S-15	LES 33	LES 33			KV-33 Keno 700 Adit
S-16	LES 35	LES 35			KV-35 Sadie Ladue Adit
S-17	LES 36	LES 36			KV-36 Flame and Moth
S-18	LES 37	LES 37			KV-37 Lightning Creek u/s Hope Gulch
S-19	LES 38	LES 38			KV-38 Charity Gulch u/s Lightning Creek
S-20	LES 39	LES 39			KV-39 Hope Gulch u/s Lightning Creek
S-21	LES 40	LES 40			KV-40 Thunder Gulch u/s Thunder Gulch
S-22	LES 41	LES 41			KV-41 Lightning Creek u/s bridge @ Keno City
S-23	LES 42	LES 42			KV-42 Bellekeno 600 Adit
S-24	LES 43	LES 43			KV-43 Bellekeno 600 Treatment Pond Decant
S-25	LES 44	LES 44			KV-44 Flat Creek upstream of Porcupine Diversion
S-26	LES 45	LES 45			KV-45 Flat Creek at Silver Trail Highway
S-27	LES 46	LES 46			KV-46 Thunder Gulch upstream of Bellekeno

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SURFACE WATER QUALITY STATIONS

Drawn By: HD	June 2009	FIGURE 2 - 4
Checked by: NS	D:\Project\AllProjects\ALEX-05-01\GIS\mxd\UKHM\Environmental_Conditions_Report\Figure2_4_Surface_WQ_Stations.mxd	



2.3.1.1 Adit Discharge Survey

In the summer of 2007, adit discharge surveys were carried out to better understand adit flow paths (*Adit Discharge Survey, 2007* see Appendix E), receiving waters and down gradient water quality. Adits included in the survey were: Silver King 100, Husky South West, Birmingham, Ruby, No Cash 500, Galkeno 300, Galkeno 900, Keno 700, Onek, and Sadie Ladue.

2.3.2 Water Quality Database and Analyses

A water quality database developed by Access Consulting Group contains analytical data for many stations dating back to the mid-1980's. However, sporadic data and poor detection limits prior to 1994 limit the value of older data and restrict the assessment period from 1994 to present. This plethora of information is sufficient for assessing water quality trends for specific parameters of interest. Data collected as a part of the monitoring program is presented in Appendix F in digital format.

Representation of the adits as point sources to specific watersheds is achieved through a mass loading model. This tool uses current water quality data to determine present site conditions and can be used predicatively in hypothetical loading scenarios. Access Consulting Group has developed this loading model to calculate as output the background capacity of each watershed or part thereof to either absorb or contribute metals loading downstream.

A water quality assessment was carried out by consultants Minnow Environmental Inc. in 2008. A baseline for water quality was developed based on receiving environment station data that had been collected over the years from stations within the property watersheds. Water quality data were compiled, evaluated and interpreted to identify parameters and locations of concern within the downstream waters relative to established guidelines and background concentrations. Additionally, a number of contaminants of concern (COCs) and potential contaminants of concern (PCOCs) were identified from among 48 parameters with adequate data for assessment. Based on this assessment, COCs were identified as cadmium and zinc. Other parameters identified as PCOCs include: aluminum, arsenic, chromium, copper manganese, nitrite, phosphorous, selenium and silver. Baseline information established from historical and

current water quality data shows that a number of contaminants are naturally elevated above CCME guidelines in the Keno Hill Silver District. Details of these and other findings are described in the report issued by Minnow (*Water Quality Assessment Report for United Keno Hill Mines*, July 2008 - see Appendix G).

2.3.3 Treatment Sites

Metals laden water discharges continually from various mine openings throughout the Keno Hill Silver District, and seasonally from the Valley Tailings Facility. The quality of this effluent does not comply with licensed effluent discharges for the site, and in order to reduce metals levels water treatment is required on an ongoing basis.

There are four mine wastewater treatment facilities located at Bellekeno 625, Galkeno 900, Galkeno 300, and Silver King 100 adit areas, while water from the Valley Tailings Area (VTA) is treated on an as-needed basis (depending on water quality and decant situation – normally requiring treatment only during spring freshet, between May and June). All water requiring treatment is circum-neutral pH with zinc and other metal concentrations exceeding regulated criteria. Treatment consists of conventional wastewater treatment technology using continual lime addition to treat mine portal effluent. Lime is mixed with fresh water (Flat Creek or Valley Tailings) at a central mixing facility in the town site of Elsa and delivered to the mine portals via a lime slurry tanker truck. Lime slurry is stored in, and continuously mixed in, lime holding tanks and then added to the mine effluent via a peristaltic metering reagent pump to a rapid mix tank. Galkeno 300 has clarifiers and a sludge pond. Flocculent is added at Galkeno 300 and Bellekeno 625. Treated effluent is directed to settling pond(s) for settling metal precipitates before discharge (decant) to the environment.

The VTA comprises a series of three earthen dams and associated ponds with tailings impounded behind dams No. 1 and 2. Wastewater treatment involves the addition of lime slurry at tailings dam decants No. 1 and 2. Tailings ponds No. 2 and 3 provide effluent treatment and settling capacity prior to discharge to the Flat Creek drainage via the dam No. 3 decant.

Discharge samples at each treatment location are taken and analyzed on a daily basis using the on-site AA machine. Review and evaluation of these results is conducted by the project manager and discussed with the treatment system operators. These results go the project manager to provide direction regarding the treatment process, (i.e. lime addition rates and pond clean-out activities). The treatment objective is to reduce zinc effluent concentrations to less than 0.05mg/L, as required under the Water Licenses. Historic correlations between zinc concentrations and other metals (i.e. arsenic, lead and cadmium) indicate that the zinc discharge treatment objective ensures that other metals are also managed. Internal records are maintained and used for analysis purposes in order to achieve the highest possible standard of treatment.

2.3.3.1 Galkeno 900 Bioreactor Cell Treatment

The Galkeno 900 bioreactor is a pilot test of sulfate-reducing bacteria (SRB) technology for treating mine drainage. The bioreactor consists of a pond filled with streambed gravels and a baffle to direct flow through the gravels. Mine waters are amended with a soluble organic carbon source mixture, primarily alcohols. The first few months of operation involve a growth phase for naturally-occurring SRB to colonize the surface of the gravels, in time forming a microbial coating over the gravels comprised primarily of SRB. The SRB metabolize the carbon source, leading to the reduction of sulfates and the formation of aqueous sulfide within the bioreactor. The sulfide reacts with soluble metals in the mine drainage, precipitating the metals within the bioreactor, where the metal precipitates are filtered by the gravels.

The pilot test is a demonstration that this SRB technology, which has been successfully employed at many sites in mine pools, wetlands, and bioreactors in warmer climates, can be successfully implemented year-round in a buried pond bioreactor in the cold climate in the Keno Hill Silver District, where temperatures of -40°C or colder are common in the winter months. To date, there are initial signs of microbial growth within the bioreactor, and the pond has maintained flow through the winter, even with minimal fresh inputs of mine water (which is 3°C year round). This demonstrates that burial of the reactor insulates it enough to maintain flow through the winter. In the spring and summer months, the growth phase is expected to be completed and the treatment phase

to be maintained. Achieving metals removal of over 90% for cadmium and zinc is primary success criteria expected to be achieved and maintained. Finally, next winter will complete the important phase of the demonstration showing that metals removal will continue even through the cold temperatures associated with wintertime.

2.4 HYDROLOGY

When the 1996 Site Characterization Report was written, the database of streamflows at the mine site was sparse, being largely limited to a few spot discharge measurements at some of the water quality monitoring stations. Owing to this dearth of site specific data, the flow characteristics of the mine site streams were inferred from streamflow data collected at the network of government gauging stations operated in the region. The regional streamflow data were supplemented with climatic water balances, which were derived from data collected at climate stations at or near the property. In 2003, a program was initiated to improve monitoring of streamflows at the mine site.

In 2008 Clearwater Consultants Ltd. were retained to update and refine the understanding of site hydrologic conditions that was developed in 1996. Clearwater's Memorandum CCL-UKHM-1 (Appendix A) processed streamflow data collected at and around the Keno Hill Silver District for the purpose of updating the site hydrologic parameters and refine the site-wide water balance and mass loading model for the site. As part of their report, Clearwater included a critique of the 1996 hydrology study and found that the methods used in the 1996 study were reasonable and can continue to be used to estimate Mean Annual Runoff at ungauged locations around the mine site. Clearwater concludes that the 1996 study provides good estimates of long-term average flows at an ungauged site, but that accuracy decreases when the method is used to determine average flows for a particular calendar month or season, but can be improved if influences of adit flows on local hydrology are accounted for.

