December 7, 2012

Fares Haddad
Coal and Industrial Developments
Energy Resources Conservation Board
Suite 1000, 250 – 5 Street SW
Calgary, Alberta T2P 0R4

Margot Trembath
EA Coordinator
Alberta Environment and Water
111, Twin Atria Bldg.
Edmonton, AB T6B 2X3

Dear Mr. Haddad/ Ms. Trembath:

RE: Coal Valley Resources Inc. Robb Trend Project, Environmental Impact Assessment and Mine Permit Application under the *Coal Conservation Act* ("CCA") and Environmental Protection & Enhancement Act (EPEA), ERCB Application 1725257, EPEA -028-00011066, Supplemental Information Requests

In July and September 2012, Alberta Environment and Sustainable Resource Development (ESRD) along with the Energy Resource and Conservation Board (ERCB) completed their initial review of the CVRI mine permit application and each issued a set of Supplemental Information Requests (SIRs). Attached are CVRI's completed responses to these SIRs.

CVRI has responded to the following requests in order to continue the review of the application.

All communications in respect to the application should be directed to:

Mr. Les Lafleur, Project Manager
Coal Valley Resources Inc.
Coal Valley Mine
Bag Service 5000
Edson, Alberta T7E 1W1
Telephone: (780) 865-8607
Fax: (780) 865-8630
email: llafleur@coalvalley.ca

Yours truly,

COAL VALLEY RESOURCES INC.

<original signed by>

Les, LaFleur
Project Manager
Robb Trend Project

c.c. Blaine Renkas, Sherritt Coal

Coal Valley Resources Inc. - Coal Valley Mine

Robb Trend Project
Environmental Impact Assessment and Mine Permit Application
EPEA - 028-00011066; ERCB - 1725257

Supplemental Information Request Responses

Submitted to
Alberta Environment and Sustainable Resource Development and the Energy Resources and Conservation Board

December 2012

cvri

Coal Valley Resources Inc. Robb Trend Project

Supplemental Information Request
EPEA Application No. 028-00011066
ERCB Application No.1725257
Received: July 26, 2012; September 18, 2012

TABLE OF CONTENTS

Page

List of Tables

List of Figures

List of Photos

List of Appendices

1. ACRONYMS USED IN THIS SUPPLEMENTAL INFORMATION REQUEST

The following acronyms are used in this Supplemental Information Request.

AAAQO	Alberta Ambient Air Quality Objectives
AAAQG	Alberta Ambient Air Quality Objectives and Guidelines
ADT	Average daily traffic volume
AENV	Alberta Environment
AEPEA	Alberta Environmental Protection and Enhancement Act
AESCC	Alberta Endangered Species Conservation Committee
AESRD	Alberta Environment and Sustainable Resource Development
AEW	Alberta Environment and Water
ANFO	Ammonium Nitrate and Fuel Oil
AQRSA	Air Quality Regional Study Area
ASTM	American Society for Testing and Materials
AT	Alberta Transportation
ARBO	Arbour Seam
AVI	Alberta Vegetation Inventory
BCM/RMT	Bank Cubic meter/raw metric tonne
BESR	Breakeven Strip Ratio
BIBP	Benthic invertebrate biomonitoring program
CACs	Criteria Air Contaminant Species
CASA	Clean Air Strategic Alliance
CCR	Coal Conservation Regulation
CEA	Cumulative Effects Assessment
CEAA	Canadian Environmental Assessment Act
CF	Capture Factors
CNC	Consultative Notation - Company
COPC	Chemical of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CR	Consultant Report
CRB	Conservation and Reclamation Business Plan
CRO	Cardinal River Operations
CVM	Coal Valley Mine
CVRI	Coal Valley Resources Inc.
D	Drop height
DFO	Department of Fisheries and Oceans Canada
E	Suspended particulate emission factor (kg/day/ha)
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EPEA	Environmental Protection and Enhancement Act
EPL	End pit lakes
ERCB	Energy Resources Conservation Board

ESRD	Environment and Sustainable Resource and Development
EUB	Energy and Utilities Board
EZE	Easement
F	Percentage of time that the unobstructed wind speed exceeds 5.14 m/s
FMA	Forest Management Area
FOB	Freight on Board
FOFN	Foothills Ojibway First Nation
FRI	Foothills Research Institute
FTOR	Final Terms of Reference
FWMIS	Fish and Wildlife Information System
GHG	Greenhouse Gas
HHRA	Human Health Risk Assessment
HLSA	Hydrogeology Local Study Area
HRIA	Historic Resources Impact Assessment
HIS	Habitat Suitability Modeling
HU	habitat supply
HWP	Hinton Wood Products
ILCR	Incremental lifetime cancer risk
IRIS	Integrated Risk Information System
ISP	Industrial Sample Plot
KAI	Key Aquatic Indicators
km	kilometre
LFN	Low Frequency Noise
LG	Lerchs-Grossman
LOC	Licence of Occupation
LTSA	long-toed salamander
LSA	Local Study Area
M	moisture content
m	metre
MDH	MDH Engineered Solutions
MLL	Miscellaneous Lease
MPOI	Maximum Point of Impingement
MSL	Mineral Surface Lease
NIA	Noise Impact Assessment
NNL	No Net Loss
NNLP	No Net Loss Habitat Compensation Plan
NRCAN	Natural Resources Canada
NPI	National Pollution Inventory
NPRI	National Pollutant Release Inventory
NRCB	Natural Resources Conservation Board
OLM	Ozone Limiting Method
PAH	polycyclic aromatic hydrocarbons
PAI	Potential Acid Input
PASZA	Peace River Airshed Zone
PDC	Planned Development Case
PIL	Pipeline Installation Lease

PLA	Pipeline Agreement
Plant	Coal Valley Coal Processing Plant
PM	Particulate Matter
PNG	Petroleum and Natural Gas
Project	Robb Trend Project
RM	Robb Main Trend
RNTR	native Athabasca Rainbow Trout
ROM	Right of Mind
RQ	Risk Quotient
RSA	Regional Study Area
RT	Robb Trend
RW	Robb West
S	silt content of aggregate (%)
SAAB	SREM Aboriginal Affairs Branch
SARA	Species at Risk Act
SG	Specific Gravity
SIL	Sampling Intensity Level
SIR	Supplemental Information Request
SKM	Sinclair Knight Merz
SML	Surface Mineral Lease
SP&P	Standard Practices and Procedures Manual
SR	Surface Runoff
SRCL	Smoky River Coal Mine
SRD	Sustainable Resource Development
TC	Transport Canada
TCH	Trans-Canada Highway
TCL	Teck Coal Ltd.
TEK	Traditional Environmental Knowledge
TERRAD	distance CALMET considers in computing terrain effects
TLU	Traditional Land Use
TOR	Terms of Reference
TPA	Trapping Area
TRVs	Toxicological Reference Values
TSP	Total Suspended Particulate
TSS	total suspended solids
TU	Trout Unlimited Canada
U	wind speed (m/s)
USEPA	United States Environmental Protection Agency
VEC	Valued Environmental Components
VOC	Volatile Organic Compound
WCAS	West Central Airshed Society
WHO	World Health Organization

2. BOARD

The responses to questions in this Board section will not be considered as part of the EIA completeness decision made by Alberta Environment.

3. GENERAL

1. Volume 1, Section A.2, Page A-2

a. What are the specific provincial and national environmental achievement awards that CVRI has received?

Response:

The statement refers to both safety and environmental awards. With regard to environmental awards, the CVM was awarded the Ammonite Award in 2005 by the Chamber of Commerce in recognition of reclamation of Lovett and Silkstone Lakes.

b. Will CVRI provide copies of reclamation certification for end pit lakes at CVRI? How does CVRI's *industry leading* practices for the development of end pit lakes differ from other coal mines?

Response:

Copies of Reclamation Certificates are provided in ESRD Appendix 1:

- Reclamation Certificate No. C-74, August 14, 1989;
- Reclamation Certificate No. C-83, October 15, 1990; and
- Reclamation Certificate No. C-96, July 15, 1996.

CVRI is a leader in end pit lake development. The Silkstone Lake has received reclamation certification. Several lakes are well in progress toward final reclamation. The process toward end pit lake development in the Alberta Foothills has been a lengthy and extensive process which will continue to evolve as techniques are adapted to provide improved results.

CVRI looks forward to continued improvement in end pit lake development including adapting techniques from other coal mines and jurisdictions. CVRI hopes to continue involvement in evolving end pit lake development guidelines and research. Lakes already established and soon to be completed will provide valuable monitoring data.

2. Volume 1, Section A.3.2.1, Table A.3-1, Pages A-3 and A-4

With respect to CVRI's evaluation factor *biophysical factors/environment – fisheries, vegetation, timber, wildlife, soils, air quality, noise, groundwater, surface water and hydrological*:

a. What does a rank of 3 (best) indicate, i.e., what are the criteria used to determine Environmental ratings for this project?

Response:

The ranking system in Table A.3-1 identifies CVRI's assessment of the understanding within the current CVM operations as to the particular biophysical factors or environmental considerations described. A ranking of 3 (best) indicates that, in the opinion of CVRI, sufficient experience exists within CVM or available external resources, to adequately assess the potential effects, related mitigations options and operational changes that may have to occur to move forward with the particular option. Also factoring in to this category is an examination of the impact of the existing infrastructure and the availability of accessible coal related to the additional spatial disturbance that would be associated with development of a new mining area.

b. Describe project elements and their effects on Environmental rating.

Response:

Project elements considered in the assessment of options include:

- distance from infrastructure;
- availability of accessible coal, and
- overall disturbance area as compared to accessible coal quantities.

All of these elements are considered within the assessment of the environmental rating on Project alternatives. For instance, if the Manalta McLeod River project area were to be pursued, there would be considerable additional environmental effects associated with the increased haul distances, the lack of available infrastructure and the uncertainty with coal quantity. It was considered that the level of disturbance associated with moving past the Project area to access the McLeod River resources would have created an unacceptable and uneconomical environmental effect.

3. Volume 1, Section C.2.1.2, and Figure C.2.1, Page C-24-25

It is stated that several external overburden dumps will be constructed and reclaimed.

a. Discuss the rationale for the number of external overburden dumps proposed.

Response:

Decisions on dumping locations are based primarily on economics accounting for hauling profile, soil salvage, overall reclamation and dump stability. The lowest cost option is normally chosen. Waste haulage costs are influenced by haul distance and vertical displacement. Short, downhill hauls are preferred.

The conceptual plan presented illustrates dumps which would be close to the pits and generally accommodate easy waste haulage. Large deep pits associated with Val d'Or and Arbour Seams will require long access to pit bottom elevations. Space accommodation for such ramps often limit backfill opportunity hence lead to increased external dumping.

CVRI has chosen to illustrate a large proportion of external dumping in order to adequately identify potential Project impacts. The disturbance footprint accommodates the reclaimed profile for these dumps.

b. Discuss/present options available to reduce the number of proposed external overburden dumps.

Response:

Planning for waste dumps is integral with pit design and haul road design in order to achieve the most efficient and least cost operation. Commonly a large pit may be developed in smaller phases in order to achieve internal backfill to avoid long distances or uphill waste haulage.

The mine plan presented within the Mine Permit application is conceptual being based on general judgment of a mining sequence and dumping arrangements. As the Project proceeds individual pit and dump designs will be further defined and submitted to regulatory authorities for approval. These plans will be developed and reviewed to optimize mining and dumping operations.

It is CVRI's experience that further engineering evaluation and design optimization will result in reduced volumes of external dumps. Section C.2.1.2 (Page C-25) notes that "future refinements of these designs will occur at the mine licencing stage". A further implication of increased in-pit backfill would be decreased volume of end pit lakes.

4. Volume 1, Section C.6.6, Page C-59

CVRI indicates that in their Environmental Protection Program they have a program for emergency response and wildfire control and prevention. There are several underground coal seam burnings/fires within and in the periphery of the RT mine development boundary. They are considered a wildfire hazard.

a. Describe CVRI understanding of the locations of these underground coal seams burnings/fires.

Response:

"Burning Coal"

"Burning' coal seams are primarily underground and not exposed to the surface. Some access to air is necessary to maintain the burn so that vents (old mine shafts or subsidence to surface) are often associated with these situations. Warm air (steam) and coal burning odors are common around these vents. Burning embers or extreme heat is rare. Ongoing creep in surface subsidence is a possible danger.

General Location

Burning coal seams in the Project area are confined to areas influenced by the two abandoned underground mines. These are located immediately around the Hamlet of Robb. Typically underground entries or near surface room and pillar development have collapsed causing surface subsidence. These local depressions provide air supply and vents to sustain underground coal fires. Over a long period of time the burning causes slow expansion of the surface depressions.

The land base around the abandoned underground mines is currently public land administered by ESRD. The local ESRD staff are aware of the burning coal seams around the Robb area and monitor their condition. Some past efforts have been made to control vegetation around subsidence areas and to identify specific sites. The most serious concern is focused on potential for initiation of forest fires.

CVRI has participated with local efforts to stabilize some of the subsidence areas to reduce safety risk to public access. Most recently a backhoe was utilized to help fill an expanding subsidence pit near a frequently used walking and quad trail.

CVRI is aware of several small subsidence areas and venting holes which produce steam and odor of burning coal. Many of these sites correspond to air shafts or entries into the old underground mines. In a few instances collapse of underground extraction have generated subsidence to the surface.

Maps of the underground development have been located and are available to CVRI to identify areas of underground development. These maps will be utilized during future mining to establish appropriate operating practices for working these areas. Such practices will include identification of the location of the underground mines through placement of signs and fencing. Specific operating practices for drilling, blasting and mining will be established for any work in these areas.

b. Discuss CVRI's approach to manage underground coal seam burnings/fires that are within the permit boundary.

Response:

The Mine Permit does not provide CVRI with access to public lands. Land access is available only after a Mineral Surface Lease is granted to the company. The MSL area will be obtained in multiple steps as mining progresses through the Project area. Until then the land remains under the jurisdiction of the province.

Operating Practices

Mine subsidence and associated coal fire vents that are within the proposed mine limits will be excavated as part of the pit. Appropriate operating practices will be applied within proximity of such area. Past practice in such situations has effectively removed the burnt or burning coal and removed or extinguished the problem.

Hazard Control

CVRI is aware of ESRD and local public concerns regarding potential wildlife starts from these underground fires. CVRI is prepared, in conjunction with ESRD, to work toward proactive efforts to reduce these hazards. Contributions toward equipment and manpower to refill and close active vents would be considered by CVRI should ESRD request company involvement.

c. Discuss CVRI's approach to manage underground coal seam burnings/fires that are in the periphery of the permit boundary.

Response:

Subsidence or vents outside the Mine Permit will remain under the jurisdiction of the province since CVRI will not have access to the land area.

Hazard Control

CVRI is aware of ESRD and local public concerns regarding potential wildlife starts from these underground fires. CVRI is prepared, in conjunction with ESRD, to work toward proactive efforts to reduce these hazards. Contributions toward equipment and manpower to refill and close active vents would be considered by CVRI should ESRD request company involvement.

3.1 Public Engagement and Aboriginal Consultation

5. Volume 4, CR #12, Section 1.3, Page 6

Coal Valley Resources Inc. states that *….field studies to identify particular traditional use locations have been largely completed, but some fieldwork is still required. Reports on the results of traditional studies are in preparation or have been finalized by the majority of the groups. Those currently completed, and permitted by those Aboriginal groups to be reproduced, appear as Appendices.*

a. What is the status of Coal Valley Resources Inc.'s outstanding fieldwork?

Response:

A single aboriginal group, the Foothills Ojibway First Nation, has not completed inspections of the entire Project area. Robb Main, Centre, and East were inspected in 2007, but Robb West and the three access corridors have not been specifically assessed. The leadership of this group has indicated that these visits will not occur in the absence of a finalized community benefit agreement between the parties.

The Paul First Nation has indicated that additional visits to salt licks in the region may be needed, but it is unclear if this will be done as the areas in question may lie outside of the Project area.

Otherwise, the other aboriginal groups appear to have sufficiently examined the Project area at various times during the last 6 years.

b. Were there any concerns regarding impacts to Rights and Traditional Uses raised by First Nations to Coal Valley Resources Inc. as a result of this additional field work? If so, how have they been discussed and avoided or mitigated?

Response:

No new field visits have been completed since the Project application was filed. We anticipate that visits of additional areas by the Foothills Ojibway First Nation (FOFN) might identify specific traditional use locations, but will not likely result in new concerns related to general Project impacts to the environment or traditional land use rights in general to be raised. The avoidance or accommodation of traditional use locations is one of the subjects of discussions between CVRI and FOFN.

c. There are no reports on the results of traditional studies in the Appendices of Consultant Report #12; Are there First Nation traditional use reports completed that can be shared? If so, provide these reports or a summary of the results of these studies.

Response:

Summaries of the results of any completed traditional use reports shared with CVRI are already found in the individual discussion sections of consultations to date with each aboriginal group. These summaries are found in CR #12, Sections 3.1.2 and 3.1.3; 3.3.2 and 3.3.3; 3.5.2 and 3.5.3; 3.6.2 and 3.6.3; 3.7.2 and 3.7.3; 3.8.2 and 3.8.3; 3.9.2 and 3.9.3. These sections provide a summary of results of studies as presented to CVRI, which most often exclude any specific site information or knowledge deemed sensitive to Aboriginal groups collectively or the individuals who shared the information.

In the time since the EIA was prepared, the Sunchild First Nation has provided two brief reports prepared as a result of traditional studies of the Project area. One of these reports includes some locational information regarding sites recorded during the studies. The studies note many mineral licks used by Sunchild hunters, gatherers, and elders. Concern is expressed about impact to animal habitat and migration routes, and permanent damage to fish-bearing creeks and natural waterways. Ceremonial sites and graves are reported for the region, but their direct association with the Project area is not clearly indicated. The reports state that any potential impacts will require further negotiation and/or compensation for the loss of traditional land use by the Sunchild First Nation members.

All Aboriginal groups who have supplied reports on traditional studies for the Project area were contacted in August 2012 with a request for permission to supply those reports either in confidentiality to SAAB or to appear in publicly available reports. No Aboriginal groups have provided written permission for those reports to appear.

d. Are there completed First Nation traditional use reports that Coal Valley Resources Inc. is not permitted to share? If so, for which First Nations?

Response:

All Aboriginal groups who have supplied reports on traditional studies for the Project area were contacted in August 2012 with a request for permission to supply those reports either in confidentiality to SAAB or to appear in publicly available reports. No Aboriginal groups have provided written permission for those reports to appear.

6. Volume 4, CR #12, Section 3, Page 17

a. How has access to traditional lands in the Project Area during all stages of the Project been discussed with First Nations?

Response:

Aboriginal groups have been told and understand that the granting of a mine permit area to CVRI for the Project will lead to restricted access to those areas. CVRI has explained that access to mine permit areas is typically not curtailed immediately upon the granting of the permit area, but rather progresses over the years as mining itself progresses, and is of course necessarily severely limited within or near active mining areas and prior to the land being reclaimed and certified for return as public lands. It is clear that both Aboriginal groups and CVRI understand that this will limit their rights to access those lands to undertake certain traditional pursuits as outlined in Treaty 6.

b. What were the outcomes of these discussions?

Response:

No Aboriginal group consulted to date has indicated that these access restrictions will have a specific, particularly deleterious effect on individual or collective abilities to undertake traditional pursuits on Crown lands in the region as protected under Treaty. All groups indicate that over the years increasing industrial activities on Crown land in the region has effectively reduced the areas available for hunting, fishing, trapping, and collecting, and has impacted the environment in typically negative fashion. The Project will further reduce the available land base, and in some cases restrict access to hunting areas. They are aware that until reclaimed and returned to the Crown, access will be restricted, and that once returned, the land will require some time before it returns to a more natural, useable state. Some individuals believe that it will never return to a useable state as seen today.

Aboriginal groups wish to see Aboriginal knowledge used to help reclaim areas so that once access restrictions are lifted, the land will be more suitable for traditional pursuits. Perhaps the most commonly heard complaint is that reclaimed lands, which often shelter significant ungulate herds, have not been returned for use quickly enough. Some groups have praised some of the results of past CVRI reclamation efforts, but stress time will be needed to assess reclamation strategies in the long run.

The purpose of discussions with individual aboriginal groups regarding community benefit agreements is an acknowledgement by both parties that proposed mining activities will restrict access to areas for traditional uses, that that restriction may have a negative, unquantifiable impact on portions of the Aboriginal communities, but that those restrictions can be mitigated through other opportunities, economic or otherwise, associated directly with the mining and reclamation activities, or in other areas such as educational programming. Some agreements either wholly or partially covering the specific Project areas and potential impacts are in place providing mitigative effects or opportunities in association with on-going mining areas and were negotiated to specifically address future Project impacts. In some cases, access to specific traditional locations within the mine permit area may be negotiated. Final community agreements with all potentially affected aboriginal groups have not been consummated.

7. Volume 4, CR #12, Table 2, Page 18

Coal Valley Resources Inc. states under the April 11, 2007 entry *…response to concerns sent May 3, 2007* to Alexis Nakota Sioux Nation.

a. Provide a copy of the written response to concerns that was sent to Alexis Nakota Sioux Nation on May 3, 2007 or outline specifically how the concerns were addressed.

Response:

The concerns were outlined in a review of the Terms of Reference (TOR) for the Mercoal West and Yellowhead Tower extension projects by an outside consultant, Martyn Glassman. Although consultation at that time included the Project, the TOR document under review was specifically related only to Mercoal West and Yellowhead Tower. As the document is a general review of the TOR, no specific concerns were tabled regarding impacts to Alexis Nakota Sioux Nation rights and traditional uses for the Project, or Mercoal West and Yellowhead Tower. Instead, the concerns were of a more generalized nature having to do with technical concerns about the regulatory process, particularly complaints about the Project being “split” from Mercoal West and Yellowhead Tower, the lack of direct consultation with Alexis Nakota Sioux Nation from representatives of the Government of Alberta, and general environmental concerns with the EIA process, including the need for a generalized “climate change” section with specific predictions for the Project area. The reviewer indicated his belief that the TOR should indicate how the proponent planned to consult specifically with the Alexis Nakota Sioux Nation on a number of issues including environmental management plans, monitoring, reclamation, and how compensation might occur to land users from any impacts that could not be mitigated, including those to First Nations current and traditional uses. The reviewer requested the inclusion of any Aboriginal recruitment and retention plans, and statistics on Aboriginal employment at the mine, and a table indicating commitments made to Aboriginal groups. The review indicated that the EIA should describe any potential effects to navigable waters (no specific note regarding how this might be related to Alexis Nakota Sioux Nation traditional uses was made).

The response to those concerns was of necessity also of a generalized format. Many of the concerns outlined by Martyn Glassman were regulatory issues that could not be addressed by CVRI, and many general environmental concerns were in fact to be addressed in the EIA. The response indicated that CVRI would continue to work with the Alexis Nakota Sioux Nation surrounding any other concerns.

The fact that the Alexis First Nation was ultimately satisfied with the response to the concerns as related in the TOR review is documented in their withdrawal of the statement of concern filed on the Mercoal West and Yellowhead Tower projects and the consummation of a long-term agreement with CVRI that addresses Alexis Nakota Sioux Nation concerns, and was specifically drafted to address the Project, Mercoal West, and Yellowhead Tower projects. No statement of concern has been filed by the ANSN regarding the Project.

8. Volume 4, CR #12, Table 8, Page 43

Coal Valley Resources Inc. states under the August 13-24, 2007 and October 17, 2007 entries that *Mitigative measures provided in the report include…report is okay to be seen in the public record….A mitigation plan was devised*

a. Provide the referenced report.

Response:

In August 2012 the O'Chiese First Nation and Nackowinewak Nation of Canada were contacted with a request for written permission to provide the document in question. The O'Chiese First Nation and Nackowinewak Nation of Canada did not provide such permission for the inclusion of the document into the public record or for the dissemination to SREM Aboriginal Affairs Branch (SAAB).

b. Provide the referenced mitigation plan developed with O'Chiese First Nation.

Response:

The aforementioned mitigation or accommodation plan is part of a confidential written agreement between CVRI, the O'Chiese First Nation, and Nakcowinewak Nation of Canada. At this time CVRI is not prepared to share any such agreements with Third Parties. The issuance of letters of authorization for the Project by the O'Chiese First Nation indicates their general satisfaction with the consultation process and any accommodation measures proposed for Project impacts that may be included in that agreement.

9. Volume 4, CR #12, Section 3.8.1, Page 46

Coal Valley Resources Inc. states …*the Paul First Nation officially provided a letter of endorsement for the Mercoal West, Yellowhead Tower, and the Project extensions on November 18, 2009.*

a. Provide the referenced November 18, 2009 letter from Paul First Nation to Coal Valley Resources Inc.

Response:

The referenced letter is provided as ESRD Appendix 9. It should be noted that because consultation is a process rather than an event, CVRI continues to be engaged in discussions with the Paul First Nation regarding the Project, potential impacts, and potential benefits.

10. Volume 4, CR #12, Section 4, Page 52
Volume 2, Section A.8.12, Page 48
Volume 5, Appendix 7, Pages 32-46

Coal Valley Resources Inc. states that *Discussions regarding First Nations concerns with the development and possible mitigation strategies are on-going, and will be finalized on a group-by-group basis after the Project application submission date.*

a. What is the status of Coal Valley Resources Inc.'s discussions with each First Nation regarding potential impacts of the Robb Trend project on First Nations Rights and Traditional Uses and the proposed avoidance or mitigation strategies for their concerns?

Response:

Given that consultation is a process rather than an event, discussions regarding potential impacts of the Project on First Nations Rights and Traditional uses, including proposed avoidance or accommodation strategies for specific or generalized concerns are on-going with all First Nations, even those with whom formal agreements have been signed or who have issued letters of authorization. No additional agreements have been signed or letters of authorization issued since the Project application was submitted. No new accommodation strategies or plans have been devised or executed. The on-going development of a corporate Aboriginal consultation plan at CVRI is expected to enhance and ensure continued Aboriginal consultation throughout the life of the Project. Statements of concern regarding the Project were filed on September 28, 2012 with the ERCB on behalf of the Ermineskin Cree Nation and the Samson Cree Nation.

b. Provide a table similar to Volume 15, Appendix 7 Public Engagement, Appendix 4, presenting; potential impacts to Treaty Rights and Traditional Uses by First Nation, Coal Valley Resources Inc.'s proposed avoidance and/or mitigation, and the First Nations responses to the proposed avoidance/mitigation.

Response:

Assuming the review is referring to Volume 5, ESRD Table 10-1 provides the best summary possible in response to the question as posed. The precise group-by-group response to the proposed accommodations, featured in pertinent sections in the EIA as well, await official formal response through Aboriginal review of the application, including this supplementary information.

Many groups have tacitly agreed to these accommodations through agreements with CVRI or letters of authorization for the Project.

Table 10-1 Potential Impacts to Treaty Rights and Traditional Uses

Potential Impact to Right or Traditional Use	Negative or Positive	Geographic Extent	Magnitude	Duration	Mitigation
Direct impact/removal of burials	Negative	Not Applicable - no such specific locales have yet been identified to CVRI within proposed Project impact zones			To date no Aboriginal group has notified CVRI of the location of a burial within the Project area. CVRI has previously modified its proposed permit area removing some known burials from the Project lands. CVRI is fully prepared to work with Aboriginal communities to avoid burials identified or undertake other mitigative options. If during operations possible burials are encountered, CVRI is prepared to work with Aboriginal communities and regulators to confirm burial association and devise an appropriate avoidance or mitigation strategy.
Direct impact/removal of ceremonial locations	Negative	Not Applicable - no such specific locales have yet been identified to CVRI within proposed Project impact zones			To date no Aboriginal group has notified CVRI of the precise location of a specific ceremonial site within the Project area. CVRI is fully prepared to work with Aboriginal communities to avoid specific ceremonial locations identified or undertake other mitigative options.
Direct impact/removal of other cultural sites (cabins, camps, gathering, teaching)	Negative	Not Applicable - no such specific locales have yet been identified to CVRI within proposed Project impact zones			To date no Aboriginal group has notified CVRI of the precise location of a specific traditional cultural site (*i.e.*, cabins, camps, gathering area, teaching areas) within the Project area. CVRI is prepared to work with Aboriginal communities to devise an appropriate mitigation strategy should such specific locations be identified within impact zones. Any mitigation strategy would have to be devised on a case-by-case basis, but could include identification of and relocation to another suitable area, ceremonies, or avoidance if possible.

Table 10-1 Potential Impacts to Treaty Rights and Traditional Uses

Potential Impact to Right or Traditional Use	Negative or Positive	Geographic Extent	Magnitude	Duration	Mitigation
Direct impact/removal of hunting areas	Negative	Not Applicable - no such specific locales have yet been identified to CVRI within proposed Project impact zones			To date no Aboriginal group has notified CVRI of the precise location of a specific important hunting location traditionally used within the Project area. Should those be identified along with an assessment of specific negative impact to the user of the hunting location, CVRI is prepared to discuss accommodation for the loss of that specific hunting resource.
Displacement of game animals	Negative	Active mining areas prior to reclamation and reestablishment of vegetation	High	Short to medium-term	During active ground disturbing activities game animals will move to adjacent patches, but will typically return to areas relatively quickly once initial reclamation activities have occurred following vegetation succession patterns. These reclaimed areas often harbour a considerably larger ungulate population after reclamation. Consensus opinion among the Aboriginal groups consulted is that potential Project benefits to the communities in the form of employment, contracting opportunities, or community support represent adequate mitigation of the potential loss of this resource in the Project area for the duration of mining activities.
Direct impact/removal of salt/mineral licks (important to game animals)	Negative	Active mining areas	High	Medium-term	Mining activities will remove some salt/mineral licks within the disturbance footprint. This process will contribute to the displacement of game animals. Over the long term, new licks will become established following reclamation and natural groundwater and surface run-off regimes. A mitigation recommendation for wildlife (CR#14) is the identification of these natural seepages during reclamation to ensure their incorporation into the end use landscape. Consensus opinion among the Aboriginal groups consulted is that potential project benefits to the communities in the form of employment, contracting opportunities, or community support represent adequate mitigation of the potential loss of this resource for the duration of mining activities and prior to the establishment of new licks.
Direct impact/removal of trapping areas	Negative	Not Applicable - no such specific locales have yet been identified to CVRI within proposed Project impact zones			To date no Aboriginal group has notified CVRI of the location of a specific important trapping location traditionally used within the Project area. Should those be identified along with an assessment of specific negative impact to the user of the trapping location, CVRI is prepared to discuss accommodation for the loss of that specific trapping resource. CVRI has engaged the owners of registered traplines to be impacted by the Project and devised a strategy to mitigate the impact of the Project on those trappers.

Table 10-1 Potential Impacts to Treaty Rights and Traditional Uses

Potential Impact to Right or Traditional Use	Negative or Positive	Geographic Extent	Magnitude	Duration	Mitigation
Displacement of fur-bearing animals	Negative	Active mining areas prior to reclamation and reestablishment of vegetation	High	Short to medium-term	During active ground disturbing activities fur-bearing animals will move to adjacent patches, but will typically return to areas once reclamation activities have occurred. Specific mitigation recommendations have been made to encourage the recolonization of reclaimed areas by fur-bearing mammals after mining operations are complete. Consensus opinion among the Aboriginal groups consulted is that potential Project benefits to the communities in the form of employment, contracting opportunities, or community support represent adequate mitigation of the potential loss of this resource for the duration of mining activities. As noted above, CVRI has addressed impacts with owners of registered traplines.
Direct impact/removal of medicinal plant gathering areas	Negative	Not Applicable - no such specific locales have yet been identified to CVRI within proposed Project impact zones			To date no Aboriginal group has notified CVRI of the precise location of a specific important medicinal plant gathering location traditionally used within the Project area. Should those be identified along with an assessment of specific negative impact to the user, CVRI is prepared to discuss accommodation for the loss of that specific resource. CVRI will also assist users in the identification of alternate locations for harvesting of specific resources. None of the medicinal plants important to Aboriginal communities identified to CVRI are uncommon in the surrounding region, and will be accessible in surrounding areas during the mine life. CVRI will work with Aboriginal groups to help specific plants return during the reclamation process using traditional ecological knowledge.
Removal of medicinal plants	Negative	Active mining areas prior to reclamation and reestablishment of vegetation	High	Short to medium-term	Mining activities will remove any medicinal plants currently growing within the disturbance footprint. Over the short, medium, and long-term, many of these plants will become re-established following reclamation. Some of these plants will re-establish naturally after soil replacement from seeds or plant communities in adjacent areas. None of the medicinal plants important to Aboriginal communities identified to CVRI are uncommon in the surrounding region, and CVRI will work with Aboriginal groups to help specific plants return during the reclamation process. Consensus opinion among the Aboriginal groups consulted is that potential Project benefits to the communities in the form of employment, contracting opportunities, or community support represent adequate mitigation of the potential loss of this resource for the duration of mining activities and prior to the establishment of new plant communities.

Table 10-1 Potential Impacts to Treaty Rights and Traditional Uses

Potential Impact to Right or Traditional Use	Negative or Positive	Geographic Extent	Magnitude	Duration	Mitigation
Direct impact/removal of food plant gathering areas	Negative	Not Applicable - no such specific locales have yet been identified to CVRI within proposed Project impact zones			To date no Aboriginal group has notified CVRI of the precise location of a specific important food plant gathering location traditionally used within the Project area. Should those be identified along with an assessment of specific negative impact to the user, CVRI is prepared to discuss accommodation for the loss of that specific resource. None of the food plants important to Aboriginal communities identified to CVRI are uncommon in the surrounding region, and CVRI will work with Aboriginal groups to help specific plants return during the reclamation process.
Removal of food plants	Negative	Active mining areas prior to reclamation and reestablishment of vegetation	High	Short to medium-term	Mining activities will remove any food plants currently growing within the disturbance footprint. Over the short, medium, and long-term, many of these plants will become re-established following reclamation. Some of these plants will re-establish naturally after soil replacement from seeds or plant communities in adjacent areas. None of the food plants important to Aboriginal communities identified to CVRI are uncommon in the surrounding region, and CVRI will work with Aboriginal groups to help specific plants return during the reclamation process. Consensus opinion among the Aboriginal groups consulted is that potential project benefits to the communities in the form of employment, contracting opportunities, or community support represent adequate mitigation of the potential loss of this resource for the duration of mining activities and prior to the establishment of new plant communities.
Direct impact/removal of fishing areas	Negative	Not Applicable - no such specific locales have yet been identified to CVRI within proposed Project impact zones			To date no Aboriginal group has notified CVRI of the location of a specific important fishing location traditionally used within the Project area. Should those be identified along with an assessment of specific negative impact to the user, CVRI is prepared to discuss accommodation for the loss of that specific resource. None of the 15 fish species identified and potentially important to Aboriginal communities are unique to Project watercourses, none are listed under the federal Species at Risk Act; one is listed Provincially as at risk, two as sensitive, one as undetermined, and one as alien (CR#6). The creation of end-pit lakes within the Project area will establish new fishing areas in the long-term, as some will be constructed to maximize habitat and biodiversity for use by native fish populations.

Table 10-1 Potential Impacts to Treaty Rights and Traditional Uses

Potential Impact to Right or Traditional Use	Negative or Positive	Geographic Extent	Magnitude	Duration	Mitigation
Removal of fish resources	Negative	Active mining areas prior to reclamation and reestablishment of vegetation	High	Short to medium-term	CVRI acknowledges that the Project has potential to disturb fish habitat and resources through land clearing, the construction of crossings, stream diversions, and end-pit lake development (CR#6). Habitat availability may be modified in some cases during specific project components such as the filling of end-pit lakes, but proposed mitigation measures are expected to reduce impact to minimal. Temporary and permanent stream diversions may result in habitat loss or alteration. CVRI has committed to working with Fisheries and Oceans Canada to develop a habitat compensation plan to address these impacts. The Project is expected to have insignificant impact to fish populations in the region. Consensus opinion among the Aboriginal groups consulted is that potential Project benefits to the communities in the form of employment, contracting opportunities, or community support represent adequate mitigation of the potential loss of this resource for the duration of mining activities and prior to the establishment of new fish habitat.
Direct impact/removal of other resource harvesting areas	Negative	Not Applicable - no such specific locales have yet been identified to CVRI within proposed Project impact zones			To date no Aboriginal group has notified CVRI of the location of a specific important resource gathering location (*i.e.,* tipi pole, firewood, *etc.*) traditionally used within the Project area. Should those be identified along with an assessment of specific negative impact to the user, CVRI is prepared to discuss accommodation for the loss of that specific resource for the duration of Project development activities.
Removal of other harvestable resources	Negative	Active mining areas prior to reclamation and reestablishment of vegetation	High	Short to medium-term	Mining activities will remove any surficial resources within the disturbance footprint. Over the short, medium, and long-term, many of these resources will become re-established following reclamation. Consensus opinion among the Aboriginal groups consulted is that potential Project benefits to the communities in the form of employment, contracting opportunities, or community support represent adequate mitigation of the potential loss of these resources for the duration of mining activities and prior to the establishment of reclaimed lands.

Table 10-1 Potential Impacts to Treaty Rights and Traditional Uses

Potential Impact to Right or Traditional Use	Negative or Positive	Geographic Extent	Magnitude	Duration	Mitigation
Restriction of access/removal of land base	Negative	Mine Permit Area; active mining areas prior to reclamation and reestablishment of vegetation	Variable over time as areas added to active mining and reclamation, or areas returned to use after certification	Short to medium-term	No aboriginal group consulted to date has indicated that access restrictions to the Project area will have a specific, particularly deleterious, non-mitigable effect on individual or collective abilities to undertake traditional pursuits on Crown lands as protected under Treaty. The purpose of discussions with individual Aboriginal groups regarding community benefit agreements is an acknowledgement by both parties that proposed mining activities will restrict access to areas for general traditional uses, that that restriction may have a negative, unquantifiable impact on portions of the aboriginal communities, but that those restrictions can be mitigated through other opportunities, economic or otherwise, associated directly with the mining and reclamation activities, or in other areas such as educational programming. Some agreements either wholly or partially covering the Project areas and potential impacts are in place providing mitigation effects or opportunities associated with on-going mining areas and were negotiated to specifically address future Project impacts. In some cases, access to specific traditional locations within the mine permit area during development may be negotiated.
General impacts to water quality in project area	Negative	Active mining areas and directly adjacent lands prior to reclamation and reestablishment of vegetation	Low	Short to medium-term	CVRI acknowledges that active mining in the Project area has potential to impact surface water quality through soil erosion and increased sediments entering streams, leaching of nitrates into water, discharges of water from impoundments into natural watercourses, changes to natural flow rates, mine water usage, dewatering, stream diversions, and the construction of end-pit lakes. The effects of these will be mitigated through a series of standard engineering and environmental design practices including diversion of clean water around disturbance areas, surface runoff collection and treatment systems, slope grading and stabilization, diverting of streams in a controlled manner, diversion ditches, sediment ponds, sumps, progressive reclamation, work during periods of relatively low surface runoff, designs of crossings under Alberta code, adhering to requirements under the Water Act, Fisheries Act, and Navigable Waters Protection Act, reducing nitrogen compounds released by explosives and minimizing water contact with them, and impounding, settling, and treating water prior to discharge. Thus on the whole mining will have insignificant impact on surface water quality compared to natural variations (see CR#6, CR#11, Section E.11.5, and Section F). CVRI has committed to long-term and continuous water quality monitoring to ensure these measures remain effective.

Table 10-1 Potential Impacts to Treaty Rights and Traditional Uses					
Potential Impact to Right or Traditional Use	**Negative or Positive**	**Geographic Extent**	**Magnitude**	**Duration**	**Mitigation**
General impacts to water quality in surrounding region	Negative	Regional	Minimal	Short to long-term	CVRI acknowledges that active mining in the Project area has potential to impact surface water quality through soil erosion and increased sediments entering streams, leaching of nitrates into water, discharges of water from impoundments into natural watercourses, changes to natural flow rates, mine water usage, dewatering, stream diversions, and the construction of end-pit lakes. The effects of these will be mitigated through a series of standard engineering and environmental design practices including diversion of clean water around disturbance areas, surface runoff collection and treatment systems, slope grading and stabilization, diverting of streams in a controlled manner, diversion ditches, sediment ponds, sumps, progressive reclamation, work during periods of relatively low surface runoff, designs of crossings under Alberta code, adhering to requirements under the Water Act, Fisheries Act, and Navigable Waters Protection Act, reducing nitrogen compounds released by explosives and minimizing water contact with them, and impounding, settling, and treating water prior to discharge. Thus on the whole mining will have insignificant impact on surface water quality compared to natural variations (see CR#6, CR#11, Section E.11.5, and Section F). As impact in the Project area is considered to be minimal, the effect on the region is also considered to be minimal. CVRI has committed to long-term and continuous water quality monitoring to ensure these measures remain effective.

Table 10-1 Potential Impacts to Treaty Rights and Traditional Uses

Potential Impact to Right or Traditional Use	Negative or Positive	Geographic Extent	Magnitude	Duration	Mitigation
General impacts to wildlife in project area	Negative	Active mining areas and directly adjacent lands prior to reclamation and reestablishment of vegetation	High	Short to medium-term	CVRI acknowledges that active mining in the Project area will have a direct impact on wildlife, including birds and amphibians, through short to medium-term removal of habitat, fragmentation of habitat, barriers to movement, and possibly direct mortality in some cases (*e.g.*, vehicle collisions *etc.*). This would have a potential impact on the generalized right to hunt, fish, and trap in these areas during mine development. CR#14 and CR#7 of the Project application detail the proposed mitigation of these effects through the identification of wildlife as a primary end use of the lands, the maintenance of as much undisturbed habitat as possible in the Project area, the revegetation of soil stockpiles to maintain wildlife use, vegetation clearing outside of breeding seasons, buffers along riparian zones, contouring to reduce lines of sight, identification of natural seepages that will become salt/mineral licks after reclamation, hunting restrictions, measures to avoid direct mortality, and a reclamation program that will promote the structural integrity and biodiversity of the landscape to enhance future wildlife use. CVRI has committed to the use of Aboriginal traditional ecological knowledge to assist in land reclamation activities to achieve these goals. The studies conclude that when recommended mitigation and monitoring occur, appropriate biodiversity will re-establish in disturbed areas in the medium to long-term (25 to 50 years), and have no cumulative effect on the region.
General impacts to wildlife in surrounding region	Negative	Regional	Minimal	Short to long-term	CR#14 and CR#7 discuss the cumulative effects of the Project on wildlife in the surrounding region. The studies conclude that when recommended mitigation and monitoring occur for the Project, appropriate biodiversity will re-establish in disturbed areas in the medium to long-term (25 to 50 years), and have no cumulative effect on wildlife in the region. Therefore, there would be no impact on the generalized right to hunt, fish, and trap in the region during mine development. CR#14 and CR#7 of the Project application detail the proposed mitigation of these effects through the identification of wildlife as a primary end use of the lands, the maintenance of as much undisturbed habitat as possible in the Project area, the revegetation of soil stockpiles to maintain wildlife use, vegetation clearing outside of breeding seasons, buffers along riparian zones, contouring to reduce lines of sight, identification of natural seepages that will become salt/mineral licks after reclamation, hunting restrictions, measures to avoid direct mortality, and a reclamation program that will promote the structural integrity and biodiversity of the landscape to enhance future wildlife use. CVRI has committed to the use of Aboriginal traditional ecological knowledge to assist in land reclamation activities to achieve these goals.

Table 10-1 Potential Impacts to Treaty Rights and Traditional Uses

Potential Impact to Right or Traditional Use	Negative or Positive	Geographic Extent	Magnitude	Duration	Mitigation
General impacts to environmental quality in project area	Negative	Active mining areas and directly adjacent lands prior to reclamation and reestablishment of vegetation	High	Short to medium-term	CVRI acknowledges that the development of the Project will impact the lands in the development footprint through the construction of roads and utility corridors, the removal of vegetation and stockpiling of topsoil, blasting and removal of overburden, mining and hauling of coal, diversion of surface runoff and streams to protect water quality, and the creation of end-pit lakes. These processes will necessarily impact the right of Aboriginal communities to undertake traditional pursuits such as hunting, fishing, and trapping within development zones. However, through a series of mitigation measures the direct impacts to the environment will be localized, and continual monitoring of water quality, air quality, and wildlife populations will be in place to ensure the mitigation measures are effective. Following development, the reclamation plan (Section F) will serve to re-establish vegetation and wildlife communities in the long-term, and allow future human uses of the Project area. CVRI has pledged to involve Aboriginal communities in the decision making process to reach the goal of returning the lands to a healthy, usable condition after mining.
General impacts to environmental quality in surrounding region	Negative	Regional	Minimal	Short to long-term	CVRI acknowledges that the development of the Project will impact the lands in the development footprint through the construction of roads and utility corridors, the removal of vegetation and stockpiling of topsoil, blasting and removal of overburden, mining and hauling of coal, diversion of surface runoff and streams to protect water quality, and the creation of end-pit lakes. These processes will necessarily impact the right of Aboriginal communities to undertake traditional pursuits such as hunting, fishing, and trapping within development zones. Access to and traditional resources within the surrounding region will not be impacted by these activities. Through a series of mitigation measures the direct impacts to the environment will be localized to the development footprint, and continual monitoring of water quality, air quality, and wildlife populations will be in place to ensure the mitigation measures are effective. Results of cumulative effects studies indicate that any Project impacts will not have a deleterious cumulative effect on the surrounding region. Following development, the reclamation plan (Section F) will serve to re-establish vegetation and wildlife communities in the long-term, and allow future human uses of the Project area. CVRI has pledged to involve Aboriginal communities in the decision making process to reach the goal of returning the lands to a healthy, usable condition after mining.

Table 10-1 Potential Impacts to Treaty Rights and Traditional Uses

Potential Impact to Right or Traditional Use	Negative or Positive	Geographic Extent	Magnitude	Duration	Mitigation
General impacts to Aboriginal health quality in surrounding region	Negative	Regional	Minimal	Short to long-term	Studies of Human Health impact (CR#5), including Aboriginal receptors utilizing a subsistence diet in the region, indicate no substantial Project-related health risks due to exposure to, inhalation, or ingestion of chemicals, toxins, carcinogens, or harmful non-carcinogens. No adverse health effects are expected for the region. CVRI will continue to implement monitoring of air, surface water, and ground water to help mitigate any potential effects.

c. How will Coal Valley Resources Inc. report on any outstanding First Nations concerns that could not be avoided or mitigated?

Response:

The Duty to consult with First Nations regarding regulatory decisions potentially impacting Treaty or Traditional use rights rests with the Crown. That Duty cannot in and of itself be delegated to a Third Party although aspects of the consultation process can. In that light, any continuing issues between CVRI and a potentially affected First Nation that may affect the Crown's regulatory decisions will be reported to SAAB in writing once it is clear that such a situation exists.

The statements of concern noted above (Ermineskin Cree Nation and the Samson Cree Nation) in the response to ESRD SIR #10a) have been supplied to SAAB. Discussions regarding these concerns have not yet been initiated.

11. Volume 4, CR #12, Section 4.4, Page 58

Coal Valley Resources Inc. states at the end of the first paragraph *Specific address of these concerns is discussed in the appropriate sections of the EA report…*

a. How have the appropriate sections of the EA report (including Consultant Reports) relating to First Nations concerns, including potential impacts to First Nation Rights and Traditional Uses, avoidance and/or mitigation as outlined in the EA, been discussed with First Nations?

Response:

The discussion of potential accommodation strategies for potential impacts to First Nations Rights and Traditional Uses is a topic of continual discussion with First Nations groups. These have always included general discussions of CVRI's mining practices, and their potential effects on water quality, animal health, biodiversity, accommodation options, and general environmental impact (see details provided in CR #12, Tables 2-10). Those discussions have factored into the formulation of any strategies presented in the EA document. The EA was provided to First Nations and other Aboriginal groups in June, 2012, with a request to provide any specific comment, question, or concern to representatives of CVRI, ESRD, or the EUB.

b. What were the outcomes of these discussions and how will Coal Valley Resources Inc. report on these discussions and outcomes?

Response:

As noted in the response to ESRD SIR #10a), two First Nations have submitted statements of concern related to the Project. Concerns noted include loss of habitat affecting grizzly bears, marten, fisher, lynx, and wolf populations, which may impact traditional pursuits. Other concerns noted are general impacts to water hydrology and environment, and the impact on fish habitat and therefore fishing rights. Given the late date of notification of these concerns, neither CVRI nor the Government of Alberta has had an opportunity to assess or respond to these concerns. To date, no other specific input has been provided to CVRI, and to our knowledge none has been provided to the appropriate regulatory agencies. Should any additional specific questions or concerns regarding potential impacts be raised following review of the EA report, these will be discussed with First Nations groups on a case-by-case basis. CVRI will provide regular updates (report bi-monthly) regarding these discussions to the Government of Alberta through the bi-monthly reporting process to SAAB as outlined in the Project Aboriginal Consultation Plan.

12. Volume 4, CR #12, Section 4.4, Page 58

Coal Valley Resources Inc. states in the second paragraph *The avoidance of ceremonial areas, specific plant species, graves and other areas during construction and operation of the proposed Project area has been negotiated, or will be negotiated, on a case-by-case basis with individual Aboriginal groups. CVRI has already agreed to avoid some areas of particular importance within or adjacent to the Project area, and has entered into agreements with some groups for longer-term monitoring of impact to medicinal and other plants, or for monitoring of general environmental impacts.*

a. What is the status of Coal Valley Resources Inc.'s negotiations with First Nations to avoid traditional sites?

Response:

Specific traditional use locations present in or near the Project area have been provided by only four groups. Specific locations presented by the O'Chiese First Nation and Nakcowinewak are now located outside of the proposed mine permit area in part due to agreement between the parties. To date, only generalized locational information has been offered by the Sunchild First Nation and Foothills Ojibway Society. Discussions are still underway about possible avoidance strategies or other accommodation options where appropriate for identified sites, when and if they are identified to CVRI as within the impact footprint associated with the Project.

To date, it is CVRI understanding that no identified First Nation grave sites, cabin sites or ceremonial sites are located within the proposed disturbance footprint of the Project.

CVRI understands that multiple sites containing traditional use plants have been identified within the Project footprint and that loss of these plant communities are of concern to various First Nation groups. CVRI has committed to mitigation efforts to attempt transplanting representative plant communities in the reclaimed profile with assistance from some of the First Nation communities.

Various 'mineral licks' and wildlife habitat areas have been identified by First Nation groups within the Project footprint and loss of these areas will impact continued hunting and trapping in the region. CVRI has communicated to First Nation groups that reclamation plans will return basic land use opportunities after mining. CVRI has agreed to help some First Nation groups participate in aspects of reclamation planning and monitor future reclamation activities on an ongoing basis.

b. Provide the monitoring agreements that Coal Valley Resources has entered into in order to avoid or mitigate impact to First Nation Rights and Traditional Uses or provide a summary of the content of those agreements.

Response:

Any accommodation /monitoring plans are part of confidential written agreements between CVRI and the potentially affected Aboriginal groups. At this time CVRI is not prepared to share any such agreements with Third Parties. A brief summary of the content of those agreements where they exist or are in development is already provided in the relevant sections of CR #12. No new agreements have been finalized since the application was filed as consultations are on-going.

3.2 Transportation

13. Volume 1, Section C.1.3.2 to C.1.3.5, Pages C-5 to C-9

CVRI discusses draglines crossing the highway, truck/ shovel operation, timber salvage, and blasting operations in these Sections. Alberta Transportation is concerned that operations will impact traveling public on the highways in the vicinity of the Project.

a. Discuss CVRI's Traffic Accommodation Strategy for the event of a dragline crossing a provincial highway;

Response:

The Project does not include any 'dragline crossings' on any provincial highway. The dragline will be moved from the current mine permit area through the Erith or Halpenny corridor. The dragline will not be moved into Robb West.

b. Provide the haul route and truck volumes for the timber salvage and truck/shovel operations; and

Response:

Log Haul

Haulage of harvested timber will be managed by the FMA holder, Hinton Wood Products (HWP). HWP will utilize their logging roads for movement of the timber. These movements will involve utilization of the 'Robb' road which runs parallel to the Project. The route involves crossing of Highway 47 near the community of Robb. This route is part of the regular log haul in the area. Such activity is anticipated to be consistent with current traffic volumes.

Mine Haulage

Mining will involve coal and waste haul on 'off-highway' haulage roads constructed and maintained by CVRI. All such roads are operated as 'private' roads and allow no public access. The Erith and Halpenny corridors connect the Project directly to the main haulraods within the current CVM operation. The Byran corridor will connect Robb West with the Yellowhead Tower haulage road. The Yellowhead haulroad includes an overpass over Highway 40 near the junction of Highway 47 and 40.

c. Discuss the impact of the operations on highway traveling public and mitigation methods.

Response:

The Project will have minimal impact on highway traffic with little change over what is currently in effect.

Current Operation

The current operation has two highway 'crossings' with a third planned for construction. The two existing crossings are 'level crossings' over Highway 40. These two crossings accommodate movement of heavy equipment and daily coal haulage. The third crossing will provide an overpass to separate mine traffic from highway traffic.

Employees and services to the mine approach the current operation utilizing Highway 47 from Edson. This traffic enters the mine at several entrances. The primary entrance is to the shop/office/plant complex located off Highway 40.

Blasting in the Pit 29 area has required temporary closure of Highway 47 as a safety measure in the event of 'fly rock'. CVRI provides flagman during these closures for traffic control. Typical closure is less than 15 minutes. A similar situation is expected when Yellowhead Tower mining approaches the highway corridor.

Robb Trend

Traffic to the office shop/plant complex will continue through the life of the Project. This traffic is expected to decline as some will be redirected to the Project facilities. This Project traffic will mostly originate in the Edson area and leave Highway 47 at the Robb Road junction.

This junction is currently used as part of the HWP logging road network and access to the Hanlan Robb gas plant. The initial part of the road is paved and also serves as a major entrance to the Robb community.

CVRI anticipates no changes to the current roads in this area as it is capable of handling this future addition of traffic. Mine related traffic to the south will be diminished.

Blasting within the Project is not anticipated to impact public highways. No short period closures or traffic controls are anticipated when blasting is occurring near the highway corridor.

Robb Road

The HWP logging road to the west of Robb (Robb Road) will be rerouted during mining of Robb West. The existing junction with Highway 47 is expected to remain.

14. Volume 1, Section C.1.5.1, Page C-12

CVRI states *The main entrance to the facility area is from Highway 40.* As per part [A] Section 2.5 of the Terms of Reference, CVRI is to *discuss the traffic implications of the Project, including the anticipated changes to traffic (e.g. type, volume) on highways. Consider other existing and planned used of the same highways*. However, CVRI did not clearly provide the anticipated traffics generated by the Project (type and volume) during construction, operation, and expansion phases, and whether any improvements to highway accesses are required.

a. Provide anticipated traffics generated by the Project (type and volume) during construction, operation, and expansion phases, and determine their impacts to highway operation and whether any improvements to highway accesses are required.

Response:

Construction Phase

No increase in traffic is expected during the construction phase. The majority of work on the new haulroads will be accommodated by existing CVRI forces. Some redirection of traffic onto the Robb Road (East) will begin to occur.

Operation Phase

As mining starts and increases in the Project area additional traffic will be redirected onto Robb Road (East). This represents a shift in direction of movement not in overall volume of traffic.

Expansion Phase

There is no expansion. The traffic volume to the mine is expected to remain the same. Some changes in the traffic flow will occur as more traffic will use the Robb Road (East) route.

Highway Improvements

No highway improvements are foreseen as needed to accommodate the future traffic to and from the mine area. Traffic south to the current plant area will diminish. A major portion of the current traffic will be redirected onto the Robb Road (East).

3.3 Historic Resources

15. Volume 3, CR #4

The FTOR for this project states:

HISTORIC RESOURCES

A. Describe the Historic Resource Impact Assessment (HRIA) work done for the Project, and provide a schedule for any future work.

B. Describe the implications of the findings of the HRIA work on Project design and scheduling.

C. Describe any Project uncertainties arising from the need for future HRIA work.

Consultant Report #4 Historic Resources of Volume 3 does not contain any information. Coal Valley states that this report was *Submitted under separate cover to Alberta Culture ad Community Spirit*. However, it is a requirement that a summary and overview of the information be provided in the EIA for the Public Record while not disclosing information that is protected under provisions of the *Historical Resources Act*.

a. Provide the information as outlined in the Terms of Reference:

i. Describe the Historic Resource Impact Assessment (HRIA) work done for the Project, and provide a schedule for any future work.

ii. Describe the implications of the findings of the HRIA work on Project design and scheduling.

iii. Describe any Project uncertainties arising from the need for future HRIA work.

