

ALBERTA COAL MINING WASTEWATER GUIDELINES

MARCH 1998

**Standards & Guidelines Branch
Environmental Assessment Division
Environmental Service**

Pub. No: T/404
ISBN: 0-7785-0130-2

We would like to thank the following groups for their assistance in the update of this document:

Land Reclamation Division - Alberta Environmental Protection
Air and Water Approvals Division - Alberta Environmental Protection
The Coal Industry

Any comments or questions regarding the "Alberta Coal Mining Wastewater Guidelines" may be directed to:

**Standards and Guidelines Branch
Environmental Assessment Division
Environmental Services
Alberta Environmental Protection
6th Floor, 9820 - 106th Street
Edmonton, Alberta T5K 2J6
Phone: 403 427-6102**

Primary Contact:
Prasad Valupadas

Additional copies may be obtained by contacting:

**Regulatory Approvals Centre
Alberta Environmental Protection
Main Floor, 9820 - 106th Street
Edmonton, Alberta T5K 2J6
Phone: (403) 427-6311**

PREFACE

These guidelines are a general reference for wastewater management at new and existing coal mining operations. Alberta Environmental Protection's expectations for the collection, treatment and disposal of mine wastewaters are described. Relevant sections of the *Environmental Protection and Enhancement Act* (EPEA) that must be followed by coal mine operators are outlined.

These guidelines describe the types of mine wastewaters generated and how they should be managed. Included are guidelines pertaining to settling pond design requirements, the use of wastewater treatment chemicals, and general comments on areas of wastewater management that require particular attention. Typical EPEA approval requirements for mine wastewater release limits, monitoring, and reporting are discussed.

This document is intended for general reference only. Site specific wastewater management are prescribed in the EPEA approval. Exploration activities are regulated by the Code of Practice for Exploration Operations. Copies of the Code of Practice may be obtained through the Queen's Printer Bookstore in Edmonton or Calgary. EPEA approvals may be obtained through Alberta Environmental Protection in the Regulatory Approvals Centre (phone (403) 427-6311).

General environmental questions on coal mines in Alberta should be directed to the Land Reclamation Division (phone (403) 427-6202). Specific wastewater questions can be directed to the Air and Water Approvals Division (phone (403) 427-5883).

TABLE OF CONTENTS

PREFACE	i
1. INTRODUCTION	1
1.1 General	1
1.2 Objectives	1
1.3 Definitions	1
1.4 EPEA Regulations	3
2. WASTEWATER MANAGEMENT	4
2.1 General	4
2.2 Coal Processing Plant Wastewater Management	4
2.3 Coal Mining Surface Runoff and Groundwater Management	5
2.4 Nitrogen Control	5
2.5 Flocculants	6
2.6 Vehicle and General Maintenance Shop Wastewater	6
2.7 Sanitary Sewage Management	6
3. WASTEWATER TREATMENT TECHNOLOGY	7
3.1 General	7
3.2 Settling Ponds	7
4. WASTEWATER RELEASE LIMITS	9
4.1 Basis for Limits	9
4.2 Limits	9
4.3 Abandonment	10
5. MONITORING	11
5.1 General	11
5.2 Settling Ponds	12
5.3 Sanitary Sewage	13
5.4 Ambient Monitoring	13
6. SAMPLING AND ANALYSIS	14
7. REPORTING	15
APPENDIX A Effect of Selected Parameters on Receiving Waters	16

1.0 INTRODUCTION

1.1 General

Alberta's coal mining industry consists primarily of surface mine operations. Water enters a mine via precipitation, groundwater seepage, and surface runoff. This water contains elevated levels of suspended solids from contact with road surfaces, overburden material, and the open pits. It may also exhibit increased levels of metals, nutrients such as nitrates, and other parameters such as oil and grease. As a result, mine wastewater requires treatment before discharge into a receiving watercourse.

1.2 Objectives

These guidelines describe wastewater controls and emission standards for coal mining operations with a view to achieving environmental protection by means of the following:

- (a) minimizing the levels of suspended solids in mine wastewater,
- (b) controlling the volume and quality of mine wastewater discharges, and
- (c) guiding coal mine operators by outlining the basis for application reviews and approval requirements pursuant to the *Environmental Protection and Enhancement Act* (EPEA).

