WOLVERINE COAL PROJECT
Wolverine EA Certificate and Mine Permit Amendments - 2.4 Mtpa, May 2005

Western Canadian Coal

Suite 900 – 580 Hornby Street
Vancouver, B.C. Canada V6C 3B6
Tel: 604-608-2692 Fax: 604-629-0075

May 31, 2005

Mr. Bob Hart
Project Review Manager
Environmental Assessment Office
PO Box 9426 Stn Prov Govt
836 Yates Street
Victoria, BC
V8W 9V1

Mr. Bob Lane
Regional Geologist
Northeast Regional Office
Ministry of Energy and Mines
2275A Quinn Street
Prince George, BC
V2N 2X4

Dear Mr. Hart

Re: Wolverine Coal Project - Application for Amendment to Environmental Assessment Certificate M04-01, and Mine Permit No. C-223

Further to the issuance of Environmental Assessment Certificate M04-01, and Mine Permit No. C-223, please find enclosed an Application for Amendment to both the Certificate and the Permit.

This Amendment Application is submitted to both the Environmental Assessment Office (EAO), and the Ministry of Energy and Mines (MEM), for concurrent review. It is understood that the EAO will lead the review process.

This Amendment Application package documents changes to project components related to a planned increase in annual production from 1.6 MT to 2.4 MT.

In addition, this document presents, where applicable, updates to information presented in the *Wolverine Coal Project - Additional Information Report*, and *Wolverine Coal Project - Application for a Mines Act Permit Approving the Mine Plan and Reclamation Program*.

During the EA and Mine Permitting process, applications have been submitted to other Regulatory Agencies, as appropriate to their jurisdiction over project components. Western is pleased to provide copies of any supporting documentation that may facilitate review of this Amendment Application.

Please don't hesitate to call if you have any further information requirements, or would like to discuss any aspect of this Application.

Yours truly,
Western Canadian Coal Corp.

Kathleen Pomeroy
Vice President, Environment & Regulatory

Encl.
Cc:
Bob Lane, Ministry of Energy and Mines, Prince George
Kim Bellefontaine, Ministry of Energy and Mines, Victoria
Chris Carr, Ministry of Energy and Mines, Victoria
Elizabeth Hunt, Ministry of Forests, Dawson Creek
Roger Stewart, Ministry of Water, Land and Air Protection, Williams Lake
Pierre Johnstone, Ministry of Water, Land and Air Protection, Fort St. John
Dave Sutherland, Ministry of Water, Land and Air Protection, Prince George
Bruce Carmichael, Ministry of Water, Land and Air Protection, Prince George
John Clark, Ministry of Water, Land and Air Protection, Prince George
Brendan Miller, Land and Water British Columbia, Fort St. John
Peter Homenuck, IER Planning, Research and Management Services, Victoria
Chief Harley Chingee, McLeod Lake Indian Band, Chetwynd / cc: Alec Chingee Jr.
Chief Allan Apsassin, Saulteau First Nation, Moberly Lake / cc: Clayton Davis
Chief Roland Willson, West Moberly First Nation, Moberly Lake / cc: Hugh Taylor
Cliff Calliou, Kelly Lake Cree Nation, Tomslake
Lyle Letendre, Kelly Lake Metis Settlement Society, Grande Prairie
Claire Gauthier, Kelly Lake First Nation, Tomslake
John Hogg, Western Canadian Coal, Vancouver (letter only)
Joan Hesketh, Deputy Minister, Environmental Assessment Office, Victoria (letter only)

Executive Summary

Overview & Purpose of Document

On 13 January 2005 Western Canadian Coal (WCC) received Environmental Certificate M04-01 (the Certificate) for the Wolverine Coal Project, located approximately 25 km west of Tumbler Ridge, British Columbia. As described in the EA Certificate, the project is an open pit coal mine with an annual production capacity of 1.6 million tonnes. The project comprises the Perry Creek and EB pits; coal processing, storage and loadout facilities; maintenance facilities; tailings pond and waste dumps; a coal dryer; an explosives magazine; modifications to the Perry Creek road and Wolverine Forest Service Road; a power line and construction camp.

The environmental baseline, management plans and assessment were presented in the documents entitled "Wolverine Coal Project – Environmental Assessment – *Additional Information Report* (*AIR*) and *Addendum Report*" and submitted to the Executive Director in May, 2004 and July, 2004 respectively.

On 31 March 2005 WCC received Permit No. C-223 (the Permit), approving the work system and reclamation program for the Wolverine Coal Project and providing permission to commence work. This work system and reclamation program are described in the documents entitled "*Wolverine* Coal *Project – Application for a Mines Act Permit Approving the Mine Plan and Reclamation Program*" and "*Wolverine Coal Project – Permit Level Geotechnical Designs for the Tailings Facility and Coarse Coal Reject Pile*", and submitted to the Chief Inspector of Mines in December, 2004 and January, 2005 respectively.

The mine plan and reclamation program presented in these documents focused on development of the Perry Creek pit, with the required permitting and development of the surface minable reserves in EB pit scheduled for a later date.

WCC is proposing to increase the annual production capacity of the Wolverine Coal Project from 1.6 million tonnes to 2.4 million tonnes.

The purposes of this document are to:

- make application to the Executive Director of the Environmental Assessment Office to amend the Certificate pursuant to s. 19(1) of the Act
- provide notification to the Chief Inspector and the District Inspector of Mines of intended changes to the mine plan and reclamation program approved by the Permit
- provide the plans, analysis, records and other information necessary for an effective assessment of the proposed changes by the Executive Director and Chief Inspector.

The scope of this application includes the Perry Creek pit, Plantsite and related facilities of the mine site as described in the Environmental Assessment Certificate and Mine Permit applications.

Description of Changes

Recent project work and coal market analysis demonstrate the feasibility to increase the planned annual production capacity of the Wolverine Coal Project to 2.4 million tonnes of metallurgical coal. This increased annual throughput will be realized by designing, constructing and operating the coal preparation plant and related facilities to this higher level and operating the Perry Creek pit at a higher production rate to release the raw coal required. This higher mining rate from the Perry Creek pit will move forward development of other coal reserves to sustain the 2.4 MCMT production level for the 15 year projected life of the project. These other coal reserves include:

- Mining of the East limb (and J-conglomerate) in Perry Creek pit if supported by planned ARD studies.
- Developing the surface minable reserves at EB pit (Mt. Spieker).
- Development of underground reserves identified in the Perry Creek deposits.

These changes to the annual throughput do not impact the overall footprint of the project area, with the following aspects of the project remaining as previously presented:

- The general arrangement of the site and construction plan for the coal processing, storage and loadout facilities, maintenance facilities, and coal dryer.
- The designs for the Perry Creek pit, the three associated waste dumps (South dump, East dump, and North dump), the tailings facilities, and Coarse Coal Reject (CCR) pile.
- The design rational and construction and operating plan for the water management structures.

Changes described in this report include:

- an update to the coal process flow
- an update to the mine plan and reclamation program
- an update to the air quality assessment based on the increased level of activity.

From these changes an assessment of the:

- waste management strategy
- water management facilities
- geotechnical stability of the mine structures
- monitoring programs

have been made to ensure their adequacy.

Air Quality Emissions

The air quality assessment has been revised to account for the increase in production. The revised assessment includes an estimation of fugitive coal dust emissions, greenhouse gas emissions, and coal dryer emissions. Refined dispersion modelling was conducted to predict maximum ground-level concentrations resulting from coal dryer emissions. A non-residency agreement has been negotiated with the Terry Ranch owners therefore there are no longer any sensitive receptors within 10 km of the site. Maximum predicted concentrations of TSP, $PM_{2.5}$ and SO_2 were found to be less than relevant ambient air quality objectives and standards. The maximum predicted daily average PM_{10} concentration is greater than the provincial objective (50 μg/m^3); however the area of exceedence is small and limited to the mine lease. In addition, the frequency of exceedence is only 0.11% or 10 hours per year. Maximum ground-level NO_2 concentrations were determined using three methods to convert predicted NO_x concentrations to NO_2: the Total Conversion Method, the Ozone Limiting Method, and the Ambient Ratio Method. When the Ozone Limiting and Ambient Ratio methods were applied maximum predicted NO_2 concentrations for all averaging periods were well below ambient air quality objectives. When the Total Conversion Method was applied the maximum daily and annual average predicted concentrations were less than ambient air quality guidelines but the maximum hourly average concentration was greater than the maximum acceptable objective (400 μg/m^3) but less than the maximum tolerable objective (1,000 μg/m^3). The area of exceedence of the maximum acceptable objective for NO_2 was small and mostly confined to the mine lease – an exceedence was predicted at only one receptor beyond the mine lease. The maximum frequency of exceedence is 1.3%. There are no residents at these locations and therefore the concern is the potential effects to vegetation rather than human health. The United Nations Economic Commission for Europe has set a NO_2 guideline for vegetation protection (29 μg/m^3 based on an annual average). The maximum predicted annual NO_2 concentration of 13.1μg/m^3, based on the conservative Total Conversion Method, is well below this vegetation guideline limit.

Land Use and Tenure Impacts

"The proposed increase in the annual production capacity will not have an impact on the existing land use tenures, nor on agreements which are currently being negotiated between Western and the tenure holders. All tenure holders however will be notified of the change in annual production, if approved."

Wildlife

Wildlife protection and management are an ongoing priority of WCC. WCC has continued to work to further define baseline information in the Project Area, and develop management plans to address wildlife issues. Ongoing initiatives include the development of a Wildlife Protection Plan, which includes the delivery of bear aware training, and participation in a caribou collar ID program.

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E E1: RWDI, April 2005 Calculation of Fugitive Dust Emission Rates

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F Keystone, December 2004 Wildlife Studies Update

G Axys Environmental, May 2005 Construction and Operations Wildlife Protection Plan (WPP) – Manager's Manual.

List of Abbreviations & Units of Measurement

Acid Base Accounting	ABA
Acid Generating Potential	AP
Acid Rock Drainage	ARD
Additional Information Report	*AIR*
Air quality management plan	AQMP
All-terrain vehicle	ATV
Alternative Investment Market of the London Stock Exchange	AIM
Ammonium nitrate fuel oil	ANFO
Animal Unit Months	AUM
Archaeology Impact Assessment	AIA
As received basis	arb
Available Water Storage Capacity	AWSC
B.C. Rail	BCR
Bank Cubic Metres	BCM
Base	“B”
Best Management Practices	BMP
British Columbia Ministry of Water, Lands and AIR Protection	MWLAP
British thermal units per pound	BTU/lb
Calcium – Magnesium	Ca-Mg
Canadian Forest Products	Canfor
Carbon dioxide	CO_2
Carbonate Neutralization Potential Ratio	CaNPR
Carbonate Neutralization Potential	CaNP
Centimetre	cm
Coal Bed Methane	CBM
Coarse Coal Reject	CCR
Cubic metre	m^3
Cubic metres per second	m^3/s
Cubic metres per second	m^3/s
Cubic Metric Tonnes	CMT
Degree	°
District of Tumbler Ridge	DTR
Dry basis	db
Emergency Response Plan	ERP
Engelmann Spruce Subalpine Fir moist very cold Bullmoose Variant	ESSFmv^2
Environmental Assessment Office	EAO
Environmental Assessment	EA
Environmental Management Plan	EMP
Environmental Protection Division	EPD
Foot	ft
Forest Service Road	FSR
Fortress Sandstone	FSs
Fresh Water Aquatic Life	FWAL
Good media for plant growth	“G”
Gram	g
Grams per centimetre cubed	g/cm^3
Greater than	>

Greenhouse gas	GHG
Harmful alteration, disruption, or destruction	HADD
Hectares	ha
High density polyethylene	HDPE
Hour	h
Hours per day	h/d
Initial Dilution Zone	IDZ
International Static Database	ISD
Iron	Fe
Kilogram	kg
Kilograms per hectare	kg/ha
Kilograms per Tonne	kg/tonne
Kilometre	km
Kilometres per hour	km/h
Kilometres squared	km^2
Kilovolt	kV
Land and Resource Management Plan	LRMP
Land and Water British Columbia, Inc.	LWBC
Less than	$<$
Light Detection and Ranging	LIDAR
Litres per cubic meter	L/m^2
Litres per second	L/s
Loose cubic meters	LCM
Lorax Environmental Services Ltd	Lorax
Material Safety Data Sheet	MSDS
Measurement of Acidity	pH
Metal Leaching	ML
methane	CH_4
Methyl Isobutyl Carbinol	MIBC
Metre	m
Micrograms per cubic meter	$\mu g/m^3$
Micrograms per litre	µg/L
Micrometre (micron)	µm
Milligrams per cubic meter	mg/m^3
milligrams per litre	mg/L
Millimetre	mm
Million Bank Cubic Metres	MBCM
Million bank cubic metres	MBCM
Million cubic metres	Mm^3
Million Cubic Metric Tonnes	MCMT
Million Loose Cubic Meters	MLCM
million tonnes per annum	Mtpa
million tonnes run-of-mine coal	MtROM
million tonnes	Mt
Ministry of Energy and Mines	MEM
Ministry of Forests	MoF
Ministry of Health Services	MHS
Ministry of Sustainable Resource Management	MSRM
Ministry of Transportation	MOT
Ministry of Water, Land and Air Protection	MWLAP

National Fire Code of Canada	NFCC
Northeast Mine Development Review Committee	NEMDRC
Net Potential Ratio	NPR
Neutralization Potential	NP
Nitrogen Dioxide	NO_2
Nitrogen oxides	NO_x
Nitrogen	N
Nitrous Oxide	N_2O
Non Acid Generating	NAG
North dump	ND
Northeast Mine Development Review Committee	NMDRC
Not Acid Generating	NAG
Not Potentially Acid Generating	NPAG
Oil and Gas Commission	OGC
Operations, Maintenance and Surveillance	OMS
Particulate matter	PM
Parts per million	ppm
Peace River Regional District Health Authority	PRRD HA
Percentage	%
Petroleum Natural Gas	PNG
Polycyclic Aromatic Hydrocarbons	PAHs
Potential Metal-Leaching	PML
Private Land Deduction	PLD
Potentially Acid Generating	PAG
Recreation Opportunity Spectrum	ROS
Quintette Operating Company	QOC
Recreation Opportunity Spectrum	ROS
Resource Management Zone	RMZ
resource road	RR
Right-of-way	ROW
Run-of-mine	ROM
Selenium	Se
semi-primitive motorized	SPM
semi-primitive non-motorized	SPNM
South dump	SD
Specific Gravity	SG
Square metre	m^2
Sub-Boreal Spruce wet cool Finlay Peace variant	$SBSwk^2$
Sulphide Acid Production Potential	SAP
Sulphur dioxide	SO_2
sulphur dioxides	SO_x
Technical Assessment Report	TAR
Terrestrial Ecosystem/Predictive Ecosystem Mapping	TEM/PEM
Tonne	t
Tonnes per cubic metre	t/m^3
Tonnes per hour	t/h
Tonnes run-of-mine	tROM
Topsoil	“T”
Toronto Stock Exchange	TSX
Total suspended particulate	TSP

Total Suspended Solids .... TSS
Transportation of Dangerous Goods Act and Regulations .... TDGR
Tree Farm License .... TFL
University of Northern British Columbia .... UNBC
US grams per minute .... USgpm
Valued ecosystem component .... VEC
Volatile organic compounds .... VOC
Volt V
Waste Management Plan .... WMP
Western Canadian Coal .... WCC or Western
Wolverine Sandstone .... WSs
Workplace hazardous materials information system .... WHMIS

Section 1 • Introduction & Overview

1.1 Regulatory Considerations

1.1.1 EA Certificate & Mine Permit Amendments

WCC received the EA Certificate for the Wolverine Mine (1.6 Mtpa) in January 2005; and the Wolverine Mine Permit on 31 March 2005. Before receipt of these approvals, detailed engineering planning, combined with market conditions, had led WCC to consider the option of building the Wolverine Mine for an initial higher production capacity – 2.4 Mtpa instead of 1.6 Mtpa.

WCC met with representatives of the Environmental Assessment Office (EAO) and the Ministry of Energy and Mines (MEM) in January 2005 to provide an update on detailed engineering planning for the Wolverine Project, including the proposal to build the initial plant for a production capability of 2.4 Mtpa, based on the rationale outlined in this report.

The EAO determined that this change to the project would require an amendment to the EA Certificate (pending at that time) for Wolverine Mine, which was to be approved for 1.6 Mtpa production. MEM determined that the change would also require an amendment to the Mine Permit (also pending at that time).

Following discussions among the parties, it was agreed that WCC would make concurrent Applications for an Amendment to the EA Certificate and Amendment to the Mine Permit. The applications would be supported by one document. Review of the concurrent Applications would be coordinated by the EAO.

Details of the review process have yet to be defined. The EAO indicated in January 2005 that, if the changes were unlikely to result in significant environmental impacts, then the review period would likely be significantly shorter than the timelines provided for a full review process under the *B.C. Environmental Assessment Act*.

The Amendment Review process will be defined by the EAO in conjunction with MEM, based on the contents of this Application Document.

WCC has offered to fund the involvement of the Third Party Reviewer who acted on behalf of the First Nations and Aboriginal communities during the initial Wolverine EA Review.

If the review results in an approval of the changes proposed, the EAO will amend the Wolverine Mine Environmental Assessment Certificate, and may change the conditions of the Certificate; and MEM will amend the Mine Permit, and may change conditions of the Permit.

1.2 Other Approvals for Perry Creek Pit

A preliminary list of key approvals for the Wolverine Mine was provided in the B.C. EAO Assessment Report on the Wolverine Project (Table 1-1)

Table 1-1 provides an updated list of required regulatory approvals and permits, summarizes the status of each permit and approval, and notes where amendments are, or may be, needed.

Table 1-1: Key Regulatory Approvals Required for the Wolverine Mine

Authority	Description	Project Facilities	Purpose & Legislation
MEM	Permit Approving the Mine Plan and Reclamation Program	Pits, waste dumps, tailings impoundment, mine infrastructure, construction and reclamation plan	Approving the conceptual life of Wolverine mine construction, operations, and reclamation and closure plan, and the detailed 5-year mine and reclamation plans. Geotechnical approval of engineering designs for dams and waste embankments - *Mines Act*.
MEM	Coal Lease	Pits, waste dumps, Plantsite, tailings impoundment, minesite infrastructure	Approving development and operation of a mine on Crown Land – *Coal Act (in place)*
MSRM LWBC	Water Licenses	Sediment ponds SP6, SP12, SP4a	Authorizing diversion, impoundment, withdrawal and use of water - *Water Act.*
MSRM LWBC	Crown Land Lease	Plantsite and Tailings Pond area Water Management Structures off the Coal Lease and Plant Site Lease	Authorizing use of Crown land for purpose of the Plantsite and tailings pond construction - Lease of about 100 ha for 29 years, and Authorizing installation of drainage control structures – *Land Act*
SRM LWBC	Forest Service Road Dedication (in favour of MoF)	Wolverine FSR Realignment	Authorizing use of Crown land for realigned Wolverine FSR- Authorizing widening of the Wolverine FSR Right of Way to accommodate powerline development – *Land Title Act*
DTR	Subdivision Approval (in favour of John Terry Estate)	South dump, Wolverine FSR Realignment	Authorizing separation of the Northwest Corner of the Terry Ranch (for purposes of sale by John Terry Estate to WCC) – *Land Title Act & Local Government Act*
MWLAP	Effluent Permit (Construction and Operations)	Discharge of treated water from settling pond	Authorizing discharge of treated minesite water from settling ponds. Authorizing discharge of package sewage treatment plant effluent from the mine office and maintenance facility to the tailings pond. – *Environmental Management Act*
MWLAP	Wildlife Permit under Section 19 of *Wildlife Act*	Tailings Pond	Removal of beaver ponds and lowering water table in tailings pond area - *Wildlife Act*. *(Permit 3FJ044629 in place)*
MoF	License to Cut	Minesite and Plantsite areas	Authorizing harvest of merchantable timber - *Forest Act*

Authority	Description	Project Facilities	Purpose & Legislation
MoF	Road Use Permit	Wolverine FSR	Authorizing use of a Forest Service Road - *Forest Act*
MoF	Special Use Permit	Wolverine FSR	Authorizing temporary and permanent relocation of FSR, *Forest Act*.
MHS PRRD HA	Potable Water Permit	Plant and offices	Authorizing construction and operation of a water works system - *Health Act*, Safe Drinking Water Regulation
MHS PRRD HA	Sewage Disposal Permit	Plant and offices	Authorizing installation of a small septic field for the preparation plan during operation – *Health Act*

Abbreviations: (P) = Provincial Government - British Columbia; (M) = Municipal Government

LWBC	Land & Water British Columbia Inc. (P)	MoF	Ministry of Forests (P)	MWLAP-EPD	Ministry of Water, Land and Air Protection, Environmental Protection Division (P)
MEM	Ministry of Energy and Mines (P)	MOT	Ministry of Transportation (P)	PRRD HA	Peace River Regional District Health Authority (P)
MHS	Ministry of Health Services (P)	MSRM	Ministry of Sustainable Resource Management (P)	DTR	District Tumbler Ridge (M)

WCC reviewed existing permits, and assessed whether amendments are required in relation to the proposed production increase.

1.3 Required Approvals for EB Pit

The Wolverine Project EA Certificate approves development of the Wolverine Mine, consisting of the Perry Creek and EB pits; coal processing; loadout and storage facilities; maintenance facilities; tailings pond and waste dumps; a coal dryer; an explosives magazine; modifications to the Perry Creek road and Wolverine Forest Service Road; a powerline and construction camp.

The Wolverine Project Mine Permit approves the mine plan and reclamation program for the Perry Creek pit and plantsite; a future Mine Permit Application is required for the EB pit.

Conditions of the EA Certificate require additional environmental and engineering studies prior to EB development. The required studies include further studies in the following areas:

- ARD/ML
- geotechnical assessment
- engineering design of the pit and waste dumps
- assessment of caribou use of the EB area
- groundwater monitoring

- meteorological data monitoring
- mapping related to the water management plan.

The increase in production rate from Perry Creek pit affects the timing of development of EB pit. The start of production from the Perry Creek pit is scheduled for January 2007. WCC expects to apply for a Mine Permit for EB pit in Year 2 of Perry Creek pit operation (2008), such that the Wolverine operation can transition to EB in Year 3 (2009). Applications for other required EB pit approvals would be made in the same time frame. This timing allows for over three years to complete required study programs and management planning.

Of note with respect to this application review is that this time frame allows for over 3 years to complete studies of caribou movements in and use of the EB pit and to define appropriate mitigation and management measures, as needed.

1.4 Other Options for Coal to Sustain Production

Other options for sustaining production at the Wolverine plant are defined in Section 2.1.2, and include the Hermann pit and the Wolverine Underground Mine. Development of these mines would require full scale environmental review processes.

1.5 Rationale for Production Increase & Economic Justification

1.5.1 Initial Plans for Wolverine Project

WCC originally conceived the Wolverine Operation to provide approximately one million tonnes of clean coal over a 12 year period, primarily from underground mining. When confirmatory drilling at Perry Creek showed more coal closer to surface than originally believed, the project was revised to develop a nominal 1.6 million tonnes per year over an eleven year period from the Perry Creek and EB pits. It was recognized that there are the possibilities of additional production from Perry Creek underground and Hermann deposits later in the life of the project. The 1 Mtpa plant designed for the underground mine was scaled up and a factored estimate done for a new plant cost. It was on this basis that the Wolverine Project B.C. Environmental Assessment Application was prepared and submitted.

1.5.2 Recent Developments

During the assessment review period:

- coal demand increased and coal prices more than doubled
- Wolverine Project capital costs increased substantially.

With the benefit of the additional design and engineering done in support of the EA Application, the capital cost was re-estimated. This estimate increased significantly through design scope changes and more detailed assessment. In particular, the estimated cost for site development, which is largely independent of plant capacity, increased greatly. At the same time, it has been identified that, although the plant capacity is optimal for the Perry Creek pit over its life, it is not optimal in terms of efficiency of plant equipment sizing. For a small additional increase in project capital cost, the plant capacity can be increased by 50% to 2.4 Mtpa from 1.6 Mtpa of clean coal.

The current high coal prices are seen as a transient phenomenon, likely achievable for two or three years before dropping back to a level somewhat higher than recent historical prices. To the extent WCC can maximize its production during the higher price period; the company can reduce its capital at long-term risk.

1.5.3 Revised Plans

To take advantage of the high prices and reduce its risk to capital, WCC plans to build the plant for 2.4 Mtpa throughput and has revised the Perry Creek mining plans to maximize the benefit of this plant. This entails faster initial mining of Perry Creek pit. The schedule set out in Section 2.1 achieves a high early mining rate, with production tapering off after the first two years. With only two years of production at the higher rate, the favourable economic impact on the company is substantial because each tonne of coal sold at the higher current price will contribute substantially more to the balance sheet than if it were produced later and sold at a lower price. This is more than adequate justification for the plant expansion. In the meantime the company will be evaluating and progressing alternatives to sustain or even increase production rates by, for example, development of the Hermann deposit, expansion of the Perry Creek pit, earlier underground mining at Perry Creek, or earlier mining from EB pit.

This new mining plan will require 10 to 20 more workers because of the increased stripping and mining rates and increased materials handling requirements. Significantly more workers will be required if and when an additional deposit is brought into production to sustain the increased production rate.

1.5.4 Future Development

Should adequate reserves be developed at Hermann and/or other nearby deposits, the company may expand the plant to a nominal 3 Mtpa of capacity. (Note: resources for the Hermann deposit are described in the technical report “Summary Report on the Hermann Coal Property” by Norwest Mine Services Ltd., and filed by WCC on the SEDAR website on 19 August 2002). Because most of the site preparation work will already have been done for the initial plant, the incremental capital cost per incremental unit of capacity is expected to be significantly lower. To facilitate such an expansion, some elements of the infrastructure are being sized to ensure they are adequate for 3 Mtpa throughput. This expansion will only happen if adequate demand for additional coal is demonstrated in the market.

Section 2 • Project Changes

2.1 Mine Plan Changes

The mine plan presented in the Permit application was based on producing 1.6 MCMT per year from the Perry Creek pit which, with pre-production waste mining, gave a mining life to the pit of just over eight years. To provide a mining schedule that releases the raw coal needed to produce 2.4 MCMT per year required adjustment to the pit's phasing and sequencing. Prior to developing the pit phasing and sequencing presented in this report the mining reserves were re-evaluated based on updated topographic mapping developed from LIDAR (light detection and ranging) technology and on adjustments made to the final northeast wall (above the syncline trough) for slope stability. The resulting mining reserves for Perry Creek pit, and phasing for the revised mining schedule are summarized in Table 2-1.

Table 2-1: Perry Creek Pit: Mining Reserve Summary

Phase	Waste (BCM x 1000)	Coal (tROM x 1000)	Mining Strip Ratio (BCM:tROM)
1	23,945	5,009	4.78
2	27,088	4,652	5.82
3	17,306	2,188	7.91
4	24,423	4,534	5.39
Total	**92,762**	**16,383**	**5.66**
EA/Permit Total	**98,217**	**17,233**	**5.70**

The differences between the waste mining quantity from the Certificate and Permit applications and the revised quantity is a combined result of the revised topographic mapping and the adjustment to the northeast wall. The difference between the coal mining quantity from the Certificate and Permit applications to the revised quantity is mainly a result of the adjustment to the northeast wall and therefore coal that will tentatively be recovered when the east limb is mined.

Perry Creek pit will be developed in four phases, with the phasing and resulting mining schedule based on the following rationale:

1. Meeting the required coal release.
2. Establishing a relatively constant annual waste mining quantity.
3. Maintaining the waste management plan (with respect to PAG material) presented in previous plans.

4. Maintaining the footprint of the pit, waste dumps and haul roads as presented in previous plans.

Following is a brief description of the phasing, with details of annual development and quantities presented in Section 2.1.2 of this plan.

Phase 1: similar to the previous mine plan, Phase 1 is located in the north-east end of the pit and targets the lower strip ratio, shallow dipping coal south of the Perry Creek syncline trough.

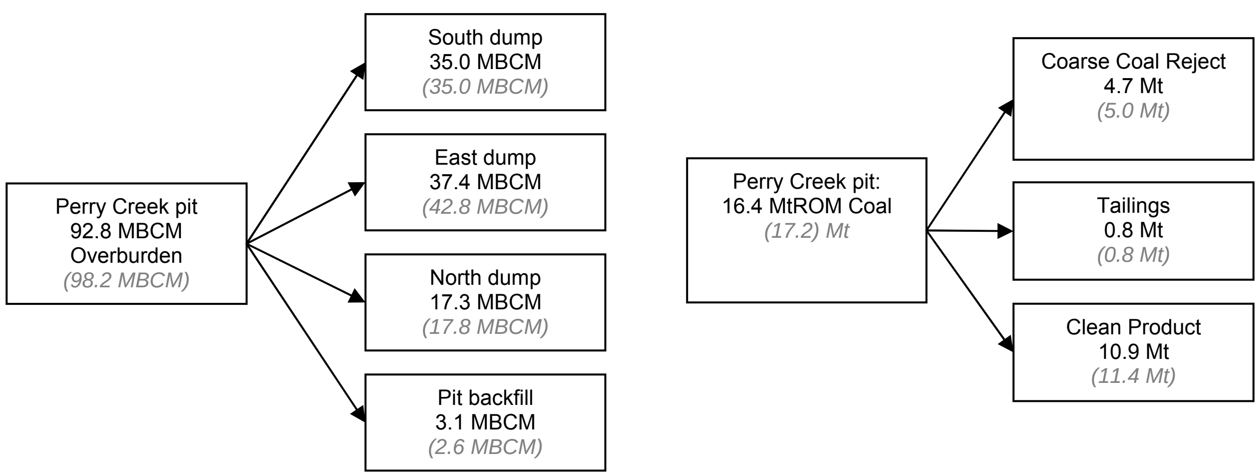
Phase 2: is located in the south-central portion of the pit and exposes final pit bottom from the subcrop to roughly the centre of the ultimate mining limit.

Phase 3: is located at the south-west end (higher elevations) of the pit and releases the coal from the Perry Creek anticline. This phase is designed with a waste mining quantity corresponding to the volume of the North dump.

Phase 4: is located in the north-central portion of the pit, between the interim wall developed in phase 3 and the final north wall of the pit.

2.1.1 Overview

Materials to be removed from the Perry Creek pit include 92.8 million bank cubic meters (MBCM) of unconsolidated overburden and waste rock and 16.4 million tonnes run-of-mine coal (MtROM). A general material balance is provided below (figures in parenthesis are from the Permit application):



From the above material balance, the most significant change from the Permit application is the amount of waste directed to the East dump from Perry Creek pit being reduced by 5.4 MBCM. The effect on the dump construction with waste from Perry Creek pit is a reduction in the elevation of the top lift from 1050 to about 1030, or by 20 m.

2.1.2 Perry Creek Pit Production Plan & Schedule

Table 2-2 summarizes the mining and coal production schedule from the Perry Creek pit.

Table 2-2: Perry Creek Pit: Mining & Coal Production Schedule

Period	Waste (BCM x 1000)	Coal Release (tROM x 1000)	Coal Processed (tROM x 1000)	Coal Produced (CMT x 1000)
Pre-Production	11,791	278	0	0
Year 1 (2007)	15,810	3,626	3,816	2,358
Year 2 (2008)	16,565	3,461	3,549	2,299
Year 3 (2009)	15,898	3,014	3,014	2,078
Year 4 (2010)	15,945	2,492	2,492	1,725
Year 5 (2011)	15,814	2,600	2,600	1,753
Year 6 (2012)	939	912	912	660
Total	**92,762**	**16,383**	**16,383**	**10,874**

The main change from the production schedule presented in the mine permit application is the amount of waste mining scheduled for the pre-production period, increasing from 6.4 MBCM to 11.8 MBCM. This increase is needed to provide the coal required during the first years of production.

The schedule tabulated above indicates that starting in Year 3 (2009) coal from another area will be required to sustain a 2.4 MCMT production level. It is anticipated that by this time coal will be available from one or a combination of the following sources:

- Perry Creek Pit East Limb: this portion of the Perry Creek pit remains out of the schedule until mining can be supported by information from ARD testing on the J-conglomerate. Plans are in place to develop a series of test pads in the second quarter of 2005. If this testing concludes that the waste from this area can be managed, amendments to the Certificate and Permit would be made in 2006 to support mining the east limb. Preliminary scheduling indicates that with east limb in the mining schedule, a 2.4 MCMT production level could be sustained through Year 3, with coal from another source supplementing Perry Creek pit in Year 4.
- EB Pit (Mt. Spieker): is located about 19 km west of Perry Creek pit and was described in the *AIR* as having approximately 8 Mt ROM coal to be phased in during the life of the Perry Creek pit. Prior to proceeding with further mining approvals for the EB pit, WCC has committed as part of the Wildlife Management Plan to contribute to studies to evaluate caribou migration routes through the EB area. Potentially, mine permitting for EB pit would be made in 2008, with mining to commence in 2009. This timing allows for over three years to complete required study programs and management planning.

- Perry Creek Underground: feasibility studies are underway regarding development on the Perry Creek deposit by underground mining methods. Potentially the EA Certificate and Mine Permit applications would be made in 2008, with mining to commence in 2009.
- Hermann Property: is located approximately 15 km south-east of Perry Creek and adjacent to coal structures mined in the 1980/90's by Quintette Coal. WCC currently has exploration, feasibility and environmental baseline studies underway to support an EA application in 2006.

2.1.2.1 Pre-Production Mining

Pre-production mining is scheduled to begin during the fourth quarter (Q4) of 2005 and continue through to commissioning of the coal processing plant in Q4 2006. The mining objectives through this period include topsoil salvage and stockpiling, haul road construction and upper bench development in both Phase 1 and 2 of the pit for coal release in subsequent years. The mining and material movement schedule for this period is summarized in Table 2-3 and outlined on Figure 2.1-1.

Table 2-3: Pre-Production Mining Schedule (all quantities in thousands)

			Coal (t ROM)		
Phase	**Benches**	**Waste (BCM)**	**Upper Seams**	**J-Seams**	**Total**
1	1080 – 975	6,991	162	21	183
2	1170 - 1065	4,800	67	28	95
Total		**11,791**	**230**	**48**	**278**

Waste mined during this time frame will be hauled to the lower lifts (880, 900, and 920) on South dump, the 920 lift on East dump (which includes the W6 rock drain) and used to construct the main coal haul road up to the 1000 elevation along the south limit of the pit.

Year 1 (2007)

Based on the current construction schedule and pre-production mining schedule, Year 1 of operation will closely correspond to calendar year 2007. During this time frame mining and plant production will reach full capacity. The mining and material movement schedule is summarized on Table 2-4 and outlined on Figure 2.1-2.

Table 2-4: Year 1 Mining Schedule (all quantities in thousands)

			Coal (t ROM)		
Phase	**Benches**	**Waste (BCM)**	**Upper Seams**	**J-Seams**	**Total**
1	960 - 900	15,810	1,710	1,916	3,626
2	-	-	-	-	-
Total		**15,810**	**1,710**	**1,916**	**3,626**

Waste mined during this time frame will be hauled to the 920, 940, 960 and 980 lifts on South dump and the 950 lift on East dump.

Year 2 (2008)

During this time frame, Phase 1 of the pit will be completed, after which the main activities will shift up to Phase 2. The mining and material movement schedule for this period is summarized on Table 2-5 and outlined on Figure 2.1-3.

Table 2-5: Year 2 Mining Schedule (all quantities in thousands)

Phase	Benches	Waste (BCM)	Coal (t ROM)		
			Upper Seams	J-Seams	Total
1	885 - 855	1,143	28	1,172	1,200
2	1075 - 990	15,422	1,328	933	2,261
Total		**16,565**	**1,356**	**2,105**	**3,461**

Waste mined during this time frame will be hauled to the 980, 1000, 1020, 1040 and 1060 lift on South dump and extend the main coal haul road to the 1060 elevation, which is the top elevation of the dump. A portion of the waste mined will be hauled to the 950 lift on East dump.

Year 3 (2009)

During this time frame, Phase 2 of the pit will be completed and mining started in Phase 3. The start of mining in Phase 3 also corresponds to the start of construction of North dump, which is well after mining activity is completed and personnel and equipment have moved out of the Phase 1 pit bottom below the dump. From the mining sequence presented in the Permit application, this represents about a two year deferral in the development of North dump, and correspondingly completion of South dump close to two years sooner. The mining and material movement schedule for this period is summarized on Table 2-6 and outlined on Figure 2.1-4.

Table 2-6: Year 3 Mining Schedule (all quantities in thousands)

Phase	Benches	Waste (BCM)	Coal (t ROM)		
			Upper Seams	J-Seams	Total
2	975 – 885	6,867	255	2,041	2,296
3	1365 - 1245	9,031	289	429	718
Total		**15,898**	**544**	**2470**	**3,014**

Waste mined during this time frame will be hauled to the 1060 lift on South dump and to extend the main coal haul road to the 1125 elevation, completing this dump. Dumping will continue on the 950 lift of East dump and construction started on the North dump. North dump will be developed in the same way as described in the Permit application; starting with a 45 m wide berm at the 1075 elevation across the W6 channel and with the southwest face resloped to 27°. This will be followed with a lift at the 1125 elevation, dumped in a direction perpendicular to the W6 channel and with the southwest face reloped to 27°. The 1125 lift is then followed by the 1150 lift which will be near completion by the end of Year 3.

Year 4 (2010)

During this time frame, both Phase 3 of the pit and North dump construction will be completed and mining started in Phase 4. The mining and material movement schedule for this period is summarized on Table 2-7 and outlined on Figure 2.1-5.

Table 2-7: Year 4 Mining Schedule (all quantities in thousands)

Phase	Benches	Waste (BCM)	Coal (t ROM)		
			Upper Seams	J-Seams	Total
3	1230 – 1170	8,274	306	1,164	1,470
4	1155 - 1125	7,671	338	684	1,022
Total		**15,945**	**644**	**1,848**	**2,492**

Waste mined during this time frame will be hauled to the 1150 and 1200 lifts on North dump and to the 950 and 1000 lifts of East dump.

Year 5 (2011)

During this time frame, Phase 4 is the only active mining area and East dump the only active out-of-pit waste discard area. The mining and material movement schedule for this period is summarized on Table 2-8 and outlined on Figure 2.1-6.

Table 2-8: Year 5 Mining Schedule (all quantities in thousands)

Phase	Benches	Waste (BCM)	Coal (t ROM)		
			Upper Seams	J-Seams	Total
3	-	-	-	-	-
4	1110 - 1005	15,814	956	1,644	2,600
Total		**15,814**	**956**	**2,600**	**2,600**

Waste mined during this time frame will be hauled to the 1000 and 1030 lifts of East dump and to place the in-pit backfill at the 910 elevation.

Year 6 (2012)

Mining will be completed in Perry Creek pit during this time frame, with the remaining waste being placed on the 1030 lift of East dump. The mining and material movement schedule for this period is summarized on Table 2-9 and outlined on Figure 2.1-7.

Table 2-9: Year 6 Mining Schedule (all quantities in thousands)

Phase	Benches	Waste (BCM)	Coal (t ROM)		
			Upper Seams	J-Seams	Total
3	-	-	-	-	-
4	990 - 945	938	48	864	912
Total		**938**	**48**	**864**	**912**

2.1.3 Waste Dumps

Table 2-10 summarizes the construction schedule for the three out of pit discard areas, with a letter report by Norwest Corporation providing an assessment of dump development and stability included as Appendix A of this report.

As noted previously, the overall footprint of the three dumps is the same as presented in the Permit application, with changes being the rate and timing of construction as summarized below.

- In the revised plan, South dump is constructed over a shorter period of time, three years as compared to close to five years in the Permit plan. The design rationale of building the dump in 20 m ascending lifts with a Not Acid Generating (NAG), coarse material outer shell and a core zone which will include mixed zones of NAG and Potentially Acid Generating (PAG) material remains the same.
- Development of North dump is deferred, starting in Year 3 as compared to Year 1 in the Permit plan. The design rationale of starting with small lifts at the 1075 and 1125 elevations with the face above the W6 drainage resloped to 27° before placing the 1150 and 1200 lifts remains the same.