Response:

As previously noted, the full HRIA reports have been submitted to the Historical Resources Management Branch of Alberta Culture for their review. Further information can be obtained from Brian Ronaghan, Head of the Archaeological Survey. Attached as ESRD Appendix 15, a summary HRIA report can be found.

16. Volume 4, CR #12, Figures 16, 17, 18 & 19, Pages 73-75

a. Did CVRI obtain permission from First Nations to have the photos of traditional camp-out published?

Response:

The photographs in question have appeared in previous public documents, and the First Nation in question has previously requested permission of the material for their use for their own promotional purposes. Participants in studies were aware that photographs were being taken for documentation purposes. The EIA has been in the possession of all Aboriginal groups since the date of submission, and no objections have been registered.

4. AIR

17. Volume 2, CR #1, Section 2.1.1, Page 4

CVRI states that the Application and Planned Development Cases are based on Year 2034 without justification with respect to consideration and exclusion of other projects in the general vicinity. Specifically, AEPEA s 47(d) states that the EIA must include *a description of potential positive and negative environmental… impacts of the proposed activity including cumulative, regional, temporal and spatial considerations.* This is particularly true for the air quality assessment where emissions from facilities several kilometers away have the ability to materially affect the predicted impacts within the Local Study Area (LSA) and Regional Study Area (RSA).

Cumulative effects assessment must have regard for reasonable foreseeable projects, activities and natural events that could affect the magnitude, duration or significance of a project's cumulative effects. As well, any overlap among multiple projects with respect to temporal and spatial scales must be considered and discussed. Several other coal mining and quarrying projects have been announced, approved, are undergoing regulatory review, or are directly associated with the Project (e.g., Lehigh, Cardinal River Operations, Coalspur) and these projects are outside the selected approximately 50 km by 50 km RSA.

a. Justify the suitability of the spatial boundary of the RSA that was selected for the cumulative effects assessment, or otherwise revise the RSA extent accordingly to account for additional projects within the general vicinity.

Response:

Approach

To address the suitability of the size of the RSA, the impact of additional projects were estimated based on information in recent applications for the Coalspur Vista Mine, Teck Coal Ltd. Cardinal River Operations (Luscar site, and Cheviot Mine) projects. The approach to the estimation was as follows:

- Identify the centre of activity in each of the three projects listed above (the active mine pits at Vista and Cardinal River Cheviot; the coal plant at Cardinal River Luscar site).
- Draw a line from the centre of this activity to the Project activity, which in this case was the community of Robb and the west pit operations. This is the path that plumes from these projects would follow to impact the Project (ESRD Figure 17-1).
- Maximum predicted concentrations without background were obtained at points along these lines, from the centre of activity to the edge of the respective model domains. The model results included all modelled sources. For Vista, this included all sources in the PDC scenario, including a future coal mine of similar production to Vista, the town of Hinton and the Hinton mill. Cardinal River Luscar and Cheviot were modelled together and modelling included other quarry operations (Lehigh) and all haul roads.
- Predictions included SO_2, NO_2, $PM_{2.5}$, PM_{10}, and TSP which were representative of exhaust and fugitive emissions.

Results

The results of the approach are shown in graphical form in ESRD Figures 17-2 to 17-6. Each graph shows the predicted fall-off of concentration with distance from the source, the background concentration used in the assessment (ESRD Table 17-1), and the applicable AAAQO. The graphs also show the distance from each project to the edge of the Project RSA and to the west pit near Robb.

The graphs indicate the following for $PM_{2.5}$:

- For emissions from the Vista PDC case, maximum 1-hour predictions at the nearest Project RSA boundary are approximately equal to the background concentration of 6.1 $\mu g/m^3$. The RSA boundary is about 8 km from the Project west pit operations.
- For emissions from Cheviot and Luscar operations, 1-hour background concentrations are reached about 22 and 25 km, respectively, from the nearest Project RSA boundary.

- For 24-hour concentrations, maximum predictions from Vista, Cheviot, and Luscar operations were less than the assumed background of about 5 $\mu g/m^3$.

For PM_{10}, the graphs indicate that predicted concentrations drop to background values at distances of about 10, 23, and 25 km from the nearest Project RSA boundary for the Vista, Luscar, and Cheviot emission scenarios, respectively.

For TSP, Coalspur Vista maximum 24-hour predictions drop to background concentration levels (32 $\mu g/m^3$) at the nearest edge of the Project RSA. Luscar and Cheviot predictions reach background values about 20 and 25 km, respectively, from the Project RSA boundary nearest their operations. All annual predictions from all operations were below the assumed background concentrations of 10-13 $\mu g/m^3$.

For NO_2, maximum 1-h predictions from Vista are expected to be above background levels at the Project RSA boundary, while predictions from Luscar and Cheviot drop to background levels about 15 km from the nearest Project RSA boundary.

Impact on Predictions

Adding Coalspur Vista PDC as Increased Background

Our assessment is that the influences of the Cheviot and Luscar operations (and the quarry and hauls roads within the respective study areas) are negligible within the Project RSA. Furthermore, as these operations exist, their influence is already accounted for in the background concentrations used in the assessment.

The new Vista project (as well as the possible future mine within its study area) is not explicitly accounted for in the existing background concentrations. Nonetheless, much of its contribution at the edge of the Project RSA is well below background concentrations. There are two exceptions: 1-h NO_2 to which AAAQOs apply and 1-h $PM_{2.5}$ to which AAAQOs do not apply. The approach taken here is to update the background concentrations to account for the new projects.

- The 1-h NO_X background concentration used in the assessment, based on 90^{th} percentile observations as recommended by ESRD (2009), was 5.6 $\mu g/m^3$. The 90^{th} percentile 1-hr NO_2 prediction from the Vista PDC case at the point nearest the Project RSA was 3.1 $\mu g/m^3$. The addition of this concentration would increase the MPOI prediction from 261 $\mu g/m^3$ (Table 5.2-1 in CR #1) to 264 $\mu g/m^3$. This 1% increase would not change the conclusions of the assessment. Note that this is a conservative approach in that the background and Vista NO_X should be added, and then converted to NO_2; however, in this case because the background is small, the over-prediction is also small.

- The 1-h $PM_{2.5}$ background concentration used in the assessment, based on 90th percentile observations as recommended by ESRD (2009), was 6.4 µg/m³. The 90th percentile 1-h $PM_{2.5}$ prediction from the Vista PDC case at the point nearest the Project RSA was 0.5 µg/m³. The addition of this concentration would increase the rounded MPOI prediction from 17 µg/m³ to 18 µg/m³ (Table 5.2-1 in CR #1). This 3% increase would not change the conclusions of the assessment. If the additional background was added to the unmitigated prediction at the MPOI, the concentration would increase from 95 µg/m³ to 96 µg/m³ compared to the AAAQG of 80 µg/m³; a change of 0.5%. In neither case would the conclusions of the assessment change.

Adding Maximum Coalspur PDC Predictions to the Robb Trend MPOI

A very conservative alternative approach is to assume that the Vista PDC maximum predictions at the point nearest the Project RSA are added to the Project MPOI. The result of this addition is listed in ESRD Table 17-2, based on the plotted values in Appendix A and the predictions in CR #1. The predictions show the following:

- All SO_2 predictions remain below the AAAQO and there is no change in EIA conclusions.
- All mitigated 1-h and 24-h $PM_{2.5}$ predictions remain below the AAAQG and AAAQO. Unmitigated 24-h $PM_{2.5}$ predictions also remain below the AAAQO and there is no change in EIA conclusions.
- All mitigated PM_{10} predictions remain below the Interim BC Objective of 50 µg/m³. Unmitigated values remain above the Objective. Therefore, no change in conclusions of the EIA is expected.
- Maximum 24-h mitigated TSP predictions of 100 µg/m³ now meet the AAAQO of 100 µg/m³. Considering that the Vista PDC prediction at the RSA boundary nearest Project has been applied at the Project MPOI about 10 km away, it is highly unlikely the mitigated exceedances will actually occur. The unmitigated 24-h prediction remains above the AAAQO. Annual mitigated and unmitigated TSP predictions continue to be less than the AAAQO. Therefore, no changes in the TSP conclusions of the EIA are expected with the inclusion of the Coalspur PDC case.

With maximum Vista PDC predictions added, maximum Project 1-h NO_2 predictions of 311 µg/m³ exceed the AAAQO of 300 µg/m³ and the following considerations apply:

- In determining this value, we have simply added maximum NO_2 concentrations after the OLM method was applied. When NO_X predictions from Vista PDC and the Project are added, and the OLM is then applied, the maximum predicted concentration is 266 µg/m^3, which remains less than the AAAQO.
- Considering that the Vista PDC prediction, at the edge of its RSA nearest the Project East Mine, has been applied at the Project MPOI about 10 km away, it is highly unlikely the prediction would be as high as calculated above.
- The Project MPOI is located just southwest of in-pit sources, pit haul roads and out-of-pit soil handling areas. It is unlikely that Vista PDC emissions, blowing into the area from the southwest, would have contributed to maximum predictions at that location at the same time.

The annual NO_2 prediction does not exceed the AAAQO. Therefore, no changes in the NO_2 conclusions of the EIA are expected with the inclusion of the Vista PDC case.

Summary

The addition of predictions from the nearest mining operations in the region around the Project, including all existing and potential future projects that result in air emissions within respective modelling domains, does not change the conclusions of the EIA.

Table 17-1 Background Concentrations Used in Air Quality Assessments (µg/m^3)

Project	SO_2	NO_2	$PM_{2.5}$	PM_{10}	TSP
Hourly					
Coal Valley Robb Trend	2.6	5.6	6.4	-	-
Coalspur Vista	2.6	5.6	6.4	-	-
Cardinal River Luscar & Cheviot	1.6	5.6	5.1	-	-
Daily					
Coal Valley Robb Trend	2.6	-	6.4	16	32
Coalspur Vista	2.6	-	6.4	16	32
Cardinal River Luscar & Cheviot	1.6	-	5.1	10	21
Annual					
Coal Valley Robb Trend	0	1.5	-	-	13
Coalspur Vista	0	1.5	-	-	13
Cardinal River Luscar & Cheviot	0	0.9	-	-	10

Table 17-2 Robb Trend MPOI Maximum Predictions Augmented by Coalspur PDC Maximum Predictions (µg/m³)

Compound:	Robb Trend MPOI Predictions			Vista PDC Maximum at Edge of Vista RSA			Robb Trend MPOI + Vista PDC Maximum		
	1 hour	24 hour	Annual	1 hour	24 hour	Annual	1 hour	24 hour	Annual
NO_2	261	-	15	50		1.5	311[1]		16.5
SO_2	117	24	1.0	2.6	2.6	0	119.6	26.6	1
$PM_{2.5}$	28 (95)	9 (17)	-	10	3	-	38 (105)	12 (20)	-
PM_{10}	-	41 (117)	-	-	8	-	-	49 (125)	-
TSP	-	98 (294)	19 (38)	-	2	2	-	100 (296)	21 (40)

[1]This value is 266 µg/m³ if NO_X values are added and then converted to NO_2.
Values in brackets are unmitigated particulate predictions

b. Provide a summary of all mining, quarrying, oil and gas and other industrial projects within the general vicinity (100 km by 100 km, or larger, if necessary) that may have the potential to affect the predicted results of the air quality assessment.

Response:

ESRD Table 17-3 summarizes distances between the modelled Project and the major sources identified in ESRD SIR #17a). ESRD Figure 17-1 shows the locations of these sources and ESRD Figure 17-7 illustrates the location of existing and proposed facilities and WCAS monitoring stations within 100 km.

Table 17-3 Existing Coal Mines within Robb-Trend Proposed Mines Area

Facility Name	Clean Coal Production (Mt)	Distance to Robb Trend (km)			Emissions (t/yr)				
								Dust	
		West Mine	East Mine	Main Mine	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}
CRO Cheviot Mine - Existing	2.1	41	55	41	0.59	146	587	7.7	24.6
CRO Luscar (plant) - Existing		32	59	34	0.33	47.9	545	4.39	20.64
Coalspur Phase 1 Mine - Proposed	5.3	28	69	31	55	1,715	1,215	139	909

Table 17-3 Existing Coal Mines within Robb-Trend Proposed Mines Area									
Facility Name	Clean Coal Production (Mt)	Distance to Robb Trend (km)			Emissions (t/yr)				
								Dust	
		West Mine	East Mine	Main Mine	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}
Coalspur Phase 2 Mine – Proposed	5.3	34	75	38	55	1,715	1,215	139	909
Obed Mine	1.2	50	91	53	3.7	180	150	43	323
Lehigh Limestone Quarry	2.6	34	53	5	a. 1.1	b. 160	c. 112	d. 11.8	e. 27.7

c. Provide a timeline for the start and duration for each of these projects, and identify the year when the potential exists for the greatest contribution, in addition to the Project emissions, to occur to regional air emissions loadings. Characterize these loadings from predicted emissions in terms of the RSA, the Robb townsite, and sensitive ecosystems (i.e., water bodies and vegetation).

Response:

The response to ESRD SIR #17a) indicates that no changes to the conclusions of the air quality assessment in the EIA result from the addition of predicted concentrations from the nearest existing mines, quarries and haul roads, or the nearest planned and possible future projects operating at full build out. Therefore, the timelines associated with these activities, by modelling full build out operations, have been accounted for in the Project modelling.

Nonetheless, ESRD Table 17-4 summarizes raw coal production for the Project and Coalspur Vista mines (Coalspur, 2012). Existing Cardinal River Cheviot mine annual production is 3 million raw tonnes annually (CRO, 2011a). The existing Obed Mine production is 2.2 million raw tonnes annually (CVRI, 2009a) and has coal reserves until 2014 (CVRI, 2009b). The timing of a possible future Coalspur mine near Vista is unknown but has been included in the Vista EIA at full build-out. Finally, the Project is an extension, not expansion, of Coal Valley's current operations at Yellowhead Tower and Mercoal West. In this important sense, the Project does not represent new regional production.

From ESRD Table 17-4, raw coal production at the Project and Coalspur Vista is expected to be stable from 2019 to 2034. Timing of a future expansion to Coalspur Vista is unknown and this production is not included.

In addition to raw coal production, other factors determine of emissions from mining operations – for example, the amount of overburden removed, length of the haul roads, and proximity to special receptors. Considering these other activities, Coalspur chose the year 2029 as the worst case scenario for Vista. Again, by including all planned or possible future projects at full build-out, concerns around timing of peak activity and loadings are reduced.

Table 17-4 Planned Raw Coal Annual Production (RMT) at Robb Trend and Coalspur Vista

Year	Robb Trend	Coalspur Vista	Year	Robb Trend	Coalspur Vista
2014	1.0	0	**2027**	8.0	9.3
2015	4.0	5.6	**2028**	8.0	9.5
2016	5.0	7.6	**2029**	8.0	9.4
2017	7.0	8.9	**2030**	8.0	9.3
2018	8.0	8.4	**2031**	8.0	9.5
2019	8.0	9.2	**2032**	8.0	9.3
2020	8.0	9.2	**2033**	8.0	7.5
2021	8.0	9.3	**2034**	8.0	8.1
2022	8.0	9.2	**2035**	7.0	0
2023	8.0	9.3	**2036**	6.5	0
2024	8.0	9.4	**2037**	6.0	0
2025	8.0	9.3	**2038**	5.0	0
2026	8.0	9.5	**2039**	0	0

d. Provide a discussion of the expected air emissions from these projects and potential for influencing the outcome of this EIA.

Response:

ESRD Appendix 17 provides estimated emissions from industrial sources within 100 km of the Project. Emissions from sources within the study areas for Cardinal River Cheviot and Luscar operations and Coalspur Vista projects are taken from their respective most recent air quality assessments (CRO 2011a, b, c; Coalspur, 2012). Emissions for industry outside these study areas are taken from NPRI for the most recent reporting period (http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=4A577BB9-1).

The following comments refer to the potential for impact in the Project RSA:

- SO_2 emissions at the Hanlan - Robb gas plant, which is the nearest SO_2 source to the Project, have been decreasing for a number of years. Given this, and the expectation that the trend will continue for the next number of years, the use of current emissions in modelling is expected to not under-estimate regional emissions.
- CVRI is unaware of other planned changes to emission sources in the region within 100 km of the Project.
- CVRI understands that the Obed mine has limited reserves of readily accessible coal to mine and process. It is possible that production will be scaled back or that activity at the mine and processing plant could cease during operation of the Project (the current mining schedule for East Limb Pit, mined presently, anticipates that production will stop in 2014 – CVRI, 2009b).

Our conclusion from ESRD SIR #17a) was that the emissions from the largest and nearest projects do not influence the conclusions of the Project air quality assessment. Given that other emissions in ESRD Appendix 17 are generally smaller and originate farther from the Project, we conclude they will have an even smaller impact. Furthermore, the impacts of these existing facilities are already accounted for in the air quality background measurements at WCAS stations. The use of background concentrations is a recommended approach to including the effects of distant industrial sources (ESRD, 2009).

e. Provide justifications for their exclusion or otherwise include and consider them in the regional air quality assessment, using numerical modeling.

Response:

ESRD Figure 17-1 shows the relative locations of the nearest mining and quarry operations. ESRD Figure 17-2 to 17-6 show that predictions decrease with distance from the source. The approach taken to evaluating the impact of the nearest major mining operations (and the industry within their study areas) was to estimate their maximum impact on the edge of their respective study areas nearest the Project RSA boundary, and to superimpose this prediction onto the Project MPOI.

The addition of predictions from the nearest existing, planned and possible future mining operations in the region around the Project, does not change the conclusions of the EIA. Given that other emissions in ESRD Appendix 17are generally smaller and originate farther from the Project, we conclude they will have an even smaller impact.

Therefore, the RSA boundary of the Project and the inclusion of existing, planned and possible future projects are shown to be justified. The inclusion of additional emission sources beyond the RSA boundary would not change the conclusions of the air quality assessment presented in the EIA.

f. Consider the staging and location of the emission sources each year for these projects in relation to Robb and confirm whether the suggested Project years (2034 and 2035) are still appropriate.

Response:

Years 2025 and 2034 were chosen for the Project assessment because during these years, the mine will be closest to the community of Robb. All other years of operations have emissions further away from the town.

The Cardinal River Luscar source is a fixed plant location. The Cheviot and Lehigh pits are too far from the Project to have a material impact on predictions. Variations in pit locations by a kilometre in any direction will have a negligible impact on concentrations at the MPOI at the Project.

The location of the Vista pits is near the northern end of the Coalspur mining area, with a large waste rock dump near the mining area boundary for maximum impact outside the mine pit. Operations at other waste dumps could occur up to 2 km farther southeast and could increase predictions at the Vista RSA boundary. However, application of Vista RSA boundary predictions at the Project is already a conservative assumption (in the response to ESRD SIR #17a) above) and movement of the pit would simply reduce the level of conservativeness.

The location of the future possible mine between Vista and Hinton is not known. Movement of the pit location by several kilometres would have a negligible impact on predictions at the Project.

g. Evaluate whether the results from the Application and Planned Development Cases may be materially affected by these additional projects.

Response:

See response to ESRD SIR #17e).

References:

Cardinal River Operations (CRO), 2011a. Air Quality Assessment Teck Coal Ltd. Cardinal River Operations Cheviot Mine Site.

Cardinal River Operations (CRO), 2011b. Air Quality Assessment Teck Coal Ltd. Cardinal River Operations Luscar Mine EPEA Approval #11767.

Cardinal River Operations (CRO), 2011c. Teck Cardinal River Operations Cheviot Mine - Air Quality Assessment for Gaseous Emissions.

Coalspur Vista Coal Project EIA (Coalspur) 2012. Application under the Coal Conservation Act (CCA) and Environmental Protection & Enhancement Act (EPEA) for the Coalspur Mines (Operations) Ltd. – Vista Coal Projects.

Coal Valley Resources Inc. (CVRI) EIA 2009a. Coal Valley Resources Inc. Obed Mountain Mine Renewal Application – Consultants Reports #1 – Air Quality.

Coal Valley Resources Inc. (CVRI) EIA 2009b. Obed Mountain Mine EPEA Amendment Renewal Application, Part A - General.

ESRD. 2009. Air quality model guideline. Prepared by A. Idriss and F. Spurrell, Climate Change, Air and Land Policy Branch. Available at: http://environment.gov.ab.ca/info/library/8151.pdf.

18. Volume 2, CR #1, Section 2.2.1.4, Page 6
Volume 2, CR #1, Section 6.2, Table 6.2-1, Page 86
Volume 2, CR #1, Section 4.3, Table 4.3-1, Page 46

Figure 7 of the AEW Air Quality Model Guideline (2009), indicates that if the Project emissions are >5% over the baseline emissions, then PAI modelling must be completed. In Table 4.3-1 of the air quality assessment, the Project Case 1 NOx emissions were calculated as being about 86% higher than the baseline or existing case. As a result, PAI results should be determined and reported.

a. The summary of annual emissions in Table 6.2-1 also support an increase of acidifying emissions above 5% although the totals do not always agree with Table 4.3-1. Confirm which totals are correct.

Response:

Both tables are correct but summarize different averaging periods. Table 6.2-1 applies to annual average emissions on a daily basis and Table 4.3-1 refers to maximum daily emissions. The two are not directly comparable because some operations are not continuous during the entire year. For example, maximum daily haul traffic and maximum daily production can be substantially higher than the annual average (essentially the difference between calendar and stream days in plant operations). Thus we expect annual average emissions, on a daily basis, to be substantially lower than maximum daily emissions and this is indicated in a comparison of the two tables.

To assist in comparison, ESRD Table 18-1 provides more detail in the annual average emissions on a daily basis. For SO_2 and NO_x, there is no discrepancy with Table 6.2-1. Emissions from the coal processing plant were inadvertently included in Project-only emissions. If this is corrected, annual SO_2 and NO_X emissions were 6 kg/d and 1200 kg/d, respectively.

Table 18-1 Summary of RSA Annual Average Emissions of PAI Precursors (kg/d)

No.	Description	SO_2	NO_x	No.	Description	SO_2	NO_x
2	Robb West Mine Emissions	1.95	118	7.	Plant Operations (Refuse Hauling, and Piles) (all emission scenarios),	0.4	113
3	Robb East/Centre Mine Emissions	0.20	12.3	8.	Plant Stack Emissions (all emission scenarios)	5.2	348
4	Robb Main Mine Emissions (Project Case 2)	2.06	121	9.	Public Roads (Baseline and Application / PDC)	1.8	54
5	Robb West Total for Haul Roads	2.97	754	10.	Gas Plants, Compressor Stations (Baseline and	6,967	2,991

Table 18-1 Summary of RSA Annual Average Emissions of PAI Precursors (kg/d)							
No.	**Description**	**SO_2**	**NO_x**	**No.**	**Description**	**SO_2**	**NO_x**
					Application / PDC)		
6	Robb East/Centre Haul Roads	1.32	328	11.	Yellowhead Mine and Haul Road (Baseline)	26	663
7	Robb Main Haul Road (Project Case 2)	3.38	845	12.	Community of Robb (Baseline and Application / PDC)	0.05	1.16
Total						**SO_2**	**NO_x**
Baseline Case (kg/d)						**7, 000**	**4,170**
Project Only Case 1 (kg/d)						**12.04**	**1,673**
Application / PDC Cases (kg/d)						**6,981**	**4,720**
Project Only Case 2 – (kg/d)						**11.03**	**1,427**

b. Undertake appropriate analyses and report PAI results, or otherwise provide a justification regarding why this is not required.

Response:

Using annual emissions in Table 6.2-1, which are consistent with annual PAI deposition, emissions of NO_x and SO_2, which are PAI precursors, for Application and PDC cases are 4.7% higher than emissions for the Baseline case. Therefore, according to ESRD Air Quality Objectives (ESRD, 2009), modelling of PAI is not required.

CVRI has modelled PAI as requested and ESRD Table 18-2 and ESRD Figures 18-1 to 18-3 summarize these results. Precursor emissions for PAI include NO_X and SO_2. The PAI modelling assumed a regionally varying background based on Cheng (2009). The background was included in Baseline, Application and Project-Only Cases. Within the RSA, the Cheng (2009) background for PAI is about 0.177 keq/ha/yr. The Project-only predictions included the plant as indicated above.

Table 18-2 Average Potential Acid Input (PAI) Predictions (keq/ha/yr)

Parameter	Baseline	Application and Planned Development	Project Only	Application Increase Over Baseline [%]
Regional Study Area				
Overall Maximum (RSA-MPOI) PAI deposition (keq/ha/yr)	0.746	0.751	0.395	0.7
RSA PAI Deposition Load Areas [km^2]				
Sensitive Soil Monitoring > 0.17 keq/ha/yr	2350	2350	2350	0
Sensitive Soil Target Level > 0.22 keq/ha/yr	798	1167	198	46
Sensitive Soil Critical Level >0.25 keq/ha/yr	70	142	24	101
Moderately Sensitive Soil Critical Level > 0.5 keq/ha/yr	1.10	1.16	0	5
LSA				
Overall Maximum (LSA-MPOI) PAI deposition (keq/ha/yr)	0.257	0.411	0.395	58
LSA PAI Deposition Load Areas [km^2]				
Sensitive Soil Monitoring > 0.17 keq/ha/yr	130	130	130	0
Sensitive Soil Target Level > 0.22 keq/ha/yr	18	103	55	481
Sensitive Soil Critical Level >0.25 keq/ha/yr	0.05	34	20	72075

Modelling results show the ESRD sensitive soil target level (0.22 keq/ha/yr) is exceeded over about 34% of the RSA in the Baseline case and 50% in the Application case. The Application case increase is mainly near West mine operations within the LSA. Similarly, the sensitive soil critical level (0.25 keq/ha/yr) is exceeded over 3% of the RSA in the Baseline and 6% in the Application case. The moderately sensitive soil critical level (0.50 keq/ha/yr) is exceeded near the Hanlan Robb Gas Plant only.

Comments that impact predictions:

- Mine sources are not fixed but move according to the mine plan. Therefore the locations impacted by deposition change annually and the model predictions at any one location should not be considered as an annual input over the life of Project operations.

- The Cheng (2009) background includes the impact of existing operations, including current CVRI operations such as Yellowhead Tower and Mercoal West. These sources in particular will not operate when the Project operates and the predictions in ESRD Table 18-2 are therefore expected to over-estimate expected deposition.
- The PAI predictions do not include the contribution from planned operations outside the RSA which have been shown in the response to ESRD SIR #17 to be small.

The MPOI values for Baseline and Application cases occur near the Suncor Hanlan Robb Sour Gas Processing Plant, which is the largest SO_2 source in the area. The Project-only maximum prediction occurred near the Robb West mine.

References:

Alberta Environment and Sustainable Resource Development (AESRD). 2009. Air quality model guideline. Prepared by A. Idriss and F. Spurrell, Climate Change, Air and Land Policy Branch. Available at: http://environment.gov.ab.ca/info/library/8151.pdf.

Cheng, L. 2009. *Acid deposition Excel Spreadsheet*. Distributed by M. Davies on behalf of Alberta Environment.

19. Volume 2, CR #1, Section 2.5.4, Page 16
Volume 2, CR #1, Section 4.2, Page 42

CVRI states that measured background concentrations represent the effect of distant industrial and all natural sources. Historical ambient measurements for years 2006 to 2010 were added to the predicted concentrations for the Project Only and Planned Development scenarios (year 2034) with no change or adjustment in concentration despite the approved, announced or otherwise public disclosure of other projects with substantial air emissions in the general vicinity, although outside of the identified RSA.

a. Explain why or if background ambient concentrations are anticipated to remain the same for the life of the Project, given these other projects have been disclosed and/or approved.

Response:

The potential influence of the existing and new developments outside the RSA was addressed in the response to ESRD SIR #17. This response showed that the expected contribution of these operations was typically much less than background concentrations. More specifically, the influences of the Cardinal River Operations and Luscar mines (and the quarry and all haul roads considered in their recent assessments) are negligible within the Project RSA. Furthermore, as these operations exist, their influence is already accounted for in the background concentrations used in the assessment.

The new Vista project (as well as the possible future mine within its study area and all industry existing in and around Hinton) was not explicitly accounted for in the existing Robb Trend background concentrations. Nonetheless, much of its contribution at the edge of the Robb Trend RSA is well below background concentrations. There are two exceptions: 1-h NO_2 to which AAAQOs apply and 1-h $PM_{2.5}$ to which AAAQOs do not apply. As the response to ESRD SIR #17 showed, adding NO_2 emissions from existing and planned developments would increase the MPOI prediction of NO_2 from 261 µg/m^3 (Table 5.2-1 in CR #1) to 264 µg/m^3. This 1% increase would not change the conclusions of the assessment. Similarly adding the $PM_{2.5}$ emissions from Vista projects and industry in and near Hinton would increase the rounded MPOI prediction from 17 µg/m^3 (Table 5.2-1 in CR #1) to 18 µg/m^3. This 3% increase would not change the conclusions of the assessment.

CVRI also examined historical air quality measurements at WCAS stations (ESRD Figures 19-1 to 19-4) and plotted 90th percentile hourly measurements of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ for each year of operation. Generally, the figures show a trend toward increasing concentrations at Hightower Ridge and Steeper prior to 2004 and a trend toward decreasing concentrations after 2008. Thus, the use of a constant background is consistent with monitoring data. Furthermore, the level of background is either approximately the average concentration over the period of record or is an over-estimate of the average.

In addition, Cheminfo (2007) projected emissions across Alberta from 2005 to 2020. Regional trends were not provided but emission growth by industry sector was. Coal mining was not considered but upstream oil and gas was considered and is a large component of industry in the region of the Project. Emissions for upstream oil and gas were forecast to decrease by 45% and 80% for SO_2 and NO_X, respectively, from 2005 to 2020. As an example, emissions at the Hanlan Robb Gas Plant have been decreasing recently. According to NPRI (2010) total SO_2 emissions were 7,928 t in 2005, 5,140 t in 2007, and 2,513 t in 2010. The CVRI assessment assumed a constant 2,543 t/year. Thus the use of a constant background is conservative with respect to these projections.

Finally, there is evidence that overall air quality in Canada is improving (ESRD Figures 19-5 to 19-8 from Fraser Institute; 2012, based on Environment Canada 2010). The improvement is a result of improved emission controls and greater fuel efficiency of combustion devices, despite larger numbers of such devices (primarily vehicles and heating/cooling units). The use of a constant background is conservative with respect to this trend.

References:

CASA (Clean Air Strategic Alliance). *Data Warehouse.* http://www.casadata.org/Reports/SelectCategory.asp Accessed September 2012.

Cheminfo. 2007. Forecast of Criteria Air Contaminants in Alberta (2002 to 2020). Prepared for Environment Canada. 138 pp.

Fraser Institute. 2012. Studies in Environmental Policy – Canadian Environmental Indicators – Air Quality, by Joel Wood, January 2012: *http://www.fraserinstitute.org/uploadedFiles/fraser-ca/Content/research-news/research/publications/canadian-environmental-indicators-air-quality-2012.pdf* .

Environment Canada. 2010. National Air Pollution Surveillance (NAPS) Network: http://www.etc-cte.ec.gc.ca/napsdata/Default.aspx, as of October 2010.

National Pollutant Release Inventory (NPRI). 2010. http://www.ec.gc.ca/pdb/websol/querysite/facility_history_e.cfm?opt_npri_id=0000003758&opt_report_year=2010.

20. Volume 2, CR #1, Section 3.1, Pages 17-18, Table 3.1-1

CVRI is relying upon historical ambient measurements that were acquired from a location that is remote from the Project. The Hightower Ridge station was chosen as *representative of rural concentrations*. It would be more accurate to characterize it as a high elevation background station, because it is unlikely to be subject to typical rural activities like farming. Ozone concentrations are higher at Hightower Ridge than Steeper, which is expected because of the higher elevation.

a. Discuss why most of the statistics for other pollutants, in particular SO_2 and NO_2, are higher at Hightower Ridge in comparison to the other stations?

Response:

The 1-hour maximum observations of NO_2, $PM_{2.5}$ and SO_2 were higher at Hightower than at Steeper. The PM_{10} 1-hour maximum was higher at Steeper. Median values of NO_2 and $PM_{2.5}$ were higher at Steeper while the PM_{10} median was higher at Hightower.

ESRD Table 20-1 compares measurements of additional percentile values where SO_2 values measured at Edson station are the consistently higher, SO_2 values measured at Hightower Ridge are lower and SO_2 values measured at Steeper are the lowest. The NO_2 values measured at Steeper are consistently higher than NO_2 values measured at Hightower Ridge, with the exception of the maximum 1-hour measurement as noted above.

Thus, measurements are influenced by nearby sources, whether of the oil and gas industry, agriculture, or forest fires.

With respect to the highest 1-hour SO_2 measurement, a review of all hours of data indicates that on one occasion, the hour after a calibration event was unusually high. In particular, the maximum 1-hour SO_2 value was recorded on July 29, 2008 at 3:00 pm after many hours when readings where zero. At 4:00 pm, there was no reading due to calibration. It appears that a part of the calibration process was recorded in the next hour of data, as readings for SO_2 were again zero for the next hours. This one hour of data would have little influence on the statistics in ESRD Table 20-1.

Table 20-1 Summary of Air Contaminant Concentrations Measured in the Region, 2006 to 2010

Compound	Edson[(a)] [μg/m³]	Hightower Ridge[(a)] [μg/m³]	Steeper[(a)] [μg/m³]	AAAQO[(b)] [μg/m³]
SO_2				
1-hour 99th Percentile	10	5	5	450
1-hour 98th Percentile	8	2.6	2.6	
1-hour 95th Percentile	5.2	2.6	2.6	
1-hour 90th Percentile	2.6	2.6[(c)]	0	
24-hour 99th Percentile	4.6	4.2	3.5	125
24-hour 98th Percentile	3.9	3.1	2.5	
24-hour 95th Percentile	3.1	2.6	1.5	
24-hour 90th Percentile	2.5	1.1	0	
Period Median	1.1	0.0	0.0	20
Period Average	0.9	0.5	0.3	
NO_2				
1-hour 99th Percentile	N/A	23	26	300
1-hour 98th Percentile	N/A	17	19	
1-hour 95th Percentile	N/A	9.4	13	
1-hour 90th Percentile	N/A	5.6[(c)]	7.5	
Period Median	N/A	1.5	1.8	45
Period Average	N/A	1.6	3.1	

[(a)] Source: CASA Data Warehouse (2011).
[(b)] Source: AESRD (2011).
[(c)] Used as background.

References:

CASA (Clean Air Strategic Alliance). Data Warehouse. http://www.casadata.org/Reports/SelectCategory.asp Accessed Oct 2011.

AESRD (2011). Alberta Ambient Air Quality Objectives and Guidelines. Issued in June, 15 2011.

21. Volume 2, CR #1, Section 3.1, Page 18, Table 3.1-1

For PM_{10}, CVRI has proposed a 24-hour maximum AAAQO of 50 µg/m^3. The cited reference is AEW (2011b).

a. Confirm the correct source for the stated value for PM_{10} and its relevance to this assessment.

Response:

The reference was incorrect. The 24 hour regulatory limit was taken from BCMOE (2009).

Reference:

British Columbia Ministry of the Environment. 2009. Air Quality Objectives and Standards. Updated April 2009. http://www.bcairquality.ca/reports/pdfs/aqotable.pdf.

22. Volume 2, CR #1, Section 3.1, Table 3.1-2, Page 19
Volume 2, CR #1, Section C3.3, Table C3-5, Page C-16

CVRI proposes to account for the non-Project emissions in the RSA by using percentile values calculated from existing monitoring stations and adding these data to the CALPUFF model predictions.

a. Confirm that the 1-hr and 24-hr SO2, PM2.5, PM10 and TSP concentrations are the same values for each contaminant.

Response:

The addition of background concentrations to account for distant industrial sources outside the RSA and natural sources is a requirement of ESRD (2009). Industrial sources within the RSA were modelled.

It is expected that daily average observations should be smaller than hourly average observations. Conservatively, hourly average observations were used in determining background 1-hour and 24-hour concentrations for the assessment.

b. Confirm the correct value for the 90th percentile $PM_{2.5}$ in Table C3-5, the value is 9 ug/m^3 compared to 6.4 ug/m^3 in Table 3.1-2.

Response:

There were typographical errors in Table 3.1-2 (main report) and Table C3-5 (Appendix C). The corrected tables are included below as ESRD Table 22-1 and ESRD Table 22-2. The correct values were used in modelling.

Table 22-1 Ambient Background Concentrations for Modelled Criteria Air Contaminants (updated Table 3.1-2)

Compounds	Hourly (µg/m^3)	8-Hour (µg/m^3)	24-Hour (µg/m^3)	Monthly (µg/m^3)	Annual (µg/m^3)	Data Source
SO_2	2.6	-	2.6	0	0	Hightower Ridge, 90th Percentile, December 1, 2007 – December 31, 2010 [(a)]
NO_2	5.6	-	-	-	1.5	Hightower Ridge, 90th Percentile, December 1, 2007 – December 31, 2010 [(a)]
$PM_{2.5}$	6.4	-	6.4	-	1.5	Steeper, 90th Percentile, March 1, 2009 to September 30, 2011 [(a)]
PM_{10}	16	-	16	-	6.3	Steeper, 90th Percentile, March 1, 2009 to September 30, 2011 [(a)]
TSP	32	-	32	-	13	2x PM_{10} Background Values as no TSP measurements available
CO	573	573	--	-	--	MAML – Town of Edson [(b)]

[(a)] Source: CASA 2011.
[(b)] Source: AENV 2002.
- No AAAQO for this averaging period, therefore background concentration not required.

Table 22-2 $PM_{2.5}$ Concentrations (µg/m^3) Measured at West Central Airshed Society Stations, 2006-2011 (updated Table C3-5)

Averaging Period	Edson	Hightower Ridge[(c)]	Hinton[(d)]	Steeper[(e)]	AAAQO[(a)]
1-h Maximum	451	451	626	451	80[(b)]
1-h 90th percentile	10	5.0	16	6.4	80[(b)]
24-h Maximum	170	280	259	179	30
24-h 99th percentile	17	24	49	40	30

Table 22-2 $PM_{2.5}$ Concentrations ($\mu g/m^3$) Measured at West Central Airshed Society Stations, 2006-2011 (updated Table C3-5)

Averaging Period	Edson	Hightower Ridge(c)	Hinton(d)	Steeper(e)	AAAQO(a)
24-h 90th percentile	8.7	5.1	14	6.3	–
Median	3.6	1.2	8.0	1.5	–

Data Source: CASA 2011
(a) Source: AEW 2011
(b) Guideline, not AAAQO
(c) December 6, 2007 – December 31, 2010
(d) February 25, 2010 – December 31, 2010
(e) August 1, 2010 – September30, 2011
N/A species not measured at this station.
- Alberta Air Quality Objective not available for this averaging period.

References:

Alberta Environment (AENV). 2002. Air Quality Monitoring: Edson and Hinton Area, September 1999 to 2000, Final Report. ISBN No. 0-7785-2041-2 (On-Line Edition). Publication No. T/638.

Alberta Environment and Water (AEW). 2011. *Alberta Ambient Air Quality Objectives and Guidelines*. Issued April 2011. (http://environment.gov.ab.ca/info/library/5726.pdf)

CASA (Clean Air Strategic Alliance). 2011. *Data Warehouse.* http://www.casadata.org/Reports/SelectCategory.asp Accessed April 2011.

23. Volume 2, CR #1, Section 4.1.1, Page 20, Project Case 1
Loading, hauling, and dumping of soil are specified by CVRI as emission sources for Robb West, and loading, hauling, dumping and bulldozing of soil are specified for Robb Main, but only bulldozing of soil is specified for Robb East and bulldozing of soil is not specified for Robb West.

a. Provide an explanation regarding these differences.

Response:

Robb West is primarily a truck/shovel operation. Limited areas will be available for reclamation during active mining operations. Soil will be conserved and transported to stockpile locations using trucks and shovels. When reclamation commences, the stockpiled soil materials are loaded, hauled and dumped on the sloped landscape. Trucks will be able to dump soil in small piles over the sloped surface. Afterwards soil will be spread in a separate operation using a minimal amount of bulldozer operations.

The Robb Main and Robb Center portions of the project have a more mixed mining arrangement with both dragline and truck/shovel pits. The truck/shovel sequence will assist in some direct placement of soil where soil can be salvaged, hauled, dumped and spread. The dragline pits most often have the soil materials conserved into nearby windrows which are then pushed back to the leveled spoil without loading and haulage needed.

The majority of Robb East will have dragline like pits where soil can be pushed back onto leveled spoil without loading and hauling.

The various cases utilized in the emissions calculations attempted to generally match what would be expected in each circumstance.

24. Volume 2, CR #1, Section 4.1.2, Page 26
Volume 2, CR #1, Section 4.1.4, Page 33

CVRI states that *Winter dust emissions from haul roads were reduced by 90% because roads will be covered by snow and/or frozen*. This statement is reiterated in Section 4.1.4 (age 33) with further explanation. However, the 43% reduction in dustfall for winter measurements compared to summer measurements at Smoky River does not, in itself, justify assuming a 90% level of control in winter. If the Sheep Creek haul road was uncontrolled in summer, then only a 43% level of control could be justified for winter. Furthermore, these findings will depend on the volume of traffic and size of vehicles using the Sheep Creek haul road, and whether that traffic is consistent throughout the year.

A 90% level of control in winter is considered an optimistic assumption. This will be achieved during periods of snow cover and when the roads are wet, but not when they are cleared and frozen. On those occasions, freeze drying of the surface and pulverization of surface material by heavy vehicles can cause appreciable dust emissions. As result, the average level of control over a winter may be substantially less than 90%, and worst-case could be at times near zero percent.

a. Provide further documentation of the Smoky River measurement program, together with documentation of what dust control was applied to the Sheep Creek haul road during the summer season at that location (amount and frequency of water or other dust suppression treatment), as well as information on the volume of traffic (by time of year) and size of vehicles on that haul road.

Response:

Smoky River Data

CVRI was unable to access historic supporting data from the time of the Smoky River Coal operations. In particular there is no data on suppression activities, haul truck activities or snowfall or snow depth. CVRI expects it would be very difficult to find detailed information about the frequency of watering and watering volumes at these particular haul roads during the period of interest.

Dustfall measurements near Grande Cache Coal haul roads are presented in ESRD Table 24-1 and ESRD Figure 24-1 (SRCL 1992, 1993). Station 4 is near the Sheep Creek haul road, which is also used by the general public; whereas station 15 is near the main haul road from the mine to plant. Haul roads used by Grande Cache Coal are said to be treated with calcium chloride in July and watered as needed (the frequency of watering is not available).

The measurements are variable with some high readings in winter. Comparing median values, the data suggest winter dustfall is lower than summer by 5 to 28%. Comparing 90th percentile values the reduction is 26% to 43%.

However, taking the most credible data from Station 15 and neglecting the November 1993 spike (which may or may not be real), the ratio of winter to summer dustfall measurements is around 0.38 (i.e. reduction of about 62%).

Table 24-1 Dustfall Measurements at GCCoal Stations (mg/100 cm2/30 days) (Winter: November to April, Summer: May to October)

Month	Raw Coal (t/hr)	Station 4	Station 15
1992			
January	506	222	98
February	494	104	54
March	476	151	55
April	416	36	146
May	446	66	101
June	465	155	-
July	488	119	109
August	493	211	123
September	486	29	268
October	522	53	84
November	535	7	104
December	624	104	31
1993			
January	503	62	34
February	532	113	80

Table 24-1 Dustfall Measurements at GCCoal Stations (mg/100 cm2/30 days) (Winter: November to April, Summer: May to October)			
Month	**Raw Coal (t/hr)**	**Station 4**	**Station 15**
March	471	80	96
April	486	174	140
May	506	133	181
June	487	131	56
July	493	220	20
August	486	100	129
September	497	83	258
October	530	18	128
November	546	48	405
December	502	103	43
Median in Winter	**503**	**104**	**88**
Median in Summer	**491**	**110**	**123**
Ratio: Winter/Summer	**1.02**	**0.95**	**0.72**
90th Percentile Winter	**545**	**151**	**146**
90th Percentile Summer	**520**	**205**	**258**
Ratio: Winter/Summer	**1.05**	**0.74**	**0.57**

Dustfall at Coal Valley

Dustfall measurements from two stations near the Project near unpaved Highway 40 are shown in ESRD Table 24-2 and ESRD Figure 24-2. Measurements were taken in 1997 and 1998 and summarized in Luscar (1999). Station 14 is much closer to the roadway and at that section of the road there are higher traffic counts than at Station 12 which is farther from highway and with lower traffic counts.

Results are more variable than Smoky River data, with some of the highest measurements in winter. For example, measurements at Station 14 were extremely high in February 1998 and measurements at Station 12 were very high in February and April 1997. In fact, measurements are low at Station 14 in February and April 1997, and they are also low at station 12 in February 1998.

Based on the complete dataset, median values support a winter reduction of 23% to 41% while the 90th percentile values show a reduction of 62% or a large increase, depending on the station.

Taking the most credible data from station 14 in 1997, the winter to summer dustfall ratio is about 0.52, or a reduction of about 48%.

Table 24-2 Dustfall Measurements at CVRI Stations (mg/100 cm2/30 days) (Luscar, 1999) (Winter: November to April, Summer: May to October).

Month	Station 12	Station 14
1997		
January	-	-
February	244	116
March	16	54
April	261	1.1
May	8.2	55
June	11	534
July	12	401
August	4.7	114
September	7.1	62
October	1.7	33
November	3.6	196
December	2.9	155
1998		
January	2.3	68
February	6.5	1,435
March	4.9	7.8
April	0	73
May	0	73
June	1.8	25
July	1.9	26
August	43	748
September	8.5	121
October	5.1	106
November	2.3	21
December	2.8	34
Median in Winter	**3.6**	**68**
Median in Summer	**6.1**	**89.5**

Table 24-2 Dustfall Measurements at CVRI Stations (mg/100 cm2/30 days) (Luscar, 1999) (Winter: November to April, Summer: May to October).		
Month	**Station 12**	**Station 14**
Ratio: Winter/Summer	**0.59**	**0.76**
90th Percentile Winter	**244**	**196**
90th Percentile Summer	**11.9**	**521**
Ratio: Winter/Summer	**21**	**0.38**

Discussion

Assuming similar sample handling and dustfall collector designs within networks, dustfall results are affected by several factors:

- proximity to dust sources;
- emission strength (traffic). For example, the summer production at Grande Cache Coal (ESRD Table 24-2) is lower than winter production, resulting in lower traffic counts in summer;
- roadway maintenance. Especially at stations near roadways, dustfall can be influenced by the presence of sanding trucks, snow spray from grading (with embedded dust), mud or snow spray from passing vehicles; and
- meteorology.

Without field notes of the dustfall monitoring programs, we are unable to determine the cause of the outlier measurements. Nonetheless our experience with other dustfall data suggests the third bullet above is one that can cause intermittent very high values such as those observed in the winter datasets.

In addition, Environment Canada guidance on estimating road dust emissions from industrial unpaved surfaces (Environment Canada, 2012) suggests that there should be no dust emissions on days with precipitation higher than 0.2 mm and on days with snow depth 1 cm or greater or days where ground was frozen. This guidance indicates that: "*Frozen ground minimizes the breakdown of the travel surface leaving less material to be entrained in the air as vehicles pass*". Using a 90% suppression efficiency throughout the winter, instead of 100% efficiency as suggested by Environment Canada during days with precipitation or snow on the ground, is a reasonable assumption by this standard.

CVRI also notes that a winter dust suppression efficiency of 90% has been used in air quality assessments for other mining operations in the region. These include:

- The former Smoky River Coal Mine (SRCL, 1999a and 1999b), where 30 t haul trucks were used.
- The Grande Cache Coal EIA (Grande Cache Coal 2001) and all subsequent applications for mine extensions (e.g., Grande Cache Coal, 2004), including the most recent mine application which considered 60 to 160 ton haul trucks (Grande Cache Coal 2010).
- Previous Coal Valley Resources Inc. Applications (CVRI 2008, 2009).
- The expansion of the Genesee mine (PMRL, 2011).
- Tech Coal Ltd. Project and EPEA Application for approval (TCL, 2011a, 2011b).

CVRI acknowledges that on rare occasions, chinook winds may cause mild weather in winter and dry the surface of the haul road. On these infrequent occasions, water will be applied to the road providing safety is not jeopardized.

The response to ESRD SIR #43 presents meteorological data supporting the statement that roads are snow covered from November to the end of March.

References:

Environment Canada 2012. Guidance on estimating road dust emissions from industrial unpaved surfaces (accessed August, 2012): http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=5DF2CF83-1.

Coal Valley Resources Inc. (CVRI). 2008. *Air Quality Assessment Mercoal West and Yellowhead Tower Mine Extension Project.*

Coal Valley Resources Inc. (CVRI). 2009. Air Quality Assessment Coal Valley Resources Inc. Obed Mountain Mine.

Grande Cache Coal (GCCoal). 2001. *EIA Application for Approval of the Grande Cache Coal Project.*

Grande Cache Coal (GCCoal). 2004. *EPEA Application for Amendment of Approvals No. 12 Mine South B2 Extension Pit.*

Grande Cache Coal (GCCoal). 2010. *Air Quality Assessment Grande Cache Coal No. 12 South A Pit.*

Luscar Ltd. 1999. Air Quality Evaluation of the Proposed Mine Permit Extension. Luscar Ltd. – Coal Valley Mine. Prepared by Cirrus Consultants.

Smoky River Coal Limited (SRCL). 1993. *1992 Annual Air Report*. Submitted to Alberta Environment, February 04, 1994.

Smoky River Coal Limited (SRCL). 1994. *1993 Annual Report, Clean Air Licence 91-AL-247*. Submitted to Alberta Environment, February 12, 1993.

Smoky River Coal Limited (SRCL). 1999a. *Air Quality Assessment of Particulate and NO_x Emissions at the Smoky River Coal Mine and ATCO Milner Generating Station (September 1999).*

Smoky River Coal Limited (SRCL). 1999a. *Air Quality Assessment of Particulate Emissions at the Smoky River Coal Mine and ATCO Milner Generating Station from Operations Associated at the New No. 7 Mine (December 1999).*

Prairie Mine and Royalty Ltd. (PMRL). 2011. *Air Quality Assessment Prairie Mine and Royalty Ltd. Genesee Mine Operations, South Extension (May 2011).*

Teck Coal Ltd. (TCL) 2011a. Air Quality Assessment Teck Coal Ltd. Cardinal River Operations, Cheviot Mine Site.

Teck Coal Ltd. (TCL) 2011b. Air Quality Assessment Teck Coal Ltd. Cardinal River Operations, Luscar Mine EPEA Approval #11767.

25. Volume 2, CR #1, Section 4.1.2, Page 26

CVRI states that *haul roads will be regularly watered in summer, reducing dust from wheel entrainment by 80%.*

a. Provide information with respect to the equipment that is expected to be deployed for watering (*e.g.*, size, number and capacity of water trucks), source of water, daily amount of water that will be available, and the rate at which water can be applied, when needed.

Response:

Current Operation

The current operation has three water trucks available for road service. Two units have a large water tank mounted in the box of a Haulpak truck. One unit is a water tank mounted on the frame of a Cat 777 truck.

These units service approximately 72 km of active haul road, dump and pit ramps. Trucks are utilized on a 24 hour x 365 day basis as required. For safety the priority is focused to the most active haulage segments such as waste loading, ROM stockpile areas and public highway crossings. Water applications are much less frequent during night operation as roads remain wet longer.

Multiple water loading stations are provided to optimize water truck usage. At these stations large pumps are provided to pump from water reservoirs. Tank capacity of the water trucks are;

Haulpak	172,000 l
Haulpak	172,000 l
Cat 777	90,000 l

Robb Trend Project

The same equipment is expected to be utilized in the Project.

At the start of the Project operation approximately 10 km of additional haul road will need to be serviced. Correspondingly, the CVM road system will drop to approximately 45 km. Therefore the same equipment can be expected to adequately service the Project.

The maximum case for the Project, late in the life of the Project will increase to a maximum of 75 km. An additional water truck may be added in these later years.

Multiple water sources will also be provided throughout the Project. The mine wastewater system generally provided within the mining disturbance provides numerous opportunities for ponds to be utilized. These ‘loading sites’ will be spread throughout the Project area as required.

26. Volume 2, CR #1, Section 4.1.2, Page 26

CVRI states *Emissions were estimated using AP42 emission factors (U.S. EPA 1998a). Criteria Air Contaminant species (CACs) which are particulate (PM2.5, PM10 and TSP) and specific gas (SO2, NOX, and CO) emissions from diesel combustion were also calculated using U.S. EPA (1994). Dust and combustion emissions from blasting were calculated using emission factors (Roy et al., 2010, NPI 2012, and NPI, 1999).*

a. Discuss the limitations and uncertainty associated with the emission factors selected to represent emission sources for the Project.

Response:

Blasting – Detonation

CVRI has adopted new methods of blasting in order to reduce noise and ground vibrations. Use of detonating cord has been replaced with use of T&D and Ikon detonator assemblies which eliminates air blast. Since there is no surface detonation the production of dust is reduced. Reduced 'emission factors' are likely a result.

Mobile Sources

Diesel combustion emission factors for CO, particulates and NO_x were estimated using engineering estimates from the U.S. EPA Nonroad model (U.S. EPA, 2004). The alternative is using AP42 emission factors – for example Chapter 3 Sections 3.3 and 3.4 (Gasoline and Diesel Industrial Engines or Large Stationary Diesel and All Stationary Dual-fuel engines). However, the Nonroad model is providing much better emission estimates, dependent on the size of engine, its age, and equipment mode of operation. The remaining emissions (*e.g.,* PAH's, and VOC's) were estimated using AP42 emission factors, since Nonroad model does not have estimates for them.

Frey (2008) overviewed methods for, and examples of, quantification of variability and uncertainty in emission factors. The typical sources of uncertainty in emission factors and inventories include:

- Random sampling error, which would be, for example, the basis for estimation of confidence intervals.
- Measurement errors due to imperfections in sampling and analytical methods. Measurement errors are typically categorized as systematic and random errors.
- Non-representativeness: This source of uncertainty arises when the specific sources that are tested, or the conditions under which the sources are tested, are not representative of the real world situation that affects emissions for the geographic area and time period of interest. Furthermore, it is possible for a set of data to be representative for one purpose but not for another. For example, some driving or test cycles used for on-road or non-road vehicles would not capture the effect of transients on emissions. The use of non-representative data typically leads to biases in emission estimates.
- Averaging time. Emissions data are measured for different averaging times depending on the pollutant. For example, emissions of some gases, such as NO_x, SO_2, and others, can be measured at short time resolutions while speciated $PM_{2.5}$ emissions might be based on 24 hour integrated filter-based samples. Many emission inventories (such as used in Project modelling) are developed on an hourly, daily basis, or annual basis. If the time

period of the inventory does not match the time period of the measurements, then there can be errors of interpolation or extrapolation. Some uncertainties in current emissions are the result of the complicated nature of mining operations and the easily match the two. Furthermore, for short averaging times, there can be substantial variability. An example of this is the use of driving cycle data to estimate vehicle emissions, given that driving cycles are highly variable from one trip to another on haul roads or for mine pit activity even if average speeds are similar.

- Omissions. A typical omission is situation in which emissions data for mobile sources are available for some pollutants for a particular emission source but not others (*e.g.,* total hydrocarbons but not speciated hydrocarbons, or total $PM_{2.5}$ mass but not speciated $PM_{2.5}$).
- Surrogate data, where directly relevant data are not available, but a judgment is made that an analogy can be made for a situation in which data are available. For some of the types of omissions discussed above, one might be able to fill data gaps based on surrogate data. For example, speciated hydrocarbon data are available for stationary engines but not for mobile sources. Such an assumption may introduce biases if the analogy is weak or not appropriate.
- Lack of relevant data. This situation occurs when there are no relevant data and no realistic or meaningful opportunity to use surrogate data. An example of this situation is the use of the dragline equation to represent some material drop activities that don't have precise emission factors. Ingoing these sources could lead to gaps in the inventory, which in turn lead to emission biases

Emission factors, despite uncertainties, are the best available tools for estimation of exhaust emissions from mine equipment.

Blasting Sources - Fragmentation

There is very little information on emissions from blasting and this is not surprising given the logistical challenges of conducting a measurement program. Nonetheless, it is an important issue for this Project given that blasting is a source of emissions.