1.3 Definitions

For the purposes of these guidelines, the following terms are defined to ensure clarity:

"coal processing plant" means a coal processing plant as defined in the *Coal Conservation Act* and generally is any installation for upgrading the quality of coal or for producing a marketable solid fuel, and includes any coal storage and load out facilities, and any associated mine wastewater handling facilities;

"Department" means the Department of Environmental Protection;

"Director" means, subject to section 40 of EPEA, a person designated by the Minister of Environmental Protection as a Director for the purposes of the *Environmental Protection and Enhancement Act*;

"grab sample" means an individual sample collected in less than 30 minutes and which is representative of the substance sampled;

"major pond" means a mine wastewater handling facility that receives mine wastewater from active mining areas, dumping locations, the plant or maintenance shop areas and discharges to the environment;

"**mine**" means all excavations, dumps, buildings, structures, processing equipment, vessels, storage facilities, material handling facilities, roadways, pipelines, other installations and the associated land as described in an application for an EPEA approval;

"**mine wastewater**" means any liquid originating from the operation of the plant or mine excluding surface runoff from undeveloped areas;

"**mine wastewater handling facilities**" means the parts of the mine that collect, transport, store or treat mine wastewater;

"**minor pond**" means a mine wastewater handling facility which has met all approval limits in the recent past or receives mine wastewater from a reclaimed area and discharges to the environment;

"**NTU**" means turbidity measured in Nephelometric Turbidity Units;

"**one in ten year storm**" means a precipitation event that in a 24 hour period produces an amount of precipitation that occurs on average once in 10 years;

"**operator**" means:

- (a) an approval or registration holder who carries on or has carried on an activity on or in respect of specified land, pursuant to an approval,
- (b) any person who carries on or has carried on an activity on or in respect of specified land other than pursuant to an approval or registration,
 - (i) the holder of a surface lease for purposes related to the carrying on of an activity on or in respect of specified land,
- (c) a successor, assignee, executor, administrator, receiver, receiver-manager or trustee of a person referred to in subclauses (a) to (b), and
- (d) a person who acts as principal or agent of a person referred to in subclauses (a) to (c).

"**process reagent**" means any substance added to promote or enhance a chemical, physical, or biological process;

"**settling pond**" means containment structures to treat and discharge mine wastewater, as per the design criteria of Section 3.2 of these guidelines;

"**storm event**" is as described by the following equation which is determined on a site specific basis:

$$\log(i) = \#\# * \log(t) + \#\#. \#\#$$

where: i = storm intensity (mm/hour)
t = storm duration (hour)

A storm event will have occurred if the actual measured intensity over a specific duration is greater than or equal to the intensity calculated from the above equation for the specific duration. This equation is valid only for determining storm intensities of 0.5 hour to 168 hours duration.

Note: This equation has been formulated with a consideration for intensity and duration variables to identify precipitation events that produce flows equivalent to a 1:10 year, 24 hour precipitation event.

"**surface mine**" means a mine worked by the removal of overlying strata and subsequent excavation of exposed coal.

1.4 EPEA Regulations

In accordance with the Activities Designation Regulation (211/96), an approval is required for the construction, operation, and reclamation of the following activities with respect to coal:

- (a) a coal mine;
- (b) a coal processing plant.

Applications must be prepared in accordance with the Approvals and Registrations Procedure Regulation (113/93 and 216/96) and submitted to Alberta Environmental Protection. These activities may also require approval in terms of the *Water Resources Act* for the diversion and use of water, and for the placing of any structure in a water body, or water course.

Proposed minor modifications to mine wastewater handling facilities that are approved under the *Environmental Protection and Enhancement Act* should be referred to the local Conservation and Reclamation Inspector in the field. If the modification is not exempted under Section 64(3) of the *Environmental Protection and Enhancement Act*, the Inspector will advise the operator to apply for an amendment under the EPEA approval process.