2.1.4 Pit Reclamation Plan & Schedule

Details of the reclamation plan and schedule are included in Section 3.6 of this report.

Table 2-10: Waste Dump Construction Schedule (LCM)

Dumps	Year	Pre-Production		Year 1 (2007)		Year 2 (2008)		Year 3 (2009)		Year 4 (2010)		Year 5 (2011)		Year 6 (2012)		Total	
		NAG	PAG	NAG	PAG	NAG	PAG	NAG	PAG	NAG	PAG	NAG	PAG	NAG	PAG	NAG	PAG
South dump																	
Haul Roads:																	
880 - 920		990,100														990,100	0
920-1000		1,747,806	5,394													1,747,806	5,394
1000-1125						1,459,300		1,000,000								2,459,300	0
880	Shell	647,100														647,100	0
	Core	647,000														647,000	0
900	Shell	2,480,000														2,480,000	0
	Core	1,411,038	211,862													1,411,038	211,862
920	Shell	2,626,598		163,402												2,790,000	0
	Core	1,896,727	91,091	771,882												2,668,609	91,091
940	Shell			2,402,499												2,402,499	0
	Core			2,838,731	408,869											2,838,731	408,869
960	Shell			2,480,000												2,480,000	0
	Core			1,688,373	660,527											1,688,373	660,527
980	Shell			344,881		1,825,118										2,169,999	0
	Core			593,967	430,481	2,662,829	208,523									3,256,796	639,004
1000	Shell					1,860,000										1,860,000	0
	Core					3,204,583	192,417									3,204,583	192,417
1020	Shell					1,317,500										1,317,500	0
	Core					2,490,077	345,822									2,490,077	345,822
1040	Shell					775,000										775,000	0
	Core					1,225,147	339,354									1,225,147	339,354
1060	Shell					266,794		198,206								465,000	0
	Core					250,244		371,156								621,400	0
Total		**12,446,369**	**308,348**	**11,283,737**	**1,499,876**	**17,336,592**	**1,086,116**	**1,569,362**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**42,636,059**	**2,894,340**
East dump																	
920/RD	Lift	2,520,032	53,718													2,520,032	53,718
950	Lift			7,089,120	680,341	2,408,100	703,921	6,768,483	588,857	1,887,428						18,153,132	1,973,119
1000	Lift									7,696,321	388,813	10,567,650	597,216			18,263,971	986,029
1050	Lift											4,869,756	523,048	1,219,757	84	6,089,513	523,132
Total		**2,520,032**	**53,718**	**7,089,120**	**680,341**	**2,408,100**	**703,921**	**6,768,483**	**588,857**	**9,583,750**	**388,813**	**15,437,405**	**1,120,264**	**1,219,757**	**84**	**45,026,647**	**3,535,998**
North dump																	
1075	Lift							120,000								120,000	0
1125	Lift							4,387,287	133,713							4,387,287	133,713
1150	Lift							6,302,305	797,891	1,884,158	152,646					8,186,463	950,537
1200	Lift									8,151,985	567,434					8,151,985	567,434
Total		**0**	**0**	**0**	**0**	**0**	**0**	**10,809,592**	**931,604**	**10,036,143**	**720,080**	**0**	**0**	**0**	**0**	**20,845,735**	**1,651,684**
Pit Backfill												**3,289,447**	**710,553**			**3,289,447**	**710,553**
Total		**14,966,400**	**362,066**	**18,372,857**	**2,180,217**	**19,744,692**	**1,790,037**	**19,147,438**	**1,520,461**	**19,619,893**	**1,108,893**	**18,726,852**	**1,830,818**	**1,219,757**	**84**	**111,797,888**	**8,792,575**

2.2 Process Plant & Facilities

2.2.1 Overview

The following is a description of changes, from the *AIR* and Permit Application to:

- the raw coal handling system
- the process system in the coal preparation plant
- the system for collecting and feeding clean coal to the dryer
- the clean coal handling system
- the tailings system
- the process water balance and recovery system

as a result of increasing the production capability of the plant from 1.6 to 2.4 MCMT.

Figure 2.2-1 provides the general arrangement of the facilities relating to the coal handling and processing systems and the maintenance/office complex. The overall general arrangement of the plant site and footprint of the area for the plant site, maintenance shop and related facilities remains the same as previously presented.

Figure 2.2-2 depicts the revised Material Handling Flow Diagram, Figures 2.2-3.1 and 2.2-3.2 the Coal Preparation Process Flow Diagrams, Figure 2.2-4 the Thermal Dryer Process Flow Diagram and Figure 2.2-5 the Water Balance Process Flow Diagram and Mass Balance for the 2.4 MCMT per year coal preparation plant.

2.2.2 Facility Description

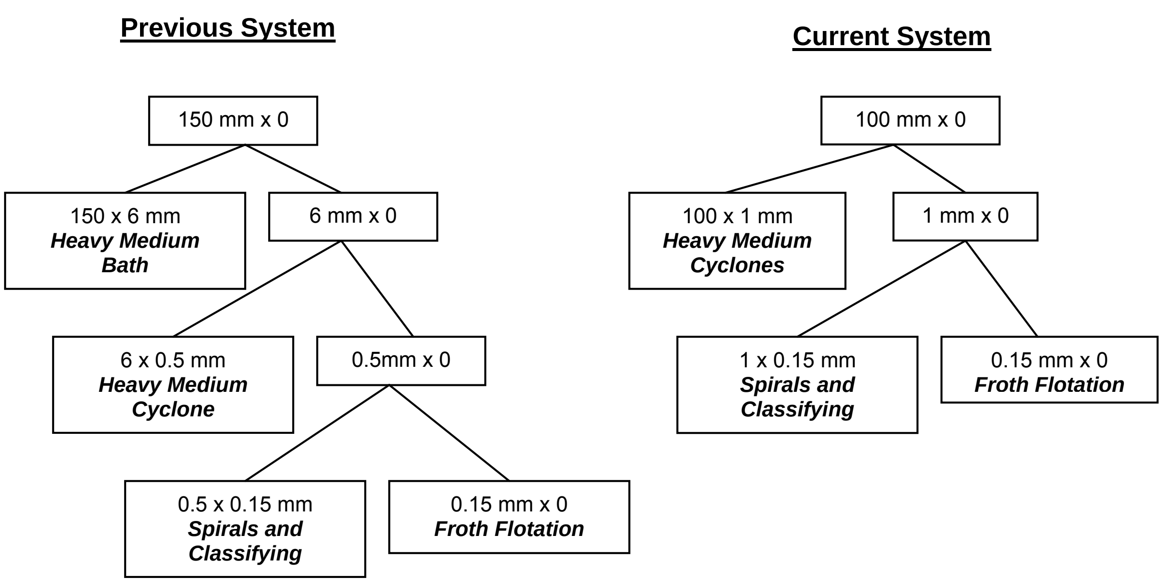
2.2.2.1 Raw Coal Handling System

Operational System	Changes
ROM coal Stockpile	As presented in the permit application, the ROM area provides for 50,000 tonne of stockpile capacity, from which coal will be trammed by a front-end-loader to a grizzly/feeder system.
Truck Dump and Rotary Breaker	As an option to stockpiling at the ROM, haul trucks can dump through a grizzly into a 350 tonne bin that feeds into the rotary breaker. Changes to this system include a reduction in the topsize from the rotary breaker (from 150 to 100 mm) and an increase in the nominal feed rate from 525 tonne/hour to 550 tonne/hour.
Raw Coal Surge Bin	As a means to control dust, this component of the raw coal handling system has been modified from an open 10,000 tonne stockpile and feeder system, to a 1,500 tonne surge bin from which coal will be fed and conveyed to the preparation plant.
Raw Coal Reclaim and Plant Feed Conveyor	The only change in this area is to the nominal feed rate into the plant, increasing from 420 tonne per hour to 550 tonne per hour.

The assessment of fugitive dust emissions from the raw coal handling system is presented in Section 3.3 of this report.

2.2.2.2 Process System in the Coal Preparation Plant

The general approach of using heavy medium magnetite slurry to process coarse coal and froth flotation for the ultra fine coal remains the same as previously presented. As noted above, there is a reduction in topsize from the rotary breaker (150 to 100 mm), which allows for a simplification and changes to the plant classification and separation processes. These changes only impact the internal workings of the coal preparation building. Below is a simplified flow chart comparison of the separation sizing and main coal cleaning processes used between the system presented in the EA and Permit applications and what is currently planned.



The most significant difference is removing the Heavy Medium Bath from the process flow and utilizing large diameter Heavy Medium Cyclones to clean the coarse size fraction. As in the previous process the froth flotation circuit will use fuel oil as a collector agent and MIBC as a frothing agent. The nominal throughput from the plant increases from 300 clean tonnes per hour to 450 clean tonnes per hour.

Refuse greater than 0.15 mm (Coarse Coal Rejects:CCR) in size will report to the refuse loadout, , from where it will be hauled either to the tailings embankment or the CCR Pile. CCR is further discussed in Section 2.4.3.

Refuse less than 0.15 mm in size will report to the thickener from which clarified water will be recirculated back to the plant process and thickened tailings pumped to the tailings pond. The storage, handling, and use of flocculant and reagent for the thickener will be the same as previously presented.

2.2.2.3 Collecting & Feeding Clean Coal to the Dryer

Other than the increase in nominal feed rate from 300 to 450 clean tonnes per hour, there are no changes to the process systems for the clean coal collection belt and fluidized bed thermal dryer.

Effluents from the thermal dryer are all contained within the dryer building and pumped back to the preparation plant for recycling, treatment, thickening, and clarifying. The assessment of dryer emissions is presented in Section 3.3 of this report.

2.2.2.4 Clean Coal Handling System

Sizes of the clean coal stockpiles: 21,000 tonnes of J-seam and 9,000 tonnes of upper seam; along with placement, reclaim and loadout systems for the clean coal remain as previously presented.

2.2.2.5 Tailings System

The tailings system, which involves pumping and pipelines (tailings line and return line), transport thickener underflow approximately 400 m from the plantsite to the tailings pond. There are no changes to this system as described in the *AIR* report. Section 2.4.5 of this report describes the production rate of tailings and waste management aspects of this material.

2.2.3 Process Water & Recovery

The preparation plant is a net consumer of water. The process has internal systems for recycling water for reuse in the process. The following summarizes the water balance for the preparation plant facilities.

	Moisture % by weight (total)	Dry Solids t/h (db)	Water t/h	Total t/h (arb)
Plant Feed	6.0	550	35	585
Coarse Plant Refuse (CCR)	13 to 15	84 to 196	14 to 84	98 to 230
Tailings (as it leaves the Plant)	60 to 70	30.3 to 60.7	91 to 107	123
Clean Coal Dryer Feed	10 to 12	297 to 430	35.8 to 50.2	337 to 430
Clean Coal Product	6.0	289 to 420	18.4 to 26.8	307 to 447
Plant Make-Up Water- annual average (before tailings recycle)			124	
Peak Plant Make-Up Water			200	
Tailing Water Recovery			0 to 124 (average 59)	

Plant Make-Up Water (with tailings recovery)	65

The data from the above table is used in Section 2.5.4 of this report to assess total site water demand.

2.2.4 Process Plant Area Effluent Control

Effluent from the tailings plant area consists of:

- tailings slurry piped to the tailings pond
- surface run-off in sediment ponds
- plant sewage.

While reassessments have been made for the higher rate of production and slightly higher manpower level, systems for handling and controlling these streams does not change from what was presented in the *AIR* report. These systems include:

Preparation Plant Tailings:	Approximately 123 cubic metres per hour (at 30 to 40% solids) being pumped to the tailings pond.
Surface Run-off:	Surface run-off from the plant site area is directed to the SP14 and SP18 settling ponds as described in the Water Management Facility Design Report presented as Appendix 4 of the Permit application.
Plant Sewage:	Will be disposed of in a septic field.

2.2.5 Plantsite Air Emissions Management

The general approach to air emission management from the plant site is the same as presented in the *AIR* and includes:

- water wetting open areas on and around stockpiles and using misting sprays at coal handling and transfer points
- enclosing transfer chute work and conveyors
- using wet scrubbers for the dryer exhaust
- periodic sampling of exhaust stack emissions to ensure compliance to standards.

Section 3.3 of this report provides an assessment of air quality based on the production increase to 2.4 MCMT.

2.2.6 Perry Creek Pit Infrastructure

Other infrastructure associated with the development of Perry Creek Pit includes the:

- Office and Maintenance Complex
- Fuel Storage Facilities
- Electric Power Structures (overhead power line and sub-station)
- Rail Line (tracking and switching for train loading)
- Explosives Storage Facilities.

Other than minor changes to reflect a slight increase in expected manpower (from 200 to about 220), there are no changes to these facilities as presented in the *AIR*.

2.2.7 Sewage & Grey Water

The sewage handling facilities and disposal methods described in the Certificate application (Section 3.5.2.4 of the *AIR*) are still adequate for the revised production plan. It is estimated that the revised plan will increase the work force by about 10%, with those workers divided among four crews working a 4-day on, 4 day-off work schedule with 12 hour shifts. These systems include:

- a single washroom in the plant discharging to a septic tank and field
- grey water (water from hand basins and showers) from the mine maintenance and shop facility (all shower facilities are located at the mine shop complex) is pumped into the preparation plant tailing line and discharged to the tailings impoundment. This grey water system also handles water from the wash bay
- sewage from the maintenance facility will be collected and processed in a sewage treatment plant, with the solids/sludge collected and disposed by a local contractor and the effluent pumped into the tailings line.

2.3 Site Access, Transportation & Traffic

The Permit application provides the details with respect to the construction, maintenance and traffic control on the different roads associated with the Perry Creek Mine. These roads include the:

- Wolverine Forestry Service Road
- Perry Creek Road
- Mine haul roads for waste and coal haul
- Access roads to different areas of the mine.

The road descriptions and traffic control protocols described in the Permit application remain unchanged.

2.4 Mine Waste Management

2.4.1 Overview

This section provides an update to the placement rate and distribution of waste materials based on the revised production quantities and schedule discussed in Section 2.1. The approach to mine waste management and its focus on the geochemical aspects of managing and disposing of waste rock, coarse coal reject and tailings remains the same as discussed in the EA Certificate and Permit applications.

The types and quantities of mine waste for the life of the Perry Creek pit are summarized below:

Waste Type	Quantities	Disposal Location
Waste Rock	92.8 MBCM	Waste Rock dumps and pit Backfill
Coarse Coal Rejects (CCR)	4.7 Mt	Tailings Embankment and CCR Pile
Tailings	0.8 Mt	Tailings Impoundment
Coal Dryer Rejects	~ 80,000 tonnes	CCR Pile

2.4.2 Waste Rock

The waste rock management plan has remained the same as originally outlined in the *AIR*. A small portion of the waste rock from the Perry Creek pit is classified as PAG (Section 2.1.3). PAG waste rock units from the Perry Creek pit that will require special handling include the Wolverine Conglomerate, the lower portion of the FSs-E2 unit and the J1 Seam roof material that will be removed with the G-J unit. The waste rock management plan is designed to prevent acid generation by mixing the PAG material with NAG from high NP rock units. The kinetic test data confirm that the metal that has the highest potential to be elevated above provincial water quality objectives in waste dump drainage is selenium (Se). The humidity cell leaching results to date indicate that the coarse grained lithologic groups such as conglomerate, sandstone and siltstone have lower solid-phase Se concentrations and lower leaching rates than claystone, mudstone and shale samples. The waste rock management plan is designed to minimize Se leaching by placing material with low Se leaching potential in portions of the dump that will have the highest potential to come into contact with infiltrating precipitation and groundwater. The operational monitoring plan that will be used to define PAG waste rock and form the basis for the preferential handling of this material is discussed in Section 3.7.

2.4.2.1 Kinetic Report Findings

Since the original submission of the *Wolverine Additional Information Report* (*AIR*) to the EAO, additional kinetic test results are available from the Perry Creek pit waste rock, tailings and CCR samples. The results from this additional work support the original findings regarding Acid Rock Drainage / Metal Leaching (ARD/ML) risk from the Perry Creek pit waste materials. The most critical finding is that the acid generating capacity of the majority of waste rock materials is limited, due to the high quantity of available Neutralization Potential (NP) from the reactive carbonate minerals and relatively low acidity production rates produced from the low-sulphide content in the rock.

The kinetic testing has also confirmed that the ARD/ML risk is related to the lithology of the material. Sandstone, siltstone, and shale lithologies, that comprise the majority of material removed from the Perry Creek pit, have high NP content (predominately in the form of calcite and dolomite) and low sulphide content. These materials also have lower solid-phase selenium content and kinetic testing indicates that these materials have lower Se release rates than finer grained lithologies. Similar to sandstone, conglomerates typically have low sulphide content, however, conglomerates also have limited amounts of NP that result in portions of this material having acid generating potential. The fine-grained lithologies that include the claystone and mudstone, are typically limited to thin interbeds within the stratigraphic sequence. These units are most common adjacent to and within coal seams, and the greatest proportion of these materials report to the tailings and CCR. These fine-grained lithologies have higher sulphide and selenium content than the aforementioned lithologies and kinetic testing has also indicated that these materials have higher pH-neutral selenium release rates and sulphide oxidation rates. A higher proportion of Iron (Fe)-containing carbonate minerals to Calcium-Magnesium (Ca-Mg) carbonates is associated with these lithologies.

The neutralization potential of the Perry Creek pit materials is derived in part from iron containing carbonate minerals, which are not as efficient as calcite in neutralizing acidity. The original *AIR* conservatively assumed that only a portion of the carbonate NP (CaNP) was available and the CaNP was adjusted to 30% and 70% for fine-grained samples and sandstone & siltstone samples, respectively. The iron carbonate effect was evaluated by reanalyzing the humidity cell samples' NP using the MEND NP method that accounts for the iron content. The reanalysis results indicate that the revised CaNP estimates are a suitable NP measure for EA and Permit purposes, as the revised CaNP values either accurately reflect the actual NP or slightly underestimate the actual NP. Thus, the revised CaNP values provide a conservative estimate of the acid generating potential of the Perry Creek pit rock and this adjustment has been maintained for this report[1]. Operational monitoring proposed by WCC will continue to evaluate the appropriateness of the revised CaNP measurement during operations for the materials that have been identified to have acid generating potential by the EA and permitting studies.

Although the J2 conglomerate was avoided in the current mine plan, J2 conglomerate samples were included in the kinetic test program. The kinetic test results indicate that, when

[1] Calculated net potential ratios in this report are listed as Revised Carbonate NP / Sulphide Acid Potential (Revised CaNP / SAP). Revised CaNP is CaNP calculated from inorganic carbon content (CaNP = $\%_{Cinorganic}$ x 83.3) revised by a factor of 0.7 for sandstone and siltstone samples and revised by a factor of 0.35 for other lithologies. SAP is calculated from sulphide sulphur (SAP = $S_{sulphide}$ x 31.25).

present, the sulphide contained in the J2 conglomerate is extremely reactive and will be depleted rapidly under oxic and low pH conditions. However, J2 conglomerate samples obtained near the top of the J2 stratigraphic unit contain minimal quantities of sulphide minerals ($S_{Tot} < 0.05\%$) and the kinetic testing indicates that the low sulphide J2 conglomerate material is inert from an acid generating perspective, as documented by extremely low rates of sulphate release and limited metal release. The extent of this low sulphide J2 conglomerate material is currently being evaluated further during the field-drilling program.

The kinetic test program is also evaluating the rate of NP depletion relative to sulphide oxidation. The results of this evaluation provide insight into an appropriate site-specific CaNP/SAP criterion to differentiate between PAG and NAG material. Due to the abundance of NP available in the bulk waste rock, development of a site-specific Carbonate Neutralization Potential / Sulphide Acid Production Potential (CaNP/SAP) ratio is not critical for these materials. The NP depletion evaluation is most relevant for the tailings and CCR material that have higher sulphide content than the waste rock and are expected to have bulk CaNP/SAP values < 5.0. The results of the tailings and CCR kinetic test samples following 17 test cycles indicate that the ratio of carbonate depletion to sulphide oxidation is currently <1.5. The leaching behaviour of this material will continue to be monitored through 40 test cycles, at which time the application of a site-specific CaNP/SAP ratio <2.0 to the CCR and tailings will be evaluated.

The revised mine schedule has resulted in no change to the stratigraphic mine units that will be removed from the Perry Creek pit during operations. The lithologic and static geochemical characterization of these units remains unchanged from the original submission. The results of the kinetic testing have confirmed the geochemical characterization results made as part of the EA. A summary of the selenium concentration and the statistical distribution of the acid generating potential of the major stratigraphic units that comprise >95% of the waste rock removed from the Perry Creek pit is listed below in Table 2-11.

Table 2-11: Major Stratigraphic Unit's Selenium concentration, CaNP/SAP Ratios & Volume

	Se (ppm)	Revised CaNP/SAP*			% of
Stratigraphic Unit	**Median**	**Min**	**Max**	**Median**	**Total Volume**
Armand Sandstone	1.0	6.31	38.27	26.60	8.8
Armand-Fortress Interburden	1.8	16.05	42.47	24.58	4.8
Fortress Mountain Unit	0.8	17.66	77.16	53.67	19.6
FSs – E2 Interburden	1.8	1.31	13.27	3.97	13.2
E –F Interburden	1.05	1.53	182.95	44.73	9.4
Wolverine Conglomerate	0.5	1.03	5.60	1.90	11.2
Wolverine Sandstone	0.5	4.07	73.43	12.82	7.0
WSs – G Interburden	1.6	6.07	76.54	25.57	10.3
G – J1 Interburden	1.5	31.06	178.75	62.85	11.2

As noted previously, the design rationale and operating strategy for the three waste dumps and the in-pit backfill remain as presented in the Certificate and Permit applications. Key features of this approach include:

- Geotechnical and geochemical characterization of the waste rock for construction of the outer shell of South dump.
- Geochemical characterization of waste rock to ensure proper mixing of PAG material with NAG material through the core zones of the dump.
- Placing coarse grained, durable material at the dump bases.
- Geochemical characterization of CCR material to management placement in the tailings embankment and ensure that the CCR pile is NAG.

Details of the operating procedures for waste characterization and management will be included in the OMS manuals that are currently being developed and will be submitted prior to construction of the waste dumps.

The revised production schedule from the Perry Creek pit has not significantly affected the bulk geochemical composition of the waste rock dumps since the lithologic composition and waste rock volumes (Table 2-12) remain similar to the original.

Table 2-12: Waste Rock Disposition (LCM) – Perry Creek Pit

	Original Application	Revised Application
910 Pit Back Fill	3,352,000	4,000,000
Haul Road (South dump)		5,197,000
South dump	45,530,000	40,333,000
North dump	23,100,000	22,497,000
East dump	55,700,000	48,563,000
Total	**127,682,000**	**120,590,000**

Note: LCM = loose cubic meters

The predicted potential for the acid production and selenium release from each stratigraphic unit remains the same as initially identified. Stratigraphic units from the Perry Creek pit that will comprise a significant proportions of the waste rock volume and have been identified as having PAG handling requirements are summarized below.

Portions of the Wolverine Conglomerate unit, which underlie the F-seam coal: Specifically, CaNP/SAP values for this unit are variable and suggest that at least portions of the unit may be PAG. Proposed management includes identifying problematic material and mixing with high NP materials: Armand Sandstone, the Fortress Mountain unit or the Wolverine Sandstone. It has been assumed that approximately 50% of the Wolverine Conglomerate is PAG.

Portions of the Fortress Sandstone (FSs) – E2 unit. This unit averages about 15 m thick, with the upper 5 m being alternating layers of shale, siltstone, and sandstone that have been identified as geotechnically acceptable for shell construction. The lower 10 m is a carbonaceous shale zone that will be hauled to the core of the dump. The bottom 2 to 3 m are identified as PAG. This PAG zone will report in part to the waste dumps and in part as Coarse Coal Rejects and tailings from out-of-seam dilution. Dump management will include blending with non-acid generating portions of the FSs – E2 and adjacent units and placement in the core of the dump. It has been assumed that 20% of the FSs – E2 unit that reports to the waste rock dumps is PAG.

A high sulphur zone of waste approximately 25 cm thick and overlying the “J1” coal ply in the northeast portion of the pit has been identified. The lower 10 cm of this material reports to raw coal as dilution and the upper 15 cm (approximately 50,000 BCM) is mined with the overlying high NP G–J Interburden. Management of the waste rock portion will include mixing during the waste loading and dumping activities, with placement in the core of the dump.

A composite humidity cell sample containing J3 parting and J2-seam footwall material indicated that the portion of this material immediately adjacent to the coal seams may be PAG. However, the two current samples that include the entire parting between the J2 and J3 seam have sufficient NP to produce a net acid consuming material. The J3 Parting material will report to the waste dumps and to the CCR and tailings as out-of-seam dilution.

Despite the low risk of acid generation from this material due to additional NP obtained from the central portion of the parting, dump management will include mixing with high NP materials and placement in the core of the dump.

The J2 conglomerate is an interseam channel deposit that is highly variable in thickness as part of the J2 parting northeast of the proposed pit area. This unit has been identified as PAG and for that reason, has been excluded from the current pit design until further testing is completed.

The remaining rock units in the Perry Creek pit contain an abundance of neutralization potential (NP), such that the bulk NP substantially exceeds and more than offsets the potential acid generating potential (AP) of the PAG materials mentioned above. Table 2-11 summarizes the neutralization potential / acid production potential ratios for the major Perry Creek pit stratigraphic units.

2.4.2.2 South Dump

The waste management plan for the South dump remains the same as outlined in the original submission. The plan is designed to ensure that construction of the shell does not result in the potential for ARD runoff or seepage from the shell. In addition, the South dump management plan schedules acid generating materials to be mixed with non acid generating materials in the core of the dump. Although the volumes of the NAG and PAG units have changed slightly from the original submission, the revised South dump schedule still provides adequate mixing to maintain a net acid consuming core with bulk CaNP/SAP ratios > 18.0 (Section 2.1.3).

Portions of the Wolverine Conglomerate unit that are identified as PAG will be mixed with high neutralization potential (NP) materials from the Armand Sandstone, the Fortress Mountain unit or the Wolverine Sandstone.

The lower portion (2 to 3 m) of the FSs – E2 unit will report in part to the waste dumps and in part as Coarse Coal Rejects (CCR) and tailings from out-of-seam dilution. South dump management will include mixing with non-acid generating portions of the FSs – E2 as well as with adjacent units and placement in the core of the dump.

A high sulphur zone of G-J waste, approximately 25 cm thick, overlies the “J1” coal ply in the northeast portion of the pit. The lower 10 cm of this material reports to raw coal as dilution and the upper 15 cm (approximately 50,000 BCM) is mined with the overlying high NP G–J Interburden. Management of the PAG G-J waste rock will include mixing during the waste loading and dumping activities and placement in the core of the dump.

A composite humidity cell sample containing J3 parting and J2-seam footwall material indicated that this material may be PAG. This material will report to the South dump and to the CCR and tailings as out-of-seam dilution. Dump management will include mixing with high NP materials and placement in the core of the dump.

The South dump management plan is designed to minimize Se leaching by placing coarse grained lithologies from the NAG sandstone and conglomerate units in the shell and base of the dump.

Features of the waste management plan for South dump include:

- Placing the Armand Sandstone, Fortress Mountain, Wolverine Sandstone and NAG Wolverine Conglomerate into the outer shell
- Identifying and placing and mixing PAG material with NAG material into the core zones of the dump.
- Placing coarse grained, durable material through the base of the dump.

Dump instrumentation, monitoring, and roll-out protection will be as described in the Permit level design report by Norwest Corporation and to be detailed in the OMS manuals.

Approximately 2,894,000 LCM of PAG waste rock will be included in the 45,530,000 LCM that comprise the South dump and haul road. The PAG material will be derived from the lower portion of the FSs-E2 Interburden and Wolverine Conglomerate and placed primarily in the core of the 900, 920 and 940 lifts (Table 2-13). This placement will minimize contact of the PAG material with infiltrating water and possible groundwater underflow, thus, retaining sulphide oxidation products within the dump and minimizing the transport of soluble metals and acidity to dump drainage waters.

Despite the revised schedule and the presence of PAG material in the dump, the overall balance of neutralization capacity and acid potential indicates that each lift remains strongly acid consuming. The weighted ratio accounts for the median amount of NP, sulphide and volume for each stratigraphic unit in each respective dump lift. The weighted Revised CaNP/SAP ratio for each lift is >15, which is much greater than the NP/AP criterion of >2.0 that is typically viewed as the cutoff for potentially acid generating materials (Table 2-13).

Table 2-13: South Dump Rock Volume by Dump Lift & Stratigraphic Rock Type

Rock Type	Stratigraphic Unit	Haul Road			880		900		920		940		960		980		1000		1020		1040		1060		Total		
		880/920	920/1000	1000/1125	Shell	Core	Shell	Core	Shell	Core	Shell	Core	Shell	Core	Shell	Core	Shell	Core	Shell	Core	Shell	Core	Shell	Core	Ramp	Shell	Core
Waste - NP	AR_SS	942,718	629,604		119,334		380,425	423,059	1,892,847						440,109		125,341	2,986		62		353			1,572,322	2,958,056	426,460
	AR_FT	29,338	574,941			280,856		72,031		1,009,991						410,028		440,277		406					604,279	0	2,213,589
	FT_MN	8,656	430,118	1,000,000	527,766	366,144	1,281,087	297,394	897,153	355,446	2,141,472		5,901		1,284,411	1,073,249	1,578,245	0	880,876		98,309			71	1,438,774	8,695,220	2,092,304
	FSSE2NAG		68,134				726,121	59,822		927,997		1,104,835	381,663	353,306	0	650,264		1,762,012		808,907		496,609		118,434	68,134	1,107,784	6,282,186
	E2_WASTE							0		0		13		0	0	0		0				2,165		2,025	0	0	4,203
	E2_E3INT		24					37,812		14,768		163,127		90,652	0	29,899		87,070		60,173		55,450		40,106	24	0	579,057
	E3_F_INT		12,695	110,221				313,575		144,823		853,725	442,404	413,703		307,614		344,225		1,132,587		278,600		250,244	122,916	442,404	4,039,096
	WVCG_NAG		441	279,330			51,257	26,945		51,680	261,027	0	907,687		49,022	0	74,582	94,714	295,910		388,028		287,206	210,520	279,771	2,314,719	383,859
	WV_SS			824,917			41,110	24,241		52,692		137,878	742,345		396,457	0	81,832	106,719	140,714		288,663		177,794		824,917	1,868,915	321,530
	WSS_GINT			244,832				68,794		54,342		369,881		629,482		286,502		224,181		278,946		127,696			244,832	0	2,039,824
	G_J_NAG							40,886		43,569		147,828		135,001		384,360		110,690		156,236		185,719			0	0	1,204,289
	J2_P_NAG							0		0		0		0		0		0							0	0	0
	J3_PRT							4,828		5,536		15,624		19,363		50,420		15,304		23,277		32,541			0	0	166,893
	undefined	9,388	31,849					41,651		7,765		45,820		46,866		64,460		16,405		29,483		46,014			41,237	0	298,464
	Total	990,100	1,747,806	2,459,300	647,100	647,000	2,480,000	1,411,038	2,790,000	2,668,609	2,402,499	2,838,731	2,480,000	1,688,373	2,169,999	3,256,796	1,860,000	3,204,583	1,317,500	2,490,077	775,000	1,225,147	465,000	621,400	5,197,206	17,387,098	20,051,754
Waste - AP	FSSE2PAG		490					88,972		29,606		136,367		160,734		218,744		88,192		145,303		138,978			490	0	1,006,896
	WVCG_PAG		4,904					122,890		61,485		272,502		499,793		420,260		104,225		200,519		200,376			4,904	0	1,882,050
	G_J_PAG																									0	0
	J2_P_PAG																									0	0
	Total	0	5,394	0	0	0	0	211,862	0	91,091	0	408,869	0	660,527	0	639,004	0	192,417	0	345,822	0	339,354	0	0	5,394	0	2,888,946
Mixing Ratio: NP:AP		-	324.0	-	-	-	-	6.7	-	29.3	-	6.9	-	2.6	-	5.1	-	16.7	-	7.2	-	3.6	-	-	963.5	-	6.9
Geochemical Ratio: NP:AP weighted revised CaNP		35	51	66	78	70	55	54	51	41	79	44	38	42	69	54	80	31	65	55	34	39	23	43			
weighted SAP		1	2	2	2	2	2	2	2	2	2	3	2	3	2	2	2	2	2	2	2	3	2	2			
weighted revised CaNP/SAP		27.3	29.0	28.7	38.7	34.0	25.7	25.3	33.1	18.4	37.7	17.6	18.1	15.9	33.2	22.0	37.6	12.8	32.0	22.2	17.2	14.6	12.6	22.1			

2.4.2.3 North Dump

The North dump management plan is designed to direct coarse-grained material (or material with low Se concentration) to the base of the dump and identifying low NP or PAG material and mixing it with high NP material.

Dump management with respect to the geochemical characteristics of the waste includes:

- placing through end-dumping, durable, coarse-grained material through the base and W6 tributary channel
- ensuring the shell of the dump (slopes and top) is NAG with no exposed PAG
- mixing any PAG material with NAG material through the core of the dump (Only 7% of the material hauled to the dump is regarded as low CaNP/SAP waste from the FSs-E2 interburden and Wolverine Conglomerate).

It is expected that end dumping of the waste rock will result in natural segregation of the larger, more durable materials in the base of the dump. Although the North dump is located near the upper limit of the W6 drainage basin, seepage and groundwater flows will be present. WCC's plan is that these flows will be conveyed through the coarser materials in the base of the dump in the original W6 channel. The Upper Diversion Ditch will be established around the perimeter of the dump to convey surface flows around the dump.

Dump instrumentation, monitoring and roll-out protection will be as described in the Permit level design report by Norwest Corporation, 2004 and to be detailed in the OMS manuals.

A total of 22,497,000 LCM of waste rock will be placed in the North dump, which is slightly less than the original 23,100, 000 LCM originally scheduled for placement in the dump. The predicted CaNP/SAP ratios for each lift of the dump remain > 25.0 (Table 2-14). Similar to the South dump, no PAG material will be placed in the lower 1075 lift. The 1,652,000 of PAG waste rock derived from the Wolverine Conglomerate and FSs-E2 Interburden will be mixed into the upper lifts via end dumping.

Table 2-14: North Dump Rock Volume by Lift & Stratigraphic Rock Type

Rock Type	Stratigraphic Unit	Lift Elevation				Total
		1075	1125	1150	1200	
Waste - NP	AR_SS	77,219	173,477	290,220	1,554,571	2,095,487
	AR_FT	41,221	246,569	192,599	278,437	758,826
	FT_MN		1,954,251	747,001	1,209,501	3,910,753
	FSSE2NAG		1,167,050	675,031	798,922	2,641,003
	E2_WASTE		56,439	61,568	20,630	138,637
	E2_E3INT		172,543	216,708	119,268	508,519
	E3_F_INT		520,087	1,843,781	969,143	3,333,011
	WVCG_NAG			792,168	459,330	1,251,498
	WV_SS			958,563	595,354	1,553,917
	WSS_GINT			1,441,913	802,915	2,244,828
	G_J_NAG			633,648	982,164	1,615,812
	J2_P_NAG			0	0	0
	J3_PRT			93,156	153,059	246,215
	undefined	1,560	96,871	240,107	208,691	547,229
	Total	**120,000**	**4,387,287**	**8,186,463**	**8,151,985**	**20,845,735**
Waste - AP	FSSE2PAG		133,713	138,386	124,307	396,406
	WVCG_PAG			812,151	443,127	1,255,278
	G_J_PAG					0
	J2_P_PAG					0
	Total	**0**	**133,713**	**950,537**	**567,434**	**1,651,684**
Mixing Ratio: NP:AP		-	32.8	8.6	14.4	12.6
Geochemical Ratio: NP:AP						
weighted revised CaNP		38.2	59.1	55.8	54.8	
weighted SAP		1.5	2.2	2.2	2.1	
weighted revised CaNP/SAP		26.0	27.2	25.1	26.5	

2.4.2.4 East Dump

Similar to the North dump, the East dump management plan includes directing coarse-grained material (which has low Se concentration) to the base of the dump and identifying PAG material and mixing it with high NP material. Only 7% of the material hauled to the dump is regarded as low CaNP/SAP waste from the FSs-E2 interburden and Wolverine Conglomerate, thus, mixing these PAG materials with the prevalent NAG material will produce a dump with excess NP.

Features of the waste management plan for East dump include:

- Identifying and placing and mixing PAG material with NAG material into the core zones of the dump.

- Placing coarse grained, durable material through the base of the dump.

Dump instrumentation, monitoring and roll-out protection will be as described in the Permit level design report by Norwest Corporation, 2004 and to be detailed in the OMS manuals.

The revised East dump is designed for 48,563,000 LCM of waste rock (Table 2-15) rather than the original 55,700,000 LCM. PAG waste rock derived from the FSs-E2 Interburden, Wolverine Conglomerate and J Seam Roof will comprise 3,536,000 LCM of this material. Mixing of the PAG waste rock with NAG materials will retain a CaNP/SAP ratio >25.0 for each lift, which will ensure that the dump will not have the potential for acid generation.

Table 2-15: East Dump Rock Volume by Lift & Stratigraphic Rock Type

Rock Type	Stratigraphic Unit	Lift Elevation				Total
		920	950	1000	1050	
Waste - NP	AR_SS	239,011	897,336	2,463,965	877	3,601,189
	AR_FT	280,924	223,887	1,707,722	24	2,212,557
	FT_MN	1,514,224	424,645	5,443,546	80	7,382,495
	FSSE2NAG	349,692	208,430	2,758,313	3,386	3,319,821
	E2_WASTE		87	31,109	4	31,200
	E2_E3INT	7,216	34,322	237,023	6,851	285,412
	E3_F_INT	62,066	431,744	1,930,890	420,811	2,845,511
	WVCG_NAG	17,843	923,028	807,208	591,598	2,339,677
	WV_SS	11,303	1,621,433	771,148	911,891	3,315,775
	WSS_GINT	7,441	4,579,074	948,318	1,772,656	7,307,489
	G_J_NAG	2,518	7,278,776	947,676	2,004,432	10,233,402
	J2_P_NAG		333,649	0	0	333,649
	J3_PRT	333	1,003,666	182,567	358,612	1,545,178
	undefined	27,461	193,055	34,486	18,291	273,293
	Total	**2,520,032**	**18,153,132**	**18,263,971**	**6,089,513**	**45,026,648**
Waste - AP	FSSE2PAG	26,188	161,016	310,728	47,467	545,399
	WVCG_PAG	27,530	1,812,041	675,301	475,665	2,990,537
	G_J_PAG		62			62
	J2_P_PAG					0
	Total	**53,718**	**1,973,119**	**986,029**	**523,132**	**3,535,998**
Mixing Ratio: NP:AP		46.9	9.2	18.5	11.6	12.7
Geochemical Ratio: NP:AP						
weighted revised CaNP		65.6	61.2	56.3	61.1	
weighted SAP		2.1	2.2	2.1	2.3	
weighted revised CaNP/SAP		30.8	28.0	26.5	26.8	

2.4.3 Coarse Coal Rejects (CCR)

The Coarse Coal Rejects (CCR) is the in-seam partings (shale, siltstone and mudstone) and strata immediately above and below the coal seams produced through the coal cleaning process. Waste management considerations given to the CCR include:

- geochemical characteristics of the material, determined by a predictive based monitoring program established during the initial year of operation and described in the Permit application.
- suitability of the material as an engineered fill for the tailings impoundment dike
- placement, including compaction, and stability of the CCR pile.

The key operational strategy is mixing of the various constituents that will make up the CCR during the coal mining and coal processing activities to ensure the resulting product is NAG.

Dump instrumentation and monitoring as described in the Permit level design report by Norwest Corporation and to be detailed in the OMS manuals.

Table 2-16 summarizes the production of CCR material and geochemical ratio created through the mixing activities of coal mining, raw coal handling and plant processing.