The coal and overburden blasting equation in AP42, upon which the NPI estimates are also based, is considered (U.S. EPA 1998) to have quality ratings that range from average (the emission factor is developed primarily from credible test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. The source category population is sufficiently specific to minimize variability) to well below average (the emission factor is developed primarily from reasonably credible rated test data from a small number of facilities, and there may be reason to suspect that these facilities do not represent a random sample of the industry. There also may be evidence of variability within the source population).

The emission factor equation was developed from 14 coal and four overburden blasts at three western surface coalmines (SKM 2005) in the late 1970s and early 1980s (Roy *et al.* 2010). The factor has not been shown to be applicable to eastern mines (U.S. EPA 1991) and therefore there is also some uncertainty in its applicability in Alberta. The dependence on moisture in an earlier version of the emission factor was considered by industry to overestimate the emissions due to the strong moisture dependence of the equation and the much lower moistures in the stone processing industry (MEPA review, 1998). In response, the USEPA developed a new equation without moisture based on a 1987 re-examination of the test blast data. In the case of mines in Alberta, material moisture content is generally higher and using moisture dependent equation should lead to more realistic emission estimation.

Only a TSP emission factor for blasting is available at this time in U.S. EPA and NPI approaches, as the original test program considered only TSP. According to SKM (2005), the contribution of blasting to total PM emissions at surface mines is usually small, so use of a TSP factor to estimate PM_{10} emissions should not be overly restrictive.

Particulate emissions from blasting, estimated using three techniques and the operational parameters applicable to the Project are summarized in ESRD Table 26-1. NPI factors which were used in the assessment are comparable to U.S. EPA emission factors but they are higher than results reported by Roy *et al.* (2010). This example illustrates that the assumption that the PM_{10} emission factor from blasting is about one-half of the TSP factor (used by both the U.S. EPA and NPI) can over-estimate emissions relative to the alternative approach of Roy *et al.* (2010) which is based on a more recent set of measurements. Roy *et al.* (2010) reported on the results of sampling for TSP and PM_{10} in 30 blast tests at two mines, with 26 of the 30 carried out in coal seams. Emission factors (averages are shown in ESRD Table 26-1) varied substantially from test to test primarily depending on the location of the monitors with respect to the dust plume path of travel but were less than the emission factors used in the Project assessment by 15% (TSP) and 75% (PM_{10}). The Roy *et al.* (2010) $PM_{2.5}$ emission factor is scaled in ESRD Table 26-1 from TSP based on the ratio in the U.S. EPA emission factor.

While uncertainty exists, there are very few alternatives to estimate particulate emissions from blasting.

Table 26.1 Emissions Calculated by Different Methods (kg/blast)			
Dust Fraction	**U.S. EPA (1998)**	**Australia - NPI (2012)**	**Roy *et al.* (2010)**
$PM_{2.5}$	4.5	4.4	3.8
PM_{10}	78	76	19.5
TSP	150	146	127

References:

U.S. EPA. 1996a. *Compilation of Air Pollutant Emission Factors: Volume I Stationary Point and Area Sources.* Part 3.4 Large Stationary Diesel And All Stationary Dual-fuel Engines, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

U.S. EPA. 1996b. *Compilation of Air Pollutant Emission Factors: Volume I Stationary Point and Area Sources*. Part 3.3 Gasoline and Diesel Industrial Engines, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

U.S. EPA. 1998. *Compilation of Air Pollutant Emission Factors: Volume I Stationary Point and Area Sources.* Part 11.9 Western Surface Coal Mining, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

U.S. EPA. 2004. *Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling – Compression Ignition.* Prepared by the Office of Transportation and Air Quality, Research Triangle Park, NC. Report No. NR-009c.

National Pollution Inventory (NPI). 2012. Emission Estimation Technique Manual for Mining Version 3.1; January 2012.

U.S. EPA 1991. Review of Surface Coal Mining Emission Factors. http://nepis.epa.gov/Exe/ZyNET.exe/2000EANW.txt?ZyActionD=ZyDocument&Client=EPA&Index=1995+Thru+1999&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=pubnumber%5E%22454R95007%22&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=pubnumber&IntQFieldOp=1&ExtQFieldOp=1&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C95thru99%5CTxt%5C00000002%5C2000EANW.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=10&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=p%7Cf&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x.

Sinclair Knight Merz (SKM). 2005. Improvement of NPI Fugitive Particulate Matter Emission Estimation Techniques. http://www.npi.gov.au/publications/emission-estimation-technique/pubs/pm10may05.pdf

Roy, S., Adhikari G.R., and Singh T.N. 2010. Development of Emission Factors for Quantification of Blasting Dust at Surface Coal Mines. Journal of Environmental Protection No. 1, 346-361.

Frey, H.C. 2008. Quantification of Uncertainty in Emission Factors and Inventories. http://www.epa.gov/ttnchie1/conference/ei16/session5/frey.pdf.

27. Volume 2, CR #1, Section 4.1.3, Page 30

CVRI indicates that 100% of daily maximum coal production is loaded into two silos and then loaded directly onto coal trains. There does not appear to be any emissions estimates or dispersion modelling of dust emissions from coal handling facilities, loadout or combustion products from any trains which are expected to use diesel oil when idling or otherwise moving within the RSA.

a. Confirm the number of freight trains, including frequencies and extents of movements, and summarize expected emissions within the RSA.

Response:

Locomotive engine emissions were not modelled, as they were considered to be within the uncertainty of Baseline emissions from other sources. This assertion is tested below, under the following assumptions:

- there are two trains going through the RSA from the Lehigh quarry and Cardinal River mines (Trains are not loaded at these facilities every day so the assumption that both trains are going through the Project RSA on the same day is conservative). Assuming each train carries 11,500 t of material, Lehigh Quarry which produces 1.5 Mt/year requires about 130 trains a year. Similarly, Cardinal River Operations Teck Mines produces 2.1 Mt of clean coal each year and requires 180 trains, for a total of about 310 trains;
- each train has two to three locomotives similar to P42DC or ALP45DP with 4400 hp engines;
- the distance travelled within the RSA for Lehigh and Cardinal River trains is about 50 km and each train travels at 60 km/hr, thus train emissions occur for less than 1 hour each day;

- there will be approximately 225 trains annually from the Plant (*i.e.,* an additional train each day in the RSA, making a total of three). Three locomotives move the train from the RSA. There is no switching locomotive;
- each Coal Valley train travels 57 km to the edge of RSA, which, at 60 km/h, is about one hour of emissions each day; and
- combustion emissions can be estimated using emission factors as published by the U.S. EPA (2009).

Further, assuming that trains from Lehigh, Cardinal River Operations and Coal Valley (including the switch locomotive) travel through the RSA simultaneously, the total contribution from locomotives to total RSA Baseline summer emissions is presented in ESRD Table 27-1.

Table 27-1 Maximum Daily Emissions (kg/d) for Locomotive Engines in Comparison to Robb Trend Baseline Case emissions

Description	SO_2	NO_x	CO	TSP	PM_{10}	$PM_{2.5}$
Locomotive Emissions from three Trains daily (one for each of: Lehigh, Cardinal River, and Coal Valley)	0.29	52	67	0.78	0.78	0.78
TOTAL RSA Baseline Emissions	7,000	4,170	1,755	22,438	5,823	653
Locomotive Contribution to Total Baseline RSA Emissions (%)	0.004	1.2	3.8	0.003	0.01	0.1

From ESRD Table 27-1, locomotive emissions, which were not included in modelling, are a small fraction of total RSA emissions and spread over 50 to 57 km of track and are considered to be within the error of other emission estimates.

Loadout fugitive emissions were modelled as a part of the Plant operations – which is in the Baseline case as the Project is a continuation of existing mining operations. Baseline loadout emissions are summarized in Table A3-7 in Appendix A to CR #1 and in Table 4.1-10 of CR #1. Due to typographical errors emissions there are discrepancies in TSP emissions. The correct value used for modeling was 54 kg/day.

Nonetheless, loadout dust emissions are considered to be conservative because the method does not reflect the actual loading activity. In the assessment it was assumed that clean coal is unloaded to the silo with dragline equation with 1.5 m drop (TSP emissions were 33 kg/day). Then it was assumed that from the same silo clean coal was loaded on train from 1 m drop height (TSP emissions were an additional 21 kg/day). Emissions should be reduced by the fact that this silo has baghouse. However, conservatively, it was assumed that this mitigation measure did not operate.

Furthermore, in present loadout operations, a chute is lowered into each car and coal drops initially from 3 m within the first 15 seconds. The coal pile in the car builds back to chute level resulting in a choke load with much-reduced emissions for the remaining 1.8 minutes of loading. This detailed process was not incorporated into the loadout emission estimate. If it had been, CVRI estimates that the emissions would have been reduced by almost half.

Reference:

U.S. EPA (2009). Emission Factors for Locomotives, Technical Highlights. http://www.epa.gov/otaq/regs/nonroad/locomotv/420f09025.pdf.

b. Confirm whether these emissions were accounted for in the CALPUFF model, or otherwise why they were not.

Response:

Dust emissions from the load-out were modelled using emissions which are expected to be higher than actual emissions, as explained above.

Locomotive emissions were not explicitly modelled as part of the Baseline, because they were small fractions – typically less than 1% - of Baseline emissions.

28. Volume 2, CR #1, Section 4.1.3, Page 30

CVRI has summarised the stack emissions for the stationary equipment that is expected to be operated continuously. No mention is made of equipment that may be used for upset, emergency or support conditions. Commonly, diesel generators, diesel fire water pumps, and diesel water pumping units are used during periods of power shortages or interruptions. Each of these types of units are also routinely tested weekly for short durations. Emissions associated with this equipment should be accounted for in the emission inventory, GHG calculations and the CALPUFF model.

a. Confirm if diesel-powered upset, emergency or support equipment is proposed for the Project, and if so, how it is accounted for in the emission inventory, GHG calculations and the CALPUFF model.

Response:

The Plant, at which stationary equipment is used, is part of the Baseline Case. It is not part of the Project. Because of this, no upset or emergency modeling was done for these sources.

There is one emergency generator at the Plant site used during power failures to provide emergency power and lighting only. There are no provisions for emergency generator capacity capable of running the plant operations. Expected usage is 2 or 3 times per year. Diesel water pumping units are not generally used in mine operations.

Fuel consumption from the emergency generator (which is a Baseline emission source) was also included in total fuel consumption for mine operations. Therefore, conservatively, emissions from the emergency generator were included in Project GHG estimates calculations and CALPUFF model of emissions of PAHs, VOCs and metals (although for the CALPUFF model, the fuel consumption was spread among other sources). The expected use of the emergency generator is once or twice each year.

29. Volume 2, CR #1, Section 4.1.3, Page 31
Volume 2, CR #1, Section A3.9, Page A-20
Volume 2, CR #1, Section B4.0, Page B-9

Dispersion models like AERMOD and CALPUFF have the ability to modify plume behaviour based on a comparison of stack heights and building dimensions using the BPIP algorithm found in both models. The user selects this option and it should be used routinely since building downwash effects can create much higher concentrations near buildings with short stacks (< 2 times building height). It is not clear whether the BPIP building downwash pre-processor was used or not, as there are contrary indications regarding this.

a. Confirm if the BPIP algorithm was used, or otherwise why it was not.

Response:

Yes, BPIP was used.

Section 4.1.3 of CR #1 notes "...The influence of building geometry on local airflow and therefore on emissions was calculated using the BPIP PRIME pre-processor..." Table 4.1-11 provides building dimensions used by BPIP and Figures 4.1-1 and 4.1-6 illustrate stack and building configurations.

30. Volume 2, CR #1, Section 4.1.4, Page 32

CVRI notes that calcium chloride is reported to be applied twice per year on Highway 40 south of Coalspur by Alberta Transportation. The assumed level of dust control for this measure is 80%. However, Figure 13.2.2-5 in Chapter 13.2.2 of U.S. EPA AP-42 indicates that a monthly application of chemical dust suppressant can achieve 40 to 80% dust control, depending on the quantity of chemical that is applied and the inventory that is built up on the road surface. For a twice-per-year program, a much lower level of average effectiveness would be expected, as the first treatment wears off, leaving the road essentially untreated for a period time before the next treatment. This effect will be exacerbated by the heavy truck traffic. As a result, the average level of control may be closer to 40% and worst-case will be near zero percent (e.g., for a period of time in spring before the first application, and for a period of time prior to the second application).

a. Provide data from published studies, field measurements or other credible sources to justify an assumption of 80% control from twice-per-year calcium chloride applications as a reasonable worst-case scenario in this case.

Response:

Highway emissions are part of the Baseline scenario. While the applicability of some U.S.EPA studies can be questioned on the grounds that U.S. roads can dry faster than those in the Project areas and that the Alberta summer season is shorter, it is possible for short periods of time, in the absence of rain and snow, the effectiveness of dust control will be lower than 80%.

In addition, it is unlikely that these short winter periods will coincide with maximum daily mine operations and the worst meteorological conditions for dispersion. As well, Highway 40 is more than 5 km from mine operations and therefore would have a negligible impact on predicted concentrations near the maximum points of impingement and the community of Robb.

Finally, CVRI understands that Highway 40 is currently being paved from Coalspur to the access road to the Plant. Paving should be completed during 2013, well before the start of operations at the Project. Emissions from paved road emissions are lower than gravel roads. ESRD Table 30-1 compares paved and unpaved emissions using the same mix of vehicles and indicates paved road emissions range from 6% for $PM_{2.5}$ to 2% for PM_{10} of unpaved emissions.

Given the new information, and while the assumption of 80% reduction of unpaved road emissions may not be conservative in all circumstances, it is conservative and a reasonable worst-case relative to paved road emissions.

Table 30-1 Comparison of Unpaved and Paved Highway 40 Road Dust Emissions

Compound	Unpaved Summer Road Emissions (kg/day)	Paved Road Emissions (kg/day)	Paved Road Emissions as Fraction of Unpaved Road Emissions (%)
$PM_{2.5}$	103	6.2	6
PM_{10}	1,026	24.1	2
TSP	*4,215*	*123*	*3*

31. Volume 2, CR #1, Section 4.2, Page 43, Table 4.2-1

CVRI created an emissions inventory of other significant emitters in their RSA and modelled these emissions. Several of the compressors listed are shown to have no NOx or CO emissions but $PM_{2.5}$ and TSP emissions are listed, which is an unlikely condition.

a. Confirm that these data are correct as reported, and if emissions from these compressors were appropriately incorporated and modelled in CALPUFF.

Response:

The data as reported is based on the NPRI reports for a small number of compressor stations where the only air emissions listed were particulates. These stations likely are generating NO_x and CO emissions, but in quantities lower than the reporting threshold. In absence of emission reports, these emissions were not modelled.

It is expected that the impact of small compressor stations will be immediately adjacent to the facilities, with negligible impact at RSA or LSA MPOI and in the community of Robb.

32. Volume 2, CR #1, Section 5.13.2.1, Page 84

Construction dust emissions related to the Project are expected to be substantial. This is a normal consequence and these effects tend to be intense but relatively short term in duration. CVRI has not provided details or commitments with respect to applying mitigation measures and using best management practices. A large area around the Processing Plant is muddy during parts of the year and has the potential to generate dust when dry due to ongoing truck activity.

a. Explain how increases in construction dust emissions can be readily managed with appropriate dust control. Provide examples and commitments to meeting the AAAQO.

Response:

CVRI would like to clarify some of the statements in the preamble to the question. In particular the Project is an amendment to an existing operation where environmental effects mitigation is an ongoing regular part of daily operations. Also, the Plant is part of the existing operations and is therefore not part of the Project. It is located about 10 km from active mines and the effects of the Plant operations have been considered within the background consideration. There are frequently muddy areas around the plant (ESRD Photo 32-1) as the main focus of the plant operations is the washing and water based processing of raw coal. The majority of the Plant yard area is continually wet so that local traffic would be unlikely to add to emissions.

Section 4 of CR#1 provided a summary of emissions, including a methodology for estimating emissions from the roadway construction phase. Based on comparison of the volume of material moved during mining operations and roadway construction, it was estimated that initial roadway construction emissions were about 15% of year 2034 emissions. It is expected that emissions of other compounds will also scale with material moved and therefore be about 15% of peak operations values.

In addition, mine construction is an ongoing process. Fuel consumption estimates provided by CVRIs mining engineers were based on the volume of material moved and these material and consumption estimates included any mine or roadway construction that took place during mining operations. Therefore, the assessment accounted for this construction dust. Moreover, the equipment needed for road construction will be taken from mine operations at the time, reducing the equipment and emissions from mine operations.

Therefore, increased emissions during construction are not expected. Because emissions during initial road construction are expected to be less than mining operations and mine construction emissions are already included in mining operations emission estimates, the dust control practices proposed for operations are expected to apply as well to construction.

ESRD Photo 32-1 A View of the Coal Processing Plant looking Northeast

b. How will the impact of construction dust emissions be evaluated in the apparent absence of ambient monitoring?

Response:

The impact of the haul road constructions will be localized. Haul roads are far from the community of Robb and regional highways and will be surrounded by forested areas. In the case of unusual drying and increased dust emissions, water will be sprayed for dust suppression and to protect workers.

In addition, construction will make use of equipment destined for mining operations. When that happens, emissions from mining will be reduced to compensate for equipment use in construction.

Finally, CVRI is unaware of dust monitoring required for other (*e.g.,* highway) construction in the region and does not anticipate that its roadway construction methods will be so different from other roadway construction approaches to warrant monitoring.

33. Volume 2, CR #1, Section 6.5, Page 89

Dispersion models in themselves are not designed to over-predict. Field trials, and model calibration verification studies suggest accuracy within factors and models tend to under-predict or over-predict depending on the application and location and some models have inherent bias. In general, it is the assumptions made by the modeler that would create an over-estimate or conservative outcome.

a. Provide evidence and references to support the following statement, *"…notwithstanding a tendency for CALPUFF to predict conservatively.*"

Response:

The reviewer is correct. The sentence was inaccurate and should have referred to the CALPUFF/CALMET system that includes typical assumptions made by experienced modellers as well as whatever inherent bias the model may have.

There numerous papers where the CALPUFF model (including modeller assumptions) was evaluated (*e.g.,* Strimaitis *et al., 1998;* Scire *et al.*, 2003; Morrison *et al.*, 2003). The general conclusion from these papers is that CALPUFF predictions are conservative for the highest concentrations compared to observations. For lower concentrations the model including modeller assumptions may over-predict or under-predict, which may be the result of a number of factors including meteorological data uncertainties or local sources influencing readings at stations.

The conservativeness of air quality models in general was recognized by Government of Alberta in their recommendations that for regulatory purposes, modellers should report 99.9th percentile hourly and 2nd highest daily maximum predictions (ESRD, 2011) and compare these values to ambient air quality objectives.

A more detailed analysis of model conservativeness specifically for modeling haul roads and mine operations is presented in the response to ESRD SIR #46.

References:

AESRD (2011). Using Ambient Air Quality Objectives in Industrial Dispersion Modelling and Individual Industrial Site Monitoring. Revised 2011.

Morrison K., Z. Wu, J. Scire J., and J. Chenier. 2003. CALPUFF-Based Predictive and Reactive Emission Control System. Presented at 96th A&WMA Annual Conference & Exhibition, San Diego, California.

Scire J., Z. Wu, and G. Moore. 2003. Evaluation of the CALPUFF Model in Predicting Concentration, Visibility, and Deposition at Class I Areas in Wyoming.

Strimaitis D.G., J.S. Scire, and J.C. Chang. 1998. Evaluation of the CALPUFF Dispersion Model with Two Power Plant Data Sets. Preprints 10th Joint Conference on the Applications of Air Pollution Meteorology. Phoenix, Arizona.

34. Volume 2, CR #1, Section 6.6, Page 90

Meteorological measurements of the standard required for dispersion modeling have not been provided by CVRI for the Project site so records from regional stations located elsewhere have been summarized.

a. Based on the wind roses reported from some of the regional meteorological stations, the best case' dust control measures evaluated, and given the very high proportion of calms that lead to poor dispersion conditions, explain why CVRI proposes to operate a continuous ambient air quality monitoring station for a period of time less than the life of the entire Robb project? For example, construction of the Halpenny and Erith Corridors is scheduled to begin in Q4 2013.

Response:

The current mine plan covers mining operations over about 50 km of mine pit progression with simultaneous activity in a number of different centres. The closest community in the area is Robb. The response to ESRD SIR #17 demonstrated that predicted concentrations drop off rapidly from the source. Therefore, CVRI proposed to begin monitoring three years before the nearest approach of the Main Mine to the community of Robb (*i.e.*, in about 2022) as CVRI believes this is the location of most concern.

b. Confirm when Robb Main is scheduled to begin operations. Table A.6-1 (Project Introduction) indicates production in Q1 2015, and Section 6.6 indicates year 2022.

Response:

CVRI expects that Robb Main will begin production in Q1 2015, depending on progress of this Application through the regulatory process.

c. Explain why continuous monitoring is only proposed near Robb, and not outside of this area, to monitor the effects of fugitive particulate matter, metals and NO_2 on the ecosystems (i.e., vegetation, waterways, etc.) in the RSA?

Response:

CVRI believes the health of the community is foremost and therefore has targeted this location for monitoring. Monitoring at that location would also provide information relevant to effects on other parts of the ecosystem sensitive to TSP, $PM_{2.5}$ and NO_2.

With respect to the impact of air quality on other ecosystem aspects, the following comments indicate there is no need for measurements to mitigation planning:

- Proven mitigation strategies will be employed to reduce the effect of using nitrogen-based explosives such that water quality is not expected to be significantly affected, therefore potential impacts to fish populations as a result of nitrogen introduction is not expected.
- The residual effects (after mitigation) of the Project on surface water quality due to increases in nitrogen caused by the use of explosives containing ammonium nitrate are assessed as insignificant in the LSA and therefore are assessed as insignificant in the RSA.

The proposed mines represent a continuation of existing CVRI mines. Air quality at the existing mines have not posed problems for vegetation and waterways. The proposed mines will be also managed according to the highest industry standards and due to progress in equipment emission controls it is highly probable that combustion emissions will be lower than emissions from existing mines.

d. In the absence of commitments to regional ambient air quality monitoring, explain how CVRI proposes to measure the effectiveness of mitigation plans?

Response:

CVRI is currently a member of the West Central Airshed Society (WCAS) and contributes financially to the maintenance of the regional airshed. The requirement for membership is a condition of its EPEA approval. CVRI is committed to the WCAS and expects to continue its contributions in the future.

The establishment of air quality monitoring in or near the community of Robb will provide data with which to check the effectiveness of mitigation plans where they are most important. CVRI will begin monitoring three years before the approach of mining to the location nearest the community in approximately 2022. That is expected to provide sufficient lead time to review the air quality in the community and to develop a more detailed emissions management plan.

Monitoring will continue until Robb East operations are completed, which is currently expected to occur about 15 years after it begins.

e. What measures will CVRI undertake to address measured exceedances of the AAAQO?

Response:

CVRI does not anticipate exceedances of the AAAQO will be measured at Robb based on the analysis it has undertaken to date.

If they occur, CVRI would apply a continuous improvement approach to reduce concentrations, including enhanced emissions management. CVRI would adopt a process similar to the following:

1. Collect information in Robb (including baseline in the years prior to the approach of operations).
2. Determine the need to improve by reviewing the ambient data to determine the conditions under which exceedances occurred and the expected source of emissions. The source may or may not be CVRI operations.
3. If the exceedences are due largely or in part to CVRI, the company would commit funds and effort to address the problem and undertake a diagnosis of the causes, with enough specificity to address the specific part of its operations contributing to the exceedences.
4. Define and test potential solutions of many options which might include enhanced road or minesite watering, road watering on Robb streets near the monitoring site, wind screens, modification of blasting approach, and many more.
5. Plan to implement the improvement, considering the feasibility of implementation.
6. Implement the solution.

7. Put in place controls to hold the new level of performance.
8. Go to Step 1.

35. Volume 2, CR #1, Section 6.6, Page 90
As required in the FTOR:

a. Explain how the data (i.e., emissions, ambient air quality and meteorological measurements, etc.) will be disseminated to the public, Aboriginal communities, and other interested parties.

Response:

As indicated in the response to ESRD SIR #225, CVRI has a long standing relationship of information exchange with all of the nearby communities. Specific to air quality monitoring data, CVRI will develop a specific communication plan for the nearby communities, possibly with a website, that notifies residents, aboriginal communities, and others of the location of mining and haul activity, along with a notification that dust and other emissions may be generated.

Air quality and meteorological monitoring data collected in Robb will also be available on the site. This data will also form part of the ongoing monitoring and reporting that is required as part of the regulatory requirements of the current operating Mine. It is CVRI's expectation that the public nature of this information will continue.

b. Discuss how the results of monitoring programs and publicly available monitoring will be integrated within CVRI's environmental management system.

Response:

Air quality and meteorological data is planned for collection in or near the community of Robb during periods when the potential for impact at the community is highest (*i.e.,* during operation of the West Mine and Main Mine). CVRI will monitor on a daily basis the potential for the Project operations to contribute to exceedences and will take additional mitigative action, such as more frequent watering of haul roads, if that occurs. CVRI may also provide road watering of other public or industrial roads in the vicinity of the community of Robb, should it be evident that very local sources contribute noticeably to dust measurements.

CVRI does not expect its operations to result in observable impacts in publicly available data collected at background stations such as Steeper and Hightower Ridge. Particulate data from these sites can be used to indicate the extent of forest fire activity, for example, that might impact the effect of the Project as well. Should values above AAAQOs be evident in this data, CVRI will pay careful attention to the monitoring data at Robb and provide additional notification of the potential for exceedences in Robb if required. CVRI will monitor the potential for Project operations to contribute to additional exceedences and will take additional mitigative action, such as more frequent watering of haul roads.

c. Describe adaptive management plans that minimize the impact of the project.

Response:

See response to ESRD SIR #35b).

36. Volume 2, CR #1, Appendix A, Section A2.2, Page A2

CVRI states that *The moisture content of coarse coal reject… was assumed to have the same moisture content as ash from power plants (Table 13.2.4-1 in AP 42; US EPA, 2006a)*. Note that Table 13.2.4-1 of AP-42 shows moisture content of ash received at a municipal landfill, and there is no indication that it was from a power plant. In any case, the high reported moisture content (27%) implies that the coal reject is handled in the form of a slurry.

a. Provide physical data on the coarse rejects to show that it compares well with fly ash, and confirm that it is handled in a high moisture form.

Response:

Volume 1 Section C (Project Description) indicates that 'coarse reject' is primarily rock removed during early stages of the coal cleaning process. While some of this material is used for road construction the majority is discarded as waste material. 'Fine reject' is finer rock material (middlings) that is removed in subsequent processing stages. The 'coarse' and 'fine' rejects are combined and directed to a bin where it can be loaded to haul trucks. These trucks haul to the reject dump. The reject dumps(s) are established as backfill in nearby older pits thus aiding in ultimate reclamation of the pits. The reject is also being dumped on older tailings ponds thus aiding in reclamation of these features.

Coarse reject is only similar to 'fly ash' in that due to the hardness and size of the material is not dusty. Rock separated from the raw coal in the rotary breaker is conveyed to the 'coarse reject bin'. This material is hard rock typically > 6 inch in size.

ESRD Figure 36-1 provides a flowchart for this material. No dust is expected to be generated from this material during the haulage activity.

37. Volume 2, CR #1, Appendix A, Section A2.2, Table A2-3

CVRI states the silt loading for Highway 40 and all other unpaved public roads is 3.8%.

Based on past experience, this is a relatively low average silt loading for unpaved roads, which suggests that the measurements were done after calcium chloride was applied and/or were too few to be representative. Calcium chloride has the effect of reducing surface silt loading, once the road has been compacted by traffic. This is a key part of its effectiveness in reducing dust emissions. To apply this silt loading in combination with an additional assumed 80% control for calcium chloride may represent significant double counting of the effect of the calcium chloride. The silt loading measurements should be taken prior to the first calcium chloride treatment in spring, to represent the road in an uncontrolled state, before applying a percentage reduction to account for calcium chloride. Also, given the length of roads involved, it is important that the measurements are made at numerous locations to ensure that a representative average value is obtained.

a. Provide details of the silt measurements from Luscar (1999) and confirm that these measurements were taken long after the last calcium chloride treatment (preferably in spring, prior to the first treatment of the year).

Response:

There are no details available pertaining to the time when measurements were taken, either with respect to time of year or relative to time of treatment.

b. Confirm that the value shown represents an average from road silt samples taken at numerous locations along Highway 40.

Response:

ESRD Table 37-1 summarizes measurements of the silt content from Luscar (1999). The calcium chloride application to Highway 40 was important at that time, since the haul road crossed a public highway, raising concerns about visibility issues and the potential for collision of local traffic with heavy mine trucks.

Some sections of the road were treated with $CaCl_2$ and some are not. The silt loading was affected by treatment, whereas silt content was not. The silt content varied from 3.1 to 5.4%, and the average was used in modeling (3.8%).

CVRI also notes that Highway 40 is currently being paved from Robb to the Plant entrance, and is expected to be complete well before the start of operations at Robb West, Robb Main, Robb Central and Robb East.

Table 37-1 Silt Content Measurements on Highway 40 and Mine Haul Road (Luscar, 1999)

No.	Location	Local Description	Mitigative Measures	Sample Silt Content (%)	Total Sample Weight (kg)	Surface Area Measured (m^2)	Silt Loading (g/m^2)
Highway 40							
1	1-13-47-20 W5M	400 m East of the Proposed Haul Road Crossing	-	5.4	2.15	1.42	81.7
2	4-13-47-20 W5M	Proposed Haul Road Crossing	$CaCl_2$	3.5	2.21	4.96	15.6
3	8-14-47-20 W5M	800 m West of the Proposed Haul Road Crossing	-	3.1	4.20	1.82	71.6
4	7-23-47-20 W5M	50 m East of Lovett River Campground	-	3.8	4.47	1.89	89.8
5	10-28-48-21 W5M	Across from the Coalspur Campground	$CaCl_2$	3.2	2.25	6.63	10.9
6	4-33-48-21 W5M	Pavement Just North of the Gravel Portion	Paved	1.0	0.44	25.5	0.17
Haul Road							
7	2-18-47-19 W5M	Current Mine Haul Road to Pit 26, South of "Y" Intersection	Water	6.9	1.25	7.80	11.1

Reference:

Luscar Ltd. 1999. Air Quality Evaluation of the Proposed Mine Permit Extension. Report 770.0-R1-4-6, March 1999.Prepared for Coal Valley Mine by Cirrus Consultants.

38. Volume 2, CR #1, Appendix A, Section A2.2, Table A2-3

The reported silt contents for raw coal and clean coal are reported by CVRI to be derived from US EPA AP-42. No source has been cited for the paved road silt loading of 0.17 g/m^2.

a. Provide information on the actual silt content of coal at the existing coal mining operations in the area, in order to confirm that the AP-42 values are appropriate for this area.

Response:

CVRI believes there is no information available regarding the silt content of coal mined in this area. However, the raw coal contains about 70% rock. The silt content of limestone is 0.4 to 2.3% and crushed limestone is 1.3 to 1.9% (Table 13.2.4-1 U.S. EPA, 2006). The same reference identifies the average silt content in coal mined at Western Coal Mines as 6.4% and for coal as received by power plants as 2.2% on average (with a range of 0.6 to 4.8%). The silt contents used in the assessment are reasonable for raw coal containing substantial solid rock material and for clean coal where all fines are washed out and disposed as Plant refuse.

b. Provide the source and justification for this paved road silt value, as it does not correspond to any values given in U.S. EPA AP-42, Chapter 13.2.1.

Response:

ESRD Table 37-1 based on Table I.2 from Luscar (1999), which provides silt loading of 0.17 g/m^2 for the paved road just north of the gravel portion of Highway 40. Since that part of the road is adjacent to the gravel road, CVRI expects the value is conservative (some gravel may be carried by wheels to the paved section). Thus, the assessment was based on an actual measurement of this parameter.

A single 'dirt sample' was recently taken from an active haul road. Lab results are provided as a single data point reflecting 'typical' road surface material (see ESRD Appendix 38).

References:

Luscar Ltd. - Coal Valley Mine. 1999. Air Quality Evaluation of the Proposed Mine Permit Extension. Report 770.0-R1-4-6, March 1999.Prepared by Cirrus Consultants.

U.S. EPA. 2006. *Compilation of Air Pollutant Emission Factors: Volume I Stationary Point and Area Sources.* Part 13.2.4 Aggregate Handling and Storage Piles, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

39. Volume 2, CR #1, Appendix A, Table A2-5, Page A-7

For public roads, such as Highway 40 south of Coalspur, CVRI states that the traffic is represented as one two-way trip per day by 512 vehicles. This translates to a daily average traffic volume (ADT) of 1024 vehicles (pass-bys rather than two-way trips) for that highway. This is inconsistent with the text below the table, which reports an average daily vehicle count of 780 vehicles (presumably pass-bys) averaged over all major roads.

a. Clarify that this data in Table A2-5 is correct, as well as the data in the text.

Response:

The traffic measurements for public roads are the average for years 2001 to 2010 and were the total number of vehicles on the road on a given day, no matter in what direction they were travelling.

However, the actual number of vehicles inside of the RSA was estimated to be 780 each day, assuming that of the 512 vehicles traveling on Highway 40 south of Coalspur, some will be travelling westward from Coalspur. Some vehicles traveling from Hinton to Robb may turn toward Hanlan; some may travel via Highway 47 (paved) and then by unpaved Highway 40 either westward or southward from Coalspur.

The number 780 of vehicles on the road on a given day was determined as follows:

1. A total of 512 vehicles travel on Highway 40.
2. Of the 512 vehicles travelling north on Highway 40 (south of Coalspur), 97 vehicles will turn left to Highway 40 westbound.
3. An additional 97 vehicles travelling from Highway 40 westbound will turn left and travel north on Highway 40 and then on Highway 47. So Highway 40 and 47 has 512 vehicles travelling north.
4. Of the 350 vehicles traveling from Hinton to Robb, it was assumed that 50 vehicles will continue to the Hanlan Robb Gas Plant. An additional 125 vehicles will turn left and travel northward on Highway 47.
5. It was assumed that 50 vehicles from Highway 47 will turn right toward the Hanlan Robb Gas Plant. It was assumed that 125 vehicles from Highway 47 will turn left and travel to Hinton by the Hinton Robb gravel road.

The total number of vehicles in the RSA can therefore be estimated as 512+97+50+125 = 784, which was rounded to 780 in calculations.

40. Volume 2, CR #1, Appendix A, Table A2-6, Page A-9

CVRI states that, for Highway 40 South of Coalspur, that there is 8760 hours/year of operation of each of 512 vehicles, which suggests that the traffic volume is actually 512 vehicles per hour rather than 1024 vehicles per day, as derived from Table A2-5, or 780 vehicles per day as derived from the text. In addition, the table shows a fuel use rate of 14 L/hr, whereas, the text below the table reports a fuel consumption of 14 L/100 km. This implies a traffic speed of 100 km/hr on Highway 40.

a. Clarify these traffic assumptions.

Response:

CVRI offers the following clarifications:

- The vehicle counts are 512 per day on Highway 40. Vehicle counts in the RSA are 780 per day (see response to ESRD SIR #39).

- The fuel consumption rate of 14 L/100 km applies to the mix of all highway traffic on Highway 40.
- Coal haul trucks are not included in highway traffic counts as they use haul roads.

The traffic counts for Highway 40 are as follows: 71% passenger cars, 5% recreational vehicles, 2% buses, 7% single units and 15% tractor trailers (AT, 2011). Based on fuel consumption that ranged from about 8 L/100 km for fuel efficient passenger vehicles to 12 L/100 km for larger vehicles to 20 L/100 km for single unit trucks and buses to 40 L/100 km for tracker trailers above 15 ton (http://oee.nrcan.gc.ca/transportation/business/reports/884,). Using traffic counts and fuel consumption estimates, an average fuel consumption of 14 L/100 km was obtained.

b. Verify the correct fuel use value and also provide information on the expected average traffic speed on Highway 40, including that of the coal trucks.

Response:

As previously stated, coal haul trucks are confined to internal haul roads and do not use Highway 40. The emission factor from some compounds (PAHs, metals, VOCs) is stated in mass per fuel consumption. Therefore, for determination of fuel usage by public road traffic, an average speed of 100 km/h was used for simplicity to yield a fuel consumption rate of 14 L/h.

This fuel consumption rate of 14 L/h is conservative for several reasons. The first one is the fact that an average speed 100 km/h was used to convert estimated fuel consumption in L/100 km to L/h. If the average vehicle speed is below 100 km/h, the consumption rate will be less than 14 L/h. Based on its experience working the area, CVRI expects that small vehicles may reach 100 km/h on Highway 40. Buses and large trucks are expected to travel slower, but are expected to travel for up to one hour in the RSA.

Modelling assumed that all vehicles, no matter their speed, travelled for one hour per day in the RSA. Therefore, the second factor contributing to conservativeness is the fact that many vehicles travel through the RSA and spend less than one hour in it. This is largely because not all vehicles travel the entire length of the RSA. For example, vehicles travelling from the Hanlan Robb Gas Plant to Hinton will spend less than about 30 minutes within it.

Reference:

Alberta Transportation (AT). 2011. *Traffic Data Mapping*. http://www2.infratrans.gov.ab.ca/mapping/. Accessed October 2011.

41. Volume 2, CR #1, Appendix A, Section A3.2, Page A-11

An equation for overburden dragline operations is applied by CVRI to all types of excavating, loading and unloading for overburden, coal and reject.

a. Provide data that demonstrates the sensitivity of the emissions to using alternate approaches, such as the equation for material handling in Chapter 13.2.4 of AP-42, so that a better understanding of the uncertainty and justification for this approach can be gained.

Response:

The Project air quality assessment used a dragline equation to estimate emissions for some aspects of material handling for coal mining operations. The equation has ratings that range from average (B) for TSP, to below average (D) for PM_{10} and $PM_{2.5}$. For overburden, the TSP emission factor calculated using the dragline equation was 0.00143 kg/t; for coal, the emission factor was 0.0011 kg/t. The dragline equation is dependent on drop height and moisture content (AP 42 Table 11.9-2 in U.S. EPA 1998a):

$$TSP\left(\frac{kg}{m^3}\right) = \frac{0.0046 * d^{1.1}}{(M)^{0.3}}$$

$$PM_{10}\left(\frac{kg}{m^3}\right) = \frac{0.75 * 0.0029 * d^{0.7}}{(M)^{0.3}}$$

$$PM_{2.5}\left(\frac{kg}{m^3}\right) = 0.017 * TSP$$

where: M is moisture content and d is the drop height.

There are a number of alternative formulations that could be used. Table 11.9-4 from AP42 (U.S. EPA, 1998), lists TSP emission factors for coal loading/unloading ranging from a low of 0.0001 kg/t to a high of 0.033 kg/t. For overburden, the range is 0.001 kg/t to 0.018 kg/t). However, the quality rating is “E” (poor) for these factors suggesting the emission factor was developed for few facilities and may be not representative of the industry in general.

With respect to the specific example in the question, the equation for material handling in Chapter 13.2.4 of AP42 (U.S. EPA, 2006) is dependent on wind speed:

$$E(kg/t) = k*(0.0106)*\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

where: k particle size multiplier (k = 0.74 for TSP, 0.35 for PM_{10} and 0.053 for $PM_{2.5}$)
U is wind speed (m/s), and
M is moisture content (%).

The equation has an "A" rating (excellent) for aggregate handling. ESRD Table 41-1 lists the emission factors as a function of wind speed if applied to coal and overburden handling. Comments on the use of this approach include the following:

- Average wind speeds in the area are about 3.45 m/s. From ESRD Table 41-1, the aggregate handling equation produces lower emissions at this speed than the dragline equation.
- Usually, the highest predicted concentrations around mines are obtained under low wind speeds. The surface winds at the nearest West Central Airshed monitoring sites (see ESRD SIR #51 or Section C4.1 in Appendix C) reflect a high frequency of calms. The aggregate handling equation provides very low wind driven emissions under those conditions.
- The aggregate handling equation produces higher emissions than the dragline equation at speeds above 7 m/s, when dispersion of dust is improved and therefore predicted concentrations are lower.
- The inclusion of a drop-height dependence provides an opportunity to estimate the impact of at least one mitigation option. From that perspective, the dragline equation is preferred.

ESRD Tables 41-2 and 41-3 summarize all available emission factors for overburden and coal, respectively.

Table 41-1 Wind Dependent TSP Emission Factors for Loading/ Unloading

Wind Speed Range (m/s)	Average Wind Speed (m/s)	Overburden TSP Emission Factor (kg/t)	Coal TSP Emission Factor (kg/t)
0 – 1.54	0.77	0.000072	0.000021
1.54 – 3.09	2.32	0.00030	0.000088

Table 41-1 Wind Dependent TSP Emission Factors for Loading/ Unloading			
Wind Speed Range (m/s)	**Average Wind Speed (m/s)**	**Overburden TSP Emission Factor (kg/t)**	**Coal TSP Emission Factor (kg/t)**
3.09 – 5.14	4.12	0.00063	0.00019
5.14 – 8.23	6.62	0.0012	0.00035
8.23 – 10.8	9.52	0.0019	0.00055
10.8 – 25.0	17.90	0.0043	0.0013

Table 41-2 Summary of Emission Factors for Loading/ Unloading of Overburden			
Reference (AP42)	**TSP (kg/t)**	**PM_{10} (kg/t)**	**$PM_{2.5}$ (kg/t)**
Table 11.9-2 Dragline Equation (Used in Assessment)	0.0011	0.00052	0.000019
Table 11.9-4 Truck Loading by Power Shovel (Batch Drop)	0.018	-	-
Table 11.9-4 Bottom Dump Truck Unloading (Batch Drop)	0.001	-	-
Section 13.2.4.3 (average wind speed – 3.45 m/s)	0.00050	0.00024	0.000036

Table 41-3 Summary of Emission Factors for Loading/ Unloading of Coal			
Reference (AP42)	**TSP (kg/t)**	**PM_{10} (kg/t)**	**$PM_{2.5}$ (kg/t)**
Table 11.9-2 Dragline Equation (Used in Assessment)	0.0014	0.00067	0.000024
Table 11.9-4 Train Loading (Batch or Continuous Drop)	0.0014	-	-
Table 11.9-4 Train Loading (Batch or Continuous Drop)	0.0001		
Table 11.9-4 Bottom Dump Truck Unloading (Batch Drop)	0.014	-	-
Table 11.9-4 Bottom Dump Truck Unloading (Batch Drop)	0.0010	-	-
Table 11.9-4 Bottom Dump Truck Unloading (Batch Drop)	0.0070	-	-
Table 11.9-4 Bottom Dump Truck Unloading (Batch Drop)	0.0330	-	-
Table 11.9-4 End Dump Truck Unloading (Batch Drop)	0.0040	-	-

Table 41-3 Summary of Emission Factors for Loading/ Unloading of Coal			
Reference (AP42)	**TSP (kg/t)**	**PM_{10} (kg/t)**	**$PM_{2.5}$ (kg/t)**
Section 13.2.4.3 (average wind speed – 3.45 m/s)	0.00015	0.00007	0.000011
Table 11.9-2 Loading of Coal on Truck	0.026	0.0043	0.00049

Emission factor formulas for loading coal onto trucks in AP 42 Table 11.9-2 (U.S. EPA 1998a) are:

$$TSP\left(\frac{kg}{t}\right) = \frac{0.580}{(M)^{1.2}}$$

$$PM_{10}\left(\frac{kg}{t}\right) = \frac{0.75 * 0.0596}{(M)^{0.9}}$$

$$PM_{2.5}\left(\frac{kg}{t}\right) = 0.019 * TSP$$

Where: *M* is moisture content.

Several emission factors taken from AP 42 Table 11.9-4 are based on measurements made at single mines. They are considered specific for the mine and are not representative of the industry. They have the lowest emission factor rating (E).

Even for the highest wind speeds listed in ESRD Table 41-1, wind speed-dependent TSP emission factors for loading and unloading are lower than the highest emission factors summarized in Table 11.9-4 of AP42 (U.S. EPA, 1998). For TSP, comparison of the dragline equation emission factor to others for overburden indicates the dragline equation produces neither the highest nor the lowest emission estimates. Similarly, the emission factor used for coal in the assessment is neither the largest nor the smallest, suggesting that the factor used in the assessment is representative of the range of factors.

According to direct observation by CVRI staff, coal loading and unloading produces visibly less dust emissions compared to haul road transport and bulldozing. Emissions for coal loading obtained by using AP 42 equations from Table 11.9-2 are significantly higher than emissions obtained by the other methods (except for one poorly rated factor in Table 11.9-4).

According to our analysis, the wind speed dependent emission factors suggested in ESRD SIR #41a) above as a reasonable alternative provide lower emissions, especially during low wind speeds when dispersion conditions are poor and emissions from other sources are more significant.

References:

U.S. EPA. 1998. *Compilation of Air Pollutant Emission Factors: Volume I Stationary Point and Area Sources.* Part 11.9 Western Surface Coal Mining, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

U.S. EPA. 2006. *Compilation of Air Pollutant Emission Factors: Volume I Stationary Point and Area Sources.* Part 13.2.4 Aggregate Handling and Storage Piles, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

42. Volume 2, CR #1, Appendix A, Section A3.4, Page A-14

CVRI indicates that the vehicle weight to be used in the unpaved road dust equations should be in metric tons; however, according to the US EPA AP-42 source, the weight should be in imperial tons. Use of metric tons would underestimate the predicted emissions.

a. Verify that imperial tons were used in this calculation.

Response:

Metric tonnes were used in the calculation, rather than imperial tons.

In CVRI's experience, their haul trucks are usually loaded to about 10% less than their nominal capacity. The average weight of CAT789C trucks used for overburden hauling in the assessment was 253 short tons (230 tonnes) and if loaded to 90% of capacity, the weight would be about 228 short tons. The model used 230 short tons which is the approximate expected weight of a loaded truck[1].

ESRD Table 42-1 compares emissions from haul trucks at full nominal capacity to those at 90% capacity. The difference (increase) in emissions is less than 5% at for trucks operating at capacity.

[1] The approximate loaded weight used in the model is the average weight of a loaded and empty truck representing both full and empty scenarios.

Table 42-1 Comparison of Emissions for Overburden Hauling at West Mine using Emission Factors from U.S. EPA (2006)

Species	Emission Factor – Full (kg/kvt)	Emission Factor – 90% (kg/kvt)	Total Emissions – Full (kg/d)	Total Emissions – 90% (kg/d)	Increase in Total Emissions (%)
TSP	6.90	6.61	13.4	12.8	4.4
PM_{10}	1.89	1.81	3.69	3.54	4.3
$PM_{2.5}$	0.19	0.18	0.40	0.38	4.0

Total maximum daily TSP emissions for the Project Case 1 (Table 3.4-1 in CR #1) are 30.7 t/d, compared to overburden hauling emissions in ESRD Table 42-1 of 0.013 t/d. The addition of a 4-5 % increase for full compared to 90% capacity haul trucks is negligible. Similar conclusions hold for PM_{10} and $PM_{2.5}$ emissions.

Reference:

U.S. EPA. 2006. *Compilation of Air Pollutant Emission Factors: Volume I Stationary Point and Area Sources*. Part 13.2.2 Unpaved Roads, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

43. Volume 2, CR #1, Appendix A, Section A3.5, Pages A-15 and A-16

CVRI states that the roads are snow covered and as such, dust emissions are significantly reduced by this natural phenomenon.

a. Provide documented information on the state of the roads in this area during winter, confirming that they are usually snow covered, with little or no exposed dust-generating material.

Response:

During the winter months the haulroads are frozen often with some degree of snow cover. Graders equipped with serrated ice blades are used to remove accumulated snow. In this condition little dust can be generated by haulage traffic.

Weather station data (ESRD Appendix 43) from CVM is provided to illustrate daily temperatures during 2011. During the November to March period, the minimum daily temperature is below -10°C, indicating that haul roads could be frozen at least overnight. Occasional warm periods during the winter can result in dry and dusty road conditions. On such occasions water trucks can be employed to treat the dust road segments.

According to Canadian Climate Normals (1971-2000), the average snow cover at Edson Station is not zero from October to April inclusively. (ESRD Table 43-1). On average, snow cover extends from October to April (more than 1 cm of snow cover). CVRI in its modelling assumed snow cover from November to March.

Table 43-1 Temperatures, Rain, Snow Fall, and Snow Cover as Recorded at Edson (1971-2000)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Daily Temperature (^{o}C)												
Average:	-11.8	-9.2	-3.3	3.5	8.9	12.6	14.6	13.7	8.8	3.4	-6.0	-11.2
Minimum	-18.2	-16.1	-10.2	-3.7	1.4	5.7	7.6	6.8	1.8	-3.5	-12.1	-17.5
Maximum	-5.2	-2.2	3.6	10.6	16.2	19.4	21.6	20.6	15.7	10.3	0.1	-5.0
Precipitation												
Rainfall (mm):	1.4	0.5	3.0	12.9	52.2	106.7	106.2	82.2	56.7	11.4	2.5	0.7
Snowfall (cm)	35.8	22.3	25.8	13.8	6.4	0	0	0.1	6.7	13.4	22.3	30.0
Ave. Snow Depth (cm)	28	28	20	4	0	0	0	0	0	1	7	17
Snow Depth at Month- End (cm)	32	24	13	0	0	0	0	0	1	3	10	21

http://climate.weatheroffice.gc.ca/climate_normals/

44. Volume 2, CR #1, Appendix A, Section A3.6, Page A-16

CVRI states that a forested area with trees ranging from 18 to 20 m tall effectively traps dust and reduces emissions from 80 to 100%. Field observations indicated that the trees are generally not densely planted nor are >18 m tall. Deciduous trees that drop their leaves in the autumn will offer no or minimal reduction or removal of dust emissions. Moreover, clearing and slashing of any trees is a natural consequence of any mining project and these activities are usually completed well in advance of over-burden removal and mining operations.

a. Provide an approximate inventory of the tree cover that will lie between the hamlet of Robb and the proposed CVM operations at their closest approach, giving an indication of the type of trees, height and density, and where there may be gaps in the tree cover.

Response:

The closest distance from the town of Robb to the disturbance within Robb West (northwest of Robb from E500599 and N5898205 to E500959 and N5898181) contains the following order of vegetation:

- 145m of 60% Shrubby Open and 40% Herbaceous/Graminoid;
- 75m of crown closure (51-70% closed crown) at 22m height made up of 50% white spruce, 30% aspen and 20% lodgepole pine;
- 100m of Herbceous/Graminoid and Highway 47; and
- 30m of crown closure (51-70% closed crown) at 19m height made up of 90% aspen and 10% balsam poplar.

The closest distance from the town of Robb to the disturbance within Robb Main (southeast of Robb from E502974 and N5896611 to E502189 and N5896891) contains the following order of vegetation:

- 148m of crown closure (51-70% closed crown) at 17m height made up of 60% lodgepole pine, 20% black spruce, 10% white spruce, and 10% aspen; and
- 663m of crown closure (51-70% closed crown) at 21m height made up of 90% aspen and 10% white spruce.

The estimations above were made through aerial ecosystem interpretation which included AVI.

With reference to the information in the response to ESRD SIR #46, the vegetation is believed to be sufficiently dense and of sufficient fetch to reduce the concentrations of dust by 75% as indicated in the air quality assessment.

CVRI has also noted that significant treed area is present within the hamlet boundary as many of the residences are located on larger lots or within forested areas. The effect of this vegetation was not included in any modelling.

45. Volume 2, CR #1, Appendix A, Section A3.7, Page A-17

For wind erosion, an equation from A&WMA (1992) is used by CVRI, as opposed to equations from either Chapter 11.9 or 13.2.5 of AP-42.

a. Provide a justification, ideally supported by data, regarding the sensitivity of the calculated emissions to using alternative equations, so that the level of uncertainty may be better understood.

Response:

Wind erosion from stockpiles at the plant site is a part of the Baseline Case, not the Project Case.

CVRI is aware of three main methods to calculate wind driven emissions but is unaware of local data that could be used to verify any of the equations. This response reviews them and compares emissions estimated from them as a measure of uncertainty.

Method 1: Industrial Wind Erosions (U.S. EPA, 2006).

The equation given in Chapter 13.2.5 of AP42 (Industrial Wind Erosions - U.S. EPA, 2006) uses the concept of fastest mile and provides an elaborate method to calculate average annual emissions from stockpile and open areas. This equation requires estimation of subareas of constant friction velocity around the stockpile (assuming that there are much lower emissions from areas near the base of pile and on the lee side compared to the top of the pile). This method is uses the concept of a threshold velocity, below which there is no wind driven emission from the stockpile.

To compare emissions, calculations were made for the ROM Pile, using the five years of meteorological data used in modelling (obtained from CALMET output at the cell corresponding to the plant – CALMET generated wind speeds are often higher than observations, making wind related emissions higher than reality). It was assumed that disturbances occurred hourly. In order to estimate the "fastest mile" (the wind gust), the hourly wind speed was multiplied by a factor 1.66 (average from wind gusts over average wind speeds for Edson Station – ESRD Table 45-1). These ratios are lower in other stations (for example, in Grande Prairie the average ratio is below 1.6)

Table 45-1 Maximum Hourly Wind Speed and Wind Gust as Recorded at Edson Station (1971-2000)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Wind Speed (km/h)												
Maximum Hourly:	56	64	47	56	47	64	48	44	56	58	54	64
Maximum Gust:	93	100	89	80	87	89	93	74	89	94	93	100
Ratio Gust/Hourly	1.66	1.56	1.89	1.43	1.85	1.39	1.94	1.68	1.59	1.62	1.72	1.56

http://climate.weatheroffice.gc.ca/climate_normals/

Assuming hourly disturbances, the following equations were used:

$$U_s^+ = (U_s/U_r)*U_{10}^+$$

where: U^+ is surface wind distribution

U_{10}^+ is fastest mile of wind (m/s) obtained by multiplying wind speed by 1.66 factor.

U_s/U_r are ratio's 0.9, 0.6 and 0.2 related to stockpile geometry.

$$U^* = 0.1*U_s^+$$

where: U^* is equivalent friction velocity (m/s)

$$P = 58*(U^*-U_t^*)^2 + 25*(U^*-U_t^*)$$

$$P= 0 \text{ for } U^* \leq U_t^*$$

where: P is TSP erosion potential (g/m^2) related to fastest mile wind speed

U_t^* is threshold friction velocity (m/s), assumed 1.12 m/s for uncrusted coal pile (Table 13.2.5.2 at U.S. EPA, 2006)

The ROM pile had an active area of 0.415 ha. The percentages of the pile surface (12, 48, and 40%), corresponding to U_s/U_r ratios (0.9, 0.6, and 0.2 respectively), were taken from the example given in U.S. EPA (2006).

Emission factors obtained by this method are not rated in AP42.

Method 2: Western Surface Coal Mines (U.S. EPA, 1998).

The second wind speed related equation is given in Table 11.9-2 (Western Surface Coal Mines; U.S. EPA, 1998):

$$E = 1.8*U$$

where: E is wind driven emission (kg/ha/hr)

U is wind speed (m/s)

To estimate emissions using this equation, it was assumed that there is no emission for wind speeds below 5.14 m/s (AWMA, 1992). The emissions were found for the average wind speed bins used in models: 5.14 – 8.23 m/s; 8.23 – 10.8 m/s and for wind speed above 10.8 m/s average from 10.8 and 16.88 m/s was used. The last value was maximum wind speed recorded in the CALMET meteorological data. Daily maximum and annual average emissions were then calculated.

Emission factor calculated by this method is rated C – average. Although no specific bias is evident, it is not clear if the facilities tested represent random sample of the industry (http://www.epa.gov/ttn/chief/faq/ap42faq.html#ratings).

Method 3: Air Pollution Engineering Manual (U.S. EPA, 1998 and NPI, 2012).

The emission factor formula for TSP used in assessment was obtained from Air & Waste Management Association (1992). The same formula is recommended in NPI (2012). The formula is dependent on silt content and average proportion of high wind speeds. Precipitation was ignored as a mitigating factor during this calculation.

$$E(kg/day/hectare) = (1.9)\left(\frac{s}{1.5}\right)\left(\frac{f}{15}\right)$$

where:

E is the suspended particulate emission factor (in kg/day/ha)

s is the silt content of aggregate (%)

f is the percentage of time that the unobstructed wind speed exceeds 5.14 m/s

According to NPI (2012) the formula gives conservative estimates for Australian conditions. The default value (0.4 kg/ha/hr) is recommended.