Analysis of streamflow gauging station data for Christal Creek, Flat Creek and Lightning Creek (KV7, KV9 and KV41 respectively) was conducted to produce a mean annual runoff (MAR) for each of the stations. Table 2-3 presents specific catchment areas, MAR, and runoff depth for the three gauging stations while Table 2-4 provides details of the minesite catchments.

**Table 2-3 Results of the Hydrological Update for Flat, Christal and Lightning
Creeks**

Site	Catchment Area	MAR	Average Runoff Depth
	km²	m³/s	mm
KV-7	43.5	0.304	221
KV-9	56.5	0.304 - 0.352	170 - 197
KV-41	59.1	0.645	344

Table 2-4 Details of Minesite Catchments

Catchment Description	Catchment Area (km2)	Catchment Median Elevation (m)	Mean Annual Runoff (MAR)	
			Depth (mm)	Volume (m3/yr)
Christal Creek above Station KV6	7.7	990	240	1,848,000
Christal Creek between Stations KV6 and KV7	35.8	970	230	8,234,000
Sandy Creek above LES-63	2.3	1180	290	667,000
No Cash Creek above LES-21	1.5	1200	300	450,000
South McQuesten River above S10 and below LES-1, S 19, LES-21, and LES-63	32.9	650	150	4,935,000
South McQuesten River above LES-1	476	940	230	109,480,000
Catchment of Dam No. 3 of Elsa Tailings Impoundment	4.3	760	180	774,000
Porcupine Creek Diversion Channel above LES-47	10.1	1110	270	2,727,000
Galena Creek above the mouth	10.9	970	240	2,616,000
Flat Creek above S9 and below LES-57, LES-47, and S1	31.2	700	170	5,304,000
South McQuesten River above S11 and below S10 and S9	29.9	670	160	4,784,000
South McQuesten River above LES-5 and below S11 and LES-10	95	850	200	19,000,000
Haldane Creek above South McQuesten Road	88.8	830	200	17,760,000

2.5 GROUNDWATER SURVEILLANCE – VTA

Groundwater surveillance monitoring is currently limited to the Valley Tailings Area where a number of wells are monitored quarterly. Well locations and details can be found in the *2007 Geotechnical Closure Studies* prepared by SRK and located in Appendix D.

In 2006, studies were carried out in the Valley Tailings Area to develop a preliminary groundwater mass loading and contaminant mass balance. A number of drive-point piezometers were installed, four of which continue to be monitored on a regular basis. Results of these studies are reported within the *“Preliminary Valley Tailings Groundwater Mass Loading and Contaminant Mass Balance Report”* prepared by Elsa Reclamation and Development Company in March 2007.

In 2007, SRK Consulting (Canada) Inc. was contracted to develop an understanding of the physical hydrogeology of the Valley Tailings Facility to enable an estimation of groundwater flux through the facility. This flux will be used to estimate current contaminant loadings from the Valley Tailings Area into the receiving environment. The study used grain size data for samples collected during hydrogeological investigations at the Valley Tailings Facility to estimate hydraulic characteristics of the unconsolidated materials beneath the tailings and dams. Results of this investigation are reported within the *“Assessment of Groundwater Regime at the Valley Tailings Facility”* prepared by SRK in February 2008.

2.6 MINE HYDROGEOLOGICAL MODELLING

An underground hydrologic evaluation is being undertaken for eight adits where adit plugs are being investigated for closure. Preliminary analysis has been conducted to evaluate the potential effects were an adit plug to be installed at each location. The eight adits where adit plugs were recommended were Silver King 100, No Cash 500, Galkeno 300, Galkeno 900, Bellekeno 625, Onek 400, Keno 700, and Sadie Ladue 600. Special attention has been placed on the Hector-Calumet mine workings as it is the dominant system generating zinc loading in the district. Work performed includes evaluation output from 3-D geological evaluations.

3.0 BIOLOGICAL ENVIRONMENT

The following chapter of this Environmental Conditions Report summarizes the biological environment for the Keno Hill Silver District including aquatic resources (fisheries, benthic invertebrates, stream sediments), wildlife and vegetation.

3.1 AQUATIC RESOURCES

Monitoring of aquatic resources including fisheries, benthic invertebrates and stream sediments has occurred a number of times over the years. A summary of the findings from these monitoring activities is provided in the ensuing sections.

3.1.1 Fisheries

Between August of 1994 and August of 1995 White Mountain Environmental Consulting conducted fisheries investigations in the waters influenced by mining near the Keno Hill Silver District including Christal Lake, Christal Creek, Flat Creek, the South McQuesten River and Lightning Creek. The goal of these preliminary investigations was to assess fish habitat, fish utilization and metal content of fish tissue with results reported in the *Site Characterization Report* prepared in 1996. In 2006, White Mountain Environmental Consulting conducted another fisheries investigation and for comparative purposes, had the same goals and within the same study area. As with the 1995 investigation, spring, summer and fall evaluations were conducted in 2006. Results from the 2006 investigations are reported in White Mountain's *Fisheries Assessments Conducted in the Keno Hill Mining Area, Including Metals Analysis of Fish Tissue Samples* prepared in January 2007.

In September 2008 another limited fisheries investigation was conducted by Access Consulting Group at seven sites including Christal Lake, Christal Creek, Flat Creek and Lightning Creek with the same purpose: to document fish utilization, habitat quality and metal content in fish tissues. Some additional habitat work was conducted on Christal Creek, characterizing potential fish barriers on the system. Recommendations regarding their removal were considered. Results from the 2008 investigation are provided within the Keno Hill Silver District Fisheries Assessment Project located in Appendix H of this report and also includes results from the previous 1995 and 2006 investigations. A

summary of results from the 1995, 2006 and 2008 fisheries investigations is provided in the following sections.

3.1.1.1 Christal Lake

Christal Lake is a small, shallow sub-alpine lake with a silt bottom covered with vegetation. Beaver activity at the lake outlet controls water levels in the lake. An old tailings pile is located on the north east corner of the lake with some tailings submerged in the lake. During each of the three investigations, slimy sculpins were the only fish species observed in Christal Lake.

3.1.1.2 Christal Creek

In 2008 three locations along Christal Creek were investigated including at the Keno Road Crossing (KV6), the Hanson Lake Road Crossing (KV7) and at a walk-in site accessed via a gravel pit off the Hanson Lake Road (C4). These sites were also investigated in 1995 and 2006 as well as an additional site at the mouth of Christal Creek where it joins with the South McQuesten River. This site was not revisited in 2008.

Slimy sculpin were the only fish species recorded in Christal Creek at the Keno Road Crossing (KV6) in 1995 and 2006 and were observed in relatively similar abundance. In 2008 no fish were captured at this location. It is worth noting that due to an extended period of precipitation all streams in September 2008 were experiencing high, fast flow with increased turbidity during the investigation, which had some impact on the effectiveness of sampling at the time.

Investigations at site KV7 in Christal Creek at the Hanson Lake Road crossing resulted in no fish observed in 2006 and 2008. A single Arctic grayling juvenile was recorded at this site in 1995.

Site C4, accessed off the Hanson Lake Road is located approximately 4.7 km downstream of Christal Lake. A number of fish barriers have been observed upstream of this site, three of which remain and appear to block upstream fish movement. No fish

were captured at this location in 2008 while Arctic grayling were observed below the barriers in 2006, although were less common and more widely dispersed than in 1995.

Christal Creek at the mouth (site KV8) was investigated in 1995 and 2006. In 1995 and 2006, slimy sculpin, Arctic grayling, and burbot were recorded in this area, although no fish were recorded during spring investigations likely due to high water levels.

3.1.1.3 Flat Creek

Fish utilization in Flat Creek (KV9) has been reported as being low subsequent to assessments performed in 1974 and 1995. In 1995, Arctic grayling, burbot, and slimy sculpin were recorded during summer and fall investigations with no fish observed during spring investigations.

During 2006 no fish were captured in the spring with a few slimy sculpin caught during August. During the summer months the lower reach of the creek had been colonized by slimy sculpin, burbot, Arctic grayling and northern pike. Juvenile Arctic grayling were more common in 1995 than in 2006. By September very few sculpin remained and no other species were present. Adult sculpin were recorded near the Shangai Road during all 2006 sample periods indicating the presence of some over-winter habitat further from the South McQuesten River confluence. During 2008 a single northern pike was captured.