2.4.4 CCR Placement & Management

As shown on Table 2-16 of the 2.9 MCM of CCR produced, 0.9 MCM is scheduled to be placed in the tailings embankment during the first three years of operation and the remaining 2.0 MCM in the CCR pile over the operating life of the pit.

The volume placed into the tailings embankment is based on the Permit level design prepared by Norwest Corporation (2005) and is the volume needed to complete the embankment after construction of the starter dike during the pre-production period. The final placement schedule will be dependent on the relationship between raw coal feed and CCR ARD characteristics established during Year 1 of operation.

A key objective of the CCR management plan under the revised schedule is still to control the placement of CCR material used in construction of the tailings impoundment dike and the CCR dump to minimize the potential for ARD and metal leaching.

Based on a worst-case prediction that uses the maximum measured sulphide content and the minimum NP, specific components of the CCR are predicted to have acid-generating potential (CaNP/SAP <2.0); however the overall bulk volume of CCR is non-acid generating. In addition, initial humidity cell results indicate that a material specific NP/AP <2.0 may be appropriate for the CCR (Section 2.4.2.1).

For planning purposes, the assumption still remains that 50% of the total CCR volume will be NAG. CCR from the Upper Seams will account for 37% of the NAG CCR and the J Seam

CCR will account for 61% of the NAG CCR. However, it must be recognized that PAG CCR will be produced concurrently with the NAG CCR. The process of mining and washing the coal results in intimate mixing of CCR produced from the various coal seams. Processing will result in intimate mixing of roof and floor materials with in-seam dilution, such that the resulting material will have a bulk CaNP/SAP that will be an average of the various NAG and PAG materials. Further mixing will occur through batch processing that will result in the Upper Seams being processed together and the J Seams processed together. The mixing of CCR with excess NP with the higher sulphur CCR is expected to result in a CCR product that is non-acid generating. Geochemical ratios expected through these mixing activities are provided in Section 2.4.2.1.

Relative to other mine waste materials produced from the Perry Creek pit, the CCR and tailings materials have the greatest potential for high rates of Se leaching that could produce drainage with elevated Se concentrations.

General findings of the geochemical study regarding Se are that:

- Se release is greatest from fine-grained lithologies
- Se is enriched in near seam lithologies (and therefore in coal processing by-products) and
- a relatively strong relationship exists between the CaNP/SAP ratio and the Se content.

Because of the correlation of acid generating potential and Se release, operational monitoring of the acid generating characteristics of the CCR, and selective placement of PAG materials in the embankment of the tailings impoundment dike, will also achieve controlled placement of the majority of materials with high Se release potential. This will allow, if necessary at closure, for a cover system to be developed for areas of the embankment with high Se release potential to minimize infiltration through the CCR. The need for a cover system or any other contingency will be determined from monitoring data collected during construction and operation of the tailings impoundment. The operational monitoring plan is discussed in Section 3.7.

To facilitate management of potentially acid generating CCR and minimize the required mitigation and monitoring during operations and closure, only non acid generating CCR materials will be placed in the CCR dump. Potentially acid generating CCR material will be placed in the tailings embankment where seepage and infiltration control measures can be most effectively implemented. Further, PAG materials will be restricted to controlled areas of the tailings embankment to the extent practical.

The tailings embankment is constructed in phases. During the construction phase, a starter dike is constructed using suitable clay type borrow material from within the footprint of the CCR storage facility. During Year 1 of operations, CCR produced will be utilized in construction of the tailings embankment. During this period, results of operational monitoring (Section 3.7) will be used to establish a relationship between the ARD characteristics of the raw coal and of the raw coal feed and the resulting CCR. As soon as this relationship is well defined, the ABA characteristics of the coarse fraction of the raw coal will allow PAG CCR to be identified and segregated. During mining of the Perry Creek pit, all identified PAG CCR material will be utilized in embankment construction. After the first year of operation, the tailings embankment is large enough that a one to two year surplus of tailings storage capacity exists. At this stage, the raw coal categorization program will provide a means for the early identification of PAG CCR during production that will allow PAG CCR to be segregated and placed in the tailings embankment and the NAG CCR placed in the CCR dump. PAG CCR in the tailings embankment will be layered with NAG in a controlled location.

Seepage from areas of the embankment containing PAG CCR will be monitored during operations. Selective placement of the PAG CCR will allow for a synthetic cover system to be developed for this material at closure to minimize infiltration through the material, if needed.

The management strategy for the CCR dump is to ensure that PAG material is not placed in this facility. One reason for this is that the current understanding of groundwater conditions of the project site indicates that seepage collection at this site would be more difficult than at the tailings facility, due to presence of the W14 colluvial fan in part of the CCR dump foundation. The features of the dump include a low top surface to slope surface area ratio and slope angles that would make it difficult to construct effective infiltration barriers.

To minimize metal loading and to ensure a well drained foundation, approximately 200,000 LCM of NAG coarse breaker material (>150 mm) or coarse competent pit waste will be placed at the base of the CCR dump.

Rather than being calculated by lift, the CCR material release and acid generating risk calculations were carried out on an annual basis for both the Upper Seam and J Seam production. A weighted revised CaNP/SAP ratio was calculated for CCR derived from both coal groups (NAG + PAG) in a given year. The NAG – PAG designation of the material that will comprise the CCR are listed in Table 2-17. These designations have not changed as they are based on the original ABA data presented in the Wolverine *AIR*. G Seam roof and floor samples are the only additional geochemical information that was incorporated into the analysis. There was not any geochemical analysis of G Seam's International Static Database (ISD) and the G ISD was estimated using the sulphur and CaNP value from the G Roof sample (Revised CaNP/SAP = 1.6). The volume of each material type is designated as 100% NAG, 100% PAG or assumed to be equally divided between NAG and PAG. The weighted revised CaNP/SAP value was calculated by dividing the sum of the weighted revised CaNP values from each unit by the sum of the weighted SAP values from each unit.

The expected Upper Seam CCR bulk CaNP/SAP ratios are near 3.0 through Year 5 of coal production (Table 2-16), indicating that the bulk CCR product will be non-acid generating with the implementation of appropriate operational management procedures outlined in Section 2.4. Upper Seam coal production will be limited to G Seam during Year 6 and slightly lower CaNP/SAP values are predicted in the CCR during this time. However, Year 6 Upper Seam CCR production comprises only 10% of that year's total CCR production. Higher CaNP/SAP ratios are predicted for the J Seam CCR that will maintain bulk ratios near 4.0 through the entire production schedule (Table 2-16).

Table 2-16: Coarse Coal Reject (CCR) Production & ARD Potential (dry tonnes)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
E2 Roof	51,558	36,962	358	14,471	19,941	0	123,290
E2 Floor	51,558	36,962	358	14,471	19,941	0	123,290
E2 ISD	105,656	75,745	733	29,654	40,863	0	252,653
E3 Roof	42,454	20,404	1,096	0	1,570	0	65,524
E3 Floor	42,454	20,404	1,096	0	1,570	0	65,524
E3 ISD	150,337	72,254	3,880	0	5,561	0	232,031
F Roof	75,019	76,698	29,695	37,097	57,467	0	275,975
F Floor	66,526	68,015	26,333	32,897	50,961	0	244,732
F ISD	74,583	76,252	29,523	36,882	57,133	0	274,374
G Roof	56,675	47,165	57,443	37,580	52,747	9,092	260,702
G Floor	56,675	47,165	57,443	37,580	52,747	9,092	260,702
G ISD	7,322	6,093	7,421	4,855	6,814	1,175	33,680
Total Upper Seams	**780,816**	**584,120**	**215,379**	**245,486**	**367,317**	**19,358**	**2,212,476**
CaNP/SAP Upper Seams	3.1	3.3	2.9	3.3	3.3	1.8	
J1 Roof	3,580	13,087	3,993	0	0	0	20,660
J1 Floor	4,556	16,656	5,082	0	0	0	26,294
J1 ISD	2,346	8,578	2,617	0	0	0	13,541
J2 Roof	2,279	28,062	7,449	0	0	0	37,790
J2 Floor	2,279	28,062	7,449	0	0	0	37,790
J2 ISD	1,698	20,909	5,550	0	0	0	28,158
J1/2 Roof	62,779	47,552	75,458	54,983	51,675	23,620	316,067
J1/2 Floor	76,730	58,119	92,226	67,202	63,158	28,868	386,304
J1/2 ISD	178,472	135,183	214,514	156,309	146,904	67,147	898,528
J3 Roof	56,534	70,933	74,916	69,334	54,654	37,818	364,190
J3 Floor	14,134	17,733	18,729	17,334	13,664	9,455	91,048
J3 ISD	42,979	53,926	56,954	52,710	41,550	28,751	276,869
Total J-Seams	437,883	460,480	553,245	417,872	371,605	195,658	**2,436,742**
CaNP/SAP J-Seams	4.0	4.3	4.1	4.0	4.0	3.9	
Total CCR	1,157,043	1,080,905	793,976	663,358	738,921	215,016	**4,649,218**
Total CCR (m^3)	723,152	675,565	496,235	414,598	461,826	134,385	**2,905,762**
Placement Allocation							
Tailings Embankment	380,000	290,000	210,000	0	0	0	880,000
Embankment Elev.	840	843	847				

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
CCR Pile	381,687	362,875	270,390	414,598	461,826	134,385	2,025,762
CCR Pile Elevation	859	867	872	878	886	888	

Table 2-17: NAG – PAG Designation for CCR Materials (based on CaNP/SAP = 2.0)

Upper Seams		J-seams	
E2 Roof	PAG	J1 Roof	PAG
E2 Floor	50/50	J1 Floor	NAG
E2 ISD	PAG	J1 ISD	NAG
E3 Roof	NAG	J2 Roof	PAG
E3 Floor	50/50	J2 Floor	PAG
E3 ISD	PAG	J2 ISD	NAG
F Roof	NAG	J1/2 Roof	PAG
F Floor	50/50	J1/2 Floor	PAG
F ISD	PAG	J1/2 ISD	NAG
G Roof	PAG	J3 Roof	50/50
G Floor	NAG	J3 Floor	NAG
G ISD	PAG	J3 ISD	NAG

2.4.5 Tailings Management

The tailings are the fine waste product from the process plant and, similar to the CCR, originate from the in-seam partings and strata immediately above and below the coal seam. Table 2-18 summarizes the production of tailings.

While specific components of the tailings are predicted to have acid-generating potential (revised CaNP/PAP <2.0), the average bulk volume of tailings is predicted to be non-acid generating (Section 2.4.2.1). Materials from which the tailings are produced are well mixed by several mining and processing activities. Out-of-seam dilution is mixed with the raw coal as it is excavated from the pit and then deposited in the raw coal stockpile. Raw coal from different seams is mixed in the raw coal stockpiles as it is introduced into the processing plant. The tailings product is more thoroughly mixed by the washing process, so that the tailings product is well blended as it is recovered from the plant and transported to the tailings storage impoundment via the tailings slurry pipeline. Thus, low CANP/SAP values that may be present in specific zones from the source materials will be blended with other materials in the final product. As a result of this blending, the placed tailing's ARD characteristics are more accurately reflected by the median Bulk CANP/SAP, which indicates that the tailings from each of the coal seams, and the blended products from the Upper and J-seams will be non-acid generating. Operational monitoring will be conducted to confirm the designation once the process plant is operational (Section 3.7).

The geochemical data used to characterize the in-seam dilution and out-of-seam dilution materials that will form the tailings are consistent with those reported in the original *AIR*. Only two additional samples from the G Seam Roof and G Seam Floor have been added for the analysis. The revised tailings production from the Perry Creek pit of approximately 790,000 t (988,000 m^3) is slightly less than the originally estimated 847,000 t. Similar to the CCR, the tailing material release and acid generating risk calculations were carried out on an annual basis for both the Upper Seam and J Seam production (Table 2-18). The predicted annual CaNP/SAP ratio for the Upper Seams Tailings (1.8 to 2.8) is lower than that predicted for J Seam tailings (~5.0). Similar to the CCR, the higher predicted CaNP/SAP ratio for the J Seam tailings is due to the abundance of carbonate in the J2 Seam that is separated into the tailings and CCR during the coal washing process.

Table 2-18: Perry Creek Pit Tailings (Dry Tonnes)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
E2 Roof	7,045	5,051	49	1,977	2,725	0	16,847
E2 Floor	7,045	5,051	49	1,977	2,725	0	16,847
E2 ISD	14,438	10,350	100	4,052	5,584	0	34,524
E3 Roof	5,802	2,788	150	0	215	0	8,954
E3 Floor	5,802	2,788	150	0	215	0	8,954
E3 ISD	20,542	9,873	530	0	760	0	31,705
F Roof	10,251	10,481	4,058	5,069	7,853	0	37,712
F Floor	9,090	9,294	3,598	4,495	6,964	0	33,441
F ISD	10,191	10,420	4,034	5,040	7,807	0	37,492
G Roof	7,744	6,445	7,849	5,135	7,208	1,242	35,624
G Floor	7,744	6,445	7,849	5,135	7,208	1,242	35,624
G ISD	1,000	833	1,014	663	931	160	4,602
Total Upper Seams	**106,695**	**79,818**	**29,431**	**33,545**	**50,192**	**2,645**	**302,325**
NPR Upper Seams							
J1 Roof	716	2,617	799	0	0	0	4,132
J1 Floor	911	3,331	1,016	0	0	0	5,259
J1 ISD	469	1,716	523	0	0	0	2,708
J2 Roof	456	5,612	1,490	0	0	0	7,558
J2 Floor	456	5,612	1,490	0	0	0	7,558
J2 ISD	340	4,182	1,110	0	0	0	5,632
J1/2 Roof	12,556	9,510	15,092	10,997	10,335	4,724	63,213
J1/2 Floor	15,346	11,624	18,445	13,440	12,632	5,774	77,261
J1/2 ISD	35,893	27,187	43,142	31,436	29,544	13,504	180,705
J3 Roof	11,307	14,187	14,983	13,867	10,931	7,564	72,838
J3 Floor	2,827	3,547	3,746	3,467	2,733	1,891	18,210
J3 ISD	8,596	10,785	11,391	10,542	8,310	5,750	55,374
Total J-Seams	**87,775**	**92,246**	**110,888**	**83,748**	**74,485**	**39,206**	**488,349**
NPR J-Seams							
Total Tailings	**194,471**	**172,064**	**140,318**	**117,293**	**124,677**	**41,852**	**790,674**
Total Tailings (m3)	**243,088**	**215,080**	**175,398**	**146,616**	**155,846**	**52,314**	**988,342**

2.4.6 Coal Dryer Ash

Dryer ash is the residual ash material produced from coal burned in the thermal dryer and will be placed and covered in the CCR Pile.

2.5 Water Management Plan (all phases)

Some minor changes have been made to the water management plan since the *AIR* submission. These changes were based on additional field information acquired in the spring and summer of 2004, and were incorporated into the *Water Management Facilities Design Report – Plantsite and Perry Creek Open Pit and Waste Dump Areas* (Piteau Associates Engineering Ltd., 2004c). This report was attached as Appendix 4 to the *Wolverine Coal Project - Application for a Mines Act Permit* (WCC, 2004).

With the exception of additional water supply requirements for the increased process water demand, no modifications were required to the Water Management Plan for the proposed 2.4 Mtpa mine plan.

Additional baseline data collected since the *AIR* submission, and changes that have been incorporated into the water management plan since the *AIR*, are summarized in the following sections.

2.5.1 Additional Baseline Data

2.5.1.1 Hydrometric Data

In August 2004, the Perry Creek flow gauging site was moved to a new location and a continuous gauging station was established on the W14 tributary, near the apex of the W14 fan. Meteorological monitoring stations, consisting of a tipping bucket rain gauge, a thermistor and humidity meter, were also set up at a location on the W14 alluvial fan and in the EB Pit area.

Flow gauging and meteorological data were downloaded in late October 2004, prior to freeze-up. Unfortunately, data from the EB pit area climate station was lost during the download procedure. Data recovered from the other meteorological station and the two flow gauging stations have been reduced and summarized in an information memorandum, attached as Appendix B.

The short data record and limited flow calibration data available to this point in time do not provide sufficient information to revise any of the runoff or water balance predictions presented in the *AIR*. However, this data will be retained to augment information that will be obtained from continuous monitoring over the mine life. Preliminary information from the meteorological and flow monitoring program will also be used to develop design criteria for the SP4b Settling Pond, to be constructed in the summer of 2009. When enough local flow data are available from the W14 gauging station and the settling ponds to calibrate the local rainfall-runoff model, site specific storm hydrograph(s) will be developed to provide parameters for the design of mine closure water management works.

2.5.1.2 TSS Sampling

A surface water sampling program was conducted in the spring and early summer of 2004 to obtain TSS and turbidity data for the smaller drainage basins in the immediate mine area. The objective of the sampling program was to obtain some baseline TSS and turbidity data on the small tributaries to the Wolverine River, and to relate this data to the longer term baselines that have been established for the Wolverine River and Perry Creek. The sampling program and results were summarized in a report prepared by Piteau (2004a). This information is attached as Appendix C.

2.5.1.3 Floodplain Flow Regime

Water elevations were measured at various locations on the Wolverine River floodplain between the northwest valley wall and the River, to determine flow directions and routings for shallow groundwater and surface flow. Water level measurement stations included nine existing shallow monitoring wells in the Plantsite, Tailings and SP6 Settling Pond areas, and twelve staff gauges that were installed on 9 June 2004. Complete measurement suites were collected on June 9 and 8 September 2004, and a partial suite was collected 29 July 2004. The data were assessed and reported by Piteau (2004b) and presented within Appendix 4 of the *Mine Permit Application*. Surface flow routing determined from this assessment is discussed in Section 2.5.3.

2.5.1.4 Groundwater Sampling

A total of five groundwater sampling suites were completed by the end of 2004. The results of these samples provide a reliable baseline for groundwater quality at the mine site. Tabulated analytical results and a discussion of the baseline groundwater chemistry are presented in Appendix D.

2.5.1.5 Terrain Hazard Reconnaisance

A terrain hazard reconnaissance was conducted in the W14, W16, W18, and W22 drainage basins in early October 2004. This reconnaissance identified a moderate risk from debris flows, as reported by Thurber Engineering Ltd. (2004) and presented within Appendix 4 of the *Mine Permit Application*. The reconnaissance findings and proposed mitigation measures are discussed in Section 3.1.

2.5.2 Runoff Collection & Sediment Control

The final footprint of the 2.4 Mtpa mine plan does not change substantially from the 1.6 Mtpa plan. With the exception of Settling Pond SP4b, all the water management structures are in place by the end of the Pre-Production Phase. The implementation schedule for the Pre-Production Phase water management facilities has been moved back two months, to reflect a later construction start.

The entire Water Management System is scheduled to be operational by the early fall of 2005, except for the Upper Diversion, which will be formally commissioned after the 2006 freshet. The upper and lower portions of this diversion will be in place in 2005, but the upper segments will be directed into a natural tributary of W6, to allow vegetation to become established in the lower segments prior to the final diversion. The main W6 tributary is diverted around the open pit area during Pre-Production (Fig. 2.5-1); thus, diverted water will not impact the pit area during pre-stripping.

The Upper Diversion design has changed since the *AIR* submission, but remains unchanged from the *Mine Permit Application*. An existing drainage course that was to have conveyed the Upper Diversion flows down to Perry Creek was inspected in the field in May 2004, and was determined to be actively eroding. The current Upper Diversion design follows the slope contour for a distance of approximately 1000 m northwest of the North dump, to a small creek (Fig. 2.5-1). This natural drainage course is characterized by a well incised, well vegetated and naturally armoured channel in its upper reaches and a highly incised bedrock channel in its lower reaches. A 200 by 8 m wide stilling basin has been incorporated into the final segment of the Upper diversion design to detain and attenuate the peak flows that will be discharged into this natural drainage course.

Settling Pond SP4A was intended to service the first four years of the mine life, after which time the East dump would cover this pond. The 2.4 Mtpa mining plan will cover this pond in Year 3 (Fig. 2.1-4); Hence, the SP4b settling pond will be constructed in the summer of 2009, versus 2010 for the 1.6 Mtpa mine plan. The site for the SP4b settling pond is relatively small, and construction of a pond based on the current rainfall-runoff model would involve a major structure in a relatively small footprint. Observations of flows in the W4 tributary indicate that runoff from the SP4b catchment is much less than for other areas of the mine. Design for the SP4b Pond is therefore to be based on analysis of monitoring data from the SP4a pond, and the development of a storm hydrograph explicitly for this catchment. A smaller pond design would be rationalized on the basis of the empirically derived relationship between rainfall and flow through the SP4a pond. The accelerated mining schedule will result in one year less runoff data to calibrate a rainfall-runoff model for the design of the SP4b pond. While this will reduce the confidence level in the rainfall-runoff model, it can be offset by incorporating a slightly higher factor of safety into the runoff flow predictions.

Due to changes to the Plantsite load-out since the *AIR* submission, Settling Ponds SP14 and SP18 have both been moved slightly to the northeast from their original locations. The current locations, shown on Fig. 2.5-1, are unchanged from the *Mine Permit Application*. Pond sizes are essentially unchanged.

An *Erosion Prevention and Sediment Control Plan* has been developed for the construction stage of the project, which will present the highest risk for sediment transport from the mine area. This plan was attached to the *Effluent Permit Technical Assessment Report (TAR)* (WCC, 2005).

2.5.3 Runoff Water Discharge

Runoff water that is discharged from the diversions and sedimentation facilities will report to the Wolverine River, with the exception of the Upper Diversion, which will report to Perry Creek. Water quality in the diversions will be essentially background, except for some elevated TSS during the initial channel "seasoning" period. Measures to mitigate potential sediment impacts in the diverted flows have been incorporated into the final design of the diversions and include:

- construction of a 200 by 8 m stilling basin at the lower end of the Upper Diversion, to settle sediments prior to discharge to the natural drainage course down to Perry Creek (Fig. 2.5-1)
- deferring commissioning of the lower segments of the Upper Diversion until after the 2006 freshet, to allow vegetation to establish itself over the fall 2005 and spring 2006 growing seasons
- routing initial flows in the upper segments of the Upper Diversion through the SP6 Settling Pond
- routing initial flows from the upper segments of the CCR Diversion onto the W18 and W22 fans, where the water will probably infiltrate into the ground. Water that does not infiltrate would report to the SP18 Settling Pond
- armouring any final sections of the diversions where velocities are predicted to exceed 1.5 m/s, and armouring the stilling basin where the CCR diversion will decant into the Wolverine River.

Discharge routes for the Settling Ponds were assessed in the summer and fall of 2005. Assessments included reconnaissance along the expected flow pathways to the Wolverine River, and the installation of staff gauges at discrete locations to determine gradients and probable flow directions across the flood plain. This information was presented by Piteau Associates Engineering Ltd. Within Appendix 4 of the *Mine Permit Application* (2004b).

An assessment of potential fish habitat areas along the identified settling pond discharge pathways was conducted in mid October by Diversified Environmental Services and presented as Appendix 15 in the *Mine Permit Application*. Results of this assessment are summarized on Table 2-19.

Table 2-19: Summary of Settling Pond Discharge Routes

Settling Pond	Discharge Route	Comments on Settling Pond Discharge	Potential Impacts to Aquatic Habitat Along Discharge Route
EXP	W2, Wolverine River	Expect very little surface flow will reach Wolverine River	None expected
SP4a	W4 (Tributary to Oxbow 5)	Expect very little surface flow will reach Oxbow 5	None expected
SP6	Oxbow 5, Wolverine River	Expect average freshet flows will exfiltrate before decanting from Oxbow 5 in early mine life. Average flows in later mine life, and storm flows throughout mine life, are expected to decant from Oxbow 5.	Some stormwater discharge impact to Oxbow 5 (not assessed, but probably not habitat). This Oxbow does not naturally decant, and essentially dries up during low flow periods.
SP12	B.C. Rail Ditch, Oxbow 2, Lower B.C. Rail Ditch, Wolverine River	Expect surface discharge will occur in all but the cold winter months.	Potential impacts to Lower B.C. Rail ditch where fish habitat has been documented [1]. Potential impacts to upper B.C. Rail ditch, but no significant aquatic habitat issues.
SP14	Temporal Wetland, Oxbow 1, Wolverine River	Expect surface decant will occur from start of freshet to freeze up.	Potential impacts to Oxbow 1, but aquatic habitat assessed to have low suitability for seasonal rearing for fluvial populations indigenous to the Wolverine [1].
SP18	Floodplain, Wolverine River (Oxbow 1- minor)	Expect surface decant will occur only during freshet and storm events.	None expected, prior to discharge to Wolverine River.

Notes: 1. From Diversified Environmental Services, 2004. **2.** The beaver impounded wetland on the Terry Ranch and Oxbows 3 and 4, which were characterized as part of the baseline fish habitat program, represent permanent aquatic habitats. They may receive mine-influenced groundwater but will not receive any mine area runoff from the settling ponds.

Potential impacts to fish habit are restricted to the Wolverine River and the short section of constructed ditch which conveys W12 water from Oxbow 2 to the Wolverine River. The water management structures and monitoring programs proposed in the *TAR* (WCC, 2005) have been designed to monitor and mitigate potential impacts at these locations (See Section 3.7).

2.5.4 Water Demand

Water will be required for the process plant, for domestic use in the office, maintenance and mine-dry facilities, and for dust control in the Plantsite area and on the Mine Haulroads. Road designs are essentially unchanged from the 1.6 Mtpa design. Dust control water requirements for the 2.4 Mtpa design will therefore remain the same as for the 1.6 Mtpa design (Table 2-20). Process water and domestic water requirements will increase from the 1.6 Mtpa design quantities.

Table 2-20: Dust Control Water Demand

Area	Length Flow (m)	Width (m)	Area (m^2)	Application Rate ($l/hr/m^2$)	Peak Day (m^3/day)	Flow (L/S)	Average (m^3/yr)	Year (L/s)
Plantsite			47,000	1	470	5.4	73,300	4.4
Plantsite Roads	2,000	22.7	45,400	1	454	5.3	70,800	4.5
Pit Area Roads	4,000	22.7	90,800	1	908	10.5	141,700	8.4
Total					**1,932**	**21.2**	**285,800**	**17.0**

The 2.4 Mtpa plant will require approximately 50% more process water than the 1.6 Mtpa plant. The average annual process water requirement is approximately 124 tonnes/hr (34.4 L/s) versus about 88 tonnes/hr (24 L/s) for the 1.6 Mtpa design. Domestic water for the office and mine dry facilites are estimated to increase from 4.7 to 5.0 tonnes/hr (1.3 to 1.4 L/s).

The estimated average annual process make-up and domestic water balance is listed on Table 2-21.

Table 2-21: Process Water & Domestic Water Balance

	FLOWS			
	tonnes/hr	**L/s**	**USgpm**	**tonnes/yr**
Process requirement	124	34.4	546	
Water in coal feed	35	9.7	154	
Water in clean coal	46	12.8	203	
Water in tailings	87	24.2	383	
Water in CCR	23	6.4	101	
Water to Tailings Impoundment (Incl CCR)	110	30.6	484	
Grey water discharge to Tailings Impoundment [1]	3.6	1.0	16	
Net precipitation over pond catchment area[2]	6	1.7	26	
Loss to pore water [3]	43.5	12.1	192	
Loss to seepage [4]	41.8	11.6	184	
Recycle from supernatant pond	17.1	4.8	75	
Recycle from seepage interception[5]	45.9	12.8	202	
Net process make-up requirement	26	7.2	114	
Domestic Water [1]				
Wash water, toilets, etc.	5.0	1.4	22	
Total Water Supply				
Average annual make-up supply	31	8.6	136	270,000
Summer make-up supply[6]	44	12.2	194	
Wolverine River 20-year 7-day low flow		610	9669	
Water supply as % of 20-year 7-day low flow		1.4%		

Notes: 1. Tailings water balance and domestic water requirement provided by Cochrane. **2.** Gain from precipitation equal to net annual precipitation over Tailings Impoundment area. This amount is negative during summer. **3.** Based on 50% of influent tailings moisture retained as pore water, over operating period of mine. **4.** Seepage loss equal to approximately 10 L/s from impoundment (based on finite-element modelling of seepage reported in the *AIR*), and 25% of the moisture content in the CCR. **5.** Interception flow will be a minimum of 10% more than seepage loss to control flow of tailings water to Wolverine River, and to account for interception of some seepage from SP12. **6.** Summer make-up rate will be higher than average annual, due to net evaporation during summer months

The average annual make-up supply of 8.7 L/s is equivalent to an annual flow of 270,000 m^3, and represents 1.4% of the 20 year 7-day low flow in the Wolverine River. The 20 year 7-day low flow would occur in the winter months.

Peak diversion rates over a dry period in the summer months would total approximately 33.2 L/s, including 12.2 L/s for process make-up water and 21 L/s for dust control water. This rate of diversion represents approximately 2% of the 1700 L/s 1:10 year low monthly summer (September) flow in the Wolverine River above Perry Creek, and only 1% of the average 3300 L/s September flow in the Wolverine River (See Table 4.7.3 in the *AIR*).

As water would be supplied primarily from the tailings seepage interception wells and water supply wells during periods of droughts (i.e. low flow periods), the impact on the Wolverine River would be considerably less than the above amount, due the damping effect provided by the large volume of storage in the alluvial sediments beneath the valley bottom. Management of supernatant pond storage would further mitigate impacts on low flows in the Wolverine River.

The total average annual water demand, for process, domestic and dust control water, is estimated to be 560,000 m^3/year (17.6 L/s).

2.5.5 Water Supply Sources

Water supply will be obtained from storm water stored in Settling Ponds SP12, SP14, and SP18, from groundwater diverted from the pit sump, and from water supply and tailings seepage interception wells.

Water will be diverted (pumped) from the SP12 pond primarily for dust control use, but provision is being included in the design to pump some water to the tailings impoundment for use as process make-up water. Water will also be pumped to the tailings impoundment from the SP14 and SP18 ponds, but only to mitigate problems with excessive suspended sediments in decant from either of these ponds. However, any water pumped from these ponds would be used for process make-up water.

The diversion amounts presented in Table 2-22 are based on the demand flows estimated in Section 2.5.4 and an upper bound estimate of the quantities of flow that may have to be pumped from SP14 and SP18 to mitigate potential problems associated with elevated TSS in the pond decants during a wet year.

Table 2-22: Total Annual Surface Water Diversion Quantities

Inflow	Dust Control	Process Make-up (m^3/yr)	Request Diversion m^3/yr	Average Annual m^3/yr
SP12	285,000 m^3/yr	160,000	500,000	1,100,000
SP14		80,000	80,000	160,000
SP18		90,000	110,000	210,000

The above annual diversion rates, which represent between about 45% and 55% of the predicted total annual inflow to each pond, have been applied for in the water licence application documents submitted April 12, 2005. These diversion amounts total 690,000 m^3/year, about 20% more than the average annual demand. This excess allows for peak demand years, when either plant productivity or dust control demands may be significantly higher than average.

In practice, it may be difficult to divert the above flows from the settling ponds, due to lack of water during dry weather and during the winter months. Storage in the SP12 Pond will be managed to sustain supply from this source during dust control periods, but management for this purpose will be secondary to maintaining storm water detention capacity, the primary purpose of the settling ponds.

Deficits between the actual water demand and the supply quantities that can be diverted from the three settling ponds will be obtained from groundwater seepage that reports to the pit sump, and from water wells. The primary groundwater source for process make-up water will be the seven tailings seepage interception wells (see locations on Fig. 2.1-2), which will be pumped at rates in excess of the tailings seepage interception rates. It is expected that these seven wells will have more than sufficient capacity to meet the process make-up water requirements. Two existing wells, located southwest of the Plantsite below the CCR storage area (Fig. 2.5-1), will provide domestic water, plus any deficit in the dust control or process water demands. These two wells were each tested at a rate of 7 L/s in early March 2005. Safe yields have not yet been determined, but will be in excess of 10 L/s each. The supply capacity provided by the first two production wells is therefore in excess of the average annual water demand for the project, and about two thirds of the peak water demand projected for a summer drought.

2.6 Construction Management Plan

For the purpose of this application, the Construction Phase is defined as all activities and facility development up to the commissioning of the coal preparation plant (i.e., to the end of Q3 2006). Project construction planning has started. Detailed engineering has continued throughout the approval period and will proceed through much of the construction period. Construction is planned to take eighteen months and will start in the spring of 2005 with preparation of sedimentation control structures. Subsequent construction of minesite facilities including: explosives handling and storage facilities, equipment maintenance and repair facilities, ancillary office and warehouse, site services and utilities, waste rock dumps, raw and clean coal storage and handling, and coal preparation facilities will occur over a period of two years. Coal production is scheduled to start in the third quarter of 2006.

Other than timing, the Construction Phase Management Plan remain as described in the Permit application (and further described in the *Technical Assessment Report* for the Effluent Permit Application). The schedule of Construction Phase activities is provided in Table 2-23.

Activities during the Construction Phase include:

- water management diversions, ditching and sedimentation pond construction
- site clearing and grubbing
- construction of water management structures
- implementation of erosion control measures
- site preparation and soil salvage
- construction of plantsite facilities including:
  - coal preparation plant and dryer
  - clean coal stockpile, recovery and loadout system
  - run-of-mine (ROM) coal handling system
- infrastructure construction including:
  - shop, office and dry facility
  - 25 kV powerline and substation
  - re-alignment of Wolverine FSR and Perry Creek Road
  - explosives storage and facility
- mine development including:
  - pit access roads and initial bench development
  - pre-stripping and haul road construction
- south dump foundation construction and commissioning to receive stripping waste
- tailings impoundment starter dam construction
- equipment erection pad preparation
- set-up and operation of a construction camp.

Table 2-23: Schedule of Key Construction Activities

	Q1 - 2005	Q2 - 2005	Q3 - 2005	Q4 - 2005	Q1 - 2006	Q2 - 2006	Q3 - 2006
Log*/Clear/ Grub	Plant and construction facility sites, including SP14 and SP18.	SP12, SP6, SP4a & SP EXP. Explosive storage site and Wolverine FSR relocation	Raw and clean coal handling and storage area. Pre-production mining area. Wolverine FSR relocation.	CCR – borrow pit area.	Tailings pond area.	Year 1 mining areas.	
Topsoil Salvage		Plant and construction facility sites. SP12, SP6, SP4a, & SP EXP. Wolverine FSR relocation.	Raw coal handling and storage area. Explosive storage site and pre-production mining area.	.		Tailings pond area.	Year 1 mining areas
Water Management		Start CCR diversion. Construct SP14 & SP18 structures. Start SP12 W14 conveyance channel	Construct SP12, SP6, SP4a & SP EXP structures. CCR diversion. Upper diversion. Start draining Tailings pond area.				
General Site Construction	Wolverine FSR realignment	Set up construction facilities, including camp. Wolverine FSR realignment	Grading for raw and clean coal handling systems. Remove the "Wye." Wolverine FSR realignment.		Power line construction. (by B.C. Hydro)	Build the tailings embankment starter dike.	
Plant		Temporary Wolverine FSR diversion. Start rough grading.	Site grading and foundation. Concrete work: plant and dryer.	Plant & Dryer steel and cladding. Concrete work: raw and clean coal handling systems.	Plant equipment and piping installation. Raw coal breaker and conveyor.	Plant electrical and instrumentation. Clean coal stacker/conveyor and electrical. B.C. rail modifications	Tailings pond piping and decant structure.
Other Infra-structure			Explosives storage facilities.	Perry Creek road realignment.	Maintenance shop/office foundation.	Maintenance shop/office construction.	
Mining Area(s)				Phase 1 pre-production mining.	Phase 1 pre-production mining.	Phase 1 pre-production mining.	Phase 1 pre-production mining.

Note: * Logging of merchantable timber will take place in one or two campaigns while clearing/grubbing will progress just ahead of soil disturbance.

Section 3 • Impact on Environmental Management Plans

3.1 Risk Management

WCC has committed to develop mine Waste Management Plans to reduce the risk associated with ARD/ML seepage emanating from each of the mine facilities, geotechnical stability of the structures and the degradation of water quality during operations and throughout post-closure. The management plan concepts for the waste rock, tailings and CCR storage facilities were presented previously in Section 2.4. The plans for each of these facilities are designed to reduce the risk of ARD and metal leaching through special handling of problematic materials based on the results obtained from operational monitoring of the waste rock and coal processing byproducts (Section 3.7). A commitment to monitoring down stream waters and waste placed in the storage facilities has also been made. This additional monitoring is to confirm that the management plans are implemented successfully and to ensure that unforeseen risks do not arise unnoticed. In the event that the downstream or post-placement monitoring detects unacceptable releases from the storage facilities, a number of contingency plans have been developed to prevent long-term impact to the receiving environment. This approach of developing and implementing proactive management, monitoring and contingency plans reduces the risk of impact by the project to the environment. Modifications to the understanding of potential risks and risk management that were identified in the *AIR* are discussed in the following section. No additional risks have been identified to result from the proposed accelerated production schedule.

3.1.1 Wolverine River Flood

As reported in Section 4.7.1.8 of the *AIR*, the 1:200 year flood in the Wolverine River is predicted to reach the CN Railway embankment, but not inundate the area on the northwest side of the tracks. Mine facilities are therefore sited above the 1:200 year Wolverine River floodplain.

Localized flooding in the lower Plantsite area will occur during extreme events, due to the very flat topography in this area. The loadout area has been moved further down the W14 fan as compared to the layout presented in the *AIR*. However, the loadout is founded on a fill and the foundation for this and all other Plantsite facilities are being designed to provide at least 1m of freeboard above the predicted 1:200 year local flood elevation.

The level or risk presented by a 1:200 year Wolverine River flood is unchanged from the 1.6 Mtpa design, and the original risk designation (Low) is applicable for the 2.4 Mtpa Amendment.

3.1.2 Inputs of ARD to the Wolverine River & Perry Creek

The results from the ongoing kinetic test program have confirmed the original Low risk rating for ARD from waste rock and coal processing byproducts. Carbonate minerals contained in the waste products actively neutralized acidity released from sulphide oxidation during the laboratory tests. The kinetic tests also indicate that the original CaNP/SAP ratio of 2.0 is a conservative criterion to differentiate between PAG and NAG materials. Thus, the original application of this criterion to designate the stratigraphic units at risk of producing ARD continues to be valid. Predictions of water discharge rates from the mine facilities have not been modified from the original water management plan. Thus, the original management plans and associated risk designations are applicable for the 2.4 Mt Amendment.

3.1.3 Metal leaching to the Wolverine River & Perry Creek

The results from the ongoing kinetic test program have confirmed; that Se is the metal that has the highest potential to be elevated in mine drainage and the Low risk rating of metal leaching to the Wolverine River. As originally suspected, the kinetic tests confirm that fine grained mudstone and claystone materials have the greatest selenium leach potential and the original management plans were designed to restrict contact of these materials with infiltrating precipitation and groundwater.

As outlined in Section 3.2 (Water Quality and Aquatic Resources), predictions of effluent quality were based on end-of-mine conditions, assuming maximum footprint and volume of PAG/PML materials (wasterock, pit walls, tailings, coarse coal reject, etc.). Given that the maximum footprint and volume of PAG/PML materials does not change as part of the 2.4 MT expansion, end-of-mine conditions remain unchanged. Therefore, the effluent quality predictions associated with those parameters which are released to the environment via the weathering (i.e., leaching) of PAG/PML materials do not change. Such considerations apply to selenium, other metals and sulphate. Accordingly, the environmental risk ratings for the Wolverine River (Impact = 1) and Perry Creek (Impact = 2) do not change.

3.1.4 High fugitive dust emissions

Section 3.3 of this report provides an assessment of air quality and outlines mitigation measures to limit fugitive dust emissions. These measures include:

- road design, construction and maintenance practices
- enclosing conveyors and transfer points
- using water sprays/sprinklers
- early reclamation.

