ENVIRONMENT CANADA REVIEW
OF THE
SAGE CREEK COAL PROJECT
STAGE II SUBMISSION

Vancouver, B.C.

JUNE 1982

3726

TABLE OF CONTENTS

TABLE OF CONTENTS

ENVIRONMENT CANADA REVIEW SUMMARY

Environment Canada considers this review as an opportunity to provide advice and constructive comments on preliminary and general environmental planning documents.

It is hoped that this review will be of assistance to the B.C. Coal Guidelines Steering Committee and to the Sage Creek Coal Company in their respective roles of ensuring that the proposed Sage Creek Coal Project would result in a minimum environmental impact (both within and outside British Columbia).

Major Recommendations

Environment Canada strongly recommends that Sage Creek Coal minimize nitrate levels released from the proposed mine by controlling blasting practices. Mine site dewatering should be to the maximum extent possible, blasting below the water table should be minimized wherever possible and available methods for explosives containment should be used.

More detailed hydrological work on bedrock geology and surficial deposits is required prior to mining such that mine site dewatering can be achieved well in advance of active mining.

The need for the Sage Creek Coal Company to strive for maximum effluent quality cannot be overstated. Ongoing monitoring will be required and modifications to sediment settling facilities may be necessary. A commitment should be made at this stage by the Company to carry out the necessary work.

Phosphorus releases to the receiving waters should be controlled rigorously. Chemical phosphate removal should be included in the sewage treatment plant design and phosphates used as detergents at wash facilities should not be allowed to reach receiving waters.

Impermeable geological units or man made liners should underlie those areas likely to generate undesirable constituents e.g. metals and nutrients, to prevent contamination of local ground and surface waters. Monitoring should be carefully instrumented around such areas.

Analyses for barium, iron and polycyclic aromatics should be undertaken in ground waters used for drinking water.

Assurances should be made that all containment control devices will remain functional with minimum maintenance. Responsibilities should be established for the maintenance of such structures and continued long term ground and surface water monitoring programs.

The acid generation potential of the Sage Creek Coal mine should be more closely examined. A monitoring program should be designed to regularly check plant refuse areas and the runoff from the run-of-mine coal piles and pit waters to confirm that acid conditions do not develop. A contingency plan should also be developed should acid generation occur.

Reclamation should be instituted as soon as disturbed areas are no longer affected by mining operations.

More detailed discussion of these recommendations may be found in the text of this review.

Summary Statement

It is Environment Canada's view that sediment and nutrient releases from the proposed Sage Creek Coal Mine pose the greatest potential impact on the Flathead River.

Environment Canada recommends that the relevant Provincial regulatory agency establish additional control objectives for the quality of the receiving waters of the Flathead River, prior to the commencement of coal strip mining in the river basin. These control objectives should include the water quality parameters phosphorus, nitrogen and suspended solids which have the greatest potential for being significantly elevated as a result of the proposed coal development. In view of the Federal Government's obligations under the Boundary Waters Treaty to ensure impacts on U.S. waters as defined by Article IV are prevented, Environment Canada also recommends that federal water quality agencies be conferred with, in establishing and in periodically reviewing these additional receiving water control objectives for the Flathead River.

DETAILED COMMENTS

I. SEDIMENTS AND EROSION CONTROL

Generally, the Stage II Sumbission provides an adequate conceptual discussion of measures to control sediments, although we do have a number of comments on specific issues.

The potential release of sediments must be controlled during the construction phase. We note that certain ponds and drainage facilities are to be installed before construction begins. This should apply to all areas, including haul roads. Similarly, Pond No. 1 or temporary sedimentation facilities should be installed before work begins on the preparation plant site.

We note that during mine operation, runoff from all haul roads is to be contained and directed to settling ponds for treatment. We strongly support this approach in view of the anticipated sediment yields shown in Table 2.11.1-1 - page 2-39 of the Text. Drainage diversion and settling facilities will be required along the haul road to Morrissey in areas of potential erosion expecially in the Flathead watershed. These facilities will be required during both haul road construction and normal operation.

Although the overall design concept used for the settling ponds appears to be adequate, we note some deficiencies. In particular no mention is made of potential short circuiting or measures to reduce this problem such as provision for baffles, optimum length to width ratios or efficient inlet/outlet structures. Potential scouring or re-entrainment of particles is not discussed. Additional test work should be conducted to ensure that ponds will operate as designed including the testing of actual representative overburden materials. A series pond system would seem to be more flexible from both a design and operation standpoint. Flocculent testing should be conducted and facilities installed prior to start up so that they are ready for use before they become necessary. In particular, we note that particles larger than 0.01 mm will be removed, however, grain size analysis curves (p. 11-12 Klohn Leonoff, December 1981) indicate that up to 20% of the material could be finer than this criteria. Flocculants would probably be required to remove these fine particles.

A review of suspended solids effluent quality data for 1980 from Fording Coal's two main settling ponds (see Table I attached) indicates that effluent quality for 1980 at Fording Coal was good with only the maximum suspended solids for the Clode Pond effluent slightyly exceeding the pollution control permit criteria. This is perhaps the best indication that the proper design and operation of settling facilities at Sage Creek

TABLE I - Suspended solids effluent quality data for 1980 from Fording Coal's two main settling ponds (taken from EQUIS)

Site Description	# of tests	Maximum	Minimum	Average
Eagle Pond Effluent (Site PE 0042406)				
TSS * (mg/l)	7	16.0	3.0	6.3
Flow (m^3/d)	11	6748.0	3120.0	5518.2
Clode Pond Effluent (Site PE 0042407)				
TSS * (mg/l)	12	52.0	2.0	15.3
Flow (m^3/d)	15	51621.0	103.0	28929.0

* Pollution Control Permit authorizes 50 mg/l

The above data is presented for illustrative purposes only. The data is for 1980 only and is not intended to imply either the state of compliance of the Fording Coal operations with Provincial Pollution Control Permits or the impacts of the Fording operations on adjacent receiving waters.

should result in effluent suspended solids concentrations meeting similar permit criteria. However, some excursions in effluent quality during high runoff periods may be experienced.

Additional Comments

The distinction between settlement ponds and sedimentation ponds is not clear (p. 2-39; p. 2-42).

The sedimentation pond overflow velocity of 5×10^5m/sec shown on page 2-42 is obviously in error. The Klohn Leonoff Report (December 1981) notes the velocity to be 5×10^{-5}m/sec.

Studies of sediment production in the vicinity of Fording Coal Ltd. by Crozier and Davis (1978) found a major source of suspended solids to be the erosion and bank sloughing of the diversion and interceptor ditches themselves. The clean water ditches around the proposed Sage Creek Coal mine site and the ditching system to and from the sedimentation ponds should be lined with a non-erodable material.

Summary Statement on Sediments and Erosion Control

The need for Sage Creek Coal to strive for maximum effluent quality cannot be overstated. Settling facilities designed on paper cannot be certain to achieve specified efficiencies. The achievement of acceptable effluent suspended solids levels will require the implementation of a rationally designed sediment control scheme. We recommend that Sage Creek Coal conduct further test work and design analyses to ensure that the settling ponds installed are optimized. This additional work should include the examination of the use of flocculents to remove fine particles, testing with actual representative overburden samples, an analysis of expected average and peak hydraulic loading (including the impact of increased pit dewatering on pond efficiencies), a comparison of series versus single pond systems and consideration of methods to reduce short circuiting and particle re-entrainment within ponds.

Further, ongoing monitoring and modifications during construction and operation will be required and a commitment should be made at this stage by the company to carry out the necessary work.

II. GROUND WATER

Large quantities of data have been collected and interpretated in the Pacific Hydrology Consultants Ltd. (1981) ground water report which the Company made available for review. It is hoped that all of their recommendations will be seriously considered and carried out. Data and most interpretations presented in the Dames and Moore (1976) geotechnical report, which the Company also made available, appear sound although their report contains a few flaws or oversights in interpretation. In particular, four large diameter wells in the low permeable rock would be grossly insufficient in dewatering the proposed mine site. The potential dewatering yields from the surficial units also appears to have been underestimated. Additional subsurface information should help clear these matters up.

Specifically, more detailed hydrogeological work prior to mining is required in:

i) bedrock geology - to better understand subsurface fracture flow, ground water volumes and to determine best sites for dewatering holes.

ii) surficial deposits - it is apparent that some of these units will require dewatering before and during mining. The units and their water bearing and yielding capabilities should be more thoroughly understood.

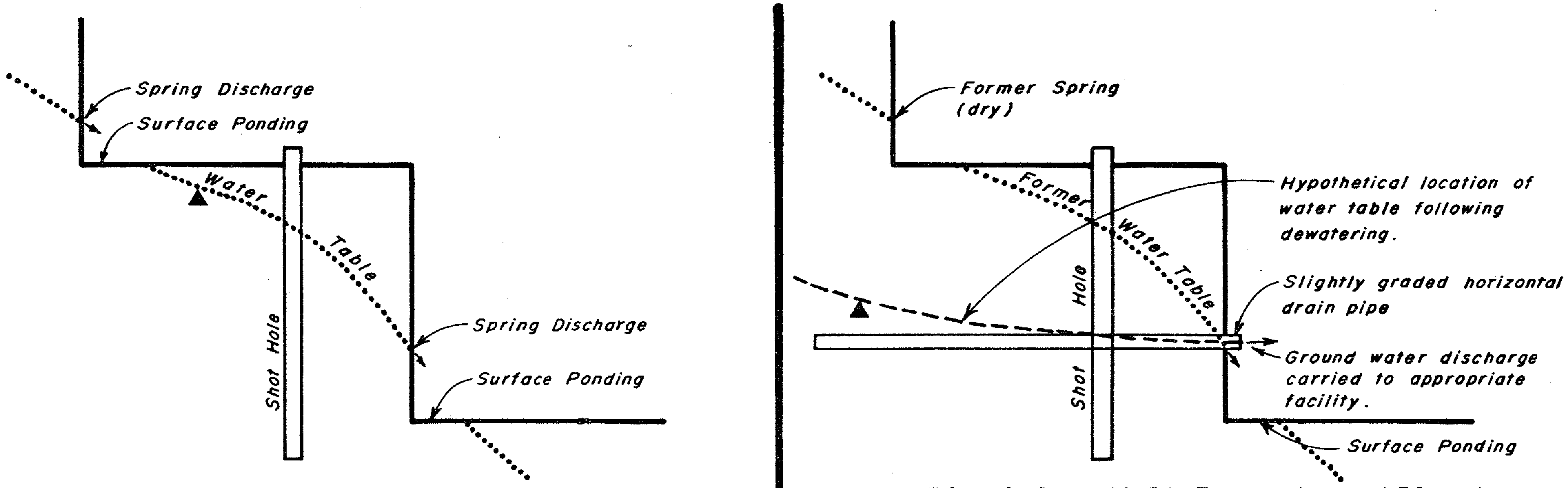
Once the hydrogeological setting is better understood then dewatering holes should be constructed and the vertical wells pumped. Horizontal wells should be placed on a slight grade to effectively remove drainage waters. Due to low fracture flow, considerable time will likely be required to drain much of the bedrock. Dewatering should commence well in advance of active mining.

A number of figures have been prepared to diagrammatically illustrate the effects of various dewatering mechanisms.

Figure 1A shows the large volume of saturated rock within a working bench prior to dewatering.

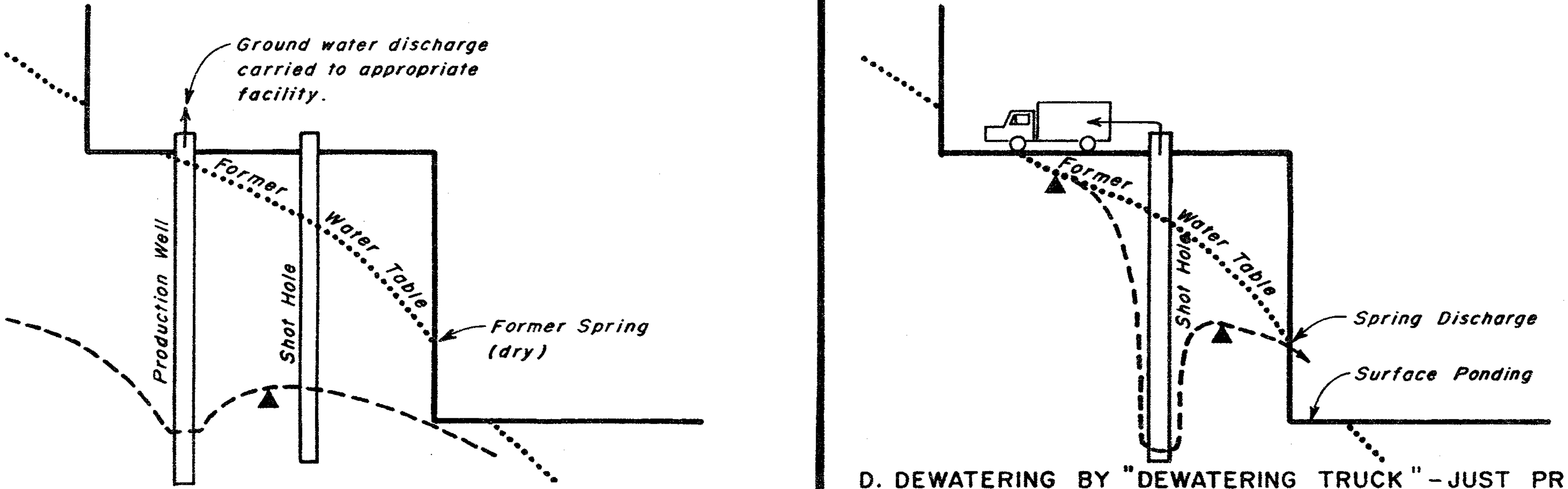
Figures 1B, 1C and 1E show hypothetical locations of induced water tables during dewatering by horizontal drain pipes and (vertical) production wells. Shapes of the induced water tables are controlled by depth of horizontal drain pipe or production well screen, time since dewatering commenced, permeabilities and degree of fracture interconnections,