3.1.1.4 Lightning Creek

Lightning Creek continues to undergo significant channel changes as a result of placer mining. For this reason the sample location used in 1995 could not be revisited in 2006 and two new locations were selected to allow more representative sampling of Lightning Creek. These sites were revisited in 2008.

In 1995 the reach of Lightning Creek surveyed extended from just downstream of Keno City to approximately 200 m above the influence of Thunder Gulch, which was being placer mined. Adult Arctic grayling were found upstream of turbid water from Thunder

Gulch and sub-adult Arctic grayling were observed in the turbid waters downstream of Thunder Gulch.

In 2006, two new stations were situated adjacent to the Keno City campground (LgT K) and just upstream of the confluence with Duncan Creek (LgT D). Both sites had been placer mined in the past and have man made channels. The fast flowing waters of LgT K contained Arctic grayling while the slower waters of LgT D had greater species diversity with slimy sculpin, round whitefish, and Arctic grayling common in August and September.

In 2008 no fish were observed in Lightning Creek adjacent to the Keno City campground while slimy sculpin and Arctic grayling were observed upstream of the confluence with Duncan Creek.

3.1.1.5 South McQuesten River

Fisheries investigations were conducted on the South McQuesten River in 1995 and 2006. In 2006, five sites along the river were sampled between McQuesten Lake and downstream of Haggart Creek and covered strategic locations such as downstream of the confluences with Flat and Christal Creeks.

Arctic grayling captured near the Haggart Creek confluence in June were assessed for maturity and spawn timing, which was determined to be around May 27. On July 31, Chinook salmon were also observed near the confluence with Haggart Creek. Fish utilization of the South McQuesten River was found to generally be higher downstream of the confluence of Haggart Creek both in terms of number of fish and species diversity. Other fish species observed in 2006 include slimy sculpin, round whitefish, northern pike, Arctic lamprey and burbot.

3.1.2 Stream Sediments

Stream sediments have been collected a number of times over the past 20 years, most recently in 2007 by LES with results provided within the *“Keno Valley Stream Sediment and Benthic Invertebrate Monitoring Programs, 2007”* report (Appendix I). In the assessment of metals levels in stream sediments sampled in 2007, six of the metals

analyzed were examined in detail as they may be found in ore bodies, can be toxic to aquatic organisms and have associated CCME guidelines for comparison. These six metals include arsenic, cadmium, copper, lead, mercury and zinc and of these, arsenic, cadmium, lead and zinc regularly exceeded the CCME Probable Effect Levels (PEL). All sites met the PEL for copper, however only three sites also met the Interim freshwater Sediment Quality Guideline (ISQG), while concentrations of mercury were relatively low. Generally concentrations greater than the PEL have a 50% incidence of creating adverse biological effects (LES, 2008).

A discussion of the 2007 metals analysis in stream sediments, and comparison of data collected over the years prepared by LES (2008) is provided below and shown in Table 3-1 and Figure 3-1. Please refer to the report (Appendix I) for detailed results and further discussion.

The stream sediments at KV-9, Flat Creek u/s South McQuesten River, had the highest mean concentrations of all the examined metals. Flat Creek has been the receiving water for effluent from the tailings facility for the past few decades. The mean concentrations of arsenic were high and exceeded the PEL at all sites. The ISQG guideline for cadmium was exceeded at KV-1, KV-37 and KV-41, with the PEL for cadmium exceeded at the remaining sites. All sites met the PEL for concentrations of copper in the stream sediments, however, only the sediments at KV-1, KV-7 and KV-41 met the ISQG guideline. The ISQG for lead was met in the stream sediments at KV-1 only. The ISQG was exceeded at KV-7, KV-37 and KV-41 and the PEL for lead was significantly exceeded at the other sites. Concentrations of mercury in the stream sediments were relatively low throughout. The ISQG was exceeded at KV-38, and the PEL was exceeded at KV-9. The concentration of zinc in the stream sediments at KV-37 was the only site to meet the ISQG guideline. The stream sediments at KV-41 exceeded the ISQG with the other sites greatly exceeding the PEL for zinc.

The concentration of metals in the stream sediments at KV-6 and KV-8 were relatively similar, however concentrations at KV-7, located midway between these sites, were considerably lower. Concentrations of the sediments at KV-7 were actually quite similar to the sediments at the upstream site on the South

McQuesten River, KV-1. The standard deviation for the triplicate samples at KV-7 was low indicating that representative samples were collected here.

There does appear to be some impact to the sediment quality of the South McQuesten River downstream of the confluences of Christal and Flat Creeks for each of the metals, as documented by slight increases at sites KV-2 and KV-4 respectively.

Within the Lightning Creek drainage, the highest concentrations were documented at KV-38, upstream of Thunder Gulch. This site is located 1.8 km downstream of Hope Gulch, which has documented high concentrations of water borne metals (Laberge, 2006). Metal levels in the stream sediments downstream at KV-41 were very similar to the upstream site, KV-37, indicating very little overall impact to Lightning Creek.

Overall, metal concentrations have been greater in the sediments of the Flat and Christal drainages than the South McQuesten and Lightning drainages. There appears to be little change in the concentrations of metals in the sediments at KV-1, KV-37 and KV-41 over time. Metals have fluctuated over time at the other sites, notably at KV-6 and KV-7.

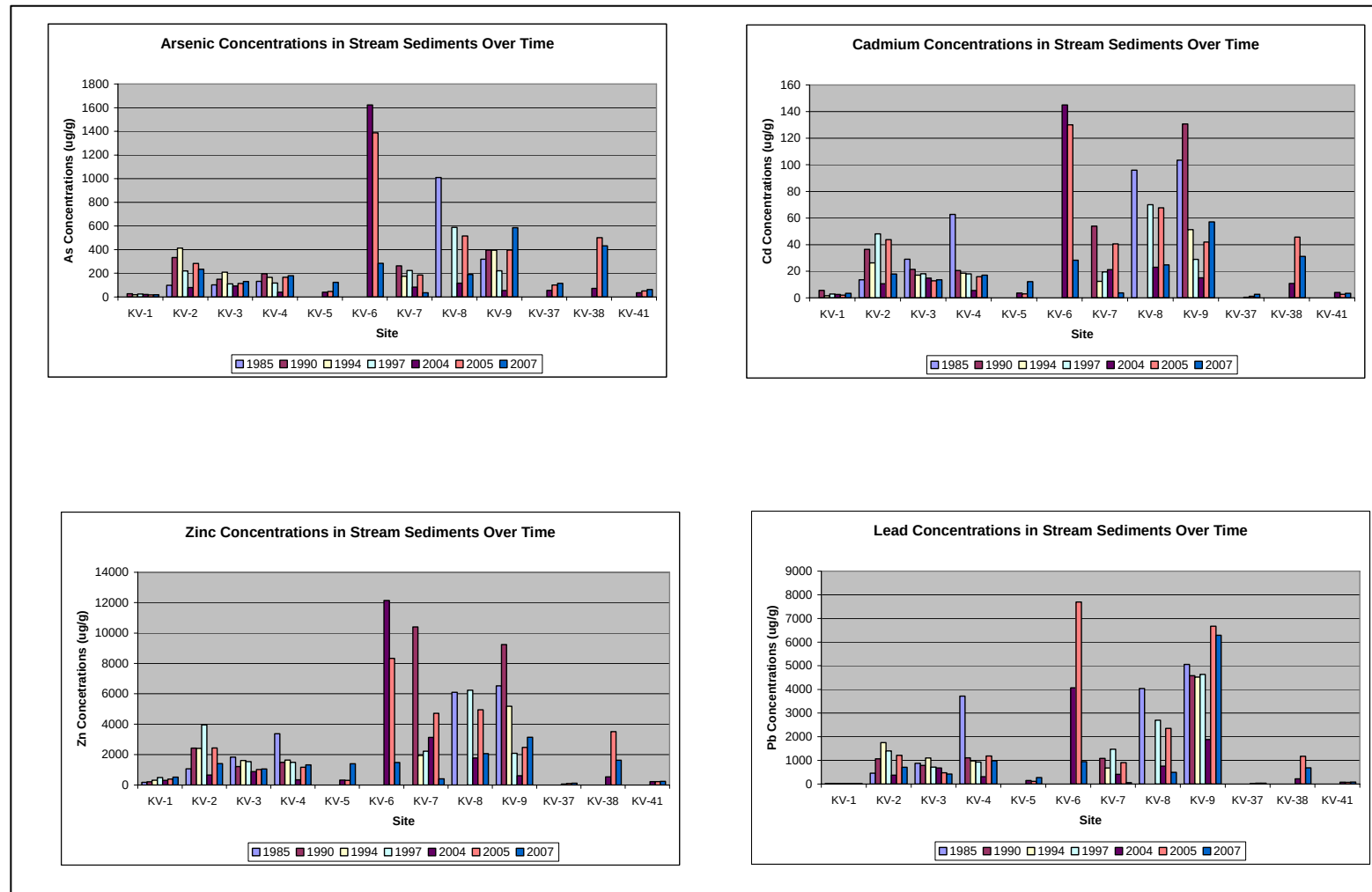
Typically, concentrations were higher in the sediments during the 1990s than during the first decade of 2000. The lowest concentrations tended to occur in 2004.