3.1.5 Debris flow through plantsite

A reconnaissance terrain hazard assessment was conducted by Thurber Engineering Ltd. and Piteau Associates Engineering Ltd. in October 2004. The results were presented within Appendix 4 of the *Mine Permit Application* The results of this assessment identified a debris flow risk in the Plantsite area, and indicated a debris flow event in the W14 drainage with a volume of approximately 3500 m^3 is likely to have a return period of greater than 200 years. Similar probabilities for debris flows events were identified for the W22 drainage basin, and the much smaller W18 drainage basin. There were no signs of debris accumulations along the drainage courses, or instability in the catchments, at the time of the reconnaissance.

Measures incorporated into the design of the W14 conveyance culverts and channel to mitigate the debris flow hazard include a debris rack installed upstream of the upper culvert and a metal grid at the culvert inlet. A deflection berm will constructed at mine closure, to prevent any debris or stormwater from flowing towards the tailings impoundment.

Debris flows from the W18 and W22 drainages are mitigated by the gentle slope of their fans, and their physical separation from the Plantsite. Debris flows in either the W22 drainage course or much smaller W18 drainage courses would not approach the Plantsite. Mitigation measures for debris flows in these drainage courses will be incorporated into the final grading plan for the CCR.

During the mine life, an annual inspection of the three catchments will also be conducted following each freshet, to evaluate the condition of the watershed and to identify any maintenance works necessary to mitigate the debris flow risk.

The mitigated risk level for potential debris flow events remains the same for the 2.4 Mtpa Amendment as was reported in the *AIR* (Low).

3.1.6 W14 Drainage flood due to culvert blockage

A debris rack, upstream of the W14 culvert, is included in the design for the W14 drainage. The monitoring and maintenance program for these structures (debris rack and culvert) will include periodic inspections and cleaning if required.

3.1.7 Tailings embankment failure due to foundation liquefaction

Stability analysis for failure along slip surfaces assumed to be fully liquefied gives factors of safety of 1.22 to greater than 1.6 (analysis by Norwest and presented in the *Permit-Level Geotechnical Design Report for the Tailings Facility* and *Coarse Coal Reject Pile*). The geotechnical instrumentation and monitoring program for the tailings embankment includes measurements for pore-water pressures and horizontal movement of foundation soils.

3.1.8 Failure of diversion channel above tailings impoundment

The diversion channels above the impoundment are designed to convey the 1:200 year flood event with adequate freeboard. In addition, the main coal haul road, located above these channels, will convey run-off in extreme events.

3.1.9 Failure of dyke on weak clay

From the Norwest report: *Geotechnical Design Report for the Tailings Facility* and *Coarse Coal Reject Pile*, the following factors of safety were determined relating to different failure modes through the clay:

- Four metre high starter dyke 1.4 and greater
- Whole dyke sliding on the Upper Clay (due to hydrostatic pressure) greater than 3
- Bulk of the dyke sliding on the Upper Clay (due to an active wedge) 1.8
- Deep rotational failure through the Lower Clay 1.42
- Lower bench failing on the Upper Clay 1.36

The geotechnical instrumentation and monitoring program for the tailings embankment includes measurements for pore-pressure and horizontal and vertical (settlement) movements.

3.1.10 Tailings impoundment freeboard issues

The operating criteria for the tailings impoundment with respect to freeboard (to be detailed in the OMS manual) includes the following key points.

- The tailings beach crest will be maintained at least 1 m below the upstream dyke crest.
- The pond elevation will be maintained a minimum of 1 m below the beach crest.
- The pond edge will be maintained a minimum 100 m from the upstream dyke crest

3.1.11 South dump failure into tailings pond

All calculated factors of safety for South dump meet or exceed the design criteria due to the design criteria and construction methodology. Piezometers and slope inclinometers will be used to monitor toe conditions.

3.1.12 ARD from tailings and tailings embankment to waterfowl habitat

The results from the ongoing kinetic test program have confirmed the original Low risk rating for ARD from the tailings and CCR embankment. Following 15 test cycles, carbonate minerals contained in the CCR and tailings kinetic test samples were being depleted at rates <1.5 times that observed for the sulphide minerals. The annual tailings and CCR production in any given year is predicted to have CaNP/SAP values that range from 1.8 to 5.0, which indicates that these materials would contain excess NP to offset sulphide acid production.

3.1.13 Metal leaching from tailings and tailings embankment to waterfowl habitat

The results from the ongoing kinetic test program have confirmed the original Moderate risk rating for selenium leaching from the tailings and CCR embankment to waterfowl habitat. Following 15 test cycles, Se release rates were typically greater from the CCR and tailings kinetic test samples than from the waste rock samples at levels that would exceed the water quality criteria.

As outlined in Section 3.2, there are two areas of the receiving environment that are most at risk from selenium inputs from the Perry Creek pit development: 1) lentic zones between the Perry Creek Pit Area and the Wolverine River; and 2) the outlet of Oxbow 2, which possesses moderate juvenile rearing potential for sport and non-sport fish species. Despite the identification of fish habitat downstream of Oxbow-2, the environmental risk rating (Impact = 3) still applies given the proposed contingency measures for selenium management. The selenium management measures associated with these zones are described in the *Selenium Management Plan* in Appendix 6 of the *Effluent Permit TAR*.

3.1.14 Seepage from SP6 & SP12 to waterfowl habitat

Given that the metal leaching results from the ongoing kinetic test program are consistent with previous interpretation, and given that effluent quality predictions do not change as part of the 2.4 Mtpa project, the environmental risk rating for the waterbird habitat downstream of SP6 and SP12 (Impact = 3) does not change.

3.1.15 Seepage from W6 channel to waterfowl habitat

Given that the metal leaching results from the ongoing kinetic test program are consistent with previous interpretation, and given that effluent quality predictions do not change as part of the 2.4 Mtpa project, the environmental risk rating for the waterbird habitat downstream of the W6 channel (Impact = 3) does not change.

3.1.16 South dump deep-seated foundation failure

The stability analysis for a failure surface that extends into the glacial till/colluvium foundation has a factor safety of 1.5. Piezometers and slope inclinometers will be used to monitor toe conditions.

3.1.17 South dump slab sliding on non-specification material

The factor of safety of a failure within the shell is between 1.7 and 1.8. Dump surface stability (example: edge slumping and sliver failures) are not considered a design issue. The OMS manual will address operating procedures for identifying and directing the proper materials to the dump shell.

3.1.18 Rock rolling down dump face

The dump design provides for a 5 m wide bench and 3 m high berm to be left along the crest of each 20 m lift. In addition, topsoil stockpiles at the base of the dump will serve as boulder roll-out protection. Boulder roll-out analyses indicates all of the runout rocks will be contained.

3.1.19 Reclaimability of south dump

The dump design with the roll-out protection benches and berms is essentially at the required resloping angle for reclamation: 2H:1V. Resloping will simply involve knocking off these features with a dozer. The factor of safety (for foundation sliding) after resloping remains at 1.5.

3.1.20 Seepage from south dump to water fowl habitat

Given that the metal leaching results from the ongoing kinetic test program are consistent with previous interpretation, and given that effluent quality predictions do not change as part of the 2.4 Mtpa project, the environmental risk rating for the waterbird habitat downstream of the South dump (Impact = 3) does not change.

3.1.21 CCR dump foundation failure by liquefaction

The CCR pile has been located so as to avoid any failure modes involving liquefied sand/silt layers or movement along the Upper or Lower Clay.

3.1.22 CCR failure caused by elevated water table

Design, construction and operational measures taken to virtually eliminate the potential for failure caused by an elevated water table include:

- sub-excavating cohesive material from the footprint
- design and construction of a gravel filter connected to the natural Bouldery/Gravel layer to act as an underdrain compacting the CCR (to 95% Standard Proctor Density) and constructing a 2H:1V slope.

3.1.23 ARD from CCR storage facility to waterfowl habitat

The results from the ongoing kinetic test program have confirmed the original Low risk rating for ARD from the CCR storage facility. Following 15 test cycles, carbonate minerals contained in the CCR kinetic test samples were being depleted at rates <1.5 times that observed for the sulphide minerals. The annual CCR production in any given year is predicted to have CaNP/SAP values that range from 1.8 to 4.3, which indicates that these materials would contain excess NP to offset sulphide acid production. The original CCR management plan, that is also proposed for the 2.4 Mt expansion, includes the selective placement of NAG material in this storage facility.

3.1.24 Metal leaching from the CCR storage facility to water fowl habitat

Given that the metal leaching results from the ongoing kinetic test program are consistent with previous interpretation, and given that effluent quality predictions do not change as part of the 2.4 Mtpa project, the environmental risk rating for the waterbird habitat downstream of the CCR Storage Facility (Impact = 3) does not change.

3.1.25 Exceedence of TSS limits in effluent from SP6, SP12, & EB-1

The design and catchment areas for these facilities do not change for the 2.4 Mtpa Amendment. The mitigated risk level remains at Low.

3.1.26 Overtopping of SP4b, SP6, SP12, and EB-1 settling pond embankments

Spillway capacity and design for these facilities has not changed for the 2.4 Mtpa Amendment. The unmitigated risk level remains at Low.

3.1.27 Construction water management issues

Construction water management issues are not affected by the 2.4 Mtpa Amendment. The mitigated risk level remains at Moderate.

3.1.28 Upstream failure of CCR diversion

The CCR design and CCR Diversion design have not changed for the 2.4 Mtpa Amendment. The unmitigated risk level remains at Low.

3.1.29 East dump large foundation failure

Factors of safety for this failure mode (deep-seated foundation failure through the undifferentiated fill and into the gravel terrace) range from 1.5 to 2.2, which exceeds the design criteria. The instrumentation and monitoring program for this dump includes wireline extensometers and visual inspections.

3.1.30 East dump flowslide

Although the risk of a flowslide is low for East dump, a restricted access zone extending 50 m from the west and north toes of the dump will be established and communicated. Under no circumstances will workers be present in the restricted access zone during active dump construction.

3.1.31 North dump large foundation failure

The factor of safety for this failure mode (deep-seated foundation failure through the undifferentiated fill and into the till-colluvium at the base of the dump) is 1.2, which meets the design criteria. The instrumentation and monitoring program for this dump includes two shallow slope inclinometer stations and one deep inclinometer to monitor foundation performance.

3.1.32 North dump flowslide

The North dump design and mining schedule have been developed to reduce the risk of flowslides, especially towards the pit.

In the mining schedule, the pit bottom area of Phase 1 of the pit is mined out and manpower and equipment moved out prior to any active dumping on the North dump.

The North dump design involves construction of two small lifts (1075 and 1125 elevations), with their slope above the W6 drained resloped to 2H: 1V. For these lifts a restricted zone extending 100 m from the toe will be established and communicated.

This restricted zone will be expanded to include the pit bottom (from Phase 1 mining) prior to constructing the 1150 lift.

3.2 Water Quality & Aquatic Resources

3.2.1 Introduction

The following section discusses the water quality management considerations associated with the proposed increase in production rate at the Wolverine Coal Project. Considerations are discussed as they apply to: 1) baseline environmental updates; 2) the quality of sedimentation pond effluents; and 3) water quality management. Each of these components is discussed in turn below. A discussion of residual/cumulative impacts to the receiving environment is presented in Section 6.1.

3.2.2 Baseline Updates

Since the submission of the *Additional Information Report* (*AIR*) in May 2004, additional studies have been conducted which augment the baseline dataset. Of particular relevance are those studies which have been undertaken in support of selenium management. As outlined in Section 12.8.3 of the *AIR*, the major concern related to selenium is its accumulation in the organic form in fish and waterbirds such that elevated organo-selenium concentrations are passed to the eggs, resulting in juvenile abnormalities and embryo death. The most significant exposure pathway for organisms is through diet. As a result, the potential for bioaccumulation and toxicity will depend on the food-chain pathway, which will in turn be dependent on the physical, biological and chemical characteristics of the water body.

It is widely recognized that lentic systems (e.g., lakes, wetlands, back waters) are at greater risk to selenium inputs than lotic systems (flowing water).

As outlined in the *Selenium Management Plan* (Appendix 6 of the *Effluent Permit TAR*), there are two areas of the receiving environment that are most at risk from selenium inputs from the Perry Creek pit development:

1. *Lentic zones between the Perry Creek Pit Area and the Wolverine River.* The lentic zones between the Perry Creek Pit Area and the Wolverine River represent potential sites for selenium exposure to waterbirds through sediment, periphyton and/or benthic invertebrates. Lentic zones may be exposed to elevated levels of selenium through contact with sediment pond effluents (Oxbows 1, 2 and 5) or groundwater inputs emanating from waste facilities (Oxbows 1-5 and the wetland on the Terry Ranch) (Figure 2.5-1).
2. *Outlet of Oxbow 2.* The outlet of Oxbow-2 comprises a 130 m long constructed channel which connects Oxbow-2 with the Wolverine River (Figure 2.5-1). The channel is seasonally accessible from the Wolverine River and possesses moderate juvenile rearing potential for sport and non-sport fish species. Since sediment pond effluents from SP12 will flow through this channel, this zone represents potentially-sensitive habitat with respect to selenium exposure to fish and waterbirds through sediment, periphyton and/or benthic invertebrate pathways.

In order to establish baseline conditions in these lentic areas, and to provide the foundation for on going selenium management, additional baseline monitoring was conducted in 2004. Baseline programs for the lentic zones in 2004 included assessments of waterbird use, water quality, sediment chemistry, benthic communities, and fish habitat/populations. These programs are described in detail in Appendix 6 of the *Effluent Permit TAR* (*Selenium Management Plan*), while brief descriptions are provided below.

- *Water Quality and Sediment Chemistry* – Baseline water quality and sediment monitoring in lentic habitats between the Project Area and the Wolverine River was completed in September 2004. The results of this study are presented in Lorax (2004) (Appendix 11 of the Effluent Permit *TAR*).
- *Benthic Communities* – In September 2004, baseline monitoring of periphyton and benthic invertebrates was attempted in the lentic zones between the project Area and the Wolverine River, and downstream of the project along the Wolverine River. The results of this study are presented in EVS (2004) (Appendix 12 of the Effluent Permit *TAR*).
- *Fish and Fish Habitat* – In 2004, Diversified Environmental completed a fish habitat survey in the B.C. Rail ditches and Oxbow 1 and 2, which are the main areas of potential habitat concern in the Wolverine River floodplain area between the mine and the river. These studies identified fish utilization in the BCR Railroad ditch and in the outlet of Oxbow 2. The results of this study are presented in Diversified (2004) (Appendix 13 of the Effluent Permit *TAR*).

- *Waterbird Use* – In 2004, studies were conducted to establish a baseline for waterbird use. Monitoring included a harlequin duck survey along the Wolverine River and Perry Creek, and a general waterfowl survey along the Wolverine River, wetlands, and oxbows in the vicinity of the mine. The results of this study are presented in Keystone (2004) (Appendix 14 of the Effluent Permit *TAR*).
- *Vegetation* – In September 2004, WCC collected vegetation samples to complete the required MEM baseline for trace element concentrations in plants on the minesite. Terrestrial vegetation samples were taken, including grasses and willows, which are used as ungulate browse and native legumes (creamy peavine). The results of this study are presented in Keystone (2004) (Appendix 6 of the *Mine Permit Application*).

Additional monitoring in support of the *Selenium Management Plan* is described in Section 3.7.

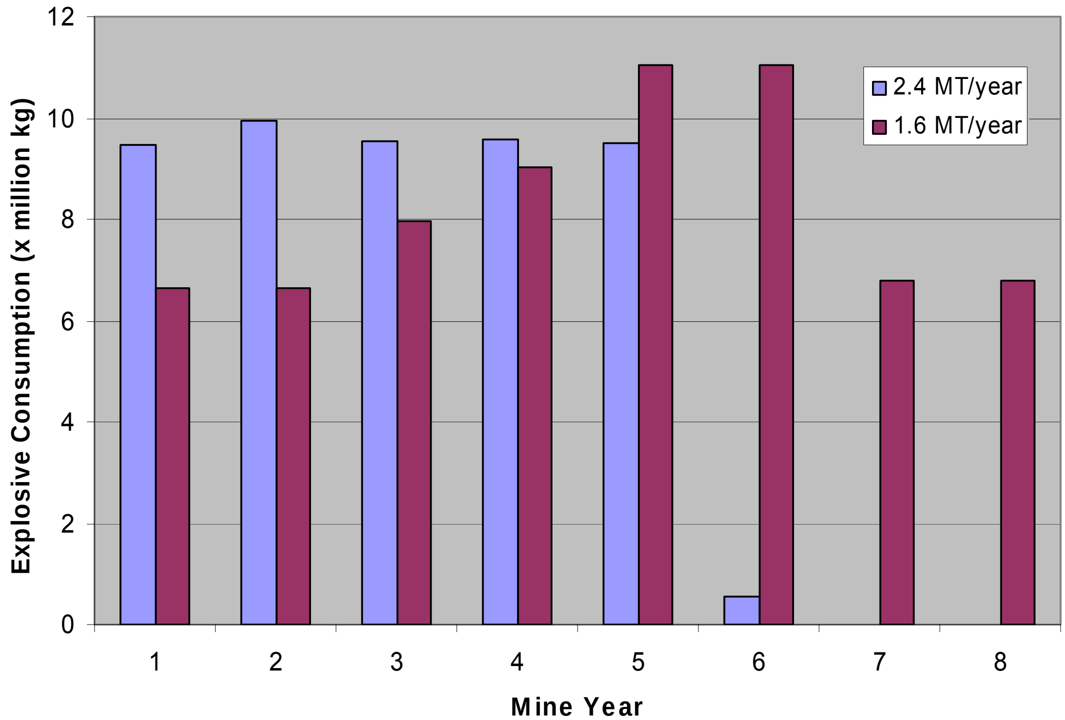
3.2.3 Quality of Sedimentation Pond Effluents

Section 3.14.4 of the *Additional Information Report* (*AIR*) provides water quality predictions for the sedimentation pond discharges. The approach for the effluent quality predictions involved the following steps: 1) defining the range in concentrations for waters in contact with potentially acid-generating (PAG) or potentially metal-leaching (PML) materials; and 2) defining the quality of sedimentation pond discharges for various flow conditions.

As part of the effluent quality assessment for sedimentation pond discharges, predictions were based on end-of-mine conditions, assuming maximum footprint and volume of PAG/PML materials (waste rock, pit walls, tailings, coarse coal reject, etc.). Given that the maximum footprint and volume of PAG/PML materials does not change as part of the 2.4 MT expansion project, end-of-mine conditions remain unchanged. Therefore, the water quality predictions associated with those parameters which are released to the environment via the weathering (i.e., leaching) of PAG/PML materials do not change. Such considerations apply to selenium, other metals and sulphate. Accordingly, the predicted water quality values for these parameters in both sedimentation pond effluents (Section 3.14.4 of *AIR*) and receiving waters (Section 12.8 of *AIR*) remain the same for conditions of increased production rate.

In contrast to metals and sulphate, the export of nitrogen compounds to the environment will reflect the flushing of residual blasting residues associated with the use of nitrogen-based explosives (e.g., Ammonium Nitrate Fuel Oil (ANFO)). Given that annual explosives consumption for the 2.4 MT project will be greater than that for the original 1.6 MT project, annual losses of nitrogen to the environment can be expected to be greater for the 2.4 MT project. As illustrated in Figure 3.2-1, annual explosive consumption for a production rate of 2.4 Mtpa is greater in than that for the original 1.6 Mtpa over the first four years of operations.

Figure 3.2-1: Annual Explosive Consumption for 2.4 Mtpa & 1.6 Mtpa Production Rates



For the Wolverine Project, the concentration of Total-Nitrogen (N) for flows in contact with PAG/PML materials was based on consideration of both site-specific modelling and examination of nitrogen data for other mines in the area. With regards to modelling, a worst-case Total-N value of 49 mg/L was generated (Section 3.14.4.2.1 of *AIR*) using the equations of Ferguson and Leask (1988). Conversely, nitrate-N concentrations in Mesa Creek downstream of the Mesa 1660 slide have ranged from 13 to 96 mg/L (Mean of 40 mg/L) (Quintette Mine Monitoring Data 1995-2003). The nitrate values measured downstream of the Mesa 1660 slide, however, are considered to be conservatively high, given the long flow path and contact time of meteoric waters in contact with wasterock. Indeed, the nitrate concentrations downstream of the slide are higher than values reported for any of the other settling ponds on the property (e.g., S-1, S-2, S-3, Mesa A, *etc.*). In order to provide a conservative range in total-N values for the impact assessment (Section 12.8 of *AIR*), a total-N range of up to **150 mg/L** was selected. The upper value represents a factor of 1.5 greater than the maximum observed at Quintette Mine.

For the 2.4 Mtpa project, the Ferguson and Leask (1988) model was applied given the revised explosive consumption rates shown in Table 3-1, and a range of flow conditions (see methods in Section 3.14.4.2 of *AIR*). This exercise yielded a “worst-case” Total-N value of 56 mg/L for flows in contact with PAG/PML materials (see Table 3-2). The maximum total loss of nitrogen for the project life-span occurs in Year-1. This maximum is a function of the high explosive consumption during this year as well as the higher proportion of emulsion

(35%), which is characterized by a higher N-loss rate than ANFO. Although the maximum value for the 2.4 Mtpa project (56 mg/L) is greater than that predicted for the 1.6 Mtpa project (49 mg/L), the effluent predictions remains unchanged. Specifically, the small increase in nitrogen loading for the 2.4 Mtpa project is insignificant relative to the conservative input value of 150 mg/L, which was selected for effluent quality modelling. As outlined above, the 150 mg/L value represents a factor of 1.5 greater than the maximum observed at Quintette Mine. Therefore, water quality predictions for nitrogen compounds discharged from the sedimentation pond associated with the 2.4 Mtpa project remain unchanged from those values presented in the *AIR* (Section 3.14.4.3 of *AIR*). Similarly, predictions for the concentrations of nitrogen compounds in the receiving environment, and the associated residual effects, remain unchanged (Section 12.8.2)

Table 3-1: Projected Explosive Consumption & Associated Predictions of Annual Nitrogen Losses for 2.4 Mtpa Production Rate (All values in kg)

	Mine Year						
	Pre-strip	**1**	**2**	**3**	**4**	**5**	**6**
ANFO	5,659,200	6,165,900	8,448,150	8,107,980	8,131,950	8,065,140	478,380
Emulsion	1,414,800	3,320,100	1,490,850	1,430,820	1,435,050	1,423,260	84,420
Total Explosives	**7,074,000**	**9,486,000**	**9,939,000**	**9,538,800**	**9,567,000**	**9,488,400**	**562,800**
% Emulsion	20	35	15	15	15	15	15
Total ANFO (as N)	**1,867,536**	**2,034,747**	**2,787,890**	**2,675,633**	**2,683,544**	**2,661,496**	**157,865**
ANFO Loss (as N)	17,555	19,127	2,788	2,676	2,684	2,661	158
Emulsion Loss (as N)	18,039	42,331	31,681	30,405	30,495	30,244	1,794
Total Loss kg N/y	**35,594**	**61,458**	**34,468**	**33,081**	**33,178**	**32,906**	**1,952**

Table 3-2: Total-N Concentrations for Flows in Contact with PAG/PML for 2.4 Mtpa Production Rate Under Varying Flow Conditions

Year	Mean Annual mg/L	Freshet mg/L	November mg/L	7-day low flow (Mean Year) mg/L	7-Day Low Flow (1 in 10 Dry Year) mg/L
1	38	56	30	21	21
2	21	31	17	12	12
3	20	30	16	11	11
4	20	30	16	11	11
5	20	30	16	11	11
6	1	2	1	1	1

3.2.4 Water Quality Management

The water quality predictions associated with sedimentation pond discharges and receiving waters remain unchanged for the 2.4 Mtpa project. This applies to all parameters considered in the environmental impact assessment, including nitrogen compounds, selenium, metals, sulphate, phosphorus, dust/emissions, process chemicals, and suspended solids. See Section 3.2.3. The lack of changes largely relates to the conservative assumptions employed in the original impact assessment in the *AIR*.

Water quality management for the Wolverine Project will focus on selenium management (Appendix 6 *Selenium Management Plan*). Measures to minimize potential for selenium leaching include mine waste management (e.g., special handling) and the diversion of surface drainages to minimize contact with potential selenium generating materials. Monitoring of groundwater down-gradient of the major facilities and water quality of sedimentation pond discharges will be used to provide early detection of potential effects on receiving waters (Section 3.7). To assess the effectiveness of selenium management and determine the need for further contingency management measures (adaptive management), a sequence of progressive monitoring approaches, triggered by threshold concentrations of selenium in the receiving environment, and linked to contingency measures, has been proposed (Appendix 6 *Selenium Management Plan*). Should the need for contingency measures be indicated, strategies include augmented water management measures, which include interception of subsurface flows and the diversion and/or re-routing of surface flows.

3.3 Air Quality Management

3.3.1 Summary of Updates to the Air Quality Assessment Section

This section briefly outlines the major changes in the air quality assessment between the original Wolverine Coal Project Environmental Assessment and the Amendment to increase annual coal production from 1.6 million tonnes to 2.4 million tonnes. The detailed air quality assessment is provided in Sections 3.3.2 through 3.3.7. Supporting documentation is provided in Appendix E.

3.3.1.1 Greenhouse Gas Emissions

The increase in coal production from 1.6 million tonnes to 2.4 million tonnes has resulted in a 155% increase in the predicted GHG emissions from the vehicle fleet, coal dryer and from the coal bed. Also adding to the increase, GHG emissions from the vehicle fleet were previously underestimated by a factor of ten.

3.3.1.2 Fugitive Dust Emissions

Fugitive dust emissions were classified as either crustal dust or coal dust. Crustal dust emission estimates were removed from the assessment due to the high level of associated uncertainty. Although crustal dust emissions have not been estimated, the management of crustal dust emissions is addressed in the Air Quality Management Plan in Section 3.3.6.

Predicted coal dust emission rates have increased from the original environmental assessment. The increase in emissions can be attributed to the rise in coal production, and from the use of worst-case meteorological data for stockpile wind erosion calculations.

The majority of the increase in predicted coal dust emissions can be attributed to the coal stockpiles. In the original air quality assessment, meteorological data for the years 1993 to 1994 from the Tumbler Ridge station were used. The station recorded a maximum wind speed of 9.4 m/s, and an average mean hourly wind speed of 2.5 m/s. Wind erosion emissions have been recalculated based on wind data from the Tumbler Denison station. The Denison station recorded a maximum wind speed of 41 m/s, and an average mean hourly wind speed of 5.9 m/s. Predicted fugitive dust emissions from the coal stockpiles increased with the use of the Tumbler Denison data since erosion potential increases rapidly with increasing wind speed.

3.3.1.3 Coal Dryer Emissions

Emission rates of nitrogen oxides (NO_x), sulphur dioxides (SO_x), and volatile organic compounds (VOCs) from the coal dryer were based on discharge factors (kg/tonne coal dried) published on the MWLAP website for coal-fired thermal dryers. The increase in the coal feed rate into the dryer from 300 tonnes/hr to 460 tonnes/hr resulted in a linear increase in predicted emission rates. WCC has also changed the fuel to the dryer from raw coal to clean coal. Although the use of clean coal is expected to reduce emissions, it was not possible to account for this reduction using the MWLAP emission factors.

Total suspended particulate emissions were based on the maximum Bullmoose permit level of 100 mg/m^3. An increase in the maximum exhaust flow rate from 43.5 m^3/s to 70.8 m^3/s due to the increase in production resulted in an increase in predicted particulate emissions.

The coal dryer stack parameters and location have changed from the original submission. Refer to Section 3.3.3.6 for the revised parameters.

3.3.1.4 Dispersion Modelling

WCC and the owners of the Terry Ranch have negotiated an agreement of non-occupancy on the Terry Ranch property. Since the Terry Ranch is no longer considered a receptor of concern and there are no other sensitive receptors within 10 km of the site, fugitive dust emissions were not modelled. However, modelling of the coal dryer was performed to predict maximum ground-level concentrations in an area with a radius of 10 km centred on the Wolverine plant site.

Refined modelling of the coal dryer was conducted. The results of the refined modelling are presented in Section 3.3.3.10. Maximum predicted concentrations of TSP, $PM_{2.5}$ and SO_2 are all less than relevant ambient air quality objectives and standards. However, the modelling does suggest that there is a limited possibility that emissions from the coal dryer may result in exceedences of the 1-hour maximum acceptable objective for NO_2 and the daily average objective for PM_{10}.

Three different methods were used to convert maximum predicted ground-level NO_x concentrations to NO_2 concentrations. Only one of these methods, the assumption of 100% conversion of NO_x to NO_2, resulted in predicted concentrations greater than the 1-hour maximum acceptable objective but less than the maximum tolerable objective. With the exception of one receptor, all exceedences were predicted to occur within the Perry Creek lease. When the ozone limiting and ambient ratio methods were used to convert NO_x to NO_2 all predicted concentrations were less than the 1-hour maximum acceptable objective for NO_2.

Effects on vegetation from NO_2 emissions are the main concern at the Wolverine plant site. A NO_2 annual average guideline of 29 $\mu g/m^3$, based on vegetation effects and set by the United Nations (UN) Economic Commission for Europe can be used to assess impacts on vegetation. The maximum predicted annual NO_2 concentration of 13.1$\mu g/m^3$, based on the conservative Total Conversion Method, is well below the vegetation guideline limit.

The results of the modelling also suggest that there is a limited possibility of exceedences of the 24-hour provincial objective for PM_{10}. However, the frequency of the exceedences is low and the area where exceedences are predicted to occur is limited to within the coal lease.

Human health effects are the prime concern from PM_{10} emissions. Since residences do not exist within a 10 km radius of the coal dryer, and all exceedences are predicted to occur within the coal license, the potential for human health impacts due to PM_{10} emissions from the mine is very low.

3.3.1.5 Dustfall Monitoring Program

A dustfall monitoring program has been included as a means to determine if provincial air quality objectives are being met and to assess the effectiveness of the Wolverine Mine Air Quality Management Plan. Since there are no private properties near the site, the main concern is deposition of coal dust into streambeds.

3.3.2 Emission Estimates

Greenhouse gas (GHG) and fugitive dust emissions were estimated for the Wolverine Coal Project mining operations. An overview of these estimates is presented in this section and detailed calculations are provided in Appendix E.

3.3.2.1 Greenhouse Gas Emissions

The main sources of GHG emissions are combustion emissions from the coal dryer and the vehicle fleet, and coal bed methane emissions from the mining and processing of coal.

GHG emissions resulting from mining operations will not have much variability from year to year since maximum efficiency of the project is achieved by maintaining constant annual raw coal feed rates to the processing plant and coal dryer.

Descriptions of how emissions were estimated for the coal dryer, vehicle fleet and coal bed methane releases are provided in the following sections. Table 3-3 summarizes the total GHG emissions predicted for the Wolverine Coal Project during mining operations. The total annual greenhouse gas emissions are approximately 170 kilotonnes. These emissions will occur annually during the mining operations between 2005 and 2015. The coal dryer is largest source, contributing 54% of the total emissions.

Table 3-3: Summary of GHG Emissions from Wolverine Coal Project

Source	Annual Emissions of CO_2 equivalent (tonnes)
Vehicle Fleet	44,050
Coal Dryer	91,560
Coal Bed Emissions	34,020
Total	**169,630**

Vehicle Fleet

GHG emissions from the vehicle fleet were based on annual fuel use estimates for the duration of the project. Annual fuel use was estimated to be 16 million litres of diesel and gasoline with little variability year to year. Emission factors from the Voluntary Challenge and Registry Inc., Guide to Entity and Facility-Based Reporting, were used to estimate carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions for heavy-duty gasoline and diesel vehicles. CH_4 and N_2O emissions were converted to CO_2 equivalent emissions to determine the overall emission rate of greenhouse gases.

The total annual emission rate of CO_2 equivalent GHG emissions from the vehicle fleet is 44,050 tonnes.

Coal Dryer

Coal dryer GHG emissions were estimated from the hourly fuel use of the dryer and extrapolated to annual fuel use based on the scheduled 6,200 hours of operation per year. The dryer will use 5.2 t/h raw coal feed acquired at the site. The energy capacity of the raw coal feed is 10,000 BTU/lb.

The total annual emission rate of CO_2 equivalent GHG emissions from the coal dryer is 91,560 tonnes.

Coal Bed Methane Emissions

Methane emissions are released when the coal is mined and the methane moves from a high-pressure state within the coal beds to atmospheric pressure. Methane is also released when the coal is crushed or pulverized in the rotary breaker. The coalfields at the Wolverine Coal mine are composed of medium volatile bituminous coal. A methane emission factor of 0.45 tonnes of methane per kilotonne of bituminous coal for surface coal mines was adopted from the Canadian Greenhouse Gas Inventory, 1990-1998 (August 2000). This information is derived from estimates of surface coal mines in Alberta. Coal bed methane emission calculations were based on the raw coal production rate. The peak raw production rate is predicted to be approximately 3.6 Mt ROM per year. GHG emissions were calculated based on this peak production rate.

The peak total annual emission rate of CO_2 equivalent GHG emissions from the coal bed methane emissions is 34,020 tonnes.

3.3.2.2 Fugitive Dust Emissions

Fugitive coal dust emissions are generated through three types of mining activities: coal transfers, screening operations, and wind erosion of coal stockpiles. Fugitive crustal dust emissions resulting from blasting, drilling, truck traffic, overburden transfers, grading operations, and wind erosion of dumps will also occur; however, estimation of these types of emissions is difficult due to a lack of reliable data. Based on the Ministry of Water, Land and Air Protection (MWLAP) guidance, crustal dust emissions were not estimated due to the high level of associated uncertainty. Although crustal dust emissions have not been estimated, the management of crustal dust emissions is addressed in the Air Quality Management Plan in Section 3.3.6.

The fugitive coal dust emission rates estimated for the Wolverine Coal Project are based on US EPA AP-42 emission factors for aggregate handling and storage piles, industrial wind erosion, crushed stone processing and pulverized mineral processing, and surface coal mining in the western United States. These emission factors may not represent the terrain, vegetation, and typical climatic conditions experienced in northern British Columbia; however, they are the most comprehensive and detailed emission factors available. Mining operations and material properties of the mined coal will also differ from the western United States. Site-specific correction parameters for the Wolverine Coal Project, such as moisture content and silt content, were used wherever possible to achieve the highest data quality rating.

Coal Transfers

Coal transfer emissions are generated from loading and unloading trucks with coal; bulldozing and front end loader operations; conveyor transfer points and surge bin coal drops. With the exception of bulldozing and conveyor transfer points, emission factors from AP-42 for transfer activities are a function of ambient wind speed (Section 13.2.4 Aggregate

Handling and Storage Piles of AP-42). As a result, the majority of the transfer emission rates are highly dependent on local meteorological conditions.

Two surface meteorological monitoring stations, Tumbler Denison and Tumbler Ridge, are located close to the Perry Creek pit. Wind speed and wind direction data from Tumbler Denison, covering the years from 1988 to 2004 but excluding winter months, were analyzed. A full year of meteorological data (1993 to 1994) from the Tumbler Ridge station was also analyzed. The Tumbler Denison station recorded higher maximum wind speeds and higher average hourly wind speeds than the Tumbler Ridge station. Therefore, the Tumbler Denison data were used in this assessment to provide worst-case emission rate estimates.

Maximum particulate emission rates in g/s for fugitive coal dust sources are presented in Table 3-4. Transfer emissions in this table were calculated based on the average hourly wind speed (5.9 m/s) measured at the Tumbler Denison meteorological monitoring site and peak hourly coal handling rates. Bulldozing emission factors from AP-42 Section 11.9 WCC Surface Coal Mining were used to estimate bulldozing emissions, which are based on the peak hourly coal handling rates, along with the moisture and silt content of the coal. For conveyor transfers, emissions were calculated using factors in AP-42 Section 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing. Conveyor transfer emissions are based on the peak hourly coal handling rate only.

Annual particulate emission rates for fugitive coal dust sources are presented in Table 3-5. The maximum emission rates in g/s cannot be scaled directly to daily or annual emission rates, as they represent the worst-case, short-term emission rates at the site. Instead, annual fugitive emissions from coal transfers are based on the average hourly wind speed (5.9 m/s) and the annual coal handling rate. Annual emissions from bulldozing are based on the anticipated equipment operating hours, along with the moisture and silt content of the coal. In general, the mining fleet will operate approximately 6,200 hours per year. For conveyor transfers, annual emissions are based on the annual coal handling rate only.

The emission summary tables show that bulldozing operations for coal clean-up at the pit and plant are the major sources of fugitive coal dust from transfer emissions both on a short-term and annual basis.

Screening Operations

Fugitive emissions from screening operations were estimated using AP-42 emission factors from Section 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing. Short-term and annual emission rates are based on the peak amount of coal screened per hour and the anticipated annual coal throughput, respectively.

Stockpile Wind Erosion

Wind erosion emission rates are based on emission factor equations presented in Section 13.2.5 Industrial Wind Erosion of the AP-42 guidelines. Dust emissions are generated by wind erosion of exposed coal storage piles. Wind erosion potential is dependent on the surface characteristics of the pile (i.e., the finite availability of erodible material) and the wind speed. Erosion potential has been found to increase rapidly with increasing wind speed (US EPA Section 13.2.5-1). Therefore, to be conservative, the highest recorded mean hourly wind speed measured at the Tumbler Denison meteorological station (41 m/s) was used to calculate the short-term erosion emissions from coal stockpiles.

The raw coal, clean coal, and coarse coal stockpiles were assessed as uncrusted coal piles with a threshold wind velocity of 23 m/s. In other words, erosion emissions were estimated to occur only when wind speeds were greater than 23 m/s. The tailings pond was assessed as a ground coal stockpile with a threshold wind velocity of 16 m/s. Annual fugitive emission rates from the coal stockpiles and tailings pond are based on the number of hours for which wind speeds were greater than 23 m/s and 16 m/s, respectively. On average, 19 hours per year were recorded with wind speeds in excess of 23 m/s, and 221 hours per year were recorded with wind speeds in excess of 16 m/s at the Tumbler Denison meteorological station.

Summary of Fugitive Dust Emissions

Hourly and annual fugitive dust emission rates are summarized in Tables 3-4 and 3-5, respectively. A review of these tables indicates that both on a short-term and annual basis, the tailings pond is the major source of fugitive coal dust. It is important to note that the maximum surface area of the tailings pond was used in the emission rate calculations and that the tailings pond does not reach this maximum size until year seven of operations. In other words, these predicted tailings pond erosion emissions may not occur until year seven of operation.

Table 3-4: Peak Fugitive Coal Dust Emission Summary for Wolverine Coal Mine Emission Sources

Emission Source	Description of Equipment	Particulate Emission Rates (g/s) for 1-hour period		
		TSP	PM_{10}	$PM_{2.5}$
Coal Transfers				
Loading Trucks at Pits with Coal[1]	Hydraulic Shovels, Front End Loader	0.926	0.438	0.138
Unloading Trucks with Coal at Plant Site[1]	186 t Haul Trucks	0.926	0.438	0.138
Plant and Pit Coal Clean-Up Operations	Bulldozers	29.5	9.06	0.266
Plant Site Coal Transfer[1]	Front End Loader, Reject Coal Haul Truck, Rail Loadout Surge Bin	1.43	0.675	0.212
Conveyor Transfers	Clean Coal Radial Stacker Conveyor, Train Loadout Conveyor	0.0677	0.0222	0.00628
Screening Operations				
Raw Coal Screening	Grizzly Screen	0.229	0.0792	0.00521

Stockpile Wind Erosion				
Wind Erosion from Coal Stockpiles[2]	J-Seam Raw Coal Stockpile, Upper Seam Raw Coal Stockpile, J-Seam Clean Coal Stockpile, Upper Seam Clean Coal Stockpile	342	171	68.4
Wind Erosion for Reject Coal Storage Pile[2]	Coarse Coal Reject Pile	1,750	876	350
Wind Erosion from Tailings Pond[2]	Tailings from Processing Plant	2,060	1,030	412
Total		**4,190**	**2,090**	**831**

Notes: 1. Transfer Emissions are based on mean hourly wind speed (5.9 m/s) as measured at the Tumbler Denison meteorological station. **2.** Wind Erosion Emissions are based on the maximum recorded mean hourly wind speed of 41 m/s measured at the Tumbler Denison meteorological station.