FIGURE I — INTERPRETATION OF DEWATERING OPTIONS AND SPECULATIVE RESULTS IN CONTOUR BENCH MINING



A. PRIOR TO DEWATERING

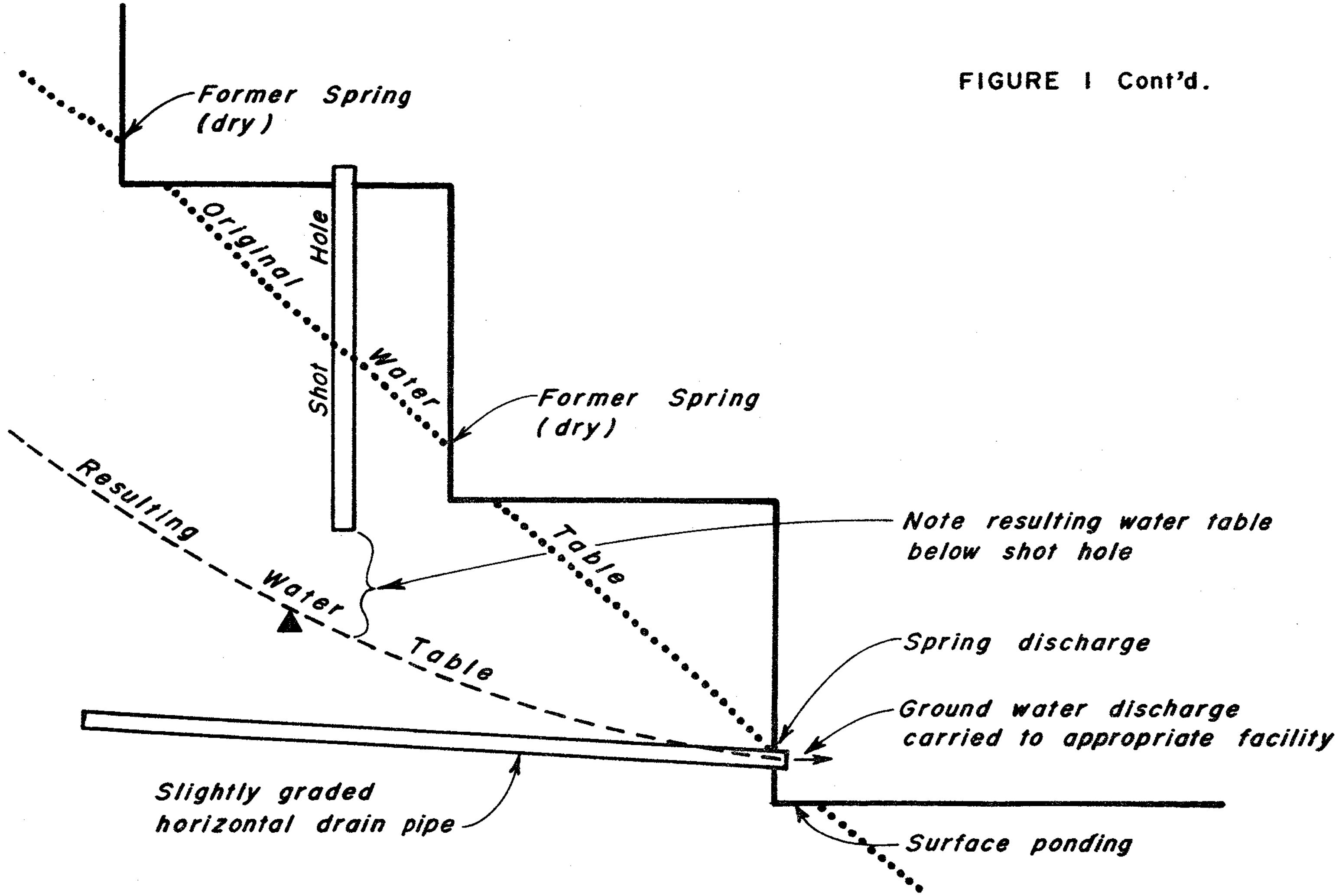
B. DEWATERING BY HORIZONTAL DRAIN PIPES WITHIN WORKING BENCH



C. DEWATERING BY PRODUCTION WELLS

D. DEWATERING BY "DEWATERING TRUCK" - JUST PRIOR TO INJECTION OF EXPLOSIVES

FIGURE I Cont'd.



E. DEWATERING BY HORIZONTAL DRAIN PIPES INSTALLED BELOW WORKING BENCH distances between dewatering devices and other variables.

Figure 1D shows the deep but narrow unsaturated cone of depression around a shot hole when drained by a dewatering truck. This unsaturated cone of depression 'rapidly' recharges when the truck's pump is shut off just prior to explosive injection. The resulting effects will be discussed shortly under potential nitrate contamination.

Ground Water Quality Impacts

The potential impacts of direct ground water disposal to surface waters has not been addressed in the Stage II Submission. Disposal of clean ground water to local streams could affect surface water temperatures. Ground water in the area averages 46°F (7.8°C) (Pacific Hydrology Consultants Ltd. 1981) and generally experiences very little (1-2°C) seasonal temperature fluctuations. Surface waters, however, can experience seasonal temperature fluctuations of 0-18°C.

The addition of the projected 900 l/sec of ground water directly to local creeks may tend to warm the creeks in the winter and cool them in the summer. The potential impacts to aquatic biota has not been considered. In particular the potential triggering or delaying of critical stages in the life cycle of certain species (e.g. overwintering bull trout eggs) may be an important consideration for the location and/or timing of significant volume discharges. Temporary surface storage of removed ground water might eliminate potential problems when ground water-surface water temperatures are incompatible for blending particularly during low stream flows in January and February when dewatered ground water discharge could exceed natural stream discharge.

It has been reported that highly mineralized ground water occurs naturally at depth beneath large portions of the Appalachian coal belt and the U.S. midcontinent regions. The removal of substantial quantities of water during dewatering can lower the hydrostatic head in the shallow zones to an extent that upwelling of the deeper mineralized water takes place thereby contaminating the shallower aquifers. The proposed long term ground water monitoring program should give advance warning if such conditions should apply at Sage Creek.

Tailings and settling ponds, local landfill, machine maintenance yard, coal washing facilities and rock waste dumps should be constructed on soils or geological units of very low permeabilities. Containment facilities should be constructed to ensure minimal harmful effluent or leachate egress beyond the designed structures. Liners should be installed under such facilities where there is threat of contaminant seepage into subsurface materials.

Preventative measures should be taken to control contaminated surface waters from entering ground waters. More information on local surficial geological materials will be required before such action can be taken. Piezometers located in critical areas will provide information on effects of surface activities. Selected locations of proposed plant operations might be reconsidered when additional surficial geological data becomes available.

Although p. 2-48 of the Text states that "Ground water in the vicinity of the proposed pits is currently within drinking quality standards"; the Stage II studies report no barium measurements or complex organic measurements such as phenols and polycyclic aromatics for the waters of the artesian wells or drill holes. Barium levels in surface waters of the Flathead River Basin have been measured above Canadian drinking water standards (1.0 mg/l, Department of National Health and Welfare 1978) at a period when discharge is low and ground water contributions to base flow are likely high. The potential for high barium levels in ground water seems great and monitoring clearly is required. Since the quantity of water pumped during dewatering and added to local creeks will be substantial, high barium levels could affect surface water quality. The recommended limits for iron in drinking water is 0.3 mg/l. Levels for iron in the artesian wells reported in Appendices 3.3.3-1 page 15 and 16 vary from 0.500 mg/l to 0.670 mg/l. Analyses for these constituents should be undertaken in ground waters used for drinking water.

Summary Statement on Ground Water

A great deal more information is required on the nature and thickness of the surficial geological deposits onlapping the valley walls and on the valley floor. Particular attention should be placed on the permeabilities of the various units to provide more realistic predictions of ground water dewatering estimates and to outline areas threatened by contaminated waters seeping into these units. These areas should be mapped by a surficial geologist and an extensive drilling program carried out under the supervision of an experienced hydrogeologist. Piezometers should be installed to supplement the existing data base, to later assist in measuring the effectiveness of dewatering and to monitor changes in ground water quality during the following mining activities.

Although a great deal of information is known about the local bedrock geology, very little information is known about the complex ground water flow regime within the rock. It is felt that additional holes should be drilled under the supervision of the above mentioned hydrogeologist with piezometers installed to monitor the parameters mentioned above. Numerous long-term pumping tests should be carried out on a number of these piezometers and/or production wells to provide a sound data base in planning the site dewatering programs.

The company should employ a full time experienced hydrogeologist to supervise the previously mentioned drilling programs, the dewatering and long term ground water monitoring programs. Once a significant data base on the physical hydrogeological parameters of the surficial and bedrock units is established, one or more of the various available computer models to predict drawdown rates of dewatering sites may be used. These models may also serve to more accurately predict pumping rates, estimate time required for dewatering, select ideal number of dewatering holes and hopefully coordinate dewatering plans with the mining schedule.

III. NUTRIENT CONTROL

Potential nutrient inputs and their impacts are understated in the Stage II Submission.

Nitrogen

For comparative information, we reviewed a 1980 EQUIS data summary for nitrate (NO_3) levels at Fording Coal Ltd's settling pond, pit water and Fording River sampling stations (see Table II). We have noted that there are no limits for nitrate established in the Pollution Control Permit for Fording Coal. With the exception of the South Greenhill pit water, the effluent data shown in Table II are below the upper limit of 25 mg/l recommended in the Pollution Control Objectives for the Mining, Smelting and Related Industries of B.C. (1979).

Nitrate levels in the Fording River downstream of the Fording Coal operations have been significantly elevated with maximum levels of 8.5 mg/l recorded in 1980. Crozier and McDonald (1980) concluded that downstream of Fording Coal Ltd's strip mine operations, nitrogen concentrations are substantially increased by leaching of nitrogen based explosives residuals.

It remains a concern that levels of nitrate discharged from the proposed Sage Creek Coal project to the Flathead River drainage might be as high as those measured from the Fording Coal operation. Perhaps the most serious concern on site will be potential nitrate contamination of ground and surface waters. In particular, the release of nitrates from ANFO explosives detonated in wet shot holes or lost and wetted in subsurface units is of most concern. Recent discussions between staff in Environment Canada and provincial monitoring agencies have indicated that a major reason for the elevated nitrate levels in effluent from Fording Coal is the amount of blasting done below the ground water table where nitrates are released from explosives.

A number of diagrams have been prepared to illustrate potential losses of explosives through shot holes.

Figure 2B shows the most ideal situation in which no explosives are lost or wetted due to explosives containment by polyethylene liners frequently

TABLE II - Nitrate levels at Fording Coal's settling pond, pit water and Fording River sampling stations during 1980 (taken from EQUIS)

"Nitrates" as NO_3 (mg/l)

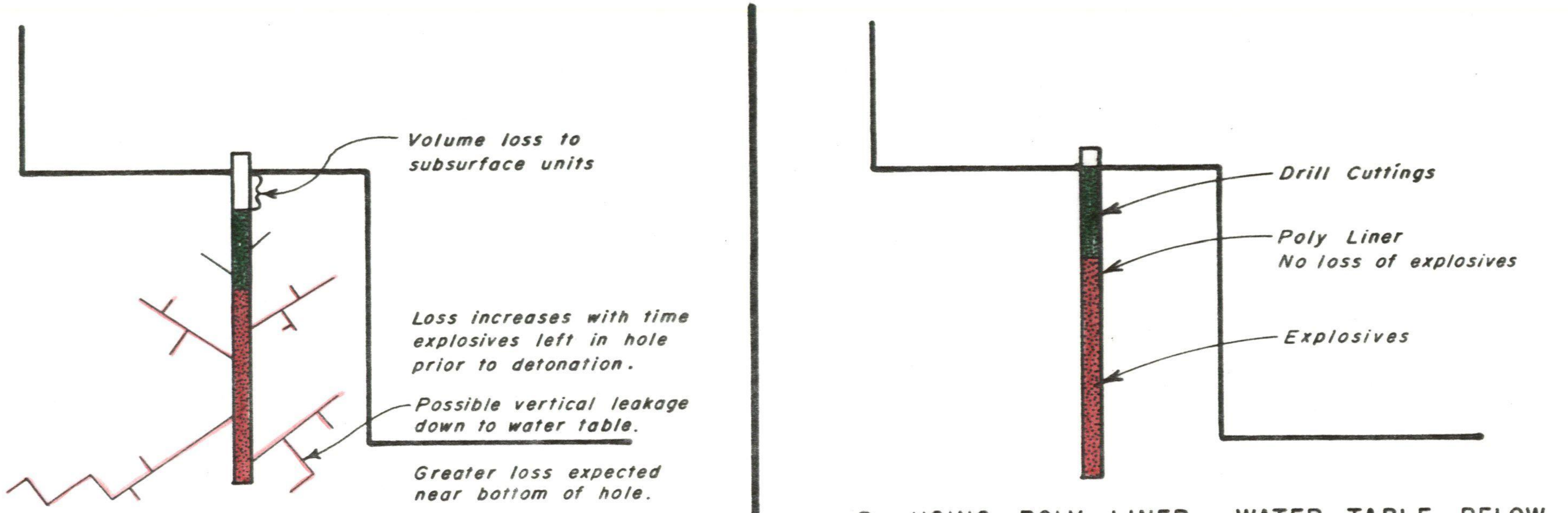
Site Description	# of tests	Maximum	Minimum	Average
Clode Settling Pond Effluent (Site PE 0042407)	7	14.7	6.3	9.4
Eagle Settling Pond Effluent (Site PE 0042406)	5	22.5	15.2	17.9
North Greenhill Pit Water (Site 0225067)	5	20.8	9.4	16.5
South Greenhill Pit Water (Site 0025069)	7	37.6	25.9	32.8
Fording River - Upstream (Site 0200251)	7	0.08	L 0.02	0.05
Fording River - Downstream of Kilmarnok Creek (Site 0200271)	40	8.4	0.5	1.8

Note - Nitrate is the most predominant form of nitrogen present followed by ammonia and then nitrite.