Table 3-1 Comparison of Metals in Stream Sediments Over Time

METAL & CCME GUIDELINES	YEAR	KV-1	KV-2	KV-3	KV-4	KV-5	KV-6	KV-7	KV-8	KV-9	KV-37	KV-38	KV-41
ARSENIC (ug/g) ISQG = 5.9 PEL = 17.0	1985	<8	99	102	132				1,010	319			
	1990	27	333	150	197			263		396			
	1994	18	413	210	166			174		395			
	1997	25	220	111	117			224	587	222			
	2004	21	79	93	41	40	1,623	83	116	55	56	72	35
	2005	17	282	113	167	45	1,387	185	516	396	100	501	51
	2007	19	235	130	180	124	284	35	190	586	115	433	62
CADMIUM (ug/g) ISQG = 0.6 PEL = 3.5	1985	0.6	14	29	63				96	104			
	1990	6	37	21	21			54		131			
	1994	2	26	17	19			12		51			
	1997	3	48	18	18			20	70	29			
	2004	3	11	15	6	4	145	21	23	15	1	11	4
	2005	2	44	13	16	3	130	41	68	42	1	46	3
	2007	3.3	18	13.5	17	12	28	3.7	24.8	57.1	3	31	3
LEAD (ug/g) ISQG = 35.0 PEL = 91.3	1985	24	463	877	3,720				4,040	5,060			
	1990	22	1,069	791	1,110			1,088		4,580			
	1994	10	1,750	1,100	980			680		4,520			
	1997	16	1,397	717	930			1,469	2,697	4,637			
	2004	12	377	677	310	150	4,067	413	755	1,883	27	223	77
	2005	16	1,217	475	1,188	117	7,700	902	2,350	6,667	39	1,172	72
	2007	13.9	707	423	985	271	954	56	496	6290	40	682	82
ZINC (ug/g) ISQG = 123 PEL = 315	1985	169	1,060	1,830	3,380				6,100	6,530			
	1990	212	2,423	1,220	1,490			10,400		9,247			
	1994	310	2,410	1,610	1,640			1,950		5,180			
	1997	486	3,950	1,540	1,487			2,217	6,237	2,090			
	2004	303	659	885	342	323	12,140	3,130	1,773	605	62	535	226
	2005	385	2,432	1,010	1,170	307	8,337	4,710	4,943	2,477	104	3,503	228
	2007	512	1410	1054	1333	1,400	1,483	404	2067	3143	125	1,637	247
Note: Values for 1985, 1990, 1997, 2004, 2005 and 2007 are the mean for triplicate samples, the values for 1994 are for one composite sample.													

Note: Adapted from Table 4, LES 2008.

Figure 3-1 Metal Concentrations in Stream Sediments Over Time



Note: Figure 4 from LES 2008.

3.1.3 Benthic Invertebrates

Benthic invertebrate sampling has taken place sporadically over the years, dating back to 1975. Environmental Protection Services carried out biological monitoring in the area in 1975, 1985 and 1990. In compliance with past water licences, various consultants carried out benthic sampling annually between 1986 and 1990 at four locations. As part of a biological monitoring survey conducted in 1994 by Laberge Environmental Services (LES), benthic invertebrate sampling was also conducted. LES also conducted stream sediment and benthic invertebrate monitoring in 2007. All study methodologies used artificial substrate samplers with a colonization period of five to six weeks with triplicate samples collected at each site. As the same methodologies were employed for the various sample events, legitimate comparisons can be made. LES has conducted this comparison within the report entitled *“Keno Valley Stream Sediment and Benthic Invertebrate Monitoring Programs, 2007”* prepared in March 2008 (Appendix I). This comparison is provided below with results shown in the associated Table 3-2 and Figure 3-2.

There is a data gap for several years for the upstream sites, KV-1 and KV-6. Only KV-1 (South McQuesten River u/s of Christal Creek) represents a true background site. Populations were very low here in the first years of sampling but were far greater in recent years. It is not known why populations were so depressed in 1975 and 1985. Populations at Flat Creek (KV-9) and South McQuesten River d/s of Flat Creek (KV-4) were depressed during the latter years of operation of the mine (operations ceased in 1989). Populations at both sites appear to have recovered somewhat in 1994 and 2005. Populations fluctuated at South McQuesten River u/s of Flat Creek (KV-3) over time with higher populations documented during the recent surveys. Populations increased significantly in Christal Creek near the Keno highway (KV-6) in recent studies as well.

Diversity has fluctuated at the sites. The communities on the South McQuesten River generally are more diverse than those on Christal and Flat Creeks. The diversity of the communities at KV-3 and KV-4 has been relatively uniform in recent years.

Diptera has usually been the dominant order at all of the sites over time. Plecoptera shared dominance at KV-3, South McQuesten River u/s Flat Creek, on several occasions. There has been a shift in recent studies at KV-1 where Ephemeroptera has also been dominant. The community at Flat Creek at the mouth, KV-9, saw the greatest shift in dominance over the years. Homoptera (true bugs) and Oligochaeta (aquatic earthworms) have shared dominance here during some of the surveys. Based on the numbers, diversity and the composition of the community, Flat Creek is the most impacted site of those examined in Table 3-2.

In summary with the limited data available, it appears that benthic populations were negatively affected during the years of mine operation, and have significantly recovered since. Without corresponding data from the background site (KV-1) during this time period it can not be stated definitively if this was a result of mining, or if natural regional conditions caused the depressed populations.

LES (2008) offers the following summary of benthic invertebrate sampling in 2007:

Benthic invertebrate populations were robust and healthy in the South McQuesten River and Lightning Creek drainages. There was good representation from the groups of insects that are known to be sensitive to chemical pollution, indicating healthy environments in these areas. There was a very high population at Christal Creek u/s of Keno Hwy, KV-6, however the community was the least diverse of those studied. Populations at the other two sites on Christal Creek and at Flat Creek, KV-9, were depressed. It appears that the high concentrations of metals in the stream sediments at Flat and Christal Creeks are negatively impacting the health of the benthos communities located on these drainages.