Exploration activities are regulated through the Code of Practice for Exploration Operations. The code includes environmental protection measures for water management and erosion control.

Where an operator believes that certain guideline requirements are impractical or not applicable due to particular site-specific circumstances, the operator may request from the Director an exemption from those conditions in the course of applying for an approval. Adequate justification must be supplied to support an application for exemption.

2.0 WASTEWATER MANAGEMENT

2.1 General

A mine is considered to include the mining areas, the coal processing plant, and the ancillary services such as maintenance shops, offices, sewage facilities, and change houses.

The types of coal recoverable in Alberta vary in rank from lignite to semi-anthracite and occur in a variety of geological and landscape settings. Alberta Environmental Protection acknowledges that numerical limits regulating wastewater quality may need to vary from one mine to another due to differences in mine type and location (e.g. Mountain mines versus Prairie mines).

The sulphur content of Alberta coal deposits is generally low, with some minor exceptions. Acidic mine drainage is therefore unlikely, and this condition has not been addressed in this document. Should the potential for this type of problem exist, wastewater standards will be set on a site specific basis, through the EPEA approval.

2.2 Coal Processing Plant Wastewater Management

The following guidelines apply to all coal processing plants as well as coal transport water for hydraulic mining unless otherwise stipulated in an EPEA approval for a specific mine:

- (a) Coal processing plants are to be designed and operated to maximize water recycle and minimize the release of plant wastewater to the environment. Mixing of surface runoff with coal processing plant wastewater should be minimized.
- (b) In order to facilitate reclamation and to minimize environmental risk, operators are to select and use process reagents that pose the least potential for adverse environmental effects. An inventory of reagent disposition in solids and liquids are to be documented by the operator and made available to Department inspectors upon request. An understanding of the chemical and physical reagent reactions and their reaction products will allow the operator to prepare such an inventory.
- (c) An ability by an operator to demonstrate that coal processing plant wastewater poses negligible threat to the receiving watershed will expedite any requests for the release of this wastewater under emergency conditions or normal operation. Typically this would include chemical, physical, and toxicological information on the wastewater.

2.3 Coal Mining Surface Runoff and Groundwater Management

Due to the land disturbance inherent in surface coal mining, the management of surface runoff and groundwater within the mine requires careful planning. Often extensive controls are required to prevent siltation of natural waterbodies. Underground mining, which causes little ground disturbance, may have runoff management issues associated with coal fines in surface runoff from coal piles and also has the potential to generate contaminated groundwater. Underground mining wastewater requires treatment prior to release to natural watercourses.

The following guidelines apply to surface and underground mines unless otherwise stipulated in an EPEA approval for a specific mine:

- (a) Mine wastewaters are subject to the mine wastewater release limits in Section 4.
- (b) New settling ponds must be designed in accordance with Section 3.
- (c) Coal and soil stockpiles are to be located such that they will not be a source of contamination to watercourses. Where necessary, stockpiles must be stabilized and ditched to prevent migration of material.
- (d) Fine solids are to be disposed of in an area not subject to erosion. In particular, settling pond dredgings are to be discarded only in a location approved by the Conservation and Reclamation Inspector.
- (e) Mine wastewater handling facilities and other water management control structures must be in place prior to undertaking activities that generate mine wastewater.
- (f) The probable interaction of the mining operation with the local groundwater regime must be established before the commencement of operations. This impact is normally addressed in an Environmental Impact Assessment and *Water Resources Act* application.
- (g) Where it is anticipated that an appreciable amount of groundwater will collect in a mine, the use of dewatering wells must be considered to lower the local groundwater table. The operator must contact the Water Administration Branch of Alberta Environmental Protection for the diversion of groundwater or for pit dewatering.