- The Objectives for the Mining, Smelting and Related Industries of B.C. (1979) quote the allowable range of Nitrate/Nitrite (as N) as 10.0 - 25.0 mg/l.

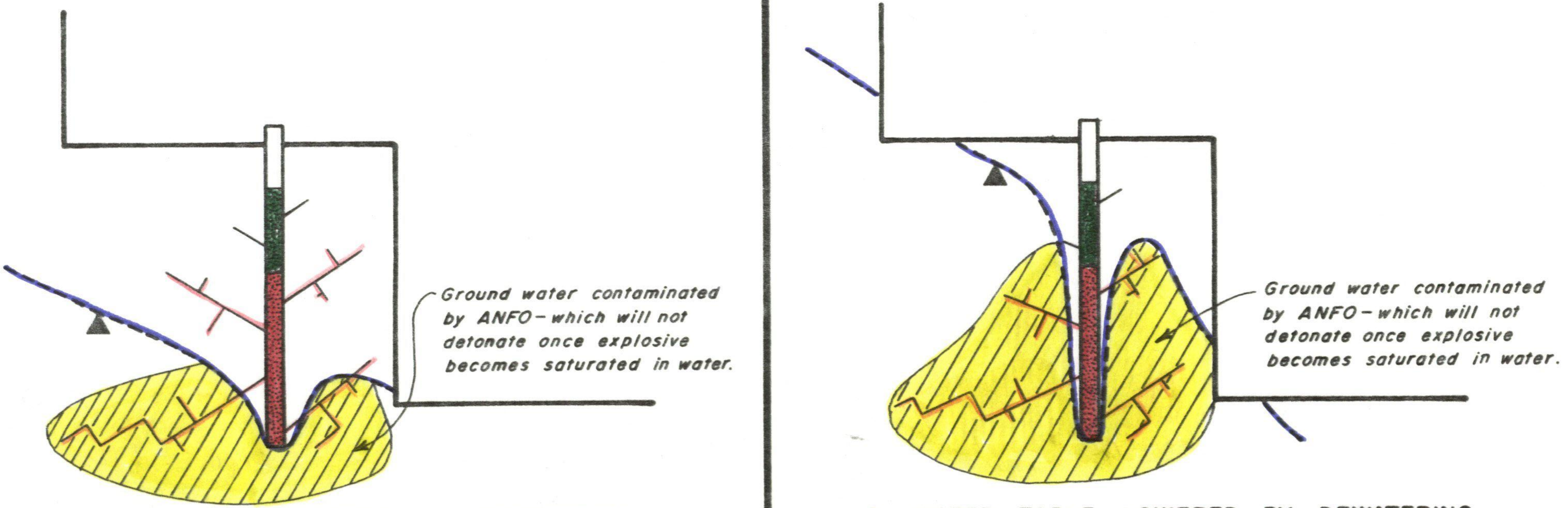
The above data is presented for illustrative purposes only. The data is for 1980 only and is not intended to imply either the state of compliance of the Fording Coal operations with Provincial Pollution Control Permits or the impacts of the Fording operations on adjacent receiving waters.

FIGURE 2 – POTENTIAL LOSS OF EXPLOSIVES THROUGH SHOT HOLE



A. WATER TABLE BELOW SHOT HOLE

B. USING POLY LINER – WATER TABLE BELOW OR ABOVE BOTTOM OF SHOT HOLE



C. WATER TABLE LOWERED VIA DEWATERING PROGRAM AND BY DEWATERING TRUCK

D. WATER TABLE LOWERED BY DEWATERING TRUCK ONLY used in the mining industry.

Figure 2A shows the water below the bottom of the shot hole with explosives loss to permeable subsurface units. Vertical leakage through large interconnecting fractures or inter-granular voids to the water table is possible. It is not known whether explosives slightly dampened in these fractures will detonate. If they do not detonate they could contaminate surface and ground waters following rainfall. Because such loss is considered to be minimal, polyethylene liners should not be required under these circumstances.

Figures 2C and 2D show ground water directly contaminated when no liner is used and when the water table lies above the base of the bore hole.

Special precautions should be taken if blasting operations require use of ANFO with a dewatering truck. According to the CIL Borehole Dewaterer Booklet, common practice is for the dewatering truck to remove water from a shot hole and then for the hole to be filled with explosives (see Figure 1D). This is repeated a number of times until the desired shot holes along the working bench have been dewatered and filled with explosives. Shot holes can number from a few to over 100. When large numbers of holes are used explosives can be left standing overnight, allowing sufficient time for additional ground water to become contaminated as saturated explosives flow out into the formation.

In order to prevent nitrate contamination of ground water Environment Canada recommends either:

1) the working bench be fully dewatered prior to blasting,

2) all wet shot holes be detonated with ANFO in polyethylene liners or,

3) less soluble nitrate based slurry explosives such as CIL's power gel or aqueous nitrate emulsion should be used in areas which are not fully dewatered.

If nitrate contamination is to be kept to a minimum then heavy duty double lined polyethylene liners should be used with ANFO in all wet blast holes. This would prevent explosive leakage and minimize nitrate contamination of ground water.

Nitrate contamination from explosives plant spillage and dust discharges around the explosives mixing plant should also be minimized. Drainage should be minimized with dry clean-up wherever possible. For example, facilities constructed by CIL at the Utah Mines - Island Copper Mine have:

i) concrete floors around the explosives plant directing runoff to containment facilities,

ii) special delivery systems designed to control spillage and dust loss during off and on loading,

iii) concrete lined explosive truck washing area which carries wash water to containment facilities.

Similar facilities should be constructed at Sage Creek.

It is recommended practice (Department of Energy, Mines and Resources, Explosives Branch 1979) to discharge damaged, dated or unwanted explosives (or explosives ingredients) directly to the soil or to ponded water. At Sage Creek, alternative disposal methods should be carried out such as detonation, burn or other disposal methods which will not result in nitrates leaching into local waters.

Nitrate Removal from Waste Waters

It is stated in the Stage II Submission that treatment will be instituted if effluent nitrate levels are found to be elevated, but there is no discussion of potential treatment schemes. It is recommended that the Sage Creek Coal Company provide details of the treatment options available for nitrate control.

The effectiveness of denitrification systems to control effluent nitrate loadings from the proposed Sage Creek Coal Project are uncertain as there appear to be few treatment options available for handling high volume - low strength nitrate waste waters. At source control is probably the most efficient means of minimizing effluent nitrate concentrations.

Summary Statement on Nitrogen Control

In view of the threat of subsurface nitrate contamination and since at source control is probably the most efficient means of minimizing effluent nitrate concentrations, it is strongly recommended that site dewatering be initiated as early as possible. All benches where blasting would take place should be thoroughly dewatered to minimize nitrate contamination. Slightly graded horizontal drain holes as recommended in Pacific Hydrology Consultants (1981) report - if installed early and at depth - could provide an effective dewatering system.

ANFO explosives should be placed in heavy duty, double walled polyethylene liners in all wet shot holes or less soluble nitrate based slurry explosives should be used in areas which cannot be completely dewatered.

The explosives plant should be specially designed to minimize the threat of nitrate contamination of local wash and runoff waters.

Phosphorus

Phosphorus control is very important particularly since there is a potential for significant nitrogen loadings to the Flathead River. The Stage II Submission (page iii) states that sanitary sewage will be treated and discharged to a drain field. Environment Canada recommends that chemical phosphate removal be included in the sewage treatment plant design. Care should be taken in the design of the sewage treatment plant to ensure that effluent quality will be maintained when the construction camp input is discontinued. Any truck wash facilities should use a low phosphate detergent and phosphates from this source must not be allowed to reach the receiving environment.

Page 4-2 of the Text makes only passing reference to "phosphate lenses which are found upstream of the mine". A more thorough analysis of core samples would have helped to define the potential for phosphate bearing rocks being exposed. According to the Geological Survey of Canada (Douglas 1970) phosphate rock occurs in three geological formations common to the southern Rocky Mountains. An examination of the Howell Creek Structure Geological Survey of Canada technical survey map (Price 1965) finds all three of these formations present. Given the sedimentary depositional environment of these geological formations, phosphate could also be finely disseminated within some of the other formations in the area. The likelihood of substantial amounts of phosphate bearing rocks ending up in waste dumps where phosphate may be leached out to receiving waters is left unanswered.

IV. POTENTIAL IMPACTS ON RIVER PERIPHYTON FROM NUTRIENTS

Phosphorus

All available evidence is consistent with the conclusion that periphyton biomass in the Flathead River is low (oligotrophic) and that the benthic algae are phosphorus, not nitrogen, limited. Species composition is "typical" of oligotrophic rivers. The inorganic N/P ratios of river waters are 15-25 (60-80 µg/l NO_3+NH_4; L 5 µg/l soluble reactive phosphorus and intracellular total N/P ratios of periphyton are 20 (Sheehan et al. 1980). Both of these are at least double the generally accepted ratio of about 10 to 1 for uptake by the algae.

Therefore, in relation to Flathead River eutrophication, the nutrient of concern is phosphorus. The fact of phosphorus limitation has several important implications. Because of low background P levels (well below growth saturation) phosphorus control will need to be rigorous. For instance, even small increases may be enough to produce periphyton blooms. This is because of the nonlinear nature of the P vs. growth relationship of the periphyton. Stockner and Shortreed (1976) in a study of a low nutrient stream on Vancouver Island (.0015-.0028 mg/l total phosphorus) found that a nutrient addition of two times the ambient concentration caused a tripling of algal biomass.

Nitrogen

Clearly the control of nitrogen alone will not guarantee prevention of algal blooms if P does increase. P could approximately double (from 3-5 to 6-10) before nitrogen would replace phosphorus as the limiting nutrient. However, increases in nitrate from the mine would have an effect if phosphorus concentrations do increase above the 6-10 µg/l level. The initial effect will be to increase standing crops in the immediate downstream reaches of the river, but once algal growth saturation is reached (probably in the 10-15 µg P/l range) the effect will be to increase the downstream areal extent of the periphyton infestations in the Flathead River. Since only about 6% of the Upper Flathead Basin drainage lies in British Columbia (Department of Natural Resources and Conservation 1977), there is a potential for future increases in phosphorus concentrations in the Flathead from other unrelated downstream activities. High nitrate waters originating from the coal operations at Sage Creek could pose the threat of combining with any downstream effluents containing phosphorus to result in nuisance growths of river periphyton.

V. CONTROL OF IMPACTS OF SEDIMENT AND NUTRIENT LOADINGS ON RECEIVING WATERS

The Pollution Control Objectives for the Mining, Smelting and Related Industries of British Columbia (B.C. Ministry of Environment 1979) has established a range of 25-75 mg/L (variances may be allowed during periods of excess run-off) for total suspended solids, a range of 10-25 mg/L for nitrite/nitrate (as N) and a range of 2-10 mg/L for phosphate (Total P biologically available in effluent). These Provincial objectives are for the final effluents discharged and are intended in part to provide for the use of the environment's assimilative capacity within limits which do not lead to unacceptable conditions. The limits of assimilative capacity and therefore the potential impacts of loadings of sediment and nutrients to the Flathead River are, of course, dependent upon background levels and dilution. Although the Provincial objectives for the Mining Industry also include some control objectives for receiving water (e.g. Turbidity - not more than 5 JTU above the natural value), there are no comparable receiving water control objectives for total suspended solids, nitrite/nitrate, or phosphate.

In view of the federal government's obligation under the Boundary Waters Treaty to ensure impacts on U.S. waters as defined by Article IV are prevented, Environment Canada recommends that the province of British Columbia establish additional control objectives for the quality of the receiving waters of the Flathead River. These objectives should include the water quality parameters phosphorus, nitrogen and suspended solids and it is further recommended that federal water quality agencies be conferred with in establishing and in periodically reviewing these receiving water quality control objectives.

VI. CONTAMINANTS CONTROL

Selected preliminary investigations should be carried out to determine the potential for release of heavy metals and release of other organic and inorganic constituents from all waste materials. No information has been provided in the Stage II Submission on the chemical constituents that may be leached from coal over-burden piles and coal stockpiles. Will changes in pH affect levels of polycyclic aromatic hydrocarbons (PAH's) and metals that may occur in leachates? Certain polycyclic aromatic compounds in coal are known to have sublethal or toxic effects on aquatic organisms (Neff 1979).

Detailed field mapping supplemented with bore hole data will be required in the vicinities of those areas where potential contaminants might be generated and released. Impermeable geological units or man made liners should underlie those areas, likely to generate undesirable constituents, to prevent contamination of local ground and surface waters. Monitoring should be carefully instrumented around such areas to ensure that undesirable leachates and effluents are minimized and contained.

On page 2-23, section 2.6.2 mine coal handling, there is a reference to the fact that raw coal piles will be established but the size and location of the piles is not indicated.

On page 2-26, section 2.6.7 clean coal handling, there is a reference to the fact that an emergency coal storage stockpile of 50,800 tonne capacity will be provided and there will be a bin storage capacity of 7,600 tonnes for one day's production. What constitutes an emergency situation? How many days of the year will the emergency storage areas be used and why is the bin storage only designed for one day's storage?