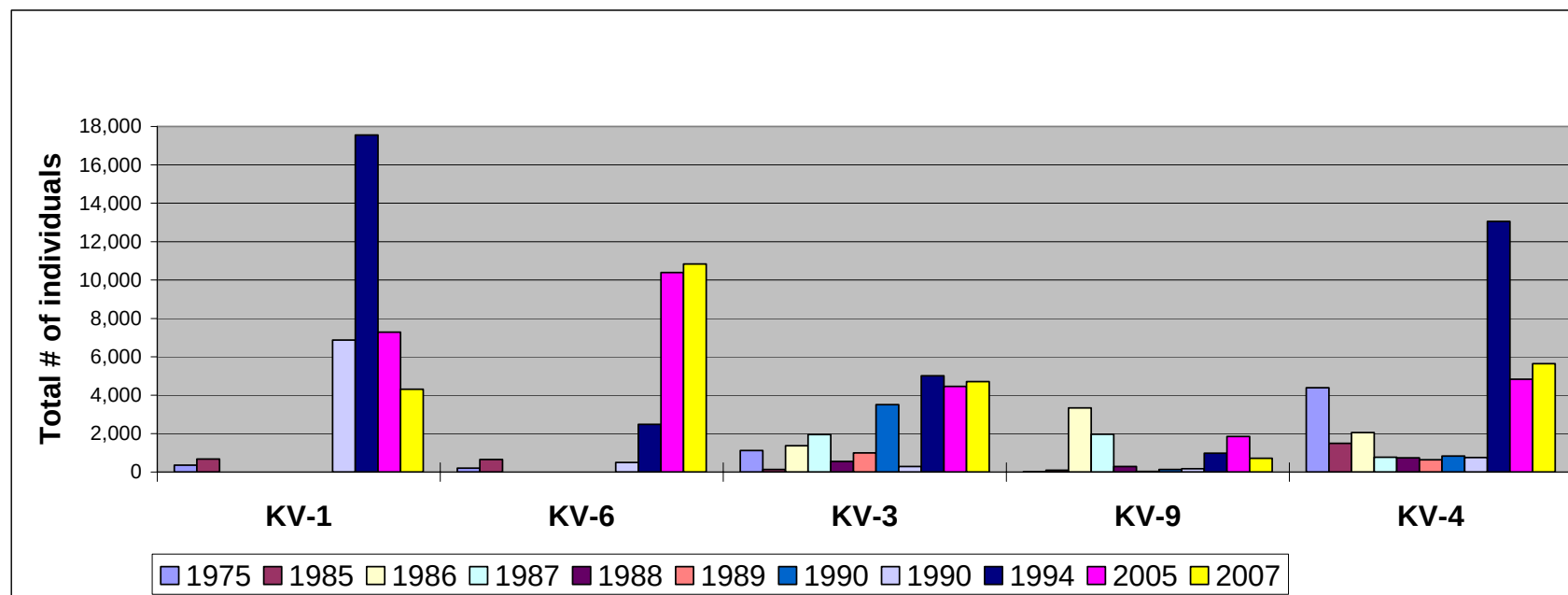
Table 3-2 Historical Benthic Data

STUDY	YEAR	S. McQuesten R. u/s Christal KV-1			Christal Cr at Keno Rd X-ing KV-6			S. McQuesten R u/s Flat Cr KV-3			Flat Cr u/s S. McQuesten R KV-9			S. McQuesten R d/s Flat Cr KV-4		
Study	Year	Total # of individuals	Total taxa	Dominance and %	Total # of individuals	Total taxa	Dominance and %	Total # of individuals	Total taxa	Dominance and %	Total # of individuals	Total taxa	Dominance and %	Total # of individuals	Total taxa	Dominance and %
EPS	1975	357	21	D 81.8	197	16	D 77.7	1129	24	D 87.9	8	5	D 62.5	4390	15	D 98.5
EPS	1985	683	26	D 76.3	655	31	D 74.2	140	20	D 32.9, P 25.7	95	14	D 42.1, P 41.1	1492	25	D 92.8
N. BIOMES	1986							1370	46	D 67.9	3343	22	D 80.7	2056	34	D 64.1
N. BIOMES	1987							1955	43	D 74.4	1976	26	P 59.4, D 36.2	775	37	D 46.5
Leverton	1988							551	36	D 44.5	282	20	D 50.3 P 42.2	740	35	D 40.6, E 27.7
Burns	1989							996	39	D 43.9, P 28.0	33	10	D 51.5	636	20	P 75.6
Burns	1990							3516	55	D 89.4	143	12	P 72.7	841	45	D 71.2
EPS	1990	6876	62	D 86.6	496	41	D 40.7, P 34.7	285	41	D 28.4, P 26.3	166	24	H 46.4, P 31.3	755	42	D 58.8
LES	1994	17557	46	D 89.6	2478	46	D 48.3, O 36.3	5016	40	D 67.5	991	36	O 53.7, D 36.6	13053	48	D 89.9
LES	2005	7290	56	D 59.7, E 27.4	10391	28	D 89.0	4464	44	D 64.8	1856	44	P 50.4, D 39.6	4838	57	D 58.7
LES	2007	4316	36	E 50.5, D 27.7	10837	30	D 86.4	4713	41	D 56.5	718	31	D 69.9	5648	44	D 63.8

D = Diptera E = Ephemeroptera P = Plecoptera O = Oligochaeta H = Homoptera

Note: Table 9 from LES 2008.

Figure 3-2 Benthos Abundance Over Time



Note: Figure 6 from LES 2008.

3.2 AQUATIC RESOURCE ASSESSMENT REPORT

Minnow Environmental prepared an Aquatic Resource Assessment Report which characterizes conditions within the South McQuesten River and tributaries receiving mine discharge. Minnow provides a summary of the findings below. The full report is located in Appendix J.

The study area that was considered included Christal, Flat and Lightening Creek as well as the South McQuesten River. Christal and Flat Creeks, which capture most of the mine-influenced drainage for UKHM, drain northwest into the South McQuesten River. Lightening Creek, a tributary of the Mayo River via Duncan Creek, also receives mine drainage (adits on Keno and Sourdough Hills) and has been affected by placer mining.

A previous analysis of water quality identified cadmium and zinc as key contaminants of concern in waters downstream of UKHM. Concentrations of these substances are at levels that are potentially toxic to aquatic biota in portions of the tributaries receiving mine drainage (particularly Christal Creek). However, contaminant levels in the South McQuesten River are currently below levels of concern.

Sediment quality data from 2008 showed that arsenic levels are consistently elevated in the fine fraction of sediments (<0.15mm) at all areas downstream of UKHM, including the South McQuesten River. Concentrations of up to 34 times the Probably Effect Levels of the Canadian sediment quality guidelines have been observed. Fine sediment concentrations of cadmium, lead and zinc were also elevated at most mine-exposed stations relative to both reference area concentrations and sediment quality guidelines. However, the guidelines are based on concentrations measured in whole sediment samples (not just the fine fraction), so potential risks to benthic biota cannot be ascertained from the available data. No consistent patterns were observed in sediment concentrations over time, although the evaluation was confounded by differences in methods for sampling and analysis.

Benthic invertebrate communities in lower Christal and Flat Creeks were characterized by relatively low abundance and number of taxa compared to reference and other, mine-exposed areas. Correlation analysis suggested that reduced number of taxa may be

related to elevated water concentrations of mine-related variables such as major ions (e.g., sulphate, hardness, conductivity), cadmium and zinc. The fish communities of the tributaries and South McQuesten River are dominated by Arctic grayling and slimy sculpin. The presence of both adults and juveniles in most watercourses indicates availability of suitable spawning and rearing habitats for both species. Portions of Christal Creek showed limited fish diversity and densities, particularly at KV7 where no fish were found in 2006. Although some differences in diversity were evident in comparison to a previous study (1994-95), no consistent patterns were evident in mine-exposed areas that would suggest either that conditions had either improved or degraded in 2006.

Whole body analysis of slimy sculpin showed levels of arsenic in excess of reference sediment concentrations and wildlife consumption benchmarks at most areas downstream of UKHM, particularly in Christal and Flat Creeks. These observations are consistent with elevations in sediment arsenic and lead levels observed in the same areas. Metal concentrations in Arctic grayling muscle were less than human or wildlife consumption benchmarks in almost all samples from all areas. Again, no consistent increases or decreases were evident over time based on comparison of data from 2006 to data from 1994-95.

3.3 WILDLIFE

The Elsa-Keno Hill area supports a variety of wildlife including ungulates, fur-bearers, small mammals, upland game birds and waterfowl.

This area is included in the range of the Mayo woodland caribou herd, although only anecdotal information on the herd is available. Little is known about the caribou population in the area, as no recent inventories have been carried out. Caribou are occasionally harvested in the area.

Moose are the most important sustenance animal in the Elsa, Keno City and associated historic mining area. Repeated surveying in the last 15 years indicates that the moose population in the area is very healthy and stable (Lortie, 2009). Aerial moose surveys in the Mayo area in 1988 and 1993 included the area between the Mayo-Elsa-Keno

highway and the South McQuesten River. The estimated density in 1993 was 119 moose/1000 km² compared to a density of 104 moose/1000 km² in 1988. The estimated average density for the entire Yukon is 127 moose/1000 km² (Ward, 1993). The resident non-native harvest in the survey area (game management zones 2-58, 4-01, and 4-04) averages about 11 moose per year. The area is not currently hunted by non-residents. No accurate record for the First Nation harvest of moose is available.

The Elsa-Keno area no longer supports thin-horn sheep. A small population had existed on Keno Hill, but was hunted out during the 1920's (Carey, 1992). There has been some discussion regarding the re-introduction of sheep to Keno Hill, but some believe that the habitat has been too much altered by mining development and access roads to make sheep re-establishment viable.

The South McQuesten River area is known as good quality fur-bearer habitat, although fur harvest records for traplines in the area are not currently available. The most commonly harvested fur-bearers are marten, wolverine and lynx. A total of 5 registered traplines occur wholly or partly in the Galena - Keno Hill area.