2.4 Nitrogen Control

The main source of nitrogen in mine wastewaters is from nitrogen compounds in explosives. Residues from mine blasting operations enter surface runoff water and are carried to settling ponds. Depending on the form (nitrate, nitrite, ammonia) and concentration of nitrogen and the characteristics of the receiving stream, nitrogen compounds can be toxic to aquatic life. When phosphorus is not limiting, elevated nitrogen levels can also increase eutrophication in receiving waters. The following measures are recommended to minimize nitrogen release to receiving waters:

- (a) Implementation of engineering blasting practices that minimize, to the extent possible, the amount of blasting material used and the residue produced.
- (b) Diversion or interceptor ditches, or any other appropriate control structure must be constructed to minimize the amount of surface runoff that can enter a blasting area.
- (c) Explosive materials are to be properly stored to prevent any contact with mine wastewaters.

If monitoring shows that elevated levels of nitrogen are being released to the receiving environment and there is a potential adverse effect, the operator must investigate and implement appropriate prevention and control options to reduce nitrogen loadings including the possible use of wetlands as a treatment measure.

2.5 Flocculants

Flocculants are used to enhance the settling properties of solids in mine wastewater settling ponds. The type of flocculant will vary from mine to mine depending on the characteristics of the solids to be settled. If a particular flocculant has not been previously authorized, written authorization from the Director is required prior to use. The request for authorization must include information regarding the chemical, physical, and toxicological characteristics of the flocculant.

Proper flocculant addition is necessary to ensure it is not added in excess of the required dosage. Excess flocculant in the wastewater discharge can be toxic to aquatic biota. Flocculant facilities are to be sited to avoid washout from a 1 in 20 year flood and must be secure from tampering and unauthorized entry. Operators must develop and implement environmental management plans to ensure proper handling of flocculants.

2.6 Vehicle and General Maintenance Shop Wastewater

Wastewater from these areas include any wash water and surface runoff from the immediate area. The wastewater must be collected and treated to remove any oil, grease and silt. Oil and grease are to be treated such that there is no visible sheen prior to release to the environment. These facilities are considered on a site specific basis as part of the EPEA application review process.

2.7 Sanitary Sewage Management

All sanitary sewage must be disposed of in accordance with site specific requirements in the EPEA approval. In the case of in-ground disposal (septic tank and field systems), the design must be in accordance with the requirements specified by the Plumbing and Gas Safety Services Branch of the Department of Labour.

In large operations, or where a construction camp is involved, the company may propose conventional above-ground biological treatment, possibly using a lagoon, a package treatment plant, or an activated sludge process. In such cases an approval under the *Environmental Protection and Enhancement Act* is required.

3.0 WASTEWATER TREATMENT TECHNOLOGY

3.1 General

Settling ponds are considered to represent best practicable technology for treating mine wastewater. They must however be properly designed and operated. Suspended solids removal is accomplished by settling, with process reagents (flocculants) often used to enhance the settling process.

3.2 Settling Ponds

Settling ponds are the most common form of mine wastewater treatment. They are effective in reducing suspended solids when properly designed, constructed and operated. Settling ponds may take the form of dugouts, impoundments or mined out pits and are operated to achieve suspended solids removal by settling.

The efficiency of a well designed settling pond is limited by the nature of the sediments handled. Sand is easily settled while clays (such as bentonite) or iron flocs can be colloidal in nature and difficult to settle. Efficient removal may require the use of flocculants to coagulate the suspended matter into a settleable form.

The following guidelines apply to the design and construction of settling ponds. Settling ponds must:

- (a) be located to capture all mine wastewater for a specific area,
- (b) be designed to withstand a washout from a 1 in 100 year flood,
- (c) achieve settleable solids standard equal to 0.5 mL/L for all water inflows up to the mine specific storm event,
- (d) allow all weather access for monitoring, dredging and maintenance,
- (e) minimize short circuiting of water flow and thereby achieve adequate settling retention time,
- (f) prevent the escape of floating hydrocarbons,
- (g) be designed and operated, if so designated in the EPEA approval, to provide reliable flow measurement, and
- (h) be designed to minimize erosion of the discharge channel.

Where conditions permit and the flow is not continuous, settling ponds must be operated such that during low in-flow conditions, the pond water level is lowered to allow maximum capacity for future rainfall events.

On completion of construction of a new settling pond, the operator must submit written notification to the Director prior to discharging any mine wastewater to the surrounding watershed. The operator must obtain written authorization from the Director for the decommissioning of a settling pond.