At source containment of oil and grease must be a priority. The tailings pond should not be used as the sole oil and grease control facility. In the fuel storage area, the tank farm berm and floor must be impermeable. There must be provision for stormwater treatment from the tank farm containment area. An over-the-dyke drainage system as recommended by the B.C. Petroleum Association (1980) should be installed. Spill control facilities must be available at the truck loading and unloading area.

The conceptual design of the tailings pond seems rational although much detailed design work remains to be done. Coarse grained alluvial deposits along the periphery of the tailings pond could result in significant seepage. This should be considered in the final designs. If a relocation of the coal plant and tailings pond is indicated, it would be desirable to locate these facilities away from the present site at the confluence of Howell and Cabin creeks. The site would then be available for extensions to the sedimentation facilities and/or denitrification facilities that may be required in future.

No details on the type and quantity of chemicals to be used in the coal preparation plant are provided in the Stage II reports.

It is stated on page 4-11 that chemical additives are to be sprinkled on the roads to control dust. No details on the type of chemical to be used or environmental consequences are discussed. These details should have been provided in the Stage II Submission.

Mitigation measures for the cleaning up of all potential contaminants should be more clearly addressed. This includes collection methods and treatment of all effluent discharges from anticipated and potential containment sources. These facilities should be designed for long-term use following mine abandonment. Assurances should be made that all containment control devices will remain functional with minimum maintenance. Agreements should also be made on establishing responsibilities for the maintenance of such structures and continued long term ground and surface water monitoring programs.

A contingency plan should be assembled which outlines actions that will be implemented during emergency situations (such as accidental spills, floods or dyke failures) in order that the potential environmental impacts on the Flathead River are minimized.

VII. ACID GENERATION POTENTIAL

Coal mines can potentially have an acid drainage problem upon the oxidation of its associated pyritic materials. In some parts of North America, notably the Appalachian region, acid drainage has led to serious environmental damage. The Stage II Submission states that the Sage Creek mine is not expected to be an acid producer since all samples of overburden and coal tested, "consumed more acid than could theoretically be produced from the contained sulphur." However, it is not possible to assess the acid generation potential of the mine or the adequacy of any mitigating measures proposed because of the following:

(1) The detailed test results of the acid-producing potential of the coal and overburden were not included. This is particularly important in light of the ambiguity surrounding the results on coal seam #4 (see Appendix 4.3.5-1 page 2).

(2) In addition not all sources of potential acid generation were tested such as coal seam 1 and 3. These seams are reported to be not economically recoverable (page 2.5 of Text) and presumably will be discarded with the overburden in the waste dumps. In light of the proposed mine development plan, this coal in the overburden could likely be exposed to weathering for a considerable period of time before reclamation occurs, thus posing a potential acid generation threat. Similarly there is a need to better describe the sulphur content of various geological stratas of the overburden since some of it will be used for road construction and/or reclamation.

(3) There is a lack of information on inseam as well as between seam variability in sulphur content. Variability in sulphur content is acknowledged in section 2.6.6, page 2-25 of the Text and states that "sulphur content of the coal averages 0.5% and has a maximum of 0.8%." However these levels are not related to any coal seam.

(4) The plant refuse area, discussed in section 2.6.8, page 2-26 of the Text, is to receive refuse from the coarse and fine circuits of the rotary breaker but it is not clear whether the solid wastes from the coal burning thermal dryer will also be deposited there. In section 4.2.2.3, page 4-12 of the Text, it mentions that ash from the coal burning dryer will likely retain 50% or possibly more of the coal's sulphur. The likelihood of this ash, leading to an acid production problem is not considered and no special mitigation measures or any monitoring of the refuse are proposed.

It is recommended that the acid generation potential of the Sage Creek Coal mine be re-addressed in light of the above-mentioned points. Also, a monitoring program should be designed to regularly check the plant refuse areas and the runoff from the run-of-mine coal piles and pit waters to confirm that acid conditions do not develop. A contingency plan should also be developed should acid generation occur.

VIII. CLIMATOLOGY

Hydrometeorology

In general the Stage II studies have done an adequate analysis of the precipitation climate of the region. The consultant has done a satisfactory and detailed analysis using available data. We concur that long-term data from Fernie-Natal region are more relevant that those from the Cranbrook area. An additional reference that could have been used is:

NOAA Atlas 2
Precipitation - Frequency Atlas of the
Western United States,
Volume I - Montana

In that reference, mapped values of 24-hour precipitation just south of the U.S. border are in the 75-115 mm range for 50-year return periods, depending on elevation and aspect.

The Stage II Submission "strongly recommends that a considerable safety factor be included in any critical engineering designs which may be based on the rainfall intensities presented." Furthermore, it is concluded that, due to the presence of snow cover at the time of maximum 24-hour rainfalls, "discharge predictions based on rainfall intensities must include a provision for water derived from snowmelt." In both cases the advice is sound. The design values suggested for 1-day events appears reasonable given they include safety factors in critical design areas.

Wind

The north-northwest to south-southeast orientation of the Flathead Valley suggests that surface winds would tend to blow from either of these directions. The report, however, states that "all records available exhibit a predominance of westerly winds, likely representative of the predominant wind conditions at the mine site." Data from Cranbrook Airport show the prevailing wind there is southerly (with a secondary maximum of westerly winds). Also the short-term record (April to October 1976) given in the K.F. Harry (1977) reference indicates prevailing southerly winds with frequent north and northwest winds. This is what might be anticipated for the terrain. The Harry study indicates the winds at the mine site are generally light with a fairly high frequency of calms.

Air Quality

In view of concerns expressed for potential air quality impacts in U.S. Glacier National Park and in Waterton Lakes National Park, the Stage II assessment of impacts on trans-boundary air flows were examined.

Expected concentrations of sulphur dioxide at the International Boundary which would result with northerly winds were calculated. In order to make these calculations, additional information on stack diameter (2.3m), emission temperature (65.6°C) and exit velocity (25.4 m/sec) which were not provided in the Stage II reports were requested and received from the Sage Creek Coal Company. Environment Canada's Atmospheric Environment Service preformed the analyses using a simple Gaussian dispersion model, and using the Alberta Environment program "STACKS" (Ref: Guidelines for Plume Dispersion Calculations", Alberta Environment 1978). Results indicate that concentrations of sulfur dioxide and oxides of nitrogen at the U.S. border will be close to those predicted in the Stage II Submission and within the Montana State guidelines (see attached copy of Ambient Air Standards for the State of Montana, Appendix A). The following short table, although it does not look at every case, will illustrate this.

PREDICTED CONCENTRATIONS AT INTERNATIONAL BOUNDARY

	Sage Creek State II	A.E.S. Calculation	Montana Guidelines
SO_2 - 1 hr. avg., inversion conditions	.034 ppm	.012 ppm	.5 ppm (not to exceed 18 times per year)
NO_2 - 1 hr. avg., inversion conditions	.019 ppm	.012 ppm	.3 ppm (once per year)

The potential for a fugitive dust problem was also assessed using ideas and data from "Survey of the Fugitive Dust from Coal Mines" prepared for EPA, Region VIII, Office of Energy Activities, Denver 80295 by PEDCo - Environmental Inc.

That survey report (p. 35) indicates fallout is highly dependent on the stability of the air. Using the rates indicated, and the frequency of occurrence of the various stability classes at Cranbrook Airport (the nearest point for which such data are available) we estimate 78 percent of the emitted dust would fall out before travelling 10 km, i.e. before reaching the International Boundary. The particulate concentration at the International Boundary is estimated to be 7 g/m^3, a value similar to that given in the Stage II reports and within the Montana guidelines. These calculations assumed a wind speed of 2 m/sec^{-1}, stability class D and dust emission rate of 57 kg/hr (coal preparation) +22 kg/hr (dryer with 98% scrubbing) +110 kg/hr (paved haul road, 85% control), and used equation 2 of the PEDco report.

Our analyses tend to confirm the proponent's calculations of pollutant concentrations at the U.S. border. It is therefore unlikely that the Montana Air Quality Standards (see Appendix A) would be violated. On the other hand, U.S. Glacier National Park is considered as a Class I, P.S.D (Prevention of Significant Deterioration) area and the Class I air quality standards are more stringent. Values for sulphur dioxide and TSP (total suspended particulate) under P.S.D. regulations are given in the following table:

ALLOWABLE AIR QUALITY INCREMENTS FOR SO_2 AND TSP UNDER U.S. E.P.A. P.S.D. REGULATIONS

		Allowable Air Quality Increments		
Pollutant	Average Time	Class I µg/m^3	Class II µg/m^3	Class III µg/m^3
SO_2	1 year	2 (.001 ppm)	20 (.008 ppm)	40 (.015 ppm)
	24 hours	5 (.002 ppm)	71 (.027 ppm)	182 (.068 ppm)
	3 hours	25 (.009 ppm)	512 (.192 ppm)	700 (.263 ppm)
TSP	1 year	5	19	37
	24 hours	10	37	75

Allowing for the fact that modelling results are only accurate under ideal conditions to within a factor of two, it seems almost certain that Class I standards would be violated.

It is strongly recommended that the proponent carry out a more detailed analysis of the air quality implications for transboundary flow of air pollution from the proposed mine. The proponent's report on this analysis should give details of analytical methods, assumptions of models used and should suggest measures to be taken to prevent violation of the Class I standards.

Because the proposed coal mine will be in a valley where evidence indicates the prevailing winds are northerly or southerly, it is unlikely that the mine would pose any significant threat to the air quality of Waterton Lakes National Park.

Additional Comments on Air Quality Impacts

The Stage II Submission does not provide any details of the modelling procedures and it is therefore difficult to assess the appropriateness of the model used.

Page 4 - 9 notes that in no event will provincial or federal air quality objectives be exceeded. Amendments to the Ambient Air Quality Objectives, No. 2 and No. 3 of the Canadian Clean Air Act are attached (see Appendix B). If a packaged incinerator is used for waste disposal, Environment Canada suggests that Sage Creek Coal also note the federal guidelines for packaged incinerators (copy attached, see Appendix C).

Also attached for reference is a copy of the U.S. Environmental Protection Agency Standards of Performance for Coal Preparation Plants (see Appendix D).

IX. SURFACE WATER HYDROLOGY

The surface water hydrology portion of the Stage II Submission lacks a statement of objectives. Clearly, the stated aim should have been to provide an estimate of the errors in the data and analytical techniques used. Such errors and therefore inherent risks in utilizing the extrapolated design flows could then be used in decision making processes. Some confidence intervals have been estimated and some observations have been made concerning the quality of the data set, but they should have been expanded and more predominantly displayed in the reports.

The surface runoff evaluaton of the Cabin Creek coal area can reasonably utilize streamflow data from four stations for varying periods of record:

	Flathead River	1929-1980,
	Couldrey Creek	1974-1980,
	Howell Creek	1978-1980,
and	Cabin Creek	1978-1890.

The Consultant also chose to bring in data from the Elk River stations and stations in Southwestern Alberta on the other side of the Divide. However, he failed to show that this additional information improved his estimates.

The potential extreme discharges have been adequately covered in the report but the long-period flood frequency analysis has outstripped the data, that is, numbers are produced from unwarranted extensions of the data. However, the short-term analysis is good and sound methods have been used. The specific hydrologic study needs are adequately covered with the exception of sediment studies.

Several specific questions and observations are raised:

It is stated on page 2-41 that culvert gradients will be matched to stream beds, however, it would be preferable to match current velocities. This would necessitate taking into account culvert roughness.

On page 3-23 it is stated that "The regional variation in runoff is similar to the distribution of annual precipitation". There should be a high correlation between annual runoff and annual precipitation. Is there something more implied by this statement? On the same page, paragraph three, there is a confusing comparision of the hydrologic response of the Flathead River with several of its tributaries. The periods of the first set of data are not given; for the second set the response of the Flathead is considerably lower (549 mm) than the response over the unspecified period (756 mm) and the response of Cabin Creek (625 mm) is greater than the Flathead, in contradiction of the first sentence in the paragraph. If this is used in a "professional judgement" (Page 3-29) adjustment, then the adjustment may be questioned.

On page 3-27 the point is well made that there are different mechanisms producing floods. Therefore multimodal flood distributions should be expected but the annual peak flow never occurred in the fall for the period of record.

On page 3-28, where did the criteria for predicted discharges come from? Later in the report Pugsley's criteria for extension of extreme precipitation events is provided. Granted precipitation is a point process open to greater variability than runoff, but extending six years of data to produce 50-year return period is extending data beyond their elastic limit.

On page 3-29, why was log normal distribution chosen and what were the "minor adjustments based on professional judgement"? This could be unwarranted tinkering.

On page 3-31 it is stated that "Extreme floods more likely occur in association with intense rainstorms of rain on snow ...". Is this speculation or can data be brought forward to support the thesis? Has a plot been made of ratio of instantaneous to mean daily discharges versus the mean daily discharges, specifying cause of occurrence?

On page 3-31 Couldrey Creek data are analyzed. What is meant by the statement "predicted discharges show a similar trend to those of the Flathead?

On page 63 of Appendix 2.11.1-1 the 25 year flood for Couldrey Creek is given as 33 m^3/sec, on page 3-30 of the Text the 25 year flood is given as 63 m^3/sec, so a better description of methods and implications is required.

Although page 3-34 presents evidence that large floods have occurred recently (last 25 years), there is no discussion of how large they were or what the impact of floods such as these would be on the coal project.

On this same page, a reference should be made to Appendix 3.3.2-2, page 4, which provides a table of photography available.

The conclusion on page 4-17 regarding greater than average precipitation and runoff contradicts the current trend according to the results (on page 3-25) which suggests precipitation and runoff may be declining. However, since no techniques for reliably projecting trends exist, there can be little done other than to include a warning.