Methods Comparison

ESRD Table 45-2 summarizes emissions obtained by three methods. The emissions estimated by alternative methods are higher than those used in the assessment. However, higher emissions do not necessarily yield higher predicted concentrations. Maximum predictions were obtained for all other mine operations, including haul roads at low wind speeds (Staniaszek *et al.*, 2011). While wind driven emissions can be quite significant at higher wind speeds, high wind speeds are also associated with good dispersion, and the contribution from this source to predictions around the plant is minor. Using constant emissions, independent of wind speed, was shown to be more conservative than using higher, wind speed dependent emissions (Staniaszek *et al.*, 2011).

The prediction obtained by NPI (2012) default value (0.4 kg/ha/hr) are higher than obtained by Method 3 equation (TSP value 4.0 kg/day for NPI default emission factor in compare to calculated by AWMA, 1992 value of 2.8 kg/day). These values are, however, much lower than emission estimates obtained using AP42 methods.

Table 45-2 Average Emissions Obtained Using Three Different Methods (kg/day)

Component	AWMA (1992) Used in Assessment	U.S. EPA (2006) Industrial Wind Erosion	U.S. EPA (2006) Western Surface Coal Mines
Maximum Daily			
$PM_{2.5}$	0.21	29	17
PM_{10}	1.4	188	109
TSP	2.8	377	219

Table 45-2 Average Emissions Obtained Using Three Different Methods (kg/day)

Component	AWMA (1992) Used in Assessment	U.S. EPA (2006) Industrial Wind Erosion	U.S. EPA (2006) Western Surface Coal Mines
Annual Average			
$PM_{2.5}$	0.21	0.54	2.08
PM_{10}	1.4	3.5	13.6
TSP	2.8	7.0	27.2

Uncertainties

One uncertainty is estimation of the active surface area of the pile. If hourly winds are used in modelling, it follows that hourly pile area disturbed hourly is the appropriate parameter. This area can be much lower in comparison to the area disturbed daily. In above calculations, based on CVRI's experience, the area 0.415 ha for the disturbed area of ROM pile is way too high for daily maximum (emissions for every hour were obtained by multiplying emission in units of kg/hr/ha by active surface of stockpile in units of ha). If the hourly disturbed area is, say, 10-20% of the daily disturbed area, then emission estimates obtained by AP 42 methods will be 5-10 times lower. In addition, the total and disturbed areas of the stockpile are estimates that vary in time.

Another uncertainty is wind gust approximation. In the example given in U.S. EPA (2006) at Figure 13.2.5-4, the range of ratios for wind gust over the average wind speed is from 1.2 to 2.3 with average value 1.56, a range of about 100%

A third uncertainty is determining sub-areas for surface wind speed distribution (U_s/U_r factors and sub-areas of the active area of the pile). These factors depend on the shape of pile (which may change constantly) and also on the orientation of pile to the direction of the fastest mile wind.

A further uncertainty is the threshold velocity, a function of the size of the material on the surface of the pile. If the coal is pulverized, the threshold may be smaller than that used in calculations.

None of these equations contain the moisture content of the stock pile. It is intuitively apparent that if the coal is moist, the wind driven emissions will be smaller, than in the case when stockpile is dry. For that reason, the original equation from Method 3 (AWMA, 1992) reduces emissions on an annual basis proportionally to the number of days with precipitation of 0.25 mm or more. Such an approach is valid for annual emissions, and was not used in the Project assessment. However, on days with heavy rain and/or snow, or frozen ground, emissions will be reduced even when occurring with high winds. From this perspective, the assessment was conservative.

Conclusions

The equations based on A&WMA (1992) and recommended by NPI (2012) appear to be based on credible measurements and assessments, and are advanced by credible organizations.

Predictions at the MPOI, which is near the mine (the West mine is about 22 km from the Plant) will be not affected by emissions from stockpiles. Stockpile emissions at the plant are part of the Baseline Case, common to all emission scenarios.

The method used in the assessment is wind speed independent and for that reason emissions from stockpiles may contribute to high predictions on days with light winds, when there are poor dispersion conditions.

Methods used to estimate wind driven emissions have a number of factors which have uncertainty (active area of stockpile, wind gust determination, factors dependent on shape of file in relation to highest mile wind speed are among them).

References:

Air & Waste Management Association (AWMA). 1992. *Air Pollution Engineering Manual.* Anthony J. Buonicore and Wayne T Davies (eds). Van Nostran Reinhold.

National Pollution Inventory (NPI). 2012. Emission Estimation Technique Manual for Mining Version 3.1; January 2012.

U.S. EPA. 2006. *Compilation of Air Pollutant Emission Factors: Volume I Stationary Point and Area Sources.* Part 13.2.5 Industrial Wind Erosion, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

U.S. EPA. 1998. *Compilation of Air Pollutant Emission Factors: Volume I Stationary Point and Area Sources.* Part 11.9 Western Surface Coal Mining, Fifth Edition (AP-42). Office of Air

Quality Planning and Standards, Research Triangle Park, North Carolina.

Staniaszek P., R. Rudolph, Y. Wong, and E. Logan. 2011. Challenges in Modelling Dioxin Emissions from Clean-up of Agent Orange Storage Areas. Proceedings of 104th Annual

Conference and Exhibition. Air & Waste Management Association. Orlando, Fl., June 2011.

46. Volume 2, CR #1, Appendix A, Section A3.6, Page A-16

Reference is made by CVRI to a paper by Cowherd, suggesting that dispersion models over-estimate impacts from fugitive dust sources by a factor of 4. This may be true for large-scale, regional gridded models (such as CMAQ), but is not necessarily so for short-range dispersion models (e.g. AERMOD) and puff models, such as CALPUFF. In large-scale gridded models, depletion of plume mass due to deposition is calculated explicitly on the grid and, as a result, the predicted amount of depletion will be sensitive to grid resolution. At typical resolutions of these models (smallest grid spacings are around 1-4 km) this can lead to a significant underestimate of deposition for low-level sources.

In CALPUFF, on the other hand, plume depletion is tracked in each puff and calculated at every time step. This amounts to a much higher resolution approach. It is clear from the title and from discussions within the paper, that Pace (2005) was thinking of regional-scale and urban-scale models, not local scale (he used the phrase "several hundred meters" as the distance over which substantial dust removal will occur). Data from other literature sources indicates that tree belts reduce particulate matter levels at low wind speeds, with the reductions being more on the order of 50% for a dense tree belt, with no gaps. At higher wind speeds, the reductions tend to be less.

Table A3-4 is derived from Pace (2005). But Pace's caveat with respect to high wind events and also the very approximate nature of these CF values were not mentioned. In the case of "Forest", the appropriate CF would be highly dependent on the density, extent and character of the forest. It also does not contemplate dispersion models such as CALPUFF, in which deposition processes are modeled differently from gridded models. Local scale models, such as CALPUFF already provide significant removal of particulate matter over "several hundred metres" through modeling of deposition processes. When these processes are modeled within CALPUFF, no additional effect of trees around the site should be added.

a. Provide a more thorough review of the relevant literature, focusing on the effect of trees over shorter distances and a justification for applying additional removal effect of trees over and above deposition processes already incorporated into CALPUFF.

Response:

Effects of Vegetation on Particulate Concentrations

Malone (2004) surveyed the effects of vegetation on dust reduction from poultry farms. He identified one two-year study (Malone and Donnelly, 2001) in which a 9-m wide belt of three rows of dense evergreen trees less than 5 m high located 15 m from a barn fan reduced total dust concentrations across the belt by 50%. The reduction was due to a substantial reduction in wind speed through the belt.

Zhu *et al.* (2012) presented measurements from towers placed at progressively farther distances from a haul road. Long grass had the highest PM_{10} removal rate. At 84 m distance from the road, concentrations decreased to 13% of near-road concentrations which were measured 8 m from the road, and at 160 m decreased to 7.5%. In desert conditions (bare land), concentrations 136 m from the road decreased to 67% of near-road (12 m) concentrations. Zhu attributed the decrease to enhanced deposition due to surface roughness. Particle deposition velocities increased with increased surface roughness.

Cowherd *et al.* (2006) conducted dust plume profiling tests showing that tall vegetation (oak and cedar trees) bordering an emission source captures fugitive dust (PM_{10} and $PM_{2.5}$) in the range of 50% over a transport distance of 25 m from an unpaved road. These rates significantly exceed the levels represented in standard air plume dispersion models used for regulatory compliance purposes, where in the current work, near-source effects were modelled with standard grid sizes in the range of 50 to 500 m.

Gillies *et al.* (2002) measured the removal of PM_{10} dust emitted from an unpaved road at 50 m and 100 m downwind. There results, obtained for unstable conditions over sparsely vegetated terrain, indicated that there was no measurable removal of PM_{10} at 100 m downwind of the source. That is, nearly all of the PM_{10} emitted from the unpaved road is regionally transportable, which was in good agreement with the predictions from a Gaussian model.

In contrast, Veranth *et al.* (2003) performed similar measurements during night-time stable conditions over very rough terrain. They measured an 85% removal (15% remaining) of PM_{10} over the first 95 m downwind of the unpaved road. The Gaussian model (ISC3) appeared to substantially over predict the transportable fraction of PM_{10} under those conditions.

Cowherd *et al.* (2006) showed that vegetation capture factor is independent on the size of particulates (factors were very similar for PM_{10} and $PM_{2.5}$). The same paper also showed that reduced the mass in plumes by 41-67% within a few tens of metres from a road source.

The above papers support claims by Pace (2005) that dense vegetation can trap significant amounts of dust. The vegetation capture factor 75% used in assessment is consistent with observations.

Overview of Challenges Modelling Road Dust

According to Cowherd (2009), the use of dispersion models to predict the impacts of fugitive dust sources is challenging, because of the difficulty of representing complex emission and dispersion phenomena associated with such sources. These challenges are:

- Proper representation of source configuration;
- Particle agglomeration and deposition near the point of release; and
- Particle capture on irregular surfaces and in stilling zones associated with flow obstacles and upward slopes downwind of the source.

Although traffic on haul roads should be represented as a series of moving points, the resultant mathematical complexity makes this approach unfeasible. Moreover, the simple deposition algorithms typically found in available models do not account for enhanced deposition of dust on vertical surfaces associated with vegetative groundcover, buildings and topographical features downwind of haul roads. In addition, there is no accounting for the enhanced agglomeration (and deposition) of electrostatically charged dust in the near-source transport zone where plume concentrations are the highest. This phenomenon is reflected in the observed stratification of dust plumes as they travel downwind from the source. Finally, there has been no standardization in modeling the effects of pit trapping that can capture on the order of half of the road dust emitted below grade.

Specific Issues

Watson and Chow (2000) hypothesized that a large fraction of PM_{10} sized dust remains 1 to 2 m above ground level, which is not accounted in Gaussian plume models which assume fixed concentrations (Kornelius and Burger, 2006, 2011). Etyemezian *et al.* (20003, 2004) also reported measurements with ISC3 model predictions and found that in stable conditions, ISC3 substantially over-predicted concentrations (under-predicted deposition).

Kornelius and Burger (2011) indicate that removal of vehicle speed from AP42 unpaved road emission equations results in over-estimation of concentrations at lower vehicles speeds (Countess, 2001; Thompson and Visser, 2001; Gillies *et al.* 2003, Etyemezian *et al.* 2003; Kuhns *et al.* 2005). They also suggest that the "line source" approach used in modelling (either by area sources or by array of volume sources), yields much higher predictions than if the model used a moving source (Reed, 2003).

The conservativeness of ISC3 for mine applications was also identified by Reed (2005). Reed showed that ISC3 overestimated dust by at least factor of two. He also suggested that CALPUFF gives very similar results to ISC3 in flat terrain.

Failure to obtain accurate predictions by dispersion models was discussed in more detail in Etyemezian *et al.* (2004). The deposition in Gaussian models (including CALPUFF) is based on the assumption that near the ground (that is, from the surface layer down), the flux of depositing species is constant with height. Related to the assumption of constant flux, the model also assumes the concentration profile through surface and quasi-laminar layers is not changing significantly over time. This can be true for distances far away from the haul road; however, near the haul road, transport of particles is turbulent through the surface layer and quasi-laminar layers. There are other assumptions pertaining to deposition parameters (for example - aerodynamic resistance), which are dependent on meteorology (stability class, Monin-Obukhov length scale, *etc.*) but models treat them as constant.

Treatment in Models

Beginning in the 1990s, a default "factor of 4" reduction of fugitive dust emission rates was incorporated into the SMOKE preprocessor for CMAQ, which is a grid-based air quality model that has seen limited use in Alberta. Pace (2005) also developed composite fugitive dust capture fractions (CF) for five basic land cover types as shown in CR #1, Appendix A, Table A3-4. By definition, Capture Fraction = 1 – Transport Fraction.

Additional transport fraction information has been developed based on the relationship between land use and representative groundcover (Pace 2005, Cowherd 2009). The resulting composite transport fractions by land use category are shown in ESRD Table 46-1 which has been updated by Mansell (for the WRAP emission inventory as reported in Cowherd; 2009). For example, the roughness created by forests essentially traps dust emissions and restricts transport outside this area.

Table 46-1 Transport Fraction (TF) by Land Use

Land Use Category	Original TF (Pace, 2005)	Original used by WRAP - TF (Cowherd, 2009)	Updated by Mansell TF (Cowherd, 2009)
Urban	0.50	0.30	0.00
Agriculture	0.75	0.85	0.75
Grassland	0.75	0.70	0.75
Shrubland	0.75	0.60	0.75
Forest	0.00	0.30	0.00
Barren / Water	1.00	0.97	1.00

Transport fractions were originally developed to apply to grid modeling of regional impacts; however, all of the modeling deficiencies cited by Cowherd (2009) apply to plume models as well as grid models when used to estimate the impact of haul roads in open pit mines. These deficiencies include source representation, treatment of near-source plume loss, and treatment of pit trapping.

Cowherd (2009) identified the main deficiencies with model representation of mining and haul road sources, as listed in ESRD Table 46-2 (Table 4 in Cowherd, 2009). He argues that the net over-prediction is at least in the "factor of 4" range, excluding the effect of pit trapping. He also notes that a conservative estimate for the modeling over-prediction without the effect of pit trapping is a factor of 4 for haul roads in open-pit mines.

Table 46-2 Dust Modelling Deficiencies

Deficiency	Estimated Over-Prediction
Misrepresentation of haul roads as continuously emitting area sources	Factor of 2
Cumulative effects of modeling deficiencies	Factor of 4 for "average" groundcover
Exclusion of near-source agglomeration and enhanced deposition	Up to a factor of 6, depending on wind and groundcover
Exclusion of trapping by vertical obstacles during horizontal transport	Factor of 2 to 6, depending on wind and groundcover
Lack of treatment of pit trapping	Factor of 2
Instant vertical mixing in grid models	Factor of 2

Application to CVRI

CVRI has not used a grid model and has attempted to treat pit trapping by incorporating the ISC model algorithm into its results. Furthermore, CVRI has included the particulate removal mechanism in its CALPUFF modelling; therefore, the full "factor of 4" as documented by Pace (2005) or Cowherd (2009) may not apply.

To determine the impact of CALPUFF deposition on the "factor of 4" assumed by CVRI, a test run was performed for all area sources at the existing Plant. In the test run, deposition was turned off, chemistry was turned off, and there were no secondary particulate generation. For daily maximum $PM_{2.5}$, predicted concentrations at the MPOI were 3% higher with no deposition. For PM_{10} and TSP at the MPOI, the increases were 6 and 21%, respectively.

As ESRD Figure 46-1 illustrates, the increase is smaller for high concentrations which typically occur in the near field. Lower concentrations typically occur at greater distances; deposition is greater as forces acting to deposit material act over longer times.

At the MPOI, the model concentrations obtained without deposition should be multiplied by 0.79 to obtain the result with deposition. The results were further multiplied by 0.25 (due to the vegetation cover), resulting in a TF of 0.20. Thus CVRI's actual CF value is near 0.80 rather than the 0.75 value presented in CR #1 – a difference of less than 7%, but still within the recommended range of 0.70 (Cowherd, 2009, WRAP original factors) and the 1.0 value for forests in ESRD Table 46-1 (Pace, 2005 and WRAP factors updated by Mansell: Cowherd, 2009). At distances farther from the MPOI, the CF value would increase as CALPUFF predicts increased deposition but would remain within the 0.7 to 1.0 range.

While there are limitations to the approach used here, CVRI is unaware of an alternative approach using CALPUFF that simply accounts for the enhanced removal effects of vegetation. CVRI recognizes that reduction is a function of vegetation size and density and the depth of the vegetation belt, and that it is not equal in all directions from all sources. At the same time, CVRI asserts that it is a first effort at more accurately estimating these effects at locally important receptors like the residents at the community of Robb. CVRI has proposed a monitoring plan to confirm its assumptions as identified in the response to ESRD SIR #34.

b. Provide an approximate inventory of the tree cover that will lie between the hamlet of Robb and the proposed CVM operations at their closest approach, giving an indication of type of trees, height and density, and where there may be gaps in the tree cover.

Response:

The vegetation inventory is approximately as follows, from the West Mine pit to the community of Robb. The distance is covered by about 100 m of forest cover and 250 m of shrubs and grasses. The crown height is 19 to 22 m. Vegetation details are as follows:

- 145 m of 60% Shrubby Open and 40% Herbaceous/Graminoid then;
- 75 m of C (51-70% closed crown) at 22 m height of Sw 50%/Aw 30% and Pl 20% then;
- 100 m of Herbaceous/Graminoid and Highway then; and
- 30 m of C (51-70% closed crown) at 19 m height of Aw 90% and Pb 10%.

The vegetation inventory is approximately as follows from the Main Mine pit to the community of Robb. The distance is covered by about 800 m of forest cover with crown heights of 17 to 21 m. The details are as follows:

- 148 m of C (51-70% closed crown) at 17 m height of Pl 60%/Sb 20%/Sw 10% and Aw 10% then;
- 663 m of C (51-70% closed crown) at 21 m height of Aw 90% and Sw 10%.

The estimates above were made through aerial ecosystem interpretation which included AVI. Based on this information CVRI has determined that the depth and density of the forest in the region of Robb in particular are sufficient to justify the CF values assumed in CR #1.

CVRI has noted that significant treed areas are present within the hamlet boundary as many of the residences are located within forested areas. The presence of this vegetation was not included in the assessment.

References:

Countess R., 2001. Methodology for estimating fugitive windblown and mechanically resuspended road emissions applicable for regional scale air quality modelling. Final Report to the Western Governors Association, Westlake Village, California.

Cowherd, C. Grelinger, M.A. and Gebhart, D.L. (2006): Development of an emission reduction tern for near-source depletion. 15th International Emission Inventory Conference, New Orleans.

Cowherd, C. 2009. Transportability Assessment of Haul Road Dust Emissions Sent to U.S. EPA, August 21, 2009).

Etyemezian V., J. Gillies, H. Kuhns, D. Nikolic, and J. Watson. 2003. Field Testing and Evaluation of Dust Deposition and Removal Mechanisms – Final Report. Desert Research Institute, Reno, NV, January, 2003.

Gillies J., V. Etyemezian, Kuhns H., Nikolic D., and D. Gillette, 2003. Effects of vehicle characteristics on unpaved road dust emissions. 12th International Symposium on Transport and Air Pollution, Arcueil, France.

Gillies, J., P. Arnott, V. Etyemezian, H. Kuhns, E. McDonald, H. Moosmuller, G. Schwemmer, D. Gillette, W. Nickling, and T. Wilkerson. 2002. Characterizing and Quantifying Local and Regional Particulate Matter Emissions from Department of Defense Installations. Report prepared by DRI, Reno, NV for DoD/SERDP.

Kornelius G. and L. W. Burger 2006. Vehicle Movement as a Source of Fugitive Dust: A Review. In Proceeding of the National Conference Climate Change and Air Quality Management, National Association for Clean Air (NACA).

Kornelius G. and L. W. Burger 2011. Vehicle Movement as a Source of Fugitive Dust: A Review. http://www.airshed.co.za/archive/KORNELIUS%20G,%20et%20al%20-%20Vehicle%20Movement%20Source%20of%20Fugitive%20(1).pdf or http://ebookbrowse.com/kornelius-g-et-al-vehicle-movement-source-of-fugitive-1-pdf-d39049319

Kuhns H., J. Gillies, V. Etyemezian, D. Dubois, S. Ahonen, D. Nikolic, and C. Durham , 2005. Spatial variability of unpaved road dust PM_{10} emission factors near El Passo, Texas. JWMA 55 (1) p. 3-12.

Pace, T.G. 2005. Methodology to Estimate the Transportable Fraction (TF) of Fugitive Dust Emissions for Regional and Urban Scale Air Quality Analyses. EPA Publication: http://www.epa.gov/ttn/chief/emch/invent/transportable_fraction_080305_rev.pdf

Reed W.R., 2003. An improvement model for prediction of PM_{10} for surface mining operations. Ph.D. Dissertation, Virginia Polytechnic Institute and State University. Blacksburg, Virginia.

Reed, W.R. 2005. Significant Dust Dispersion Models for Mining Operations. Centre for Disease Control. http://www.cdc.gov/niosh/mining/pubs/pdfs/2005-138.pdf

Thompson R.J. and A.T. Visser 2001. Mine haul road fugitive dust emission and exposure characteristics. Report submitted to SIMRAC. http://www.up.ac.za/academic/mining/research/thompsomdust.pdf

Watson, J.G. and J.C. Chow (2000). Reconciling urban fugitive dust emission inventory and ambient source contribution estimates: summary of current knowledge and needed research. Desert Research Institute document 6110.4F

Zhu D., J. Gillies, H. Kuhns, J. Engelbrecht, V. Etyemezian, and G. Nikolich. 2012. Influence of Surface Roughness on Particle Deposition. Proceedings of Air & Waste Management Association (AWMA) 105^{th} - Annual Conference and Exhibition, San Antonio, Texas.

Malone, B. 2004. USING TREES TO REDUCE DUST AND ODOUR EMISSIONS FROM POULTRY FARMS. Proceedings 2004 Poultry Information Exchange., Surfers Paradise, Queensland, Australia. pp. 33-38. http://ag.udel.edu/rec/poultryextension/Vegetative%20Environmental%20Buffers/Using%20Trees%20for%20Dust%20and%20Odour%20Control%204_2004.pdf

Malone, G.W. and D. Donnelly. 2001. The benefits of planting trees around poultry farms. University of Delaware Extension Bulletin #159 (www.rec.udel.edu/poultry/publications).

Veranth, J.M., G. Seshadri, E. Pardyjak. 2003. Vehicle-Generated Fugitive Dust Transport: Analytic Models and Field Study, Atmos Environ. 37:2295-2303.

47. Volume 2, CR #1, Appendix A, Section A4.1, Page A22, Table A4-2

Table A4-2 cites an average NO_X emission factor for ANFO of 3.34 kg/ton. The source of this information was the Australian National Pollution Inventory document "Emission estimation technique manual for Explosives detonation and firing ranges." The current version (V. 3, 2012) cites an emission factor of 8 kg/tonne (same as US EPA AP-42) for ANFO mixed on site, with 6% fuel oil content. For branded mixtures of ANFO, it gives values of 1.4 and 3.8 kg/tonne. The branded ANFO products are named as Energen and Powergel. It also suggests an adjustment factor of 4 for each additional 1% of fuel added to the mixture, relative to the 6% normal. Thus, the emission factor for 7% ANFO mixed on site would be 32 g/kg, or about a factor of 10 higher than the value used for the proposed coal mine in the present case. Thus, the value of 3.4 kg/tonne appears to be a low-end value from among the wide range of possible emissions. Without more detailed info on the specific ANFO to be used, it would seem appropriate to use a higher end value of emission factor.

a. Provide details of the ANFO that the proponent expects to use, whether it is an on-site mix or a branded product, potential brands, and the upper bound of fuel oil content in the explosives mixture.

Response:

The NO_x emission factor was estimated as an average of all emission factors listed in NPI (2011) document (at the time of modelling, the 2012 version was not available). This factor (3.34 kg/t) is similar to the emission factor for branded ANFO < 152 mm (3.8 kg/t). The branded ANFO > 152 mm NO_x emission factor is considerably lower (1.4 kg/t). The average for heavy ANFO is also lower (2.0 kg/t).

The ANFO used at CVRI mines is an on-site mix with 6% fuel oil content. According to CVRI field experience, this is an optimum mixture, yielding minimum emissions. Rowland and Mainiero (2000) showed that ANFO with oil content lower and higher than 6% increased emissions of NO_2.

The ANFO used by CVRI is manufactured on site by a very experienced team. It is not the typical "on-site mix" referred by NPI (2012), where on site mixtures may vary in oil content. The ANFO mixture used by CVRI can be considered as "branded ANFO" in terms of quality and accuracy of preparation.

Nonetheless, the discussion below estimates how higher emission factors from other ANFO mixtures could influence the results of modelling. Blasting is part of normal mine operations and occurs every second day. In 2034 (Project Case No 1), there will be three mines active, each with blasting. For that reason blasting will occur at different mines. It can be at Robb Centre or Robb East instead at Robb West. Blasting would not occur at two mines on the same day.

In modelling, it was assumed that blasting occurred during one hour each day and does not interrupt other mine activities. In fact, pit activity will stop before, during, and after blasting for a period of time for safety reasons. Furthermore, CVRI estimates that, at Robb West where blasting was modelled (since Robb East is farther from the community of Robb), blasting may occur less than 80 hours each year.

It is prudent to analyze maximum hourly NO_2 predictions during blasting events compared to "normal" mine operations. ESRD Table 47-1 summarizes this comparison. The results from blasting only (last column of the table) were scaled from modelling results using an emission factor of 8 kg/tonne NO_x. Similarly the results obtained for blasting MPOI were scaled from modelling results and combined with results from the other sources in order to obtain Application and Planned Development Cases with higher emission factor. This estimate was provided only at regional and Robb area MPOIs.

Table 47-1 Predicted Nitrogen Dioxide Concentrations

Receptor Location	Baseline Case [μg/m^3]	CR#1 Table 5.2-1: Application and Planned Development Cases [μg/m^3]	Without Blasting Application and Planned Development Cases [μg/m^3]	Blasting at West Mine Only (3.34 kg/t factor) [μg/m^3]	Blasting at West Mine Only (8 kg/t factor) [μg/m^3]	Application and Planned Development Cases (8 kg/t factor) [μg/m^3]
Total Conversion Method						
9th highest 1-hour (99.9th Percentile)						
Overall Maximum (RSA-MPOI)	297	1506	831	1,248	2,981	3,034
Robb Area Maximum	165	1506	831	1,248	2,981	3,034
R1 – SE Robb	15	178	132	170	400	-
R2 – NW Robb	20	674	531	383	910	-
R3 – Robb - Denison Rd Intersection	12	47	46	33	72	-
R4 – Lund Rd @ Lendrum Creek	9.3	21	21	8	12	-
R5 – Halpenny Creek and Erith River	9.3	22	22	10	17	-
R6 – Former Coalspur Cabin	28	64	58	17	34	-
R7 – Mercoal	29	44	27	12	22	-
R8 – Oke	14	62	59	26	55	-

Table 47-1 Predicted Nitrogen Dioxide Concentrations

Receptor Location	Baseline Case [μg/m³]	CR#1 Table 5.2-1: Application and Planned Development Cases [μg/m³]	Without Blasting Application and Planned Development Cases [μg/m³]	Blasting at West Mine Only (3.34 kg/t factor) [μg/m³]	Blasting at West Mine Only (8 kg/t factor) [μg/m³]	Application and Planned Development Cases (8 kg/t factor) [μg/m³]
R9 – Embarras	15	24	23	10	17	-
R10– Steeper AQ Station	16	34	23	9	13	-
R11– Yellowhead Tower	50	65	44	39	85	-
R12– Lovett River Campground	24	46	46	8	11	-
R13– Lovett Tower	14	30	30	8	10	-
R14 - Campground	13	104	90	80	185	-
R15– Residence	12	169	142	113	262	-
R16– Cabin 1	12	156	155	26	56	-
R17– Cabin 2	15	35	35	8	10	-
R18– Fairfax Lake	8.5	18	17	9	15	-
ESRD AAAQO[(a)]	**300**	**300**	**300**	**300**	**300**	**300**
Ozone Limiting Method						
9th highest 1-hour (99.9th Percentile)						
Overall Maximum (RSA-MPOI)	142	261	193	235	408	413
Robb Area Maximum	128	261	193	235	408	413
R1 – SE Robb	15	128	123	127	150	-
R2 – NW Robb	20	177	163	148	201	-
R3 – Robb - Denison Rd Intersection	12	47	46	33	72	-
R4 – Lund Rd @ Lendrum Creek	9.3	21	21	8	12	-
R5 – Halpenny Creek and Erith River	9.3	22	22	10	17	-
R6 – Former Coalspur Cabin	28	64	64	58	99	-
R7 – Mercoal	29	44	44	30	43	-

Table 47-1 Predicted Nitrogen Dioxide Concentrations

Receptor Location	Baseline Case [µg/m³]	CR#1 Table 5.2-1: Application and Planned Development Cases [µg/m³]	Without Blasting Application and Planned Development Cases [µg/m³]	Blasting at West Mine Only (3.34 kg/t factor) [µg/m³]	Blasting at West Mine Only (8 kg/t factor) [µg/m³]	Application and Planned Development Cases (8 kg/t factor) [µg/m³]
R8 – Oke	14	62	59	26	55	-
R9 – Embarras	15	24	23	10	17	-
R10– Steeper AQ Station	16	34	23	9	13	-
R11– Yellowhead Tower	50	65	44	39	85	-
R12– Lovett River Campground	24	46	46	8	11	-
R13– Lovett Tower	14	30	30	8	10	-
R14 - Campground	13	104	90	80	127	-
R15– Residence	12	127	124	113	136	-
R16– Cabin 1	12	126	125	26	56	-
R17– Cabin 2	15	35	35	8	10	-
R18– Fairfax Lake	8.5	18	17	9	15	-
ESRD AAAQO[(a)]	**300**	**300**	**300**	**300**	**300**	**300**

[(a)] Source: AESRD (2011)

Results of NO_2 predictions at the maximum point of impingement for Application and Planned Development Cases and with the 8 kg/t emission factor blasting are similar to Blasting Only predictions (Blasting Only – 408 µg/m³ and Blasting with all other sources - 413 µg/m³).

Predictions above the ESRD AAAQO limit (300 µg/m³) were predicted for 8 hours during five years which is 0.4% of the time for the Application and Development case with blasting at 8 kg/t NO_x.

Since blasting occurs one hour each day and not every day, an increase in blasting emissions of NO_x from 3.34 kg/t to 8.0 kg/t will cause a small increase in annual predictions. Results of modeling show that the annual average maximum NO_x (and NO_2) prediction without blasting is 13 µg/m³ and the annual average maximum for blasting only is 10.7 µg/m³ (using 8 kg/t emission factor). Even these two maxima occur at the same place (they did not), the total maximum average annual NO_2 prediction remains smaller than the ESRD AAAQO of 45 µg/m³.

Thus, while the use of a larger emission factor for blasting increases NO_X concentrations, the increases are relatively small and would not change the conclusions of the assessment. CVRI considers its ANFO mix to be "branded ANFO" in terms of quality and accuracy of preparation and expects that potential deviations from the 6% oil content to be small.

References:

ESRD. 2011. Alberta Ambient Air Quality Objectives and Guidelines. Issued in June, 15 2011.

National Pollution Inventory (NPI). 2011 and 2012. Emission Estimation Technique Manual for Explosives Detonation and Firing Ranges Version 3.0; January 2011 and 2012.

Rowland J.H. and Mainiero R.J. 2000. Factors affecting ANFO fumes production. Proceedings of the 26th International Conference on Explosives and Blasting Technique, Anaheim, California.

48. Volume 2, CR #1, Appendix A, Table A4-1, Page A-21

The units are shown by CVRI as g/kWh, but the units in NONROAD documentation for these emission factors indicate the units are in g/hp-hr. (Exhaust and Crankcase Emission Factors Nonroad Engine Modelling – Compression-Ignition, U.S. EPA, 2010).

a. Verify that the correct units were used in the actual emission calculations.

Response:

The correct units were used, converted from g/hp-hr to g/kWh.

49. Volume 2, CR #1, Appendix A, Section A4.3, Page A-26, Table A4-8

Emissions of metals are an important calculation for input to the CALPUFF dispersion model. This section does not indicate the source of emission metal emission factors for the Dryer Stack cited in Table A4-8.

a. Provide a copy of the reference document, CVRI (2007).

Response:

Appendix A of CR #1 contained a reference error. The referenced document, CVRI (2007), was not the source of metals data for either dryer stack or metals in soil/overburden/rock/coal emissions. The metal emissions for the Dryer Stack were taken from AP42 Table 1.1-18 – emission factors for trace metals from controlled coal combustion (U.S. EPA, 1998). The metals data for soil was compiled from recent soil chemistry information during soil samples collected in 2007 and analyzed in 2008. The averaged laboratory analysis was used as metals data source. If all measurements for a given trace metal were below detection limit, the values used for air quality purposes was 1/3 of the detection limit. The soil chemistry information is summarized in CR #10, Table 9.

b. Provide the source of that information and a sample hand calculation showing how the metal emission factors were scaled by the $PM_{2.5}$ emissions.

Response:

The source of that information is provided in the response to ESRD SIR #49a).

As an example of metal emission calculation for stack emission, the stack emission factor for antimony was listed in AP42 Table 1.1-18 as 1.8E-05 lb/ton. Using the conversion factor (1 lb/ton = 0.5 kg/tonne), the emission factor was expressed as 9.0E-06 kg/t. Assuming that 2% of the daily clean coal production is used as fuel in the dryer (200.9 t/day of coal), the emission of antimony from the stack was estimated to be 1.81 g/day.

As an example of the metal emissions calculation for soil emissions, the total annual average TSP emission from haul roads, waste dumps, plant and mine operations (excluding exhaust particulate emissions) was estimated at 9.39 t/day. Daily emissions of barium, related to dust emissions, presented in Table 4.1-18 (CR #1), were calculated as follows:

Barium in Dust = 1.59E-04 g/g * 9.39E+06 g/day = 1,493 g/day

where: 1.59E-04 g/g is the barium content in overburden (Table A4.8, Appendix A in CR #1).

Reference:

U.S. EPA. 1998. *Compilation of Air Pollutant Emission Factors: Volume I Stationary Point and Area Sources - External Combustion Sources*. Part 1.1 Bituminous And Subbituminous Coal Combustion , Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

50. Volume 2, CR #1, Appendix C, Page C-7
Volume 2, CR #1, Section 3.1, Table 3.1-2, Page 19

CVRI states (Page C-7) that *in accordance with AEW (2009a) for a detailed assessment, 90^{th} percentile hourly and daily and annual average measurements are added to model predictions*. The cited Air Quality Model Guideline allows two interpretations for the calculation of background concentrations for 1-hour and 24-hour background concentrations: 1) use the same 90th percentile of 1-hour average concentrations; or 2) use the 90th percentile of 1-hour averages and the 90th percentile 24-hour averages, respectively.

The quoted sentence suggests that the report followed the second approach. However, Table 3.1-2 (Page 19) shows identical values for hourly and 24-hour background concentrations for all four pollutants for which 24-hour AAAQO exist. This is unlikely if the second approach was used.

a. Confirm the calculated values are correct as reported.

Response:

Conservatively, the 90th percentile 1-hour averages from measurements were used as hourly and daily background.

51. Volume 2, CR #1, Appendix C, Pages C-23 and C-24, Figures C3-8 and C3-9

CVRI has summarized the background ambient concentrations of PM10 measured at several regional stations.

a. Why are diurnal and seasonal cycles at Hinton and Steeper so different?

Response:

The Hinton station is located within the Athabasca River about 2.3 km from the Hinton pulp mill (475 kg/day of PM_{10}) which is also located within the valley. Steeper is about 1.2 km from an unpaved stretch of Highway 40 west of Coalspur. Hightower Ridge is about 1.2 km from paved Highway 40 (between Hinton and Grande Prairie).

ESRD Figure 51-1 shows that maximum 1-hour measurements are higher in Hinton than in Steeper. Maximum measurements are highest during daylight hours at Steeper and lowest during daylight hours at Hightower Ridge. No trend in median measurements is evident at Steeper while median measurements at Hightower Ridge are highest in early morning and late evening.

Maximum concentrations at Steeper are determined by forest fires that occurred on August 28, 2009, as shown in ESRD Figure 51-2. Similarly, maximum concentrations at Hightower Ridge were recorded on July 29, 2004. The diurnal variation of the maximum hourly observations would be determined by the fire activity on fire days to which CVRI does not have access. Other local emission sources contributing to non-peak measurements at Steeper include road dust and agricultural activities, most of which would occur in daylight hours.

Maximum 1-hour concentrations in Hinton are not determined by forest fires as shown in ESRD Figure 51-2 where high concentrations occur in all months of the year. Maximum concentrations in Hinton are largely a result of the location of the station in the river valley which contains major particulate sources and is subject to a high frequency of calms and inversions. According to ESRD Figure 51-3, winds at Hinton are very light in all but afternoon hours. The combination of calm winds and night-time valley inversions create an opportunity for accumulation of emission within the valley walls. Lower daytime concentrations are the result of dilution by higher wind speeds (CASA, 2011).

Particulate measurements at Steeper were used to calculate background values.

b. Provide a similar figure for the Hightower Ridge station.

Response:

Diurnal and seasonal cycles of PM_{10} at Hightower Ridge are presented in ESRD Figures 51-1 and 51-2, respectively. Hightower Ridge is located about 1.2 km from paved Highway 40.

The measurements of PM_{10} at Hightower Ridge appear to be unaffected by forest fire activity during the period of data that can influence the highest concentrations. The station is located on a ridge distant from the nearest industrial and agricultural particulate sources. Maximum concentrations are lower during night-time hours, but the magnitude of the diurnal variation is small. The magnitude of the seasonal variation is also small, with higher values in summer months.

Reference:

CASA (Clean Air Strategic Alliance). *Data Warehouse.* http://www.casadata.org/Reports/SelectCategory.asp Accessed April 2011.

52. Volume 2, CR #1, Appendix C, Page C-25

CVRI has summarized the background ambient concentrations of ozone measured at several regional stations.

a. Explain why observations at Hightower Ridge are consistently higher than at Steeper in every hour of day and every month of the year.

Response:

Altshuller (1986) indicated ground-level concentrations of ozone can be influenced by:

- downward transport of stratospheric ozone;
- photochemical formation within a pristine troposphere;
- photochemical formation within a polluted troposphere especially during passage of warm high pressure systems; and
- ozone formation within plumes.

Ground-level ozone concentrations are determined by formation, destruction and transport processes. Lefohn *et al.* (1990) reported ozone values at relatively pristine locations.

Ozone and precursor values for Alberta are summarized in a large number of publications, for example, Angle and Sandhu (1986 and 1989). The observations generally indicate elevated stations have higher ground-level concentrations and show little diurnal variation (Angle and Sandhu 1986, Legge and Krupa 1990);

The Hightower Ridge is at slightly higher elevation in the foothills and is located in a more pristine area, northwest of Steeper. It may be that elevation and latitude is a partial answer to the question of why Hightower values are consistently higher than Steeper values.

However, it is most likely that the period of data is the cause of the consistent results, as they are not the same at the two stations. CVRI briefly reviewed the 2009 West Central Airshed Society annual report (http://wcas.ca/documents/WCAS_AR_2009.pdf). That document indicated that monthly maximum and average concentrations were higher at Steeper than at Hightower in a small number of months in the year. It also indicated that maximum Genesee station values were the highest recorded in summer, substantially higher than Hightower values, while Hightower values were higher in most other months. Thus, in direct comparisons, Hightower concentrations are not consistently higher than at other stations.

References:

Altshuller, A.P., 1986. The role of nitrogen oxides in non-urban ozone formation in the planetary boundary layer over North America, western Europe and adjacent areas of ocean. *Atmospheric Environment* 20:245268.

Angle, R.P. and H.S. Sandhu, 1986. Rural ozone concentrations in Alberta, Canada. *Atmospheric Environment* 20: 12211228.

Angle, R.P. and H.S. Sandhu, 1989. Urban and rural ozone concentrations in Alberta, Canada. *Atmospheric Environment* 23: 215221.

Leforn, A.S., S.V. Krupa and D. Winstanley, 1990. Surface ozone exposures measured at clean locations around the world. *Environmental Pollution* 63:189224.

Legge, A.H. and S.V. Krupa (eds.), 1990. Acid Deposition: Sulphur and Nitrogen Oxides. The Alberta Government-Industry Acid Deposition Research Program (ADRO). Ann Arbor, MI: Lewis Publishers.

53. Volume 2, CR #1, Appendix C, Page C-26, Figure C3-10
CVRI has summarized the background ambient concentrations of ozone measured at several regional stations.

a. What is the reason for the unusual behaviour for the ozone concentrations in the fourth hour of the day at both stations?

Response:

In the fourth hour of the day at all stations there are no measurements recorded due to calibration (zero-span) of the instrument.

54. Volume 2, CR #1, Appendix C, Page C-33, Figure C4-1
CVRI has summarized the wind climate statistics from several regional stations. These data are important to help assess the dispersion potential.

a. What are the percentages of calms for the Edson, Hinton and Hightower Ridge Stations?

Response:

Percentage of calm winds (from Figure C4-1 of Appendix C):

- Edson – 6.8%,
- Hinton - 43.9%
- Hightower Ridge – 2.4%

b. Why are the calms so high for the Coal Valley Mine office?

Response:

The high percentage of calms (39%) for the Coal Valley office may be result of the siting of this station on the roof of the plant office, or of its later location on the lawn outside the office (ESRD Photo 54-1). CVRI believes the data collected at the plant site are not of sufficient quality to include in dispersion modelling for the following reasons:

- The height of the station (< 1.5 m, see ESRD Photo 54-1) is below the standard height of 10 m and measurements would need to be adjusted upward to be compared to WCAS station data collected at 10 m..
- The monitor is located immediately adjacent to a tree and the site may not meet the standard ESRD siting criteria (Alberta Environment 1989). The tree would likely also reduce recorded wind speeds and the frequency of winds from its direction.

- The instrument is a Vantage Pro2 produced by Davis Instruments with fairly standard specifications: range from 1 m/s to 80 m/s, nominal accuracy +/- 1 m/s, and resolution 0.4 m/s (http://www.davisnet.com/product_documents/weather/manuals/07395-234_IM_06312.pdf). The stall speed of the instrument is not known.

The placement of the station and the quality of the wind speed instrument likely explain the high percentage of calms measured at the CVM office station.

ESRD Photo 54-1 Wind Sensor Siting at the CVRI Coal Processing Plant

c. What was the wind sensor height above grade at the Coal Valley Mine office?

Response:

The wind sensor was first placed on the top of the office building roof, about 10 m above ground level, then moved to the lawn in front of the office where the height is less than 1.5 m. The CVM office is located in a broad treed valley about 10 km wide (ESRD Photo 54-2).

ESRD Photo 54-2 Aerial Photograph of the Coal Processing Plant and the Office/Shop Complex

d. Are these high percentages of calms representative of Project site conditions, as they suggest higher than expected frequency of poor dispersion conditions?

Response:

As indicated in the responses to ESRD SIR #54b) and c) above, CVRI believes the data collected at the plant site are not of sufficient quality to include in dispersion modelling and because of their location on the roof atop the office and on the front lawn are not representative of conditions in the proposed mining area 22 km from the Plant.

ESRD Figure 54-1 shows the observed wind rose at the Suncor Hanlan Robb Gas Plant which is considered to be a better sited station. The frequency of calms is less than 1%. Furthermore, the CALMET windrose at the location of the gas plant agrees well with observations, with a calm frequency of less than 3%.

ESRD Figure 54-1 also compares wind roses at the CVRI Plant with those obtained from CALMET. The gaps in some wind directions in the observed data suggest siting of the monitoring station is less than optimum.

Reference:

Alberta Environment 1989. Air Monitoring Directive, Monitoring Division, June 1989. Appendix A-1: Standard site criteria.

55. Volume 2, CR #1, Appendix C, Page C-33, Figure C4-3

CVRI has summarized the wind climate statistics from several regional stations. These data are important to help assess the dispersion potential.

a. Why are the measured calms so high at the Hinton (69%) and Steeper (55%) stations?

Response:

The scope of the Project does not allow a detailed analysis (and QA/QC) of the wind speed measurements at WCAS stations. Nonetheless, the Wagoner station which is located in the North Saskatchewan River valley has a similarly high number of calms. Hinton is located in the Athabasca River valley and it is likely the sheltering effect of the valley contributes to the high frequency of calms. While the station is also proximate to forest on some sides (see ESRD Photos 55-1 to 55-5 from WCAS 2008), it is not clear the extent to which the local siting influences wind speeds.

Steeper is located in the foothills south of Hinton and it is likely its location is also sheltered as a result.

ESRD Photo 55-1 View from the station facing North

ESRD Photo 55-2 View from the station facing West

ESRD Photo 55-3 View from the station facing South

ESRD Photo 55-4 View from the station facing East

ESRD Photo 55-5 Monitoring trailer from the south

Reference:

West Central Airshed Society. 2008 – Station 906: Hinton Site Documentation

56. Volume 2, CR #1, Appendix C, Pages C-41 and C-42, Figure C4-6
CVRI has summarized ambient temperature statistics from several regional stations:

a. The caption states that the data sources are CASA 2011 and CVRI 2011. Was the data for Edson not taken from Environment Canada? If not, explain why, because for comparison with the climate normals for Edson, one should use the same station.

Response:

The CASA website was the source of meteorological data in the assessment as it provided information for several regional stations. Thus, for consistency, this information was provided along with climate normals. The assessment does not rely on either set of meteorological data which were presented for comparison purposes.

b. Confirm that the figure panels and underlying data have been fully confirmed (given that there appear to be a number of unlikely temperatures), or otherwise review and update. For example, see:
   i. Comparison with Edson's climate data make it appear unlikely that a minimum temperature of less than -30 degrees Celsius occurred in June. Hinton, which covers the same period, shows an expected minimum temperature above -10 degrees.
   ii. A maximum temperature of almost 30 degrees in January on Hightower Ridge, was not confirmed at any of the other locations.
   iii. A minimum temperature below -40 degrees in September in Edson and Hightower Ridge is not in agreement with Hinton's minimum temperature above -10 degrees, which is more in agreement with Edson's September minimum temperature of -11.4 degrees over the climate normals period.

Response:

The scope of the Project did not allow analysis (and QA/QC) of the meteorological and air quality at WCAS stations. Nonetheless, there are a number of questionable data points, including those identified by the reviewer. In our report, we have simply restated the data from the CASA data warehouse for parameters that were not critical to the assessments. This includes all meteorological data which are presented for comparison only, as MM5 data were used as input to the CALMET model. Where data were used in the assessment (*e.g.*, as part of background air quality estimation), more care was taken in data review.

Data posted to the CASA data warehouse are quality-checked prior to being uploaded, using the general approach in ESRD Figure 56-1. Typically, data that are not demonstrated by WCAS QA/QC staff to be in error are considered to be acceptable.

Corrections to meteorological measurements will not change the assessment conclusions.

Reference:

Clean Air Strategic Alliance (CASA) 2009 Ambient Air Monitoring Strategy for Alberta, A Report to the CASA Board from the AMSP Project Team, September, 2009 (http://casahome.org/DesktopModules/Bring2mind/DMX/Download.aspx?Command=Core_Download&EntryId=187&PortalId=0&TabId=78)

57. Volume 2, CR #1, Appendix C, Section C5.0, Page C-53

CVRI states that measurements at the Hightower Ridge station are representative of background concentrations.

a. Why was the Hightower Ridge station not used to determine PM background concentration, in lieu of using data from Steeper, which is within the RSA?

Response:

There were several reasons for choice of the most representative station for background particulate. ESRD Figure 17-1 (in the response to SIR #17) shows station locations. Neither station has a particularly long period of unbroken measurements as station operations were interrupted and technology changes were made in the last decade.

PM_{10} measurements at Hightower Ridge were made from June10, 1999 to September 30, 2004. The station re-started operations in December 2007 with but with $PM_{2.5}$. Steeper measured PM_{10} from June 2009 to July 2010. $PM_{2.5}$ measurements began in August 2010.

Hourly 90th percentile PM_{10} and $PM_{2.5}$ measurements were higher at Steeper. Hightower Ridge PM_{10} = 14 µg/m^3; $PM_{2.5}$ = 6.4 µg/m^3, Steeper PM_{10} = 16 µg/m^3; $PM_{2.5}$ = 5.0 µg/m^3. Thus the use of Steeper measurements results in a more conservative assessment.

58. Volume 2, CR #1, Appendix C, Page C-15

CVRI states that there were no $PM_{2.5}$ measurements at Hinton, but there are data summarized in Table C3-5.

a. Which of these is correct?

Response:

The statement in the report was in error. The $PM_{2.5}$ measurements began in February 2010.

b. It seems highly unlikely that Edson, Hinton, and Steeper all had the same maximum 1-hour maximum concentration. Confirm these data or otherwise correct.

Response:

The measurements (all are 451 µg/m^3) appear to be correct, or at least correctly reflect the data recorded in the CASA data warehouse. All were measured during forest fires in August 2010. At Hightower, the maximum was recorded on August 19, 2010 at hours 13:00 and 14:00, at Edson from 13:00 to 15:00 and at Steeper from 18:00 to 21:00.

59. Volume 2, CR #1, Section A4.4-1, Page A-27
CVRI has identified, calculated and summarized expected GHG emissions.

a. Confirm that GHG emissions are accounted for from all transportation emission sources such as trains, etc.

Response:

Emissions of transport equipment operated by the CVRI, such as haul trucks, have been included in GHG emission estimates. This has been done even though the Project emissions are not "new" per se, as the mining activity in the Project is a continuation of mining activity currently conducted in nearby pits.

Locomotives are part of Baseline activities. GHG emissions have been estimated only for Project sources.

60. Volume 2, CR #1, Section B1.0, Page B-1
The Air Quality Model Guideline requires that specific versions of meteorological and dispersion models are used. The versions of CALMET and CALPUFF used for the study are not cited.

a. Provide the versions of the models used and the justification for choosing them.

Response:

Modelling used CALMET version 6.328 and CALPUFF version 6.269.

These versions of the models are not yet approved by the U.S. Environmental Protection Agency. However, the approved CALPUFF version 5.8 has known errors in the code, which have been addressed in Version 6. Version 6 is recommended by model developers (Scire and Robe, 2012).

Reference:

Scire, J. and F. Robe. 2012. CALPUFF Training Course, Canadian Prairie and Northern Section of the Air and Waste Management Association, Edmonton, Alberta.

61. Volume 2, CR #1, Section B2.1, Page B-1

Selection of the appropriate model parameters are based on decisions with respect to selecting recommended default values and best engineering judgement. A horizontal grid size of 1000 m for CALMET was used by CVRI. CVRI states that *This grid size was chosen to capture major terrain feature influences on wind flow patterns in the area.*

a. Explain, in terms of scale of variation of terrain and land use in the study area, as to why the chosen horizontal grid size is sufficient.

Response:

The terrain around the Project is complex with hills and valleys tens of metres deep. On a larger scale, the terrain rises to the foothills of the Rockies in the southwestern part of the RSA.

ESRD Figure 61-1 shows terrain features in the area and their scale varies. The major features on the landscape are several valley systems. The valley within which the Plant is located is about 10 km from peak to peak of the terrain elevation. The valley in which Highway 47 is located (connecting the communities of Robb and Coalspur) and the valley southwest of the processing plant valley are about 7 to 8 km wide (peak to peak). A grid spacing of 1000 m approximates the 5 to 10 CALMET grid cells within these valleys to resolve terrain features (Section 2.1.4 in Frequently Asked Questions: http://www.src.com/calpuff/FAQ-answers.htm).

Furthermore, ESRD Figures 61-2 and 61-3 show that changing the CALMET grid spacing from 500 m to 1 km does not cause material changes in terrain. In particular, the differences around the West Mine and community of Robb are minor.

In terms of land use, 88% of the land in the RSA is forest which is distributed over the landscape as shown in ESRD Figure 61-4. The size of the land use features varies from 1 to 5 km, which corresponds to a maximum of five model grid lengths. The area around the West Mine is homogeneously forested and therefore the impact of variations in grid size is negligible.

To test the effect of model grid spacing prior to the conduct of modelling, CALMET was run with grid spacings of 500 m and 1000 m. The surface layer wind roses (ESRD Figures 61-5 and 61-6) were similar and appear to be relatively insensitive to grid spacing in the 500 m to 1000 m range. Similar results were found at other locations (Robb Main, Robb East, and Robb Centre).

Considering the scale of land use and terrain variations, the choice of grid size is reasonable for this application.

62. Volume 2, CR #1, Section B2.1, Page B-2
Volume 2, CR #1, Section C4.0, Page C-32

CVRI indicates that only meteorological data from MM5 were used and *No surface stations were used as there are none in the RSA.* Hourly observations from the Steeper and Coal Valley Mine Office were summarized and presented in Section 4.0 and both stations are located in the RSA.

a. Clarify why hourly observations from these two stations were summarised in the climate analysis but not used in the CALMET model.

Response:

The two stations (Steeper and Coal Valley Office) have characteristics that make them undesirable to include in modelling:

- both are in complex terrain and relatively far from Robb West (13 km and 22 km, for Steeper and the Plant, respectively);
- steeper ended the recording of meteorological data in August 2003, partway through the 2002-2006 modelling period;
- given the monitoring location on a rooftop at the plant, data from CVRI are considered less desirable for modelling purposes. The station was moved from the rooftop to the lawn in front of the building at some point during the period of measurement; and
- neither station has all parameters required by CALMET.

Studies conducted by the University of Washington (2005) show that the MM5 model is an effective tool for characterizing winds in the Pacific Northwest. It also suggested that CALMET could be run exclusively with MM5 data and that MM5 data were important in dispersion modeling, providing information throughout the modelling domain and in regions where measurements are not readily accessible. In other CALPUFF 3-D modelling studies completed in western Canada (*e.g.*, BC Environment 2000), MM5 data were used exclusively when generating CALMET 3-D data.

Alberta Air Quality Modelling Guidelines (ERSD, 2009) note that they developed MM5 data for the whole province, and that a 5-year period is to be used for refined modelling.

Guidelines for Air Quality Dispersion Modelling in British Columbia (BC, 2008), lists many advantages for using MM5 data in modelling that also apply to the Project:

- provides data for any location (avoiding the cost to set up a new meteorological station)

- in hindcast mode (where past conditions are generated), can take less time to generate a data set than a monitoring program (in forecast mode, it takes the same time)
- avoids subjective decisions regarding the use of quasi-representative meteorological data (for example, adjusting/rotating winds to account for different terrain orientations)
- provides details of the space and time variability of the meteorology in three dimensions within a modelling domain, especially important for B.C. given the complex geophysical setting.

References:

AESRD. 2009. Air quality model guideline. Prepared by A. Idriss and F. Spurrell, Climate Change, Air and Land Policy Branch. (http://www.bcairquality.ca/reports/pdfs/air_disp_model_08.pdf). 44 pp.

British Columbia Ministry of Environment, Lands and Parks (BC Environment). 2000. Submission by BC Environment to Washington State Energy Facility Site Evaluation Council Regarding the Proposed Sumas Energy Project. Victoria, BC.

B.C. Environment (British Columbia Ministry of the Environment). 2008. Guidelines for Air Quality Dispersion Modelling in British Columbia (*http://www.bcairquality.ca/reports/pdfs/air_disp_model_08.pdf*). 139 pp.

University of Washington. 2005. Pacific Northwest MM5 Verification Statistics. Available at: (http://www.atmos.washington.edu/mm5rt/verify.html).

63. Volume 2, CR #1, Section B2.2, Page B-2

Selection of the appropriate model parameters are based on decisions with respect to selecting recommended default values and best engineering judgement. The radius of influence for surface and upper air and vertical extrapolation of surface winds are discussed by CVRI, but it is stated that MM5 are the only input data for CALMET, which would render these options irrelevant.

a. Clarify why these options are included in the discussion, if only MM5 data were used.

Response:

The radius of influence is in the input file. However, when MM5 data are used to the exclusion of other observations, this parameter is ignored in modelling. The reviewer is correct in that the options need not have been discussed.

64. Volume 2, CR #1, Section B2.2, Page B-2, Table B2-1

Selection of the appropriate model parameters are based on decisions with respect to selecting recommended default values and best engineering judgement. The radius of influence for terrain influences, TERRAD, was chosen as 1 km by CVRI. According to CALMET guidance from SRC in the link below, *Odds are TERRAD is going to be of order 5 to 10 grid lengths expressed in km*. For the chosen horizontal grid resolution of 1 km, guidance suggests that TERRAD should be on the order of 5 to 10 km.

http://www.src.com/calpuff/FAQ-answers.htm#2.7.1

a. Explain the choice of 1 km for the TERRAD parameter.