4.0 WASTEWATER RELEASE LIMITS

4.1 Basis for Limits

The limits in this section for suspended solids are based primarily on literature reviews, demonstrated technology for total suspended solids (TSS) removal, and an analysis of historical monitoring information from the East Slope Mountain/Foothills coal mines to determine acceptable short and long term levels of TSS. Literature values and technological capability were evaluated against mine performance data to arrive at a Maximum Daily Average TSS value and a Maximum Daily TSS value. The values also reflect aesthetic considerations and the desire to mitigate the impact of sediment on receiving streams. The two types of limits on releases containing suspended solids are:

- (a) a maximum daily concentration of total suspended solids, that accounts for technological capability and provides aquatic life protection for short-term high exposures, and
- (b) a maximum daily average concentration of total suspended solids, that accounts for technological capability and provides long-term aquatic life protection.

For more information on the derivation of the limits, please consult the Standards and Guidelines Branch or the Industrial Waste and Wastewater Branch of Alberta Environmental Protection.

4.2 Limits

The limits in Table 1 apply to all coal mine wastewaters released to the receiving waters unless otherwise specified in a mine specific EPEA approval. Coal processing plant wastewater discharges may be subject to additional requirements. Because the volume and nature of wastewater from a coal mine are generally unrelated to coal production quantities, all wastewater limits are expressed in terms of concentration rather than units of production.

Table 1 refers to the analysis of any mine wastewater as sampled after release from a final mine wastewater handling facility or settling pond, but prior to release into the receiving watershed.

TABLE 1. WASTEWATER RELEASE LIMITS

Parameter	LIMITATIONS	
	Maximum Daily	Maximum Daily Average (for any month)
Total Suspended Solids (TSS)	<350 mg/L	<50 mg/L
pH	Between 6.0 to 9.5 at all times	
Floating Solids and Foam	None - except in trace amounts	
Oil and Grease	No visible sheen	

Exemption from the limits is permitted as authorized in the EPEA approval for the operation. Storm exemptions are authorized for rainfall events that are beyond reasonable control. Exemptions are based on site specific storm curves which run from 0.5 hour to 7 day rainfall intensity. This is designed to take into account antecedent moisture (saturated ground) conditions and short, intense storms.

Specific control on nitrogen in mine wastewater is addressed on a site-specific basis. An EPEA approval may require some form of source prevention and control if monitoring of settling pond water shows elevated levels of nitrogen and a potential to impact the environment.

4.3 Abandonment

The mine wastewater limits in Section 4.2 (Table 1) will remain in force until the disturbed land in the watershed for the mine wastewater handling facility is reclaimed in terms of an EPEA approved reclamation plan and a reclamation certificate is issued.

5.0 MONITORING

5.1 General

Operators of coal mines are required to adhere to a regular wastewater monitoring program. Because the operation, location, and scope of coal mines vary widely, it is not possible to specify overall monitoring guidelines; therefore, monitoring requirements are specified in individual EPEA approvals.

Sampling focuses on actual wastewater release points. The frequency of monitoring depends on the seasonal and operational flow characteristics (i.e. typical rate and variability) and the expected or usual concentration of contaminants. Background monitoring of receiving streams may also be required to ascertain the natural background level of relevant physical and chemical parameters.

Depending on the number of wastewater releases, monitoring requirements are generally reduced after winter freeze-up as specified in each mine approval.

Typical analyses required on a routine basis include:

- (a) Total Suspended Solids;
- (b) pH;
- (c) Turbidity; and
- (d) Nitrate-Nitrogen.

Note: Turbidity can be an acceptable replacement for TSS monitoring when a site specific formula relating turbidity to TSS has been derived.

Depending on site-specific circumstances, certain additional information may be required such as:

- (a) more intensive water chemistry analyses;
- (b) heavy metal analyses;
- (c) bioassays;
- (d) biological surveys on receiving waters;
- (e) groundwater monitoring; and
- (f) flow in the case of major ponds using flocculants.