Table 3-5: Annual Fugitive Coal Dust Emission Summary for Wolverine Coal Mine Emission Sources (Mg/yr)

Emission Source	Description of Equipment	Annual Particulate Emission Rates (Mg/year)		
		TSP	**PM_{10}**	**$PM_{2.5}$**
Coal Transfers				
Loading Trucks at Pits with Coal[1]	Hydraulic Shovels, Front End Loader	4.54	2.15	0.674
Unloading Trucks with Coal at Plant Site[1]	186 t haul trucks	4.54	2.15	0.674
Plant and Pit Coal Clean-Up Operations	Bulldozers	658	202	5.93
Plant Site Coal Transfer[1]	Front End Loader, Reject Coal Haul Truck, Rail Loadout Surge Bin	6.59	3.12	0.980
Conveyor Transfers	Clean Coal Radial Stacker Conveyor, Train Loadout Conveyor	0.336	0.110	0.0312
Screening Operations				
Raw Coal Screening	Grizzly Screen	3.98	1.38	0.0905
Stockpile Wind Erosion				
Wind Erosion from Coal Stockpiles[2]	J-Seam Raw Coal Stockpile, Upper Seam Raw Coal Stockpile, J-Seam Clean Coal Stockpile, Upper Seam Clean Coal Stockpile	23.4	11.7	4.68
Wind Erosion for Reject Coal Storage Pile[2]	Coarse Coal Reject Pile	120	59.9	24.0
Wind Erosion from Tailing Pond[3]	Tailings from Processing Plant	1,640	819	327
Total		**2,460**	**1,100**	**356**

Notes: 1. Transfer Emissions are based on mean hourly wind speed (5.9 m/s) as measured at the Tumbler Denison meteorological station. **2.** Wind Erosion Emissions are based on gust wind speeds in excess of 23 m/s occurring for 19 hours of the year. **3.** Wind Erosion Emissions are based on gust wind speeds in excess of 16 m/s occurring for 221 hours of the year.

Discussion of Uncertainty

The emission factors from US EPA AP-42 used for the calculation of fugitive dust emission rates may or may not be conservative. Every effort was made to use site-specific correction parameters so that the highest data quality rating could be achieved, but there is still a large degree of uncertainty over the predicted emission rates. Mining operations were considered for the worst-case 1-hour period and include the majority of equipment operating continuously. This high level of activity is unlikely and therefore this is a conservative assumption.

3.3.2.3 Coal Dryer Emissions

The coal dryer that will be installed at the Wolverine Coal Project plant site consists of a fluidized bed with a scrubber and multiple dust cyclones. It is the same design and has the same capacity as the Bullmoose dryer and will have the same emission control equipment (scrubber and multiple dust cyclones). As a result, the emissions are anticipated to be very similar.

Estimated particulate emissions are based on the maximum Bullmoose coal dryer permit level of 100 mg/m^3 and the assumption that the dryer will operate approximately 6,200 hours per year. To account for a worst case scenario, particulate emission rates were calculated based on the maximum exhaust flow rate, 70.8 m^3/s, as provided by Cochrane Engineering.

Emissions of volatile organic compounds (VOC), sulphur oxides (SO_x), and nitrogen oxides (NO_x) were estimated using discharge factors (kg/tonne coal dried) published on the MWLAP website for coal-fired thermal dryers. To account for a worst case scenario, emission rates were calculated based on the maximum rate of coal to the dryer, 460 tonnes/hr, as provided by Cochrane Engineering. In place of raw coal, clean coal will now be used as fuel for the coal dryer. The heating value associated with clean coal is higher than that for raw coal; therefore less fuel will be required. Combustion emissions (NO_X, SO_X, and VOCs) are expected to decrease with the use of clean coal, however, MWLAP emission factors do not account for the type of fuel used. Therefore the emission rates calculated using these factors are likely greater than the actual emission rates of the coal dryer.

The SO_x emission rates presented in Table 3-6 assume a venturi scrubber control efficiency of 80% for coal with a sulphur content less than 0.5%. PM_{10} and $PM_{2.5}$ emission rates were calculated based on size fractions of TSP presented in AP-42.

Table 3-6: Summary of Short-Term & Annual Emission Rates for Coal Dryer

Emission Rates	TSP	PM_{10}[1]	$PM_{2.5}$[1]	VOC	SO_X	NO_X
Hourly Emissions (g/s)	7.08	6.16	2.69	6.39	5.62	8.94
Annual Emissions (Mg/yr)	158	138	60.0	143	126	200

Notes: 1. Conversion from TSP based on AP-42 Combustion of Anthracite Coal from multiple cyclone emission.

3.3.3 Dispersion Modelling

3.3.3.1 Assessment Approach

WCC and the owners of the Terry Ranch have negotiated an agreement of non-occupancy on the Terry Ranch property. Since the Terry Ranch is no longer considered a receptor of concern and there are no other sensitive receptors within 10 km of the site, fugitive dust emissions were not modelled. However, modelling of the coal dryer was performed to predict maximum ground-level concentrations in an area with a radius of 10 km centred on the Wolverine plant site.

3.3.3.2 Ambient Air Quality Objectives

As a measure of the air quality in a region, ground-level concentrations are compared to air quality objectives. Air quality objectives are developed by environmental and health authorities to provide guidance for environmental protection decisions. They are based on scientific studies that consider the effects of the contaminant on such receptors as humans, wildlife, vegetation, as well as aesthetic qualities such as visibility. National and provincial air quality objectives for particulate are listed in Table 3-7. It is of note that the air quality objectives for particulate matter are for 24-hour or annual averaging periods only. Air quality objectives for nitrogen dioxide and sulphur dioxide are presented in Table 3-8.

Table 3-7: National & Provincial Ambient Air Quality Objectives & Standards for Particulate

	Objectives/ Standards	Level	24-Hour (ug/m^3)	Annual Geometric Mean (ug/m^3)
Total Suspended Particulate (TSP)	National	Maximum Desirable Maximum Acceptable Maximum Tolerable	-- 120 400	60 70 --
	British Columbia	Level A Level B Level C	150 200 260	60 70 75
PM_{10}[(a)]	Provincial B.C. MWLAP (PM_{10})[(a)]	Objective	50	--
$PM_{2.5}$	Canada-Wide Standard	Target[(b)]	30	--

Notes: (a) B.C. Ministry of Water, Land and Air Protection. **(b)** 98th percentile annual ambient measurement, averaged over 3 consecutive years.

Table 3-8: National & Provincial Ambient Air Quality Objectives for NO_2 & SO_2

	Objectives/ Standards	Level	1-Hour (ug/m^3)	3-Hour (ug/m^3)	24-Hour (ug/m^3)	Annual (ug/m^3)
NO_2	National	Maximum Desirable	-	-	-	60
		Maximum Acceptable	400	-	200	100
		Maximum Tolerable	1,000	-	300	-
SO_2	National	Maximum Desirable	450	-	150	30
		Maximum Acceptable	900	-	300	60
		Maximum Tolerable	-	-	800	-
	British Columbia	Level A	450	375	160	25
		Level B	900	665	260	50
		Level C	900-1,300	-	360	80

3.3.3.3 SCREEN3 Dispersion Modelling

As a first estimate, emissions from the coal dryer were modelled using SCREEN3. The modelling results showed that there is the possibility that ambient air quality objectives might be exceeded, particularly in the elevated terrain immediately to the northwest of the coal dryer location. This assessment indicated the need to perform refined modelling to more accurately determine dispersion of coal dryer emissions.

3.3.3.4 Refined Dispersion Modelling

Refined dispersion modelling was conducted using CALPUFF (Scire et al, 2000), a multi-layer, multi-species, non-steady-state puff dispersion model that can simulate the effects of time- and space-varying meteorological conditions on pollutant transport, transformation, and deposition. CALPUFF can use the three-dimensional meteorological fields developed by CALMET model, or simple, single station winds in a format consistent with the meteorological files used to drive the ISCST3 steady-state Gaussian model.

CALPUFF contains algorithms for near-source effects such as building downwash, transitional plume rise, partial plume penetration, sub-grid scale terrain interactions as well as longer-range effects such as pollutant removal (wet scavenging and dry deposition), chemical transformation, vertical wind shear, over-water transport, and coastal interaction effects. It can accommodate arbitrarily varying point source and gridded area source emissions. Most of the algorithms contain options to treat the physical processes at different levels of detail depending on the model application.

For this assessment, CALPUFF was applied in ISC mode, using a single site-specific ISC formatted meteorological file. This simplified approach allows the modeller to use the plume dispersion algorithms contained in the model without having to develop fully 3-dimensional wind fields. This also allows the modeller to use one model for all terrain receptors rather than splitting receptors among ISC and RTDM as is commonly done for assessments in complex terrain within B.C.

3.3.3.5 Conversion of NO_X to NO_2

The ratio of NO_2 to NO_X emissions from the coal dryer is uncertain. The extent of chemical transformation in the atmosphere also adds to the uncertainty of the NO_X to NO_2 ratio. Three methods were used to determine the amount of NO_2 in the coal dryer plume: Total Conversion Method (TCM), Ozone Limiting Method (OLM), and the Ambient Ratio Method (ARM).

Total Conversion Method

This is the most conservative approach for assessing the conversion of NO_X to NO_2. This method assumes that all NO_X emissions are converted to NO_2.

Ozone Limiting Method

Using the ozone (O_3) limiting method, a factor of 0.10 is assumed for the thermal conversion of NO_X to NO_2 for the coal dryer. If the remaining concentration of NO_X is less than the ozone concentration, then it is assumed that 100% of the NO_X is converted to NO_2 according to the following equation:

$$NO_2 = NO_X \qquad \text{for } 0.9NO_X \leq O_3$$

However, if the concentration of NO_X is greater than that of ozone, then ozone is the limiting factor and the following relationship is applied:

$$NO_2 = 0.1NO_X + O_3 \qquad \text{for } 0.9NO_X > O_3$$

It should be noted that this method assumes that the peak NO_2 concentrations occur when adverse dispersion and high ozone concentrations occur simultaneously, which may be a conservative assumption.

A 50 ppb ozone concentration for Northern British Columbia was estimated from the MWLAP report on the Status and Trends in Ground Level Ozone in British Columbia (Annual 4^{th} Highest 8-hour daily maximum ozone concentrations averaged for 1998 – 2000). The report notes that most jurisdictions have switched from a one-hour maximum to the 4^{th} highest 8-hour daily maximum to account for longer periods of exposure rather than single high events.

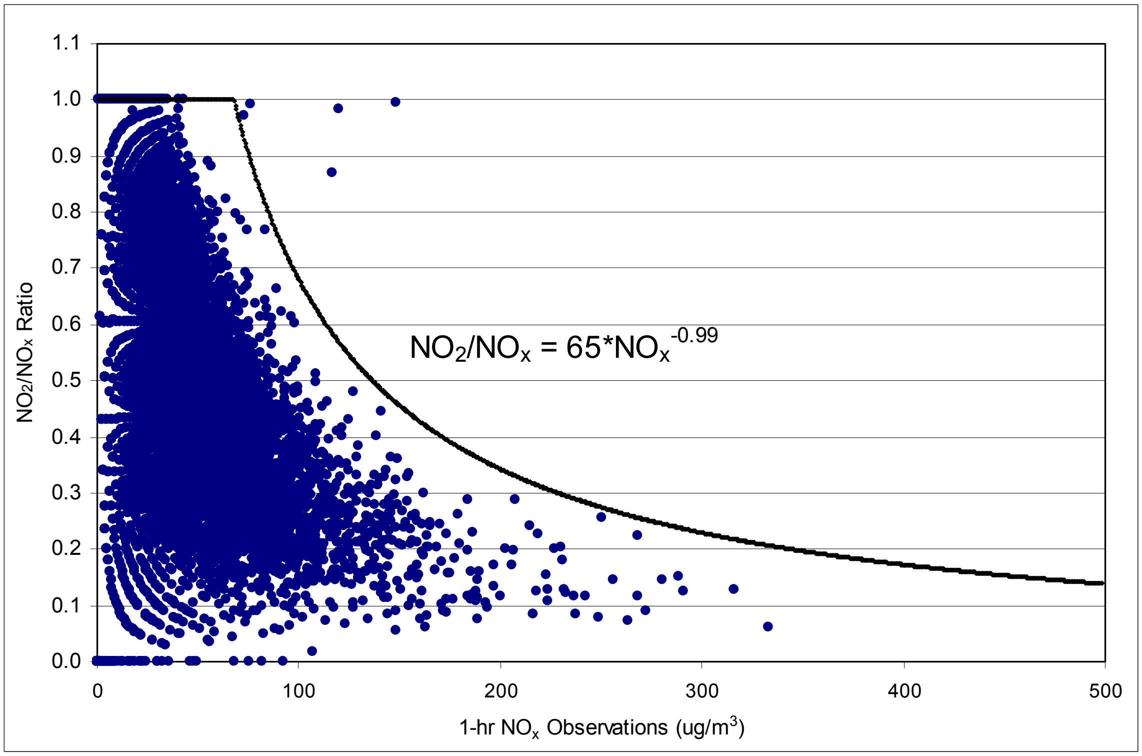
Ambient Ratio Method

The ambient ratio method (ARM) relies on obtaining an estimate of the NO_2/NO_x ratio based on representative ambient observations. Use of the ARM requires at least one year of NO_X and NO_2 monitoring data within the airshed. This data is used to derive an empirical relationship between NO_X and NO_2 which is applied to the model predicted NO_X concentration.

The ARM requires representative and preferably site-specific NO_X and NO_2 data, however, site-specific data were not available. The closest monitoring station with NO_X and NO_2 instruments is the Taylor Town Site, located approximately 130 km from the Wolverine mine. Hourly NO and NO_2 measurements were obtained from the Taylor Town Site for the period from April of 1996 to January of 2002, almost six years in total.

The ratio of NO_2/ NO_x versus total NO_x based on these data is shown in Figure 3.3-1. For the ARM, an exponential curve was fitted to the upper-envelope of observed NO_2/NO_x versus NO_x scatter points. For the case of low NO_x concentrations, up to a set threshold, 100% conversion from NO_x to NO_2 was assumed. For higher NO_x concentrations, an exponential relationship was adopted as per the equation shown on Figure 3.3-1.

Figure 3.3-1: Ambient NO_X to NO_2 Ratio



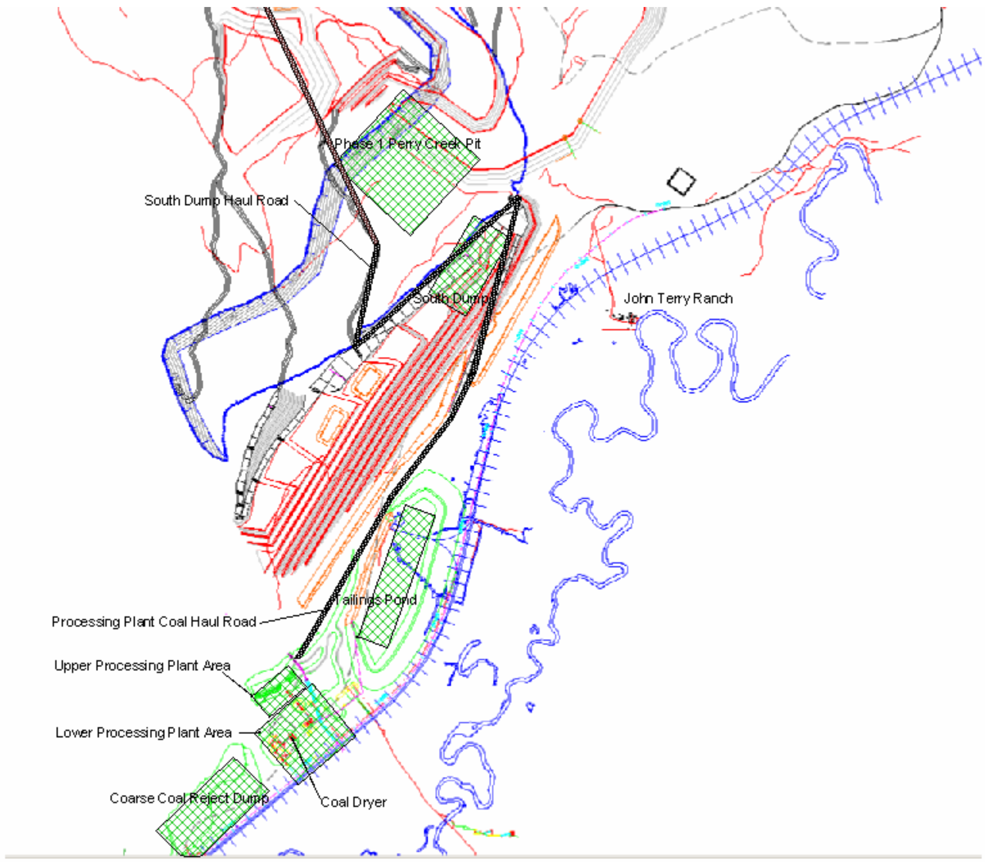
3.3.3.6 Coal Dryer Exhaust Parameters

A summary of the coal dryer stack parameters used in the modelling is presented in Table 3-9. The location of the coal dryer within the site plan is shown in Figure 3-2.

Table 3-9: Coal Dryer Stack Parameters

Coal Dryer Stack Parameters	
Stack Diameter	2.219 m
Exhaust Flow Rate	70.8 m^3/s
Exhaust Exit Velocity	18.3 m/s
Exhaust Exit Temperature	328 K
Height of Stack	39 m above grade

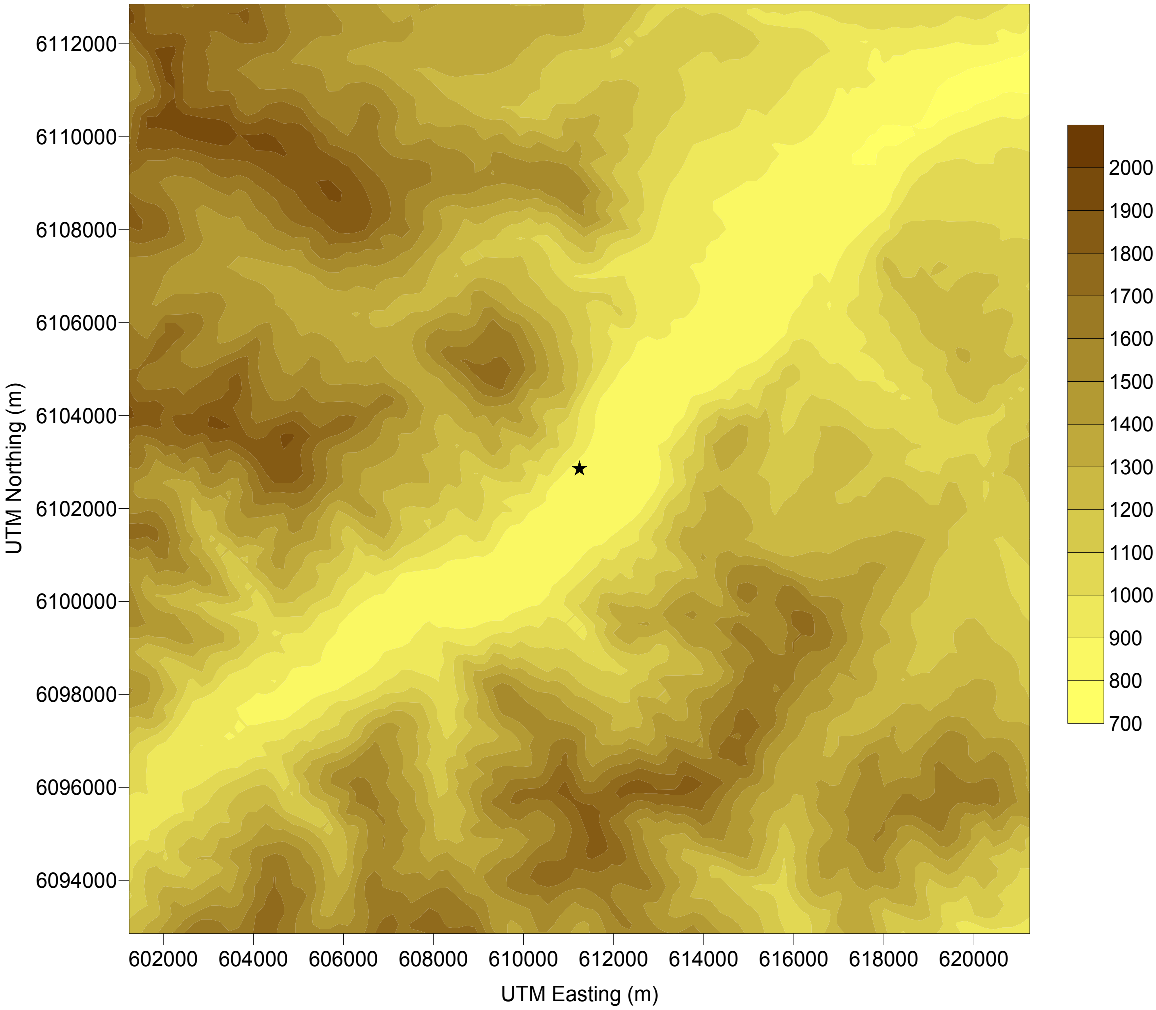
Figure 3.3-2: Location of Coal Dryer



3.3.3.7 Model Domain

The model domain is shown in Figure 3.3-3. It extends 10 km in both the east-west and north-south directions from the coal dryer location. The dominant terrain feature is the Perry Creek basin running from the southwest to the northeast of the domain. Highest terrain is to the northwest of the coal dryer.

Figure 3.3-3: Model Domain



★ Coal Dryer Location (UTM Zone 10 611240E 6102855N)

Note: Colour scale gives elevation above sea level in metres

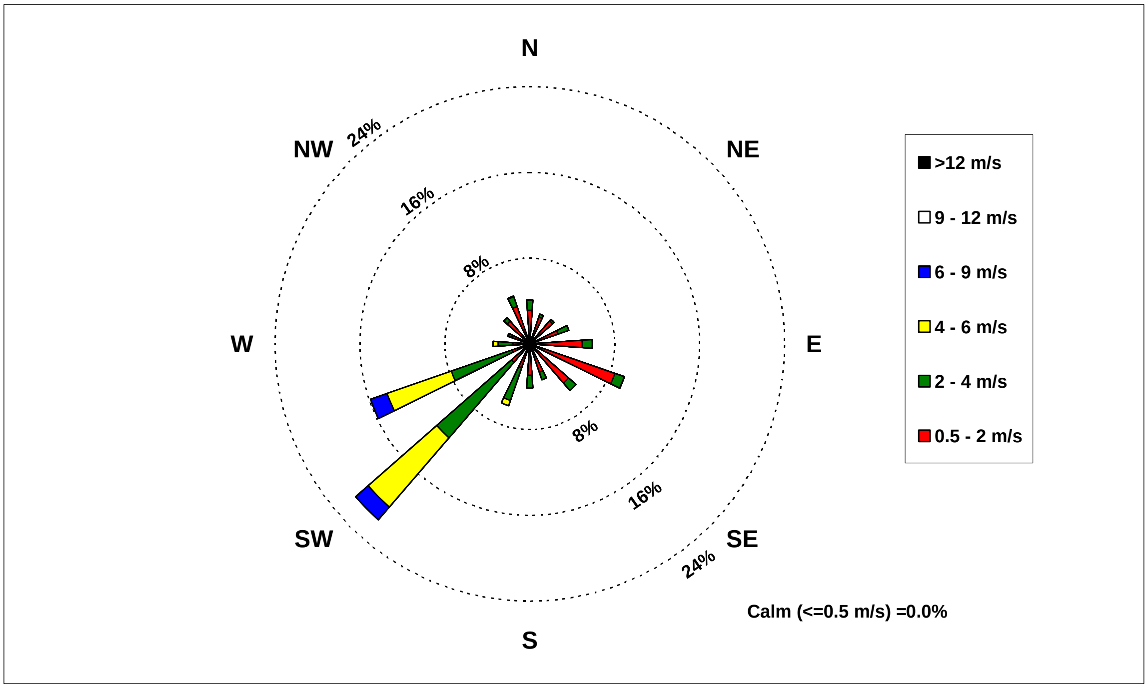
3.3.3.8 Meteorology

There is a paucity of meteorological data that is suitable for modelling available for this region of B.C. In consultation with MWLAP, data from Tumbler Ridge was deemed most suitable. This data covers a span of 9,228 hours from October 1993 to November 1994. A wind rose showing the distribution of wind speed and direction from Tumbler Ridge is shown in Figure 3.3-4. Dominant wind directions are from the southwest and west-southwest, with a secondary influence from the east-southeast. Maximum wind speeds are associated with a south-westerly component, while lower wind speeds are observed for winds with an easterly component.

The prevailing wind direction in Tumbler Ridge is fairly well aligned with the Perry Creek Basin. As such, no rotation of the wind directions in the Tumbler Ridge data was performed.

As per MWLAP protocol, hourly mixing heights were calculated using the ‘plume height plus one’ method based on the coal dryer emission parameters.

Figure 3.3-4: Wind Rose of Tumbler Ridge Data, October 1993 to November 1994



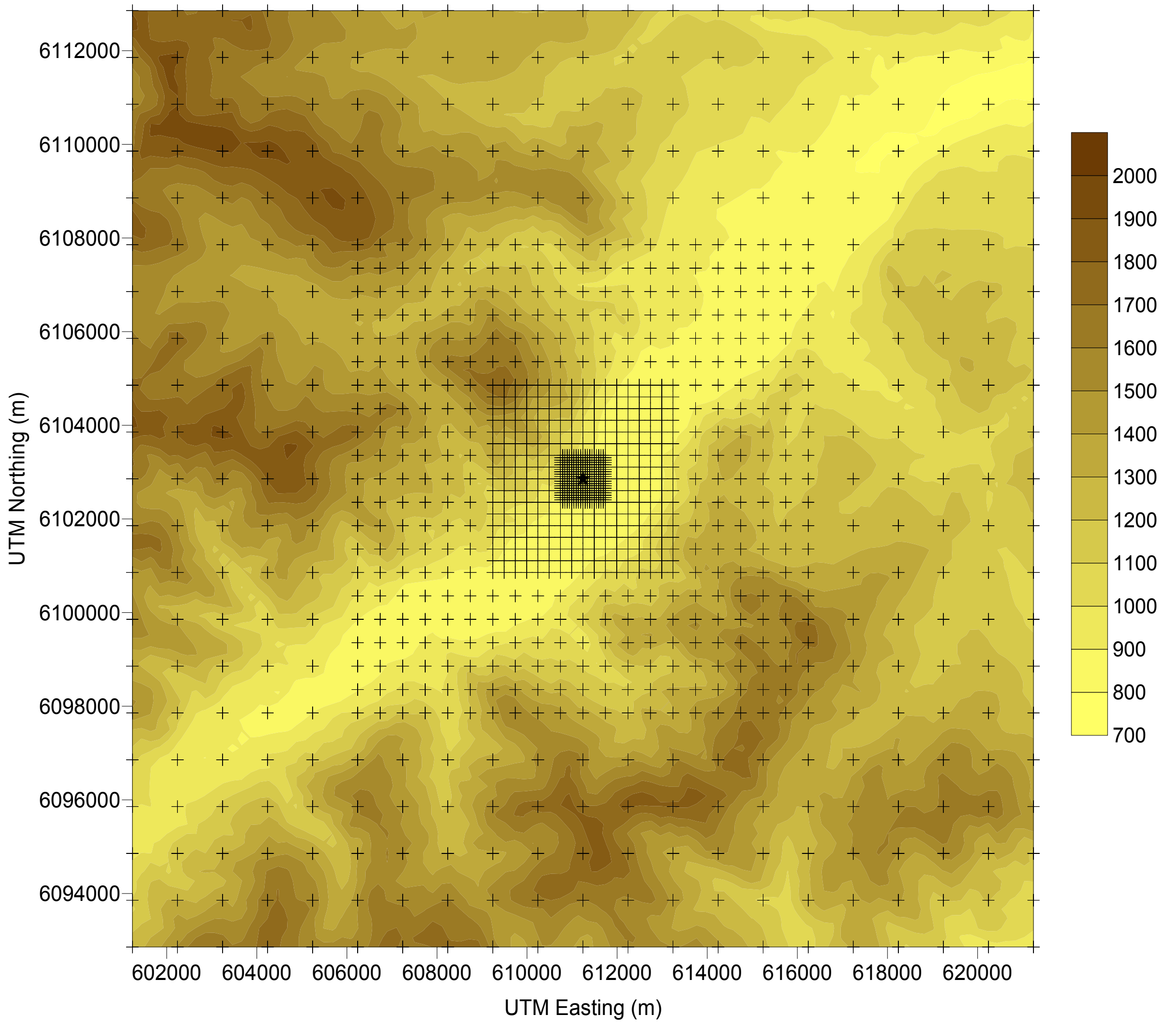
3.3.3.9 Receptors

A total of 1,384 receptors were placed at ground level in a nested grid centered on the coal dryer. The grid spacing was set as follows:

- 50 m spacing within 500 m of the coal dryer,
- 250 m spacing within 2 km of the coal dryer
- 500 m spacing within 5 km of the coal dryer
- 1000 m spacing from 5 to 10km from the coal dryer.

The receptor grid is shown overlain on the model domain in Figure 3.3-5.

Figure 3.3-5: Receptor Grid



★ Coal Dryer Location (UTM Zone 10 611240E 6102855N)

Note: Colour scale gives elevation above sea level in metres

3.3.3.10 Modelling Results

Maximum 1-hour, 24-hour, and annual average concentrations resulting from coal dryer emissions are presented in Tables 3-10, 3-11, and 3-12, respectively. These tables reflect results of applying the Total Conversion Method, which results in the highest concentrations, for both NO_2 and SO_2. The predicted concentrations are compared to the most stringent air quality objectives in British Columbia to demonstrate their relative impact.

Table 3-10: Summary of Predicted Worst-Case Hourly Concentrations from Coal Dryer Emissions

Contaminant	Maximum Predicted 1-hr Concentration (μg/m^3)	1-hr Objective (μg/m^3)	Frequency of Objective Exceedance (hrs/yr)
TSP	496	-	-
PM_{10}	431	-	-
$PM_{2.5}$	188	-	-
VOC	447	-	-
NO_2	626[c]	400[a]	1.30%
SO_2	394	450[b]	0%

Notes: a) Maximum acceptable objective. The maximum tolerable objective is 1,000 μg/m^3. **b)** Maximum desirable objective. **c)** Total Conversion Method.

Table 3-11: Summary of Predicted Worst-Case 24-Hour Concentrations from Coal Dryer Emissions

Contaminant	Maximum Predicted 24-hr Concentration (μg/m^3)	24-hr Objective (μg/m^3)	Frequency of Objective Exceedance (hrs/yr)
TSP	105	120	0%
PM_{10}	91.5	50	0.11%
$PM_{2.5}$	27.3[c]	30[d]	0%
VOC	94.9	-	-
NO_2	133[e]	200[a]	0%
SO_2	83.5	150[b]	0%

Notes: a) Maximum acceptable objective. **b)** Maximum desirable objective. **c)** 98th percentile 24-hour predicted concentration. **d)** 98th percentile annual ambient measurement, averaged over 3 consecutive years. **e)** Total Conversion Method.

Table 3-12: Summary of Predicted Worst-Case Annual Concentrations from Coal Dryer Emissions

Contaminant	Maximum Predicted Annual Concentration (μg/m^3)	Annual Objective (μg/m^3)	Frequency of Objective Exceedance (hrs/yr)
TSP	10.4	60	0%
PM_{10}	9.03	-	-
$PM_{2.5}$	3.94	-	-
VOC	9.36	-	-
NO_2	13.1[a]	60	0%
SO_2	8.24	25	0%

Notes: a) Total Conversion Method.

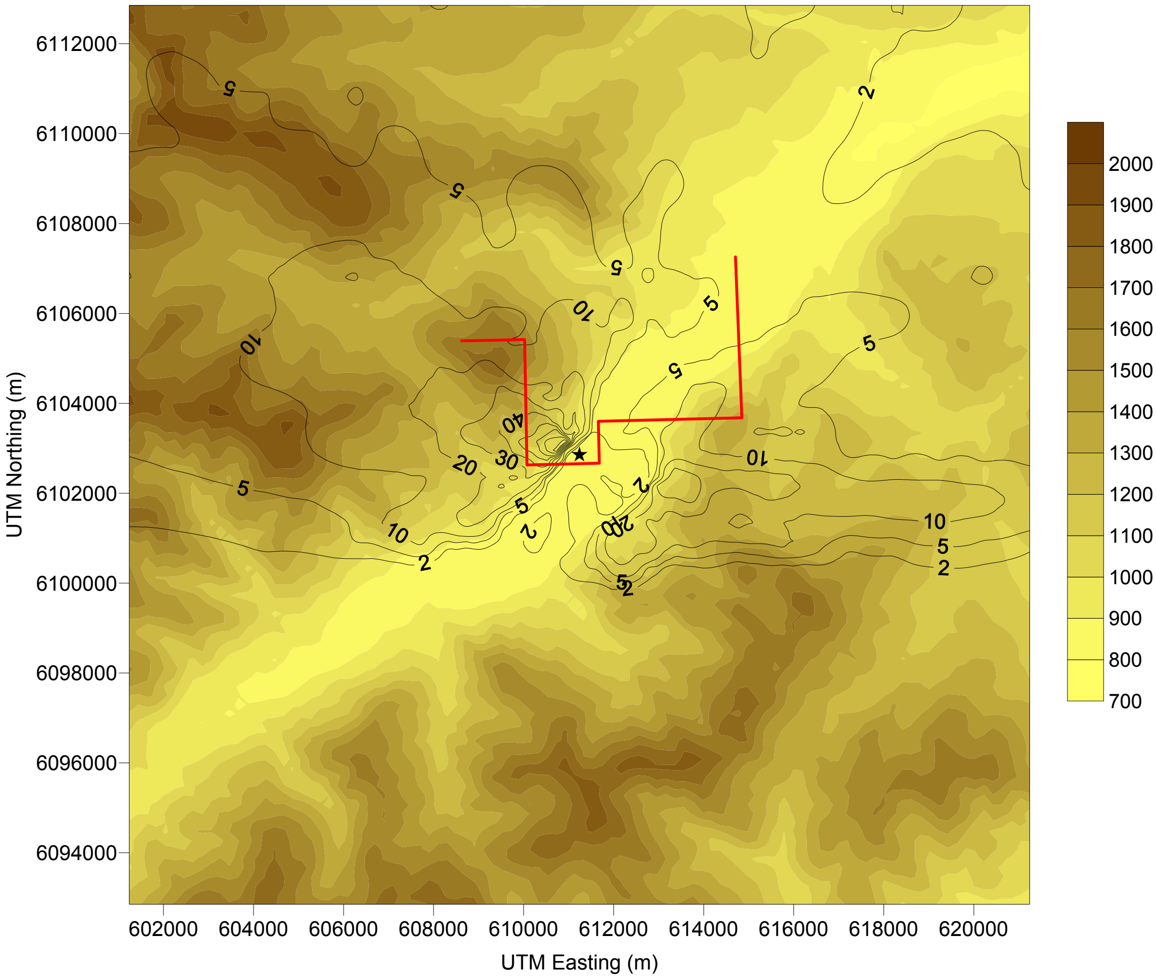
Particulates

There are daily and annual objectives for TSP whereas there are only daily objectives or standards for PM_{10} and $PM_{2.5}$. Daily and annual average particulate concentrations are presented in Tables 3-11 and 3-12, respectively. Figures 3.3-6, 3.3-7, and 3.3-8 show the maximum predicted 24-hour TSP, PM_{10}, and $PM_{2.5}$ concentrations, respectively.

The maximum predicted 24-hour and annual average TSP concentrations are less than the corresponding ambient air quality objectives. Also, the highest 98th percentile 24-hour $PM_{2.5}$ concentration is less than the Canada Wide Standard (CWS).

The maximum predicted 24-hour PM_{10} concentration, equal to 91.5 $\mu g/m^3$, is greater than the provincial objective of 50 $\mu g/m^3$. However, Figure 3.3-6 shows that the area of exceedence is small and limited to the elevated terrain to the immediate northwest of the coal dryer location within the boundaries of the Perry Creek coal license lease. No exceedences are predicted to occur beyond the lease boundary. Furthermore, the maximum predicted frequency of exceedence of the 24-hour PM_{10} objective is only 0.11%, which corresponds to approximately 10 hours per year.

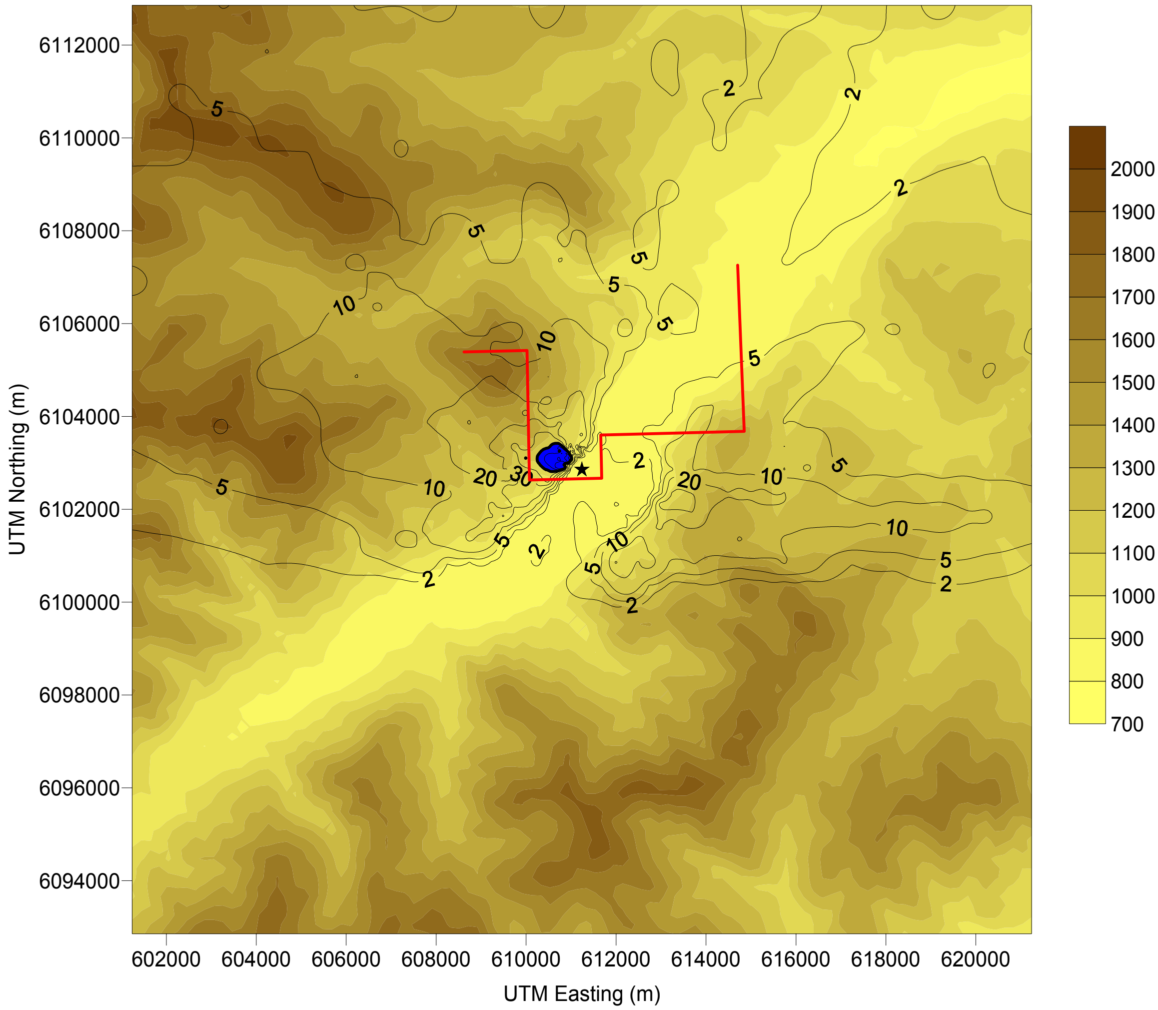
Figure 3.3-6: Maximum Predicted 24-hour TSP Concentrations (μg/m³)



★ Coal Dryer Location (UTM Zone 10 611240E 6102855N)

Note: Colour scale gives elevation above sea level in metres. Perry Creek lease boundary shown in red.