Response:

TERRAD is the distance CALMET considers in computing terrain effects. For instance, the terrain slope is needed to compute the slope flow. If TERRAD is too small, then the nearby valley wall will not be seen. If TERRAD is too large, then the hill several valleys away are considered, instead of those nearby.

Terrain is plotted in ERSD Figure 61-1. The width of the various valleys (peak to peak ranges up from about 6 km. Of specific importance is the gap in the hills near the community of Robb, where the peak to peak distance is about 7 km. The width of the valley in which the coal processing plant is located is about 10 km. These distance scales suggest the TERRAD parameter should be no more than 6 km and perhaps less than 5 km to provide resolution near Robb.

ESRD Figure 64-1 shows wind roses obtained at the Suncor Hanlan Robb Gas Plant location based on measurements and from CALMET with TERRAD values of 1 km and 15 km. The wind rose obtained for TERRAD = 1 km is much closer to the observed wind rose than the wind rose obtained for TERRAD = 15 km. The latter has prevailing southwesterly winds, which is not supported by observations. Therefore, at this location, a TERRAD value of 1 km better reflects winds than a value of 15 km.

Winds generated using the 1 km and 15 km TERRAD parameters were compared at pit locations within the Mine. The wind rose for the Robb East pit location from CALMET with TERRAD = 15 km has prevailing southwesterly winds, whereas winds for TERRAD = 1 km are more broadly from the western sector (ESRD Figure 64-2). The wind roses at the community of Robb obtained for TERRAD = 15 km and 1 km are similar (ESRD Figure 64-2). The wind roses at obtained at Robb Main and Robb Center pits are also similar for TERRAD 15 and 1 km (ESRD Figure 64-3).

65. Volume 2, CR #1, Section B2.2, Page B-2
Volume 2, CR #1, Section B2.3, Page B-2

Selection of the appropriate model parameters are based on decisions with respect to selecting recommended default values and best engineering judgement. CVRI states that *Hourly surface heat fluxes, as well as the observed morning and afternoon temperature soundings, were used to calculate mixing heights*. However, in Section B-2, it was stated that MM5 was the only input to CALMET.

a. Provide an explanation regarding this discrepancy.

Response:

There is no discrepancy. The CALMET model was used in no-observations mode, as the MM5 dataset was the only source of meteorological information.

Mixing heights are one of the outputs accessible from CALMET. CALMET uses MM5 information, which is based on upper air and surface observations, to determine the parameters used to calculate mixing height.

66. Volume 2, CR #1, Section B2.3, Page B-2

Selection of the appropriate model parameters are based on decisions with respect to selecting recommended default values and best engineering judgement. CVRI states that *The inverse distance-squared method, which was recommended by Dean and Snyder (1977) and Weiand McGuinness (1976), was used to interpolate air temperature, with a radius of influence of 500 km*. However, in the model options given in Table B2-4, ITPROG is given as 2, which would indicate that MM5 data was used for temperature.

a. Clarify which method was used.

Response:

MM5 meteorology was used, with ITPROG = 2.

67. Volume 2, CR #1, Section B4.0, Page B-16

Selection of the appropriate model parameters are based on decisions with respect to selecting recommended default values and best engineering judgement. Table B4-9 and Table B4-1 provide the dry and wet deposition parameters used for the study, respectively.

a. Provide a reference for these selections.

Response:

The only non-default parameters relating to deposition are listed in Tables B4-8 and B4-10.

All dry deposition parameters used in modelling and listed in Table B4-7 are also defaults. It includes default parameters for NO and CO, which were missing in Table B4-7. For that reason Table B4-7 in Appendix B (CR #1) should be corrected as follows (Listed as ESRD Table 67-1 (the previously missed parameters are expressed in bold):

Table 67-1 (Revised Table B4-7) Dry Deposition Parameters for Gases (Input Group 7)

Species	Default	Current	Description
SO_2	0.1509	0.1509	Diffusivity (cm^2/s)
	10000.0	1000.0	Alpha star
	8.0	8.0	Reactivity
	0.0	0.0	Mesophyll resistance (s/cm)
	0.4	0.04	Henry's Law coefficient
NO	**0.1345**	0.1345	Diffusivity (cm^2/s)
	1.0	1.0	Alpha star
	2.0	2.0	Reactivity
	25.0	25.0	Mesophyll resistance (s/cm)
	18.0	18.0	Henry's Law coefficient
NO_2	0.1656	0.1656	Diffusivity (cm^2/s)
	1.0	1.0	Alpha star
	8.0	8.0	Reactivity
	5.0	5.0	Mesophyll resistance (s/cm)
	3.5	3.5	Henry's Law coefficient
HNO_3	0.1628	0.1628	Diffusivity (cm^2/s)
	1.0	1.0	Alpha star
	18.0	18.0	Reactivity
	0.0	0.0	Mesophyll resistance (s/cm)
	0.00000008	0.0000001	Henry's Law coefficient
CO	**0.186**	0.186	Diffusivity (cm^2/s)
	1.0	1.0	Alpha star
	2.0	2.0	Reactivity
	61.0	61.0	Mesophyll resistance (s/cm)
	44.0	44.0	Henry's Law coefficient

Table B4-8 summarizes dry deposition parameters. The only non-default values there are particulate sizes, and the rationale from Watson and Chow (2000) follows. The particulate sizes of used in modelling fractions for $PM_{2.5}$, PM_{10}, and TSP were picked using ESRD Figure 67-1. CALPUFF has default values for the $PM_{2.5}$ range of 0.56 µm, 0.81 µm, 1.12 µm, and 1.87 µm. According to the figure, the smallest fraction is centred near 0.05 µm. The second peak is captured by 0.25 µm fraction. This approach provides particulate distributions that more closely reflect observations for dispersion modelling and for emission estimation (Table A3-5 – with size dependent escape fractions).

The wet deposition parameters from Table B4-10 were extrapolated from default values to the size fractions used in the CALPUFF model.

Reference:

Watson J.G. and Chow J.C. 2000. Reconciling Urban Fugitive Dust Emissions Inventory and Ambient Source Contribution Estimates: Summary of Current Knowledge and Needed Research. DRI Document No. 6110.4F; May 2000.

68. Volume 2, CR #1, Section B4.0, Page B-17

Selection of the appropriate model parameters are based on decisions with respect to selecting recommended default values and best engineering judgement. In Table B4-11, monthly background ozone and ammonia concentrations are selected as 12*23, and 12*0.22, respectively.

a. Explain how these values were chosen and provide references.

Response:

Ozone

Appendix B, Table B4-11 of CR #1 contained a typographical error as it showed that a constant value of 23 ppb was used for ozone background in the assessment. In fact, monthly average ozone concentrations measured in Steeper (March 2009 to December 2010) were used in CALPUFF (data from CASA, 2011). Since there were gaps in ozone measurements, it was not possible to use hourly ozone data in modeling.

The Hightower Ridge station is at 1,525 m asl elevation and Steeper station is at 1,440 m asl level, whereas Robb Trend mines and Plant and the community of Robb are at 1,100 to 1,300 m asl. For that reason, Steeper measurements were considered more appropriate to use in modelling. The Hightower and Steeper ozone annual average concentrations were 43 and 38 ppb, respectively.

ESRD Table 68-1 compares measurements at Steeper and Hightower Ridge. For this comparison, monthly average concentrations were calculated from measurements at Hightower

Ridge from January to December 2004, and from December 2007 to December 2010 (using data from CASA, 2011). Monthly average concentrations were higher at Hightower Ridge than at Steeper in every month, possibly as a result of Hightower Ridge's higher elevation.

In CALPUFF, ozone input serves as a surrogate for the hydroxyl radical. Lower ozone concentrations result in decreased production of the hydroxyl radical which is involved in the non-linear formation of sulphate and nitrate. As the concentrations of NO_2 and SO_2 vary regionally, the impact of the use of monthly average ozone in the model (instead of hourly values which can be lower or higher than monthly averages) may also vary spatially. Lower ozone values may have slightly over-predicted SO_2 and NO_x and slightly under predicted secondary particulate formation which is accounted in $PM_{2.5}$ predictions.

Ammonia

Ammonia is not widely monitored in Alberta. It is monitored in Lethbridge due mainly to the presence of nearby large-scale cattle confined feeding operations. It is also monitored by the Fort Air Partnership at the Fort Saskatchewan, Range Road 220, Ross Creek, Station 401, and Redwater Industrial stations however it is a substance of interest in that Airshed because of the fertilizer production industry. It is also measured in the oilsands. Most measurements in Alberta have been made in the Fort Saskatchewan area where the town-site station annual average concentration is about 3 ppb and the 90^{th} percentile hourly concentration is 6 ppb (data from January 1, 2000 to May 31, 2012) (CASA 2012). However, there are major ammonia emitting industrial sources in the region (NPRI, 2010). To CVRI's knowledge, there are no ammonia measurements in the modelling area.

PASZA (2011) measured ammonia for one year in the Girouxville area. For over 93% of the study, ammonia concentrations were at or below the detection limit of the instrument (1 ppb). Seasonal variations were due to local sources such as manure spreading.

The annual average concentration of ammonia in Fort McKay station, north of Fort McMurray are around 0.22 ppb, and this value was used in modelling. It appears to be reasonable compared to the PAZA measurements but lower than those in Fort Saskatchewan. The result of lower ammonia values in model chemistry would be the preferable formation of the NO_3 ion and lower production of the SO_4 ion, which may cause slightly higher SO_2 predictions and slightly lower NO_2 predictions.

Since predicted acid deposition is small, the choice of ozone and ammonia background values will have little effect on this parameter.

Table 68-1 Ozone Monthly Average Measurements at Hightower Ridge and Steeper (Used in Assessment)

Month	Hightower Ridge (ppb)	Steeper (ppb)
January	44	35
February	49	42
March	53	45
April	57	52
May	52	46
June	42	39
July	34	30
August	36	31
September	34	30
October	38	31
November	43	39
December	40	36
Annual Average	43	38

References:

CASA (Clean Air Strategic Alliance). *Data Warehouse.* http://www.casadata.org/Reports/SelectCategory.asp Accessed April 2011.

CASA (Clean Air Strategic Alliance). *Data Warehouse.* http://www.casadata.org/Reports/SelectCategory.asp Accessed September 2012.

NPRI (National Pollutant Release Inventory). (e.g. Agrium Inc. Fort Saskatchewan Nitrogen Operations:http://www.ec.gc.ca/pdb/websol/querysite/facility_substance_summary_e.cfm ?opt_npri_id=0000004874&opt_report_year=2010) Accessed September 2012.

Peace River Airshed Zone (PASZA). 2011. Girouxville Area Ambient Air Quality Monitoring Summary Report. 27 pp.

69. Volume 2, CR #1, Section C4.4, Page C-46

Selection of the appropriate model parameters are based on decisions with respect to selecting recommended default values and best engineering judgement. CVRI states that *Mixing heights are not explicitly used as inputs to the CALPUFF model*. However, CVRI states, in Section B2.1, Page B-1, that *the [CALMET] overland boundary layer module computes gridded fields of surface friction velocity, convective velocity scale,* *Monin-Obukhov length, mixing height, Pasquill-Gifford stability class, air temperature, and precipitation rate.*

a. Explain the discrepancy between the two statements.

Response:

There is no discrepancy, as both are correct. These parameters are part of the binary CALMET output file which is input to the CALPUFF model. To obtain explicit values for mixing heights, the post-processor PRTMET must be run.

5. WATER

5.1 Hydrogeology

70. Volume 2, CR #3, Section 2.3.4, Page 14

In Section 2.3.4 (Page 14), CVRI indicates that pumping rates to dewater the mine for coal extraction have been observed at the Coal Valley Mine to range from 330 to 12,000 m^3/ day, based on previous coal mining operations to the west.

a. Provide a numerical groundwater model for the Rob Trend Project site, including adjacent areas as appropriate, illustrating the baseline hydrogeological conditions. The modeling should follow guidelines published by the American Society for Testing and Materials (ASTM).

Response:

CVRI believes that the Application has satisfied the Terms of Reference (TOR) for the Project. With regard to methodology for hydrogeologic impact assessment, CVRI has chosen to use the substantial volume of hydrogeological information collected over the course of mining in the precisely similar hydrogeological regimes as evidence of the probability and nature of impact. This substantial body of knowledge is more valid as a predictor of future impacts in the Project than any computer model.

The Project Application has identified one particular area of future assessment where the presence of the underground mines near Robb exceeds the past experience of the CVM.

b. Provide site specific hydrogeological data and analysis, taking into account the variability in hydrogeological parameters, to quantify the amounts of water that are anticipated to be required to be removed during mining operations. For this assessment, use the numerical model generated in a) to confirm the predicted drawdown. Provide an analysis of potential error in the prediction.

Response:

Site-specific data have been provided in CR #3 Appendix C.

The potential impact of surface water diverted by groundwater diversions to accommodate mining operations are discussed in CR #6, Section 4.2.4 and CR #3. The application has outlined that any diverted groundwater will be released into adjacent watercourses therefore the impact has been demonstrated to be insignificant. The response to the request for computer modeling has been provided in the response to ESRD SIR #70a).

71. Volume 2, CR #3, Section 2.3.5, Page 15

In Section 2.3.5 (Page 15), CVRI states that drawdown adjacent to the pits will be insignificant beyond approximately 200 m from the pit. This assertion is based upon observations at previous mining operations to the west.

a. Provide site specific hydrogeological data and analysis quantifying the drawdown of groundwater during mining operations at the site and in adjacent areas. For this assessment, use the numerical model generated in SIR 1a) to confirm the predicted drawdown. Provide an analysis of potential error in the prediction.

Response:

The assessments of distance-drawdown have been provided in Appendix C of CR #3. This information, along with the position that the Project is precisely similar hydrogeological regime, are used to demonstrate that drawdown of water levels are reliably predicted to extend to approximately 200m from the mine pit. It has also been demonstrated in Appendix C of CR #3 that water levels recover rapidly after mining leaves the area.

b. Provide a balanced water budget quantifying the groundwater contribution to stream flow in the pit footprint, and adjacent areas where groundwater drawdown is predicted. Provide the balanced water budget for time periods prior to, during and after mining operations are completed. Define the length of time from the end of active mining operations until static conditions are re-established.

Response:

CVRI has considerable experience with the impacts associated with groundwater intercepted by mining operations adjacent to surface water features. This is detailed in Appendix C of CR #3. The Project will continue with this practice by returning the groundwater intercepted by the proposed pits to adjacent watercourses. This rapid return of any diverted quantities of groundwater and the localized nature of observed groundwater drawdown effects has lead CVRI to conclude that the impact is insignificant. As the impact is insignificant, no mitigation is required and the overall water balance/interaction between ground and surface water is unaffected.

The length of time predicted from the end of mining operations to the return of static conditions was provided in Section 3.0, Appendix C, where it is predicted that at return to premining conditions will occur within 4 to 9 months.

c. Quantify the effects on stream, wetland and peatland water levels that will result from the reduction of groundwater levels in the mine pit footprint and adjacent areas where groundwater drawdown is predicted.

Response:

CR #3, Section 4 summarizes the known effects and necessary mitigation associated with the groundwater effects of the Project. Tables 4.2-1 and 4.3-1 of CR #3 outline that no significant impacts are predicted.

d. Quantify the groundwater contributions to stream flow (before, during and after mining) for streams in the area where drawdown is predicted due to dewatering of the mine pit footprint and adjacent affected areas. Quantify the percent reduction in stream flows that will result from the reductions in groundwater levels.

Response:

Section 4.2.6.1 of CR # 3 states clearly that with the return of pit water to adjacent watercourses there will be no reduction in flow.

e. Quantify the anticipated effects on stream flow associated with reduced groundwater recharges to the streams in the areas affected by the groundwater level declines.

Response:

Section 4.2.6.1 of CR # 3 states clearly that with the return of pit water to adjacent watercourses there will be no significant reduction in flow.

72. Volume 2, CR #3, Section 3.3.3, Page 24

In Section 3.3 (Page 24), CVRI states that groundwater is anticipated to be drawn down in the area of the abandoned Lakeside and Bryan underground mines. As a consequence CVRI anticipates that groundwater levels will decline to 1,050 m on the southeast side of the Hamlet of Robb and to 1,040 m on the northwest side of the Hamlet of Robb.

a. Provide site specific hydrogeological data and analysis, taking into account the variability in hydrogeological parameters, to quantify the drawdown of groundwater anticipated during these dewatering operations in the area of the abandoned Lakeside and Bryan underground mines and adjacent affected areas.

Response:

Section 4.2.4 of CR #3 outlines CVRI's proposed mitigation for the uncertainty surrounding the Hamlet of Robb. It is acknowledged that the situation was potentially significant and in need of substantial study and assessment. Further it is pointed out that mitigation was possible through the deepening of wells in the Hamlet of Robb. The temporal component of the situation surrounding the Hamlet of Robb is also discussed in that the situation would certainly change between this assessment and the time that the underground mines needed to be dewatered. Section 2.3.10 of CR #3 clearly states that impacts of wells in Robb would not be expected before 2025. Over this ten year period numerous situation may arise, such as wells being drilled and taken out of service in the Hamlet, or the possibility that the Hamlet could be serviced by municipal water, which would change the nature of the assessment.

In recognition of this uncertainty, CR #3 put forth a recommended plan, complete with suggested timing, for a detailed evaluation of the effects of dewatering the underground mines. It was further speculated that this uncertainty would be mitigated by conditions within ensuing approvals which could include conditions related to this situation and the plan for future assessment.

Dentherm (1982) undertook a computer model of the drawdown adjacent to the dewatered Lakeside and Bryan Mines. The amount of drawdown of the water level in the workings was similar to that anticipated for this proposed Project – approximately 60 m. Section 3.4.8.3 (page 3.4-27-28) states as follows:

"Computer simulation of groundwater flow around the final pit was conducted using a transient finite element model.

It is predicted that the pit will not affect bedrock flow systems beyond a distance of a few tens of metres from the pit walls due to the presence of low permeability and anisotropic rock formations."

Appendix C-1 of CR #3 documents drawdown in the vicinity of Mercoal 4,000E as mining pits passed through that line. The pit in the vicinity of 4,000E was of the same depth dimension (60 m) as is planned for the Project pits in the vicinity of the underground workings. Appendix C-1 describes the situation in detail however the following points are relevant to the questions posed in ERCB SIR #72:

- the pit was of the same depth dimension as is planned for near the underground workings – that is approximately 60 m;
- the drawdown of water level reached a maximum of 3 m at a distance of 300 m from the pit;
- water levels recovered to original levels in approximately 9 months; and
- the hydrogeological regime is virtually the same at 4,000E and in the vicinity of Robb.

Appendix C-2 of CR #3 documents drawdown in the vicinity of Pit 35 in the original CVM. In this case, the drawdown at the pit was 25 m. It is documented (Appendix C-2 – Table C2-1) that drawdown at a distance of 220 m was 3 m. If this example is projected to a hypothetical 60 m drawdown in the pit the drawdown might have been 10 m. Similarly, observed drawdown at 280 m and 420 m from the pit can be projected to 2 m and 7 m respectively. None of these projected drawdowns represent a significant proportion of the theoretical available drawdown of 60 m.

Computer modeling has shown that drawdown will not extend beyond the range of "several tens of metres". Two documented examples in the CVM operations have confirmed the findings of the model. Significant drawdown is not expected beyond approximately 300 m.

The situation is adequately understood at this point in the assessment. Simulation with present-day computer models will not provide additional insight. The two examples cited in CR #3 Appendix D provide far better predictive capability than a computer model.

Reference:

Dentherm Resources Limited (1982): Coalspur Project, Volume V, Environmental Impact Assessment, Section 3.4, Groundwater Hydrology; Draft document for the Coalspur Project – application not submitted. July.

b. Provide site specific hydrogeological data and analysis quantifying the lateral extent of the drawdowns of groundwater anticipated during these dewatering operations.

Response:

See Response to ESRD SIR #72 a).

c. Following the completion of mining operations, how long will it take for the water levels to recover to static levels observed before the beginning of mining operations?

Response:

See Response to ESRD SIR #72 a). It is anticipated that water levels will recover approximately 9 months after dewatering ceases.

d. For a) to c) above, use the numerical model generated in the earlier SIR to confirm the predicted drawdowns and recovery times. Provide an analysis of potential error in the predictions.

Response:

See Response to ESRD SIR #72 a).

73. Volume 2, CR #3, Section 4.2.9, Table 4.2.1, Page 38
Volume 2, CR #3, Section 3.3, Page 24
Volume 2, CR #3, Section 4.2.6.1, Page 35

In Table 4.2.1 (Page 38), CVRI states that significant impact to surface water quantity is not anticipated. In Section 3.3, CVRI indicates that groundwater levels will be drawn down significantly due to dewatering the abandoned Lakeside and Bryan underground mines and in Section 4.2.6.1, CVRI states that groundwater contributes to stream flow.

a. For streams in the affected areas, provide a balanced quantitative water budget that quantifies stream input and output parameters prior to, during and after mining operations. Provide this quantitative analysis for each stream that transects the mining footprint, and including adjacent affected areas.

Response:

See Response to ESRD SIR #73c).

b. Describe and quantify the groundwater contribution to the streams in the area where drawdown is anticipated in relation to the dewatering of the Lakeside and Bryan underground mines.

Response:

See Response to ESRD SIR #73c).

c. Quantify the anticipated declines in wetland and peatland water levels associated with reduced groundwater recharge in the areas affected by the groundwater level declines.

Response:

Response to ESRD SIR #73a), b), c) → CVRI has proposed a plan of action with respect to the situation surrounding the mine plans and the underground mines. CVRI acknowledges that the proposed plan does not include the types of impacts noted in ESRD SIR #65 however they could easily be addressed as additional items within that plan.

CVRI will commit at this time to transporting water diverted from watercourses through groundwater back to the adjacent watercourse. This will effectively mitigate the issues pointed out above.

74. Volume 2, CR #3, Section 4.2.9, Table 4.2.1, Page 38
Volume 2, CR #3, Section 2.3.4, Page 14
Volume 2, CR #3, Section 2.3.5, Page 15

In Table 4.2.1 (Page 38), CVRI does not indicate potential impacts to streams as a consequence of declining groundwater levels during mining and the time that water will be recharging the pit lakes. In Section 2.3.4 (Page 14) and Section 2.3.5 (Page 15), CVRI indicates that groundwater levels will be drawn down significantly (to the depth of the mine pit below the water table) due to dewatering in the mine footprint, and adjacent areas, respectively.

a. Provide a balanced quantitative water budget showing stream input and output parameters prior to, during and after mining operations in the pit footprint and outlying areas. Provide this quantitative analysis for each stream that transects the mining footprint.

Response:

See response to ESRD SIR #74c).

b. Describe and quantify the groundwater contributions to the streams in the areas where drawdowns are predicted by dewatering the mine pit footprint and adjacent affected areas.

Response:

See response to ESRD SIR #74c).

c. Quantify the anticipated declines in stream levels associated with the reduced groundwater recharge to the streams in the areas affected by the groundwater level declines.

Response:

Response to ESRD SIR 74 a), b), c) → CVRI has in the past, and will continue into the future, to return groundwater that has entered mine pits from adjacent watercourse to those same watercourses.

This process acknowledges that whatever the amount of water being diverted, it will be returned to the adjacent watercourse. Any impact is thus mitigated and thus becomes insignificant.

CVRI is not prepared to undertake the requested water balance because it is maintained that there will ultimately be no impact to assess.

5.2 Hydrology/Surface Water

75. Volume 1, Section C.4.3, Pages C-49 to C-50, Figures C.1-7 and C.4-1
Volume 3, CR #6, Section 4.4.3, Pages 51-52

The referenced sections discuss channel diversions. Volume 1, Figure C.4-1 shows the locations of 15 major watercourses that cross the planned mine area and which need to be diverted for surface mining to occur, but there is no companion figure showing the final layout. The expected timing and nature of these diversions is summarized in Volume 1, Table C.4-2 and a corresponding table (Table 12) in Volume 3. Volume 1, Figure C.1-7 illustrates a typical watercourse diversion plan which shows a three stage process ending with restoration of the watercourse with a close-to-original alignment over a land bridge fill over the mined pit.

The discussion of diversions emphasizes activity during the mine operation phase and it is unclear whether the project is proposing any permanent reclamation phase diversions as illustrated in the third stage in Figure C.1-7 or as described in Volume 3, CR #6, Table 15, Page 66: *Restore all channels to replicate natural regime sized channels… improve habitat in main restored channels… with fine gravel zones for spawning areas*. Except for figures involving the Erith River, reviewers were unable to locate a figure for the hydrology assessment that shows the planned final configuration of end pit lakes and permanent diversions in the project area. Volume 1, Section F, Figures F.4-1 and F.4-2 show conceptual reclaimed landscape and conceptual end land use plans, but the lake boundaries are unclear (some of the lakes appear to be connected by wetland or riparian zones) and there appear to be more waterbodies than identified in CR #6.

a. Provide a figure which shows the anticipated configuration of end pit lakes and final channel alignments. Identify locations of restored channels.

Response:

See ESRD Figures 75-1 to 75-7.

b. Provide a summary of diversions to be completed over land bridge fills over previously mined areas, per illustrated Stages 2 and 3 in Volume 1 Figure C.1-7. Indicate the anticipated lifespan of each land bridge diversion, the maximum depth of fill, and the amount of fill settlement which can be expected over the life of each diversion.

Response:

See ESRD Table 75-1.

Table 75-1 Summary of Land Bridge Fill Diversions

Diversion No.	Stream	Period of Operation by Year	# of Years	Length Over Pit (m)	Total Length (m)	Maximum Fill (m)?	*Expected Settlement (m)
1	Erith	8 - 13	6	280	700	70	0.70
2	ERT1	3 - 7	4	120	300	35	0.35
3	Bacon	3 - 7	4	100	200	25	0.25
4	HLT1	8 - 9	2 or 3	120	550	30	0.30
5	Halpenny	8 - 9	2 or 3	90	480	15	0.15
5	Halpenny	10 - 13	3	120	540	40	0.40
7	LET1	10 - 12	3	180	200	20	0.20
8	LET3	10 - 12	3	180	200	20	0.20
8 & 9	LET3/Lendrum	10 - 13	4	100	300	25	0.25
11	LDT1	12 - 20	8	150	400	40	0.40
11	LDT1	12 - 20	8	50	80	15	0.15
11	LDT1	15 - 21	8	300	500	25	0.25
12	LDT3	12 - 22	10	120	550	20	0.20
12	LDT3	13 - 22	11	100	200	20	0.20
14	Lund	17 - 24	8	150	750	15	0.15

* Settlement based on 1% settlement rate.

c. Describe the basis for the settlement amounts and reference any empirical studies or data which were used for this analysis.

Response:

Rock Dump Behavior

CVRI is proposing that short term diversions will be established over backfilled dumps. Such rockfilled dumps will settle over time which could impact the constructed channel carrying the diverted flow. The 'self-weight' of the rock fill can create compaction of the fill resulting in surface settlement.

The degree of settlement is dependent upon the characteristics of the fill material, the height of fill and the method of fill placement. Coarse rock will settle more than fine gravel material. Greater 'lifts' of fill will settle more than shallow fills. 'End dumped' rock will be less dense than dumps constructed with multiple shallow lifts.

The rock dumps developed at CVM are comprised of a wide size distribution of material ranging from boulders to silt size. The resulting fill volume has lower void ratios leading to reduced self-compaction potential.

CVRI has some experience in constructed rock dumps within varying situations and varying fill heights. In a few occasions surfaces of these dumps have been used as haulroads, stockpile sites, building sites and drainage platforms, including creek diversions. Through this experience the degree of surface settlement of rock dumps has been observed to be limited. The small degree of settlement that occurs in moderately high dumps is often handled by re-leveling surface areas or providing berms around drainage ditches or channels.

Engineering Assessments

Few recent technical assessments of rock dump settlement are available. The Ministry of Energy, Mines and Petroleum Resources, British Columbia funded various 'mine spoil' studies during the 1990's. One of these reports, *Review of Long Term Geotechnical Stability of Mine Spoil Piles*, AGRA Earth & Environmental Limited, August, 1995, reviews a number of elements related to spoil pile stability. The report further references an early report, Compressibility of Broken Rock and the Settlement of Rockfills, Sowers, G.F., Williams, R.C., Wallace T.S., 1965.

The chart provided illustrates settlement rates for rockfilled dams. Settlements start at about 0.1% of fill height at the time of construction. Rates increase to 0.8% of fill height at 5 years after construction. For a 50 m high rockfill the settlement after 5 years can be expected to be in the order of 0.4 m.

76. Volume 1, Section E, Page E-30
Volume 3, CR #6, Section 4.5.2, Page 59

CVRI describes that the upper 70% of the Bacon Creek watershed will be diverted to the Erith River and the remaining downstream 2.4 km long channel will have only about 30% of its original flow. This assessment does not disclose that the upper end of the remaining 2.4 km long channel will have zero flow.

a. Clarify the impact to Bacon Creek and assess what, if any, portions of the remaining downstream channel would be expected to have perennial flow.

Response:

The diversion of the upper 70% of the Bacon Creek watershed will reduce low flows to the lower remaining reach of Bacon Creek to make it an intermittent stream. At its mouth, based upon its natural drainage area and the regional low flow relations in Figure 13 (CR#6), its natural May to October 7Q10 low flow is estimated at 9.5 L/s and winter 7Q10 is only 2.5 L/s (the measured flow at the mouth was 33 L/s on October 5, 2006). Therefore, it may not naturally have flow at all times. With the loss of the upper watershed, the computed corresponding May-October 7Q10 value would drop to 3.1 L/s and the winter 7Q10 would essentially be zero.

Options to provide an outlet from Lake 5 East to lower Bacon Creek are discussed in ESRD SIR #184.

77. Volume 1, Section E.2.3.2, Page E-30
Volume 1, Section E.6.3.2, Pages E-85 to E-90
Volume 3, CR #6, Section 4.5, Pages 56-63

The referenced sections discuss changes in flow regime. In a summary table (Volume 1, Page E-30), CVRI states that the potential change to the flow regime of the Erith River includes *flow regulation due to settling ponds* and a *10% reduction in peak flows*. In Volume 1, Page E-87, CVRI states that *while the lakes are filling, downstream flows will be maintained by pumping* and indicates that a pump rate of 1.52 m^3/s will be provided. On the same page, it is stated that the long term impact on the Erith River will include *extensive flood peak attenuation* and that hydrologic routing of flood events through the constructed lakes *results in estimated flood peak reductions by approximately 60%*. From Page 53 of Volume 3, CR #6, design flows listed for the Erith River diversion(s) range from 8.1 to 29.7 m^3/s for 2-year and 20-year return intervals. If downstream flows are limited to the suggested pump capacity during such events, this would produce flood peak reductions of from 80% to 95% of the natural flow. In Volume 3, CR #6, Table 14, CVRI shows that high flows during filling will be reduced by 15% but indicates, in an associated footnote, that *Percentage reductions in high flows may be greater*. Also in Table 14, CVRI discusses high flow residual impacts but does not associate these with any specific return period.

The referenced sections on flow regime do not adequately disclose and consider the very large effects on peak flows which are likely to occur when flows are maintained by pumping. Volume 3, CR #6 does not adequately describe the basis for the residual impacts to high flows, as shown in Table 14, which presumably are from flow routing through the end pit lakes. The Terms of Reference (Volume 1, Appendix 1, Page 1-15; in particular, see TOR #3.3.2 [B]) for this proposed project requires that assessments be undertaken of changes to channel regime and river regime. Channel regime is often associated with channel formative discharge with a return period in the range of five to 10 years. From an aquatic habitat perspective, regime flows are important because they serve as flushing flows in gravel bed streams.

a. For each of the watercourses to be diverted by pumping and/or routing through end pit lakes, identify the natural five-year peak instantaneous discharge or other suitable estimate of the channel regime discharge.

Response:

Most of the proposed diversions will be managed by gravity diversion channels as outlined in detail in ESRD Appendix 86. Hay Creek and Lendrum Creek above its confluence with LET3 are the only watercourses which will be diverted by pumping for a period of more than one year through the peak flow season. Peak flows in these streams will be reduced and managed by ponds and in-pit storage. Estimated five-year peak instantaneous discharges for these watercourses, the estimated mining period and proposed peak release rates during mining for these are:

- Hay Creek at 1.3 m^3/s (year 12-17 mining period), peak flow release of 0.6 m^3/s; and
- Lendrum Creek above LET3 at 1.3 m^3/s (year 10-12 mining period), peak flow release of 0.4 m^3/s.

Other watercourses which may be diverted for short periods of up to 4 months between August to April, outside of their peak flow season, and their estimated five-year peak instantaneous discharges are:

- HLT1 2.0 m^3/s;
- LET1 2.7 m^3/s; and
- LET3 3.2 m^3/s.

Maximum anticipated pump rates for these temporary diversions are estimated at 0.17 m^3/s (2250 igpm) which would be in excess of a runoff rate of 15 $L/s/km^2$.

b. Update Volume 3, CR #6, Table 14 to provide realistic estimates of project-related impacts on peak flows which will result from pump capacity limitations during mining and lake filling stages.

Response:

With the planned diversion ditches, as discussed in ESRD Appendix 86, the Project-related impacts on peak flows due to pump capacity limitations are minimized during mining and lake filling. Hay Creek is the only watercourse that would substantially require pumping during mining and following mining for Lake 3 filling. Hence the 50% reduction in peak flows assumed during mining in Volume 3, CR #6, Table 14. During lake filling options for Hay

Creek are to: discontinue downstream flows and the impact is 100% for 10 years or more, to maintain pumping up to an agreed upon peak rate (at an unrealistically high rate of say 0.4 m^3/s the impact is 70% of the 5-year peak discharge) or pump from the Embarras River during high flows to reduce the filling time to a more realistic 5 year time frame.

As noted in the footnote 1 in Volume 3, CR #6, Table 14 the "*Estimated maximum magnitude of impact, [and related] effects can vary significantly and be reduced depending upon specific mine operations and hydrologic conditions at the time.*" Therefore, no other changes in the estimated maximum impact on high flows during mining and lake filling are predicted.

Other significant site specific impacts on stream segments during and following mining that are not included in CR #6, Table 14 are on Lendrum Creek upstream of LET3 and on Lund Creek upstream of LDT3 confluence, as discussed in ESRD Appendix 86.

c. Update Volume 3, CR #6, Table 14 residual high flow impacts to specify residual impacts to (1) regime flows and (2) 100-year flows.

Response:

An updated Table 14, CR #6 is provided below as ESRD Table 77-1.

Table 77-1 Residual Impact on High Flows Due to Lake Regulation (SIR 77c and d)

Watershed	Location	Pre-Mine Drainage Area (km^2)	Post-Mine Drainage Area (km^2)	5 Year Natural Peak Discharge (m^3/s)	High Flow Residual Impacts(1)		Comments	Change in Flushing Flow Return Period from 2-Year(2)
					5 Year Peak Flows	100 Year Peak Flows		
Erith River	Lake 5 Outlet	74.3	76.7	21.8	-16%	-11%	routed through Lake 4 and middle of Lake 5 ignoring east and west ends of lake 5	2.30
Halpenny Creek	Lake 6 Outlet	24.8	24.8	7.0	-24%	-11%		2.38
Hay Creek	Lake 3 Outlet	4.6	5.9	1.3	-49%	-43%		5.32
Bryan Creek	Lake 2 Outlet	22.4	24.4	6.4	-61%	-54%	with Lake 1 routing in upper third of basin	6.54
Lendrum Creek	Lake 7 Outlet	24.8	25.1	7.1	-9%	-2%	steep outlet channel	2.13
Lund Tributary 1 (LDT1)	Lake 8 Outlet	10.5	10.5	3.0	-14%	-14%	with Lake 9 routed outflow, steep outlet channels	2.39
Lund Tributary 3 (LDT3)	Lake 10 Outlet	6.3	25.0	6.1	242%	248%	Lake 11 and 12 routed to Lake 10, 850 m of LDT3 channel will need assessment and stabilization work	n/a
Lund Creek	below LDT3 confluence	21.6	30.3	6.1	-27	-27%	minor inflow from Lake 10 outlet to downstream confluence not included, Lake 11 and 12 routed to Lake 10	2.63

(1) Impacts are compared to pre-mine estimated peak flows at locations indicated.
(2) As discussed in ESRD SIR #77d)

Assumptions for hydrologic flood peak routing:

1. Used average of 1980 flood hydrograph shape scaled according to regional peaks based upon Figure 13 of CR #6 for both 5 and 100 year events
2. Outlets sizes slightly larger than natural downstream channel and meeting local gradients.

d. Estimate the future frequency of occurrence (return period) of regime flows sufficient to mobilize and flush channel substrate materials and maintain aquatic habitat.

Response:

Various methods have been proposed and applied for East Slopes and other gravel bed rivers to define flushing flows (*i.e.,* flows sufficient to mobilize and flush channel substrate materials) (Alberta Environmental Protection, 1993, EMA and W-E-R, 1994). These include: the Tenant method at 200% of the mean annual flow (Reiser *et al.* 1985), Hoppe method at the 17 percentile on the annual flow duration curve (Hoppe 1975), the dominant discharge or bankfull discharge which is normally taken as the 1.5-year to 2-year return period maximum daily flood (Montana Dept. of Fish, Wildlife and Parks, 1981), and the incipient motion method (Reiser *et al.* 1985) from Shields equation where the beginning of motion is at a Shields parameter of 0.03. Results from the Shields and other incipient motion equations ranged from the between above methods up to about a 2-year return period flood (Alberta Environmental Protection, 1993, EMA and W-E-R, 1994).

For residual impact illustration purposes, the future frequency of flows required to be equivalent to the natural pre-mine 2 year return period mean daily floods are estimated for the channels below the end pit lake outlets. The results are summarized in the last column of ESRD Table 77-1.

References:

Alberta Environmental Protection, 1993. Flushing flow requirements for the Highwood River.

Environmental Management Associates and W-E-R Engineering (EMA and W-E-R), 1994. Instream Flow Needs Investigation for the Bow River, Part 1. Prepared for Fish and Wildlife Division, Edmonton.

Hoppe, R. D. 1975. Minimum Streamflows for Fish. Paper presented at Soils-Hydrology Workshop, USFS., Montana State University.

Montana Department of Fish, Wildlife and Parks, 1981. Instream Flow evaluation for selected waterways in western Montana. US Forest Service.

Reiser, D. W., M. P. Ramey and T. R. Lambert. 1985. Review of flushing flow requirements in regulated streams. Report prepared by Bechtel Group for Pacific Gas and Electric Company, San Ramon California.

78. Volume 1, Section E.6.3.2, Pages E-85 to E-90
Volume 3, CR #6, Section 4.4.3, Page 51
Volume 3, CR #6, Section 5, Pages 56-63

In the above-noted sections, CVRI discusses diversions and pumped flows during lake filling. There are several discrepancies in the project description. In Volume 3, CR #6, Page 51, CVRI states that pumped diversion was *not used for the Erith due to the magnitude of flow* and identifies 15 main watercourse diversions which *are fish bearing streams where natural bypass flows will be maintained at all times*. However, from the sections in Volume 1 and Volume 3 which discuss filling of the pit lakes, it is stated that the downstream flows in many fish bearing streams will require pumping for periods as long as 57 years (Table 13).

In Volume 1, Pages E-85 to E-89, CVRI states that for the Erith River, *When Lakes 4 and 5 are filling, downstream flows will be maintained by pumping*. For Halpenny Creek, *Instream flows can be maintained during lake filling… with bypass pumping*. For Hay Creek, *The end pit lake in this watershed will take up to 44 years to fill with downstream flows maintained… by using bypass pumping.* For Bryan Creek, *Extensive time will be required to fill the two end pit lakes in this watershed with downstream flows maintained… using bypass pumping.* For Lendrum Creek, *The end pit in this watershed is estimated to fill in less than two years with downstream flows maintained… using bypass pumping*. For Lund Creek, *The end pit lake is expected to take 28 years to fill with downstream flows… using bypass pumping.*

a. Describe how natural flows for fish passage will be maintained at all times in fish bearing streams when downstream flows are maintained by pumping.

Response:

Channel diversions will be utilized rather than pumping in most all instances to provide for fish passage and maintain downstream flows, as previously discussed in ESRD SIR #77.

b. For each downstream watercourse which will be dependent on pumped flow, assess and describe the downstream extent of adverse impacts if the pump system should fail. An initial estimate of downstream extent can made by identifying the point at which the headwater basin intercepted by the pit accounts for less than 15% of the total basin area.

Response:

The points downstream at which the headwater basin intercepted by the pumped diversion or lake control accounts for less than 15% of the total basin area are listed below along with the length of channel potentially affected:

Year Round Diversions:

Hay Creek – at its mouth (2.3 km of channel)

Lendrum Creek above LET3 – confluence with LET3 (up to 0.6 km of channel)

<u>Temporary Seasonal Diversions (possible - may or may not be used):</u>

HLT1 – mouth of Halpenny Creek (up to 6.4 km of tributary channel)

LET1 – to Lendrum-Lund confluence (up to 15.1 km of channel)

LET3 – to Lendrum-Lund confluence (up to 15.8 km of channel)

The above assumes that all pumps in place for that diversion fail and no flow is discharged downstream. On the other watercourses, gravity flowing bypass channels will be in place at all times except when planned diversion switches are made.

c. Describe how pumping will be performed during winter conditions and the effects that winter period pumping will have on downstream ice production and ice cover.

Response:

CVRI has experience in previous pump operations during winter in excess of 1000 igpm which have not resulted in ice production problems.

Pumping will typically be from excavated sumps or ponds with temperatures comparable to the incoming water. Constructed release channels will be provided to transition to natural streams to control erosion and ice conditions. Pump rates will be adjusted and monitored during freeze-up to control icing conditions in these constructed release channels. It is expected that an initial high flow rate will be utilized during freeze-up to develop an insulating ice cover in the downstream channel transition sections and then the flow will be dropped down to allow conveyance under the ice. As there is a general gradual recession in flow in the winter with relatively little variation, only minor subsequent adjustments in pump rates will be required. A management protocol, based upon site specific conditions and experience, will need to be developed to control icing conditions.

Where ponds or lakes are pumped from, due to the low winter flows, pumping all or more than the incoming flow rate will not be problematic. This may be required and beneficial to maintain downstream flows and control icing.

d. For each affected watercourse, describe what instrumentation and techniques will be considered to collect real-time streamflow data under open water and winter ice conditions and how compliance with instream flow guidelines will be achieved. When responding, consider the following statement by CVRI, from Volume 3, CR #6, Section 2.5.5: W*inter flow data are limited. This is a common deficiency for all but larger rivers due to the difficulty in accurately measuring flows during ice conditions.*

Response:

Flows are difficult to monitor in the winter to provide a continuous database such as for Water Survey of Canada records. However, the objective here will be to measure flows at discrete times (typically weekly) in order to adjust bypass flow rates, as needed. As experience is obtained fewer measurements (monthly or even less frequent) may be required and recession rule curves could be established through the winter to define pump rates.

For land bridge diversion channels across end pits gated culvert controls, syphons or stop-log weirs may be used to divert controlled flows to the pits during filling. As winter flows are minimal in terms of volumes for lake filling, taking off 15% of the flow from planned diversion channels running across or around lakes, may be more problematic than he benefit of the fill volume provided. Therefore, diversion of flows into lakes may be much lower or completely suspended during winter low flow conditions. This would marginally increase lake filling times. Due to critical winter low flow conditions in some fish bearing streams, individual diversion management frameworks will need to be developed and applied for each stream such that the maximum diversion rate may range from 0% up to 15% depending upon the flow and time of year.

e. Determine and describe the maximum number of natural flow pump stations which will need to be simultaneously maintained and operated.

Response:

Based upon the current mine plan schedule, up to 4 watercourses (3 of which may only be pumped for short periods) will be intercepted within the Year 10-12 period – HLT1, LET1, LET3 and Lendrum. It is expected that, at most, three may be operated at the same time for Lendrum Creek and up to two of the others. Total pump requirements for up to three stations operating at one time will be less than 10,000 igpm (0.75 m^3/s). Additional smaller water management pump systems will be required throughout the mine for both disturbed runoff and small clean water bypasses where possible.

f. Describe how pumps will be powered, and what fuel storage or other infrastructure will be required. If power or fuel storage requirements are substantial, assess all associated secondary effects including air emissions. Provide a description of backup systems that CVRI will provide for pump system components (pumps, power supply, fuel, etc.).

Response:

CVRI anticipates that such major 'pumping stations' will be operated by electrical power through the mine electrical distribution system which supplies the dragline operations.

Operating staff including electrical and mechanical trades are presence at the mine on a 24/7/365 basis to respond to inspections, breakdowns and maintenance. Parts and spare equipment are available on the mine site for replacement of critical equipment. Local sources of replacement or rental pumps and supplies are available.

CVRI maintains a maintenance and replacement schedule for all major pumps.

Pump inventory includes portable, diesel operated pumps mounted on trailers that can be placed into operation on short notice for backup.

g. Discuss the feasibility, in the event of a pump component malfunction, of CVRI providing continuous uninterrupted pumping operations, or if pump system down time would be unavoidable while a problem is being diagnosed and repairs are implemented.

Response:

The use of multiple pumps with multiple lines reduces the risk of complete shutdown of all bypass flow at any time. Each pump and line will be operated independently of each other. With this setup, at least some downstream flow will be maintained. Excavated sump/forebay areas or ponds will be provided to allow for short term backup and storage in the event of pump malfunctions.

h. Describe CVRI's past experience with sustained pump operations, specifically 1) continuous uninterrupted operation for periods longer than three months; 2) continuous uninterrupted operation under adverse weather conditions; and 3) pump type(s) and rated discharge capacities.

Response:

CVRI utilizes several large capacity, continuous service pumps throughout the operation including fire pumps, process water pumps, tailings slurry pumps, and process water systems. Many involve multiple and staged pump installations with process controls to alarm low flows or upset conditions. Critical parts are maintained on site with experienced maintenance staff available on a continuous basis.

Process Water Recycle

As an example, the tailings system at CVM uses two electric pumps within a barge on the tailings pond to recycle up to 1800 gpm. This system operates full time throughout all seasons. This is a severe service situation with pumps on a barge in the pond which is subject to full ice cover. The water is pumped through an above ground sclair line to an open channel which then flows to a reservoir.

A similar situation occurs at Obed Mountain Mine where a pumping system with a capacity of 2475 gpm is installed.

Pit 26 Dewatering

CVRI has pumped out Pit 26 on various occasions in order to accommodate short term mining operations. This is a large and deep pit located in a muskeg area. The pit becomes partially flooded when mining is suspended. On one occasion large pumps and discharge lines where rented to assist dewatering the pit. Multiple electric pumps and multiple water lines, up to 12 inch diameter, where utilized in the operation. Pumping head for the pit was in the order of 75 m so that some lines used staged pumping. The operation continued for several months with discharge to an adjacent abandoned pit.

Pit 123 Underground

During mining in the western end of Pit 123 an intersection occurred with the underground mine workings associated with the Mercoal mine. The pit was inundated with water flowing from the underground workings. Multiple pumps with multiple discharge lines were immediately installed to control the flow and reduce the flooding so that coal recovery could continue. Both electric and diesel operated pumps where utilized. The operation continued for several months as the advance of the pit continued westward.

**79. Volume 1, Section F, Figure F.4-1,
Volume 3, CR #6, Figure 27**

CVRI proposes mining along long continuous seams which will be reclaimed as a series of lakes at various elevations, as listed in text boxes in Volume 3, CR #6, Figure 27. There are several instances of adjacent lakes within a continuous pit that will separated by backfill material of potentially high permeability (blasted and excavated rock overburden). It has not been considered whether the available backfill material is suitable to achieve and maintain lake level differentials as proposed. West of Robb, same-pit Lakes 1 and 2 (Upper and Lower Bryan Lakes) have a proposed head difference of 15 m. East of Robb, the proposed elevations for same-pit Lakes 3, 5, 6, 7 and 8 (Hay, Lower Erith, Halpenny, Lendrum and NW Lund Lakes) vary by up to 40 m between adjacent lakes. The hydraulic permeability of the backfill which will separate these lakes needs to be assessed and an evaluation made as to whether the lakes will be able to hold water at the differential elevations proposed.

a. Assess the permeability of mine spoil material which would be available to backfill the pits and create separate lakes.

Response:

The CVM does not have site specific information regarding the hydraulic conductivity of in-place spoil from the rock units being mined in this area.

Smith *et al.* (1995) cited hydraulic conductivities in the range of 10^{-4} to 10^{-6} m/s for waste rock dumps at Elkview Mine, B.C. Fala *et al.* (2003) stated that hydraulic conductivity of waste rock piles might range from 10^{-2} m/s in volcanic / metamorphic rock to 10^{-9} m/s for dumps of argillaceous rock. The response to inquiry "b" below will demonstrate that these ranges, except for the very lowest values, would not sufficiently contain flow in the setting of these end pit lakes.

Under these circumstances, it must be assumed that the in-place spoil has sufficient hydraulic conductivity such that end pit lake to end pit lake flow might be an issue. Therefore, at this time, CVM will assume that mitigation may be necessary and will commit to the placement of an engineered barrier of glacial till to reduce flow. CVM may elect to undertake testing of existing spoil to determine in-place hydraulic conductivity in order to confirm the actual need for the engineered till barrier. This information will be shared with ESRD if the results show that an engineered barrier is unnecessary.

Where the hydraulic connection from one lake to another is not desired and in order to maintain natural drainage patterns, compacted glacial till material, typically 5 m thick, will be installed as a low permeable barrier between lakes. This is schematically shown as a dam core in ESRD Figure 79-1 or it may be installed near the upstream sloping face of the backfill. The low permeable barrier would extend to above the high water level of the upstream lake. All locations where connecting backfilled pits between water bodies are listed in the table in ESRD Figure 79-1. The other 'semi-connected' lakes are either at the same elevation or on separate seams separated by solid rock.

References:

Fala, O., M. Aubertin, J. Molson, B. Bussiere, G. Wilson, R Chapuis and V. Martin (2003): Numerical Modelling of Unsaturated Flow in Uniform and Heterogeneous Waste Rock Piles; Proceedings of 6th International Conference on Acid Rock Drainage, Cairns, July, pp. 895-902.

Smith, Leslie, D. Lopez, R. Beckie, K. Morin, R. Dawson, W. Price (1995): Hydrogeology of Waste Rock Dumps; MEND Report PA-1, 115 pages.

b. Evaluate the amount of groundwater seepage flow which is likely between adjacent lake cells, and interpret the results in terms of lake fill times, the ability to sustain the proposed differential water levels, and implications on the proposed reclamation plan and environmental impacts.

Response:

The table in ESRD Figure 79-1 shows estimated seepage rates through the various backfills between the lakes and assuming a hydraulic conductivity of 10-7 m/s or lower for the compacted barrier material. This table shows the magnitude of this seepage compared with the estimated mean annual outflows from the lakes is a small overall surface flow component that will allow for the planned differential lake levels and maintain the flow patterns as indicated.

80. Volume 3, CR #6, Section 2.4, Pages 8-11

CVRI indicates that the mean annual precipitation at Coal Valley is 618 mm, but this is computed in Volume 3, CR #6, Table 1 (Page 10) as the sum of mean monthly values which have variable periods of record. The mean annual precipitation should more correctly be taken as the average of all years for which complete records are available, i.e., the "annual" column from Table 1. This gives a mean annual value of 611 mm. CVRI indicates on Page 11 that a typical small basin would have "*a mean runoff rate of 280 mm, as discussed in the next section.*" On Page 40, it is stated "*SR - Surface Runoff, estimated at 233 for Project basins.*" The hydrology report has internal inconsistencies as to mean annual runoff and groundwater recharge in the study area.

Confirm which mean annual values for precipitation and runoff CVRI recommends for use in water balance calculations for the study area.

Response:

The 280 mm mean annual runoff rate was from previous work for basins further to the west. The 233 mm mean annual runoff rate was applied for most streams in the Project area. A total precipitation value of 615.2 mm was used in the water balance shown in Figure 4 of CR #6 as this figure was generated based upon an earlier estimated mean annual value. A value of 618.5 mm was used for lake water balance calculations. A variation from 610 to 620 mm has little impact on overall observations and conclusions.

81. Volume 3, CR #6, Section 2.5.4, Page 17

CVRI identifies that *Some years commonly show a noticeable decrease and then a subsequent recovery in flow in late November… this is believed to be due to extreme cold spells when a significant percentage of flow is lost to the formation of ice.*

A more likely explanation for the decrease and subsequent recovery of flow is the added hydraulic resistance which occurs when an ice cover develops. When the ice cover develops, additional depth of flow is needed to pass the same discharge and this significantly increases the volume of water in the channel.

a. Provide a discussion on the potential effect of hydraulic resistance associated with ice cover as related to the patterns of decrease and subsequent recovery of flow observed in November, and how this may affect operation of natural flow pump stations during periods of ice cover establishment.

Response:

The statement that *a significant percentage of flow is lost to the formation of ice* was poorly phrased and was intended to include the backwater effects created during ice formation.

As stated in ESRD SIR #78c) pump rates will be adjusted and monitored during freeze-up to meet incoming flows and control icing conditions in downstream constructed release channels. Pond storage drawdown may be utilized to provide an initial high pump rate during freeze-up and develop an insulating ice cover in the downstream constructed receiving channel transition section. Then the flow will be dropped down to allow conveyance under the ice.

The long term year round stations on Hay and Lendrum creeks will have several ponds and the pit to draw water from. Timing of incoming natural inflows from other streams will be more problematic and therefore sumps will be required.

Also see ESRD SIR #180e).

82. Volume 3, CR #6, Section 4.2.7, Pages 42-43
Volume 3, CR #6, Section 4.2.7, Table 1, Page 10
Volume 3, CR #6, Section 4.2.7, Table 13, Page 55

CVRI discusses water withdrawals and provides a summary of surface water licenses in the Regional Study Area, but appears to have overlooked the future water consumption which will result from the planned conversion of land areas to end pit lakes.

From Volume 3, CR #6, Table 13, (Page 55), the end pit lakes will have a total combined surface area of 625 ha. Under present conditions, this land area produces approximately 233 mm of annual runoff. As an open water surface, the same area will have annual water deficit of about 11 mm, because the mean annual precipitation (611 mm based on the average of years with complete data in Volume 3, CR #6, Table 1(Page 10)) is less than mean annual lake evaporation (622 mm from Page 11). The loss of runoff production is equivalent to an annual withdrawal of approximately 1,500,000 m^3.

a. Given this scenario for future water consumption, reassess project effects on water withdrawals, downstream users, and Water Act approvals that may be required.

Response:

The approximate 1.5 million m^3 as computed in the question corresponds to an average flow rate of 0.048 m^3/s. By comparison the mean annual runoff from all the streams affected (470.5 km^2)

in Figure 2, CR#6, at 233 mm of annual runoff, is equivalent to a flow rate of 3.48 m^3/s. Therefore, the above noted impact of the water bodies created amounts to about 1.4% on average streamflows. Individually, this impact is more or less on specific watersheds. For example, this effect from the large Lake 3 in the small Hay Creek watershed amounts to 8% of the mean annual flow in this creek.

As there are no downstream surface water users within the RSA, the effects of the lakes are negligible. The end pit lakes will be included in the fenceline *Water Act* approval for the Project.

83. Volume 4, CR#11, Section 4.0,
TOR Section 3.4.2 [B] requires discussion *of any changes in water quality resulting from the Project including impacts on drinking water quality*. No information is provided on drinking water or other surface water users in the reaches of watercourses downstream of proposed mining activity in Section 4.1 to 4.4.

a. Provide details of downstream surface water users (existing and future), including potable surface water users (if any), and describe and assess potential changes and impacts to surface water users.

Response:

The discussion of potential changes in water quality resulting from the Project including impacts on drinking water quality is provided in CR# 5, Human Health.

84. Volume 4, CR#11, Section 4.0,
TOR Section 3.4.2 [B] d) requires discussion of *the effect of changes in surface runoff or groundwater discharge on water quality in surface waterbodies*. In Section 4.4.2.3 on P. 56, it states that *All of the end-pit lakes proposed for the Project will likely have groundwater as a major source of water*.

a. Given that creeks flowing into the end-pit lakes, once completed, will now be subject to mixing with significant amounts of groundwater, are there any expected changes to the temperature of flows exiting the end-pit lakes during specific times of the year?