All analyses must be conducted using the analytical techniques described in Section 6, or as otherwise authorized in an EPEA approval.

5.2 Settling Ponds

Monitoring requirements are based on the classification of mine wastewater handling facilities (i.e. major and minor ponds) and also by season (i.e. summer vs winter). The frequency of monitoring major ponds is site-specific based on the operator's settling pond management control procedures, past performance, and the need for enhanced settling using flocculants. New mine wastewater handling facilities are normally required to follow the monitoring requirements for major ponds. Typical monitoring requirements are listed below when releases are occurring:

TABLE 2. MONITORING: MAJOR PONDS

PARAMETER	SAMPLE TYPE	FREQUENCY
Flow	continuous	ponds using flocculants
TSS (mg/L)	grab	once/week and when turbidity is greater than 50 NTU
Turbidity (NTU)	grab	2 to 7 times per week (summer) once/week (winter)
pH	grab	3 to 7 times per week (summer) once/week (winter)
Oil and Grease	visual	once per week
Nitrate-Nitrogen	grab	once per week

TABLE 3. MONITORING: MINOR PONDS

PARAMETER	SAMPLE TYPE	FREQUENCY
TSS (mg/L)	grab	once/week
pH	grab	once/week
Oil and Grease	visual	once/week
Nitrate-Nitrogen	grab	once/month

Note: Normal sample days are pre-specified prior to each new year by the mine operator through the EPEA approval.

In order to prevent upset conditions on non-sample days, an operator must inspect daily all major ponds and those minor ponds using flocculants, unless dry weather conditions warrant otherwise. Inspections must include:

- (a) checking that all flocculant stations are functioning properly,
- (b) visually checking that the discharge is not abnormally turbid, and
- (c) taking a wastewater sample for analysis of suspended solids if the discharge appears abnormally turbid (i.e. greater than 50 NTU) and comparing the result with the limits specified in Table 1.

5.3 Sanitary Sewage

Monitoring varies depending on the type of treatment (e.g. mechanical, lagoons, etc.) and past performance. Generally, as a minimum requirement, Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) are monitored weekly for mechanical plants with continuous discharge. Mines with a one year retention time sewage lagoon are normally required to sample once annually at the time of discharge.

5.4 Ambient Monitoring

On significant creeks or rivers, an operator is generally required to conduct upstream and downstream comprehensive chemical analysis on a yearly basis. Biological monitoring for benthic invertebrates is initially required once every two years on potentially impacted streams. Subsequent monitoring results may determine the need for a change in sampling frequency. Periodic fish surveys and an assessment of fish habitat may also be required. These requirements will be specified in the EPEA approval.

6.0 SAMPLING AND ANALYSIS

Compliance with the maximum daily concentration limit (350 mg/L) for total suspended solids (TSS) (section 4, Table 1) is based on an instantaneous grab sample. Compliance with the maximum daily average for any month limit (50 mg/L) is based on the arithmetic mean of all daily determinations of TSS during the month. The limit applying to pH is not subject to variance and is to be met at all times on the basis of an instantaneous grab sample.

The analytical methods to be used for the monitoring are as follows unless otherwise stipulated in an EPEA approval:

All Physical and Chemical analyses shall be conducted in accordance with the following references:

1. the latest edition of *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association, American Water Works Association, and the Water Environment Federation, as amended; or
2. the *Methods Manual for Chemical Analysis of Water and Wastes*, Alberta Environmental Centre, as amended.

For biological monitoring:

1. the *Guidelines for Monitoring Benthos in Freshwater Environments*, Environment Canada, January, 1993, as amended.

For toxicity testing:

1. the *Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout*, Environment Canada, Environmental Protection Series 1/RM/13, July 1990, as amended.
2. the *Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Daphnia Magna*, Environment Canada, Environmental Protection Series 1/RM/14, July 1990, as amended.