The statement on page 4-20 "...tailings pond is considered to be beyond the limit of the design (200-year) event" is confusing. Is the pond beyond the Cabin Creek floodplain at 200-year flood or has the pond the capacity to contain the 200-year flood in the small creek flowing through it? Numbers should be specified as the breaching of a pond could lead to serious water quality problems.

Page 4-41 states that the southeast corner of waste rock dump E will be protected from the 200 year flood by coarse sandstone riprap. Well graded riprap or transition filters between the dump material and riprap will be required to adequately protect against the potential loss of fine material. It will also be prudent to check the sandstone for durability. The 200 year flood would encroach on Pond No. 4, possibly to a greater degree than just the two edges as suggested on page 2-42. We recommend that more riprap protection be provided. Alternatively, to further minimize risks to the adjacent biologically important Howell Creek, the pond and its decant discharge should be relocated perhaps by an expansion of Pond 3.

The Stage II Submission states on page 4-16 that "As no surface water will be withdrawn from creeks in the mine site area, the downstream water supply will not be affected by the project". In the event domestic supplies cannot be drawn from ground water and surface waters are relied upon, a water intake located upstream of the mine's influence would have to be certain to avoid instream impacts, particularly at low natural discharge periods.

X. SURFACE WATER QUALITY

According to Figure 3.3.3.1 the U.S.G.S. and Environment Canada's Inland Waters Directorate have joint sites at the same places throughout the basin. This is incorrect. The U.S.G.S. has only the one station at the International Boundary.

Table 3.3.3.-1 on page 3-41 identifies the water quality study Environment Canada undertook in 1975-76. It should also be noted that a subsequent monitoring program was initiated in 1979 on the Flathead River at the International Boundary and at Sage Creek. This latter monitoring program includes several parameters.

The second paragraph on page 3-42 indicates a peak value for turbidity of 75 NTU's occurred in the Flathead River during May/or June, but the data in Appendix 3.3.3-5 shows a peak value of 90 NTU.

The maximum sediment load of 51,543 tonnes/day (May 11, 1976) quoted from Knapton (1978) on page 3-42 fails to point out that this maximum measurement was made at Columbia Falls which is located many kilometres downstream of the International Boundary.

The statement on page 3-42 that "The Flathead River at the International Boundary (site 4) was clearer than site 3 during the spring, presumably due to settling of material in the stretch of river between these points" is speculative. Local conditions could have resulted in increased sediment load to the river at site 3.

Page 3-43 quotes a maximum nitrate concentration value of 0.8 mg/N/liter as being recorded at the International Boundary by the U.S.G.S. (Knapton, 1978). This is incorrect; it should be .08 mg/N/liter (p. 58, Knapton 1978).

Page 3-45 states that the level of total phosphorus rises to 0.2 mg/litre during runoff in the Flathead River and in Cabin Creek. This level has been exceeded as documented by the data in Appendices 3.3.3-1 and by Environment Canada's Water Quality Study (Sheehan et al. 1980).

All analysis for metals presented in the Stage II Submission were measured as "dissolved". Metal analyses provided by the U.S.G.S. and Environment Canada for the Flathead include dissolved, extractable and total metals and the Canadian recommended surface water quality objectives (1979) are based on total metals.

Page 3-45 states that a barium level of 2.0 mg/litre was measured at the International Boundary by the U.S.G.S. (Knapton 1978). This is incorrect. The barium level reported in September by the U.S.G.S. was 0.2 mg/l (p. 61, Knapton 1978).

The water quality effects predicted by the (QUAL II) modelling results presented in the Stage II Submission are questionable. For example, given the anticipated loss of nitrogen from explosives the marginal increase in organic nitrogen predicted is not realistic. Model inputs and/or assumptions are obviously in error.

XI. WASTE DUMPS

The maintenance of the diversion ditches, particularly above waste dumps B and D, will be important to waste dump stability and control of surface erosion. In addition, consideration should be given to the potential effect of springs at waste dump B mentioned on page 4-42 of the Text. Excess flows could result in erosion while excess pore pressures may result in waste dump instability.

It is mentioned on page 2-19 of the Text that 3 waste dumps are provided for the North Hill Pit but drawings show four. What is dump F to be used for?

The Report states that a 90m green belt is to be provided between the waste dumps and the creeks. It appears that up to 60m of this would be protective berm with perhaps 10m of haul road, and 5m of ditching. The term "greenbelt" is probably not appropriate for this zone.

It is not clear if the protective berms are in the 200 year floodplain and if so, what erosion protective measures are to be implemented. Also, is the contaminated water ditch on the dump or creek side of the road? The road runoff should be diverted to this ditch. Protective berms are to be placed around dumps C and D. Why are they not proposed for other dumps?

Page 4-43 of the Text points out that occasional slumping is anticipated at the face of dump A. A protective berm at the toe of this waste dump may be in order as disturbance of the ponds is undesirable (page 5-2 Text) due to the potential introduction of fine material into the natural watercourses. Although the Text concludes that mass wasting or slide debris at waste dump B would not be a threat to Cabin Creek (page 4-42 Text) it still may affect the efficiency of the drainage ditch. Again a protective berm may be in order.

Have protective berms been designed to hold the anticipated quantity of slump materials, and have provisions been made to clear out drainage ditches as slumps or mass wasting occur?

XII. WATER BALANCE

No information is provided on whether start up water demands will be met prior to recycling being possible. As a general rule reclaim water must be used as a priority to minimize water storage in the tailings pond and requirements for makeup. We support the concept for the use of settling pond effluent for preparation plant process water.

XIII. RECLAMATION

As a general policy, reclamation must be instituted as soon as disturbed areas, roads, and piles are no longer affected by mining operations.

It is noted in the abandonment scheme that drainage will be diverted to natural channels. This may be difficult in the area of the tailings pond and Pond No. 1 since these facilities appear to be located on natural drainage channels. Moreover, it is stated that the tailings pond will dry as inflow ceases. It is preferable that no natural drainage enters the pond after abandonment. The drainage diversion ditches above the waste dumps cannot be returned to natural channels so appropriate safety factors should be used in their design to ensure their permanence.

XIV. LIST OF DOCUMENS CONSULTED FOR THE REVIEW OF SAGE CREEK COAL LTD.'s STAGE II SUBMISSION

Alberta Environment. 1978. Guideline for plume dispersion calculations.

Aquatico Environmental Consultants Ltd. 1975. Benthic sampling in the Flathead River System, 1975. Prepared for B.R. Hinton and Associates Ltd. 27 p.

B.C. Ministry of Environment. 1976. Kootenay air and water quality study Phase I: water quality in region I, the Flathead River basin. Water Resources Service, Victoria, B.C. 19 p.

B.C. Ministry of Environment. 1978. Kootenay air and water quality study Phase II: water quality in the Elk and Flathead River basins. Water Investigations Branch, Victoria, B.C. 289 p.

B.C. Ministry of Environment. 1979. Pollution control objectives: for the mining, smelting and related industries. Pollution Control Board, Victoria, B.C. 15 p.

B.C. Ministry of Environment. Water quality data for some parameters of the Elk River basin stations, up to April 1982, on EQUIS. Water Resources Service, Victoria, B.C.

B.C. Petroleum Association. April 1980. Guidelines for consumer bulked petroleum product storing and handling facility.

Canada Gazette. 1978. Department of Fisheries and the Environment: packaged incinerators national emission guidelines Part I: 7004-7008 November 25, 1978.

Canada Gazette. 1978. Clean air act: ambient air quality objectives, No. 3, amendment. Part II Vol. 112 No. 21. p. 3929.

C.I.L. Explosives. Borehole dewaterer: operating and instruction manual.

Crozier, R.J. 1978. Report on sediment production in the vicinity of east Kootenay coal mining operations, August, 1978. Waste Management Branch, B.C. Ministry of Environment. 62 p.

Crozier, R.J., and R.J. Davies. 1979. Sediment production during the spring of 1978 in the vicinity of Fording Coal Ltd., coal mining operations. Waste Management Branch, B.C. Ministry of Environment. 34 p.

Crozier, R.J., and R.W. Grimm. 1979. Sediment production in the vicinity of Byron Creek Colliers Ltd., coal mining operations, November, 1979. Waste Management Branch, B.C. Ministry of Environment. 14 p.

Crozier, R.J., and R.W. Grimm. 1979. Sediment production in the vicinity of Kaiser Resources, coal mining operations, November, 1979. Waste Management Branch, B.C. Ministry of Environment. 16 p.

Crozier, R.J., and L.E. McDonald. 1979. Sediment production during the spring of 1979 in the vicinity of Fording Coal Ltd., coal mining operations. Waste Management Branch, B.C. Ministry of Environment. 29 p.

Crozier, R.J., and L.E. McDonald. 1980. Preliminary evaluation of the nutrient-algal relationship in the Elk River basin. Waste Management Branch, B.C. Ministry of Environment. 50 p.

Dames and Moore. 1976. Geotechnical investigation of Sage Creek development area.

Department of Energy, Mines and Resources. 1979. Blasting explosives and blasting caps: storage, possession, transportation, destination and sale. Explosives Branch, Ottawa, Canada. 28 p.

Department of National Health and Welfare. 1979. Guidelines for Canadian drinking water quality 1978. Federal-Provincial Working Group on Drinking Water. 79 p.

Department of National Resources and Conservation. 1977. Upper Flathead River Basin Study - Montana. Water Resources Division. 135 p.

Douglas, R.J.W. (ed.) 1970. Geology and economic minerals of Canada. Geological Survey of Canada, Department of Energy, Mines and Resources, Ottawa, Canada. 838 p.

Environment Canada. Water quality data for the Flathead River basin stations, up to April 1982, on NAQUADAT. Water Quality Branch, Inland Waters Directorate, Ottawa, Canada.

Environment Canada. 1979. Guidelines for surface water quality: Vol. I inorganic chemical substances. Water Quality Branch, Inland Waters Directorate, Ottawa, Canada.

Grimm, R.W. 1981. Sediment production in the vicinity of Byron Creek Collieries Ltd., coal mining operations, 1980. Waste Management Branch, B.C. Ministry of Environment. 16 p.

Harry, K.F. 1977. The Sage Creek climatological program September 1975-October 1976. B.C. Research, Vancouver, B.C. 20 p.

Klohn Leonoff Consultants Ltd. 1978. Site hydrology, 1978 program. Prepared for Sage Creek Coal Limited. 14 p.

Klohn Leonoff Consultants Ltd. 1979. Site drainage. Prepared for Sage Creek Coal Limited. 30 p.

Klohn Leonoff Consulting Engineers. November 1981. Tailings dam feasibility study. Prepared for Sage Creek Coal Limited, Vancouver, B.C. 15 p. plus Appendices.

Klohn Leonoff Consulting Engineers. December 1981. Drainage for Sage Creek Coal, southeastern British Columbia. Prepared for Norecol Environmental Consultants Ltd., 32 p. plus Appendices.

Knapton, J.R. 1978. Evaluation and correlation of water quality data for the north fork Flathead River, Northwestern Montana. U.S. Geological Survey, Water Resources Investigations, 78-111. Helena, Montana. 95 p.

McNeely, R.N., V.P. Neimanis, and L. Dwyer. 1979. Water quality sourcebook: a guide to water quality parameters. Water Quality Branch, Inland Waters Driectorate, Environment Canada, Ottawa, Canada. 88 p.

McTaggart-Cowan, I. 1978. Coal mining and environmental management in the Fernie area of British Columbia, p. 19-33. In: Canadian Environmental Advisory Council, Annual Review 1977-78. Environment Canada, Ottawa.

Metzger, S.W., and R.J. Crozier. 1979. Sediment production in the vicinity of Byron Creek Collieries Ltd. and Coleman Collieries Ltd., coal mining operations. A supplementary report to a report on sediment production in the vicinity of East Kootenay coal mining operations, August, 1978. Waste Management Branch, B.C. Ministry of Enviromment. 6 p.

Metzger, S.W., and R.J. Crozier. 1979. Sediment production in the vicinity of Kaiser Resource, coal mining operations. A supplementary report to a report on sediment production in the vicinity of East Kootenay coal mining operations, August, 1978. Waste Management Branch, B.C. Ministry of Environment. 18 p.

Neff, J.M. 1979. Polycyclic aromatic hydrocarbons in the aquatic environment: sources, fates and biological effects. Applied Science Publishers Ltd., London. 262 p.

Nemenishen, W. 1977. Incorporating river basin physiography and climatic factors in flood frequency analysis, p. 224-255. In: Proceedings, Canadian Hydrology Symposium, '77-Floods. National Research Council of Canada, Associate Committee on Hydrology.

NOAA Atlas 2. Precipiation-Frequency atlas of the western United States. Volume 1 - Montana.

Norecol Environment Consultants Ltd. 1982. Preliminary environmental assessment of the 230 kV transmission line route to Sage Creek Coal Mine site. Prepared for Sage Creek Coal Limited. Vancouver, B.C. 98 p.

Pacific Hydrology Consultants Ltd. 1981. Sage Creek Coal Limited Stage II environmental studies - Groundwater Study. Prepared for Sage Creek Coal Limited.

PEDco Environmental Inc. Survey of fugitive dust from coal mines. Prepared for EPA, Region VIII, Office of Energy Activities, Denver, 80295.

Price, R.A. 1965. Flathead map-area, British Columbia and Alberta. Geological Survey of Canada Memoir 336. 221 p.

Pugsley, W.I. 1981. Flood hydrology - guide for Canada: hydrometeorologic design techniques. Atmospheric Environment Service CLl 3-81, Environment Canada. 102 p.

State of Montana. Ambient air quality standards.

Sheehan, S.W., G.L. Ennis, and R.L. Hallam. 1980. A water quality study of the Flathead River basin in British Columbia prior to proposed coal mining. Water Quality Branch, Inland Waters Directorate, Environment Canada. 137 p.