Response:

There are predicted to be no changes to the temperature of flows exiting the end-pit lakes during specific times of the year as a result of influence of groundwater entering the end-pit lakes, and there are predicted to be no downstream effects on aquatic resources.

Volume 4, CR #11, Section 4.4, beginning on Page 45, contains the assessment of end-pit lake characteristics on surface water quality. The following were two conclusions made with respect to this issue:

1. All of the end-pit lakes proposed for the Project will have groundwater as an available source of water.
2. Some of the end-pit lakes proposed for the Project will be meromictic, others will be holomictic, and others will likely exhibit partial mixis. The specific turnover pattern of any particular end-pit lake cannot be predicted, although the likelihood that an end-pit lake will be holomictic will be greater with similar salinity of (any) surface and groundwater inflows and shallower end-pit lake depth.

The temperature of water exiting end-pit lakes that are meromictic will not be influenced by the temperature of water in lower levels that is derived primarily from groundwater, and any potential influence of temperature of groundwater on the temperature of groundwater exiting end-pit lakes is likely only possible with mixis, or lake turnover.

Appendix 9 of the Application provides the results of a detailed study of surface water quality conditions in existing CVM end-pit lakes, in which detailed water quality sampling was conducted in summer, fall, and winter 2010 and spring 2011 in nine existing end-pit lakes (as well as one natural lake). The data gathered during this study were used to estimate what the lake water temperature would be immediately after mixing if the lakes were to mix ; the results are provided in ESRD Table 84-1 below.

With the exception of the winter season all predicted lake temperatures are within the range of measured stream temperatures in the LSA. The predicted end-pit lake temperatures for the winter are higher than the range of measured stream temperatures in the LSA. The winter results are largely irrelevant, however, as there will be no turnover of end-pit lakes in the winter season.

Table 84-1 Surface Water Quality – End Pit Lake Survey

Sampling	Predicted Average Lake Temperature (°C)								Measured Average Stream Temperature (°C)	
	Pit 45	Pit 35	25E	25S	44	142	Lovett	Silkstone	Median	Range
July 2010 (summer)	17.1	16.9	11.8	15.1	14.1	16.9	15.4	14.9	13.3	8.4 to 19.6
August 2010 (summer)	15.7	16.9	12.6	16.1	15.8	17.4	16.0	15.4		
September 2010 (fall)	10.8	11.1	8.7	10.3	11.5	9.5	10.1	9.4	5.25	1 to 17.0
October 2010 (fall)	8.4	8.4	7.5	8.0	9.2	7.6	8.3	7.9		

Table 84-1 Surface Water Quality – End Pit Lake Survey										
Sampling	Predicted Average Lake Temperature (°C)								Measured Average Stream Temperature (°C)	
	Pit 45	Pit 35	25E	25S	44	142	Lovett	Silkstone	Median	Range
February 2011 (winter)	2.8	2.9	5.0	2.8		1.9	3.1		<1	<1 to 1.2
June 2011 (spring)	6.0	11.3	8.8	9.7	9.1	8.6	10.0	10.0	8.7	<1 to 16.6

Note: Pit 44 and Silkstone Lakes were not sampled in February 2011 due to unsafe ice conditions.
Note: Measured Average Stream Temperature is from Volume 4, CR No. 11, Table 6, Page 11

b. If so, how might these changes affect downstream aquatic resources?

Response:

There are predicted to be no changes to the temperature of flows exiting the end-pit lakes during specific times of the year as a result of influence of groundwater entering the end-pit lakes, and there are predicted to be no downstream effects on aquatic resources.

85. Volume 4, CR#11, Section 4.0

The Air review noted the PAI modelling should be carried out for this project based on the AEW Air Quality Model Guidelines (2009) unless it can be shown that critical thresholds will not be exceeded (Air Question #2).

a. If PAI modelling is carried out, describe and quantify effects that are expected on acid deposition (if any) in lakes and other waterbodies in the region. The evaluation should be extended to check if impacts further apply to soils and/or vegetation.

Response:

The Air Quality Regional Study Area (AQRSA), with a total area of 2,350 km^2, lies entirely within an area of the province of Alberta that is classified as being moderately sensitive to acidification (CASA 1999), based upon the combination of soil sensitivity and the ability of soil to reduce incoming acidity. This combined sensitivity classification is used as the basis of application of critical, target and monitoring loads for the assessment of acid deposition in Alberta. The established critical load and target load for areas classified as being moderately-sensitive to acidification are 0.5 keq H^+/ha/yr and 0.45 keq H^+/ha/yr, respectively. Potential Acid Inputs (PAI) are predicted to be below both the established target load in the Baseline Case at all but 1 of the 2,350 receptors in the AQRSA simulated in the air quality model. The PAI for the single predicted exceedance is 0.746 keq H^+/ha/yr which also exceeds the established critical load. This single predicted exceedance represents approximately 0.5 km^2 or 0.02% of the entire area of the AQRSA. These results are the same for the Application Case; with only 1 of the

2,350 receptors in the AQRSA simulated in the air quality model predicted to have a PAI exceeding the established critical load and all other predicted PAI values being lower than that established target load. Furthermore, none of the 81 special receptors simulated in air quality model had a PAI that was predicted to exceed the established target load in either the Baseline or the Application Cases. The residual (after mitigation) effects of the Project on surface water quality via potential effects of acidifying emissions are therefore assessed as ***Insignificant.***

Reference:

Clean Air Strategic Alliance. 1999. Application of critical, target, and monitoring loads for the evaluation and management of acid deposition. 65 pp. plus appendices.

5.3 Fish

86. Volume 1, Section A.8.2, Pages A-21 to A-25

There is a high probability that both Bull trout and Athabasca Rainbow trout could be listed (within 2-3 years) as 'threatened' provincially. Athabasca Rainbow trout have already been considered by the Alberta Endangered Species Conservation Committee (AESCC) and have been recommended as 'threatened'.

a. Describe if the current considerations by the AESCC were included in the discussion pertaining to risk for Athabasca Rainbow trout.

Response:

The EIA considered that Athabasca Rainbow Trout is currently At Risk and that the Alberta's Endangered Species Conservation Committee recommended that Athabasca Rainbow Trout be listed as Threatened under the *Wildlife Act* (CR #2, Table 4.3, pages 20,21). Additional discussion is provided in the response to ESRD SIR #104.

b. How will these designations influence consideration of alternate strategies related to watercourse crossings, water diversions, and development of mine pits and reclamation of end pit lakes?

Response:

The status of Athabasca Rainbow Trout and Bull Trout were considered during the environmental impact assessment process that was presented in the Application. CVRI has also initiated more detailed water management planning (with a key goal of avoiding critical habitats) as described in the Water Management and Aquatics Discussion Paper (see response to ESRD SIR #105). While mine planning to avoid impacts to critical habitats will be a key strategy moving forward, reclamation strategies such as creation of spawning habitat in the inlets and/or outlets of end pit lakes and enhancement of existing lotic habitat will also be considered.

Potential benefits to salmonid populations as a result of creating end pit lakes in the post-mining landscape are discussed in the response to ESRD SIR #168.

In addition, CVRI is committed to participating in the implementation of a Rainbow Trout recovery plan and currently has a representative on the Athabasca Rainbow Recovery Committee.

c. What compensation achieves No Net Loss (NNL) of habitat when this development will directly result in the loss of 'critical' spawning and early rearing habitat for both species?

Response:

As indicated in CR #2 and in the responses to ESRD SIR #98 and ESRD SIR #100, Bull Trout are relatively uncommon in the LSA and Bull Trout spawning habitat is virtually non-existent in the study area. A more detailed discussion of potential impacts to critical Bull Trout habitat is provided in the response to ESRD SIR #98.

Athabasca Rainbow Trout spawn in various sections of the study area that will be directly impacted by proposed mine activities. The primary mitigative action employed by CVRI will be to develop mine plans to minimize direct disturbance to critical habitats. As indicated in the response to ESRD SIR #174 CVRI there are several concepts that will be considered as part of habitat compensation planning including development of spawning habitat in the inlet and outlet of lakes and enhancement of existing habitat to increase spawning potential. Other potential benefits to fish that may occur as a result of the end pit lakes include an overall increase in available habitat, an increase in wintering habitat, and attenuation of peak flows and retention of sediment (see response to ESRD SIR #174). There is also potential to implement specific research studies and/or management initiatives for Rainbow Trout or other species. In addition, there is evidence that Athabasca Rainbow Trout densities in streams downstream of end pit lakes were higher than they were previous to the development of the lake (see response to ESRD SIR #168).

Information regarding habitat compensation concepts are described in CR #2, Section 5.4.6.2 and discussed in the responses to ESRD SIR #167 and ESRD SIR #174. As indicated, fish habitat compensation measures will be developed at the mine licensing stage once detailed mine planning has been completed.

d. Considering that portions of several fish bearing watercourses, including an important portion of the Erith River, will be diverted, channelized, pumped, and/or dewatered, explain how the impact to fish populations as a result of flow changes is expected to be minimal.

Response:

A discussion of potential impacts to fish populations as a result of changes in flow was provided in CR #2 Section 5.3.1.2 and 5.3.2. Mitigation to address these effects was described CR #2 Section 5.4 and CR #6 Section 4.0.

In addition, a revised and more detailed description of proposed diversions is described in the water management and aquatic discussion paper and an updated discussion of potential impacts to aquatic resources is provided in the response to ESRD SIR #170, ESRD SIR #182, and ESRD SIR #186. As described:

- Potential impacts to flows during mining will be mitigated by following instream flow guidelines (ESRD 2011) and by using open channel diversions instead of pumped diversions.
- During end pit lake filling of all lakes (with the exception of Lake 3 on Hay Creek), downstream flows will be maintained by natural flows while the end pit lakes will be filled via controlled overflows (pump bypasses not required);
- Impacts to fish populations that are the result of permanent changes to surface drainage patterns (Bacon Creek, Lendrum Creek, Lund Creek, PET1, and possibly Hay Creek) will be assessed and quantified to determine the extent of the impact and a specific mitigation/habitat enhancement plan will be developed to ensure no net loss of fisheries productivity.

e. Considering that rainbow trout only spawn in specific stream habitats, explain how CVRI plans to mitigate the long-term loss of annual recruitment from the permanent loss of nearly 30 km of critical spawning and rearing habitat for Athabasca Rainbow Trout in this development.

Response:

CVRI's plans to mitigate the impacts of the Project are discussed in numerous locations within the Application. In particular, but not limited to, CR #2, Aquatic Resources Environmental Impact Assessment, Volume 1 – Section E, Environmental Assessment and Volume 1 – Section F, Reclamation Plan. The mitigation plans and proposals were developed in consideration of the long history of CVRI not only at the CVM, but elsewhere within the Province of Alberta. The mitigation plans and proposals are also developed in the knowledge that the Project, if approved, is scheduled to occur over a substantial amount of time during which existing approved and new habitat mitigation projects will be executed. This iterative and learning process will be applied to the Project mitigation projects.

In addition the refined water management and diversion plans presented in ESRD Appendix 86 indicate fewer direct impacts to high value habitat than was originally presented in the Project Application. A key consideration for future detailed planning will be the avoidance of impacts to critical habitats.

As indicated in the response to ESRD SIR #174, CVRI there are several concepts that will be considered as part of habitat compensation planning including development of spawning habitat in the inlet and outlet of lakes and enhancement of existing habitat to increase spawning potential. Other potential benefits to Rainbow Trout that may occur as a result of the end pit lakes include an overall increase in available habitat, an increase in wintering habitat, and attenuation of peak flows and retention of sediment (see response to ESRD SIR #174). There is also potential to implement specific research studies and/or management initiatives for Rainbow Trout. In addition, there is evidence that Athabasca Rainbow Trout densities in streams downstream of end pit lakes were higher than they were previous to the development of the lake (see response to ESRD SIR #168).

f. Considering that this mine development will create a number of large waterbodies that have a high probability of being colonized by northern pike, explain how CVRI will mitigate or compensate this significant shift in the fish community?

Response:

CVRI's intent is to develop self-sustaining native fisheries within the end pit lakes. CVRI will consider installing barriers to limit fish access to lakes if precluding fish access is a preferred fisheries management objective for the region. A more detailed discussion regarding the proposed end pit lakes and the establishment of salmonid populations within the lakes is provided in a response to ESRD SIR #168. Additional discussion of existing end pit lakes and their ability to support fish populations is provided in the response to ESRD SIR #185.

g. Explain how monitoring components of the compensation plan post-construction will enable effective modifications post-construction?

Response:

As indicated in CR #2 Section 6.0, components of any compensation plan will be monitoring post-construction to assess the effectiveness of the compensation and to identify modifications that will be made. The components of the monitoring plan would depend on the specific objectives of the habitat compensation works. Discussions of how CVRI plans for post-construction monitoring are provided in the responses to ESRD SIR # 168 and ESRD SIR #174.

h. Given the scale of stream diversions and end pit lake construction proposed by CVRI in this landscape, discuss how CVRI's adaptive management process will address habitat compensation work at CVRI to yield improvements to biological productivity, water quality and other physical properties. Explain how this is being considered in pre-construction planning.

Response:

CVRI will implement an extensive monitoring program over the life of the Project. The program will include measures of biological productivity, water quality and physical works. Information and conclusions from the monitoring will be used to evaluate habitat compensation measures as well as to aid in the 25 + years of planned mine development. Discussions of how CVRI plans to monitor works and implement adaptive management are provided in the responses to ESRD SIR #87, SIR #93, SIR #95, SIR #99, SIR #167, SIR #168, SIR #171, and SIR #174.

87. Volume 1, Section A.8.11, Pages A-42-44

Settled sediments (i.e., embeddedness) are having severe impacts to fish habitat and communities in several watercourses (Embarrass, Erith, Dummy) in relation to existing CVRI mines. The mitigation measures and technology proposed for this project are similar to those being utilized in existing CVRI mines, where impacts are severe.

a. Discuss how CVRI will measure, evaluate and mitigate for settled sediment (embeddedness) during construction, operations and closure in order to achieve insignificant impacts.

Response:

CVRI's approach to mitigating sediment introductions will include a comprehensive surface water management plan that includes regular inspection and maintenance of water management facilities.

Monitoring

CVRI currently employs a benthic invertebrate biomonitoring program (BIBP) that will continue. As indicated in CR #2, Section 6.0, the program is proposed to be expanded to include sample sites on potentially impacted watercourses as mining progresses. The monitoring of benthic invertebrate populations to detect changes in the benthic community as a result of sedimentation (and other contaminants or physical impacts) is an established practice that is recognized by Provincial and Federal Regulators (ERSD 1990, ENV CAN 1993).

For instream works, turbidity monitoring will be the primary tool utilized by CVRI to document and assess if instream work is resulting in detrimental sediment introductions downstream of the work site. A turbidity monitoring program will be developed by CVRI and will include:

- method to determine the relationship between turbidity and total suspended solids (TSS);
- method to determine sample locations;
- required sampling frequency;
- standard sampling methodology;
- compliance criteria; and
- actions to be implemented if compliance criteria are exceeded.

CVRI will also use turbidity loggers to document turbidity levels in receiving watercourses (streams draining the mine area) during mine operation. The turbidity logger program will be developed as mine plans progress. In general the program is likely to include the following:

- Deployment of the loggers during the construction phase (simultaneous with turbidity monitoring) however, the loggers would remain in place during the operation phase.
- Installation of loggers upstream and downstream of mining activities (such as a diversion) to document changes in turbidity that can be directly attributed to the mine.
- Data would be downloaded regularly, however, the frequency of the data download would depend on local conditions (*i.e.,* the size of the waterbody, the type and extent of mine activity that is being monitored, the time of year, flow conditions).

Mitigation

If the monitoring data indicates that a significant sediment introduction has occurred as a result of mining activities, then a habitat assessment will be completed to:

- identify visible sediment depositions (if any);
- identify the zone of impact; and
- quantify the amount (percentage) of fines in the substrate which can be compared to pre-mine habitat inventory data to help determine the level of impact.

Remedial measures would be implemented as required and may include:

- identification of the source of the sediment and implementation of measures to address the problem;

- removal of sediment; and
- habitat enhancement.

References:

Alberta Environment. 1990. Selected methods for monitoring benthic invertebrates in Alberta rivers. Alberta Environmental Protection, Surface Water Assessment Branch.

Environment Canada. 1993. Guidelines for monitoring benthos in freshwater environments. Prepared by EVS Consultants, Vancouver, BC.

b. How will adaptive management inform the process?

Response:

The monitoring programs outlined in the response to ESRD SIR #87a) describe how information obtained during monitoring will be reported and the process whereby actions will be initiated in response to these results.

88. Volume 1, Section A.8.11, Pages A-42 to A-44.

Dissolved oxygen concentration with depth is a major water quality variable influencing the amount of suitable aquatic habitat available.

a. Discuss why CVRI has chosen not to adjust end reclamation to ensure that all constructed lentic habitats are productive.

Response:

Volume 4, CR #11, Section 4.4, beginning on Page 45, presents an assessment of the limnological implications of constructing end-pit lakes with respect to oxygen stratification. This assessment is based on a review of three sets of studies conducted on the CVM end-pit lakes, a number of which do not meet all the guidelines contained in Volume 3, CR #6, Table 15:

- the studies in the 1990s conducted on Lovett, Silkstone, and Stirling (Pit 24) lakes (Agbeti 1998, Mackay 1999);
- the 2006 studies conducted on Lovett, Silkstone, and Stirling (Pit 24) lakes plus Pit 35 and Pit 45 lakes (Hatfield 2008); and
- a detailed study of surface water quality conditions in existing CVM end-pit lakes (Appendix 9 of this Application).

A main conclusion of this assessment was that, while patterns of dissolved oxygen concentration with depth and changes in these patterns are likely to be the major water quality variable influencing amount of suitable aquatic habitat available for aquatic life in the end-pit lakes proposed for the Project, the relative amount of suitable aquatic habitat available for aquatic life in end-pit lakes proposed for the Project, as a proportion of total end-pit lake volume, is predicted to be similar across all end-pit lakes and generally independent of their turnover pattern or whether or not they exhibit chemoclines. In addition, while lake turnover is generally considered an important ecological process in most productive lakes (Hutchinson 1938, Effler and Perkins 1987 and Wetzel 2001) it is not a necessary process governing the ability of a lake to sustain healthy fish populations (Effler and Perkins 1987, Trimbee and Prepas 1988).

References:

Agbeti, M.D. 1998. Water quality of two end-pit lakes in relation to fishery sustainability. Prepared for: Luscar Ltd. Prepared by: Bio-Limno Research & Consulting. 80 pp.

Agbeti, M.D. 1999. Water quality of two end-pit lakes in relation to fishery sustainability. Prepared for: Luscar Ltd. Prepared by: Bio-Limno Research & Consulting. 80 pp.

Effler, S.W. and W.G. Perkins. 1987. Failure of Spring Turnover in Onondaga Lake, NY. Water, Air, and Soil Pollution, 34: 285-291.

Hatfield (Hatfield Consultants). 2008. Surface Water Quality EIA: Mercoal West and Yellowhead Tower Project.

Hutchinson, G.E. 1938. On the relationship between the oxygen deficit and the productivity and topology of lakes. Int. Rev. Hydrobiol. 36: 336-355.

Mackay, W.C. 1999. Coal Valley Mine Extension: Cumulative effects of reclaimed end-pit lakes on water quality and fisheries resources. Prepared for: Luscar Ltd. Prepared by: W.C. Mackay & Associates. 39 pp.

Trimbee, A.M. and E.E. Prepas. 1988. Dependence of lake oxygen depletion rates on maximum oxygen storage in a partially meromictic lake in Alberta. Can. J. Fish. Aquat. Sci. 45:571-576.

Wetzel, R.G. 2001. Limnology: Lake and River Ecosystems. Third Edition. Academic Press, San Diego, California. 1006 pp.

b. Considering the significant loss of fully productive lotic habitats and the creation of lentic habitats with productivity influenced by anoxia, discuss CVRI's claim that the effects on surface water quality in end-pit lakes is insignificant?

Response:

See response to ESRD SIR #88a).

c. Since none of the proposed lakes mimic, in form or function, natural lakes in the area, explain any plans to have equivalent productivity studies completed, comparing end-pit lakes to the natural lakes and streams in the area.

Response:

CVRI is planning to continue additional investigations to document physical and biological conditions of CVM end pit lakes over time. Through application of adaptive management principles such monitoring results would be utilized in refining subsequent lake developments.

With respect to comparative studies in the CVM area it has been noted that natural lakes in the area with channel connectivity are uncommon. However, the suitability of CVM's completed end pit lakes as aquatic habitat has been studied historically by Hatfield (2008) and (2011) and comparisons have been made to Fairfax Lake (which has an outlet). Key findings from Hatfield (2001) included:

- The concentration of some water quality variables are higher in end-pit lakes than in natural lakes but not to an extent that would impact the ecological viability of the lakes.
- There have been relatively few water quality variable measurements in exceedance of provincial or federal water quality guidelines.
- The incidence of water quality exceedences is not measurably greater in end-pit lakes than in natural lakes in the CVM area.
- The trophic status of end-pit lakes is similar to that of natural lakes in the area.

References:

Hatfield. 2008. An evaluation of existing end-pit lakes. Prepared for Coal Valley Resources Inc. Prepared by: Hatfield Consultants 42pp+ Appendices.

Hatfield. 2011. An evaluation of water quality in existing end pit lakes in the Coal Valley Mine Area. Prepared for Coal Valley Resources Inc. Prepared by Hatfield Consultants 39pp+ Appendices

Sonnenberg, Rob. 2011. Development of Aquatic Communities in High-Altitude Mine Pit Lake Systems of West-Central Alberta. A thesis submitted to the School of Graduate Studies of the University of Lethbridge. 175 pp + Appendices.

89. Volume 1, Section C.1.6.3, Page C-19-20

a. Present information and images from previously diverted and reconstructed stream channels at CVRI indicating/supporting how this proposed methodology has successfully protected the integrity of the stream channel and water quality, and maintained functional fish habitat.

Response:

Center Creek – Pit 26

Mining of Pit 26 required relocation of a reach of Center Creek in order to accommodate the pit excavation. A large wetland area was also involved as part of the drainage basis of Center Creek. The diversion required an excavation of a 2250 m channel to provide a bypass for continued flow of the creek. The channel was excavated by backhoe and material trucked away from the site. Bedrock was encountered at several locations as the depth of cut reached over 5 m.

The design included a shallow gradient and some meandering alignment. Deep cuts utilized a benched configuration to lessen steep embankments. Gravel was placed in the bottom of the cut and bedrock contact was maintained where possible. Slopes where seeded with grass to minimize erosion and hand placement of seedlings and some transplanted shrubs were put into place.

The diversion is now well established. Vegetation is stable and embankments have shown little sign of movement. Flows are clear with some riffles and gravel beds. Fish are present and utilize portions of the new channel.

Center Creek – Pit 25

A diversion channel with a length of 730 m was required to accommodate mining of Pit 25. This channel was located in lower reaches of Center Creek. The channel provided a bypass flow around the mine area. A new channel was excavated by backhoe and material removed by truck. Similar treatment was established in this channel with vegetation established for erosion control. The channel is now well established. Fish are present and move through the diversion length.

Upper Embarras River

A length of Upper Embarras River was diverted to accommodate mining of Pit 122, 132, and 142. Portions of the river removed included a wetland formed by multiple beaverdams. This area was heavily silted and flows slow moving. Multiple blockages to flow where present before mining.

The diversion included 2300 m of lined channel and 600 m of open, unlined channel. The channel was constructed by backhoe through wet silty and muskeg areas. Material was sidecast away from the new channel. A channel profile up to 4 m deep was formed with a shallow gradient. Embankments were generally sloped to be 1.5:1. A plastic liner was placed into the channel and extended onto the flat embankments on each side. The sides were weighted with fill material.

Over the life of the diversion, the embankments slumped in many locations which caused the liner to rise and form low blockages in the base of the channel. Such events did not stop flow as the water level adjusted to the new profile. The plastic liner remained intact.

Beyond four years of service the liner began to show signs of weathering as some rips appeared and small sections on the slopes gave away. A more durable liner would have avoided this situation.

After the river was re-diverted to its new and final channel, fish were recovered from the old liner sections. A large number of various species showed that the channel had been well populated and fish movement was well established. No vegetation had been established in the channel. No artificial fish habitat had been constructed anywhere within the length of the diversion.

Mercoal Creek

A 1500 m length of upper Mercoal Creek was routed through a constructed channel to bypass the mining activity within Pit 143. A narrow, shallow ‘ditch’ was established with a backhoe for the new alignment. Material in the area was silty gravel. Depth of cut was generally 2 to 3 m.

The excavation was purposely narrow with pronounced meanders and severe ‘twists and turns’. Deeper ‘stilling pools’ were established at intervals of approximately 50 m. Trees were placed over and into the channel as were available to provide cover and reduce flow velocity.

The construction techniques were based on knowledge that initial flows would create significant erosion and sediment. It was also expected that with the gravel and coarse materials, that a stable bed and embankment would be quickly established. Flows into the new channel were introduced slowly and the initial sediment laden flow was pumped away from the downstream channel. Once flows became clear the channel was connected downstream.

The channel is now well established. Embankments have slumped in many locations but much of the channel has cobble bottom and is stable. Groundwater seepage from the surrounding silt and gravel is evident. No evaluations of fish populations or movement have yet been made in this channel.

Mercoal Creek Tributary

Mining in Mercoal West required mining out a short section of a tributary of Mercoal Creek. The creek was diverted into a ditch to bypass the mining area. Subsequently a permanent channel has been reconstructed. This channel is approximately 400 m in length and accommodates a small seasonal flow.

Other Mine Sites

CVRI, through current staff, operators and predecessor companies have extensive experience at other nearby coal mines including;

- Former Luscar Ltd Gregg River Mine – Berry Creek diversion, Sphinx Creek diversion, Gregg River diversion.
- Former Luscar Ltd Cardinal River Mine – Luscar Creek diversion, Jarvis Creek diversion, Leyland Creek diversion.

Lessons Learned

Projects such as those described above have provided valuable experience that can be applied to future construction. Some of the key principles noted include the following:

- The new channel must adequately accommodate the flows and gradient involved in the specific situations. Higher flows and steeper gradients are more difficult to handle.
- Surficial materials in which the channel is to be constructed must be accounted for. Easily eroded and unstable materials must be removed and well sloped. Adequate flow width in an armoured or stabilized channel is necessary.
- Liners such as plastic can perform well in temporary channels. Edges of the liner must be secured and embankment slumping anticipated.

- Significant work is required in permanent channels to establish vegetation and in stream enhancement such as gravel beds, cover and fish habitat. Time should be taken in advance to properly prepare the channel before flows are started.
- Sediment loads from the reconstructed channel should be anticipated in early usage of the channel until all the surfaces and embankments stabilize.

90. Volume 1, Section C.1.6.5, Page C-20

a. Describe the proposed end land uses alluded to.

Response:

The end land uses being alluded to in Section C.1.6.5 are referring to those possible and, as yet, undetermined uses of this public land upon the completion of mining and reclamation activities. It is CRVI's experience with existing certified reclaimed lakes that wildlife habitat and recreational use are the most common end land uses desired by the Province and the public. End pit lakes and associated littoral zones provide wildlife habitat for various species including fish, ungulates, amphibians, waterfowl and mammalian carnivores. These types of end land use features also provide possible recreational opportunities for anglers, outdoorsman and hikers

b. If the intension is to develop a stocked recreational fishery managed by ESRD, include where and how access will be developed to support this plan.

Response:

In general it is CVRI's intent to develop a self-sustaining native fishery within the end-pit lakes. In the event that an end-pit lake is designed for development of a stocked recreational fishery, CVRI is prepared to participate in land use planning for the post mining area just as it has in the recent Gregg River mine reclamation area. This participation can include inclusion of access roads into the reclamation profiles for fish stocking and monitoring purposes. However, end use planning for elements such as recreation opportunities or facilities, public access, fish stocking, hunting, motorized vehicle restrictions is considered to be primarily a provincial responsibility.

91. Volume 1, Section C.2.1.1, Page C-23-24

a. Since the Robb West development (Section C.3.8.4) will necessitate the retention of the Mercoal West/Yellowhead Tower haul road for a considerable length of time, discuss the potential for CVRI to relocate the haul road in the vicinity of Pits 122 & 142 to the east, along a remaining portion of the Mercoal Main, to bring closure to outstanding water management and reclamation issues that compromise the development of an ad-fluvial population of Athabasca Rainbow Trout in these pit lakes.

Response:

The Robb West development will not require continuation of the Mercoal West or Mercoal East haulroad.

92. Volume 1, Section C.4.1, Page C-47

a. What is the design criteria used to establish the size of these settling ponds?

Response:

Sediment control facilities are designed to:

- Meet the *Alberta Coal Mining Wastewater* Guidelines (AENV, 1998) and the discharge limits and design and construction criteria stipulated in the *Environmental Protection and Enhancement Act* approvals.
- Meet total suspended solids wastewater criteria during the one in 10 year peak outflow.

The criteria applied for pond sizing are as follows:

- Apply the 1:10 year storm event for sediment control.
- Settling facilities should be capable of providing storage for the design storm event to meet the settleable solids criteria of 0.5 ml/L (millilitres/Litre). Pond design is based on settling material coarser than medium silt, typically 15 microns. Stokes equation is applied for settling times with the following assumed settling factors: a particle settling rate of 0.02 cm/s, a non-spherical particle shape factor of 1.2, a non-ideal settling factor of 1.2 and, a minimum factor of 1.3 to allow for some loss in effective area caused by sedimentation. The high proportion of particle sizes smaller than 15 microns means that flocculants are utilized, in controlled amounts, to improve the settling performance of the ponds, as has been the experience at CVM.
- The 1:100 year maximum instantaneous discharge is applied for the pond outlets such that the facility does not suffer any significant damage during this discharge event. Freeboard allowances above the 1:100 year flood level are based on the size and location of the facility, the magnitude of the design flows and the consequences in the event of overtopping.
  Design peak flows are typically estimated using the Rational Method with a composite runoff coefficient determined based upon the relative areas of each land type and coefficients ranging from 0.9 for the roads (*i.e.*, 90% directly runs off during the design event) and 0.4 for other disturbed ground to 0.1 for natural low-moderate sloping terrain.

Peak inflows are attenuated by the pond and are typically reduced by 10% to compute peak outflows.

Standard design features for the ponds are as follows:

- The ponds will have flocculants stations (floc) and smaller pre-settling cells at the inlets. The pre-settling cells serve as mixing cells for the floc, trap the heavier coarse material and allow for easy / regular cleanout with a backhoe. Armoured overflow channels are usually provided from one cell to the other.
- Ponds are typically excavated in natural ground with depths of 3 m or more to provide for at least 1 to 1.5 m of settlement storage. Pond cleanout would be required when the depth of deposition reaches 1.5 m. Length to width ratios of 5 or more are preferred to maximize settling efficiency.
- Side slopes are typically excavated at 2H:1V to be stable. Flatter slopes or over-excavation of unstable silt material may be required depending upon site specific materials encountered. Downslope berm fill slopes are typically 3H:1V or flatter depending upon material and space available. Access is provided for monitoring and maintenance with the need for full access around the entire perimeter determined on a site specific basis.
- Outlets consist of corrugated metal pipe culverts or V-weir structures. Stoplogs or low level outlets are provided for drawdown and subsequent additional backup storage for storm events. The outlet size is minimized to increase the backup retention yet not create excessive backup during 1:100 year flood conditions. In some instances, separate emergency overflows may be provided to safely convey in excess of the 1:20 year to the 1:100 year flood event with freeboard.

b. What is the design retention time?

Response:

The retention time varies with the inflow hydrograph, the amount of deposition in the pond and if pumped inflows are present. At the design 10-year peak outflow rate, the retention time is typically 6 to 12 hours for small ponds and with backup controls can be increased by up to 4 hours depending upon the pond and amount of backup available. CVRI will provide over-sizing to provide for additional deposition storage where sediment loading is expected to be high (*i.e.,* road runoff or active in-pit sumps are the main inflow) and maintenance response times for cleanout may be limited.

93. Volume 1, Section C.4.3, Page C-49

a. Describe how adaptive management from previous stream diversion and watercourse reclamation work at existing CVRI mine projects will be utilized to reduce risk to fish populations in the Robb Trend project.

Response:

Recent diversions that CVRI have completed include Chance Creek, the upper Embarras River, and several unnamed tributaries to Mercoal Creek. Information gained during these projects that will be incorporated into future diversions include:

- schedule works to avoid spring and early summer (periods of high flow);
- channel side slopes should be stable; generally a 2.5:1 slope is adequate;
- if the channel is lined the liner should extend to cover the entire side slope and seams should be overlapped; and
- minimize the gradient of the diversion channel.

b. In reference to the mining sequence that will affect the main stem Erith River, explain/clarify what is meant by the 'ultimate river channel'.

Response:

The ultimate river channel refers to the river alignment upon final reclamation, which will flow through the reclaimed pits of the Mynheer Seam. A more detailed description of the potential mining and drainage plans for the Erith River is provided in the Water Management Plan described in CR#6 and the Aquatic report in CR#2 as well as ESRD Appendix 86.

c. The reclamation plan, Section F, does not describe the re-establishment of the Erith River following mining of the Mynheer Seam, but rather the conversion of lotic to lentic habitat. If this is correct, explain how this is deemed reclamation, and how it contributes to NNL of lotic fish habitat. If this is not the plan, describe in detail the criteria to be used for re-establishing the Erith River channel.

Response:

As previously noted, mine plans and water management plans will be refined during detailed planning and design phases. At present, there are several options that could be implemented to reduce potential impacts to aquatic habitats to the Erith River. ESRD Appendix 86 provides a preliminary description of these options.

CVRI is committed to implementing a No Net Loss Habitat Compensation Plan (NNLP). As indicated in CR#2, Section 5.4.6 the NNLP will be developed and refined as subsequent planning phases and further mine plan details become available and following consultation with regulators and stakeholders.

As indicated in CR#2, Section 5.4.6.2 the NNLP will consider the hierarchy of compensation preferences as outlined in the Fisheries and Oceans Canada Practitioners Guide to Habitat Compensation (2006) and the Policy for Management of Fish Habitat (DFO 1986). These preferences in order of priority are:

- create or increase the productive capacity of like-for-like habitat in the same ecological unit;
- create or raise the productive capacity of unlike habitat in the same ecological unit;
- create or increase productive capacity in a different ecological unit; and
- use of artificial production techniques to maintain a stock of fish, deferred compensation, or restoration of chemically contaminated sites.

As such, the NNLP may include the enhancement/construction of lotic habitat (*i.e.*, the creation or increase in productive capacity of like-for-like habitat in the same ecological unit) but may also include the creation of lentic habitat (*i.e.*, creation or increase in productive capacity of unlike habitat in the same ecological unit). Other compensation options including off-site compensation and/or use of artificial production techniques will also be considered.

References:

Department of Fisheries and Oceans (DFO). 1986. Policy for the Management of Fish Habitat. Department of Fisheries and Oceans. Ottawa. Ontario.

Department of Fisheries and Oceans. 2006. Practioners Guide to Habitat Compensation. Department of Fisheries and Oceans, Ottawa, Ontario.

94. Volume 1, Section C.4.5, Page C-53-54, and Section C.6, Page C-57

CVRI has proposed lakes that, while achieving specified water quality requirements, will not achieve the production values for the stream habitats they are replacing. The proposed lakes contradict the statements provided in the first paragraph of Section C.6; Environmental Management.

a. Explain this apparent contradiction and describe how CVRI will reclaim stream habitat in the post-mining landscape.

There is no contradiction between the environmental management commitments that CVRI has made in this Application, the commitments that CVRI supports in its daily activities not only at the CVM, but elsewhere throughout its operations and the statements within Section C.6.

As stated in CR #2, Section 5.4.6, CVRI is committed to implementing a habitat compensation plan to satisfy the No Net Loss principle in terms of maintaining productive fish habitat.

As indicated in the Project Application, the mine plan presented in the Application represents a preliminary plan that is focused towards maximizing coal recovery. Once detailed planning and design have been completed (at the mine licensing stage) detailed habitat mitigation and compensation plans will be developed. As indicated in CR#2 Section 5.4.6.2, key components that will be considered in the development of the No Net Loss Plan include both the restoration and enhancement of stream channels and the development of end pit lakes to maximize habitat and biological diversity and use by native fish populations.

Fish production in rivers has been reported to be approximately 3 times greater than in lakes (Randell et. al. 1995) however, the amount of available habitat provided by the end pit lakes (CR #6, Table 12), will be approximately 35 times greater than the preliminary estimate of habitat altered or lost (CR#2, Table 5.19). While these estimates are based on a number of assumptions (and therefore may be subject to some adjustment), it seems apparent that overall fish production for the impacted area is likely to increase rather than decrease due to the expansion in available habitat.

Reference:

Randell, R.G., J.R.M. Kelso, and C.K. Minns. 1995. Fish production in freshwaters: Are rivers more productive than lakes? Canadian Journal of Fisheries and Aquatic Sciences 52:631-643.

95. Volume 1, Section C.6.6.1, Page C-59

Adaptive Management uses structured evaluation of effect to direct future applications that reduce risk or improve outcomes. In that context, the lessons of past lake development should be directing the development of future lakes.

a. Explain how CVRI plans to incorporate lessons learned from past experiences in lake development (i.e., applying Adaptive Management) to improve the long-term productivity and sustainability of the end pit lakes it is proposing for the Robb Trend Project.

Response:

In the ongoing interest of improving the design and functionality of end pit lakes, CVRI has implemented several end pit lake studies in recent history and additional studies are planned as part of the Yellowhead Tower Extension Project. Information and conclusions from these studies will be used in the design and construction of end pit lakes for the Project.

Two studies conducted by Hatfield Consultants (Hatfield 2008, 2011) evaluated water quality conditions in existing end pit lakes on the CVM and identified several design strategies for consideration in future end pit lake development including:

- maximize ratio of lake area to lake depth;
- vegetate around the lakes to decrease erosion;
- minimize slope gradients;
- decrease the amount of total solids entering the lake;
- attempt to construct inflows and outflows;
- increase lake flushing rate;
- maximize habitat diversity within lake; and
- while complete lake turnover would be optimal, it is not a necessary process governing the ability of a lake to sustain healthy fish populations.

CVRI has also implemented a monitoring program, in consultation with ESRD, for the end pit lakes in the headwaters of the Embarras River. This program, initiated in 2011, will be ongoing for at least 5 years and will include annual reporting of the condition of various physical and biological components within lakes and connecting channels including:

- Stability of surrounding lands and inlet and outlets;
- Water quality;
- Benthic and planktonic communities;
- Aquatic macrophytes; and
- Fish populations.

A monitoring program similar to the Embarras Lakes program described above will be implemented on the Chance Creek drainage as part of the approved Yellowhead Tower Extension.

Information and conclusions from both the Embarras River and Chance Creek monitoring programs will be available to use in the planning and development of end pit lakes for the Project.

References:

Hatfield (Hatfield Consultants). 2008. Coal Valley Mine: An Evaluation of Existing End Pit Lakes. 42pp. + App.

Hatfield (Hatfield Consultants). 2011. An Evaluation of Existing End Pit Lake in the Coal Valley Mine Areas. 41pp. + App.

96. Volume 1, Section E.2, Page E-15-41

a. The rankings in Table E.2-3 do not appear to have been scaled to account for differing ecological parameters. Overwintering by RNTR in small tributaries is unconfirmed and further confounds rankings. Include rankings that account for a mean wintering pool depth of 0.65 m (TCEW) and a mean spawning particle size of 10 mm (TCEW).

Response:

The rankings in Table E.2-3 are intended to provide a general understanding of habitat potential and habitat utilization of the study streams. A description of the habitat ranking system is previously provided in CR #2, Table 4.12. The ranking system relies on a number of evaluation parameters (considered important for various habitat components) including pool depth (for wintering) and particle size (for spawning). Results from habitat inventories and specific investigations (to assess both wintering and spawning potential) were used to apply the rankings. As indicated in the response to ESRD SIR #102, habitat suitability modeling (scaled to account for specific requirements by species) may be completed in the future as part of no net loss planning to support applications to Fisheries and Oceans Canada.

Overwintering assessments were conducted and was previously provided for specific information with regards to overwintering potential based on water quality, flow, water depth, substrate, and presence of fish (using underwater camera) (CR #2, Appendix B).

Assessment of spawning potential for Rainbow Trout was completed and was previously provided. It found that mean particle size of spawning substrates was greater than 10mm (CR #2, Appendix B).

b. For Table E.2-4, include sediment in the impact assessment for road crossings.

Response:

Table E.2-4 refers to direct habitat impacts (*i.e.,* those components of the Project that could result in an instream footprint). The potential for sediment (including potential sediment generated at road crossings) to affect aquatic habitat is addressed in CR #2, Section E.2.3.3.

c. For Table E.2-5, the potential impact is unspecified. Provide a classification for risk associated with each diversion. Include the risk to invoke a fish community shift, from one dominated by salmonids to one dominated by pike, suckers and cyprinids.

Response:

Table E.2-5 provides a description of habitat impacts that are expected to occur as a result of planned diversions (based on preliminary mine planning). Quantification of the area of habitat impacted by a project is common practice in environmental impact assessment to characterize or specify an impact. For Table E.2-5, a general ranking of habitat potential/utilization is provided to further describe (specify) the impact.

As noted in the Application and described in the water management and aquatics discussion paper, mine plans and water management plans will be refined during detailed planning and design phases and as such the impacts identified in Table E.2-5 should be considered preliminary and are likely subject to change. For example, additional water management planning indicates that most of the diversions listed in Table E.2-5 will be gravity diversion channels and will not require pumping. As such, an assessment of risk at this stage of the Project could be inaccurate since it would be subject to a number of assumptions based on preliminary design information. In addition, while Table E.2-5 provides a description of impacts it does not include a description of mitigation measures that may be incorporated as part of the project (mitigation concepts presented in CR #2, Section 5.4 with detailed mitigation planning to be conducted as mine plans progress), which should also be considered in a risk assessment.

CVRI contends that residual effects will be fully mitigated and impacts to aquatic resources are expected to be insignificant (CR #2, Table 7.1). However, when considering the sensitivity of impacted habitats as well as the magnitude of the impact, CVRI acknowledges the following statements regarding potential risk to aquatic resources as a result of stream diversion:

- There is increased risk associated with impacts to habitats with high potential/utilization rank (Table E.2-5).
- The level of risk associated with stream diversions will increase as the size (footprint) of the impact increases.

- There is a greater level of risk associated with diverting larger watercourses (*i.e.*, Erith River).
- There is greater level of risk when employing mitigation measures that have not been previously employed and proven to be effective.

As indicated in the response to ESRD SIR #168 there is a number of mitigation measures than can be employed to minimize the risk of a potential shift in fish community composition.

d. For Table E.2-7, quantify the expected loss in production in terms of spawning and annual standing stock for all impacted lotic habits. Proposed reclaimed lakes will not address these losses. Describe compensation to offset these losses.

Response:

CVRI is not in agreement with the statement that reclaimed lakes cannot address losses and believes there is evidence to support the contrary (see response to ESRD SIR #168 and ESRD SIR #185). At present CVRI does not anticipate loss of production and standing stock once no net loss plans have been implemented. A description of habitat compensation concepts that may be implemented as part of no net loss planning is provided in the response to ESRD SIR #174.

97. Volume 1, Section E.2.3.5, Page E-34

CVRI states *Activities associated with the Project that have potential to directly impact fish habitat and, consequently, fish populations will not extend into the RSA.*

a. Describe how the impacts will extend into the RSA given that fish are mobile and some fish will move as mining operations affect their local habitat.

Response:

The referenced statement refers to direct habitat impacts (*i.e.*, diversions, watercourse crossings) that will be spatially limited to the LSA and will be mitigated locally (within the LSA). Potential impacts (*i.e.*, changes to water quality, flow regime, resource use) that have the potential to extend into the RSA are addressed in subsequent paragraphs in the previously provided Section E.2.3.5.

98. Volume 1, Section E.2.3.7, Page E-35

The successful spawning of Bull Trout is contingent on the retention and health of specific habitats in the Erith watershed. CVRI has not identified these critical habitats and the impact associated with them.

a. Complete an assessment of critical habitat and impacts, and reassess the risk of the project to Bull Trout.

Response:

Bull Trout were only found in the Erith River and one Erith River tributary during baseline sampling. There is historical reference of Bull Trout in several other water bodies including Bacon Creek and Halpenny Creek but their frequency of occurrence was low (one or two individuals) (FWMIS 2012). The 2011 sampling by ESRD captured only three Bull Trout and they were found some distance downstream of the Project. Based on this information it seems evident that Bull Trout habitat utilization of the upper Erith River drainage is limited and it would appear that the habitat is primarily food production habitat that may be used sporadically for rearing.

While critical Bull Trout habitats in the region (Mackenzie drainage, Berland drainage, Bolten drainage) have been designated as Class A habitat by ESRD (ESRD 2006), no critical Bull Trout habitat (or Class A habitat in general) has been identified within the Project area (ESRD 2006). All of the habitats within and immediately adjacent to the Project are designated Class C habitat (ESRD 2006) which is defined as moderate sensitivity, broadly distributed habitats that supports local fish populations (ESRD 2000).

References:

Alberta Environment. 2000 (Rev 2001). Guide to the Code of Practice for Watercourse Crossings including guidelines for complying with the Code of Practice. 29 pp. ISBN No. 0-7785-1483-8

Alberta Environment. 2006. Alberta Code of Practice Edson Management Area Map.

b. Describe the range of production losses (fish species including losses to invertebrates) resulting from reductions in flow and creation of end pit lakes.

Response:

Long term flow reduction for most watercourses is expected to be within the range of 15% or less, which is considered to be acceptable by Alberta guidelines (Alberta Environment 2011).

The reduction of peak flows may benefit Rainbow Trout (as described in the response to ESRD SIR #104) and studies at other end pit lakes in the region have found that fish densities in streams downstream of lakes has increased following the creation of the lake (Sonnenberg 2011 and response to ESRD SIR #185).

As indicated in the response to ESRD SIR #94, fish production in the Project area is expected to increase rather than decrease since there will be substantially more fish habitat available once the lakes have been constructed. Production of benthic invertebrates in the project area is also expected to increase since there will be more available habitat and benthic densities in surface connected end pit lakes in the region appear to be similar to densities in local streams (Pisces 2008, 2011).

References:

Alberta Environment and Sustainable Resource Development AENV) 2011. A Desk-top Method for Establishing Environmental Flows in Alberta Rivers and Streams. ISBN:978-0-7785-9979-1.

Pisces Environmental Consulting Services Ltd. 2008. Benthic Invertebrate Monitoring in Streams on and Adjacent to the Coal Valley Mine, 2008. Prepared for Coal Valley Resources Inc. Edson AB. 22pp.+App.

Pisces Environmental Consulting Services Ltd. 2011. Limnological Surveys of Five End Pit Lakes on the Gregg River Mine, 2009-10. Prepared for Sherritt Coal, Edmonton, AB. 48 pp.+App.

c. Discuss the impact of a shift in the fish community of the upper Erith watershed.

Response:

As indicated in the response to ESRD SIR #168, there are several options that are being considered to limit the potential movement of certain fish species into an end pit lake system. These initiatives could be implemented in concert with regional fisheries management objectives. As indicated in the response to ESRD SIR #185, CVRI has successfully installed an exclusion device downstream of the Embarras Lakes system.

The creation of end pit lakes also has the potential to improve local habitat suitability for species such as Arctic Grayling and Bull Trout (see response to ESRD SIR #168). Bull Trout have been known to occur in nearby reclaimed end pit lakes, successfully reproducing in a connected inlet channel (Sonnenberg 2011).

99. Volume 1, Section E.2.5.2, Pages E-39-40.

The proposed monitoring plan is no different than any monitoring plan previously proposed. Current mining, including reclamation following mining, needs to be refined based on lessons learned from previous mining in these landscapes (adaptive management).

a. Describe how adaptive management has been and will be applied to the monitoring of end pit lakes in order to yield physical changes to the design, in order to provide for improvements in fish use, biological productivity, water quality and other physical properties.

Response:

A detailed description of past, current, and future end pit lake monitoring programs and a discussion of how the monitoring data will be used in future end pit lake planning is provided in the Response to ESRD SIR #95.

100. Volume 2, CR#2 , Section 3.1.2; Page 8

Some data reported is nearly 5 years old. ESRD completed comprehensive surveys for the Erith/Embarras watershed in 2011.

a. Include this survey data in the EIA and present the revised analysis.

Response:

Given the large scope of the project and in an effort to accurately depict baseline conditions, fisheries data was collected over a number of years beginning in 2005. The EIA also included a summary of existing fish sampling data (conducted by others) that was available through the Fish and Wildlife Information System (FWMIS) at the time of report preparation in early 2012 (CR#2, Table 4.2). The 2011 data referred to above was received from ESRD on August 23, 2012. Upon review, the results from the sampling completed by ESRD in 2011 appeared to be consistent with the results and analysis presented in the EIA as part of the Project application:

- Species composition remains unchanged (no additional species captured within the LSA or RSA during the 2011 sampling).
- Athabasca Rainbow Trout remain the predominant species (most abundant and widespread) within the LSA and were also captured quite frequently during the 2011 sampling in the RSA (lower Erith River).
- Bull Trout remain relatively uncommon in the LSA and were captured infrequently during the 2011 sampling in the RSA (lower Erith River).
- Arctic Grayling remain relatively rare in the LSA; 2011 sampling in the RSA (lower Erith River) found Grayling to be quite abundant.

References:

FWMIS (Fish and Wildlife Management Information System). 2012. Alberta Environment and Sustainable Resource Development.

ESRD (Alberta Sustainable Resource Development). 2010. The General Status of Alberta Wild Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service. Edmonton, AB. 51 pp.

101. Volume 2, CR#2, Section 3.1.3.1, Page 9

Population estimates and expressions of density do not conform to standard reporting practices for ESRD, hence cannot be compared to historical data available for these watersheds. The Consultant has been advised on several occasions that population data is to be provided as first-pass catch/m^2. To complete 2 passes of a technique that requires a minimum of 4 passes for reliable estimation.

a. Describe the criteria used for the analysis.

Response:

The criteria used for population estimates was as follows:

- If low numbers of fish were captured on the first pass (generally <10) and the % reduction in catch between passes 1 and 2 was >60% then the probability of capture for a 2 pass estimate was likely near 0.8, and no additional passes were completed. If the criteria were not met then additional passes were completed. Armour *et al.* (1983) note that a 2 pass removal estimate with a $p \geq 0.8$ is reliable and the model of Sweka *et al.* (2006) for removal estimates suggests that negative bias is <4% when $p>0.7$. All estimates were then divided by the area sampled (100m^2) to derive a density estimate.

The information required to determine first-pass catch/m^2 for comparison to historical data was previously provided as part of the Project Application; first-pass catch is provided in CR#2, Appendix C and area sampled is provided in CR#2, Appendix B. In addition, data for first-pass catch and area sampled was provided to ESRD in the form of Fish Research License data returns.

References:

Armour, C.L., K.P. Burnham and W.S. Platts. 1983. Field methods and statistical analysis for monitoring small salmonid streams. U.S. Fish & Wildlife Service, FWS/OBS-83/dd. 200 pp.

Sweka, J.A., C.M. Legault, K.V. Beland, J. Trial and M.J. Millard. 2006. Evaluation of removal sampling for basinwide assessment of Atlantic Salmon. North American Journal of Fisheries Management 26:995-1002.

b. Describe rationale for using population density and expressions of density.

Response:

Population density is a parameter of interest and import to CVRI and the consultant. Over time, such data could be used to develop a density estimator based on first pass catch and subsequent density estimates could be used to validate the estimator.

Since variable effort (seconds per unit area) decreases the reliability of CPUE as an index of density, and CPUA is highly correlated with density (pending ESRD Fisheries Management Branch Standard for Small Stream Surveys), it is advised to express first-pass catch in terms of catch per unit area.

c. Rebuild Figure 4 with the following values:
- X – Sample Site
- Y – First-pass Catch (RNTR) as fish per m^2.

Response:

Revised figure is attached and listed as ESRD Figure 101-1.

102. Volume 2, CR#2, Section 3.1.4.2, Page 10 and Appendix A, Table A.1, Page A-3

a. For Table A.1, clarify how these features are scaled to account for the adaptation of Athabasca Rainbow trout to the small headwater streams of western Alberta.

Response:

Table A.1 provides a description of the parameters used to inventory fish habitat in general and is not intended to be a species-specific habitat suitability assessment tool. However, habitat data obtained through this type of inventory can be compiled and analyzed to help determine potential habitat suitability for a fish species. Key parameters from Table A.1 that can be used in assessing habitat in terms of suitability for Athabasca Rainbow Trout include:

- Percent instream and overhead cover;
- Percent pools;
- Average habitat depth;
- Average substrate size in spawning areas;
- Predominant substrate type in riffle-run areas;
- Percent fines substrates in riffle-run areas; and
- Riparian vegetation composition and stability of streambanks.

Habitat Suitability Modeling (HSI) was not required nor conducted as part of the EIA submitted with the Project Application. However, as mine plans progress HSI modeling may be implemented as part of habitat enhancement and compensation planning to support applications to Fisheries and Oceans Canada.

The habitat suitability indices for Rainbow Trout developed by the U.S. Fish and Wildlife Service (Raleigh *et al.* 1984) provide a good basis for assessing habitat suitability for Rainbow Trout. However, CVRI recognizes that there are wide variations in life history patterns and in habitat selected by Rainbow Trout and may (depending on availability and applicability of information) consider modifying some aspects of the Raleigh (1984) model to better reflect specific habitat requirements of Athabasca Rainbow Trout. Information collected by CVRI and data from the Tri-Creeks Watershed Study (Sterling 1986) would be the primary sources for such modifications.

b. Explain why the HSI model for Athabasca rainbow trout (preferred spawning substrate - geometric mean particle size 1.0 cm; range 0.3 – 3.1 cm) wasn't used.

Response:

As indicated in the response above, HSI modeling was not required nor conducted as part of the EIA submitted with the Project Application. However, as mine planning progresses HSI modeling may be implemented as part of habitat enhancement and compensation planning to support applications to Fisheries and Oceans Canada.

Assessment of spawning potential for Rainbow Trout included visual assessment to identify fish engaged in typical spawning behavior, possible redd excavations and confirmed redd sites. Gravel samples were obtained from these sites and measured for average size of gravel. Results are provided in CR #2, Appendix B.

103. Volume 2, CR#2, Section 3.1.4.3, Page 10

a. Clarify if fish were sampled under ice to determine actual wintering.

Response:

The referenced text refers to winter habitat conditions assessment and therefore does not include fish sampling under the ice. The assessment included the measurement of various physical and chemical parameters as indicated in CR#2, Appendix A.

104. Volume 2, CR#2, Section 3.2.3, Section 4.2 & Table 4.3 Pages 12-14, 64
The provincial status for Athabasca rainbow trout is currently under review and the AESCC (Alberta Endangered Species Conservation Committee) has recommended to list Athabasca Rainbow trout as 'Threatened' is pending the approval by the Minister of ESRD.

a. Discuss how the native Athabasca Rainbow Trout population has been impacted from introduced trout in the Athabasca drainage system.

Response:

There is concern that Athabasca Rainbow Trout may be subject to interspecific competition with Brook Trout but the interactions between the two species are not well understood. Limiting factors associated with potential interspecific competition identified in the Status Report for Athabasca Rainbow Trout (2009) include the following:

- In general, Brook Trout are well adapted to live in the streams of the Athabasca region.
- It is thought that Brook Trout may be less vulnerable to siltation effects compared to Rainbow Trout since they will excavate through silt and mud to find good spawning gravel. In addition, Rainbow Trout emerge later than Brook Trout do, which may mean that there is increased potential for Rainbow Trout eggs to be covered by sediment that is mobilized during the spring freshet.
- Potential benefits of the proposed end pit lakes is the attenuating effect of high flow events which could benefit Rainbow Trout during early life stages as well as the sediment retention that will occur in the lakes.
- It is thought that Brook Trout may gain a competitive advantage since they emerge earlier and reach maturity earlier than Rainbow Trout.

b. Provide an updated evaluated risk by evaluating risk based on a status of 'threatened'.

Response:

As indicated in CR#2, Table 4.3, pages 20, 21, CVRI recognizes that native Athabasca Rainbow Trout populations are "At Risk" and that a "Threatened" designation has been recommended by Alberta's Endangered Species Conservation Committee. This information was considered during the environmental impact assessment process that was presented in the Application. CVRI recognizes that a Rainbow Trout recovery plan will be developed if/once the "Threatened" designation is in place and is committed to participating with the implementation of this plan. CVRI currently has a representative on the Athabasca Rainbow Recovery Committee.