Other small mammals common to the area include muskrat, beaver, ground squirrel, red squirrel, varying hare, fox, mink, weasel, vole and shrew. Less common are porcupine, river otter and chipmunk. Alpine areas have local populations of hoary marmot and pika. Large carnivores include black bear, grizzly bear and timber wolf.

Information on waterfowl populations is restricted to casual observations. No systematic surveys have been carried out. There are reports of Canada geese nesting on wetlands in the area, and large numbers of Canada, snow and white-fronted geese have been seen to use the area during spring and fall migrations. Loons, grebes and diving ducks have been seen on larger water bodies such as McQuesten Lake and dabbling ducks have been observed in the wetlands.

Game birds common to the area include spruce grouse and ptarmigan. Less common are ruffed grouse, blue grouse and sharp-tailed grouse.

The health of the local wildlife populations near the Galena - Keno Hills area has not been studied. Within the last two years local people have expressed concern over the health of local wildlife which are routinely consumed. Government programs have attempted to address this issue by collecting wildlife muscle, kidney, and liver tissue; particularly for caribou and moose, and analyzing these tissues for metal and organo chlorine levels. To date, a limited number of moose (2 samples) and caribou samples have been specifically collected from the South McQuesten River area. Although a detailed comparison is not possible, metal levels from the moose tissue were not atypical of other animal results in the territory. A detailed summary of all wildlife test results by local communities is being compiled (M. Palmer, M. Gamberg, 1996) Y.T.G. Renewable Resources routinely accepts wildlife tissue samples for metal analyses. It is expected that a database of metal levels in local wildlife species will develop as additional data is compiled.

Yukon Species at Risk

Species at risk in Yukon and all of Canada as identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Yukon Wildlife Act, and whose ranges could conceivably overlap within the study area include:

- wood bison, peregrine falcon Anatum subspecies (identified by COSEWIC as Threatened);
- grizzly bear, wolverine, short-eared owl, peregrine falcon Tundra subspecies (identified by COSEWIC as Special Concern); and
- mule deer, elk, cougar (identified by the Yukon Wildlife Act – at risk in Yukon but not elsewhere).

A Community-based Fish and Wildlife Management Plan for the Nacho Nyak Dun Traditional Territory for 2002 – 2007 has been compiled and will be referred to for community concerns about moose, caribou, bears, wolves, and fish populations, along with habitat, harvest, and wildlife viewing.

3.4 VEGETATION

The Keno Hill Silver District is located within the Yukon Plateau-North ecoregion. The region is characterized by discontinuous widespread permafrost, with much of the area poorly drained and underlain by perennially frozen ground. Many valleys include peatlands, palsas, fens and meadows of sedge tussocks. Upper slopes may be covered with scree material, with treeline occurring at 1,350 to 1,500 meters.

Predominant tree cover in the area consists of white spruce (*Picea glauca*), black spruce (*Picea mariana*) and willows (*Salix spp.*). Less commonly occurring trees are trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), and white birch (*Betula papyrifera*). Alpine fir (*Abies lasiocarpa*) is common at higher elevations and alder (*Alnus crispa*) occurs along creek banks and in disturbed areas. Isolated pockets of lodgepole pine (*Pinus contorta*) can also be found.

Most south-facing slopes are covered with white spruce along with aspen, balsam poplar and willows, while north-facing slopes are underlain by permafrost and covered with stunted black spruce. Much of the drier south-facing slopes have been burned at some point.

The shrub layer on the north facing slopes and peatbog areas consists of dwarf birch (*Betula glandulosa*), willows (*Salix spp.*), shrubby cinquefoil (*Potentilla fruticosa*), crowberry (*Empetrum nigrum*), cloudberry (*Rubus chamaemorus*) and dwarf raspberry (*Rubus acaulis*), as well as ericaceous shrubs such as Labrador tea (*Ledum decumbens*), bearberry (*Arctostaphylos rubra*), blueberry (*Vaccinium uliginosum*), cranberry (*Vaccinium vitis-idaea*) and bog cranberry (*Oxycoccus microcarpus*). The drier south-facing slopes have a shrub layer which includes rose (*Rosa acicularis*), twinflower (*Linnaea borealis*), and gooseberry (*Ribes oxycanthoides*).

Alpine areas support a variety of plant communities. The low ground vegetation mainly consists of mat forming plants such as moss campion (*Silene acaulis*) and ericaceous shrubs such as heather (*Cassiope spp.*). A variety of alpine flowering forb species are also found. Dry areas, particularly well-drained rocky alpine sites, have extensive lichen development.

Wetland species are mostly graminoids, including sedges such as *Carex aquatilis* and *Carex lugens*, cotton-grass sedges (*Eriophorum augustifolium*, *Eriophorum russeolum* and *Eriophorum vaginatum*), and grasses such as reed-bentgrass (*Calamagrostis canadensis*). Forb species such as Sudeten lousewort (*Pedicularis sudetica*), wintergreen (*Pyrola spp.*) and coltsfoot (*Petasites spp.*) are also scattered throughout wetland areas.

Aquatic plants commonly found in the area include water-milfoil (*Myriophyllum exalbescens*), pondweed (*Potamogeton richardsonii*), mare's-tail (*Hippuris vulgaris*) and bur-reed (*Sparganium spp.*).

Common horsetail (*Equisetum arvense*) is the predominant species of vegetation occurring on the unsubmerged portion of the Elsa tailings impoundment. Squirrel-tail grass (*Hordeum jubatum*) is found in large patches in the higher, drier areas. Hairgrass (*Deschampsia caespitosa*) and willows (*Salix spp.*) are scattered throughout. Sedge (*Carex aquatilis*) is the predominant plant in the wetter tailings and shallow water, along with occasional occurrences of willow, water horsetail (*Equisetum arvense*) and sloughgrass (*Beckmannia syzigachne*).

3.4.1 Metals Levels in Wetlands Testwork

Metal levels in local wetland plant species were investigated as part of the Galkeno 900 pilot wetlands testwork in 1995. Samples for metal analyses were collected from wetland plant tissue and sediments to determine the extent of metal uptake by plants. Test results indicate that sediments contain considerable quantities of metals, while plant tissue metal levels remain near reported values for non-enriched sites. Results from this study including a discussion of metals uptake by plants was reported in the “*Design of a Passive System for Treatment of Discharges from the Galkeno 900 Adit at the United Keno Hill Mine Camp*” prepared by Microbial Technologies in 1995 and included as an appendix to the *Site Characterization Report*.

3.4.2 Lichen as an Indicator of Airborne Contamination Near the VTA

In 2007, EDI Environmental Dynamics Inc. was retained to complete phase 1 of a Terrestrial Effects Study in the vicinity of the Valley Tailings Area. The objective of this phase of the study was to determine if aerial dispersion of metals has occurred and, if so, the extent of such dispersion into the terrestrial ecosystem. While the terrestrial ecosystem includes plants, soils and animals, this study focused on lichens as they receive most of their nutrients from air and rainfall and can be used as indicators of airborne contamination. Results of the study indicate aerial contamination of metals in a limited spatial extent around the eastern ‘dry’ portion of the Valley Tailings Area. To confirm the extent of ongoing aerial contamination, deployment of moss bags has been recommended to assess airborne and precipitation based deposition of contaminants. Results from this study are reported in the *Elsa Tailings Terrestrial Effects Assessment – Phase 1* prepared by EDI in March 2008 and can be found in Appendix K.

A second study was conducting by EDI in 2008 based on recommendations in the 2007 project report (Refer to Appendix L) and a community based request to provide information on metals in plants traditionally harvested and consumed for medical purposes by NND. The objectives of the phase 2 study were to determine if, and to what extent the plants had been impacted by metals in and around the study area. The second study added two additional sites to the 2007 study design to include; one mine tailings (Mackeno) and one site used by the NND for traditional harvesting of medicinal plants. The results of the second study resulted in evidence of elevated heavy metal concentrations at sample sites in the immediate areas around the Elsa and Mackeno tailings sites. The findings of the second study reflected those found in the Phase 1 report. Further results of this study are reported in the *Elsa Tailings Terrestrial Effects Assessment-Phase 2* prepared by EDI in 2008 and can be found in Appendix L.

3.4.3 VTA Revegetation Assessment

In the summer of 2007, an inventory of the state of natural revegetation occurring on the Valley Tailings Area was carried out and the vegetation types delineated on an aerial photograph of the area. Results from this study are provided in the *Keno Hill Property Valley Tailings Revegetation Assessment* prepared by S.P. Withers in January 2008.