Stockner, John G., and K.R.S. Shortreed. 1976. Autotrophic production in Carnation Creek, a coastal rainforest stream on Vancouver Island, British Columbia. J. Fish. Res. Board Can. 33:1553-1563.

U.S. Environmental Protection Agency. Standards of performance for coal preparation plants.

APPENDIX A. State of Montana. Ambient air quality standards.

Ambient Air Quality Standards

Montana

SO_2	1 hr.	0.5 ppm	not to exceed 18 times per year less than 12 consecutive times per year
	24 hrs.	0.1 ppm	once per year
	1 yr.	0.02 ppm	arithmetic mean
TSP	24 hrs.	200 ug/m^3	once per year
	1 yr.	75 ug/m^3	arithmetic mean
CO	1 hr.	23 ppm	once per year
	8 hr.	9 ppm	once per year
NO_2	1 hr.	0.3 ppm	once per year
	1 yr.	0.05 ppm	once per year
O_3	1 hr.	0.1 ppm	once per year

APPENDIX B. Canada Gazette. 1978. Clean air act: ambient air quality objectives, No. 2 and No. 3; amendments.

Registration
SOR/75-32 20 January, 1975

CLEAN AIR ACT

Ambient Air Quality Objectives, No. 2

P.C. 1975-10 16 January, 1975

His Excellency the Governor General in Council, on the recommendation of the Minister of the Environment, pursuant to subsection 4(2) of the Clean Air Act, is pleased hereby to prescribe the annexed ambient air quality objectives for air contaminants formulated by the Minister of the Environment on the 20th day of December, 1974.

AMBIENT AIR QUALITY OBJECTIVES FOR AIR CONTAMINANTS

Short Title

1. These Objectives may be cited as the *Ambient Air Quality Objectives, No. 2.*

Formulation of Ambient Air Quality Objectives

2. The ambient air quality objectives with respect to the air contaminant set out in column I of Schedule I is the range of quality of the ambient air in relation to that contaminant set out in column III of that Schedule where the air contaminant is in a concentration set out in column II of that Schedule.

3. For the purpose of section 2, the air contaminant set out in column I of Schedule II shall be measured

(*a*) by the method set out in column II of that Schedule; or

(*b*) by a method that will consistently give a measurement from which the measurement that would be determined by the method prescribed in paragraph (*a*) can be calculated.

4. For the purpose of section 2, the concentration of an air contaminant shall be measured and corrected to a reference temperature of 25 degrees Centigrade and to a reference pressure of 760 millimetres of mercury.

Enregistrement
DORS/75-32 20 janvier 1975

LOI SUR LA LUTTE CONTRE LA POLLUTION ATMOSPHÉRIQUE

Objectifs afférents à la qualité de l'air ambiant, n° 2

C.P. 1975-10 16 janvier 1975

Sur avis conforme du ministre de l'Environnement et en vertu du paragraphe 4(2) de la Loi sur la lutte contre la pollution atmosphérique, il plaît à Son Excellence le Gouverneur général en conseil de prescrire les Objectifs afférents à la qualité de l'air ambiant concernant les agents de contamination de l'air, ci-après, exposés par le ministre de l'Environnement le 20 décembre 1974.

OBJECTIFS AFFÉRENTS À LA QUALITÉ DE L'AIR AMBIANT CONCERNANT LES AGENTS DE CONTAMINATION DE L'AIR

Titre abrégé

1. Les présents objectifs peuvent être cités sous le titre: *Objectifs afférents à la qualité de l'air ambiant, n° 2.*

Exposé des objectifs afférents à la qualité de l'air ambiant

2. L'objectif afférent à la qualité de l'air ambiant, concernant un agent de contamination de l'air mentionné à la colonne I de l'annexe I, est le niveau de qualité de l'air ambiant par rapport à cet agent de contamination, indiqué à la colonne III de cette annexe, lorsque la concentration de l'agent de contamination est comprise dans les concentrations indiquées à la colonne II de cette annexe.

3. Aux fins de l'article 2, un agent de contamination de l'air mentionné à la colonne I de l'annexe II, doit être mesuré

a) par la méthode indiquée à la colonne II de cette annexe; ou

b) par une méthode qui donnera toujours une mesure à partir de laquelle peut être calculée la mesure qui serait obtenue par la méthode désignée à l'alinéa *a*).

4. Aux fins de l'article 2, la concentration d'un agent de contamination de l'air doit être mesurée et corrigée à une température de référence de 25°C et à une pression de référence de 760 millimètres de mercure.

SCHEDULE I

Column I	Column II	Column III
Air Contaminants	Concentrations	Range of Quality
Nitrogen Dioxide	0 to 60 micrograms per cubic meter annual arithmetic mean	Desirable
	0 to 100 micrograms per cubic meter annual arithmetic mean	Acceptable
	0 to 200 micrograms per cubic meter average concentration over a 24 hour period	
	0 to 400 micrograms per cubic meter average concentration over a one hour period	

SCHEDULE II

Column I	Column II
Nitrogen Dioxide	Chemiluminescent Method Report No. EPS 1-AP-74-2

ANNEXE I

Colonne I	Colonne II	Colonne III
Agents de contamination de l'air	Concentrations	Niveau de qualité
Dioxyde d'azote	de 0 à 60 microgrammes par mètre cube, moyenne arithmétique annuelle	Souhaitable
	de 0 à 100 microgrammes par mètre cube, moyenne arithmétique annuelle	Acceptable
	de 0 à 200 microgrammes par mètre cube, concentration moyenne sur une période de 24 heures	
	de 0 à 400 microgrammes par mètre cube, concentration moyenne sur une période d'une heure	

ANNEXE II

Colonne I	Colonne II
Dioxyde d'azote	Méthode par chimiluminescence Rapport n° EPS 1-AP-74-2

Registration
SOR/78-74 24 January, 1978

CLEAN AIR ACT

Ambient Air Quality Objectives, No. 3

P.C. 1978-105 19 January, 1978

His Excellency the Governor General in Council, on the recommendation of the Minister of Fisheries and the Environment, pursuant to subsection 4(2) of the Clean Air Act, is pleased hereby to prescribe the annexed Ambient Air Quality Objectives for Air Contaminants.

AMBIENT AIR QUALITY OBJECTIVES FOR AIR CONTAMINANTS

Short Title

1. These Objectives may be cited as the *Ambient Air Quality Objectives, No. 3*.

Formulation of Ambient Air Quality Objectives

2. The ambient air quality objectives with respect to an air contaminant set out in column I of an item of Schedule I is the range of quality of the ambient air in relation to that contaminant set out in column III of that item where the air contaminant is in a concentration set out in column II of that item.

3. For the purpose of section 2, an air contaminant set out in column I of an item of Schedule II shall be measured

(*a*) by the method set out in column II of that item; or

(*b*) by a method that will consistently give a measurement from which the measurement that would be determined by the method prescribed in paragraph (*a*) can be calculated.

4. For the purpose of section 2, the concentration of an air contaminant shall be measured and corrected to a reference temperature of 25 degrees Centigrade and to a reference pressure of 100.9 kilopascals (760 millimetres) of mercury.

Enregistrement
DORS/78-74 24 janvier 1978

LOI SUR LA LUTTE CONTRE LA POLLUTION ATMOSPHÉRIQUE

Objectifs afférents à la qualité de l'air ambiant (n° 3)

C.P. 1978-105 19 janvier 1978

Sur avis conforme du ministre des Pêcheries et de l'Environnement et en vertu du paragraphe 4(2) de la Loi sur la lutte contre la pollution atmosphérique, il plaît à Son Excellence le Gouverneur général en conseil de prescrire les objectifs afférents à la qualité de l'air ambiant concernant les agents de contamination de l'air, ci-après.

OBJECTIFS AFFÉRENTS À LA QUALITÉ DE L'AIR AMBIANT CONCERNANT LES AGENTS DE CONTAMINATION DE L'AIR

Titre abrégé

1. *Objectifs afférents à la qualité de l'air ambiant (n° 3).*

Formulation des objectifs

2. Les marges de qualité déterminées selon l'annexe I pour les agents de contamination de l'air y mentionnés sont les objectifs afférents à la qualité de l'air ambiant.

Mesure quantitative

3. Les agents de contamination sont mesurés selon les méthodes visées à l'annexe II ou par toute autre qui permet d'en arriver aux mêmes résultats.

4. La concentration des agents de contamination est mesurée et corrigée en fonction d'une température de 25°C et d'une pression de 100,9 kPa (760 mm) de mercure.

SCHEDULE I

	Column I	Column II	Column III
	Air Contaminants	Concentrations	Range of Quality
1.	Sulphur dioxide	300 to 800 micrograms per cubic metre average concentration over a continuous 24 hour period	Tolerable
2.	Suspended particulate matter	120 to 400 micrograms per cubic metre average concentration over a continuous 24 hour period	Tolerable
3.	Carbon monoxide	15 to 20 milligrams per cubic metre average concentration over a continuous 8 hour period	Tolerable
4.	Oxidants (ozone)	160 to 300 micrograms per cubic metre average concentration over a continuous one hour period	Tolerable
5.	Nitrogen dioxide	400 to 1,000 micrograms per cubic metre average concentration over a continuous one hour period	Tolerable

SCHEDULE II

	Column I	Column II
1.	Sulphur dioxide	West-Gaeke Method (Pararosaniline Method) Report No. EPS 1-AP-72-4
2.	Suspended particulate matter	High Volume Method Report No. EPS 1-AP-73-2
3.	Carbon monoxide	Non-dispersive Infra-red Spectrometry Method Report No. EPS 1-AP-73-1
4.	Oxidants (ozone)	Chemiluminescent Method Report No. EPS 1-AP-73-7
5.	Nitrogen dioxide	Chemiluminescent Method Report No. EPS 1-AP-74-2

ANNEXE I

	Colonne I	Colonne II	Colonne III
	Agents de contamination de l'air	Concentrations (par période continue)	Marges de qualité
1.	Anhydride sulfureux	300 à 800 ug/m^3, concentration moyenne pendant 24 h	Tolérable
2.	Particules en suspension	120 à 400 ug/m^3, concentration moyenne pendant 24 h	Tolérable
3.	Monoxyde de carbone	15 à 20 mg/m^3, concentration moyenne pendant 8 h	Tolérable
4.	Oxydants (ozone)	160 à 300 ug/m^3, concentration moyenne pendant 1 h	Tolérable
5.	Dioxyde d'azote	400 à 1000 ug/m^3, concentration moyenne pendant 1 h	Tolérable

ANNEXE II

	Colonne I	Colonne II
1.	Anhydride sulfureux	Méthode de West-Gaeke (méthode à la pararosaniline) Rapport n° EPS-1-AP-72-4
2.	Particules en suspension	Méthode d'échantillonnage à grand débit Rapport n° EPS-1-AP-73-2
3.	Monoxyde de carbone	Méthode de spectrométrie infra-rouge non dispersive Rapport n° EPS-1-AP-73-1
4.	Oxydants (ozone)	Méthode par chimiluminescence Rapport n° EPS-1-AP-73-7
5.	Dioxyde d'azote	Méthode par chimiluminescence Rapport n° EPS-1-AP-74-2

GR38-CA APPENDIX C. Canada Gazette: 1978. Department of Fisheries and the Environment: packaged incinerators national emission guidelines. Part I: 7004-7008.

DEPARTMENT OF FISHERIES AND THE ENVIRONMENT

PACKAGED INCINERATORS NATIONAL EMISSION GUIDELINES

The Minister of the Environment is pleased hereby to publish the annexed National Emision Guidelines indicating quantities in which particulate matter, hydrogen chloride and sulphur dioxide should not be emitted into the ambient air from new installations of packaged incinerators. Visible emission limits are recommended as a practical means of assessing the performance of both new and existing sources.

These guidelines have been developed in consultation with representatives of provincial governments and members of the industry and are based on best practicable technology currently available to the incinerator industry to control these emissions to the ambient air. Department of Fisheries and the Environment Report No. EPS 3-AP-77-3 entitled "Air Pollution Emissions and Control Technology: Packaged Incinerators" incorporates this background information. Based on this study we have selected pollutants which we believe should be controlled and we have proposed emission limits for these pollutants which can be achieved with modern incinerator technology.

The Minister of the Environment recognizes the difficulties that could be encountered in requesting existing sources to meet these emission limits and therefore recommends existing packaged incinerators be examined on a case by case basis and upgraded as necessary. The proposed criteria for visible emissions can be used as a guide for assistance in the evaluation of existing sources.

Interpretation

1. In these guidelines:

"existing installation" means a packaged incinerator which was in operation or under construction prior to December 1, 1978;

"initial startup" means the date when waste material is first burned in a new installation;

"modification" means any physical change in the packaged incinerator, change in the method of operation, or change in the type or quantity of waste which increases the amount of any air pollutant emitted to the atmosphere;

"new installation" means a packaged incinerator constructed or modified after December 1, 1978;

"opacity" means the degree to which emissions reduce the transmission of light and obscure the view of an object in the background;

"operator" means the person having the charge, management or control of the packaged incinerator, whether on his own account or as the agent of any other person;

"packaged incinerator" means any furnace used in the process of burning solid waste whose maximum burning rate does not exceed 900 kg of solid waste per hour;

"reference conditions" means a temperature of 25°C and a pressure of 100.9 kPa;

"solid waste" means any discarded or otherwise unwanted material predominantly composed of one or more of the materials classified in Schedule A;

MINISTÈRE DES PÊCHES ET DE L'ENVIRONNEMENT

LIGNES DIRECTRICES NATIONALES RELATIVES AUX ÉMISSIONS DES INCINÉRATEURS COMPACTS

Il plaît au ministre de l'Environnement de publier, ci-après, les lignes directrices nationales indiquant les quantités de particules, de chlorure d'hydrogène et de dioxyde de soufre que les nouveaux incinérateurs compacts peuvent dégager dans l'atmosphère. Les limites d'émission visible constituent un moyen pratique d'évaluer le rendement des incinérateurs nouveaux et existants.