As indicated in the response to ESRD SIR #104a), the proposed end pit lakes may result in a direct benefit to Athabasca Rainbow Trout populations by attenuating peak flows and potential sediment transport during sensitive periods. In addition, the proposed Project could provide the opportunity to implement specific recovery initiatives such as:

- Creation of self-sustaining Athabasca Rainbow Trout populations that are isolated from Brook Trout.
- Installation of barriers that limit the upstream movement of Brook Trout and other selected species.
- Implementation of Brook Trout removal programs.
- Construction of habitat enhancements that specifically target the requirements of Athabasca Rainbow Trout.
- Implementation of specific research programs (*i.e.*, further research into the biotic interactions between Brook Trout and Athabasca Rainbow Trout).

105. Volume 2, CR#2, Table 4.12; Page-33

a. Provide an updated assessment with rescaled parameters to account for ecological impacts owing to spawning and wintering habitat losses.

Response:

Table 4.12 of CR #2 provides a description of the system used to rank existing habitat conditions. The purpose of the ranking system is to provide a general understanding of the value of the existing habitat in terms of fish use during various life cycle phases. The rankings for study streams are presented in CR #2, Section 4.3 while potential impacts such as loss of spawning or wintering habitat are addressed in CR #2, Section 5.2.1.; estimates of the total area impacted (based on the current mine plan) as well as the rank of the impacted habitat are provided.

As noted in the Project Application, the current mine plan has been developed to provide conceptual Project level information necessary for government regulators to decide whether or not the Project ensures the orderly, efficient and economic development of Alberta's coal resources in the public interest. As such, the proposed mine plan should be considered a conceptual plan and CVRI recognizes that additional information will be required for specific approvals and/or authorizations pursuant to various Provincial and Federal regulations. To that end CVRI has initiated more detailed water management planning as described in ESRD Appendix 86. The proposed mine plan will result in the creation of a number of end pit lakes that will provide wintering habitat for fish. While the final configuration of the lakes has not been determined it is clear that the amount of wintering habitat will increase substantially as a result of the Project. This increase in wintering habitat is considered a net benefit to local fish populations.

6. TERRESTRIAL

6.1 Conservation and Reclamation

106. Volume 1, Section A.8.10, Page A-40 and A-47
Volume 1, Section E.10.3.2, Page E-159
Volume 1, Section F.4.1.2, Page F-38
Volume 4, CR #10, Section 3.2, Table 1, Page 9
Volume 4, CR #10, Section 5.4, Page 59
Volume 4, CR #10, Section 5.4, Table 12, Page 60 and 61
Volume 4, CR #10, Section 6.2.1.2, Page 72

CVRI states on Page A-40 that areas where the soils are too wet will not have surface soil salvaged. On Page A-47, CVRI states that during construction, peat and topsoil materials from wetlands will be salvaged and stored for replacement during reclamation.

a. Discuss the methods and criteria CVRI will use to determine if soils are "too wet" to salvage surface soils.

Response:

The CVM salvages two types of surface soils; upland mineral soils and organic soils. The "too wet" for salvage criteria is applied to upland mineral soils. Upland soils can be "too wet" for salvage because of local climatic events or because of the local moisture regime. If the "too wet" designation is applied because of climatic conditions the salvage operations can be delayed until drier conditions come about. If the "too wet" criterion is applicable to upland soils that are saturated for extended periods of time the soils may not be available for salvage.

Soil structure is used to describe the soil aggregate or primary particle arrangement and pore system. Salvage of "too wet" soils can lead deterioration of the soil structure as wet soils are more susceptible to soil degradation such as mixing with subsoils and compaction. The end result is that soil handling under wet conditions can compromise the salvaged soil quality and ultimately the quality of the final reclamation.

One of the factors influencing the determination of "too wet" soils is operability. This is based on the ability of the earthmoving equipment being able to effectively salvage the soils. When soil is "too wet" heavy equipment is not able to efficiently undertake the soil salvage operations.

As a general rule of thumb; if soils are wet enough to cause rutting which will cause mixing of upper soil horizons with the underlying subsoils the soils are "too wet" and salvage operations should not be undertaken.

The decision to salvage wet soils is also influenced by the soil balance. If there are insufficient volumes of soils available for salvage for the soil replacement demand of the reclamation program all the soils will have to be salvaged. It may be possible to delay salvage until frozen conditions are present. Salvaging under frozen conditions will allow the heavy equipment to access the "too wet" soil salvage areas and will minimize any deterioration of the soils.

Reference:

Alberta Transportation Guide to reclaiming Borrow Excavations Used for Road Construction (EBA Engineering Consultants Ltd. May 2002)

b. Discuss the rationale under which peatlands and wetlands, which generally have a high water table and would be considered very wet with very poor drainage, will have surface soil salvaged, while other areas, with poor drainage such a soil landscape units F1, F2, F3, F4, L6, and M6, will not have surface soil salvaged.

Response:

Peatlands and most wetlands contain organic soils which are comprised of decomposing hydrophytic plant materials and generally do not have a defined structure. As a result organic soils are not as vulnerable to degradation as upland soils.

Soils from soil landscape units F1, F2, F3, F4, are subhygric and in general will not pose salvageability issues and will be salvaged. Soils from soil landscapes L6, and M6 are subhydric to hydric and will likely not be salvaged due to the water table being near to the soil surface.

The salvage of wetland or organic soils is a specialized operation that is completed to supply soil for the reconstruction of wetlands and to augment insufficient volumes of upland soils. When salvaging organic soils to augment upland soil volumes mixing of the organic horizon with the underlying mineral horizons is completed to provide a peat/mineral soil mixture. Therefore there are no concerns with soil mixing when salvaging organic soils.

c. Provide information on how these "too wet" areas will be identified in the field.

Response:

Prior to the commencement of soil salvage areas the soil salvage monitor will, with the pit operations personnel, inspect the salvage area and determine if there are limiting factors such as wetness that will require modifications to the salvage plan. The inspection will look for signs, such as standing water or soil sticking to boots, which indicate that the soil is too wet and could impact the soil quality if salvaged.

Once the salvage operations commence the soils salvage monitor will observe the salvage operations and if it is determined by professional judgement that excessive mixing is occurring salvage operations will be suspended.

d. Provide updates to the reclamation material balances and EIA, Reclamation Plan, and CR #10 Soil Resources report as required.

Response:

No adjustments to the reclamation material balances are required at this time.

107. Volume 1, Section A.8.10, Page A-41
Volume 1, Section F.4.1.3, Page F-39
Volume 4, CR #10, Section 4.2.2, Table 8, Pages 33-38
Volume 4, CR #10, Section 5.3.2, Page 56
Volume 4, CR #10, Section 5.4, Page 59

CVRI states *that during the mining process the dragline generally places the overburden on the top of the spoil piles, and that when the overburden is recontoured, the lower overburden will be close or at the ground surface.* From Table 8 in the Soil Resources report, it appears that the majority of the lower overburden is rated as unsuitable. CVRI further states that in order to reduce the overall impact of the project on soil resources, CVRI will sample the surface spoil on the recontoured land surface to identify potentially sodic spoil prior to coversoil placement. CVRI further states that they will *ensure that sufficient quantities of suitable overburden are available either by identifying a borrow site or by stockpiling suitable overburden.*

a. Discuss CVRI's confidence that there is sufficient overburden rated as suitable to provide a minimum 1 m cover over the recontoured land surface.

Response:

CVRI notes that caution must be exercised in review of the data. Although many of the samples indicate 'unsuitable' conditions the samples taken do not represent a true representative picture of the full overburden volume that will be mined. Some of the drillhole samples are clustered and some are only short segments of the full overburden column.

Some observations from the data include:

- Drillholes RT-10-75 and RW-11-03 were drilled into overburden around the Mynheer Seam. The bottom part of Drillhole RT-10-75 is below the Mynheer Seam, in footwall rock.
  By discounting the portion below the seam, which will not be mined, the vast majority of overburden above the Mynheer Seam will be suitable material. Therefore CVRI is confident that suitable Mynheer overburden material will be available on contoured slopes.
  Further sampling, prior to licence submissions, will be undertaken for a more detailed review of material characteristics.
- The bottom half of Drillholes RT-10-161 is located below the Val d'Or Seam into footwall rock which will not be mined. Drillhole RW-11-07 was sampled entirely below the Val d'Or Seam.
  The remaining data for the Val d'Or overburden suggests a portion of the material to be unsuitable with a greater degree toward Robb East. Insufficient sampling is available to identify any specific strata or 'horizon' as problematic.
  Further sampling, prior to licence submissions, will be undertaken for a more detailed review of material characteristics.

Table 8 of the Soils Resource Report provides data from the drillhole information that has been collected for the Project. A summary of the depths of suitable overburden as detailed in Table 8 is provided below, in ESRD Table 107-1:

Table 107-1 Robb Trend - Overburden Suitability

Corehole	Suitable Overburden Depth Range (metres)		
	Surface Deposit	Buried Strata	
RT-07-70	0-10		
RT-08-70	0-5	15-30	
RT-09-350	0-12.2		
RT-10-75	0-12.2	18.3-24.4	36.6-42.7
RT-10-161	0-18.3		
RT-10-272	0-12.2		
RT-10-414	0-12.2		
RT-11-40	0-18.3	24.4-30.5	
RW-11-01		5-10	
RW-11-02	0-20		
RW-11-03		20-35	

Table 107-1 Robb Trend - Overburden Suitability			
Corehole	**Suitable Overburden Depth Range (metres)**		
	Surface Deposit	**Buried Strata**	
RW-11-05	0-21	28-49	
RW-11-06	0-40		
RW-11-07	0-20		

As illustrated in ESRD Table 107-1 the majority of the drill holes indicate that the upper overburden is rated as suitable from the surface to an average depth of 12 to 18 metres. There are also intermediate strata that are rated as suitable.

The mining areas (pits), where overburden will be excavated, are approximately 1780 ha in area (Table C.2-2). Using a conservative average depth of suitable overburden of 10 metres it is calculated that there will be approximately 178,000,000 m^3 of suitable overburden excavated. Placing one metre of suitable overburden over the entire disturbance area of approximately 5729 ha (Table C.2-2) will require approximately 57,290,000 m^3 of suitable overburden.

Based on these results CVRI is confident that there are sufficient quantities of suitable overburden present within the development area to ensure that one meter of suitable overburden will be placed on top of areas with unsuitable overburden.

b. Based on CVRI's operational experience at the existing mines, discuss the expected area (ha) that is likely to have sodic or other unsuitable spoil material at the surface prior to coversoil placement.

Response:

CVM has moved nearly 0.5 Billion cubic meters of material since start of mining.

Sodic overburden has shown up only occasionally during the life of the Project. Early indications were found in some of the early Mynheer pits located northeast of the plant. These small areas were handled by adding suitable overburden to the recontoured surfaces and/or applying additional soil materials. Only recently has unsuitable material been identified again. In these instances small areas in Mercoal East pits have shown elevated pH values. These areas are being handled through addition of suitable overburden or delaying soil application until weathering decrease the pH values.

CVM has noted from monitoring data that characteristics of recontoured overburden do change readily over short periods of exposure. Rainfall can quickly and significantly modify pH and sodicity values in surface exposed overburden.

Recent overburden sampling in Mercoal West and Yellowhead Tower has raised concern for potential sodic recontoured overburden. To date there have not been any instances of unsuitable recontoured overburden surfaces found in these reclaim areas.

CVM experience to date indicates rare occurrence of sodic conditions in reclaimed areas. Minor additions of additional material have been sufficient to remedy any past occurrences.

Based on this experience, CVRI does not expect there to be issues with unsuitable overburden.

c. Discuss the sampling strategy (initial sampling density, delineation density, and sampling depths) that will be employed during the surface spoil sampling program.

Response:

The sampling depth will be one metre and the sampling density will be equivalent to Sampling Intensity Level (SIL) 1 which will be one sampling site per ha. The sampling density will be one test pit/ha multiplied by the hectares of the area being sampled.

d. If a borrow site is required, discuss potential locations of the borrow pit (i.e., is it anticipated that the borrow would be located within the mine permit boundary?) and discuss the conceptual reclamation plan for the borrow pit.

Response:

Borrow Opportunities

CVRI believes that 'borrow' for suitable overburden will not be required or at most on rare occasions.

Should 'borrow sites' be necessary to provide suitable material for placing on unsuitable overburden it is anticipated that the borrow material would be obtained from other mined overburden. Additional material could be obtained by hauling mined rock from an adjacent active pit, digging into an adjacent waste pile or by dozing nearby material over the affected areas. In each of these instances the 'borrow' site would be within the disturbance area of the mine and would be reclaimed with the remainder of the mine operation.

e. If CVRI decides to stockpile suitable overburden separately from unsuitable overburden, evaluate and discuss whether or not the proposed project disturbance footprint and mine permit boundaries have sufficient space to accommodate the separate suitable overburden stockpiles.

Response:

See response to ESRD SIR #107d).

CVRI does not expect that separate 'stockpiles' of suitable overburden will be required. Should 'borrow' material be required the material will be obtained from nearby waste piles.

When CVRI determines the need to stockpile suitable overburden they will designate specific areas of rock dumps as suitable overburden stockpiles. The rock dumps are designed to accommodate all of the overburden that requires external disposal so designating areas as suitable overburden stockpiles will not change the dump boundaries.

108. Volume 1, Section C.2.1.1, Figure C.2-1, Page C-24
Volume 4, CR #10, Figures 2f, 3f, and 4f

Figure C.2-1 and Figures 2f, 3f and 4f show the project footprint as being in close proximity to the Pembina River, which has a meandering configuration. The project will intercept a tributary of the Pembina River, so it is deduced that that the end pit lake to be created adjacent to the river will have a lake surface level which is lower than the river water level. The EA should assess the risk of seepage flow from the Pembina River to the end pit lake, and also the possibility of future channel migration towards the pit.

a. Assess the possibility of a groundwater hydraulic connection between the Pembina River and proposed easternmost end pit lake, and the consequence of this on Pembina River low flows.

Response:

Dump Location

Waste dumps developed from the Val d'Or/Arbour pits will be located to the northeast of the pits and located above the Pembina River western shoreline. Reclaimed slopes of the mostly easterly dump will reach to the rim of the Pembina River floodplain. The toe of the reclaimed slope is expected to remain approximately 20 m above the current river elevation.

Pit Location

CVRI proposes mining of the Val d'Or, McPherson and Mynheer seams to an eastern limit which approaches the Pembina River valley. The eastern most pit rims are located approximately 50 m from the western edge of the river floodplain. As a result, an intact, un-mined zone will remain between the river and the mined out pit. This intervening section will remain as intact bedrock serving as a barrier to the river flow.

As the strike of the strata is in a northwest/southeast direction the potential connection would most likely through bedding planes. Coal seams may provide potential hydraulic route.

Hydraulic Connectivity

In the event that a hydraulic connectivity is established between the Pembina River and the proposed mining area, it is important to provide context around the question of the volume of water moving out of the Pembina River and associated tributaries towards the end pit lake:

The potential volume is estimated by the equation: hydraulic conductivity x hydraulic gradient x area of flow.

It is assumed that there is 500 lineal metres of shoreline on Lund Lake that potentially is receiving water from the River and the tributary. It is further assumed that the depth over which the water flows into the lake is 25 m. Therefore the area of flow is 10,000 m^2

The hydraulic gradient is = 25 m over an estimated average horizontal distance of 500 m = 0.05

The median hydraulic conductivity of bedrock unit in this area is 3 x 10-6 m/sec (CR# 3 – Section 2.3.1)

A reasonable estimate of the rate that water might flow from the Pembina River or the associated local tributaries is 3 x 10-6 m^3/sec *0.05*10000 = 0.0015 m^3/s.

The Pembina River drainage area adjacent to the project is approximately 535 km^2.

Applying the low flow chart in Figure 13, CR #6, the estimated 7Q10 (7-day, 10 year annual low flow) is 0.24 m^3/s and the mean monthly flow in March (from Figure 9, CR #6) is 0.55 m^3/s.

Therefore, using the rate of 0.0015 m^3/s indicated above, the impact on Pembina River low flows would be:

- 0.63% of the 7Q10, and 0.27% of the mean monthly flow in March.

b. Assess Pembina River flood levels and possible effects of channel migration relative to proposed project activities.

Response:

The proposed Project mining area is outside of the Pembina River floodplain. Therefore the Project is not expected to have any effects on the Pembina River channel migration.

ESRD Figure 108-1 illustrates the eastern end of the Project in the vicinity of Pembina River. The topography indicates a defined floodplain embankment outside the proposed mining area. This limit was utilized in defining the mine disturbance limit. The floodplain embankment is approximately 15 m in height. The embankment is founded on exposed bedrock which effectively controls the channel migration in this area. ESRD Photo 108-1 provides an image of the embankment with exposed bedrock at the base of the slope.

A detailed assessment of flood levels and potential channel migration risks will be required during detailed planning for the mine extent and end pit lake development in this area.

Based upon a drainage area of 535 km^2 at this location and the regional flood frequency relation in Figure 13 (CR#6), the Pembina River 1:100 year peak flood is estimated at 290 m^3/s at this location. From the available 5 m contour mapping and aerial photos in this area, the active channel is 30 to 50 m wide and gradient is 0.47%. This indicates the estimated 1:100 year mean flow depth may be 2.3 to 3.3 m deep or to about elevation 1258 m adjacent to the pit and up to 1260 m across the upstream meander. It appears ground level at the east end of the pit and valley wall of the river is at 1265 m or higher based upon the contour data. This height of the valley wall contains the river during extreme flood events.

A review of historical aerial photographs in this area indicates the Pembina River is moderately stable with densely vegetated mature trees in the floodplain area across the meanders. Channel changes have been minor with an erosion scar at the west (left) bank and valley wall on the downstream meander. This location is downstream of the planned pit where dump development is planned above the valley wall. The following photo of the west (left) valley wall on this meander bend shows exposed bedrock at the downstream meander bend adjacent to the rock dump. The exposed bedrock limits potential channel migration in that area. No channel migration is evident over the past 25 years.

During the detailed design phase, a safe setback limit for the dump development will be established where the downstream meander bend is aligned along the west valley wall. This will ensure that the final pit and dump limits will not encroach into the floodplain or the valley wall of the river.

ESRD Photo 108-1 West Bank of the Pembina River

109. Volume 1, Section E.10.3.3, Page E-160
Volume 1, Section A.8.10, Page A-47
Volume 4, CR #10, Section 6.2.1.3, Page 72

CVRI states that *soils from different soil landscapes are subject to mixing in the stockpile and further mixing occurs during placement and peat and topsoil materials from wetlands will be salvaged and stored for replacement during reclamation.*

a. Confirm if salvaged mineral surface soils will be stored separately from salvaged peat materials, and describe how that will be accomplished.

Response:

As per Section 3.2.6 (a) of the current EPEA approval CVRI will separately stockpile upland and organic soils. Stockpile sites will be designated for each material and the soil salvage monitor will ensure that the soils are transported to the correct stockpile location. Stockpiles will be developed considering the requirements of Sections 3.2.6 (b-e) of the EPEA Approval.

The locations of soil stockpiles will be determined for the licensing stage of the regulatory process.

b. If the materials are to be stored together, has CVRI investigated opportunities to store these two materials separately? Discuss.

Response:

See response to ESRD SIR #109a).

110. Volume 1, Section E.10.3.5, Page E-160
Volume 1, Section E.10.6, Table E.10-3, Page E-163
Volume 4, CR #10, Section 6.2.1.5, Page 73

CVRI states that the *planned reclamation approach will provide for considerable landscape and ecological diversity* and this will act as the mitigation approach to the potential loss of soil landscape diversity.

a. Identify and describe any unique soils within the study area that will or may be lost as a result of the planned mine and resulting disturbance.

Response:

No unique soils were identified in the Soil Survey report (CR #10). The identified soils belonging to the soil orders of Luvisols, Brunisols, Regosols, Gleysols and Organics are the same soil types that have been previously identified by the many soil surveys conducted for CVRI.

b. If any unique soils will be lost due to the project development, discuss any expected impacts to ecological diversity, especially with respect to the ability of CVRI to implement effective rare plant mitigation strategies.

Response:

See response to ESRD SIR #110a).

111. Volume 1, Section F, Pages F 11- F 14

a. Since the ecological performance of the two lakes (Pits 122 & 142) has not been evaluated or deemed successful, explain the relevance of referencing this reclamation as a model for the Robb Trend project.

Response:

The Pit 122 and 142 end pit lakes (EPL) are the two latest EPL's that have been reclaimed on the CVM. The development and reclamation of the two lakes draws on the knowledge gained from previous EPL development and the lake studies completed by Hatfield Consultants. The Lovett and Silkstone lakes were included in the Lake Assessment (Coal Valley Mine, Hatfield 2008) which provided recommendations for further end pit development. These recommendations were applied to the design and reclamation of the Pit 122 and 142 lakes.

The Pit 122 and 142 EPL's represent the latest knowledge and techniques for EPL development that have been employed at the CVM which is why they were referenced in the Project application.

112. Volume 1, Section F.2.4.3; Page F-9, Page F-11

Reclaiming pit areas to include end pit lakes may affect fish habitat and productivity.

a. Describe specific design criteria supported by the Fish & Wildlife Division that were incorporated into the planned reclamation of pit areas.

Response:

The CVM is committed to working with appropriate ESRD personnel in incorporating design criteria that is supported by ESRD in the final end pit lake designs when they are developed.

Conditions 6.3.7 and 6.3.8 of the CVM EPEA Approval provides direction for the development of plans for EPL's. It is anticipated that these condition will be applied to the Project development. As per these conditions detailed design work for the development of the lakes will be completed prior to the completion of mining and the commencement of lake development.

Basic design elements such as incorporation of adequate amounts of littoral zone were considered in the initial design work that was completed for the first stage of the regulatory process.

b. Describe specific design criteria that enhance productivity in these lake developments?

Response:

Refer to the response for ESRD SIR #112a).

113. Volume 1, Section F.2.5.6, Page F-17.

The project will result in substantial loss of vegetation through clearing. CVRI indicates that *it is planning to increase the planting of understory species to promote the development of structural complexity in regenerated forest. CVRI will also plant shrubby species for the development of shrub and shrubby meadow areas.*

Targeting these native ecosystems will result in a high demand for native plant propagules in the future.

a. Discuss steps that CVRI has taken or will undertake to conserve the genetic diversity from the landbase particularly shrubs, considering the life of the project and the need to reclaim the proposed mine footprint to native ecosystem types.

Response:

The primary responsibility of the reclamation program at the CVM is to reclaim the disturbed areas to equivalent land capability in consideration of the desired end land use. CVRI will be taking steps to ensure that to conserve the genetic diversity of the Project development. The actions will include the following:

- Plant propagules: CVRI will collect seed and plant propagules from the local area for the propagation of tree and shrub reclamation stock.
- Limiting disturbance: Mine planning with a goal of limiting disturbance and leaving remnant vegetation patches within the disturbance areas. The remnant vegetation patches provide a local source for the ingress of desirable species.
- Native plant seed mix; the use of native species seed mix will limit the introduction of agronomic species to the reclaim areas.
- Direct placement of soil materials: the retention of native plant propagules in the salvaged soil when they are transported to the soil placement areas.
- Understory species planting program: the re-introduction of a shrub and forb planting program will increase the bio-diversity of the reclamation areas.
- Stockpiled soil: Not all salvaged soil materials can be direct placed requiring the development of soil stockpiles. Common practice, emphasized by the requirements of the EPEA approval to revegetate stockpiles, is to seed the stockpiles to minimize wind and water erosion. CVRI will assess the erosion risk and if possible not seed the upland soil stockpiles allowing the vegetative propagules and native seedbank to grow and establish a vegetation cover on the stockpiles. The stockpiled soil materials will be allowed to naturally re-establish vegetation whenever possible. The soil stockpiles will be monitored and if necessary, seeding with an appropriate native seed mix will be implemented on areas where natural re-establishment has not occurred. When the stockpile is utilized the viable plant propagules will be transported to the soil replacement areas.

114. Volume 1, Section F.2.5.6, Page F-17.

CVRI states, *the fertilizer commonly used by CVRI is a blend of ammonium phosphate (27-27-0) with an application rate of approximately 180 kg/ha. CVRI uses advice from the seed supplier for the type of fertilizer to use for the seed mixes being used. The application rate is one that has been historically used at CVM with good results.* The above text suggests that fertilizer application rate is not based on the nutrient potential associated with the reclamation materials.

a. Discuss how CVRI will use nutrient data from reclamation materials to determine fertilizer application rates whenever CVRI decides to carry out fertilization for exiting projects and this project.

Response:

CVRI will use nutrient data, in conjunction with past practices and the professional judgements of our seed and plant suppliers, to determine fertilizer application rates.

One of the priorities of the re-vegetation program at the CVM is to protect the soils resource from erosion. The mine invests in the conservation of the soil resource during development so it is essential that the soil resource be protected. One of the primary tools used by the mine to protect the soil from erosion is the quick establishment of a vegetative cover. Fertilization has been used to ensure that a vegetative cover is established as quickly as possible.

Standard practice at the CVM has been to include fertilization with all of the seeding programs undertaken at the minesite. This is a onetime application when the reclamation area is seeded. There may be occasions where remedial fertilization is completed on vegetation deficient areas. As referenced in the question, the fertilizer commonly used by the CVM is a blend of ammonium phosphate (27-27-0) with an application rate of approximately 180 kg/ha.

Research at the CVM has included the use of fertilizer as one of the action items in the minesite Continuous Improvement Program. The CVM is putting more emphasis on the design of the fertilization process to address the specific needs of the revegetation program. The slope and aspect of the revegetation areas coupled with an assessment of the erosion potential will be one of the criteria used to determine fertilizer requirements. When it is determined that fertilization will be applied soil samples will be taken to determine the nutrient requirements so an optimal fertilizer composition and application rate for the area can be developed.

115. Volume 1, Section F.2.5.6, Page F-18

The Project development area differs from previously mined areas as it contains large areas of deciduous and mixed wood stands (1,430 ha of deciduous and mixed wood stands in the development area). To date, CVRI has not undertaken extensive planting of deciduous species.

The importance of deciduous species and mixed wood stands has been stressed on several occasions. However, it has also been indicated that the deciduous species are susceptible to competition and browsing by wildlife, and a lack of deciduous species has been noted as a deficiency in the reclamation program at the CVM in the past.

a. Explain CVRI's options and plans to make replacement of deciduous and mixed wood stands a success.

Response:

Timing

The Project requires that approximately 1430 ha of deciduous forest and mixedwood forest be re-established at reclamation (Application, C& R Plan, Section F.4.2.5). The primary objective of returning the landbase to a deciduous/mixedwood forest is for the re-establishment of wildlife habitat. CVRI has committed to replacement of approximately 1400 ha of deciduous and mixedwood forest on reclaimed lands through a deciduous/mixedwood reforestation program. Developing a shrub layer on these reclaimed lands is also a focus of CVRI reforestation program.

As stated in the C&R plan, CVRI intends to progressively reclaim lands over the life of the Project (25 years). Figures C.3-1 to C.3-11 of the Application shows the development stages for the Project. Based on conceptual development schedule, progressive reclamation is not expected to commence until approximately Year 6 of the Project. From Year 6 to Year 25 establishment of the deciduous/mixed wood forest will occur as lands are progressively reclaimed. In general, it is expected that CVRI will reclaim approximately 30 to 100 ha per year to deciduous/mixedwood forest (over a 19 year period) depending on the amount of area that was reclaimed in a given year. In the final stages of reclamation (approximately Year 26 to 28) a larger deciduous/mixedwood reforestation program is expected as the mining of the development areas are completed.

Advance Planning

The C&R Plan (particularly Section F.4.2.3 to Section F.4.2.5) provides a plan to reclaim lands to deciduous/mixedwood forest which includes incorporation of shrubs. To make CVRI deciduous/mixedwood reforestation program a success CVRI will incorporate the following components into its planning.

- pre-planning for seed/cutting sourcing;
- evaluation of reclaimed area;
- selection of reforestation methods;
- execution of works;
- reclamation and plantation monitoring; and
- reforestation trials.

Pre-Planning for Seed/cutting Sourcing

CVRI will determine the seed/cutting requirements for the Project. All seed/cuttings collected, stored and utilized will be in accordance with the *Alberta Forest Genetic Resource Management* *and Conservation Standards*. The Project falls within two seed zones; namely, the Upper Foothills1.4 and Lower Foothills 2.1.

For seed, CVRI will determine the deciduous and coniferous seed requirements, which includes species and quantity, for the Project. A seed pick for the Project is to occur between Project Approval and Year 4/5 to acquire seed. CRVI recognizes that success of a planting program is contingent upon a quality seed source and that seed may not be available each year due to a low seed production year or disease. CVRI will source and collect seed within the Projects seed zone and register and store the seed as required by Alberta's policies. CVRI will determine species to be collected for the reforestation program (*e.g.,* trembling aspen is typically grown from seed).

For cuttings, CVRI will secure a source and collect, as required, within the Projects seed zone. Typically one year old cuttings are preferred. CVRI will collect cuttings at timing intervals required by the tree nursery to meet out-plant dates. Cuttings are typically collected in the winter a year before out-planting.

CVRI has made initial contact with several tree nurseries to determine the availability of growing space to meet the Projects annual seedling requirements. It has been found that there are tree nurseries that can meet CVRIs growing space requirements with advanced notice (1 -2 years). The nurseries have experience growing deciduous seedlings/cuttings for industrial clients as it is becoming a more common practice on reclaimed lands. CVRI will ensure that seed/cuttings are collected in a timely manner to meet the tree nurseries sowing timelines.

As outlined in the C&R Plan, Sections F.2.4.6 and Section F.4.2.5 of the Application, shrubs and herbaceous plants will be incorporated into the deciduous/mixedwood plantations to develop a more complex stand structure. Seed/cuttings for shrubs will be collected in advance of sowing (each species has specific seed/cutting collection timing window) should CVRI use tree nurseries to grow shrub seedlings.

Evaluation of the Reclaimed Area

CVRI will evaluate each reclamation area for species selection, species mix, and reforestation method. Percent slope, slope position, aspect, soil characteristics, erosion potential and other factors will be incorporated into the evaluation. Species selected will be suited to the reclaimed ecosites. For example, trembling aspen is suited to upper slope/crest areas with moderate to well drained soils. Table F.4-6 of the Application identifies the deciduous species that could be incorporated into the Projects reclamation program. Conifer and shrub species that can be used are to be determined by ecosite.

During reclamation, CVRI will attempt to re-establish a similar mix of deciduous and mixedwood forest stands; the site evaluation will be used to select the appropriate species for each reclaimed site. A percentage of confir will be incorporated into the planting mix.

Selection of Reforestation Methods

As discussed in the C&R Plan, Section F.2.4.6 of the Application, CVRI will employ a number of reforestation methods. A deciduous tree planting program (seed/rooted cuttings) is expected to be the primary method of reforestation for the Project. Direct placement of soils will be considered where it is economically feasible (short haul distances).

Forests adjacent to the Project and remnant forest patches within the development areas will contain deciduous trees so it is anticipated that natural ingress will augment deciduous densities over time.

For shrubs CVRI has had success with transplanting LFH plugs for shrubs and may incorporate using shrub seedlings, grown from seed or cuttings at a tree nursery, into the reforestation program.

Execution Plan

CVRI will complete all recontouring and site preparation works in-house. Site preparation will focus on creating a microsite that allows proper tree seedling root development and seedling establishment. Direct placement of soils will be completed where possible. The Section F.4.2 of the C&R Plan addresses soil replacement and contouring.

Tree and shrub planting will be completed by tree planting contractors experienced in planting deciduous trees and shrubs. CVRI will assess the quality of tree and shrub planting to ensure seedlings and shrubs meet typical planting contact standards.

Areas with low erosion potential may not be seeded (grass/legumes) prior to tree/shrub planting. (C&R Plan, Section F.4.2.3).

Wildlife Browsing

Browsing by wildlife is a concern in tree seedling establishment. CVRIs plans to establish trees in a manner that promotes height growth as the intent is for the planted tree to outgrow the browse height as quickly as possible.

CVRI is considering the following practices to ensure survival and development of planted tree seedlings:

- plant trees in the spring to allow a full year's growth before freeze up;
- plant larger stock types where soils allow;
- plant a mix of different deciduous species (*e.x.,* balsam poplar is known to have a lower palatability for wildlife);
- complete trials using different deciduous tree species, stocktypes, spacing, and planting season (spring/summer), fertilizer (ex. tea bags) to determine the best planting regime that will mitigate effects of browse;
- look into use of repellents (*e.g.,* automated bangers, chemical deterrents, visual deterrents (flagging)) that will deter animals from browsing plantations; and
- use of enclosures/exclosures. CVRI will evaluate the cost effectiveness of fences, barriers, guards versus the costs of replanting should a plantation fail due to browsing damage.

It is not expected that shrubs outgrow the browse height and will be heavily browsed. CVRI will complete trials that use a mix of shrubs within treed plantation settings to determine the best success for shrubs and trees on CVRI reclaimed lands. The use of long-term soil stockpiles to establish shrubs is being considered. The intent is to determine the success of natural shrub regeneration from propagules once soil is replaced.

Monitoring

Plantation success will be monitored and through the minesite's adaptive management program CVRI will address any concerns found. CVRI will also incorporate any findings from the monitoring program to adapt future reclamation and reforestation practices. The C&R plan, Section F.5.2 of the Application highlights the objectives of CVRI vegetation monitoring program.

Reforestation Trials

CVRI intends to conduct trials to determine the most successful approach to deciduous reforestation; particularly with respect to browsing. Any findings from trials and initial out-plantings will be incorporated into CVRI deciduous reforestation program. Trials may be conducted in association with other research agencies or inhouse (less formal; ad hoc). CVRI intends to begin trials as soon as areas become available for planting.

Types of trials that CVRI is considering include:

- using long-term soil coversoil piles as nursery site to establish deciduous tree and shrub propagules prior to placement of soils on reclaimed lands;
- determine the most effective species planting mixes, stock types, season of planting, use of fertilizer to establish deciduous species and mitigate browse;
- determine if incorporation of a mix of shrub species will impact plantation success;
- effectiveness of deterrents; and
- methods of site preparation.

116. Volume 1, Section F.3.1, Page F-21
CVRI states *CVRI, along with all other interested stakeholders groups, commits to being a participant in land-use planning processes that are initiated.*

a. Explain why CVRI wants to be just a participant and not partner in this initiative.

Response:

At this time, CVRI is not aware of any active 'land use planning' programs in the CVM area. CVRI representatives are monitoring progress on the Alberta Land Use Framework and the Upper Athabasca Region Plan. The company participates at various levels with other regional programs such as the Hinton Wood Products Forest Resource Advisory Group, the Foothills Research Institute programs, and Foothills Recreation Management Association which provides local camping site facilities. CVRI also recently worked with ESRD on the Luscar & Gregg River Mines Land Management Integrated Decision.

CVRI will undertake whatever role is required to make a land use initiative a success.

117. Volume 1, Section F.4.1.1, Page F-35.
CVRI states, *the baseline vegetation assessment identified 46 rare plants and one rare plant community within the LSA. Of those, four species (Vegetation Assessment Table 5.6) require special mitigation prior to clearing operations. These four plant species are assigned mitigation measures of transplanting to a suitable plant community, and aiding in the dispersal of propagules. The locations of the plants are known and will be identified in the field and mitigation will be applied prior to any clearing operations.*

a. The above text indicates that CVRI proposes to transplant rare plant species as a mitigation strategy should the project be approved. Citing specific examples, discuss how this approach has been successful on previous rare plant transplants that CVRI has undertaken.

Response:

The only recently documented transplanting program at the CVM is the huckleberry transplant program currently being carried out by CVRI in conjunction with Navus Environmental. The initial trials in the Pit 28, Pit 26 and Pit 131 areas were completed to determine the feasibility of transplanting whole plants, root cuttings and LFH plugs from donor sites in adjacent undisturbed areas. Navus reports that the initial results indicate that the LFH plugs are proving to be the most successful method for transplanting native species onto the reclamation areas.

CVRI plans to continue this program and will expand it to include other species that are identified as being a desirable component of the revegetation program.

Another approach that will be considered by CVRI is to transplant rare vascular species to an appropriate location outside of the disturbance footprint. Rare plant propagules will be harvested from development areas prior to disturbance and re-located to these nursery areas that have been set aside for growing native species. It is anticipated that a plug containing the rare plant and consisting of the LFH layer and 10 cm of mineral soil will be cut out from undisturbed areas and transplanted to the nursery area. During reclamation these plants will be transplanted in the revegetation areas (Mackenzie & Naeth 2010). An alternative location may be to designate a soil stockpile as a nursery site for the transplanted rare vascular species.

It is anticipated that the transplanting of native plants will be an opportunity to engage the local aboriginal communities. It is understood that local First Nation groups have participated in such programs related to reclamation of pipelines in Jasper National Park area which included transplanting of various species.

118. Volume 1, Section F.4.1.2, Page F-38.

CVRI states, *the soil inventory of the Robb West development area indicates there is a minimum of 2.6 M m^3 of upland surface soil available for salvage and reclamation compared to a coversoil need of about 2.9 M m^3. This indicates that there is potential 0.3 M m^3 shortfall of upland surface soil available for the reclamation requirements. It is emphasized that this is a potential shortfall as the mean volume estimate of salvageable soil is 3.3 M m^3. Refer to CR#10 for additional details on the potential shortfall. There is more than enough organic peat material available to meet all the wetland and littoral area reclamation needs across the entire Project area. Refer to Table F.4-2 for volumes of organic soils within the LSA.*

Organic and transitional soils are suitable reclamation materials, and can be used as coversoil in upland reclamation.

a. Does the reclamation materials balance include potential salvageable organic and transitional soils?

Response:

CR #10, Section 5.4, Table 12, Pages 60 and 61 shows all soil material that is available for salvage including peat from Organic and Gleysolic (transitional) soils, and A & B horizon material from Gleysolic and Fluvial soils. The shaded cells in CR #10, Table 12, representing transitional soils, are not used in calculating the Coversoil Material Balance of CR #10, Table 15 (Page 63).

In regards to the potential shortfall, CR #10, Section 5.4, Page 62, states that "further mitigation, if necessary, could involve salvaging surface soil (peat, A and B horizon material) from Gleysolic soils and Fluvial landscapes for use in upland reclamation which is estimated to be 0.3 M m^3 (CR #10, Table 12)." If the potential shortfall turns out to be real, this would make up the difference.

As the Project progresses soil salvage requirements and replacement volumes will be monitored so that adjustments to include organic and transitional soils to satisfy any projected shortfalls can occur.

b. If not, has CVRI considered salvaging all organic and transitional soils to make up the potential shortfall?

Response:

See the response to ESRD SIR #118a).

119. Volume 1, Section F.4.1.3, Page F-39.

CVRI states *Mynheer overburden is known to be sodic with unsuitable SAR (greater than 12) occurring at depth in the Project area. The Mynheer overburden is expected to produce spoil having an unsuitable SAR* [see Volume 4, CR#10, Section 4.4, Page 48]. Management of overburden in other CVRI mines has raised concerns for Alberta Environment and Sustainable Resource Development.

a. Discuss how CVRI will manage overburden differently for this project such that Mynheer overburden will not be close to the surface.

Response:

CVRI is not anticipating any new or different overburden handling procedure for control of Mynheer overburden. Much of the Mynheer mining will be accomplished by dragline mining. This method produces spoil piles beside the linear mine cut. During reclamation much of this spoil material is pushed back into the mined cut.

The proposed reclamation process will monitor recontoured spoil surfaces prior to soil placement. Options to exposed unsuitable surfaces include additional recontouring and/or 'capping' with suitable overburden.

120. Volume 1, Section F.4.1.3, Page F-39.

CVRI states, *CVRI will place a minimum of one metre of material meeting the suitable overburden criteria prior to soil replacement. CVRI will ensure that sufficient quantities of suitable overburden are available for the soil replacement program by either identifying a borrow site or by stockpiling suitable overburden as it is mined.*

a. Clarify what is meant by borrow site.

Response:

A 'borrow site' is defined as a site from which earth is taken to fill another site. In this context CVRI intends to take suitable overburden from a nearby waste dump to place over unsuitable spoil in order to achieve a minimum of 1 meter of suitable material.

b. At what stage in the project life cycle will CVRI know when to stockpile suitable overburden?

Response:

Additional overburden sampling is planned throughout the Project to further define the proportion and general location of 'unsuitable' overburden.

It is anticipated that the decision to stockpile suitable overburden will be made during the operations phase of the Project life cycle. Throughout the life cycle of the Project development, CVRI will monitor the suitability of spoil material and determining the need to conserve and stockpile suitable overburden. Movement of this suitable material will be tracked should it be required for reclamation purposes.

c. If suitable overburden will not be stockpiled at strategic locations within the project footprint early on in the development, is CVRI committed to hauling suitable overburden to cap deleterious materials (e.g., saline and/or sodic overburden) no matter what the hauling distance required?

Response:

CVRI is committed to providing suitable overburden/subsoil to cover any unsuitable material as per Condition 3.23 and 3.2.3.1 in the current EPEA Approval No. 11066-02-00. All options would be explored to determine the best (efficient and effective) approach to accomplish the task.

In achieving these commitments, CVRI may or may not utilize stockpiles of overburden. It is CVRI experience that suitable overburden will be readily available should 'capping' be necessary.

121. Volume 1, Section F.4.2.5, Page F-51.

Text indicates that CVRI has never undertaken large scale plantings of deciduous species such as trembling aspen and balsam poplar. CVRI also states, *it is anticipated that CVRI will investigate mitigation actions for limiting the browse damage to deciduous reforestation. Mitigation options may include: Exclosures – fencing, netting, protectors and other physical barriers; Repellents – irritants (scents/taste), noise, visual (flagging); Replanting – planting more stock than are damaged each year*.

Given that repellant may be ineffective in managing browsing in the long-term, and exclosures and planting will be labor intensive and expensive as indicated in the application, clarify the following.

a. Discuss the ecological implications of the perceived challenges of establishing deciduous species.

Response:

CVRI is committed to ensuring that the deciduous component of the revegetation program is successful. CVRI will develop and implement the strategies that are required to ensure that the deciduous tree and shrub plantings will continue to flourish despite browsing by wildlife.

Strategies will depend on the wildlife species that are identified as causing the browsing damage. As example, the strategies for the protection of plantings from ungulates will be different from those required for protecting the seedlings from damage by rodents and rabbits.

Deciduous and mixed wood forest stands provide habitat for a host of species. If CVRI is unable to establish the deciduous and mixed wood forest stands, wildlife species that require a deciduous component in their habitat will not be attracted to the reclamation area until the deciduous component occurs through natural succession. In addition, if the deciduous plantings are not successful there will be an equivalent increase in the amount of coniferous stands. In general deciduous stands exhibit more bio-diversity than coniferous stands so there will be an overall decrease in bio-diversity until natural succession occurs.

b. Evaluation of the three mitigation options does not provide enough assurance that CVRI will do whatever it takes to establish deciduous and mixed wood forests. Identify which of the three options CVRI will implement should the project be approved to ensure that deciduous and mixed wood forests will be established at closure?

Response:

It is anticipated that all three mitigation options will be part of the mitigation strategy for browsing. The mitigation method used will be dependent on the site conditions, the wildlife identified as causing the browsing issue and the species that were planted.

One strategy that will be evaluated is to select species that are not as palatable to wildlife. As example, CVRI is planning on planting species such as balsam poplar which is not as susceptible to browsing issues as aspen. Other species include green alder and cinquefoil.

It should be noted that the establishment of deciduous species will be a component of the approved reclamation plan. Compliance with the approved reclamation plan will be required to obtain land reclamation certification.

122. Volume 1, Section F.4.2.5, Page F-52 and Figure F.4.1, Page F-35

Linear pattern of end pit lakes in post mining landscape.

a. Discuss social, economic and environmental impact of linear configuration of the proposed 12 end pit lakes extending almost 60 km with only few gaps in between.

Response:

Current Linear Profile

The Project consists of two segments: 1) Robb West which is located west of the community of Robb and 2) Robb Main, Center, East which stretches from east of Robb to the Pembina River. Both segments align as a long linear development situated in a northwest/southeast strike.

The disturbance footprint of the Robb West segment is approximately 6.5 km. There is currently one logging road in the area which will be rerouted and maintained during and after the mine development.

Robb West is separated from the eastern development by lands occupied by the community of Robb. Within this 3.2 km separation the land is occupied by two major powerlines, a gas pipeline route, Highway 47, the community of Robb, and the Embarras River valley.

The Robb Main, Center, East portion of the development is 39.2 km in length. Within this length two logging roads and several gas pipeline routes pass across. Several watercourses flow along and cross through the development area. A 5.5 km long segment of the Erith River flows parallel through the linear disturbance footprint before flowing out of the area.

Not all of the development area will be under development at the same time. Development will be staged in progressive phased sequence.

Post Mining Linear Profile

ESRD Figure 122-1 is provided to illustrate the reclaimed profile for the Project. In order to illustrate the linear 'proportions' a 'longitudinal' line has been drawn through the project from the western disturbance boundary to the eastern disturbance boundary. The line approximately follows the Val d'Or subcrop. ESRD Figure 122-1 provides a tabulation of measurements on lake length along this longitudinal profile.

In Robb West two end pit lakes consume nearly the entire disturbance length. A narrow 'land bridge' separates the two lakes. Total linear length of the lakes is 6.2 km within the entire 6.5 km long development.

The Highway 47 corridor width of 3.2 km remains.

The Robb Main/Center/East disturbance length is 39.2 km of which 23.0 km is occupied by 11 water bodies. Multiple 'land bridges' are provided to 'break-up' the water bodies.

Gas pipeline corridors will remain across the mined area. It is also anticipated that logging roads across the Project will also be replaced.

b. Discuss options available to reduce the number of end pit lakes and the linear alignment.

Response:

Conceptual Level

The development plan presented thus far is a conceptual 'first pass' intended to illustrate the potential development and corresponding disturbance footprint. This plan provided a basis for potential mitigation and reclamation plans followed by impact assessments. Further plan refinements would follow as individual pit and dump operating applications are developed and submitted for government approval.

Additional coal exploration is underway. Detailed dump foundation analysis will be required for definition of final dump configurations. Addition economic evaluations of mining layouts and options will be investigated as part of ongoing engineering design for pits and dumps. These elements may result in changes to the mine plan.

Future Plans

Ongoing engineering design for pits and dumps will focus on several key elements such as:

- Maximize recovery of available coal resources while balancing environmental values.
- Accommodation of current mining economics reflecting capital and operating costs, exchange rates, market prices and plant recovery.
- Minimizing land disturbance area and costs:
  - increased backfill; and
  - maximizing dump volumes.
- Minimizing water resource impacts:
  - minimizing disruption of water courses; and
  - accommodating buffer zones to water courses.
- Improvements to land use plan and reclamation plan:
  - avoidance of sensitive areas;
  - reducing end pit lakes, size and depth; and
  - adding terrain diversity to dump and pit slopes.

Changes Foreseen

A primary objective during future engineering design will focus on reduction of the size and depth of some of the biggest lakes. It is anticipated that the large pits involved can be broken into phased segments to achieve a greater degree of backfill. For example:

- Robb West (Val d'Or pits) can likely be developed in multiple phases so as to increase backfill quantity. A larger bridge could be provided separating two smaller lakes. This would lessen the water depth and corresponding fill times.
- The Mynheer Pit in Robb West could possibly be developed and reclaimed to provide a channel for Bryan Creek. This would keep the creek flow independent from the end pit lakes and allow replacement of lost creek habitat.
- Val d'Or Pits in Robb Center could possibly be divided into addition phased segments which would increase in pit backfill thus reducing lake depth and size.
- Mynheer Pit in the Erith River could possibly be reclaimed as a series of 'chain' lakes instead of a single long lake. The 'chain' lakes would be connected with reconstructed channels thus replacing some of the lost creek bed habitat.

- The large Val d'Or Lake in the eastern end of Robb East could possibly be developed in a different sequence so as to increase backfill volumes. The goal would be to reduce the end pit lake size and depth.

123. Volume 1, Section F.4.1.2, Table F.4-2, Page F-38
Volume 4, CR #10, Section 5.4, Table 13, Page 61

CVRI has provided information on the expected minimum volumes of material available for salvage within the project area, but there are discrepancies between the volumes presented in Tables F.4-2 and Table 13.

a. Clarify the expected minimum available volumes of material available for savage within the project footprint.

Response:

The minimum soil salvage volume estimates were taken from the soils report (CR #10). A revised Table F.4-2 is provided listed as ESRD Table 123-1. The minimum soil salvage volumes in the table are now in agreement with those provided in CR #10.

Table 123-1 (Revised Table F.4-2) Soil Material Balance

Disturbance Area	Organic Peat		Upland Soil					
	Available	Peat for Reclamation	Glesolic Peat	Upland A Horizons	Upland B Horizons	Total	Coversoil for Reclamation	
	Minimum Available	Volume Required	Minumum Available				Volume Required	Volume Shortfall
	BCM	BCM	BCM	BCM	BCM	BCM	BCM	BCM
Robb Main, Center, East 4579.4 ha	4,024,100	687,100	117,600	4,414,900	8,519,600	13,052,100	12,083,700	
Robb West 1149.1 ha	1,419,200	44,850	139,300	844,500	1,638,900	2,622,700	2,955,300	(332,600)
Total	**5,443,300**	**731,950**	**256,900**	**5,259,400**	**10,158,500**	**15,674,800**	**15,039,000**	**(332,600)**

b. Provide updates to the Reclamation Plan and CR #10 Soil Resources report as appropriate.

Response:

Please refer to the response to ESRD SIR #123a).

124. Volume 1, Section F.4.2.1, Pages F-40 to F-42
Volume 1, Section F.4.2.2, Pages F-42 to F-43
CVRI has provided information on the proposed recontouring and minesoil profile construction methods planned for the mine, but no information could be found regarding reclamation of the haul roads.

a. Provide reclamation plans and procedures for the Bryan, Erith, and Halpenny corridors.

Response:

As illustrated on Figure F.4-2 of the application the haulroad corridors were included in the reclamation plan for the Project.

The haulroad corridors will be reclaimed to the same standards as those planned for the entire Project development. As the roads will have heavy haul truck traffic the road surface will be ripped to relieve compaction, the rights of way will be contoured to integrate with adjacent undisturbed lands, soils will be replaced and then the disturbance areas will be revegetated.

Detailed reclamation plans for the haulroad corridors will be provided at the licensing phase of the regulatory process.

125. Volume 1, Section F.4.3, Page F-55
Volume 1, Section F.4.4, Table F.4-8, Page F-56
CVRI describes the post-reclamation land management Phase III (following Reclamation Certification) as taking place 10 to 16 years following initial mine activities. Table F.4-8 indicates that Reclamation Certification is expected approximately 15-20 years after Resloping/Minesoil placement takes place.

a. Clarify this apparent discrepancy in the expected timeframe within CVRI expects to achieve reclamation certification on the reclaimed areas of the mine site.

Response:

An application for a reclamation certificate will be submitted when CVRI determines that the reclamation program has achieved the requirements of the EPEA approval. The time it takes to achieve these requirements is dependent on the mine schedule and the end land use of the lands in question. The estimated timeframe for achieving the requirements of the EPEA approval is in the range of 15-20 years after the commencement of mining activities. The anticipated duration for a reclamation certificate application is beyond the control of CVRI, however the current process can frequently take in excess of 3 years before a certificate application is registered or processed.

b. Provide updates to the Reclamation Plan as needed.

Response:

The dates will be reconciled in subsequent reclamation plans.

126. Volume 1, Section F.5.4, Page F-61.
CVRI states, *The objectives of the soil monitoring program are to conduct field investigations on the reclaimed lands to: … identify concerns such as erosion, poor vegetation growth, soil problems, etc.*

a. From past operational practices, list soil problems that CVRI has encountered and discuss how they have been dealt with (i.e., describe the adaptive management that CVRI has carried out).

Response:

Soil problems encountered at the existing CVM include:

- erosion;
- unsuitable overburden;
- poor vegetation establishment; and
- compaction.

In regards to the limited areas of unsuitable overburden that have been encountered at the mine past practice has been to spread additional coversoil. Areas of erosion are identified, repaired and if required recontouring will be completed to modify the drainage patterns. Poor vegetation establishment is dealt with by fertilizing, adding soil or reseeding. Compaction issues were easily dealt with by ripping of the compacted areas.

b. What other soil related problems does CVRI anticipate will be encountered as suggested by the use of 'etc'?

Response:

The use of '*etc.*' was not meant to be specific to soil concerns. '*Etc.*' was meant to infer that the observations made during the soil monitoring program were not limited to only soil issues but included any concerns that may be observed during the monitoring. Other concerns could include slope stability, weed occurrence, debris and wildlife.

127. Volume 1, Section F.5.4, Page F-61

CVRI states that the *reclamation practice will be to replace coversoil at a minimum average depth of 30 cm on at least 80% of the reclaimed area, based on a 1 hectare area.* CVRI further states that *one of the objectives of the proposed soil monitoring program will be to evaluate 'equivalent capability' of the reclaimed soils and landscape.*

a. Discuss the potential mitigation measures CVRI may use to achieve the required minimum coversoil depth if the detailed soil and terrain data collected indicates that insufficient coversoil is present on the reclaimed minescape.

Response:

Achieving the required minimum coversoil depth is a condition in the current EPEA Approval and it is anticipated that similar conditions will be placed in the Approval for the Project development.

The soil replacement operations will be monitored by qualified personnel who will identify areas with a deficient replaced soil depth. Identifying areas with an insufficient replacement depth after revegetation has occurred is inefficient as the vegetation will have to be disturbed to provide mitigation which will delay the revegetation and reforestation programs.

If an area is identified that has an insufficient depth of soil replaced the primary mitigation method will be to replace additional soils until the replacement criteria is achieved. If there are insufficient upland soils available for replacement, transitional and organic/mineral soil mixes will be used to provide the additional soils that are required.

b. Discuss the criteria that will be used to evaluate 'equivalent capability' of the reclaimed soils.

Response:

The determination of equivalent capability for a regulated site such as the CVM is to achieve compliance with the reclamation conditions within the EPEA operating approval. Specifically for soil at the CVM, in addition to replacement depth criteria, 'equivalent capability' generally means that the reclaimed soil (minesoil) has the ability to provide for the key land uses, which are: watershed protection, wildlife and forestry (see CR #10, Section 5.2, Page 49). The same criteria used in the EIA for evaluating the suitability of overburden and baseline soils will be used for evaluating the minesoil. For general characteristics, the *Criteria for evaluating the suitability of root zone material in the Eastern Slopes Region* as provided by the Soil Quality Criteria Working Group (1993) will be used and is discussed in CR #10, Section 4.2, Pages 32 to 43. Prior to placement of coversoil, the landscaped surface spoil must meet additional criteria provided by AESRD through the Approval Conditions (described in CR #10, Section 5.3.2, Page 56) which are designed to eliminate spoil with Poor and Unsuitable quality from occurring at the surface. The Alberta Tier 1 and Tier 2 criteria will be used for trace elements and a trace elements discussion is provided in CR #10, Section 4.3, Pages 44 to 46. Approval Conditions also specify that all upland surface soil be salvaged from all areas to be disturbed by mining, and sufficient surface organic soil be salvaged to meet reclamation objectives. The quality of baseline surface soil is described in CR #10, Section 3.5.2, Pages 16 to 23, and in CR #10, Section 5.3.1, Pages 53 to 55: for upland soil: the A horizon is generally Poor to Fair quality while the B horizon is generally Fair to Poor quality. The use of salvaged organic material is discussed in CR #10, Section 5.3.1.1, Page 56. Achieving coversoil thickness requirements for Upland and Lowland/Wetland areas is discussed in ESRD SIR #127b). Reclamation experience at the CVM shows that construction of minesoils according to these conditions and criteria, with the expectation that any inadvertent contamination is remedied (see discussion in ESRD SIR #131) and any inadvertent soil compaction is removed by ripping, will allow vegetation to become established for initial erosion control, and eventual reforestation.

c. Evaluate and discuss potential mitigation measures, including implementation strategies, that may be required if the reclaimed soils or landscapes have achieved 'equivalent capability' based on the selected criteria.

Response:

NOTE: It is believed that ESRD SIR #127c) should have read "… if the reclaimed soils or landscapes have not achieved 'equivalent capability' based on the selected criteria", and is addressed as such.