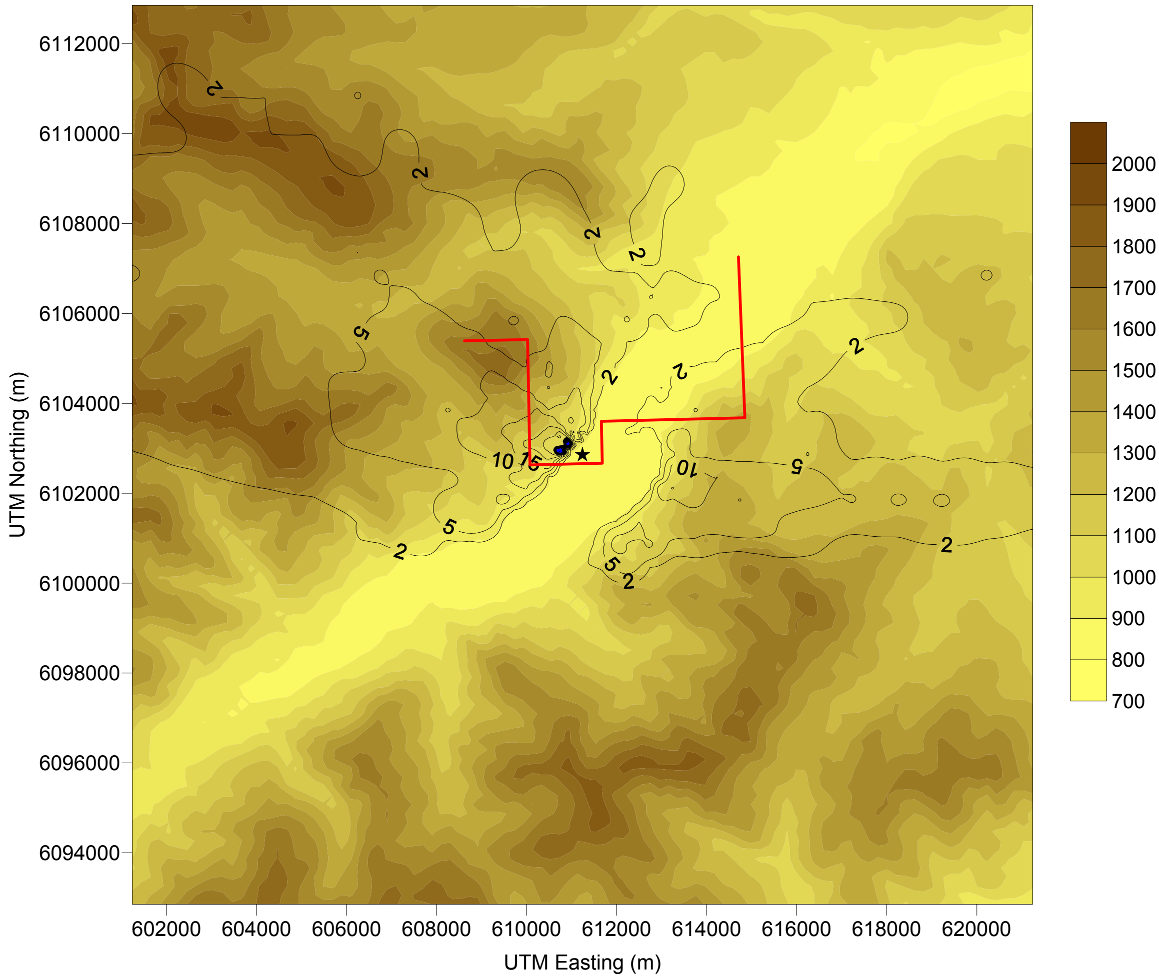
Figure 3.3-7: Maximum Predicted 24-hour PM_{10} Concentrations (µg/m^3)



★ Coal Dryer Location (UTM Zone 10 611240E 6102855N)

Note: Colour scale gives elevation above sea level in metres. Predicted PM_{10} values greater than 50 µg/m^3 are shown in blue. Perry Creek lease boundary shown in red.

Figure 3.3-8: Maximum Predicted 24-hour $PM_{2.5}$ Concentrations (μg/m³)



★ Coal Dryer Location (UTM Zone 10 611240E 6102855N)

Note: Colour scale gives elevation above sea level in metres. Perry Creek lease boundary shown in red.

Volatile Organic Compounds

Maximum predicted 1-hour, 24-hour and annual average VOC concentrations are presented in Tables 3-10, 3-11, and 3-12 respectively. There are no provincial or national VOC objectives that can be used to assess the impact of the maximum predicted concentrations.

Nitrogen Dioxide

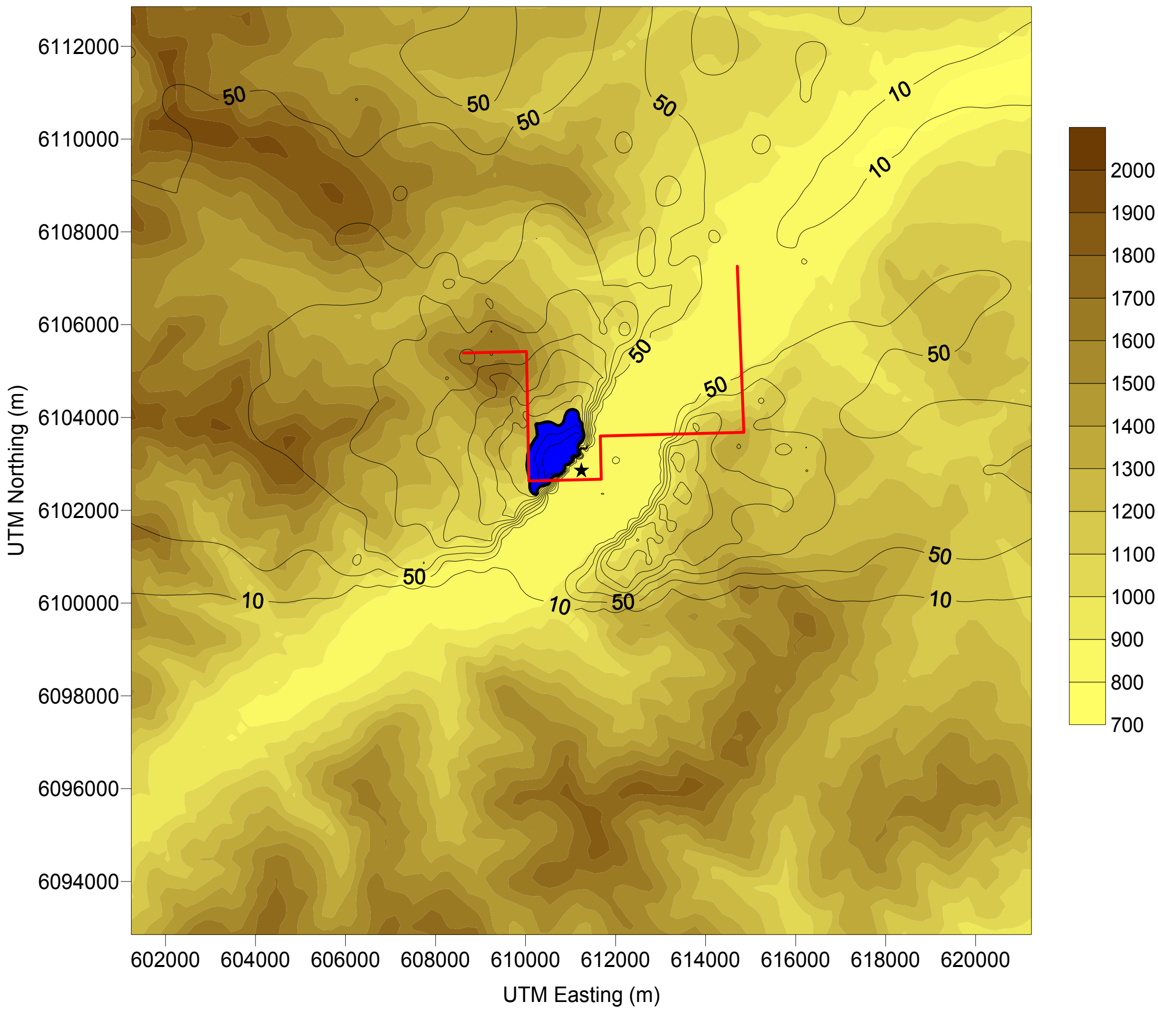
As discussed in the methodology section, three methods were used to convert maximum predicted ground-level NO_x concentrations to NO_2 concentrations: the Total Conversion Method, the Ozone Limiting Method, and the Ambient Ratio Method. The results of the three methods are presented in the following sub-sections.

Total Conversion Method

Table 3-10 shows that the maximum 1-hour NO_2 concentration predicted using the Total Conversion Method, equal to 626 µg/m^3, is greater than the maximum acceptable objective (400 µg/m^3) but less than the maximum tolerable objective (1,000 µg/m^3). The maximum frequency of exceedence of the 1-hour NO_2 objective is 1.30%, which corresponds to about 114 hours per year. Tables 3-11 and 3-12 show that the 24-hour and annual NO_2 objectives are not exceeded.

Maximum predicted 1-hour NO_2 concentrations, based on the Total Conversion Method, are shown Figure 3.3-9. Throughout the majority of the model domain, predicted 1-hour concentrations are less than 50 µg/m^3, with higher concentrations occurring over the valley slopes to the east and west of the coal dryer location. Blue shaded areas indicate exceedences of the 1-hour NO_2 maximum acceptable objective of 400 µg/m^3. Exceedences are limited to the elevated terrain to the northwest of the coal dryer. For reference, the boundary of the Perry Creek coal license lease in the vicinity of the coal dryer is shown in red. The plot shows that the region where predicted NO_2 concentrations exceed the maximum acceptable 1-hour objective is small and is located close to the coal dryer. Of all the receptors for which exceedences of the 1-hour NO_2 guideline are predicted, only one lies outside of the Perry Creek coal license lease, and the frequency of exceedence at this receptor is only one hour of 9,228 hours modelled. WCC has verified that 25% of the area where NO_2 exceedences are predicted to occur will be cleared for mine construction and operations.

Figure 3.3-9: ***Maximum Predicted 1-hour NO_2 Concentrations (µg/m^3) (Total Conversion Method)***



★ Coal Dryer Location (UTM Zone 10 611240E 6102855N)

Note: Colour scale gives elevation above sea level in metres. Predicted NO_2 values greater than 400 µg/m^3 are shown in blue. Perry Creek lease boundary shown in red.

Ozone Limiting Method

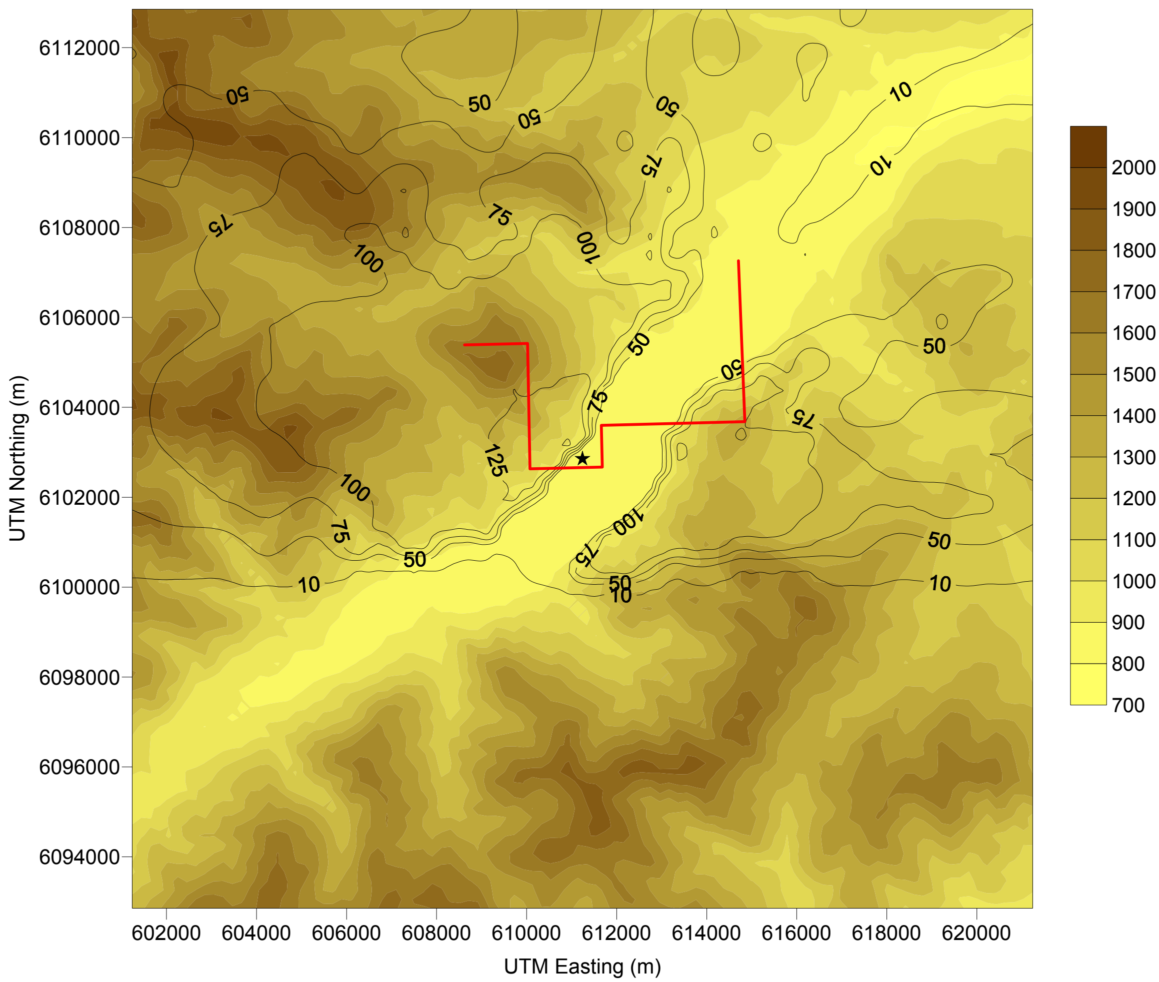
Maximum 1-hour NO_2 concentrations predicted using the three methods of NO_x to NO_2 conversion are compared in Table 3-13. Using the OLM method and an ozone concentration of 50 ppb, the maximum predicted 1-hour NO_2 concentration is 157 µg/m^3. This predicted concentration is well below the maximum acceptable objective of 400 µg/m^3. Maximum predicted 1-hour NO_2 concentrations, based on the OLM, are shown Figure 3.3-10. Predicted concentrations are less than 50 µg/m^3 throughout the majority of the domain.

Table 3-13: Comparison of Maximum Predicted 1-hour NO_2 Concentrations using Three NO_x to NO_2 Conversion Methods

NO_x to NO_2 Conversion Method	Maximum Predicted 1-hr NO_2 Concentration (μg/m^3)	1-hr Objective (μg/m^3)	Frequency of Objective Exceedance (hrs/yr)
Total Conversion Method	626	400[a]	1.30%
Ozone Limiting Method	157	400[a]	0%
Ambient Ratio Method	130	400[a]	0%

Notes: a) Maximum acceptable objective.

Figure 3.3-10: Maximum Predicted 1-hour NO_2 Concentrations (μg/m^3) (Ozone Limiting Method)



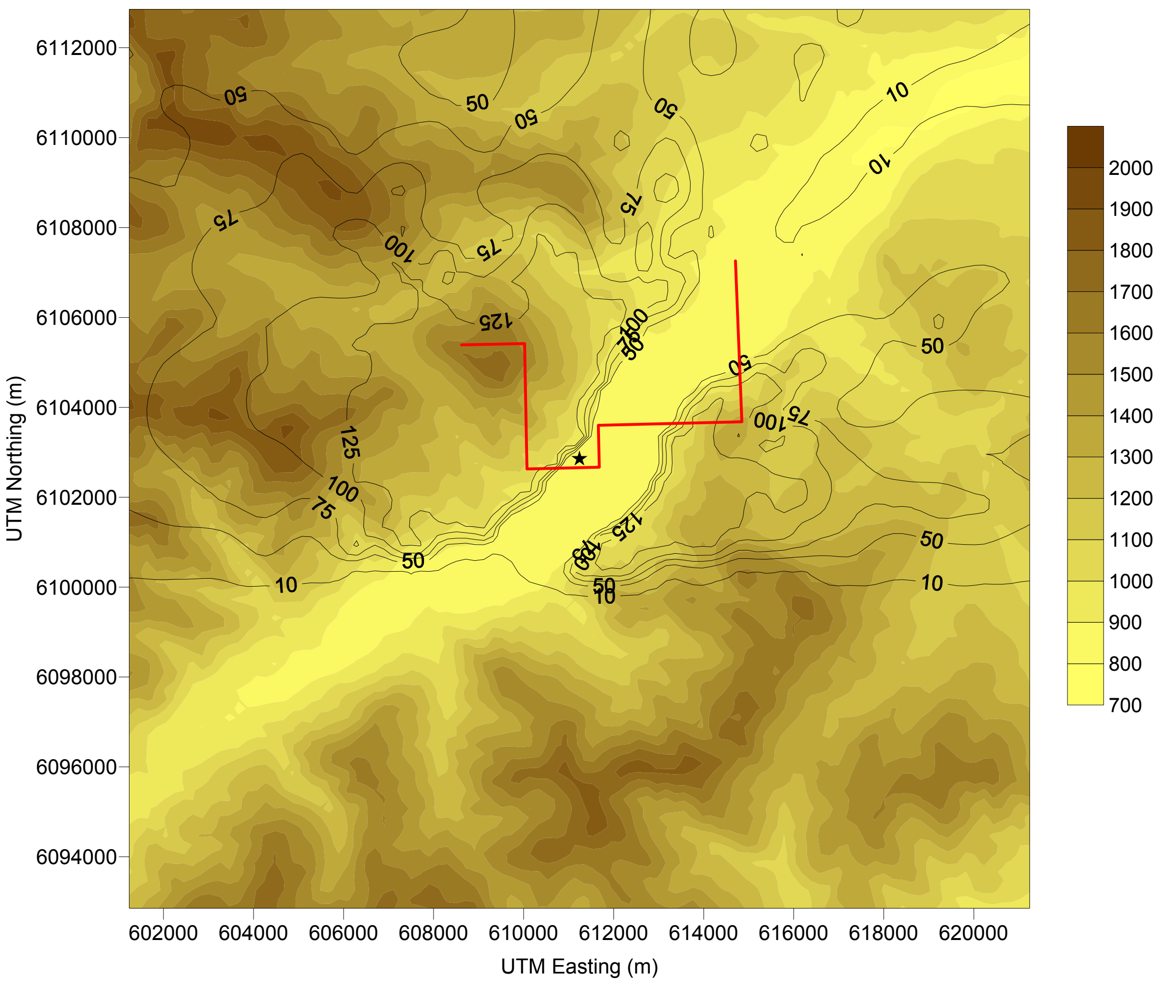
★ Coal Dryer Location (UTM Zone 10 611240E 6102855N)

Note: Colour scale gives elevation above sea level in metres. Perry Creek lease boundary shown in red.

Ambient Ratio Method

Using the ARM method, the maximum predicted 1-hour NO_2 concentration is 130 µg/m^3. This predicted concentration is well below the maximum acceptable objective of 400 µg/m^3. Maximum predicted 1-hour NO_2 concentrations, based on the ARM, are shown on Figure 3.3-11. Predicted concentrations are less than 50 µg/m^3 throughout the majority of the domain.

Figure 3.3-11: Maximum Predicted 1-hour NO_2 Concentrations (µg/m^3) (Ambient Ratio Method)



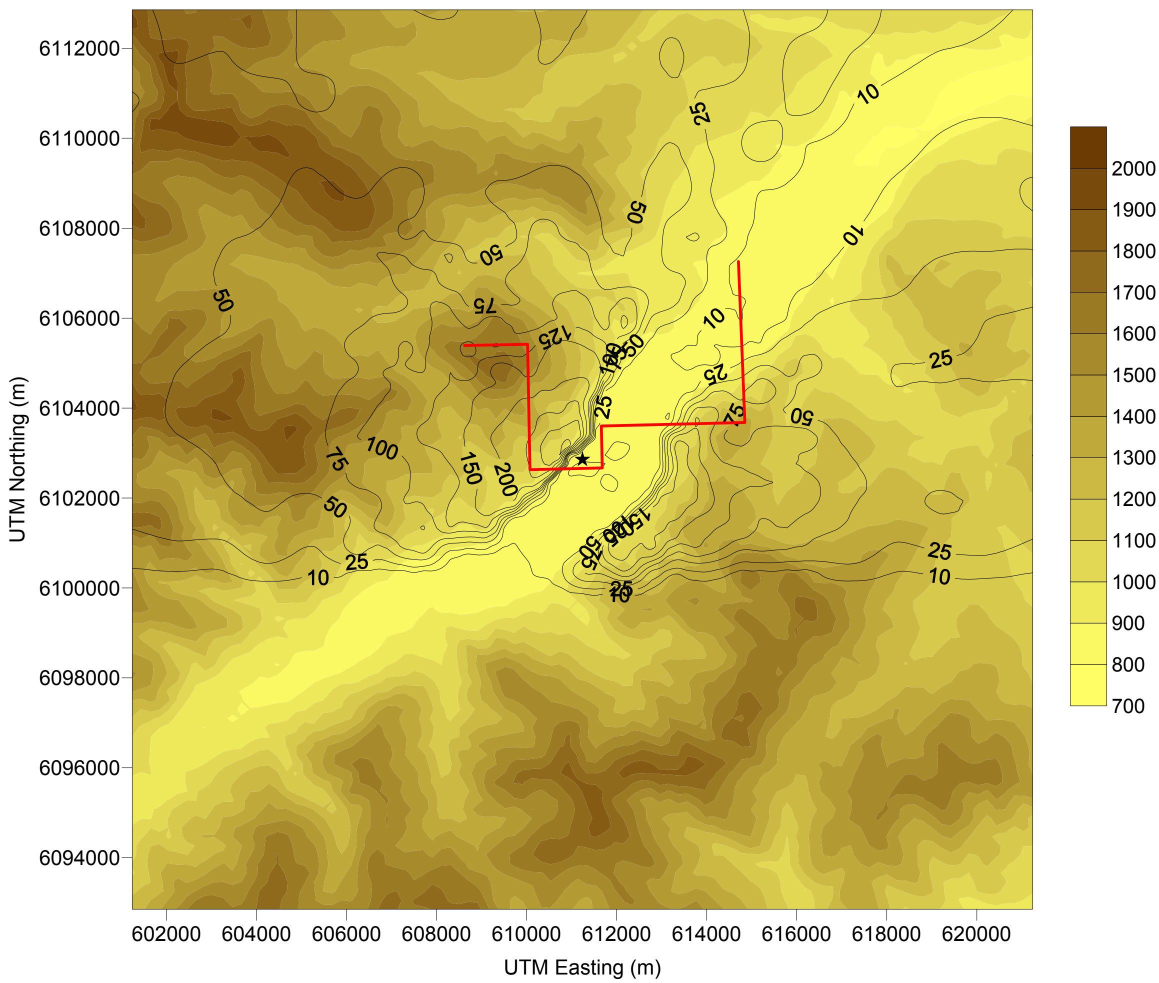
★ Coal Dryer Location (UTM Zone 10 611240E 6102855N)

Note: Colour scale gives elevation above sea level in metres. Perry Creek lease boundary shown in red.

Sulphur Dioxide

As shown in Tables 3-10, 3-11, and 3-12, maximum model predictions of SO_2 are less than the most stringent 1-hour, 24-hour, and annual ambient air quality objectives. Maximum predicted 1-hour SO_2 concentrations are plotted in Figure 3.3-12. As was the case for NO_2, maximum concentrations are predicted to occur on the valley slopes to the east and west of the coal dryer location.

Figure 3.3-12: Maximum Predicted 1-hour SO_2 Concentrations (µg/m^3)



★ Coal Dryer Location (UTM Zone 10 611240E 6102855N)

Note: Colour scale gives elevation above sea level in metres. Perry Creek lease boundary shown in red.

Discussion of Uncertainty

There is some uncertainty in the modelling due to the meteorology used. Though the Tumbler Ridge data set was deemed most appropriate, it is from another location. As such it will include variations that are due to the specific terrain characteristics of the actual measurement location and will similarly not include any estimation of local terrain influences within the Perry Creek valley. The Tumbler Ridge meteorology does allow for some estimation of the relative frequency of wind conditions and predicted concentrations and thus does allow for a more detailed assessment than screening meteorology, but it is important to place this information in the context that the Tumbler Ridge data represent the most suitable analogue to Perry Creek meteorology rather than an exact replica.

In particular, the highest predicted concentrations are associated with a relatively frequent easterly and when placed within Perry Creek at the coal dryer site, this uphill wind component causes the model plume to impact on the elevated terrain to the west-northwest of the coal dryer. It is possible that wind data actually measured at the coal dryer location would not contain a similar frequency of easterly uphill winds. However, the only way to determine the actual wind distribution at the Perry Creek site is to perform meteorological monitoring at the site.

3.3.4 Impact Assessment

3.3.4.1 Wolverine Coal Mining Project Air Emissions

Air quality impacts need to be considered for all phases of the Wolverine Coal Mining Project including the construction, operation, closure, and post-closure phases. The mining operation phase will be the major contributor to the project air emissions. The construction phase will contribute some air emissions from the operation of diesel or gasoline powered construction equipment to build roads, prepare the plant site and construct the coal dryer and processing plant. These emissions will be minimal when compared to the air emissions estimated in Section 3.3.2 and will occur for a much shorter duration. Post-closure of the Wolverine Coal Mine will have some activity related to reclamation and monitoring, but these activities also have minimal emissions compared to mining operations. At the closure of the project, when all erodible surfaces that may be sources of fugitive dust emissions have been stabilized, air emissions will for all practical purposes cease.

3.3.4.2 Fugitive Coal Dust

Fugitive coal dust emissions from mining operations are ground-based releases. Since the transport potential of ground-based releases is low, coal dust emissions will have only localized effects and should not contribute significantly to possible degradation of the airshed. An air quality management plan has been outlined to control emissions during mining operations. Dustfall will be monitored around the site as a method of determining the effectiveness of the air quality management plan. The air quality management plan and dustfall monitoring program are outlined in Sections 3.3.6 and 3.7 respectively.

3.3.4.3 Coal Dryer Emissions

Particulates

The modelling suggests that there is a limited possibility that emissions from the coal dryer may result in exceedances of the 24-hour objective for PM_{10}. However, the frequency of the exceedances is relatively low and the area where exceedances are predicted is limited. All receptors where exceedances are predicted are within the mine lease boundary. Therefore the potential impact of PM_{10} emissions from the coal dryer on human health is considered to be low.

Nitrogen Dioxide

The modelling suggests that there is a limited possibility that emissions from the coal dryer may result in exceedences of the 1-hour maximum acceptable objective for NO_2. As with the PM_{10} results, the frequency of the exceedences is relatively low and the area where exceedences are predicted is limited. All but one receptor where exceedences are predicted are located within the Perry Creek lease. WCC has verified that 25% of the area where NO_2 exceedences occur will be cleared for mine construction and operations.

The emission factors used to calculate the NO_X emission rate from the coal dryer entail a level of uncertainty. The emission factors are based upon the amount of coal dried and do not consider the amount or type of fuel used for combustion. WCC has changed their coal dryer fuel from raw coal to clean coal. This fuel change should result in reduced combustion emissions (including NO_X) however one cannot account for this reduction using the MWLAP emission factors as they are independent of coal type.

As mentioned previously, there is also some uncertainty in the modelling due to the meteorology used. In particular, NO_2 impacts are associated with a relatively frequent easterly while it may be possible that wind data actually measured at the coal dryer location would not contain a similar frequency of easterly uphill winds.

The NO_2 model predictions are based on the very conservative assumption that all NO_x will be converted to NO_2. In reality, the conversion would likely not be complete. If the conversion of NO_x to NO_2 is calculated using the ozone limiting method or the ambient ratio method, NO_2 concentrations are not predicted to exceed the 1-hour maximum acceptable objective.

Since residences do not exist within a 10 km area surrounding the site, effects on vegetation from NO_2 emissions is the prime concern. The United Nations Economic Commission for Europe has set a NO_2 guideline based on vegetation effects. The guideline limit is 29 $\mu g/m^3$ based on an annual average. The maximum predicted annual NO_2 concentration of 13.1$\mu g/m^3$, based on the conservative Total Conversion Method, is well below this vegetation guideline limit.

It should be noted that the effects of NO_2 on vegetation are uncertain. The potential for NO_2 to cause sever acute injury to vegetation is limited to situations where massive concentrations may occur as a result of an accidental industrial release. Chronic visible injury clearly attributable to NO_2 has rarely been observed in nature; therefore it is hard to determine whether NO_2 is a significant air pollutant for vegetation (Bates, D.V. & Caton, R.B. (2002). *A Citizen's Guide to Air Pollution (2nd ed.)* Vancouver, B.C.: David Suzuki Foundation).

3.3.5 Air Quality Management Plan

3.3.5.1 Overview

The air quality management plan (AQMP) for the Wolverine Coal Mine outlines the best management practices, mitigation measures and ambient monitoring program that will be undertaken to minimize the air quality impacts of the mining operations. The plan considers the mining operations at the Perry Creek Property and the Mt. Spieker Property including the EB pit, the Perry Creek pit and the plant site. The plan will be implemented for the expected eleven-year lifetime of the project.

3.3.5.2 Emission Sources

Emissions of fugitive dust, greenhouse gases and products of combustion will result from the Wolverine Coal Mine Project. Fugitive dust emissions will be the major source of air emissions from the Wolverine Coal Mine and they are also the primary concern for potential human health effects. Operations that involve the movement of overburden material or coal, and those that expose erodible surface areas will generate fugitive dust emissions. Plant site processes such as screening and conveying will also contribute to fugitive dust emissions. Table 3-15 presents a comprehensive list of emission sources for the Wolverine Coal Project during the eleven years of mining operations (2005 to 2015).

Road construction, preparation of the plant site, and construction of the coal dryer and processing plant will contribute to fugitive dust and other criteria air contaminant emissions but they are of limited duration and are expected to have a negligible impact compared to the emissions that will be released during mining operations. Post-closure of the Wolverine Coal Mine will have some activity related to reclamation and continued monitoring, but these activities also have minimal emissions compared to mining operations.

Table 3-14: Emission Sources for Wolverine Coal Mine

Emission Source	Locations	Type of Emission
Blasting	Perry Creek pit EB pit	Fugitive Dust (TSP, PM_{10}, $PM_{2.5}$)
Drilling	Perry Creek pit EB pit	Fugitive Dust (TSP, PM_{10}, $PM_{2..5}$)
Truck Traffic on Haul Roads	Plant Haul Route dump Haul Route	Fugitive Dust (TSP, PM_{10}, $PM_{2..5}$)
Loading trucks with overburden and coal	Perry Creek pit EB pit	Fugitive Dust (TSP, PM_{10}, $PM_{2..5}$)
Unloading trucks with overburden and coal	Perry Creek South, East and North dumps EB pit East and West dumps Plant Site	Fugitive Dust (TSP, PM_{10}, $PM_{2..5}$)
Bulldozing operations	Perry Creek pit EB pit South, North, West dumps Plant Site	Fugitive Dust (TSP, PM_{10}, $PM_{2..5}$)
Plant site Coal Transfer and Clean-up Operations	Plant Site	Fugitive Dust (TSP, PM_{10}, $PM_{2..5}$)
Grader operations	Haul Routes Perry Creek pit EB pit	Fugitive Dust (TSP, PM_{10}, $PM_{2..5}$)
Raw Coal Screening	Plant Site	Fugitive Dust (TSP, PM_{10}, $PM_{2..5}$)
Conveyor Transfers	Plant Site	Fugitive Dust (TSP, PM_{10}, $PM_{2..5}$)
Wind Erosion from Coal Piles	Stockpiles at Plant Site Reject Coal Pile ROM Stockpile at EB pit	Fugitive Dust (TSP, PM_{10}, $PM_{2..5}$)
Wind Erosion from Tailing Pond	Tailing Pond Adjacent to Plant Site	Fugitive Dust (TSP, PM_{10}, $PM_{2..5}$)
Wind Erosion from dumps	South, North, West dumps	Fugitive Dust (TSP, PM_{10}, $PM_{2..5}$)
Coal Dryer	Plant Site	GHG (CO_2), TSP, PM_{10}, $PM_{2..5}$, VOC, NOx, SO_X
Vehicle Fleet	Pit Site	GHGs, combustion products
Coal Bed Mining	Pit Site	GHG (methane)

3.3.5.3 Fugitive Dust Management

Effective dust control measures are important to reduce the potential for high particulate concentrations during all phases of the project. The following sections outline specific mitigation measures that will be incorporated into the design and a few recommendations to limit fugitive dust emissions.

Unpaved Roads

Vehicle speed controls

Traveling speeds should be controlled to reduce traffic-induced dust dispersion and re-suspension within the site from the operation of haul trucks and access roads around the site. The Wolverine Coal Project has set maximum speed limits of 50 km/h on their haul truck routes. These speed limits should be enforced for the duration of the project.

Road construction

The proposed road surface is crushed sandstone. Using large rock fragments, several centimetres in diameter, or aggregate can help to reduce fugitive dust emissions. The route for truck haul roads should be selected to minimize the hauling distance as much as possible. Steep grades in the hauling route should be avoided wherever possible.

Road watering

A water truck will be on site to control potential fugitive dust emissions from the haul truck routes and other roads with high traffic volumes during dry conditions. The control efficiency of watering unpaved haul routes depends on the amount of water used, the frequency of application, the volume of traffic, and the prevailing weather conditions. To be effective, watering of unpaved areas should be conducted several times a day during periods of dry weather.

Based on the capacity of the truck and the average length and width of the haul truck routes, one truck could apply up to 1.4 L/m^2 to the coal haul truck route and dump haul truck route every hour.

Table 3-16 indicates the mitigation control efficiency of fugitive dust emissions for dry conditions based on the hourly application rate for the dump haul truck route and the coal haul truck route.

Table 3-15: Road Watering Mitigation Control Efficiency

Water Application Rate (L/m^2)	Coal Haul Truck Route 6 trucks/hour	Dump Haul Truck Route 25 trucks/hour
0.25	94%	54%
0.5	97%	77%
0.75	98%	85%
1	98%	89%
1.25	99%	91%
1.5	99%	92%

Conveyors & Transfer Points

A number of conveyors are used at the plant site to transport coal at various stages of the coal processing. All of the conveyors are enclosed or covered to reduce fugitive dust emissions that could arise from wind erosion. The primary source of dust emissions associated with the conveyors occurs when material is dropped from a height onto a pile. Such emissions will be greatest as a result of wind gusts or during high wind conditions. The conveyors proposed at the Plant site incorporate a number of mitigation features, which are outlined in Table 3-17.

Table 3-16: Conveyor Mitigation Features

Conveyor Name/Description	Mitigation Controls
Raw Coal Stockpile Conveyor	• Conveyor is hooded. • Raw coal is delivered to an enclosed silo equipped with a dust collection system (no drop fugitive dust emissions).
Plant Feed Conveyor	• Conveyor is hooded. • No drop fugitive dust emissions as raw coal is delivered directly into enclosed coal preparation plant equipped with a dust collection system.
Refuse Conveyor	• Conveyor is fully enclosed, no drop emissions.
Dryer Feed Conveyor	• Conveyor is fully enclosed, no drop emissions.
Clean Coal Radial Stacker Conveyor	• Conveyor is hooded. • Spray system is installed to control dust at the thermal dryer before loading onto conveyor.
Train Loadout Conveyor	• Conveyor is hooded.

Stockpiles

The concern with stockpiles is the generation of fugitive dust by strong winds. If wind erosion from stockpiles is observed it can be readily controlled by stabilizing the affected surfaces by using chemical suppressants or regular watering. Sprinklers can be installed to periodically wet the piles and increase the moisture content of the material to reduce fugitive dust emissions from high winds and gusts.

Windscreens may also be used to provide some reduction in wind speed and thus reduction in wind-blown dust emissions. Screens would need to be high and relatively impervious to reduce speeds when winds are strongest. This would require guying which may impede traffic flow. Alternatively, natural or planted vegetation such as a tree line can be used as a natural wind break.

Tailing Ponds

Wind erosion from tailing ponds occur when material accumulates to create banks of exposed tailings that lie above the water. The exposed tailings can dry out and result in fugitive emissions during periods of high winds and gusts. Substantial amounts of exposed tailings will not likely occur until the end of the life of the tailings pond. If required, water sprays will be applied to the tailings to control fugitive dust emissions.

Material Handling

The transfer of overburden and coal into trucks and the transportation of materials by bulldozing, front-end loaders, and grading operations can cause considerable fugitive dust emissions. In order to minimize and mitigate material handling emissions, the following measures will be considered:

- the heights from which excavated materials are dropped will be kept as low as practical to minimize fugitive dust emission from unloading
- operators will load material in a manner that reduces the potential for overloading and hence reduces the potential for spillage on the haul routes.

During dry conditions and for periods of high winds, fugitive dust emissions may attain levels that require additional temporary mitigation measures for material handling. During such circumstances, water will be applied to the coal and overburden at the pit prior to transportation off-site.

Blasting

Blasting results in the instantaneous release of a large dust cloud. High concentrations of ground level particulate matter can result when wind speeds are low. Emissions can be controlled by restricting blasting to periods when wind speeds are high.

Coal Dryer

The coal dryer will be equipped with cyclones and a scrubber to remove particulate emissions and reduce other criteria air contaminants. A wet scrubber will be used to control exhaust stack particulate and SO_2 emissions. Dust cyclones with mist spray systems are located at the clean coal exit from the dryer. The clean coal is then transported by covered conveyor to the clean coal stockpiles. The control efficiency of the scrubber for particulates released from the stack can be as high as 99 %.

Train Loadout

The train loadout of processed coal will occur approximately every two days and take from four to seven hours. The clean coal that is loaded by the conveyor has a high moisture content of approximately 7 % as a result of wetting and mist spray systems from the thermal dryer. The high moisture content is effective in reducing fugitive dust emissions at the loadout. Once the coal is loaded into the rail car it is sprayed with an emulsion to form a crust on top of the coal to control dust emissions during transport.

Reclamation

Early reclamation of land is an important fugitive dust emission strategy. Exposed ground surfaces stripped for surface mining and dump areas will be sources of fugitive dust if they are not reclaimed as soon as possible. Dust emissions from excavation and earth removal operations can be reduced by minimizing the area of disturbed land. Unused exposed areas should be stabilized and seeded with vegetation as soon as possible. If disturbed areas are left exposed for extended periods, these areas should be stabilized by applying dust suppressants (chemical suppressants or water) to minimize wind erosion. If the exposed area is large, it may be advantageous to hydro-seed to reduce potential wind erosion.

Vehicle Fleet

WCC should consider the following to reduce fuel consumption and emissions from the vehicle fleet:

- carefully plan the haul routes to minimize the vehicle kilometres traveled from the pits to the dump site and plant
- prescribe low NO_x and SO_2 vehicle emissions when tendering the truck fleet, or replacing the truck fleet in the future
- buy low sulfur diesel fuel for the truck fleet.

3.3.5.4 Greenhouse Gas Management

Position of Western Canadian Coal

WCC will consider steps and measures that can be taken to reduce emissions of greenhouse gases from the Wolverine Coal Project. It is recognized that efforts to reduce greenhouse gases often result in increased efficiency of operations and ultimately result in savings.