Les présentes lignes directrices, élaborées avec l'avis des représentants des gouvernements provinciaux et de l'industrie, se fondent sur les meilleures techniques praticables d'épuration actuellement à la portée de cette industrie. Les renseignements à ce sujet figurent dans le rapport n° EPS 3-AP-77-3, intitulé «Air Pollution Emissions and Control Technology: Packaged Incinerators», du ministère des Pêches et de l'Environnement. C'est d'après cette étude que nous avons sélectionné les polluants dont, à notre avis, l'air devrait être épuré et pour lesquels nous proposons des limites d'émission à la portée des techniques modernes d'incinération.

Le ministre de l'Environnement admet qu'il sera peut-être difficile, pour les incinérateurs existants, de ne pas dépasser les limites fixées et il recommande par conséquent que chacun d'entre eux soit considéré comme un cas particulier et que ces limites soient relevées si c'est nécessaire. Le critère d'émission visible peut aider à évaluer les incinérateurs existants.

Interprétation

1. Dans les présentes:

«conditions de référence» correspond à une température de 25°C et à une pression de 100.9 kPa;

«déchet» désigne tout rebut ou toute matière encombrante composée principalement d'au moins une des substances classées à l'annexe A;

«démarrage» désigne la première incinération dans un nouvel incinérateur;

«incinérateur compact» désigne tout four utilisé pour brûler des déchets, dont la capacité maximale d'incinération ne dépasse pas 900 kg de déchets par heure;

«incinérateur existant» désigne un incinérateur compact en service ou en construction avant le 1er décembre 1978;

«modification» désigne tout changement d'ordre physique apporté à un incinérateur compact, ou tout changement ayant trait à sa méthode de fonctionnement ou au type ou à la quantité de déchets, qui a pour effet d'augmenter les émissions de tout polluant atmosphérique;

«nouvel incinérateur» désigne tout incinérateur compact construit ou modifié après le 1er décembre 1978.

«opacité» désigne l'intensité avec laquelle les émissions nuisent au passage de la lumière et masquent un objet placé en arrière-plan;

«responsable» désigne le responsable d'un incinérateur compact ou celui qui en assure la direction ou le fonctionnement soit pour son propre compte, soit pour celui d'une autre personne;

Emission Limits for New Installations

2. Gases discharged to the atmosphere, as a consequence of the operation of a new installation, should not

(*a*) exhibit visible emissions which exceed zero opacity,

(*b*) contain particulate matter in excess of 0.75 g/kg of solid waste burned,

(*c*) contain hydrogen chloride in excess of 100 ppm on a dry basis and corrected to 50% excess air,

(*d*) contain sulphur dioxide in excess of 250 ppm on a dry basis and corrected to 50% excess air.

Emission Limits for Existing Installations

3. Gases discharged to the atmosphere, as a consequence of the operation of an existing installation should not exhibit visible emissions which exceed 20% opacity.

Assessing Compliance

4. Before construction of a new installation, the prospective owner should apply to the authority having jurisdiction for permission to construct a packaged incinerator. Construction should not commence until permission has been granted.

5. The operator of a new installation should

(*a*) within a period of 90 days, commencing at initial startup, test the incinerator for particulate matter emissions as specified in section 10 and provide the authority having jurisdiction with a written report of the test results, or

(*b*) provide the authority having jurisdiction with a written report of the results of a particulate emission test conducted in accordance with section 10, on an incinerator which is similar in design, construction and operation to the new installation and which demonstrates to the satisfaction of the authority having jurisdiction that the gases emitted from the new installation will not contain particulate matter in excess of the limit specified in section 2 paragraph (*b*).

6. The operator of a new installation should, within a period of 90 days commencing at initial startup, test the incinerator for hydrogen chloride emissions as specified in section 11 and provide the authority having jurisdiction with a written report of the test results; except that the authority having jurisdiction may waive the requirement for testing and consider the incinerator to be in compliance with section 2 paragraph (*c*) if the incinerator is not to be charged with halogenated material, classified as Type E in Schedule A, at a rate which exceeds 0.25% of the rated capacity of the incinerator.

7. The operator of a new installation should, within a period of 90 days commencing at initial startup, test the incinerator for sulphur dioxide emissions as specified in section 12 and provide the authority having jurisdiction with a written report of the test results; except that the authority having jurisdiction may waive the requirement for testing and consider the incinerator to be in compliance with section 2 paragraph (*d*) if the incinerator is not to be charged with rubber compounds classified as Type F in Schedule A, at a rate in excess of 20% of the rated capacity of the incinerator.

8. The operator of a new installation should, within a period of 90 days commencing at initial startup, operate the incinerator under normal conditions for one complete operating cycle

Limites d'émission pour les nouveaux incinérateurs

2. Les gaz rejetés dans l'atmosphère, par suite du fonctionnement d'un nouvel incinérateur, ne devraient pas

a) être visibles ni opaques,

b) contenir plus de 0.75 g de particules par kg de déchet incinéré,

c) contenir plus de 100 ppm de chlorure d'hydrogène ramené à 50% d'excès d'air, à l'état sec,

d) contenir plus de 250 ppm de dioxyde de soufre, ramené à 50% d'excès d'air, à l'état sec.

Limites d'émission pour les incinérateurs existants

3. L'opacité des gaz rejetés dans l'atmosphère, par suite du fonctionnement d'un incinérateur existant, ne devrait pas dépasser 20%.

Mise à l'essai des incinérateurs

4. Avant de construire un nouvel incinérateur, le propriétaire éventuel devrait demander à l'autorité compétente la permission de le construire et ne pas entreprendre la construction avant que l'autorisation ait été accordée.

5. Le responsable d'un nouvel incinérateur devrait

a) dans les 90 jours suivant la date du démarrage, en mesurer les émissions de particules, conformément à l'article 10, et fournir à l'autorité compétente un rapport écrit sur les résultats de ce contrôle, ou

b) fournir à l'autorité compétente un rapport écrit sur les résultats du contrôle réalisé conformément à l'article 10, d'un prototype dont la conception, la construction et le fonctionnement sont comparables à ceux du nouvel incinérateur, et qui démontre à ladite autorité que la teneur en particules des gaz émis par l'incinérateur ne dépasse pas la limite indiquée à l'alinéa 2*b*).

6. Le responsable d'un nouvel incinérateur devrait, dans les 90 jours suivant la date du démarrage, en mesurer les émissions de chlorure d'hydrogène, conformément à l'article 11, et fournir à l'autorité compétente un rapport écrit sur les résultats de ce contrôle; l'autorité compétente peut toutefois l'en exempter et considérer que l'incinérateur est conforme aux dispositions de l'alinéa 2*c*) s'il n'est pas alimenté en matières halogénées, classées du type E de l'annexe A, à raison de plus de 0.25% de sa capacité théorique.

7. Le responsable d'un nouvel incinérateur devrait, dans les 90 jours suivant la date du démarrage, en mesurer les émissions de dioxyde de soufre, conformément à l'article 12, et fournir à l'autorité compétente un rapport écrit sur les résultats de ce contrôle; l'autorité compétente peut toutefois l'en exempter et considérer que l'incinérateur est conforme aux dispositions de l'alinéa 2*d*) s'il n'est pas alimenté en composés de caoutchouc, classés du type F de l'annexe A, à raison de plus de 20% de sa capacité théorique.

8. Le responsable d'un nouvel incinérateur devrait, dans les 90 jours suivant la date du démarrage, faire fonctionner normalement l'incinérateur pendant un cycle complet, pour

so as to afford the authority having jurisdiction an opportunity to measure the opacity of the emissions.

Emission Testing

9. All emission tests to be used for assessing compliance should be conducted by an independent testing authority and witnessed by a representative of the authority having jurisdiction. During the test, the incinerator should be operated under conditions representative of normal operation or under such other conditions as the authority having jurisdiction may specify.

10. (1) The particulate matter emission rate should be measured in accordance with the reference method specified in Department of Fisheries and the Environment Report EPS 1-AP-74-1, "Standard Reference Methods for Source Testing: Measurement of Emissions of Particulates from Stationary Sources". The integrated sample technique of Method C should be used for determining the molecular weight. The minimum sampling time should be 60 minutes and the minimum sampling volume should be 0.85 dry cubic metres at reference conditions. One repetition of the method constitutes one run.

(2) The average burning rate of the packaged incinerator should be determined for each run by dividing the weight of waste charged into the incinerator by the time between ignition of the first charge and the completion of combustion of the last charge.

(3) The particulate matter emissions expressed as grams per kilogram of waste burned, should be determined for each run by dividing the particulate matter emission rate as determined in subsection (1) by the average burning rate as determined in subsection (2).

(4) A complete particulate matter emission test should consist of three runs of the procedures specified by subsections (1) and (2). The arithmetic mean of the results determined according to subsection (3) should not exceed the limit specified in section 2, paragraph (*b*).

→ 11. (1) The hydrogen chloride emission rate should be measured in accordance with the reference method specified in Department of Fisheries and the Environment Report EPS 1-AP-78-1, "Standard Reference Methods for Source Testing: Measurement of Emissions of Hydrogen Chloride from Stationary Sources". The minimum sampling time should be 20 minutes and the minimum sampling volume should be 0.02 dry cubic metres at reference conditions. Two repetitions of the reference method conducted within a 60 minute period constitute one run.

(2) The concentration of hydrogen chloride in the dry flue gas expressed as parts per million by volume corrected to 50% excess air should be determined for each repetition according to the following formula:

$$E_{HCl} = 6.66 \times 10^2 \times \frac{11.30}{(N_2/O_2)} \times C_{HCl}$$

where E_{HCl} is the volume concentration of hydrogen chloride in the dry flue gas, ppm corrected to 50% excess air;

N_2/O_2 is the nitrogen to oxygen ratio in the flue gas on a dry volumetric basis from Orsat analysis;

C_{HCl} is the concentration of hydrogen chloride in the dry flue gas at reference conditions as determined from the reference method, g/m³;

permettre à l'autorité compétente de mesurer l'opacité des émissions.

Contrôle des émissions

9. Tout contrôle de la conformité des émissions aux lignes directrices, devrait être mené par un organisme indépendant, en présence d'un représentant de l'autorité compétente. Durant le contrôle, l'incinérateur devra fonctionner dans des conditions normales ou de la façon que l'autorité compétente pourra préciser.

10. (1) La mesure de l'émission des particules devrait se faire conformément à la méthode exposée dans la publication EPS 1-AP-74-1 du ministère des Pêches et de l'Environnement, intitulée «Méthodes de référence normalisées en vue d'essais aux sources: mesure des émissions de particules provenant de sources fixes». La technique d'échantillonnage intégrée de la méthode C servira à déterminer le poids moléculaire. La durée minimale de l'échantillonnage sera de 60 minutes et le volume minimal de l'échantillonnage, de 0.85 mètre cube sec dans les conditions de référence. La répétition d'un essai par cette méthode constitue une épreuve.

(2) L'allure moyenne de la combustion dans l'incinérateur compact pour chaque épreuve s'obtient par la division de la charge de l'incinérateur par le temps écoulé entre l'allumage de la première charge et la fin de la combustion de la dernière.

(3) Pour déterminer l'émission de particules, exprimée en grammes par kilogramme de déchets brûlés à chaque épreuve, on divise l'émission de particules, déterminée selon le paragraphe (1), par l'allure moyenne de la combustion, déterminée selon le paragraphe (2).

(4) Une série complète de contrôles de l'émission des particules comprend trois épreuves tel qu'il est précisé aux paragraphes (1) et (2). La moyenne arithmétique des résultats, calculée conformément au paragraphe (3), ne devrait pas dépasser la limite indiquée à l'alinéa 2*b*).

11. (1) La mesure de l'émission de chlorure d'hydrogène devrait se faire conformément à la méthode actuellement mise au point et qui sera exposée dans la publication EPS 1-AP-78-1, «Méthodes de référence normalisées en vue du contrôle des sources: mesure des émissions de chlorure d'hydrogène émis par les sources fixes», du ministère des Pêches et de l'Environnement. La durée minimale de l'échantillonnage sera de 20 minutes et le volume minimal de l'échantillonnage, de 0.02 mètre cube sec dans les conditions de référence. Deux répétitions en 60 minutes constituent une épreuve.

(2) La concentration de chlorure d'hydrogène dans les gaz d'émission secs, exprimée en parties par million et ramenée à 50% d'excès d'air, sera calculée pour chaque répétition, d'après la formule suivante:

$$E_{HCl} = 6.66 \times 10^2 \times \frac{11.30}{(N_2/O_2)} \times C_{HCl}$$

où E_{HCl} est la concentration volumique de chlorure d'hydrogène (ppm) dans les gaz secs d'émission, ramenée à 50% d'excès d'air;

N_2/O_2 est le rapport des concentrations volumiques à sec de l'azote à oxygène dans les gaz d'émission d'après l'appareil d'Orsat;

6.66×10^2 is a constant, m^3/g;
11.30 is the volumetric ratio of nitrogen to oxygen at 50% excess air.

(3) A complete hydrogen chloride emission test consists of three runs as specified in subsection (1). The arithmetic mean of the results determined according to subsection (2) should not exceed the limit specified in section 2 paragraph (*c*). Incinerators which operate in a single batch mode should be tested at the rate of one run per operating cycle and the run should be carried out during the 60 minute period immediately following ignition of the waste.

12. (1) The sulphur dioxide emission rate should be measured in accordance with the reference method specified in Department of Fisheries and the Environment Report EPS 1-AP-74-3 "Standard Reference Methods for Source Testing: Measurement of Emissions of Sulphur Dioxide from Stationary Sources". The minimum sampling time should be 20 minutes and the minimum sampling volume should be 0.02 dry cubic metres at reference conditions. Two repetitions of the reference method conducted within a 60 minute period constitute one run.