7.0 REPORTING

Typically, the following requirements apply to all coal mines:

- (a) The operator must immediately report, or confirm any awareness of, the occurrence of any non-compliance with any condition of an EPEA approval or any uncontrolled release of a contaminant, accidental spill or discharge, as specified in the approval and the Release Reporting Regulation to the Director of Pollution Control.
- (b) A monthly report is generally required to be submitted in accordance with approval requirements and usually includes:
 - (i) the results of analytical wastewater monitoring;
 - (ii) brief comments relating to the operation of the coal processing plant and the mine wastewater handling facilities if any non-routine conditions, relevant to water quality, were encountered; and
 - (iii) the type and quantity of chemical flocculants used to enhance settling.
- (c) An annual report is generally required to be submitted in accordance with approval requirements and usually includes:
 - (i) a statistical summary of the mine wastewater monitoring results from Section 5.0. This includes high, low, and average values for every parameter routinely monitored;
 - (ii) an assessment of the data relative to the limits in Table 1, including a trend analysis, using appropriate control charts or graphs to demonstrate performance;
 - (iii) a summary and evaluation of the performance of all mine wastewater handling facilities including remarks on sediment accumulation, dredging activities, extensions and alterations of the facilities;
 - (iv) details of any approval non-compliances and follow-up action; and
 - (v) a description of mining activities in the upcoming year which may significantly affect the mine wastewater handling facilities.

APPENDIX A: Effect of Selected Parameters on Receiving Waters

Coal mine operations have the potential to affect water quality. The following selected parameters are monitored at coal mines in Alberta. The release limits and monitoring programs discussed in the guidelines ensure that water management at coal mines will maintain water quality in the receiving environment. The following discussion briefly describes the effects of selected parameters on receiving waters.

(a) Suspended Solids

The effects of high suspended solids levels and sedimentation on stream habitats has been well documented. Suspended solids in the water column increase turbidity, reduce light penetration, and potentially reduce photosynthesis thereby affecting overall stream productivity. Elevated levels of suspended solids can damage aquatic habitats by clogging the respiratory organs of fish and aquatic fauna. Sedimentation on stream habitats can blanket the stream bottom which can kill eggs, young, and food organisms and destroy spawning beds. Suspended solids, in the form of clay and coal fines, impart an aesthetically unpleasant appearance to streams and lakes, which negatively affects recreational potential.

(b) pH

Although pH indicates whether water is acidic or alkaline, it should not be confused with the measures of acidity or alkalinity. Wastewaters with a pH of less than 6.0 are generally classed as acidic drainage, an unlikely occurrence in Alberta, due to the low sulphur content in Alberta coal and geological formations. High and low pH levels create intolerable conditions for aquatic fauna. A pH range of 5 to 9 has been found tolerable for most fish with a range of 6.5 to 8.5 considered as good fish fauna waters.

(c) Nitrogen

The primary source of nitrogen in coal mine wastewater is from nitrogen based explosives. Nitrogen is released in the form of ammonia, nitrate and nitrite. Ammonia and nitrite readily oxidize to nitrate (nitrification) under well oxygenated conditions, and therefore nitrate is the major form found in wastewater. Uptake by plants and microorganisms is the primary fate of ammonia and nitrate that is released into receiving waters. When phosphorus is not limiting, high concentrations of nitrogen can increase eutrophication. Depending on the form of nitrogen (nitrate, nitrite, ammonia) and the characteristics of the receiving stream, high concentrations of nitrogen compounds can be toxic to aquatic life.

(d) Iron

Iron almost always occurs in a mildly alkaline or near neutral medium in Alberta and is largely insoluble, or after oxidation, becomes insoluble. Excessive levels of precipitated iron hydroxide or iron oxide have effects on aquatic habitats similar to those of suspended solids. Iron can exhibit toxicity but the level of fish toxicity has been shown, both in Alberta and elsewhere, to be greatly reduced in hard water. This has been attributed to a synergistic reaction with calcium. Due to the hardness of Alberta waters, iron does not normally pose an environmental problem. Some exceptions exist, especially in underground workings; therefore, limitations on iron concentrations in mine wastewater must be evaluated on a case specific basis. A limit on iron is no longer necessary as monitoring data has shown that iron is present as solid iron hydroxide and can therefore be correlated through TSS measurements.