Sources of Greenhouse Gas Emissions

There are three major sources of greenhouse gases associated with the Wolverine Coal Project: fuel combustion associated with the vehicle fleet, operation of the coal dryer, and the inadvertent release of coal bed methane emissions when mining and processing raw coal. Some greenhouse gas emissions will also be attributed to electricity consumption at the plant site. Estimates of these emissions are presented in Section 3.3.2. Mitigation options that should be considered are outlined in the following section.

Mitigation Options

Reduction of Greenhouse Gas Emissions from Vehicle Fleet

Greenhouse gas emissions from the vehicle fleet can be reduced by prioritizing fuel economy when purchasing, upgrading, or maintaining the vehicle fleet and by minimizing the amount of time that truck engines are left idling under all environmental conditions.

Reduction of Greenhouse Gas Emissions from Coal Dryer

To reduce GHG emissions from the coal dryer, shutdowns and startups should be avoided as much as possible in order to operate the dryer at its highest level of efficiency. Also, improvements to the dewatering process of the input coal should be considered to reduce the moisture content and corresponding fuel use.

Reduction of Emissions from Coal bed Methane Emissions

Recovery and on-site use of coal bed methane emissions where feasible is a possible GHG mitigation measure.

3.4 Wildlife Protection & Management

3.4.1 Overview and Background

3.4.1.1 Overview

Wildlife protection and management are an ongoing priority of WCC's environmental management programs for the existing Wolverine Mine. The Northeast BC area, including the Wolverine Valley, is rich in wildlife resources.

The *AIR*, and the *Mine Permit Application* provided baseline information for wildlife in the project area, as well as impact mitigation and management plans. Eleven focal wildlife species were defined for baseline and impact assessment studies, with caribou and grizzly bear being the key species of management interest due to their status as red-listed species, and moose also recognized as important to First Nations and Aboriginal communities in the context of traditional food supply.

Wildlife impact assessments and management plans for the mine were reviewed for adequacy as part of the EA review process which concluded with the granting of the EA Certificate in January 2005. At that time, it was concluded that the impacts of the Wolverine Mine on wildlife could be satisfactorily managed with the proposed mitigation and management plans.

The wildlife section of the Application to the EAO and MEM for approval to expand production levels at the Wolverine Mine from 1.6 Mtpa and 2.4 Mtpa provides a brief summary and update of the wildlife baseline studies and wildlife management planning for the approved Wolverine 1.6 Mtpa mine, and identifies aspects of the proposed mine expansion that could affect the conclusions of earlier assessments and planning.

Details of the wildlife baseline and management plans were provided in the *AIR* in Sections 4.5, 4.10.5, 4.11.4, 10.6, 10.7.15, 10.9.22, 12.6, and Appendix E; and in Sections 4.5, 6.5 and Appendix 7 and 11 of the *Mine Permit Application.*

3.4.1.2 Baseline Studies Completed Subsequent to Submission of AIR

The following wildlife or wildlife-related studies and management plans were completed in 2004 subsequent to submission of the original *AIR* and the July *Addendum Report* for the Wolverine Project, with results submitted to the Wildlife Working Group during the *AIR* review period:

1/ Field truthing and identification of wildlife habitat features along the powerline ROW by Keystone Wildlife

2/ Field truthing of habitat mapping in the Perry Creek and EB Pit areas and in the Plantsite area; and refinement of the habitat rating values based on field information.

The following additional studies were completed in 2004 subsequent to submission of the *AIR* and *Addendum Report* and included in the *Mine Permit Application* in 2004:

1/ Wildlife Studies Update

2/ Waterfowl Survey Summary

3/ Assessment of Fisheries Habitat Potential at “Oxbow 1” and “BC Rail Ditch”

The following additional studies and plans were completed subsequent to *AIR* review and submitted as Appendices to the WLAP *Effluent Permit Application* in 2005

1/ Biological Monitoring – Rationale and Methodology

2/ Wetland Habitat Characterization

3.4.1.3 Conclusions of EA Review and EA Certificate Commitments

Wildlife aspects of the project were reviewed in detail by the EAO and MWLAP, and by a Third Party consultant (IER) funded to provide an independent technical review of the environmental assessment reports, with a focus on wildlife. A Wildlife Working Group was established as part of the EA Review process, and included the Third Party consultant, representatives of WCC, Keystone Wildlife, and EVS Consultants, who participated in Working Group meetings to provide information and to assist in developing management responses to any issues identified. The Working Group focused on three species: caribou, grizzly bear, and moose. Minutes and correspondence related to Working Group meetings are posted on the EAO website.

During the review of the Wolverine Mine *AIR*, a number of issues were raised with respect to the available baseline information and the potential for impacts on wildlife as a result of the development and operation of the mine. Keystone, EVS, WCC, and the government agencies brought forward new information to assist in the evaluation of some impacts and resolution of concerns, and Western made a number of commitments for further wildlife studies during mine construction and operation.

During the *AIR* review process, Western completed additional field programs to augment data for management planning. These programs included field-truthing of habitat mapping in the mine area, and additional bird and waterfowl surveys in the minesite, and between the mine and the Wolverine River. The results of the habitat work were reviewed and discussed by the Working Group. Results indicated that the potential impacts of the mine on caribou habitats had been over-estimated by the original mapping; and that actual habitat values were lower due mainly to actual lichen values and additionally to topographic limitations (see below). Habitat ratings for other species were not significantly changed as a result of the 2004 field program.

As part of the review process, WCC consolidated key management commitments into a framework for wildlife protection planning, which was submitted to WLAP and EAO in November 2004 (and is posted on the EAO website).

In general, issues raised during the course of the EA review were satisfactorily resolved, although the WMFN and Saulteau FN, as well as IER on behalf of all First Nations and Aboriginal communities, expressed some residual concerns with respect to impacts from selenium and coal dust.

The EA Certificate was issued on January 19, 2005. Attached to the certificate was a series of commitments made by WCC. Commitments 86-97, and 101 were specifically related to wildlife. The applicable EA commitments, as outlined in the EA Certificate Schedule B, related to the following areas:

- Design of mine structures – sed ponds and roads – to avoid wildlife hazards, including stranding/drowning and roadkill, respectively.
- Completion of a Wildlife Protection Plan for mine construction and operation.
- Restriction of clearing windows to periods outside the breeding bird season (states as May 1-July 31).
- Incorporation of native species of importance to wildlife in reclamation planning.

- Participation in monitoring programs to better define caribou migration routes, and caribou use of habitats in and around the Wolverine Valley, and in particular the EB Pit area. Specifically, Western committed to participation in the monitoring program led by MoF (Dale Seip), maintenance of wildlife siting records, and other strategic wildlife monitoring as needed during pre-development at EB, as well as during construction and operation of both mines.

- Monitoring of wildlife use of the mine during construction, operation, and post closure.

- Monitoring of habitat in wetlands between the Mine and the Wolverine River.

- A selenium monitoring program, including baseline and follow-up monitoring of terrestrial vegetation, and aquatic vegetation in wetlands potentially affected by mine development.

The Mine Permit stipulated an additional condition for mine development, which was “An effective program of beaver removal and control shall be developed.” Further to this end, programs for beaver removal and management have been ongoing under *Wildlife Act* Permit FJ044629.

3.4.1.4 Work Completed Subsequent to EA

Significant work has been completed toward meeting the EA commitments related to wildlife. A status report on the EA commitments was submitted to the EAO on May 11, and is posted on the EAO website.

A summary of the baseline updates is provided in Section 3.4.2.

The Wildlife Protection Plan for the 1.6 Mtpa Wolverine Mine has been completed based on the framework developed during the *AIR* review and was submitted to the EAO for information, and to the Ministry of Water, Land and Air Protection, Fort St. John, for approval of the Wildlife Manager. (See Section 3.4.3). A copy of the plan is provided as Appendix G.

3.4.2 Baseline Summary and Updates

The wildlife habitat baseline information was updated for the Wolverine Mine by Keystone and provided in Appendix 11 of the Wolverine Coal Project *Mine Permit Application*. The update is summarized below.

Following the submission of the *AIR*, fieldwork was conducted in 2004 by Keystone to field-truth the PEM and TEM habitat mapping presented in the *AIR*, and to search for signs of use by the focal species. An additional breeding bird survey was also conducted following submission of the *AIR* to provide coverage for the expanded project area, to complete a species list of birds present in the area, and to survey for the presence of red or blue-listed bird species.

3.4.2.1 Perry Creek Pit / Plantsite Area – Wildlife Habitat

The 2004 field program provided good coverage of the Perry Creek mine area, including the area of the Pit and dumps. Low-lying areas adjacent to the river (Settling Pond SP6) were also sampled. Habitat suitability/capability ratings initially defined for the Perry Creek Pit/Plantsite area in the Wolverine Project *AIR* ratings were adjusted based on the summer 2004 habitat suitability assessment in the field.

There was a lack of caribou sign in the Perry Creek footprint, indicating that the habitat is not currently heavily used by caribou. The habitat ratings for both the northern and mountain caribou were down-graded based on the field assessment. There is no class-1 (high value) capable or suitable habitat for either ecotype within the proposed Perry Creek footprint. The capability and suitability values for the other focal species did not change significantly.

3.4.2.2 EB Mine Site Area – Wildlife Habitat

Further baseline work was also conducted in the EB mine site area by Keystone in 2004. A habitat suitability assessment in the EB mine footprint was completed at 24 sites between June and July 2004. Caribou pellets were discovered at four sites, and one game trail with caribou tracks was noted; however, too few pellets were found to indicate relative use of habitats and areas. Arboreal lichen loads were evaluated and were found to be adequate for site ratings of Class 2-3; however, portions of the site have significant slopes, which make it less useable for caribou.

The EB area is criss-crossed with roads and seismic lines, and if caribou migrate through the EB area, they may use the roads to travel. Caribou avoid steep areas, so if they were traveling through the EB pit site, they might tend to move along the more gently sloped areas, which also tend to be road routes. One road runs over the height of the land to the alpine areas outside the EB pit area where caribou winter.

Habitat suitability ratings in the EB Pit area were adjusted based on the information collected in the field. Pre-field habitat assessments were significantly lowered for caribou subsequent to field-truthing. No high suitability habitat for mountain caribou was found in the EB footprint area. For northern caribou, there is no high or moderately high suitability habitat present in the EB footprint. The capability and suitability values for the other focal species did not change significantly.

Additional data from radio-collared animals will be needed to evaluate the area's importance as a caribou migration corridor. This data will be available for consideration in updating the site wildlife management and protection plans prior to the Application for a Mine Permit for EB Pit (approximately 5 years after initial production from Perry Creek).

Other Species

For marten, there are three areas of high suitability. For wolverine, there were three hectares of moderate suitability habitat – the rest was rated low to nil.

For grizzly bears, the EB pit area is a mix of moderately high to moderate suitability habitat. Mountain goat habitat values were low for winter feeding and summer shelter habitat. Habitat values for Black-throated Blue Warbler, Northern Goshawk, Fisher, and Moose were low due to high elevation, deep and persistent snow cover and lower productivity forest cover.

Bird Survey Update

The Project Area is home to a variety of bird species, including waterfowl, raptor, game birds and passerines (songbirds). The purpose of the spring breeding survey was to sample within representative habitats for areas not sampled during the 2002 surveys to complete the baseline program. The list of bird species in the area was completed, and the area was surveyed for use of the area by red or blue-listed species. A total of 86 songbird and raptor species were documented in the area during the songbird/raptor surveys. The habitats observed were typical of the forest type. No rare or unusual bird habitats were observed. Two blue-listed species were observed in or near the study site. (LeConte's Sparrow, Black-throated Green Warbler). Both these species are common in the Prairie Provinces although they have restricted distributions in BC. No red-listed species were recorded.

Keystone concluded that it is unlikely that development of either the Perry Creek or EB footprints will have effects on bird populations at the regional level, as the habitat types to be affected by the mine are common.

Keystone also completed an overview survey of waterfowl use in the area between the railroad tracks and the Wolverine River, including wetlands on the Terry Ranch. Although this area will not be directly disturbed by mining, portions of the area will be affected by surface water discharged via mine-site settling ponds, and by seepage from the plantsite/tailings pond area. The objective of these waterfowl surveys was to provide repeat sampling to document the numbers and species of waterfowl using these areas, thus strengthening the database for the selenium monitoring plan. This baseline data will guide the development of the bird component of selenium monitoring programs, if and when required; specifically, in the event that increases in selenium area are measured in wetland water column and sediments.

Vegetation Metals Baseline

WCC completed required reporting on pre-disturbance vegetation metals/trace element concentrations. The program covered appropriate browse species (grasses and willows) to provide a baseline for species of concern in a wildlife management context, and native legume species, because metal/trace element uptake, particularly selenium, uptake is known to be high in these species. The report was completed by CE Jones in 2004 and submitted as part of the Wolverine *Mine Permit Application*.

Forest Productivity Monitoring

Standard forestry regeneration and productivity monitoring will be conducted on reclaimed and reforested land, to evaluate and document achievement of equivalent capability and forestry end land use objectives. It will also provide a measure of successful reforestation that will be relevant to wildlife habitat assessments.

Monitoring of the reclaimed landscape will be conducted both immediately after reclamation treatments, to assess success in re-establishing vegetation on the reclaimed landscape, and over time prior to achieving equivalent capability and end land use objectives. A baseline forest productivity assessment was completed by CE Jones in 2004 and submitted as part of the Wolverine *Mine Permit Application*.

3.4.3 Wildlife Protection Plan

The Wildlife Protection Plan for the Wolverine Mine has been outlined in a manual (currently in draft subject to WLAP review and endorsement), called: *Construction and Operations Wildlife Protection Plan (WPP) – Manager's Manual*. The plan incorporates a comprehensive training program targeted to various levels of detail, depending on the employee/contractor likelihood of engagement with wildlife during the course of their normal duties. The manual is attached as Appendix G.

The manual takes management recommendations for the mitigation of potential Project-related effects on wildlife and their habitat, and makes them a reality "on-the-ground" during the construction phases of the Wolverine Coal Project. The manual is the companion document to the *Construction and Operations Wildlife Protection Plan (WPP) Information Sheets*, which will be made available to Project workers and consultants under the direction of the Site Environmental Superintendent, by direct distribution and on-site posting.

The manual provides the Site Environmental Superintendent or designates(s) (which may include, at the discretion of the Site Environmental Superintendent, field crew leaders, security personnel, or assistants to the Site Environmental Superintendent), with:

1/ additional instructions and/or context for the restrictions, requirements and recommendations provided in the Construction and Operations WPP information sheets ('Additional Information');

2/ recommendations or approaches for communicating the content and intent of the WPP ('Communication Strategy'); and

3/ monitoring tasks to assess the effectiveness of the various components of the WPP and/or identify issues of concern ('Monitoring').

The WPP covers the following topics:

- General Restrictions for Wildlife Protection
- Wildlife Attractants
- Garbage Management
- Preventing Problem Wildlife
- Dealing with Problem Wildlife
- Bears
- Bear Aware Program
- Bear Safety
- Wildlife and Vehicles
- Wildlife Habitat Use
- Wildlife Health
- Woodland Caribou
- Reporting Wildlife Observations and Incidents

The WPP is part of the WCC Environmental Management System (EMS) for the Wolverine Coal Project.

The WPP will be reviewed every two years, and maintained and updated as a living document, as needed to reflect new information and management priorities.

3.4.4 Caribou Study Program

A key commitment made by WCC during the EA review was ongoing participation in studies to better define the use of the EB area by caribou, and to determine the importance of the EB and adjacent areas to caribou in a regional context. WCC agreed to contribute to efforts related to caribou recovery monitoring studies and management planning, in the context of the Caribou Recovery Program being undertaken under the leadership of Dale Seip, MoF. Western emphasized that funding commitments were made in the context of an expected overall strategy led by government for cumulative effects management, and that the level of commitment and funding by Western should be commensurate with Western's level of impact on key factors affecting the caribou population. WCC noted that the EB area is the key area of concern for this project, and was not expected to be developed for about eight years, allowing time to develop an improved database for mitigation and management planning. In the meantime, other industrial users (Oil and Gas) are active in the area. WCC agreed to contribute to studies to confirm movement through EB area in the context of the regional caribou studies.

WCC consulted with Dale Seip (MoF) in the winter of 2004-2005 to identify the most appropriate actions to be taken at this time to support the ongoing regional caribou study administered by MoF. As a result of those discussions, WCC contributed funds to MoF to collar and monitor 5 additional caribou, with the focus to be on caribou that may use, or migrate through, the EB/Mt.Spieker area. Funding was to be used to purchase the required new collars, and to fund collaring of five animals, and follow-up monitoring and collar removal. Further ground-based studies were not judged by Mr. Seip to be important to the program for 2004-2005.

MoF has since reported to WCC that the collars were put on the caribou on April 11, 2005. Three were put on animals at Mount Spieker, just north of Perry Creek. It is expected that these animals may move around or through the Wolverine Mine area when they move to their summer ranges, and when they return to the Wolverine area next winter. A fourth collar was placed on a caribou in the Brazion Creek area. The objective was to collar an additional animal in the Brazion Creek areas; but no other caribou were available in the target area, and the collar was placed on a caribou further to the west.

In addition to the GPS collars recently installed, the MoF have several VHF collars on animals in the Wolverine and Brazion areas.

All collared caribou will be located every two weeks for the coming year. Some of WCC's funding will be used to help pay for the telemetry flights, with the remaining money being held back to pay for the recovery of the GPS collars in April 2006.

The caribou study by MoF is ongoing, and the GPS collars from the caribou tracked for the past year have been recovered. Two of these animals used the Wolverine Mine area, and one was from the Brazion area. Mapping of the resulting data points is underway. When available, the resulting maps will be sent to WCC. This data set will be further augmented with the information retrieved next year, from animals currently being tracked. (Dale Seip, pers comm.)

New information concerning caribou will be incorporated in the Wildlife Management Plan during annual reviews as information becomes available. A ground elevation of caribou migration routes (e.g. trails) in the area of the EB Pit will be completed prior to EB Mine Permit Application.

Any development at EB pit will be subject to a complete review of the accumulating database from this program as part of the Mine Permitting process.

3.4.5 Potential Impacts of the Production Increase on Wildlife

This Application for Amendment to the Wolverine Mine EA Certificate and Mine Permit requests an increase in maximum production level at the mine from 1.6 to 2.4 Mtpa. This section defines the project parameters with the potential to effect the wildlife impact assessment and mitigation planning for the project.

The following summarizes how the increase in production levels affects project parameters related to the wildlife impact assessment. Most potential impacts remain largely unchanged.

- Mine Footprint – There is no significant change in the proposed mine layout or total area of disturbance at either EB or Perry Creek. Minor changes in the production scheduling results in minor shifts in dump development schedules, as described in Section 2. There are no significant changes in the expected areas of wildlife habitat impacted.

- Operating Mine Life – The overall operating mine life for the project has been shortened. This allows for reclamation of the Perry Creek and EB Pits sooner than planned, and shortens the duration of habitat impacts on these areas (in the context of a stand-alone operation with no other pits approved).

- Pit Development Schedule – The pit development sequence remains the same – specifically, Perry Creek Pit will be developed first, followed by development of EB Pit. General sequencing within the Perry Creek Pit is similar as for the 1.6 Mtpa operation, and development plans for EB Pit remain unchanged.

  The increased production level at Perry Creek means that the Perry Creek pit will be mined out sooner, and operations could shift to EB Pit sooner, if there are no other changes to the overall mining plan. A key mitigation planning question that was considered is whether or not the shorter mine life at Perry Creek and potential earlier mining at EB is significant in the context of the requirement to complete caribou monitoring programs and caribou protection planning prior to mining at EB, as outlined above.

  The Wolverine Mine as approved at 1.6 Mtpa was not expected to have significant impacts on caribou populations using the area due to the relatively low use of the area. Caribou appear to move through the area, and are expected to favour the higher elevations ridges above EB. If caribou do move through the EB Pit area en route to winter habitats, they will likely continue to move through or around the area when mining proceeds. As documented in the Wolverine *AIR*, caribou will locate near mine areas, and travel through and around mine areas during migration.

  As noted above, it is a condition of the EA Certificate that additional work be done to confirm that assessment. Work was to include monitoring of caribou migration and definition of areas utilized. This work is ongoing, as described above. Data have now been collected on collared animals for the EB Pit area through the MoF collaring program for two years, and Western has contributed money to extend and expand that program. Requirements for ongoing monitoring will be evaluated as data are reviewed. The proposed timelines allow for information from a seven-eight year period to be used to describe caribou use of the area and to develop appropriate mitigation plans.

  - Mine Infrastructure – The proposed road access and transportation network for the mine is unchanged.

- Plant Infrastructure – The proposed plantsite infrastructure/layout remains largely unchanged; with the exception of the changes to the equipment within the coal dryer and the coal preparation plant buildings, which have been re-sized to accommodate increased throughput rate.

- Water Management – The physical water management system components and proposed system operation remain essentially as described for the 1.6 Mtpa mine in the *AIR* and in the *Mine Permit Application*. Potential impacts related to wildlife and waterfowl remain substantially unchanged.

- Project Effluents / Aquatic Impacts – These could potentially affect wildlife and waterfowl use of receiving waters, with the key area of interest being the area between the mine and the Wolverine River. These are addressed in the section on Aquatic Impacts. (In summary, increases in production rates have relatively minor effect on the projected aquatic impacts, because most impact factors for the project relate to maximum disturbance and waste rock exposure rather than to annual production rates). Monitoring and contingency plans for the project were well defined in the *AIR*, and will apply for the 2.4 Mtpa mine.

- Air Emissions/Air Quality Impacts – the Wolverine *AIR* review addressed the potential for dust to affect ungulates. No impacts were expected. Dust management plans were defined in the *AIR* and will apply for the 2.4 Mtpa mine.

- Workforce – The increase in production is achieved primarily by increasing the size of mining equipment; such that numbers of people employed in the mine changes very little. As a result, changes in mine traffic as related to potential for roadkill are minimal. A Wildlife Protection Plan is in place to mitigate these impacts.

3.5 Land Use & Tenure Impacts

3.5.1 Introduction

WCC has been working with tenure holders and resource users in the Wolverine Project area since 2002 with the objective of minimizing land and resource use conflicts, mitigating impacts, and achieving compatible multiple resource use. As of 15 April 2005, with clearing beginning in advance of construction for the Wolverine Coal Mine (1.6 Mtpa); detailed arrangements have been worked out to resolve most land use issues. Written agreements are in place or being developed with key stakeholders, required tenure arrangements are being negotiated, and most compensation requirements have been addressed.

Because the increase in production rates from the Perry Creek Mine has not significantly changed the project footprint, the change in land and resource impacts related to the proposed production increase to 2.4 Mtpa is negligible.

However, the overall picture of land and resource use in the area has changed somewhat due to:

- changes in tenure holdings and resource activity in the area over the past year, notably related to forestry and Petroleum and Natural Gas activities
- clarification by regulatory agencies of land tenures required
- minor refinements to mine infrastructure design and location during final design of the 1.6 Mtpa operation, which have required minor adjustments to tenure boundaries.

Therefore, in order to present a full picture of land use and tenuring considerations, this Section summarizes and updates land use considerations and tenures being put in place for the Wolverine Mine (1.6 Mtpa); as a background for discussion of changes in land use and tenuring considerations for the 2.4 Mtpa mine. See Figure 3.5-1 for an overview of General land use.

Information is provided only for the Perry Creek and Plantsite areas, as the scope of the change discussed relates to those areas.

3.5.2 Regional Land Use Plans

Coal mining is an accepted land use in the Wolverine Project area, as defined by the Dawson Creek Land and Resource Management Plan (LRMP) prepared by the B.C. Land Use Co-ordination Office, 1999. Expansion of the mine is compatible with management objectives for the area.

3.5.3 B.C. Ministry of Forests

The Ministry of Forests (MoF) administers forest land, issues approvals for timber harvesting and grazing licenses, and approves Special Use Permits for road development. The mine area is located within the Prince George Forest Region and administered through the Dawson Creek Forest District.

The change from a 1.6 Mtpa to a 2.4 Mtpa operation does not require new MoF approvals, nor alterations to approvals for the 1.6 Mtpa operation.

MoF holds a 20 m right of way (ROW) for the Wolverine Forest Service Road (FSR), which provides primary access to the mine from Highway 29. The ROW is being widened to 30 m to accommodate the power line for the 1.6 Mtpa project. A MoF Work Permit will be issued for construction of the powerline within the expanded ROW.

The 1.6 Mtpa operation requires a temporary and permanent realignment of Wolverine FSR within the plantsite area. MoF will approve the realignment engineering designs and issue Special Use Permits (SUP) for construction. (As of 15 April 2005, this approval process is nearing completion.) The proposed road designs accommodate MoF and Canfor concerns related to safety, grades, curves, sightlines, etc related to log hauling and other traffic around the minesite. The road will remain open to public and industrial traffic at all times.

Private land required for a statutory ROW for the FSR realignment will be ceded to the Crown by B.C. Rail and by WCC (from land purchased from the Terry Estate), and dedicated as road for the FSR realignment (through both Crown and private land).

Western holds a Ministry of Forests License to Cut (LTC) for the first phase of the Wolverine Mine Applications for second and third phase clearing are pending.

3.5.4 Canfor

The Wolverine Project area falls within Canadian Forest Products Ltd.'s (Canfor's) Tree Farm License (TFL) 48. The production increase does not change the proportion of the TFL affected by mining.

Canfor is the MoF- designated Primary User of the Wolverine FSR, and carries out road maintenance and road improvements as needed. Western has signed an umbrella Road Use Agreement with Canfor authorizing use of the Wolverine FSR road. WCC is in negotiation with Canfor on details of road use and maintenance costs.

Canfor constructs and maintains other roads in the vicinity of the project area as needed in support of harvest plans.

Canfor has been harvesting timber over the last year on cut blocks in the Wolverine Valley, and will continue work in this area into the mine construction period. Portions of the Perry

Creek Mine area were clearcut over the past year. During much of the early operational life of the Perry Creek Mine, harvest operations will be centred in other parts of the TFL.

Due to requirements for harvesting stands infected with pine beetle, Canfor cutting plans are subject to change. At the 1 February 2005 meeting of the Northeast Mine Development Review Committee (NEMDRC), WCC committed to work with Canfor, if needed, to ensure access near and below dumps if needed to accommodate changes in harvesting requirements during mining.

3.5.5 Coal Tenure

WCC holds a coal lease #414696 over 3,128 ha and coal licenses that cover most of the Wolverine Mine site. WCC's lease and licenses cover all areas where coal will be extracted.

WCC has applied for an additional coal license to cover proposed disturbance in the area of the East dump. WCC's coal lease, licenses and license applications, subdivided into the Perry Creek Property and EB (Mt. Spieker) Property, are shown on Figure 3.5-1.

Elk Valley Coal holds Coal Licenses 327341 and 327337 in the area of the Plantsite/Tailings Pond (Figure 3.5-1). Elk Valley Coal has confirmed that it does not object to Western building mine-related facilities on these coal licenses, and has provided letters of non-objection for use of land both northwest and southeast of the railroad tracks. Use of lands southeast of the tracks is required for small water management structures only, such as culverts and ditches.

The proposed production increase does not affect WCC's use of Elk Valley's Coal tenures.

3.5.6 Petroleum & Natural Gas

3.5.6.1 Overview

Petroleum and Natural Gas (PNG) Leases and Drilling Licenses in the Wolverine Project area were listed and mapped in the *Additional Information Report* (Figure 4.10-4). In conjunction with Wolverine *AIR* submission in May 2005, Western notified all overlapping PNG tenure holders of plans to develop the proposed Wolverine Project. At that time, Talisman Energy, Shell Canada, and Koch Petroleum were the three parties whose interests in the area that could potentially be affected by the Wolverine Mine.

Since that time, Talisman took over Shell Canada's leases, seemingly leaving only two potentially affected parties, Talisman and Koch. However, Shell has been in contact with WCC recently, alerting WCC to their plans in the area. Western will be meeting with Shell to discuss those plans. Remaining Wolverine-area PNG tenure holders did not respond to the notifications and follow-up attempts, or indicated that they did not object to the Wolverine Mine development.

See Table 3-18 for a summary of status of Petroleum Well Licenses and Pipelines in the Wolverine Project Area.

The production increase does not significantly change potential impacts on Talisman, Koch or Shell.

Table 3-18: Status of Petroleum Well Licenses & Pipelines in Wolverine Project Area

Well License	License Holder	Area	Status
CBM Well	Koch Exploration	Perry Creek	Drilling program completed 2002 east of PC pit. One well now capped and one well not drilled
Application a-10-G 93-P-3	Koch Exploration	Perry Creek	Currently active test well, approved October, 2003. Ongoing test approved to June 2005, with possible extension if there are delays in development of the Perry Creek Phase I Pit
Bullmoose IVa Well	Talisman	Perry Creek	Future Perry Creek Underground Mine area north of Perry Creek North Dump
Proposed Well	Talisman	In the area of the plantsite	Proposed well site under review by both Talisman and Western.
Well	Talisman	North of Perry Creek	To be drilled in 2005.
Pipeline	Talisman Pipeline	North of Perry Creek	Approved in 2005.
Pipeline Designation	Holder		Status
	Westcoast Energy	Wolverine FSR	Constructed, Statutory ROW, Prince George Land Title File 8005177
	Westcoast Energy	Wolverine FSR	Constructed Statutory ROW, Land Title File 0337943

3.5.6.2 Talisman Energy Canada

The increase in Wolverine Mine production to 2.4 Mtpa will not significantly affect interactions with Talisman's operations in the Wolverine Mine area. The following is an update on Talisman's activities in relation to the Wolverine Mine.

Talisman Energy Inc., as operator for various joint venture partners, holds extensive PNG Leases in the Wolverine Mine area, most of which are outside Perry Creek in the EB pit area. Associated wells and pipelines as of May 2004 were documented in the *Additional Information Report* (Figure 4.10-4). Talisman has since established two new well(s), one north of Perry Creek and one in the EB area.

Talisman holds PNG leases in the future Perry Creek Underground Mine area, and has proposed development of a well which is within Talisman's approved mineral license in the plantsite area.

Western has four formal agreements with Talisman related to operations in the areas of overlapping interest:

- an overall Agreement-in-Principle agreement on the Wolverine Project, signed September 2003
- a well and pipeline agreement regarding the Perry 2E Pipeline in the EB Pit area, signed August 2003
- a well and pipeline agreement regarding the a-39-F/93P5 Pipeline, which is pending and for which there are no outstanding issues
- signed an agreement with respect to the construction of a pipeline north of the Perry Creek pit.

The last agreement is important only in the context of EB pit access, as the pipeline follows the Perry Creek Road.

Western is reviewing Talisman's confidential plans for areas of overlapping tenures, with a view to avoiding conflicts between PNG and coal operations. Agreement between WCC and Talisman on Talisman's future activities will be documented in amendments to the existing Joint Use Agreement.

Talisman regularly uses the Wolverine FSR and Perry Creek Road to access the well sites and pipelines in upper Perry Creek. Road construction and traffic management plans will ensure that continuous access is maintained during construction.

The shorter mine life at Perry Creek due to increased production rate may mean that WCC shifts operations to the EB/Mt.Spieker area in 2012. Talisman is more active in that area than at Perry Creek; however, agreement has been reached on all issues of concern, as reported in the *AIR.*

3.5.6.3 Koch Petroleum

Koch Petroleum Canada L.P.'s PNG leases for Coal Bed Methane (CBM) overlap the Perry Creek pit and Plantsite (AIR Figure 4.10-4). Two wells are of interest with respect to the Wolverine Mine.

Koch has a well site overlapping the SP6 pond site which contains a capped CBM well (D-99-B) and a proposed, not drilled, well D-A99-B. During final design for the 1.6 Mtpa mine, the location and configuration of SP6 pond was shifted slightly to direct drainage away from the wetlands in the W6 and W12 drainages, and toward W4. The resulting pond encroaches on Koch's PNG drilling licence 52015 by 35 m. WCC has contacted Koch and has requested approval for overlapping use of this land area. Negotiations are ongoing.

In early 2003, Koch established a CBM test well at A-10-G and road access in the Perry Creek Phase I pit area under authorization from the B.C. Oil and Gas Commission (OGC) (*AIR* Figure 4.10-4). Koch has approval to operate this well until June 2005, or until such time as mine development requires its abandonment for safety reasons. WCC and Koch signed a Letter Agreement in November 2003 with respect to activities and mutual obligations in the well area. On 16 February 2005, WCC notified Koch of proposed clearing activities in the wellsite area.

3.5.6.4 Shell

WCC has been contacted by Shell with regard to their future, potential development in the area of Western's coal lease and licenses. Negotiations are underway.

3.5.7 B.C. Rail

The B.C. Rail Tumbler Ridge Branch Line runs the length of the Wolverine Valley. In the area of the Plantsite, the existing rail line is double tracked, and a wye structure for turning trains is located in the tailings pond area. The existing ROW for the Railroad is owned by B.C. Rail and the rail line is operated by CN Rail. The relocated Wolverine FSR overlaps the B.C. Rail ROW and WCC is working with B.C. Rail and CN Rail to draft a statutory ROW document (between B.C. Rail/CN Rail and MoF) which grants the MOF the necessary rights for the FSR. WCC also has negotiated the use of other areas of the B.C. Rail right of way to accommodate culverts, train load out facilities and tailings facilities. Western will enter into a separate statutory ROW agreement (between Western and B.C. Rail/CN Rail) for these lands. Western has entered into a Release of Liability and Permit, dated 31 March 2005 to cover the use of the lands until such time as the documentation is complete.

In addition to WCC's plan to construct a rail loadout at the Plantsite, WCC will also make improvements to the rail line in the Plantsite area as required to accommodate loading of coal trains.

3.5.8 Terry Ranch

The production increase does not change potential impacts on the B.C. Rail lands**,**

There is one private land holding in proximity to the Project - DL 305 and 306 - covering an approximate area of 139 ha on the west side of the Wolverine River near the Plantsite (AIR Figure 4.10-1). This property, known as the Terry Ranch, is held by Mary Ann Eyben and Ardith Booi, as Executors of the John Terry Estate. The Terry Ranch has a Grazing Tenure, as described in Section 4.10.9. of the AIR.

The Wolverine FSR realignment and South Dump will overlap the northwest corner of Lot 305 (*AIR* Figure 4.10-6). Additional facility overlap and impacts are described in AIR Section 10.7.8. The relationship of key mine components to the ranch is summarized in Table 3-19, including approximate distances to residential buildings (currently seasonally occupied), and the relationship to the boundaries of the District Lot and the associated Grazing Tenure.

WCC has entered into an agreement with the executors of the Estate of John Terry. The overall Offer agreement documents the agreement on the part of the Estate to subdivide and sell the Northwest corner of the Terry Ranch property to WCC and to lease the remaining ranch lands to WCC for the life of the project. The subdivided Northwest corner will contain a road dedication for the relocated Wolverine FSR. The Estate has an Option to Purchase the Northwest corner (except the FSR road dedication) at the end of the mine project.

Table 3-19: Relationships between Key Mine Components & Terry Ranch

Mine Component	Distance to Residential Buildings	Relation to Grazing License Boundary	Relation to District Lot Boundary
Perry Creek pit	~0.8 km	Outside	Outside
South dump	~0.5 km	Partly within	Overlaps northeast corner
Coal haul road	~0.4 km	Partly within	Overlaps northeast corner
Tailings pond	~1.1 km	Within	Outside
Wolverine FSR realignment	~0.4 km	Within	Overlaps northeast corner
Plantsite	~2.5 km	Within	Outside

The production increase does not change potential impacts on the Terry Ranch lands.

3.5.9 Agriculture & Range Lands

A portion of the mine site – approximately 215 ha - will occur within MoF Grazing License RAN072880 held by Mary Ann Eyben and Ardith Booi as executers of the John Terry estate. This tenure was issued 1 January 2001 and remains in effect until 31 December 2005. The total area of the tenure is 2676 ha. It extends along the Wolverine Valley from lower Perry Creek to a point approximately 13 km upstream on the Wolverine River (*AIR* Figure 4.10-1). The Grazing Tenure occupies both the north and south sides of the Wolverine Valley (AIR Figure 4.10-1).

The license holders propose to continue, and potentially increase, grazing activity on the license over the coming years. Under the current tenure and range plan, the tenure holders are permitted to have 20 broodmares with colts. The horses can be pastured on the Grazing Tenure area between June 1st and September 30th annually, after which they must be rotated back to private land – specified as the Terry Ranch under the terms of the tenure. The tenure allows for a total of 80 Animal Unit Months (AUMs), with a 50% Private Land Deduction (PLD). As a result, the tenure allows 40 AUMs on the tenure area, or approximately 65 ha per AUM. The tenure allows for substitution of horses with some cows during the 5 year tenure period.

The tenure holders have indicated to WCC that actual use levels are somewhat lower than what is allowed under the terms of the tenure.

3.5.10 Trapping

The entire Foothills Resource Management Zone (RMZ) is under tenure to trappers, and the maintenance of furbearers and furbearer habitat is important to the continuation of these trapping tenures. The Wolverine Valley and Perry Creek fall within Registered Trap line # 721T006 (AIR Figure 4.10-1). The trap line is actively trapped annually with marten, squirrel, fisher, weasel, mink, wolverine, coyote, wolf and beaver included in the catch. Trapping is active during most of the trapping season (October 15 to May 31) with some preparatory activities during the off-season. The trapper makes heavy use of the existing access roads by automobile, ATV and snowmobile. The location of the trap lines varies from year to year, with trapping occurring in some years in the Perry Creek pit area, and in some years in other parts of the territory.

WCC is currently negotiating with the registered trapper #721T006 and hopes to have an agreement in place within the next two months. In the meantime, the trapper has entered into an agreement with Western with regard to trapping beavers.

The increase in production does not change the potential impacts on this trapping license area.

3.5.11 Guide-Outfitting

Wolverine Guide-Outfitters operates a guided hunting services business within the Wolverine Valley under Guide-Outfitting License 721P998. The license area covers the Wolverine Valley, including the area of the proposed Wolverine Project. Other land uses, including mining, are permitted within the lease area.

The Guide-Outfitter is very active in the area, living at and operating from a base camp established at km 9 on the Wolverine FSR under provisions of the Guide-Outfitting License. The base camp is tenured as a License of Occupation (#8013764). The business currently primarily serves American hunting clientele (A. Didier, pers. comm.). The guided hunting focuses on big game. There is no waterfowl or upland game bird hunting. Although only hunting trips are presently offered, the Guide-Outfitter has plans to offer eco-tourism backcountry trips in the future, with transportation by horse (summer) or by snowmobile (winter).

Wolverine Guide-Outfitters' improvements include a cookhouse and hunters cabins at the base camp; a cabin (helicopter access only) on Mt. Spieker; and various trails constructed and maintained throughout the License area.

The Guide-Outfitter has been building the business over the last few years, and proposes to operate it full time, and pass it down in the family.

The Guide-Outfitter holds a permit from MWLAP to hunt grizzly bear as part of the guided hunting operation.

An agreement has been reached between WCC and the Guide-Outfitter. Documentation of that agreement is underway.

The increase in production does not change the potential impact on the Guide-Outfitting territory.

3.5.12 Roads

There are two main roads in and providing access to the Wolverine Project area – the Wolverine Forest Service Road (FSR), which is under the jurisdiction of and controlled by the Ministry of Forests, and the Perry Creek Road, which is a non-status road.

The Wolverine FSR is an all weather road that provides the main access to the minesite from Highway 29. The B.C. Ministry of Forests holds a Right-of-Way (ROW) for, and controls use of, the road. The current ROW width is 20 m. Canfor is the designated primary user of the road, and is responsible for routine road maintenance. Other road users, including WCC, have road use agreements with Canfor.

The Perry Creek Road is a non-status road. This road is maintained as needed by the road users, currently Talisman.

3.5.13 Powerline

Electrical power requirements for the site will be served by power obtained from B.C. Hydro's Tumbler Ridge Substation via an existing powerline (upgrades required) to the Wolverine FSR, and then by a new powerline to be constructed along the Wolverine FSR to the Minesite.