(2) The concentration of sulphur dioxide in the dry flue gas expressed as parts per million by volume corrected to 50% excess air should be determined for each repetition according to the following formula:

$$E_{SO_2} = 3.73 \times 10^2 \times \frac{11.30}{(N_2/O_2)} \times C_{SO_2}$$

where E_{SO_2} is the volume concentration of sulphur dioxide in the dry flue gas, ppm corrected to 50% excess air;
N_2/O_2 is the nitrogen to oxygen ratio in the flue gas on a dry volumetric basis from Orsat analysis;
C_{SO_2} is the concentration of sulphur dioxide in the dry flue gas at reference conditions as determined from the reference method, g/m^3;
3.73×10^2 is a constant, m^3/g;
11.30 is the volumetric ratio of nitrogen to oxygen at 50% excess air.

(3) A complete sulphur dioxide emission test consists of three runs as specified in subsection (1). The arithmetic mean of the results determined according to subsection (2) should not exceed the limit specified in section 2 paragraph (*d*).

13. (1) The opacity of the visible emissions should be measured in accordance with Method A specified in Department of Fisheries and the Environment Report EPS 1-AP-75-2, "Standard Reference Methods for Source Testing: Measurement of Opacity of Emissions from Stationary Sources".

(2) Where the emission of heat or uncombined water is the only reason for failure to meet the requirements of section 2 paragraph (*a*), such failure should not be considered a violation.

Information and Notification

14. Every operator of a new installation should in respect thereof

(*a*) provide, at the request of the authority having jurisdiction,

C_{HCl} est la concentration (g/m^3) de chlorure d'hydrogène dans les gaz secs d'émission dans les conditions de référence, déterminée d'après la méthode de référence;
6.66×10^2 est une constante (m^3/g);
11.30 est le rapport volumique de l'azote à l'oxygène à 50% d'excès d'air.

(3) Une série complète de contrôles de l'émission de chlorure d'hydrogène consiste en trois épreuves comme il est décrit au paragraphe (1). La moyenne arithmétique des résultats, calculée conformément au paragraphe (2), ne devrait pas dépasser la limite indiquée à l'alinéa 2*c*). Pour les incinérateurs qui brûlent une charge à la fois, le contrôle doit se faire au rythme d'une épreuve par cycle de fonctionnement d'une durée de 60 minutes, commençant immédiatement après l'allumage.

12. (1) La mesure de l'émission de dioxyde de soufre devrait se faire conformément à la méthode indiquée dans la publication EPS 1-AP-74-3, intitulée «Méthodes de référence normalisées pour le contrôle à la source: dosage du dioxyde de soufre émis par les sources fixes», du ministère des Pêches et de l'Environnement. La durée minimale de l'échantillonnage sera de 20 minutes et le volume minimal de l'échantillonnage, de 0.02 mètre cube sec dans les conditions de référence. Deux répétitions en 60 minutes constituent une épreuve.

(2) La concentration de dioxyde de soufre dans les gaz secs d'émission, exprimée en parties par million et ramenée à 50% d'excès d'air, se calcule, pour chaque répétition, d'après la formule suivante:

$$E_{SO_2} = 3.73 \times 10^2 \times \frac{11.30}{(N_2/O_2)} \times C_{SO_2}$$

où E_{SO_2} est la concentration volumique de dioxyde de soufre (ppm) dans les gaz d'émission, ramenée à 50% d'excès d'air;
N_2/O_2 est le rapport des concentrations volumiques à sec de l'azote à l'oxygène dans les gaz d'émission d'après l'appareil d'Orsat;
C_{SO_2} est la concentration (g/m^3) de dioxyde de soufre dans les conditions de référence, déterminée d'après la méthode de référence;
3.73×10^2 est une constante (m^3/g);
11.30 est le rapport volumique de l'azote à l'oxygène, à 50% d'excès d'air.

(3) Une série complète de contrôles de l'émission de dioxyde de soufre consiste en trois épreuves comme il est décrit au paragraphe (1). La moyenne arithmétique des résultats, calculée conformément au paragraphe (2), ne devrait pas dépasser la limite indiquée à l'alinéa 2*d*).

13. (1) L'opacité des émissions visibles devrait se mesurer conformément à la méthode A, indiquée dans la publication EPS 1-AP-75-2, intitulée «Méthodes normalisées de référence pour le contrôle de l'opacité des émissions provenant de sources fixes», du ministère des Pêches et de l'Environnement.

(2) Le non-respect des dispositions de l'alinéa 2*a*) à cause du dégagement de chaleur ou d'eau non liée ne constitue pas une violation.

Information et avertissement

14. Le responsable d'un nouvel incinérateur devrait concernant ce dernier

a) fournir, à la demande de l'autorité compétente,

(i) a copy of such plans, specifications and technical information as may reasonably be required to determine compliance with the provisions of this guideline. The information should be submitted in a manner acceptable to the authority having jurisdiction,

(ii) a description of the waste to be incinerated, identified according to the types listed in Schedule A and the average and maximum percentage by weight of each type. The description should also include the maximum hourly charging rate and the maximum amount of waste to be incinerated daily;

(*b*) notify the authority having jurisdiction at least 30 days prior to any emission tests to be carried out pursuant to these guidelines so that a witness may be present at such tests.

SCHEDULE A

Classification of Wastes

Type	Description	Examples
A	Cellulosic solids, up to 15 percent moisture (wet basis)	dry paper, cardboard boxes, wooden pallets, furniture, photographic film
B	Cellulosic solids, 10-50 percent moisture (wet basis)	wet paper, moist sawdust, damp rags or clothing, residential refuse, bark
C	Cellulosic solids, over 40 percent moisture (wet basis)	fruits and vegetables, garden trimmings, kitchen wastes
D	Plastics and asphaltic solids, non-halogenated	polyethylene containers, polystyrene toys, asphalt shingles, waxes
E	Plastic and asphaltic solids, halogenated	PVC (polyvinyl chlorides), DDT powder
F	Rubber	tires
G	Animal materials	leather, hair and wool, feathers, glue, fur
H	Animal and human wastes	manure, dried sewage sludge
I	Non-combustible solids	glass, cans, ashes and sand, salt, crockery, metal objects
J	Pathological materials	hospital dressings, disposable bedding and gowns
K	Pathological remains	dead animals, parts of humans and animals
L	Cadavers, coffin encased	

[47-1-o]

(i) un exemplaire des plans, des caractéristiques et des renseignements techniques normalement exigibles pour déterminer si les dispositions des présentes lignes directrices sont respectées. Ces renseignements devraient être fournis à l'autorité compétente sous une forme qui lui agrée,

(ii) une description des types de déchets à incinérer, classés d'après l'annexe A; le pourcentage moyen et maximal de chaque type en fonction du poids, ainsi que le rythme maximal de chargement horaire et la quantité maximale de déchets à incinérer quotidiennement;

b) prévenir l'autorité compétente au moins 30 jour avant le contrôle des émissions, conformément aux présentes lignes directrices, pour qu'un témoin puisse y assister.

ANNEXE A

Classification des déchets

Type	Description	Exemples
A	Matières cellulosiques, jusqu'à 15% d'humidité (poids humide)	papiers secs, boites de carton, palettes de bois, meubles, pellicules photographiques
B	Matières cellulosiques, de 10 à 50% d'humidité (poids humide)	papiers humides, sciures humides, chiffons ou vêtements humides, déchets domestiques, écorce
C	Matières cellulosiques, plus de 40% d'humidité (poids humide)	fruits et légumes, déchets de jardinage, déchets de cuisine
D	Matières asphaltiques et plastiques non halogénées	contenant de polyéthylène, jouets en polystyrène, bardeaux d'asphalte, cires
E	Matières plastiques et asphaltiques halogénées	chlorures de polyvinyle (PVC), poudre de DDT
F	Caoutchouc	pneus
G	Matières animales	cuir, poils et laine, plumes, colle, fourrure
H	Déchets animaux et humains	fumier, boues résiduaires, séchées
I	Matières incombustibles	verre, boîtes de conserve, cendres et sable, sel, poteries, objets métalliques
J	Effets d'hôpitaux	bandages et pansements, literie et vêtements à usage unique
K	Déchets anatomiques	animaux morts, parties de corps humains et d'animaux
L	Cadavres dans leur cercueil	

[47-1-o]

APPENDIX D. U.S. Environmental Protection Agency. Standards of performance for coal preparation plants.

Subpart Y—Standards of Performance for Coal Preparation Plants [26]

§ 60.250 Applicability and designation of affected facility.[64]

(a) The provisions of this subpart are applicable to any of the following affected facilities in coal preparation plants which process more than 200 tons per day: thermal dryers, pneumatic coal-cleaning equipment (air tables), coal processing and conveying equipment (including breakers and crushers), coal storage systems, and coal transfer and loading systems.

(b) Any facility under paragraph (a) of this section that commences construction or modification after October 24, 1974, is subject to the requirements of this subpart.[71]

§ 60.251 Definitions.

As used in this subpart, all terms not defined herein have the meaning given them in the Act and in subpart A of this part.

(a) "Coal preparation plant" means any facility (excluding underground mining operations) which prepares coal by one or more of the following processes: breaking, crushing, screening, wet or dry cleaning, and thermal drying.

(b) "Bituminous coal" means solid fossil fuel classified as bituminous coal by A.S.T.M. Designation D–388–66.

(c) "Coal" means all solid fossil fuels classified as anthracite, bituminous, subbituminous, or lignite by A.S.T.M. Designation D–388–66.

(d) "Cyclonic flow" means a spiraling movement of exhaust gases within a duct or stack.

(e) "Thermal dryer" means any facility in which the moisture content of bituminous coal is reduced by contact with a heated gas stream which is exhausted to the atmosphere.

(f) "Pneumatic coal-cleaning equipment" means any facility which classifies bituminous coal by size or separates bituminous coal from refuse by application of air stream(s).

(g) "Coal processing and conveying equipment" means any machinery used to reduce the size of coal or to separate coal from refuse, and the equipment used to convey coal to or remove coal and refuse from the machinery. This includes, but is not limited to, breakers, crushers, screens, and conveyor belts.

(h) "Coal storage system" means any facility used to store coal except for open storage piles.

(i) "Transfer and loading system" means any facility used to transfer and load coal for shipment.

§ 60.252 Standards for particulate matter.

(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, an owner or operator subject to the provisions of this subpart shall not cause to be discharged into the atmosphere from any thermal dryer gases which:

(1) Contain particulate matter in excess of 0.070 g/dscm (0.031 gr/dscf).

(2) Exhibit 20 percent opacity or greater.

(b) On and after the date on which the performance test required to be conducted by § 60.8 is completed, an owner or operator subject to the provisions of this subpart shall not cause to be discharged into the atmosphere from any pneumatic coal cleaning equipment, gases which:

(1) Contain particulate matter in excess of 0.040 g/dscm (0.018 gr/dscf).

(2) Exhibit 10 percent opacity or greater.

(c) On and after the date on which the performance test required to be conducted by § 60.8 is completed, an owner or operator subject to the provisions of this subpart shall not cause to be discharged into the atmosphere from any coal processing and conveying equipment, coal storage system, or coal transfer and loading system processing coal, gases which exhibit 20 percent opacity or greater.

§ 60.253 Monitoring of operations.

(a) The owner or operator of any thermal dryer shall install, calibrate, maintain, and continuously operate monitoring devices as follows:

(1) A monitoring device for the measurement of the temperature of the gas stream at the exit of the thermal dryer on a continuous basis. The monitoring device is to be certified by the manufacturer to be accurate within ±3° Fahrenheit.

(2) For affected facilities that use venturi scrubber emission control equipment:

(i) A monitoring device for the continuous measurement of the pressure loss through the venturi constriction of the control equipment. The monitoring device is to be certified by the manufacturer to be accurate within ±1 inch water gage.

(ii) A monitoring device for the continuous measurement of the water supply pressure to the control equipment. The monitoring device is to be certified by the manufacturer to be accurate within ±5 percent of design water supply pressure. The pressure sensor or tap must be located close to the water discharge point. The Administrator may be consulted for approval of alternative locations.

(b) All monitoring devices under paragraph (a) of this section are to be recalibrated annually in accordance with procedures under § 60.13(b)(3) of this part.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c–9).).[68]

§ 60.254 Test methods and procedures.

(a) The reference methods in Appendix A of this part, except as provided in § 60.8(b), are used to determine compliance with the standards prescribed in § 60.252 as follows:

(1) Method 5 for the concentration of particulate matter and associated moisture content,

(2) Method 1 for sample and velocity traverses,

(3) Method 2 for velocity and volumetric flow rate, and

(4) Method 3 for gas analysis.

(b) For Method 5, the sampling time for each run is at least 60 minutes and the minimum sample volume is 0.85 dscm (30 dscf) except that shorter sampling times or smaller volumes, when necessitated by process variables or other factors, may be approved by the Administrator. Sampling is not to be started until 30 minutes after start-up and is to be terminated before shutdown procedures commence. The owner or operator of the affected facility shall eliminate cyclonic flow during performance tests in a manner acceptable to the Administrator.

(c) The owner or operator shall construct the facility so that particulate emissions from thermal dryers or pneumatic coal cleaning equipment can be accurately determined by applicable test methods and procedures under paragraph (a) of this section.

(Sec. 114 of the Clean Air Act as amended (42 U.S.C. 1857c–9).).[68]

36 FR 24876, 12/23/71 (1)

as amended

41 FR 2231, 1/15/76 (26)
42 FR 37936, 7/25/77 (64)
42 FR 41424, 8/17/77 (68)
42 FR 44812, 9/7/77 (71)