3.4.4 Revegetation Trials – Galena Hill Waste Rock Dumps

To establish effective measures for revegetating waste rock dumps in the Keno Hill Silver District, three revegetation test sites were established on Galena Hill in 2007. A preliminary assessment of the three sites (Simes and Hector waste rocks dumps and one control site) was carried out which included an inventory of the naturally occurring vegetation. Soil and vegetation samples were collected from the surfaces of the waste rock dumps prior to recontouring and seed and fertilizer application. Results from this work in 2007 is documented in the *Keno Hill Property Revegetation Trials – Galena Hill Waste Rock Dumps* prepared by S.P. Withers in January 2008.

4.0 HUMAN ENVIRONMENT

The following sections provide an overview of the human environment within the Keno Hill Silver District including heritage resources, current land uses and socio-economic conditions.

4.1 HERITAGE RESOURCES

The Keno Hill Silver District includes numerous old historic mine workings and the old company town of Elsa. Elsa Reclamation and Development Company's closure plan for the property will recognize the heritage potential of a number of these older historic workings.

A Cooperation Agreement has been negotiated with the NNDFN which specifically refers to Heritage Resources.

Initial discussions have taken place with the local Silver Trail Tourism Association and YG Heritage Branch regarding the status of older mine workings and tourism potential. Older historic sites which are of interest have been identified. The company is prepared to work with the Silver Trail Tourism Association, the local Chamber of Commerce and YG Heritage Branch to select sites for restoration and possible tourism potential. The company plans to support these initiatives, while maintaining adequate public safety and closure objectives for the property.

4.2 LAND USES

Land use within the Keno Hill Silver District has evolved from a long history of occupation and development. Significant development activity and local population increases have historically occurred in the area. Historically, regional land use has been influenced by the following activities:

- the area has been utilized by First Nations for centuries;

- a variety of anthropogenic activities have occurred throughout the region including both hardrock and placer mining, forestry, hunting and gathering, transportation, recreation and residential;
- a total of 5 trapline concessions occur entirely or partially within the regional area (currently there is some active trapping occurring on Galena Hill);
- numerous historic mining related building and structures exist on the property and are of interest to local community groups and government; and,
- the area is known and used for recreational pursuits and has potential for significant tourism development.

Today the Hamlet of Keno City is much smaller than it was historically and no major population influx is expected in this community. The maintenance of a dedicated community to support mining activity is now considered unnecessary and inappropriate for a mining company. Any increase in development activity could affect the community of Mayo which is now considered the major population centre for the area.

Increased human activity in the area may have negatively impacted local trapping concessions in the area. This is not considered a long term impact as local community populations have been reduced. Continued efforts to improve wildlife habitat will also improve trapping efforts.

It is expected that the area will continue to see both hardrock and placer exploration activities. Alexco's renewed exploration program with supporting camp in the Keno Hill Silver District is expected to continue providing local employment opportunities. Alexco is currently undergoing an environmental assessment for the Bellekeno mine, with a proposed mill site in the vicinity of Christal Lake with hopes of moving forward with mine production in 2010.

A placer mine operated by Bardusan Placers Ltd. (headquartered in Mayo Yukon) is located along Lightning Creek upstream of Thunder Gulch. The Water Licence that supports water use for this activity (PM04-408) expires May 1, 2013. A maximum of 5,400 m³/day may be obtained from Seepage Pond, Lightning Creek and Thunder Gulch. Water / wastewater is discharged back into Lightning Creek and Thunder Gulch.

A Joint Use Agreement with Bardusan Placers Ltd. will be completed which includes road use and general agreements regarding exploration in the area.

Underground workings in the district once supported numerous small scale logging operations mainly to provide timber for mine development. Local estimates for timber use in underground developments are approximately 5 million board feet. The potential for further logging exists as the area has regenerated over the years.

It is expected that the area will continue to see both tourism and recreational uses. The local tourism association is actively pursuing options for development in the area. The remnants of past mining activities could enhance some of these initiatives in this regard.

The Keno Hill Silver District is located within the Nă-cho N'yak Dun First Nation (NNDFN) traditional territory. The NNDFN R-Block 20B is situated northwest of the project area. Land tenure in the study area is composed of various mining claims and leases, and commercial, recreational, and residential surface properties (leases, titled fee simple and determinable, crown grants, etc.). There are several other quartz and placer claim holders in the area, many of which lie within or adjacent to the area being explored. Regional land status and current land use in the area is described in Table 4-1.

Table 4-1 List of Current Land Use Activities near Keno Hill Silver District

General Area		
Activity Type	Holder/Operator	Comments
Outfitting		
ROC #4	Alan Young	Midnight Sun Outfitting Ltd. - Whitehorse
ROC #7	Fred Lackie	Rogue River Outfitters Ltd. - Duncan, BC
Tourism		
Charter Air Service	Mayo Flying Service	Sport Fishing Excursions
Charter Air Service	Black Sheep Aviation	Sport Fishing Excursions
Charter Air Service	Action Aviation	Sport Fishing Excursions
Camping		
Recreational	YTG	Hanson Lake (Lease #2973, 0.81ha.)
Campground	YTG	Land Lease #1241 Campground at Hanson Lake (Lot 1064, Group 1054, Hanson Lake 49.30ha.)
Keno Valley West (NTS Quad. 105 M/13)		
Activity Type	Holder/Operator	Comments
Trapping Concessions		
RTC #43	Alvin Peterson, Peter Hart	
RTC #44	Keith Hepner, Rafe Hepner, Sonia Stange	Includes 1.0 ha. Trappers Residence on Cache Creek, 1km south of McQuesten Lake
RTC #82	No Listing, not settled	Concession Transfer Pending Estate Settlement (Current Holder Deceased)
RTC #85	Denis Buyck	Resident of Mayo
RTC# 81	Bruce MacGregor, Mary Beattie	
Land Tenure		
Lease #1679	ERDC	Elsa Campsite (56.16ha.)
Lease #1734	ERDC	In Vicinity of Elsa Camp (26.82 ha.)
Other	ERDC	Two other surface Leases East of Elsa at Hector Calumet Adit and No Cash Adit
Keno Valley East (NTS Quad. 105 M/14)		
Activity Type	Holder/Operator	Comments
Tourism		
Historic Interpretation	Mike Mancini	Keno City Mining Museum
Hiking and Scenic Viewing	Silver Trail Tourism Association	Various hiking trails and scenic viewing area in around Keno City and along the Silver Trail
Outdoor Adventure Guiding	Dick Brost	Subarctic Wilderness Tours - Keno City
Outdoor Adventure Guiding	Keno City Packers	Keno City Packers
Camping		
Keno City Community Campground	Keno City Community Club	Vicinity of Keno City at Lightning Creek
Trapping Concessions		
RTC #83	Christine Hager	Registered Category 1 (NND authorized)
RTC #86	Michael Arden	
Land Tenure		
Lease #1660	ERDC	Galena Hill (41.81ha.)
Lease #1672	ERDC	Lot 24, Group 1054, (18.55ha.)
Lease #1661	ERDC	Lot 223, Group 1054, (18.29ha.)
Other	ERDC	Two other surface Leases at Keno 700 Adit and Keno Summit
Block Land Transfer	YTG	Keno City PC 1987-1703 (Various fee simple properties, YTG - Fire Hall reserve, YTG- communications reserve Northwest Tel/Canadian Broadcasting Company)

4.3 SOCIO-ECONOMIC CONDITIONS

The Keno Hill Silver District has been the focus of intensive and wide spread mining and related activities for the past ninety or so years. Consequently, the intervening years can be characterized as a time when mining and related activities have replaced virtually all other activities in the area. Similarly, and in spite of the fact that there will be an effort to improve the general quality of the area, it is extremely unlikely that any interest will be developed in the establishment of outfitter or hunting and fishing camps in the area. Currently, the land use is primarily for trapping and hunting by members of the local community.

With the shutdown of the mining operations in the 1980's, there was an evacuation of the population of the Hamlet of Elsa, its housing stock, and much of the domestic infrastructure that was in place when the community flourished. Road access to Keno City has not changed, nor has the power and other services to Keno City. Road access to the workings on Galena Hill, Sourdough Hill and Keno Hill is currently maintained as required and such access for other legitimate mining interests should not be impaired. Access for potential users of other resources in the area such as forestry, recreation, and the like, is available since all access through the property to Keno City and beyond, or to the Hanson Lakes and beyond, is on government roads.