3.5.14 Recreation

3.5.14.1 Commercial

The Revised Project description Report identified that the Mistahaya Wayatinaw Tourism Co-operative held a 2-year Commercial Recreation Temporary Use Permit (#8013790) authorizing the use of six parcels of land in the Peace River District for a range of guided recreation activities. One of the six Activity Areas, Spieker Mountain Trail, was comprised of approximately 1080 ha of unsurveyed Crown land in the vicinity of Mt Spieker, and overlapped the EB Pit area. Discussions with representatives of the Co-operative in the fall of 2003 indicated that there had been no active use of the Permit in that area. Land and Water B.C. Inc. (LWBC) has confirmed that the Permit expired in February 2004.

3.5.14.2 Dispersed Non-Commercial

Recreation resources of the study area were documented as part of the early studies on the northeast coal block . Recreational activities and opportunities in the Foothills RMZ were documented more recently in conjunction with development of the Dawson Creek Land and

Resource Management Plan (LRMP). These include wildlife viewing, camping, fishing, hunting, hiking, berry picking and horseback riding.

Recreation Opportunity Spectrum (ROS) classes within the RMZ are mainly 'semi-primitive motorized' (SPM) and 'resource road' (RR) with some 'semi-primitive non-motorized' (SPNM). Motorized recreational activities include snowmobiling and all-terrain vehicle (ATV) use.

The Tumbler Ridge Snowmobile Association maintains a “cabin” (old bus) in the headwaters of Perry Creek. The Perry Creek Road is registered with Ministry of Forests as a snowmobile trail. Use levels are reported by the President of the association to be low in relation to other more popular destinations, with approximately 15 snowmobilers using the proposed mine area.

Mt. Spieker offers hiking trails with easy access to alpine areas, wilderness, and mountain scenery. It is one of a number of hiking areas in the Tumbler Ridge area, although those in Monkman Provincial Park are better known and probably receive more use.

3.5.15 Wildlife & Fisheries Resources

Information on wildlife and fisheries resources and on potential changes in impacts due to the Revised Project is presented in Section 4. Both fish and wildlife are valued in terms of local recreational use and by First Nations in relation to sustenance use and other traditional values.

3.6 Reclamation Plan (EA Level)

3.6.1 Overview

The following section presents an outline of reclamation activities and plans based on the revised mining schedule for Perry Creek pit. The criteria for soil salvage and replacement and post closure ecosystems remain unchanged from the information presented in the Certificate and Permit applications.

Revised reclamation liability costing, based on changes to the reclamation sequence will be developed and submitted under a separate cover.

3.6.2 Soil Handling Plan

Table 3-20 and Figure 3.6-1 provide a summary of the soil salvage schedule and stockpile plan for the revised Perry Creek pit mining schedule. The total quantity of topsoil scheduled for salvage (“T” and “B” Class) remains the same as presented in the Permit application.

The main change from the previous schedule is the additional quantity (162,300 BCM) salvaged in the pre-production period from Perry Creek pit, East dump and North dump for pit and dump development and road construction. The revised mining schedule combined with the revised reclamation schedule also allows for more direct placement of topsoil.

Table 3-20: Perry Creek Pit: Soil Salvage & Stockpiles

Periods/Area	TSP 1	TSP 2	TSP 3	TSP 4	TSP 5	TSP 6	TSP 7	TSP 8	TSP 9	TSP 10	TSP 11	TSP 12	TSP 13	TSP 14	TSP 15	TSP 16	Direct Place	Total
Pre-Production																		
CCR	46,500																	46,500
Plantsite	43,500	5,000	9,000	8,900	55,000	20,000	13,000	42,000										196,400
Tailings Embankment								249,600										249,600
SP12										37,300								37,300
SP6											20,300							20,300
South dump								68,400	173,700	197,000								439,100
Perry Creek pit										310,700							32,500	343,200
East dump														106,100				106,100
North dump												41,300						41,300
Explosive Storage															19,000			19,000
Sub-Total	90,000	5,000	9,000	8,900	55,000	20,000	13,000	360,000	173,700	545,000	20,300	41,300	0	106,100	19,000		32,500	1,498,800
Year 1																		0
Perry Creek pit																		0
East dump														72,700	86,700		48,500	207,900
North dump												0						0
Sub-Total	0	0	0	0	0	0	0	0	0	0	0	0	0	72,700	86,700		48,500	207,900
Year 2																		0
East dump																	141,500	141,500
North dump												41,200	0					41,200
Sub-Total	0	0	0	0	0	0	0	0	0	0	0	41,200	0	0	0		141,500	182,700
Year 3																		0
Perry Creek pit																	21,200	21,200
East dump																		0
North dump												114,200	43,500					157,700
SP4 Pond																	12,500	12,500
Sub-Total	0	0	0	0	0	0	0	0	0	0	0	114,200	43,500	0	0	0	33,700	191,400
Year 4																		0
East dump														38,500			32,500	71,000
SP4																		0
Sub-Total	0	0	0	0	0	0	0	0	0	0	0	0	0	38,500	0	0	32,500	71,000
Total	90,000	5,000	9,000	8,900	55,000	20,000	13,000	360,000	173,700	545,000	20,300	196,700	43,500	217,300	105,700	0	288,700	2,151,800

3.6.3 Perry Creek Reclamation Sequence

Following is a brief discussion of planned reclamation activities in the mining areas during the pre-production period and each year of operation. These activities are depicted on the respective periods site activity drawing: Figures 2.1-1 through to 2.1-7.

Pre-Production

During the pre-production period small areas of the East dump slope above the W6 rock drain and the South dump slope above the SP6 drainage ditch will be reclaimed (resloped, resurfaced with topsoil and the revegetation program started if timing permits). Pre-Production reclamation activities are presented in Table 3-21.

Table 3-21: Pre-Production Reclamation Activities

Area	Resloping (ha)	Soil Replacement		
		Depth (cm)	Hectares (ha)	M^3
South dump	3.5	50	3.5	17,500
East dump	3.0	50	3.0	15,000

Year 1

With the faster development of South dump, reclamation work on the northeast end will start in Year 1 (versus Year 3 in the Permit application). During this time frame the East dump slopes above the SP4a drainage ditch and Perry Creek road re-alignment will also be reclaimed. Year 1 reclamation activities are presented in Table 3-22.

Table 3-22: Year 1 Reclamation Activities

Area	Resloping (ha)	Soil Replacement		
		Depth (cm)	Hectares (ha)	M^3
South dump	6.5	50	6.5	32,500
East dump	3.2	50	3.2	16,000

Year 2

As South dump develops in an ascending fashion and to the southeast, the northeast end of the dump will be progressively reclaimed. Year 2 reclamation activities are presented in Table 3-23.

Table 3-23: Year 2 Reclamation Activities

Area	Resloping (ha)	Soil Replacement		
		Depth (cm)	Hectares (ha)	M^3
South dump	31.0	50	31.0	155,200

Year 3

During this time frame reclamation work will continue on South dump, begins (soil replacement only) on a portion of the pit floor footwall slope and address a small area on the lower slope of East dump. Year 3 reclamation activities are presented in Table 3-24.

Table 3-24: Year 3 Reclamation Activities

Area	Resloping (ha)	Soil Replacement		
		Depth (cm)	Hectares (ha)	M^3
South dump	21.1	50	21.1	105,500
East dump	1.9	50	1.9	9,500
Perry Creek pit	-	50	19.0	95,000

Year 4

During Year 4 mining is completed on the upper benches at the south end of the pit allowing soil replacement over that area and construction is completed on North dump allowing that area and its associated haul roads to be reclaimed. Year 4 reclamation activities are presented in Table 3-25.

Table 3-25: Year 4 Reclamation Activities

Area	Resloping (ha)	Soil Replacement		
		Depth (cm)	Hectares (ha)	M^3
North dump	53.0	40	53.0	212,000
Perry Creek pit	-	50	6.5	32,500

Year 5

In Year 5 reclamation work will start on the main coal haul road (part of South dump) in a top to bottom direction, the 910 backfill pad in the Perry Creek pit will be placed and surfaced with topsoil and reclamation work will continue on the lower slopes on East dump. Year 5 reclamation activities are shown in Table 3-26.

Table 3-26: Year 5 Reclamation Activity

Area	Resloping (ha)	Soil Replacement		
		Depth (cm)	Hectares (ha)	M^3
South dump	17.6	50	17.6	88,000
East dump	15.8	50	15.8	79,000
Perry Creek pit	-	50	23.7	118,500

Year 6

Perry Creek pit will be mined out early in Year 6 allowing the completion of reclamation work on South dump and East dump and on the pit floor footwall slope in Perry Creek pit. Year 6 reclamation activities are presented in Table 3-27.

Table 3-27: Year 6 Reclamation Activity

Area	Resloping (ha)	Soil Replacement		
		Depth (cm)	Hectares (ha)	M^3
South dump	22.0	50	22.0	110,000
East dump	74.9	50	74.9	374,500
Perry Creek pit	-	50	36.2	181,000

3.6.4 Conceptual Reclamation Plan: Mine Closure

The conceptual closure plans for all mine components, including the Plantsite and post-closure monitoring remains unchanged from what was described and depicted in the Permit application.

3.7 Monitoring (General – EA Level)

3.7.1 Effluent & Receiving Water Quality Monitoring

A proposed construction phase monitoring program has been submitted to MWLAP with the Effluent Permit Application. The construction phase monitoring program, presented in Table 3-28, closely resembles the program proposed in Tables 10.9.4-2, 10.9.4-3, and 10.9.5-1 of the *AIR*, with the following modifications:

- Frequency of monitoring settling pond decant flows and immediately downstream receiving waters has increased from weekly during freshet and monthly for remainder of year, to three times a week or weekly, with daily field measurements if a trigger threshold is reached.
- Monthly Total Extractable Hydrocarbons (TEH) has been added to the list of analytes for ponds SP6, SP12, SP14, and SP18.

- 96 hour LC^{50} tests have been added to the SP12 decant, and will be performed whenever the flocculation plan is in operation, to check for toxicity associated with residual coagulant chemical.
- Dewatering flows for the SP12 and Tailings Impoundment construction areas have been added to the list of monitored sites.
- Background sampling sites have been added to the Upper Diversion and the CCR Diversion, to provide a comparative result to assess the performance of the constructed diversions.

Effluent and water quality monitoring sites are shown on Figs. 3.7-1 and 3.7-2. SP12 effluent will flow through Oxbow 2, into a constructed B.C. Rail Ditch and then into the Wolverine River. This constructed ditch has been identified as fish habitat (Diversified Environmental Services, 2004), presented in Appendix 15 of the *Mine Permit Application*, and Appendix 13 of the *TAR*. The SP12 effluent quality monitoring point (SP12-2) has therefore been moved from the actual pond decant to the upstream end of the B.C. Rail Ditch, to demonstrate compliance at this location.

A proposed monitoring program has not yet been submitted to MWLAP for the operational effluent permit. It is expected that it will be very similar to the construction phase monitoring program listed in Table 3-28, except dewatering flows will be dropped and the intercepted tailings seepage flow, which is recycled to the tailings supernatant pond, will be added. This flow will be sampled at a monthly frequency as a composite from the seven seepage interception wells (see well locations on Figure 2.1-1 through 2.1-7).

Some of the monitoring frequencies for the operational monitoring program will also be reduced from those proposed in the *AIR*, pending an assessment of the construction phase monitoring data and documented performance of the diversions and sediment control measures. It is expected that monitoring frequencies for the clean water diversions and some of the receiving waters will be reduced to weekly and monthly, from the construction phase schedule of three times per week and weekly.

3.7.2 Operational Monitoring for ARD

Section 3.6.7 of the Permit application describes the ARD Monitoring and Analysis Plans for the waste rock, CCR, tailings and dryer ash which will be further detailed in the OMS Manuals. Operational monitoring proposed by WCC will continue to evaluate the appropriateness of the revised CaNP measurement during operations for the materials that have been identified to have acid generating potential by the EA and permitting studies.

Table 3-28: Monitoring & Reporting Summary Table / Wolverine Project: Construction Phase

	Water Quality Sampling Site	Field Turbidity	pH, Field Turbidity, Field Conductivity	Lab TSS, Turbidity, Conductivity	Temp, Lab TSS, TDS, Turb., Conductivity, pH, Major anions, Ammonia, TKN, Nitrate, Nitrite, Total phosphate, Diss orthophosphate, Alkalinity, Hardness, Sulphate, TOC, PAH	Dissolved ICMPS Metals	Total ICMPS Metals	T E H	96 Hour LC_{50}	Flow (see note 3)
Report results within		7 days	7 days	30 days	30 days	30 days	30 days	30 days	30 days	Annual
Process flows										
Batch Plant sed pond	None envisaged	closed system - receiving water sampling only								
Camp Sewage Exfiltration Basin	STP discharge				see Note 6					
Effluent Flows [4]										
SP4a Decant	SP4a-1	3, D (Note 2)	W if flow	W, D (note 2)	-	-	-	-	-	W - (D see Note 3)
SP6 Inlet (W6)	SP6-1	3, D (Note 2)	W	W	-	-	-	-	-	-
SP6 Decant	SP6-2 [7]	3, D (Note 2)	W if flow	W, D (note 2)	M	-	M	M	-	Continuous
SP6 Fan (SP12 Dewatering)	SP6-3	3, D (Note 2)	W if flow	W, D (note 2)	-	-	-	-	-	-
SP12 Inlet (W12)	SP12-1	3, D (Note 2)	W if flow	W	-	-	-	-	-	-
SP12 Decant	SP12-2	3, D (Note 2)	W if flow	W, D (note 2)	M if flow	-	M if flow	M if flow	W if floccing	Continuous
SP 14 Decant	SP14-1	3, D (Note 2)	W if flow	W, D (note 2)	-	-	-	M if flow	-	W - (D see Note 3)
SP18 Decant	SP18-1	3, D (Note 2)	W if flow	W, D (note 2)	-	-	-	M if flow	-	W - (D see Note 3)
SP EXP Decant	W2-1 [7]	3, D (Note 2)	W if flow	W, D (note 2)	-	-	-	Q	-	W
Tailings Dewatering	Pumped	3, D (Note 2)	W if flow	W, D (note 2)	-	-	-	-	-	D
Background Flows [4]										
W14 u/s	W14-1	3, D (Note 2)	W	W, D (note 2)	M	-	M	-	-	Continuous

	Water Quality Sampling Site	Field Turbidity	pH, Field Turbidity, Field Conductivity	Lab TSS, Turbidity, Conductivity	Temp, Lab TSS, TDS, Turb., Conductivity, pH, Major anions, Ammonia, TKN, Nitrate, Nitrite, Total phosphate, Diss orthophosphate, Alkalinity, Hardness, Sulphate, TOC, PAH	Dissolved ICMPS Metals	Total ICMPS Metals	T E H	96 Hour LC_{50}	Flow (see note 3)
CCR u/s	CCR-1	3, D (Note 2)	W	W, D (note 2)	-	-	-	-	-	-
Upper Diversion (u/s)	UD-1	3, D (Note 2)	W if flow	W, D (note 2)	-	-	-	-	-	-
Perry Creek u/s	PC-2	-	W	W	M	M	M	-	-	Continuous
Wolverine River (u/s)	WR-1	-	W	W	M	M	M	-	-	-
Report results within		7 days	7 days	30 days	30 days	30 days	30 days	30 days	30 days	Annual
Receiving Surface Water [4]										
W14 d/s	W14-2	3, D (Note 2)	W	W, D (note 2)	M	-	M	-	-	
CCR d/s	CCR-2	3, D (Note 2)	W	W, D (note 2)	-	-	-	-	-	-
Upper Diversion (d/s)	UD-2	3, D (Note 2)	W	W, D (note 2)	-	-	-	-	-	-
W4 at FSR	W4-1	3, D (Note 2)	W if flow	W if flow	M if flow	-	M if flow	-	-	-
Perry Creek (d/s)	PC-3	-	W	W	M	M	M	-	-	-
Wolverine River (d/s)	WR-2	-	-	-	M	M	M	-	-	See note 5
	WR-3	-	-	-	M	M	M	-	-	-
	WR-4	-	W	W	M	M	M	-	-	-
Receiving Groundwater										
CCR area	MW-1	-	-	-	Q (no PAH or TOC)	Q	Q	-	-	Q (water level)
Plantsite Area	MW-2	-	-	-	Q (no PAH or TOC)	Q	Q	-	-	Q (water level)
Tailings Area	MW-3	-	-	-	Q (no PAH or TOC)	Q	Q	-	-	Q (water level)
South Dump Area	MW-4 / MW-5	-	-	-	Q (no PAH or TOC)	Q	Q	-	-	Q (water level)
Pit and South Dump Area	MW-6	-	-	-	Q (no PAH or TOC)	Q	Q	-	-	Q (water level)

	Water Quality Sampling Site	Field Turbidity	pH, Field Turbidity, Field Conductivity	Lab TSS, Turbidity, Conductivity	Temp, Lab TSS, TDS, Turb., Conductivity, pH, Major anions, Ammonia, TKN, Nitrate, Nitrite, Total phosphate, Diss orthophosphate, Alkalinity, Hardness, Sulphate, TOC, PAH	Dissolved ICMPS Metals	Total ICMPS Metals	T E H	96 Hour LC_{50}	Flow (see note 3)
East Dump Area	MW-7 / 8	-	-	-	Q (no PAH or TOC)	Q	Q	-	-	Q (water level)

Notes: 1. Q = Quarterly, B = Bimonthly, M = Monthly, W = Weekly, 3 = Monday, Wednesday, Friday, D = Daily. **2.** Sampling at lower frequency unless turbidity exceeds 75 NTU or SP12 flow exceeds 0.2 m^3/s, when frequency will step up to daily for duration of elevated turbidity/flow. **3.** Flow monitoring for ponds will be at pond decants, and will not be initiated at SP4a, SP EXP, SP12 , SP14 and SP18 until the ponds are commissioned. W6 flow will be monitored with staff gauge in channel, prior to SP6 commissioning. Monitoring at all manual sites will increase to daily when SP12 flow > 0.2 m^3/s. **4.** TSS monitoring on weekly schedule to reflect risk during construction period, to provide additional baseline data and to establish turbidity - TSS relationship. **5.** Wolverine River flows will be measured at Mast Creek bridge. Weekly April 1 to November 30, Monthly December 1 to April 1 when not frozen. Additional spot measurements during flood events **6.** Monthly monitoring of pH, conductance, nitrate, ammonia, dissolved orthorphosphate, total phosphate, BOD, TSS and total/fecal coliform. **7.** If these sites are dry at time of monthly sampling, samples would be collected from pond decant flow or from water stored in pond.

3.7.3 Dustfall Monitoring Program

3.7.3.1 Overview

Total dustfall particulate samples will be collected from the Wolverine Mine sites to determine if provincial air quality objectives are being met and to assess the effectiveness of the Wolverine Mine Air Quality Management Plan. The Ministry dustfall objective is 1.75 mg/dm^2/d based on a monthly average. Since there are no private properties near the site, the main concern is deposition of coal dust into streambeds.

3.7.3.2 Dustfall Monitoring Locations

The selection of appropriate dustfall sampling locations should consider the potential sources of fugitive dust and coal dust from the mine including major sources such as blasting, coal crushing and processing, bulldozing and roadways, as well as, the dominant wind directions that will affect dispersion. Monitoring at several distances from sources of fugitive dust would also permit an assessment of how particulate matter concentrations will decrease with distance.

The meteorological data from the Tumbler Ridge station indicates that the predominant winds are from the southwest. The data also indicates that during the winter northerly winds are also common. Although winds at the Wolverine Mine site may vary from those measured at the Tumbler Ridge Station, this is the best source of information available to prepare the dust fall monitoring program.

Based on the wind frequency data available, sampling sites should be placed to the northeast of the mine site and to south of the mine site to consider the dominant wind directions.

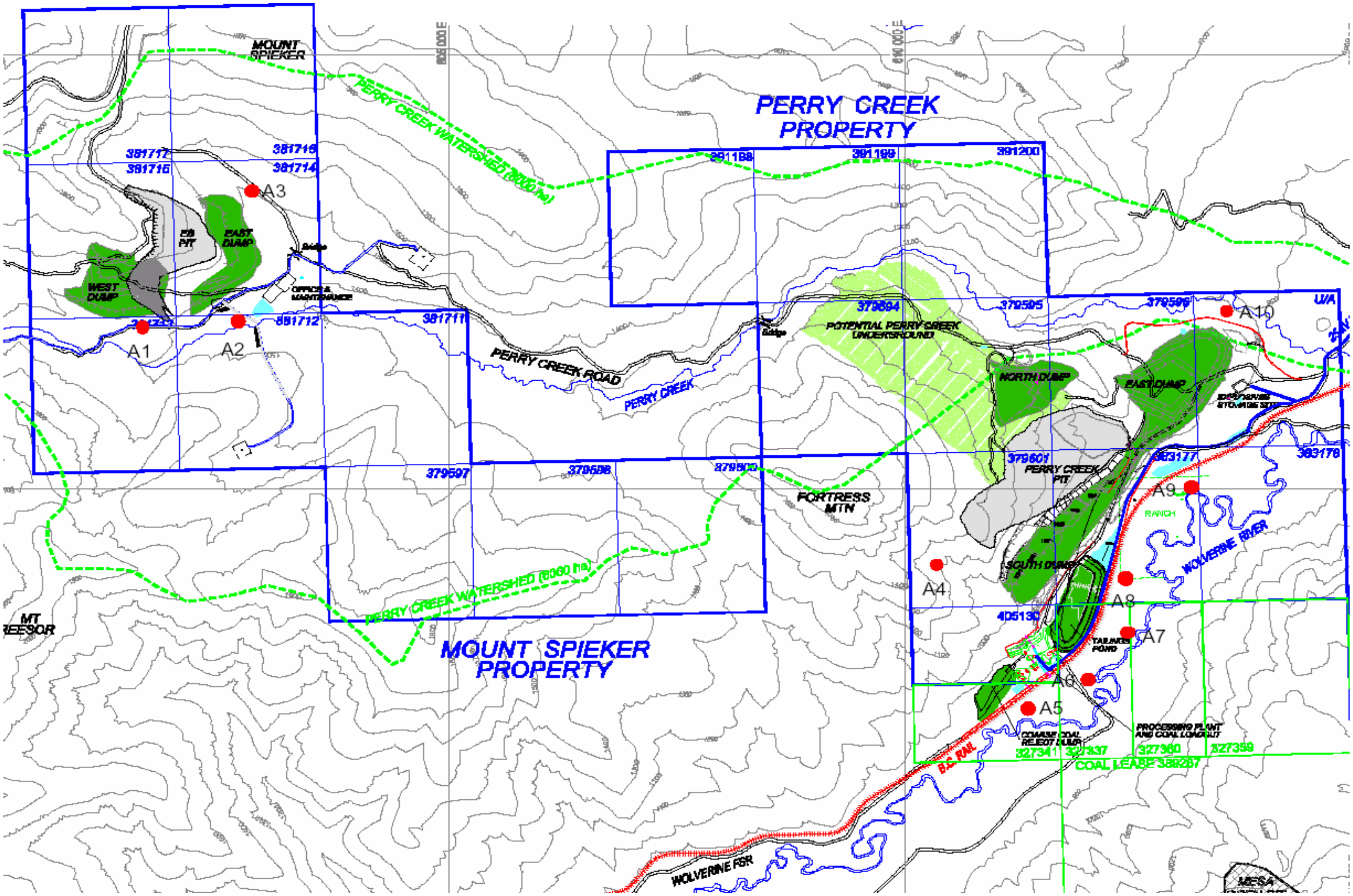
Most of the visible deposition of large dust particles is predicted to occur within a few hundred metres of the fugitive dust emission sources at the Wolverine Mine. Fine particles (i.e., those less than 10 microns) may be transported larger distances from the source and the distance they are transported is dependent on wind speed, meteorological conditions, terrain and vegetation cover. For this reason sampling locations were selected between 100 and 1000 metres to demonstrate how dustfall concentrations will decrease with distance from the Wolverine Mine site.

A total of 10 sampling sites are proposed. The sites were chosen to consider the predominant wind directions, measure dustfall near streambeds and to provide accessibility to the site. Approximate locations of the proposed sampling sites and rationale for their selection are provided in Table 3-29 and shown in Figure 3.7-4.

Table 3-29: Proposed Dustfall Monitoring Locations & Selection Rationale

Sampling Site Label	Description of Location	Rationale for Selection
A1	South of West Dump and EB pit	Location will consider northwesterly winds frequent in winter for fugitive dust emissions from the West Dump.
A2	Southeast of the West Dump, EB pit, and East Dump along Perry Creek	Location will consider northwesterly winds frequent in winter for fugitive dust emissions from the pit and dumps, and monitor deposition along Perry Creek.
A3	Northeast for the EB pit and East dump	Location will consider predominant southwesterly winds for fugitive dust emissions from pit activities and dumps.
A4	Southwest of Perry Creek pit, west of South Dump, and northwest of plant site	Location will monitor deposition near creek.
A5	South of plant site and loadout, southeast of coarse coal reject dump	Location will monitor deposition along Wolverine River.
A6	East of plant site and south of tailings pond	Location will monitor deposition along Wolverine River.
A7	East of Tailings Pond, northeast of plant site	Location will consider predominant southwesterly winds for fugitive dust emissions from the plant site, loadout and tailings pond, and monitor deposition along Wolverine River.
A8	Northeast of Tailings Pond	Location will consider predominant southwesterly winds for fugitive dust emissions from the tailings pond.
A9	East of Perry Creek pit	Location will consider predominant southwesterly winds for fugitive dust emissions from pit activities, dumps, and tailings pond, and monitor deposition along Wolverine River.
A10	Northeast of East dump	Location will consider predominant southwesterly winds for fugitive dust emissions from the East Dump and monitor deposition along Perry Creek.

Figure 3.7-4: Dustfall Monitoring Locations



3.7.3.3 Sampling Frequency

The dustfall monitors will be maintained for one year after mine start up. Data will be evaluated at that time to determine whether any measurable effects attributable to mining activities are evident from the data. The program will be evaluated and adjusted in consultation with MWLAP.

3.7.3.4 Analysis Method

Sampling methods will comply with procedures described in the British Columbia Field Sampling Guide. Laboratory analysis of each sample will include the combustible fraction of the dustfall in addition to the measurement of total mass.

3.7.3.5 Reporting

The dustfall monitoring results will be submitted by the analyzing laboratory, by fax, once a month upon completion of the analysis. Dustfall monitoring results that exceed the Ministry objective at the creeks will be examined to determine the likely cause of the exceedence. Wind speed and direction data measured at the site during the applicable monitoring period will be used to identify likely sources of fugitive dust. Where mining sources of fugitive dust are related to exceedences of the ministry dustfall objective at creek locations, the air quality management plan will be reviewed and dust management actions implemented as necessary.

3.7.4 Selenium Monitoring

The *Selenium Management Plan* requires that both water quality and sediment quality be monitored in the receiving water courses. The monitoring program that will be implemented for the Selenium Management Plan is summarized in Table 3-25. Sampling sites are shown on Figs. 3.7-1, 3.7-2, and 3.7-3. Sampling efforts will not be duplicated where Selenium Management Plan monitoring overlaps the effluent monitoring program.

The cumulative effects monitoring program proposed in the *AIR* (Table 10.9.4-2) has been incorporated into Table 3-29, except that the upstream WR-0 sampling site and the tributaries that drain the Quintette Mine have been dropped. The WR-0 site, located upstream of the B.C. Rail tunnel, has been dropped, as WR-1 is considered to provide the upstream background data. The tributaries that drain the Quintette site have been dropped, as we understand that these are now being monitored by the Quintette Operating Company (QOC).

Table 3-30: Recommended Monitoring Related to Selenium Management Plan: Construction Phase

Site (Italics indicates monitoring site included on TAR Table 8-1)	Sampling Site	Water Quality (dissolved/total metals, physical parameters, nutrients, major ions)	Sediment Chemistry (total metals, grain size, total organic carbon)	Periphyton (selenium tissue content, composition)	Benthic Invertebrates (selenium tissue content, composition)	Fish (selenium tissue content)
Effluent Flows [4]						
SP6 Decant	*SP6-2*	*M*	-	-	-	-
SP12 Decant	*SP12-2*	*M (Note 2)*	-	-	-	-
Lotic Environments [4]						
Perry Creek	*PC-2*	*M*	-	-	-	A
	PC-3	*M*	Note 3	Note 3	Note 3	
	WR-1	*M*	Note 4	Note 4	Note 4	A
Wolverine River	*WR-2*	*M*	Note 4	Note 4	Note 4	A
	WR-3	*M*	Note 4	Note 4	Note 4	A
	WR-4	*M*	Note 4	Note 4	Note 4	A
	WR-5	3x/year (Note 5)	-	-	-	-
Cumulative Effects Stations	WR-6	3x/year (Note 5)	-	-	-	-
	MR-1	3x/year (Note 5)	-	-	-	-
Lentic Environments between Project Area and Wolverine River	Oxbow-1	2x/year (Note 6)	Note 7	Note 7	Note 7	-
Oxbows	Oxbow-3	2x/year (Note 6)	Note 7	Note 7	Note 7	-
	Oxbow-4	2x/year (Note 6)	Note 7	Note 7	Note 7	-
Terry Ranch Wetland	W6-2	2x/year (Note 6)	Note 7	Note 7	Note 7	-
	W6-3	2x/year (Note 6)	Note 7	Note 7	Note 7	-
Lentic Environments along Main Stem of Wolverine River	LTS-1	Note 8		-	-	-
	LTS-2	Note 8		-	-	-
	LTS-3	Note 8		-	-	-
	LTS-4	Note 8		-	-	-
	LTS-5	Note 8		-	-	-
Receiving Groundwater						
CCR area	*MW-1*	*Q*	-	-	-	-
Plantsite Area	*MW-2*	*Q*	-	-	-	-
Tailings Area	*MW-3*	*Q*	-	-	-	-
South Dump Area	*MW-4 / MW-5*	*Q*	-	-	-	-
Pit and South Dump Area	*MW-6*	*Q*	-	-	-	-
East Dump Area	*MW-7 / 8*	*Q*	-	-	-	-

Notes: 1. M = Monthly, Q = Quarterly, A = Annually. **2.** Baseline conditions with respect to WQ, sediments, periphyton, benthos and selenium in fish tissue will be characterized in constructed stream channel as part of 2005 sampling. **3.** Monitoring of sediments, benthic invertebrates and periphyton will commence on a yearly basis at PC-3 following the construction phase of the EB pit operation. **4.** Baseline sediment sampling will be conducted in 2005. The need for additional sediment sampling will be assessed following the results of the 2005 program. **5.** During the pre-production period, Cumulative Effects stations on the Wolverine and Murray Rivers will be sampled three times per year during major flow periods (freshet, summer low flow, winter low flow). During operations, these stations will be sampled if it is demonstrated that the Wolverine Project contributes to elevated selenium levels in the Wolverine River. **6.** Water quality in lentic zones between Project Area and Wolverine River will be monitored in Spring and Fall. **7.** Sediments, periphyton and benthos will be re-characterized in lentic zones as part of sampling to be conducted in 2005. Subsequent monitoring during operations of these components will be triggered by water quality selenium levels as per Monitoring Framework (Section 7.1). **8.** LTS stations will be sampled if it is demonstrated that the Wolverine Project contributes to elevated selenium levels in the Wolverine River

Section 4 • Archaeology

4.1 Overview

The EA and Mine Permit Amendments will not result in a change to the project footprint, therefore, no additional archaeology studies have been conducted since the presentation of previous reports. The results of the archaeology assessments conducted by Landsong Heritage Consultants Ltd. were reported at various stages during the EA and Mine Permit Application process. See *AIR* Sections 3.11.2.4, 4.11.8, 6, and App N. Results of a Traditional Land Use Study were presented in Appendix 9 of the *Mine Permit Application*. As a result of the traditional land use findings, a list of vegetation species appropriate for revegetation was incorporated into the reclamation plan.

Further to the information presented in the *AIR* is the report presented in the Wolverine Coal Project *Addendum Report* (July 2004). This report presented the results of an archaeological assessment of the proposed WCC Power Line Right-of-Way, Lateral Power Line Right-of-Way, and Explosives Site. The report stated that the development area was tested extensively, and that no archaeological concerns exist within, or directly adjacent to the proposed development areas.

Section 5 • Socio-Economic

Construction spending locally and in the region will be increased due to the increased plant size. At current prices, funds available to WCC to spend financing its other coal projects in the region will be increased by approximately $50 million in each of the first two years of operation at the 2.4 Mtpa rate vs. 1.6 Mtpa. Depending on later coal prices, a significant portion of this would represent increased income rather than just accelerated income.

During the initial years, there would be a small increase on the demand for housing and municipal services due to the 10 to 20 person increase in the expected workforce. There would be a greater impact if and when additional production capacity outside the Perry Creek pit is brought on line to sustain the production increase.

Section 6 • Summary of Residual & Cumulative Impacts

6.1 Residual & Cumulative Impacts on Water Quality

As part of the surface water quality impact assessment, the following parameters were discussed with respect to the potential for residual and/or cumulative effects:

- Nitrogen compounds (nitrate, ammonia, nitrite)
- Selenium
- Sulphate
- Metals
- Phosphorus
- Dust and Emissions (including coal dust)
- Process Chemicals
- Total Suspended Solids.

As discussed above, the water quality predictions for nitrogen compounds, selenium, other metals and sulphate for the 2.4 Mtpa project do not change from the original predictions presented in the *AIR*. Accordingly, the residual and cumulative impact assessments associated with these parameters also remain unchanged. In the following sections, considerations for residual impacts and/or cumulative effects are discussed with respect to phosphorus; dust and emissions; process chemicals; and total suspended solids.

6.1.1 Phosphorus

As per Section 12.8.5 of the *AIR*, elevated phosphorus concentrations will be associated with sewage effluents from the preparation plant, as well as from the maintenance and office building. For the preparation plant sewage system, an aerobic treatment unit will be used in combination with a conventional disposal field. Conversely, the tertiary quality effluent from the wastewater treatment plant at the maintenance and office building will be pumped to the tailings pond. As per the impact calculations presented in Section 12.8.5 of the *AIR*, it was demonstrated that phosphorus loadings to groundwater beneath the disposal field and Tailings Pond will be negligible due to the phosphate storage potential of the underlying soils. Given that the work force is predicted to increase by only 10% as part of the 2.4 Mtpa operation, it can be concluded that loadings of phosphorus to groundwater will not change significantly as part of the 2.4 Mtpa operation. Accordingly, it can be concluded that the potential impacts to the Wolverine River and associated upstream lentic habitat will be insignificant. Given the above discussion, there are no cumulative effects predicted for phosphorus loadings from the Plant Site.

6.1.2 Dust & Emissions

As part of the impact assessment for the Wolverine Project, the contribution of loadings of fugitive dust to air quality was assessed (Section 12.7 of *AIR*). Such information was used to formulate an impact assessment of dust and emissions on water quality and aquatic resources (Section 12.8.7). The assessment demonstrated that dust inputs will have a negligible impact on water quality and aquatic resources.

Impacts of fugitive dust on water quality were estimated using the worst-case dust concentrations predicted from the model at the John Terry Ranch, assuming a maximum footprint of disturbed ground. Given that the maximum footprint of mine-related disturbances does not change as part of the 2.4 MT expansion project, “worst-case” conditions remain unchanged. Therefore, the impact predictions presented in Section 12.8.7 of the *AIR* do not change.

6.1.3 Fugitive Coal Dust

Currently there are no other major industrial sources of coal dust emissions within a radius of 10 km of the Wolverine site. Therefore, the cumulative impact of fugitive coal dust emissions from the mining operations is expected to be similar to the impact due to the Wolverine Coal Project mining operations alone.

6.1.4 Fugitive Crustal Dust

Logging activities and limited oil and gas exploration occur within and around the Wolverine site, but there are currently no major sources of particulate emissions from facilities within a radius of 10 km. Road traffic from commercial users of the Wolverine Forest Service Road, including Canfor and Shell, will result in some fugitive crustal dust emissions. These commercial users account for a significant percentage of overall traffic during the winter months between October and February. However, fugitive dust emissions are significantly reduced during winter months from unpaved roads due to snow and ice cover of the roads. Therefore, the overall impacts due to emissions other than from the Wolverine Coal Project are small within the 10 km radius of the air quality study area.

6.1.5 Coal Dryer Emissions

Ground-level concentrations of NO_2 and PM_{10} resulting from the coal dryer emissions combined with other sources of combustion (mining fleet and diesel engines) may exceed B.C. air quality objectives on the Wolverine property near the coal dryer. Since the major source of emissions will be from the coal dryer, any impacts that may occur will be infrequent. Cumulative impacts outside of the Wolverine coal license are expected to be minimal.

6.1.6 Greenhouse Gases

Greenhouse gas emissions have a global effect that cannot easily be measured on a local or regional scale. Cumulative impacts of greenhouse gas emissions associated with the Wolverine Coal Project are low when compared to provincial and national estimates. The estimate of annual greenhouse gas emissions from the Project represents a 0.25% increase relative to the year 2002 greenhouse gas emissions for British Columbia (Canada's Greenhouse Gas Inventory 1990-2002).

6.1.7 Residual Impacts

A residual impact matrix for the project is presented in Table 6-1 and evaluates fugitive dust emissions, greenhouse gas emissions and coal dryer emissions for the different phases of the project.

6.1.8 Process Chemicals

As described in Section 12.8.8 of the *AIR*, process chemicals to be added to the mill stream include fuel oil (e.g., diesel), flocculants, MIBC (methyl isobutyl carbinol) and magnetite. Of these, residual quantities of fuel oil, flocculants, and MIBC may be expected in the effluents discharged to the tailings pond, with the exposure pathway to the receiving environment being through tailings pond seepage to groundwater. Given that quantities of these consumables within the plant will be precisely controlled in order to minimize reagent costs, as well as to maximize coal recovery, the residual quantities of these consumable are not predicted to increase significantly as part of the 2.4 Mtpa project. As outlined in Section 12.8.8 of the *AIR*, the volatile nature (MIBC) and particle reactive properties (MIBC, diesel, flocculants) of the additives suggest that impacts to the Wolverine River and associated upstream lentic habitat will be negligible.

6.1.9 Total Suspended Solids

Increased production associated with the 2.4 Mtpa project does not affect the performance of erosion control measures or sedimentation ponds. Given these considerations, the export of total suspended solids/turbidity from the sedimentation ponds is predicted to exert negligible impacts to the receiving environment. The same conclusion also applies to the export of TSS/turbidity from both the Upper and CCR Diversions, which will be designed to minimize erosion. Details of the plans for erosion prevention and sediment control are provided in Piteau (2005) (Appendix 4, *Mine Permit Application*).

Table 6-1 : Residual Impact Matrix for Air Quality

Project Phase	Impact	Evaluation of Criteria for Assessing Significance						Residual Environmental Effect Rating	Level of Confidence
		Magnitude	Geographic Extent[1]	Duration	Frequency	Reversibility	Ecological Context		
Construction	Fugitive Dust Emissions	Low	Local	Short-term	Low	Reversible	Low	Low	Low
	Greenhouse Gas Emissions	Low	Global	Short-term	Low	Non-reversible	Low	Low	Medium
Operations	Fugitive Dust Emissions	Medium	Local	Mid-term	Moderate	Reversible	Moderate	Moderate	Medium
	Greenhouse Gas Emissions	Low	Global	Mid-term	Low	Non-reversible	Low	Low	Medium
	Coal Dryer Emissions	Medium	Local	Mid-term	Low	Reversible	Low	Moderate	Medium
Closure	Fugitive Dust Emissions	Low	Local	Short-term	Low	Reversible	Low	Low	Medium
	Greenhouse Gas Emissions	Low	Global	Short-term	Low	Non-reversible	Low	Low	Medium
Post-Closure	Fugitive Dust Emissions	Low	Local	Short-term	Low	Reversible	Low	Low	Medium
	Greenhouse Gas Emissions	Low	Global	Short-term	Low	Non-reversible	Low	Low	Medium

Notes: 1. The local geographic extent includes the air quality study area (10 km radius from the Wolverine Coal Project).

Section 7 • References

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