Future activities in the Keno Hill Silver District are expected bring about an economic upswing in the local area. Increasing expenditures for exploration and development, and reclamation work are expected to be significant in the near future (next 1-5 years). In addition, continued care and maintenance expenditures will benefit the local economy. The majority of these full time care and maintenance employees reside in Keno City or Mayo. Seasonally the number of employees increases during the exploration season and will increase significantly should Alexco move forward with production at Bellekeno and/or some of the other site that have production potential.

Public awareness and transparency of proposed exploration and preliminary development in the district is integral to Alexco's operations. The office in Elsa is open to local visitors and general inquiries.

On September 25, 2007 Alexco and the NNDFN announced that they had entered into a Negotiation Agreement relating to the activities of Alexco's subsidiary, Elsa Reclamation and Development Corp. ("ERDC") on and around the former United Keno Hill Mine property. The Negotiation Agreement provides for the negotiation and settlement of two further agreements between ERDC and the NNDFN. The first of these is a Cooperation Agreement concerning the care and maintenance and exploration activities currently undertaken by ERDC. The second is a "Comprehensive Cooperation and Benefits Agreement" to be concluded if ERDC determines as a result of its exploration activities that any portion of this large property should be developed into a mine operation. Under the Negotiation Agreement, ERDC has provided funding to the NNDFN to cover their costs of negotiation expenses.

The Negotiation Agreement provides for collaboration by ERDC and the NNDFN as well as support in principle by the NNDFN in relation to current activities at the property. It contemplates that ERDC and the NNDFN will work collaboratively in good faith with one another in order to facilitate and ensure the meaningful participation of the NNDFN in regulatory processes concerning the Keno Hill Project.

4.3.1 Mayo

The following socio-economic information for Mayo has been summarized from the "Yukon Community Profiles" website, which was produced by Human Resources Development Canada in partnership with the Yukon Chamber of Commerce:

Website address: <http://www.yukoncommunities.yk.ca>.

The community of Mayo is located at the confluence of the Mayo and Stewart Rivers, about 400 km northwest of Whitehorse, and serves as a distribution and service centre for the surrounding area. In addition to being a tourist destination, the community is a base for wilderness tourism, canoeing, hiking, big-game hunting and fly-in fishing.

In 2003, the average population of Mayo was 409, which is down from an average of 504 in 1997. The NNDFN comprise 60 – 70% of the community population. In Mayo more people are over the age of 65 (11%), compared to the Yukon average of 7%.

There are fewer people proportionally in the 25 to 44 age group, which reflects some movement out of the area by people looking for work elsewhere.

The Nä-cho N'yak Dun Development Corporation is establishing a number of training, work, and apprenticeship programs in the community. The First Nation works toward participation in land developments in their traditional territory and employs approximately 60 people.

The economy of Mayo is linked to the provision of services to the people of Mayo and the surrounding areas. One third of the jobs in the community are related to Government services, including First Nation and territorial administration. Placer mining and mineral exploration also provide an economic base for the community. Construction is a variable sector, but provided a significant share of employment in 2001. Tourism in the Mayo area is a growing industry. Accommodations, food services, recreation services (i.e. guiding and outfitting) and retail cater to tourists provide work for local residents. Tourist attractions in the area have to do with the history of mining around Mayo, Keno and Elsa including a mining museum and interpretive centre. Camping and hiking, hunting and fishing, and other outdoor pursuits comprise the activities undertaken by tourists in the area.

Some of the community services in Mayo include:

- J.V. Clark elementary level to post secondary level school with Yukon College Mayo Campus;
- Mayo Nursing Station;
- RCMP detachment;
- Community social services (YG Health and Social Services, Yukon Housing Corporation, Yukon Family Services (Dawson City), NNDFN social services);
- Village of Mayo community and municipal services (volunteer firefighting services, recreation and leisure services, etc.);
- Ambulance services (provided by community volunteers in partnership with YG);
- Yukon Energy Corporation supplies electric power from the Mayo hydroelectric dam;
- Mayo airport with weather station;

- YG Department of Environment office, Energy, Mines and Resources office, and a Mining Recorder's office;
- Post office;
- Internet services;
- Banking services;
- Tourist services (two motels, three campgrounds, two restaurants; two service stations, a store, businesses catering to wilderness tours and fishing);
- Helicopter, float-plane and taxi services; and
- The Silver Trail Area, including Keno, offers a lodge, cabins and eating facilities for tourists.

4.3.2 Keno City

Keno City is located within the Keno Hill Silver District and has approximately 24 residents. Keno City has a small but steady tourism economy based on recreational use of the area. In addition to a comprehensive mining museum, which provides historical perspective on the Keno Hill Silver District, a unique population of butterflies also exists in the region and attracts interested individuals. The “signpost” viewpoint on Keno Hill Summit also attracts numerous tourists throughout the summer months. In recognition of this, significant efforts have been made to ensure public safety around historic sites.

4.4 CONSULTATION

As part of its comprehensive campaign of exploration, care and maintenance, and closure and reclamation in the Keno Hill Silver District, Alexco will continue its multi-faceted consultation efforts. Having embarked upon consultation efforts towards development of the district-wide closure plan, the public and First Nation of Nacho N'yak Dun are becoming generally more aware of Alexco, and developing a greater familiarity with the Companies' approach to the Keno Hill Silver District.

Alexco will support its commitment to the local communities of Mayo and Keno City and to the First Nation of Nacho Nyak Dun by routinely providing opportunities for discussion about activities in the district.

5.0 REFERENCES

- Access Mining Consultants Ltd., June 3, 1996. *United Keno Hill Mines Limited, Report No. UKH/96/01, Site Characterization.*
- Access Mining Consultants Ltd., March 2008, *Adit Discharge Survey 2007; Keno Hill Property.*
- Access Mining Consultants Ltd, March 2009. *Site Investigation and Improvements, Special Projects; Fisheries Assessment Project September 17-19, 2008.*
- Boyle, R.W., 1965. *Lead-Zinc-Silver Deposits, Keno Hill-Galena Hill Area.* Geological Survey of Canada, Bulletin 111.
- Clearwater Consultants Ltd., May 16, 2008. *Memorandum CCL-UKHM-1 United Keno Hill Mines – Hydrological Update and Assessment.*
- EDI Environmental Dynamic Inc., March 2008. *Elsa Tailings Terrestrial Effects Assessment – Phase 1.*
- EDI Environmental Dynamic Inc., February 2008. *Elsa Tailings Terrestrial Effects Assessment – Phase 2.*
- Elsa Reclamation and Development Company, February 2009. *2008 Annual Water Licence Report.*
- Elsa Reclamation and Development Company, March 2007. *Preliminary Valley Tailings Groundwater Mass Loading and Contaminant Mass Balance Report.*
- Elsa Reclamation and Development Company, March 2007. *Preliminary Soils Characterization Study Report; United Keno Hill Mines Property*
- Elsa Reclamation and Development Company, March 2007. *Soils Characterization and Drilling Report.*
- Elsa Reclamation and Development Company, March 2008. *2007 Geotechnical Closure Studies; Keno Hill, YT.*
- First Nation of Nacho Nyak Dun, Mayo District Renewable Resources Council and YG Environment, *Community-based Fish and Wildlife Management Plan – Nacho Nyak Dun Traditional Territory, 2002 – 2007.*
- Green, L.H., 1971. *Geology of Mayo Lake, Scougale Creek and McQuesten Lake Map-Areas, Yukon Territory.* Geological Survey of Canada, Ottawa.
- Laberge Environmental Services, March 2008. *Keno Valley Stream Sediment and Benthic Invertebrate Monitoring Programs, 2007.*

Lortie, G, February 2009. *Current State of Wildlife in the Keno Hill Silver District.*

Microbial Technologies, December 1995. *Design of a Passive System for Treatment of Discharges from the Galkeno 900 Adit at the United Keno Hill Mine Camp (Draft Technical Report).*

Minnow Environmental Inc, July 2008. *Water Quality Assessment Report for United Keno Hill Mines.*

Minnow Environmental Inc, March 2009. *Aquatic Resource Assessment Report for United Keno Hill Mines.*

SRK Consulting (Canada) Inc., February 2008. *Assessment of Groundwater Regime at the Valley Tailings Facility.*

White Mountain Environmental Consulting, January 2006. *Fisheries Assessments Conducted in the Keno Hill Mining Area, Including Metals Analysis of Fish Tissue Samples.*

Withers, S.P., January 2008. *Draft Keno Hill Property Valley Tailings Revegetation Assessment.*

Withers, S.P., January 2008. *Draft Keno Hill Property Revegetation Trials – Galena Hill Waste Rock Dumps.*