As discussed in ESRD SIR #127a) and b), monitoring of spoil quality prior to cover soil placement, and monitoring of coversoil thickness during placement or prior to reforestation, will identify any deficiencies and allow for improved implementation of reclamation activities.

128. Volume 4, CR #10, Section 3.2, Table 1, Page 7, 8, and 9
Volume 4, CR #10, Section 5.4, Table 12, Page 60 and 61

CVRI describes the Soil Landscape Models F5 and F6 as having imperfectly well and well drained Luvisol, Brunisol, and Regosol soils in Table 1, and in Table 12, CVRI indicates that surface soil (A and B horizon material) from these two landscape units will not be salvaged because of wet conditions. Conversely, CVRI describes other landscape models such as G5 and M5 as having imperfectly drained Luvisol soils, but in Table 12, CVRI indicates that surface soil will be salvaged from the G5 and M5 landscape units (as well as other moderately well and well drained units).

a. Discuss the rationale under which surface soil is salvaged from some units with imperfectly drained soils, while it is not salvaged from other units with what appear to be similar soil moisture conditions.

Response:

Landscape Models G5, L5 and M5 are used to describe imperfectly drained soils occurring on glaciofluvial, glaciolacustrine and morainal landscapes. These imperfectly drained soils generally occur on lower slope positions and on low-lying landscapes, and it is fair enough to consider these as upland soils. None of the Fluvial Landscape Models (F1 to F6) were considered as having upland soils even though some describe soils which are imperfectly drained or drier. Fluvial Landscape Models describe soil occurring on the floodplains and terraces of streams and rivers which are subject to periodic flooding. Some of these valleys and floodplains may be broad enough to allow for effective operation of salvage equipment, but often the terrain is rough and narrow, because of valley walls and an incised stream channel, so that good soil salvage is difficult.

Imperfectly and well drained, fluvial landscapes (F5 and F6 Landscape Models) represent only 2.8% of the Robb Main LSA where there is more than enough upland surface soil for effective soil reclamation. F5 and F6 Landscape Models do not occur in the Robb West LSA.

b. Provide updates to the reclamation material balances and EIA, Reclamation Plan, and CR #10 Soil Resources report as required.

Response:

For the reasons described in ESRD SIR #128a), no updates are required.

6.2 Terrain and Soils

129. Volume 1, Section A.8.13, Page A-49

CVRI states that *in order to assess the effectiveness of the mitigation measures, CVRI will conduct a rare plant survey on any new development areas not included in the assessment.*

a. Clarify if CVRI is planning any new developments outside of the proposed disturbance footprint.

Response:

No new development areas outside of the proposed disturbance footprint for the Project are being planned by CVRI. For clarification purposes, the proposed disturbance footprint represents the level of planning that is appropriate for an environmental impact assessment sufficient to inform the decision on whether or not CVRI will be allowed to proceed with the proposed Project. Once CVRI has been given a decision to proceed with mining in the Project, additional detailed plans will become necessary and may result in some adjustments to the disturbance footprint. If that happens, updates to the environmental assessment for the appropriate disciplines will be part of the process at that time.

b. If new development areas are being planned, discuss the rationale for not including those areas within the current assessment.

Response:

See the response to ESRD SIR #129a).

c. Clarify if CVRI will also conduct additional studies or surveys on soils, vegetation, wildlife, etc. on any new development areas.

Response:

See the response to ESRD SIR #129a).

d. If no additional studies will be conducted, discuss the rationale for conducting only rare plant surveys.

Response:

See the response to ESRD SIR #129a).

130. Volume 1, Section C.2.1.1, Figure C.2-1, Page C-24
Volume 4, CR #10, Figures 2f, 3f, and 4f

The proposed footprint disturbance boundary (LSA) shown on the referenced maps appear to extend right to the edge and even into the Pembina River, but no discussion of adverse impacts directly to the Pembina River could be found.

a. Confirm the boundary of the proposed footprint disturbance and discuss its proximity to the Pembina River and the Pembina River floodplain.

Response:

Figure C.2-1 referred to in the question, presents a conceptual development plan for the Project mining areas. The figures referred to in CR #10 were based on the same figure. The scale of the figures has resulted in the development looking like it will impact the river and its floodplain.

In the Robb East area the west bank of the Pembina River is controlled by a 15- 30 m bedrock embankment. The mine development will not extend past the embankment and therefore will not impact the river or floodplain (ESRD Figure 130-1).

b. If the disturbance area will extend into the Pembina River or on to the Pembina River floodplain, discuss the potential for impacts through loss of spoil pile material or coversoil stockpiles due to flooding of the Pembina River.

Response:

The mine disturbance, including space for clearing, mining, dumps, soil stockpile, or reclamation sloping of dumps will not encroach on the Pembina River floodplain. As a result there will not be any rock dumps or soil stockpiles located on the floodplain.

c. Provide information on the minimum separation distance between the proposed disturbance area, including tree clearing and stockpile locations, and the Pembina River.

Response:

See the response to ESRD SIR #130b).

For purposes of this EIA, a vegetation buffer of 30m will be maintained along streams and rivers which are not being diverted. Disturbance, including space for clearing, mining, dumps, soil stockpile, or reclamation sloping of dumps will not enter into the Pembina River or its floodplain.

d. Discuss any impacts that may be expected on the Pembina River and any mitigation measures that may be required.

Response:

See the response to ESRD SIR #130a).

No significant impacts on Pembina River are expected. The flow of a small unnamed creek will be diverted from Pembina River to the Lund Creek basin.

e. Provide updates to the EIA as required.

Response:

See the response to ESRD SIR #130a).

Updates to the EIA are not required. No impacts to the Pembina River or its floodplain are expected.

131. Volume 1, Section C.6.6.8, Page C-62

CVRI describes the general spill clean-up procedures to be used on site and states that *spilled material that cannot be recovered will be picked up and stored for proper disposal*. However, no information could be found that describes how CVRI will ensure that soil or groundwater resources left in place have not been adversely impacted by the spill.

a. Discuss the methods or techniques CVRI will employ to ensure that any soil or groundwater resources left in place after the initial spill response and removal of spilled product have not been adversely affected by the spill.

Response:

CVRI operates with a defined 'spill response procedure' which includes steps to control the spill event, control its spread and recover any contaminated soil.

The first step in spill management is to prevent the spill from occurring. CVRI undertakes regular inspections of storage areas to ensure the secure storage of materials. CVRI has also instituted procedures for the transportation and handling of materials that are designed to prevent product spills.

In the event of a spill mine personnel and emergency response teams are trained in spill management and cleanup procedures. The emergency response teams are fully equipped with the equipment and materials to handle spills on the land and into water. Spill response plans have been developed to contain spills in the various areas of the mine. The emergency response teams undertake regular training exercises on spill containment and cleanup.

The most common events involve spills of diesel or lubricating oil. The rapid implementation of the spill response procedures will limit the initial impacts of the spill. A combination of temporary berms and absorbent materials are used to control the spread and to recover spilled products. Mine equipment (graders, dozers) can be used to berm the spill area to control the spilled material and/or isolate the spill area. Additional absorbent materials and/or vacuum trucks would be utilized to complete pickup of spilled products. Typically mine equipment is then utilized to remove the contaminated materials to the hazardous storage yard. This material is then removed from the property to an appropriate waste disposal site.

During removal, CVRI staff supervises the spill cleanup to ensure completion of the cleanup activities. After removal of spilled product and the impacted soil resources, samples will be collected to confirm that all affected material has been removed and disposed of.

b. Discuss the contaminant guidelines CVRI will use to evaluate any potential impacts as a result of contaminants on site.

Response:

Soil sample results from spill sites can also be compared to the Alberta Tier 1 Soil and Groundwater Remediation Guidelines (Alberta Environment, 2009, as amended). Where removal of all affected soil or groundwater resources is not possible, potential impacts will be evaluated using Alberta Tier 2 Soil and Groundwater Remediation Guidelines (Alberta Environment, 2009, as amended).

c. If any impacts are identified following initial spill response activities, discuss possible contaminant remediation measures that may be used to address those impacts.

Response:

The remediation methods that will be used will be dependant on the type of the spilled product and the severity of the spill. Mitigation options can include the excavation of additional material and on-site remediation. Remedial measures will continue until no further indications of the spill impact are found.

If groundwater impacts are identified, specialist consultants will be retained to assess the situation and to develop appropriate mitigation strategies.

132. Volume 1, Section E.10.1, Page E-149
Volume 4, CR #10, Section 2.1, Page 3
Volume 4, CR #10, Figures 2, 3, and 4

CVRI states that the *soils of the Regional Study Area (RSA) corresponds with the proposed Mine Permit Boundary*, but no discussion of the appropriateness of this boundary was provided. Figures 2, 3, and 4 indicate that in several places, the proposed footprint disturbance approaches very close to and in some cases appears to overlap with the proposed mine permit boundary.

a. Discuss the rationale for selection of the mine permit boundary for the RSA.

Response:

The mine permit boundary was selected as the RSA because the main impact to soils from mining is direct disturbance for haul roads, pits, dumps, ponds and all mine activity will be within the permitted area.

b. Discuss the rationale, when setting the RSA extent, for not using a minimum buffer distance around the project disturbance footprint, including but not limited to the full extent of peatland and wetland soil landscape units that may be affected.

Response:

The Development Plan illustrated in Figure C.2-1 indicates that a small buffer is included between most of the development features and the proposed disturbance boundary. See the discussion in ESRD SIR #132c) for why all adjacent peatlands and wetlands have not been included in the RSA.

c. Discuss the potential effects on soils outside of the mine permit boundary that may be affected by disturbance activities within the proposed mine footprint. For example, what effect will peat salvage operations have on any organic soils outside the mine permit boundary through potential draw down of the shallow water table or changes to the local hydrological flow regime?

Response:

One of the main factors in the development of organic soils is the frequency of excess water on the soil landscape. The persistence of a very wet soil condition favors the support of certain vegetation species over others, and allows for organic material to accumulate faster than it decomposes. Fluctuating moisture conditions of organic soil landscapes is normal, and is influenced by the frequency and volume of water from rain storms and snow melt, seasonal differences, and even successive years of above or below average precipitation. The current function of organic soil is the result of these fluctuating conditions over many years. A drastic or prolonged change to the moisture regime of organic soils would first influence the vegetation community, and in time, result in the accumulation or loss of peat material, according to the direction and severity of the change.

Whether or not disturbance of organic soil will result in a drastic and prolonged change to the hydrology of organic soil-landscapes outside the proposed footprint depends on many other factors and conditions which vary across the Project area. These factors include, but are not limited to, the source and volume of water, direction of flow within the organic soil, presence or absence of stream channels, and the relation and connection of surface water to the underlying material.

Water within organic soil generally comes from surface inputs and is held up at the surface by moderately fine to fine textured sediments which overlie the bedrock geology. Any dewatering to an open pit must first move very slowly through glaciated sediments and into the underlying bedrock formation, and then very slowly again across the bedrock formation toward a dewatered pit. Note that the comment in CR#3, Section 2.3.5, Page 15 regarding groundwater drawdown is referring to water which moves very slowly across bedrock formations because of the steep geological dip. The rate of inputs from rainfall, snowmelt and runoff, and subsequent loss through surface drainage, is expected to be much greater, and therefore be more important to the continued functionality of both organic and mineral wetland soils, than the rate of water percolation through surface and bedrock materials. In the two documented cases of groundwater drawdown, one case never occurred as far as 50 m from the pit and the other may have been observed up to 200 m from the pit. These observations in no way imply that a pit which causes groundwater levels to become lowered will result in dewatering of organic soil, or even mineral wetlands. In fact, CR #3, Section 2.3.5, Page 15, also states “the impact of pit dewatering is not widespread and groundwater levels return to normal in less than one year”.

Most of the organic soil proposed for direct disturbance is located within a valley, and along creeks or stream channels which move water through and out of the proposed footprint. During mining, the flow of water will be directed to maintain downstream flows, which will support the existing hydrology of both upstream and downstream organic soils. As a result no adverse effect to organic soil outside of the proposed disturbance is expected.

A second scenario is where mining will directly disturb only part of the organic soil-landscape either by storage of salvaged soil or placement of spoil. Soil piles and spoil dumps will limit, and probably prevent, non-disturbed organic soil from being dewatered into the pit, while allowing surface runoff to recharge the organic soil and still maintain a natural outlet to prevent flooding. As a result no adverse effect to organic soil outside of the proposed disturbance is expected.

A third scenario is where the mine pit will intersect with organic soil at the proposed disturbance boundary, with the potential for organic soil water to flow out and drain into the pit. This occurs in Robb West at the west end of Pits 1 and 2. The west end of Pits 1 and 2 occur within a relatively broad area of organic soil on nearly level to gently sloping topography, where the direction of natural drainage is gently divided eastward and westward. Water in the organic soil here is being held up by the underlying, moderately fine to fine textured sediments. After pit development, water in the remaining organic soil will be supplied by rainfall and snowmelt, and naturally flow westward, away from the pits. In the short-term, this condition will limit, if not prevent, dewatering of the organic soil while Pits 1 and 2 are opened. In the long-term (following reclamation), Pit 1 will be contoured into an end pit lake while Pit 2 will become an upland area. Bi-directional surface runoff from the reclaimed area will be added to the non-disturbed organic soil in continued support of pre-disturbance conditions so that adverse effect is expected in the long-term.

The third, and final, location where the mine pit will intersect with organic soil at the proposed disturbance boundary is in Robb Main (Pit 3) where the Erith River leaves the proposed development area. Although the Erith will be redirected during pit development and mining, water flow and elevations will be maintained which will support the water regime of the immediately adjacent organic soil. Organic soil occurs above the floodplain, on both sides, and soil storage piles are planned along the disturbance boundary on almost all of the westward side, and much of the eastward side. As previously discussed, no effect to non-disturbed organic soil is expected from soil storage piles. The organic soil landscape on the eastward side of the Erith drains in two directions: westward into the Erith, and northward into another stream channel. Pit development on the eastward side of the Erith will remove the organic soil which drains into the Erith leaving the non-disturbed organic soil to continue to drain northward, away from Pit 3, and limit, if not prevent, direct and drastic dewatering while Pit 3 is open. Following reclamation, Pit 3 will become a lake with a water elevation that conforms to the Erith River and which will continue to support pre-disturbance conditions of the adjacent organic soil.

For the reasons discussed, no adverse effect to peatlands or wetlands outside the disturbance area is expected. As noted in CR #3, Section 2.3.5, Page 15, CVRI has not observed distress on vegetation communities adjacent to dewatered pits.

d. Discuss any changes to the EIA that may occur if the RSA was expanded to encompass, at a minimum, all organic and wetland units that may be directly affected by activities within the disturbance footprint.

Response:

As discussed in ESRD SIR #132c), no direct effects to organic and wetland soil-landscapes are expected therefore no changes to the RSA are provided.

e. Provide updates to the EIA, Conservation and Reclamation Plan, and CR #10 Soil Resources report as required.

Response:

No direct effects to organic and wetland soil-landscapes are expected therefore no updates to the EIA, Conservation and Reclamation Plan, and the Soil Resources report are provided.

133. Volume 1, Section E.10.2.1, Table E.10-1, Pages E-150 to E-153
Volume 4, CR #10, Section 3.3, Table 2, Pages 12 and 13
In Table E.10-1, CVRI indicates a total RSA area of 13,548.7 ha, while CR #10, Table 2 indicates a total RSA area of 10,113.6 ha.

a. Clarify the correct size of the RSA, and if the correct size was used consistently throughout the EIA, Reclamation Plan, and CR #10 Soil Resources Report in the evaluation of potential impacts and reclamation material balance calculations.

Response:

The RSA area for soils in CR #10, 10,113.6 ha, is the correct area.

Table E.10-1 has an incorrect RSA area and the corrected table is provided in ESRD SIR #133b). The evaluation of potential impacts to soil and material balance calculations were not based on the RSA values but on the LSA values.

b. Provide updates to the EIA, Conservation and Reclamation Plan, and CR #10 Soil Resources report as necessary.

Response:

A revised Table E.10.2.1 (listed as ESRD Table 133-1) is provided indicating the correct RSA area of 10,113.6 ha. No other updates are necessary.

Table 133-1 (Revised Table E.10-1)Distribution of Soil Landscape Models in the RSA

Model [1]	Landform	Drainage	Soil Quality Rating[2] by Organic, A, B & C Horizon (thickness in cm)[3]	Area (ha)	Proportion (%)
Fluvial Terrain					
F1	Fluvial: a, b, t	Poor	Organic: Good (0-40) A: Poor (0-20) B: Good (15-43) & Fair (0-50) & Poor (42) C: Good (28-63) & Fair (10-75) & Poor (17)	236.3	2.3
F2	Fluvial: t, v Moraine or Saprolite	Poor	Organic: Good (0-35) A: Poor (0-20) B: Fair (0-32) C: Good (28-63) & Fair (25-100)	78.3	0.7
F3	Fluvial: t, b	Poor	Organic: Good (0-15) A: Poor (0-26) B: Good (20-36) & Fair (0-20) C: Good (50-65) & Fair (92) & Poor (56-100)	42.2	0.4
F4	Fluvial: v, t	Poor	Organic: - A: Poor (0-6) B: Good (0-15) C: Good (90) & Poor (81)	7.3	0.1
F5	Fluvial: v, b, t	Imperfect to Well	Organic: - A: Fair (0-22) B: Fair (0-53) C: Fair (35-97) & Poor (83)	130	1.3
F6	Fluvial: v, b, t	Well	Organic: - A: Fair (0-22) B: Fair (0-39) C: Fair (35-97) & Poor (83)	115.5	1.1

Table 133-1 (Revised Table E.10-1)Distribution of Soil Landscape Models in the RSA

Model [(1)]	Landform	Drainage	Soil Quality Rating[(2)] by Organic, A, B & C Horizon (thickness in cm)[(3)]	Area (ha)	Proportion (%)
1.0 Subtotal				**609.6**	**6.0**
Glaciofluvial Terrain					
G1	Glaciofluvial: v, b Moraine or Glaciolacustrine	Well to Moderately well	Organic: - A: Poor (2-24) B: Fair (12-46) C: Fair (30-75) & Poor (44)	136.2	1.4
G5	Glaciofluvial: v, b Moraine	Imperfect	Organic: - A: Poor (25) B: Fair (15) C: Fair (55)	7.8	0.1
G6	Glaciofluvial: v Moraine	Poor	Organic: Good (18) A: Poor (3) B: Fair (18) C: Fair (61)	12.3	0.1
2.0 Subtotal				**156.3**	**1.5**
Glaciolacustrine Terrain					
L1	Glaciolacustrine: v-b Moraine: b, u	Moderately well	Organic: - A: Poor (5-30) B: Fair (20-54) & Poor (28-55) C: Fair (20-63) & Poor (30-50)	1513.4	15.0
L2	Glaciolacustrine: v-b Moraine: b	Well to Moderately well	Organic: - A: Poor (3-20) B: Fair (20-30) C: Fair (50-74)	47.6	0.5
L3	Glaciolacustrine: v Softrock	Moderately well	Organic: A: Poor (19-25) B: Fair (34-46) C: Good (30) & Fair (20)	6.7	0.1
L4	Glaciolacustrine: v Bedrock	Moderately well	Organic: - A: Poor (10-13) B: Fair (29-40) C: Fair (15-38)	15.4	0.2
L5	Glaciolacustrine: v, b Moraine b, u	Imperfect	Organic: - A: Poor (3-49) B: Fair (13-42) & Poor (24-56) C: Fair (30-76) & Poor (25-60)	375.3	3.7
L6	Glaciolacustrine: v, b Moriane: b, I, u	Poor	Organic: Good (0-40) A: Poor (0-30) B: Good (21-30) & Fair(0-49) & Poor(20-30) C: Good(35-60) & Fair(20-63) &Poor(30-80)	192.4	1.9

Table 133-1 (Revised Table E.10-1)Distribution of Soil Landscape Models in the RSA

Model [1]	Landform	Drainage	Soil Quality Rating[2] by Organic, A, B & C Horizon (thickness in cm)[3]	Area (ha)	Proportion (%)
3.0	**Subtotal**			**2150.8**	**21.3**
Moraine Terrain					
M1	Moraine: b, i, r, u	Moderately well	Organic: - A: Fair (5-35) B: Fair (10-46) & Poor (22-34) C: Good (45-60) & Fair (25-65) & Poor (50)	3435.2	34.0
M2	Moraine: v Saprolite or Bedrock	Moderately well	Organic: - A: Fair (10-29) & Poor (2-23) B: Fair (15-42) C: Good (14) & Fair (0-65) & Poor (23-58)	795	7.9
M3	Moraine: b, i, r	Well	Organic: - A: Fair (0-23) & Poor (14) B: Fair (17-63) C: Fair (22-70)	343.1	3.4
M4	Moraine: v Saprolite or Bedrock	Well	Organic: - A: Poor (0-32) B: Fair (14-35) C: fair (0-65)	532.1	3.4
M5	Moraine: b, v Softrock	Imperfect	Organic: - A: Poor (0-33) B: Fair (18-47) & Poor (41) C: Good (30-53) & Fair (30-63)	274.1	2.7
M6	Moraine: b, i	Poor	Organic: Good (0-40) A: Fair (0-30) B: Fair (0-47) C: Good (60-95) & Fair (15-95) & Poor (90)	107.5	1.1
4.0	**Subtotal**			**5487**	**54.3**
Organic Terrain					
O1	Organic: blanket	Very poor	Organic: Good (100) A: - B: - C: -	468	4.6
O2	Organic: v-b Fluvial, Glaciolacustrine or Moraine	Very poor	Organic: Good (45-100) A: - B: - C: Fair (6-55) & Poor (5-50)	352.6	3.5
O4	Organic: b	Very poor	Organic: Good (100) A: - B: - C: -	202.1	2.0
5.0	**Subtotal**			**1022.7**	**10.1**
Saprolite Terrain					
S1	Saprolite: v Bedrock: r	Well	Organc: - A: Poor (0-6) B: Fair (19) & Poor (46) C: Poor (0-44)	82.9	0.8

Table 133-1 (Revised Table E.10-1)Distribution of Soil Landscape Models in the RSA

Model [1]	Landform	Drainage	Soil Quality Rating[2] by Organic, A, B & C Horizon (thickness in cm)[3]	Area (ha)	Proportion (%)
S2	Saprolite: b, r, i	Moderately well	Organic: - A: Poor (6-16) B: Fair (14-29) C: Fair (67) & Poor (50-65)	23.1	0.2
S3	Saprolite: v, b Bedrock: i, r	Well	Organic: - A: Poor (5-40) B: Fair (0-30) C: Fair (30-62) & Poor (24)	120.7	1.2
S4	Saprolite: b, i, r	Moderately well	Organic: - A: Poor (0-17) B: Fair (15-50) C: fair (46-65)	35	0.4
S5	Saprolite: r	Moderately well to Imperfect	Organic: - A: Poor (8-21) B: Fair (21-36) & Poor (16) C: Fair (42-60) & Poor (36-55)	104.2	1.0
6.0	**Subtotal**			**365.9**	**3.6**
			Other		
BD	Beaver Dam	-	7.0 Not Rated	0.6	0.0
DL	Disturbed Land	-	8.0 Not Rated	18.6	0.2
GP	Gravel Pit	-	9.0 Not Rated	2.5	0.0
OW	Open Water	-	10.0 Not Rated	2.7	0.0
PT	Pit (open mine)	-	11.0 Not Rated	5.7	0.0
RB1	Rough Broken 1		12.0 Not Rated	4.2	0.0
RB2	Rough Broken 2	-	13.0 Not Rated	85.3	0.8
RD	Road	-	14.0 Not Rated	176.7	1.7
SP	Spoil	-	15.0 Not Rated	14	0.1
WS	Well Site	-	16.0 Not Rated	11	0.1
17.0	**Subtotal**			**321.3**	**3.2**
18.0	**Total**			**10,113.6**	**100**

(1) Soil model characteristics are described in CR #10, Table 1.
(2) Ratings for East Slope root zone material (after ASAC, 1987)
(3) Depth of soil rating is based on investigation to 100 cm.

134. Volume 1, Section F.3.4.1, Page F-27
Volume 1, Section F.3.4.2, Page F-29
Volume 1, Section F.3.4.3, Page F-31
Volume 1, Section F.3.4.4, Page F-33
Volume 4, CR #10, Section 3.3, Page 11
Volume 4, CR #10, Section 3.3, Table 2, Pages 12 and 13
Volume 4, CR #10, Section 5.4, Table 12, Pages 60 and 61

For each of the referenced Biophysical Reclamation Units, CVRI states that the *surficial deposits are dominated by glaciolacustrine deposits (Upper Ridge) or as lacustrine or residuum deposits (Lower Slopes, Forested Lowlands, and Riparian Lowlands*). However, Section 3.3 and Tables 2 and 12 in the Soil Resources Report indicate that the moraine landforms occupy the majority of the area within the RSA and LSA, respectively.

a. Clarify the dominant surficial deposits within the project area (RSA and LSA) and within each of the biophysical reclamation units described within the reclamation plan.

Response:

CR #10 identifies the dominant surficial deposits as morainal and glaciolacustrine material. In both the Upper and Lower Foothills Subregions, morainal deposits are typically located on higher landscape positions such as ridges while glaciolacustrine deposits occur on lower landscape positions and in valleys. Other surficial material includes soft and hard bedrock material, glaciofluvial and fluvial material and accumulated peat.

Biophysical Reclamation Units are a conceptual construct used to describe general types of reclaimed landscapes. Reclaimed landscapes will initially be built with spoil composed of bedrock (residuum), morainal and glaciolacustrine materials remaining after soil salvage is completed. In general mining through the higher landscape positions will generate residuum and moraine materials for landscape reconstruction of Upper Ridge units. Mining of the lower landscapes will generally generate residuum and glaciolacustrine materials. It is in this sense that the Biophysical Reclamation Units were described as having various material deposits.

b. Provide updates to the EIA, Reclamation Plan, and CR #10 Soils Resources report as necessary.

Response:

The soils component of the BRU descriptions in the reclamation plan will be corrected for the detailed mine and reclamation planning that will be required for the second stage of the regulatory process. No updates to CR #10 or the EIA are required.

135. Volume 1, Section F.4.1.1, Page F-36

CVRI states that *non-salvageable debris that cannot be incorporated into the soil will be windrowed to allow soil salvage to proceed and will be buried during mining operations.*

a. Provide information on the expected volumes and percentage of fallen debris and non-merchantable vegetation that will be incorporated during salvage, and buried during mining operations.

Response:

It is anticipated that the majority of the woody debris generated by the clearing and salvage operations will retained in the salvage soil. It has been reported that excessive volumes of woody debris in soil will tie up the nitrogen affecting the nutrient availability for vegetation. (Organic Materials as Soil Amendments in Reclamation: A Review of Literature – RRTAC 93-4).

CVRI has not collected data on the volumes of woody debris that has been hauled to the rock dumps. The volumes and percentage of woody debris that will not be retained in the salvaged soil is difficult to accurately estimate for the following reasons:

- The volume will be dependent on the efficiency of the timber salvage operations as inefficient operations may leave more debris;
- The distribution of the woody debris will be dependent on the type of machinery that is used during the timber salvage operations. Delimbers working at a landing will leave large accumulations of debris at the landing while processors will spread the debris fairly evenly throughout the timber salvage area.
- Types of forest stands – pine stands produce much less woody debris than spruce stands. Deciduous stands also produce much more debris than coniferous stands
- At this point it is not known how much of the deciduous timber will be utilized by the forest industry. Woody debris from non merchantable forest stands and shrublands will be mechanically reduced by the dozers and mixed with the soils during the salvage operations. The volume of woody debris from these areas that can be incorporated in the salvaged soil has not been quantified by CVRI.

The soil salvage monitoring personnel will make a field decision on whether or not there is too much woody debris to mix with the salvaged soil.

It is when there are heavy accumulations of woody debris where there may be instances where the entire volume of debris will not be retained in the soil. Standard procedure has been to windrow the excess woody debris on the mine development area where it will be incorporated into the overburden mined from the pits and hauled to the rock dumps.

b. Discuss alternative uses for this non-salvageable debris besides burial (such as coarse woody debris on coversoil stockpiles), including benefits and constraints to use.

Response:

As discussed in the previous response it is anticipated that the majority of the woody debris generated by the clearing operations will be incorporated in the salvaged soils.

There are few alternative uses for the woody debris. One alternative use is firewood for the local residents. There are access and liability concerns that would have to be addressed before local residents could utilize this woody debris.

136. Volume 4, CR #10, Section 3.2, Table 1, Page 7
The landform of Soil Landscape Model F1 is described as Fluvial with surface expressions a, b, and t. No definition of the surface expression 'a' could be found.

a. Provide a definition for the surface expression 'a'.

Response:

The surface expression code 'a' means 'apron'.

b. Provide updates to the EIA, Reclamation Plan and CR #10 Soil Resources report as necessary.

Response:

No updates to the EIA or the Reclamation Plan are necessary.

An updated 'Key to Soil Profile Codes for Landform and Surface Expression' in CR #10, Appendix B, Soil Landscapes and Profile Descriptions, is provided here (below) to include the surface expression code 'a' and the description of 'apron'.

Landform & Surface Expression:

F	-	Fluvial
G	-	Glaciofluvial
L	-	Glaciolacustrine
M	-	Morainal
O	-	Organic
R	-	Bedrock (hard)

S	-	Saprolite (soft bedrock)
BD	-	Beaver Dam
DL	-	Disturbed Land
PT	-	Pit (open mine)
RB1	-	Rough Broken 1
RB2	-	Rough Broken 2
RD	-	Road
SP	-	Spoil
WS	-	Well Site
a	-	apron
b	-	blanket (>1m)
i	-	inclined
m	-	rolling
r	-	ridged
t	-	terraced
u	-	undulating
v	-	veneer (<1m)
(c)	-	coarse textured
(m)	-	medium textured
(f)	-	fine textured

137. Volume 4, CR #10, Figure 3
Volume 4, CR #3, Section 2.3.5, Page 15

Several organic soil landscape map units (e.g., O1/2 map unit at western end of Robb West mine in Section 36-049-22 W5M) extend from inside the project disturbance footprint, across the RSA, and beyond the mine permit boundary, and CVRI has stated that they will salvage peat from these landscape units within the project footprint. Further, CVRI has stated that significant groundwater drawdown may extend up to 200 m from the pit.

a. Discuss how peatlands and wetlands will be affected by the predicted drawdown of shallow groundwater in the areas adjacent to the disturbance footprint.

Response:

In 2009, the results of a four year groundwater monitoring program in the Mercoal Phase 2 area wetlands were summarized in the Annual Groundwater Monitoring Report (MEMS 2010). The monitoring program data has not shown any issues with the lowering of groundwater levels as the drawdown of water levels adjacent to operating pits was found to be minimal. Monitoring of groundwater levels in the vicinity of the Mercoal Phase 2 area wetlands has continued and still shows minimal drawdown of groundwater in the vicinity of the active mine areas.

b. Will any peatlands or peatland remnants be isolated by the project, and if yes, discuss how the hydrology of these isolated peatlands will be affected.

Response:

No peatlands or peatland remnants will be isolated by the Project. See discussion in ESRD SIR #132 c).

c. Discuss any monitoring programs planned to ensure that the peatlands and wetlands adjacent to the project disturbance footprint are not being affected.

Response:

As discussed in the response to ESRD SIR #137a), CVM has been monitoring groundwater levels in the vicinity of the MP2 wetlands since 2005. Monitoring programs are normally established during the licence stage when EPEA approvals are formulated for the proposed development. As an example, a Wetland Monitoring Program (see ESRD Appendix 137) was proposed in 2011 and is currently under review in an effort to begin monitoring specific wetlands in the current CVM operational area. This program meets the requirements of Condition 4.5 of EPEA Approval No. 11066-02-00 which states:

4.5.5 The approval holder shall submit a revised Wetland Monitoring Program Proposal to the Director by June 30th, 2011, unless otherwise authorized in writing by the Director.

4.5.6 The Revised Wetland Monitoring Program Proposal shall include, at a minimum all of the following information:

(a) Existing wetland monitoring program information and results (water quality/quantity) and vegetative information;

(b) A plan to monitor and determine potential effects of road and pit development on water levels (surface and subsurface) and vegetation communities within wetland areas adjacent to pit development;

(c) A plan to monitor the success of wetland reclamation; and

(d) Corrective measures, where appropriate, to protect affected wetland communities.

CVRI anticipates that similar requirements will be required and satisfied at the next stage of approvals. Programs will be tailored to the circumstances evident at that time.

d. Provide mitigation measures that may be implemented if the monitoring programs described in c) indicate that peatlands and wetlands are being affected.

Response:

If the monitoring programs indicate that wetlands are being affected by mine operations an investigation will be undertaken to determine the cause, the significance of the effect and to develop a mitigation strategy. Specialists in hydrogeology and wetlands will undertake the investigation.

e. Provide updates to the EIA, Reclamation Plan, and CR #10 Soil Resources Report as required.

Response:

No updates to the Reclamation Plan and CR #10 are needed (see ESRD SIR #132c).

138. Volume 4, CR #10, Section 3.3, Page 11
Volume 4, CR #10, Section 5.3.1, Table 11, Pages 54 to 55
Volume 4, CR #10, Section 5.4, Table 12, Pages 60 to 61
Volume 4, CR #10, Appendix B

CVRI states that representative soil profiles for each landscape are presented in Appendix B, and Table 11 summarizes the baseline soil horizon thicknesses, for each soil landscape model, used to calculate volumes of salvageable soil. Several of the representative soil profiles in Appendix B have Peat, LFH, A Horizon, and B Horizons thicknesses that are outside of the depth ranges summarized in Table 11. For example, the representative M2 soil profile in Appendix B has an A Horizon thickness of 3 cm. In Table 11, the A Horizon thickness range for the M2 soil landscape unit is 9-23 cm in the Robb Main-Centre East Pits and 8-29 cm in the Robb West pit, both considerably greater than the representative thickness of 3 cm, suggesting that the total volume of salvageable A Horizon material may have been overestimated.

a. Review and confirm that appropriate depth ranges have been used for each of the soil landscape models in Table 11.

Response:

Note that the site description and soil horizons representing the M2 soil landscape unit is from soil inspection site B853 and the horizon sequence is Ae/Bm/Bt. In CR #10, Section 3.4.1, Page 14, a Brunisolic Gray Luvisol is described as having a Bm horizon, with an Ae that is above or below the Bm, or even absent, and that ‘topsoil’ is composed of a Bm and/or an Ae horizon. What this means for the soil salvage plan and Table 11 (CR #10) is that the A Horizon column represents those soil horizons which will be salvaged as ‘topsoil’. At site B853 then, ‘topsoil’ thickness would be represented in the A Horizon column of Table 11 (CR #10) by Ae+Bm which is 8 cm. For further clarification, the horizon thickness in Table 11 (CR #10) is a summary of map units (related polygon data) rather than the site inspection data. In other words, horizon thicknesses from inspection sites within a polygon are summarized for that polygon, and polygon data is then summarized for Table 11 (CR#10). In summary, horizon thicknesses are calculated on a polygon basis so that volume of salvaged horizons can also be calculated on an area basis.

b. Based on any changes resulting from the review of a), provide updates to the surface soil salvage volume estimates in Table 12 as needed.

Response:

As no updates to Table 11 are required (see ESRD SIR #138a), Table 12 requires no updates.

c. Provide updates to the Reclamation Plan and CR #10 Soil Resources report as needed.

Response:

No updates to the Reclamation Plan and CR #10 are needed (see ESRD SIR #138a).

139. Volume 4, CR #10, Section 3.5.1, Page 15; Section 4.2.1, Page 32
Volume 4, CR#10, Section 5.1, Page 49
Volume 4, CR#10, Section 5.3.4, Page 58
Volume 4, CR #10, Section 6.2.2 Page 73

Equivalent land capability issues have been discussed in various sections.

a. Explain how CVRI plans to engage reclamation strategies so that equivalent land capabilities (biological productivity) will be achieved.

Response:

The strategy to ensure that equivalent land capability is achieved is the implementation of the reclamation plan and achievement of the condition within the EPEA operating approval. As described in Section F.2.4 of the application the reclamation plan has been designed to return the mined lands to provide equivalent land capability. As stated in Section F.2.4 of the application soils and vegetation are used to evaluate the other bio-physical site factors in the reclaimed areas.

140. Volume 4, CR #10, Section 3.5.1, Table 3, Page 16
Volume 4, CR #10, Section 3.5.2, Table 4, Pages 17 to 20

Table 3 indicates a number of parameters used to evaluate the reclamation suitability of soils in the Eastern Slopes Region of Alberta, including pH, salinity, sodicity, saturation %, coarse fragment content, texture, moist consistence, and $CaCO_3$ %. Table 4 provides physical and chemical data from sampled soils, but does not include information on coarse fragment content or $CaCO_3$ %.

a. Discuss the rationale for not including coarse fragment content or $CaCO_3$ % when evaluating the reclamation suitability of the sampled soils within the disturbance footprint.

Response:

During the soil survey, most soils were found to have very low percentage of coarse fragments. Coarse fragments in the majority of glaciated material was in the order of 1 to 5%, and only a small area of stony till was encountered where coarse fragments was in the order of 20%. Bedrock material has a much higher percentage of coarse fragments but is not part of the soil salvage plan. These are the reasons why coarse fragment content was not included in Table 4 (CR #10).

During the soil survey, lime was seldom encountered within 1 m of the surface and the reaction (pH) was naturally found to be low. A screening test (pH > 7.5) was used to trigger analysis for inorganic carbon. Soil analysis from the few Ck horizons revealed that equivalent $CaCO_3$ is in the order of 8 to 12%, and samples where no lime was observed in the field had no detectable inorganic carbon. These are the reasons why $CaCO_3$ was not included in Table 4.

b. Evaluate the potential changes to reclamation suitability ratings of the soils within the project footprint if coarse fragment content or $CaCO_3$ % are included in the ratings evaluation.

Response:

Root zone material having a coarse fragment content of <30% is rated as having a Good suitability. All soil material encountered (with the exception of bedrock) was found to be in this category which does not change the reported reclamation suitability ratings.

The limited presence of subsoil lime encountered is insufficient for material suitability to be anything above a Fair rating, and those materials are already rated as Fair and Poor for other reasons.

c. Provide updates to the EIA, Reclamation Plan, and CR #10 Soil Resources report as necessary.

Response:

As discussed in SIR #140a) and b), no updates to the EIA, Reclamation Plan, and Soil Resources Report are necessary.

141. Volume 4, CR #10, Section 3.5.2, Table 4, Pages 17 to 20
Volume 4, CR #10, Section 3.5.2, Table 5, Pages 21 to 23

Table 5 provides Soil Quality Ratings for each soil landscape model in the Robb Trend study area. No soil sample data was presented in Table 4 for the majority of the soil landscape models, however. For example, data from 14 'L1' sites was provided in Table 4, but no data from the 'L2' and 'L4' landscape units was provided in Table 4.

a. Discuss the methods used to calculate Soil Quality Ratings when no soil chemistry was available to represent a given soil landscape model.

Response:

Both chemical and physical soil data was used to evaluate the suitability ratings of soil horizons. During the soil survey, physical properties of each soil horizon, such as field texture, were recorded and became part of the attributes for the particular polygon during final mapping. Each polygon has a suitability rating for each soil horizon based on texture – this is not a calculated rating but assigned according to groupings. Soil samples were collected to represent the main soils encountered, and not collected to represent each soil landscape model (CR #10, Appendix C). Results of the laboratory analysis confirm the expectation, developed during previous soil surveys for CVRI, that salinity and sodicity do not limit the baseline soil suitability. The chemical data also shows that pH varies within horizons and between horizons (Table 4, CR #10) and the resulting suitability ratings are assigned (not calculated) based on the range of reactions. This chemical knowledge derived from of sampled soils is then extrapolated to represent soils that have not been sampled, using all accumulated soil survey experience.

b. Discuss the rationale for not collecting representative soil sample data for each soil landscape model.

Response:

Some of the reasons for not collecting representative soil sample data from each soil landscape model are:

- Soil samples were collected during the soil survey field inspections which often took place in a transect type fashion for delineation of potential polygons. Polygons were finalized after the completion of field work, rather than in the field, because of the long and linear nature of many polygons, and to maximize field time for field work. Mapping was concluded with final polygon delineation and subsequent assignment of soil landscape models. Soil landscape models were not known nor assigned during field work when soil samples were collected.
- In some cases, the soil in landscape models with no sample data have the same soils as other landscape models which do have sample data and is easily extrapolated.

- Many of the soil landscape models which have no soil sample data are from the haul roads. Soil samples were only collected from within the proposed pit disturbance, soil storage and dump areas.
- Some of the soil landscape models with no sample data represent limited hectares.

c. If data was collected but not presented, provide the additional data.

Response:

All the laboratory analysis data is available in the Appendices of CR #10. Field data has been incorporated into the digital soil mapping, as mentioned in ESRD SIR #142a), and is not presented as part of the EIA.

142. Volume 4, CR#10, Section 4.3, Page F-44.
Baseline trace elements data suggest that arsenic, barium, cobalt, molybdenum, nickel, and selenium exceed CCME guidelines. It is possible that the extent and magnitude of exceedances may be underestimated based on the sampling intensity.

a. Discuss strategies that CVRI will use to manage geologic materials with high concentration of the above trace elements such that they will not pose an ecological threat during operation and at closure.

Response:

Overburden testing for trace elements reveals that normal concentrations are generally below CCME guidelines except for a few exceedances. These few exceedances reveal no pattern according to site, depth, or even element.

Since the exceedances are few, scattered, and of minor magnitude they will not pose an ecological threat during operation or at closure. CVRI will not manage overburden placement for these conditions.

143. Volume 4, CR #10, Section 5.3.1, Page 53
Volume 4, CR #10, Section 5.4, Page 59
Volume 4, CR #10, Section 5.4, Table 12, Pages 60-61
Volume 4, CR #10, Figures 3a to 3f
CVRI states that *Upland surface soil… salvage is limited to a maximum slope steepness of 45 percent to allow for the safe operation of equipment and slopes in excess of 45% are not included in the calculations* of surface soil salvage volumes. It appears from Table 12 and Figures 3a to 3f, however, that selected polygons with slopes in excess of 45% may have been included. For example, an S3/8-9 polygon located along the south edge of Section 30-049-21 W5M on Figure 3a appears to be located within the proposed

footprint disturbance, and appears to have been included within the volumes of soil available for salvage in Table 12. Other examples were also found.

a. Provide information of the area of land (total area and area for each soil landscape model) within the disturbance footprint with slopes greater than 45%.

Response:

The following are soil landscape models within the proposed disturbance area having slopes greater than 45%:

Robb Main-Center-East Pits & Haul Roads

M3/8 1 polygon = 2.5 ha

M4.2/8 5 polygons = 5.2 ha

Total = 7.7 ha

Robb West Pits & Haul Road

RB2/8 3 polygons = 16.3 ha

S1/8 7 polygons = 23.6 ha

S2/8 1 polygon = 4.6 ha

S3/8-9 4 polygons = 17.5 ha

Total = 62.0 ha

b. Confirm that all landscape with slopes greater than 45% have been excluded from the soil volume calculations.

Response:

In Table 12 of CR #10, the shaded cells only include the wet soil areas which are excluded from the total salvageable volume calculations. Landscapes with slopes greater than 45% have also been excluded from the total salvageable volume calculations but were indicated on Table 12 of CR #10.

c. Provide updates to the Reclamation Plan and CR #10 Soil Resources report as needed.

Response:

Soil volume calculations in Table 12 of CR #10 do not include polygons with slopes greater than 45% and do not need to be updated.

144. Volume 4, CR #10, Section 5.3.4, Page 58
Volume 4, CR #10, Section 5.4, Page 62
Volume 4, CR #10, Section 5.4, Table 15, Page 63

CVRI states that *thicker coversoil does not necessarily equate to better quality minesoil*. Based on the average soil horizon thickness averages provided in the report, CVRI concludes that *there is sufficient surface soil available to meet coversoil requirements in all areas of the proposed project disturbance*. Information provided by CVRI suggests that there may be greater than 1 million cubic metres of excess upland surface soil available for salvage.

a. Discuss CVRI's plans for this potential excess volume of salvaged surface soil.

Response:

The basis for the above statement of 'greater than 1 million cubic metres of potential excess salvaged surface soil' appears to be in reference to the last three columns of Table 15 on page 63 of CR #10 for Robb Main-Center-East Pits & Haul Roads. Please note that the last two columns of Table 15 of CR #10 represent the volume of all A and B material from upland soils, and the Peat material from Gleysolic soils. The total thickness of A+B horizons from upland soils (and the resulting volume) is different than the thickness of upland surface soil defined by ESRD in the Approval Conditions for the CVM. The definition of 'upland surface soil' in the Approval Conditions is essentially a stratum salvaged from an upland soil (mineral parent material with imperfect drainage or drier) that includes the LFH, A horizon, and in some cases part, or all, of the B horizon. In addition, the Approval Conditions for minesoil profiles of Upland Reclaimed Areas (stated in CR #10, Section 5.3.4, Page 58) is 0.30 meters of surface soil. Comparing the volume of A horizon material available for salvage with the volume of coversoil required to meet the 0.30m Approval Condition reveals that most, if not all, of the B horizon material will be required. The current CVM practice to comply with the Approval Conditions is to salvage all of the upland A horizon material, the Gleysolic peat material, and sufficient B horizon material for use in upland minesoil construction. There is no excess salvaged surface soil. All of the salvaged surface soil will be used for reclamation.

6.3 Wildlife

145. Volume 3, CR#7, Section 4.5.4; Page 53

a. Based on Foothills Research Institute Grizzly Bear Project (FRIGBP) data points and open access densities in the vicinity of the CVM permit area, discuss if and how attractive food resources on the reclaimed area may concentrate bear activity in the vicinity of the mine permit area relative to the remainder of their home ranges and how this might effect mortality risk.

Response:

As noted in the previously submitted Section 4.5.4 of CR #7 of the EIA a total of 16 radio-collared grizzly bears (960 locations) occurred within the CVM permit area between 1999 and 2005. Eight of these animals spent time in the permit area for more than one year with one bear spending 4 years, two bears for 3 years and five bears for 2 years. It was noted the CVM permit area supports one of the highest number of grizzly bear locations (6.2) per km^2 and was utilized by a large number of different bears relative to its small size. The high densities of grizzly bear locations in the vicinity of the CVM is likely due to the attractive sources of digestible protein (ungulates) and high energy herbaceous forage. ESRD Figure 145-1 shows total telemetry locations (1999 to 2005) of each of the 16 aforementioned grizzly bears both inside and outside of the CVM permit area. It is readily apparent that grizzly bears that use the CVM permit area for a portion of their range also utilize large portions of the remainder of the RSA, and even outside of the RSA. ESRD Table 145-1 summarizes the percentage of total observations per each grizzly bear that occurred within versus outside of the CVM permit area from 1999 to 2005. Overall, the percentage of grizzly observations per bear that occurred inside of the CVM versus elsewhere was 5.5%. These values ranged from 0.1% to 28.7% with females (5.6%) and males (5.5%) spending a very similar proportion of time in the CVM permit area.

Table 145-1 Grizzly Bear telemetry locations inside and outside of CVM Permit Area (1999-2005)

NAME	SEX	Number of Bears in CVM	Number of Bears Outside CVM	Total Number of Bears locations	% Observations in CVM Permit
G007	F	110	273	383	28.7
G011	F	34	326	360	9.4
G012	F	12	2244	2256	0.5
G014	M	34	359	393	8.6
G023	F	24	2063	2087	1.1
G024	M	3	1502	1505	0.2

Table 145-1 Grizzly Bear telemetry locations inside and outside of CVM Permit Area (1999-2005)

NAME	SEX	Number of Bears in CVM	Number of Bears Outside CVM	Total Number of Bears locations	% Observations in CVM Permit
G026	F	40	206	246	16.2
G027	F	139	1032	1171	11.9
G029	M	61	2400	2461	2.5
G033	M	248	2887	3135	7.9
G054	M	9	115	124	7.2
G055	M	4	439	443	0.9
G061	F	118	556	674	17.5
G062	M	6	372	378	1.6
G100	F	1	1550	1551	0.1
G208	M	118	296	414	28.5
Total		961	16620	17581	5.5

The Foothills Research Institute mapped mortality risk in the RSA using radio-telemetry locations, open motorized density, and regression analysis of 297 grizzly bear mortalities in the central Rockies ecosystem, and validated in other parts of Alberta. Average values for baseline mortality risk were calculated for each BMU and CVM permit area (CR #7, Section 4.5.5, Table 24, p. 54). Mortality risk ranges from 1 (lowest) to 10 (highest). The CVM permit area encompasses portions of the Upper Pembina (52.1%), Embarras (19.9%), Lendrum (13.0%), Beaverdam (7.8%) and McLeod (7.2%) Bear Management Units. The average total road density of these 5 BMU is 0.72 km/km^2. This is the same as the average for the entire RSA (Table 5, CR #7). The average mortality risk for the 5 BMUs in the vicinity of the CVM permit area is 6.1 which are the same as for the RSA-wide average. In summary, there is little evidence that mortality risk driven by road densities has potential to result in disproportionate mortality of grizzly bears in the vicinity of the CVM permit area.

146. Volume 3, CR#7, Section 5.3.5.3. Page 77
Volume 5, CR#14, Section 13.0. Page 107

The proposed reclamation plan calls for about 31 kms of long, linear end-pit lakes on the 50 km mine permit area (62% of mine length) with narrow gaps between lakes.

a. Discuss the impacts this will have on grizzly bear movements and eastward dispersal.

Response:

Review of ESRD Figure 145-1 (ESRD SIR #145a)) shows that the vast majority of grizzly bear locations from 1999 to 2006 were found along the eastern arm of the CVM south of Sterco. This area also supports the highest concentration of end pit lakes on the CVM including Silkstone Lake, Lovett Lake, Pit 24 (Stirling Lake), Pit 45 and Pit 35. These lakes were constructed from 1985 to 1999 and as such grizzly bears were subject to the potential effects of these lakes for the entire period of telemetry monitoring. Closer examination of ESRD Figure 145-1 shows that locations of several individual grizzly bears are distributed both west and east of the CVM permit area where the majority of end pit lakes are found. These bears female grizzlies G027, G026, and G061 as well as male grizzlies G014, G033, and G208. All of these bears were regular visitors to the CVM with % of total locations within the CVM boundaries ranging from 7.9% to 28.5% (mean = 15.1%). It is apparent that grizzly bears using the CVM permit travelled readily from east to were across and between the end pit lakes in the area. The answer to ESRD SIR #146c) (below) compares end pit lake coverage in the CVM to that of the proposed Project. This comparison shows that the percentage of end pit lake length to the total length of the CVM is greater than that of the proposed Project.

An 18-km stretch of the Trans-Canada Highway (Phase IIIA) through Banff National Park was twinned and fenced in 1997. This is comparable to the 19.5 km length of the CVM permit area. A total of 14 wildlife passage structures were constructed along the fenced Phase IIIA highway stretch, including 12 underpasses and 2 overpasses. The underpasses averaged less than 5 meters in width, and the two overpasses are 50 meters wide. The % of crossing gaps/opportunities relative to length of twinned highway is approximately 1% as opposed to the 38% for the proposed Project. Traffic volume along the Trans-Canada Highway (TCH) was very high at 17,970 vehicles per day in 2008 (Highway Service Centre, Parks Canada, Banff, Alberta).

In spite of the limited width of available crossings and the high traffic volumes grizzly bears crossed the Phase IIIA stretch 381 times from 1999 to 2008. The majority (82%) of crossings were at the 50 meter wide overpasses which are located approximately 10-km apart. Grizzly bears showed a steady increase in wildlife crossing structure use relative to other species, from less than 0.05 percent of all detected crossings to 20 times that amount at 1.1 percent of all crossings per year (Clevenger *et al.* 2009).

Based on the above empirical data from the study region and the movement patterns of grizzly bears across the much less porous Trans-Canada Highway, it is unlikely that the end pit lakes proposed for the Project will obstruct grizzly bear movements or eastward dispersal.

b. Address how this will impact grizzly bear population recovery and recolonization?

Response:

Both male and female grizzly bears readily utilize narrow (50 meter) crossing structures on the Trans-Canada Highway. Sawaya (2012) detected 7 different female and 8 different male grizzly bears crossing the Trans-Canada Highway from 2006 to 2008 in Banff National Park and concluded that this level of wildlife crossings allowed sufficient gene flow to prevent genetic isolation of grizzly bear populations in Banff National Park. Based on the above findings and the information in the response to ESRD SIR #147a, we do not anticipate that end pit lakes will block grizzly bear movements or dispersal in the vicinity of the Project. As such it is not likely that grizzly bear population recolonization of recovery will be affects by movement obstruction associated with the positioning or amount of end pit lakes proposed at the Project.

c. Discuss what effects this would have on ungulate seasonal movements, dispersal, recolonization and predation risk.

Response:

The first lakes to be reclaimed as fishery habitats on the Coal Valley Base Mine were the Silkstone and Lovett Lakes. These lakes are situated beside each other and separated by a ridge and the Lovett River. This is a similar configuration to much of the Project development. Final reclamation activities on the Silkstone and Lovett Lakes were completed in 1991 and the lakes were stocked with hatchery fish in 1991 and 1992 respectively. Food organisms had accumulated in the lakes for 4-6 years prior to introduction. In 1991, Pit 24 and Pit 25 were still under development. Continuous mining and reclamation have occurred on the Coal Valley Base Mine since Silkstone and Lovett Lakes were established.

Table F.2-2 (Section F, Page F-9) list the current Coal Valley End Pit Lakes and Figure 1 (Appendix 8) identifies lake names in the Coal Valley Base Mine area. This 20-25 year period from the initial development of Silkstone and Lovett Lakes is long enough to evaluate ungulate response to linear developments in the Coal Valley Base Mine. Reports summarizing ungulate activity on the CVM include:

- a 1991/1992 wildlife inventory of the Coal Valley Base Mine (Bighorn. 1995. Wildlife Inventory of the Coal Valley Mine 1991-1992);
- a 2006/2007 ground survey of the Coal Valley Base Mine, West Extension and South Block (Bighorn. 2008. *IN* Mercoal West-Yellowhead Tower Mine Extension Project: Ungulate, Small Mammal, Avifauna, Amphibian Assessment. CR #14 in CVM, Mercoal West and Yellowhead Tower Mine Extension Project); and

- four winter air surveys of the Lovett Ridge area including all Coal Valley Mine developments, in 1996, 1997, 2007 and 2008/2011 (CR #14, Page 29).

The 1991/1992 wildlife inventory of the Coal Valley Base Mine indicated that elk were the most abundant ungulate on the mine followed by white-tailed deer, mule deer and moose (Bighorn 1995, Page 7). This pattern of abundance was the same using various inventory techniques – winter track counts, pellet-group counts and visual observations made throughout the year in all seasons during systematic ground surveys. The highest count of elk on any one day was 80, of white-tailed deer (18), mule deer (14) and moose (2). All species varied their use seasonally.

Elk made the highest use of mixedwood and reclaimed habitats; use was highest closest to the forest/grassland edge. Pellet-group counts on the ridge between Silkstone and Lovett Lakes indicated use was highest on the ridge top and south-facing slope above Silkstone Lake and lower on the north-facing slope (Bighorn 1995, Page 11). Distribution of elk on the Coal Valley Base Mine was related to proximity to the edge between forest and grassland and aspect, rather than any factor due to the presence of lakes.

Bighorn (1995) indicated that riparian habitats received the highest use by moose. Nine moose were observed using riparian habitat associated with the Lovett River in the vicinity of Silkstone Lake in early winter of 1992/1993. Deer used reclaimed habitats, mixedwood and riparian habitats most heavily. Highest use as measured by pellet-group counts was found on Halpenny West and north of Lovett Lake. The pellet-group count technique identified more extensive use by deer on the mine than winter track counts. It is possible that certain habitats are used more heavily by deer in seasons without snow (Bighorn 1995:11).

The 2006/2007 ground survey of the Coal Valley Base Mine (Bighorn 2008, Page 24) indicated that elk were most abundant (57% of observations), followed by white-tailed deer (36%) and mule deer (7%); a similar pattern as observed in 1991/1992.

The 2008/2011 air survey of the Lovett Ridge area indicated that 98% of the 187 elk observations were centred on the Coal Valley Base Mine (CR #14, Page 34). Figure 5.1 of CR #14 (with satellite image) indicates an area of concentration on the southeast corner of the mine. There are a number of lakes or waterbodies in this part of the mine associated with Pit 34, Pit 35, Pit 25, Pit 44 and Pit 45.

The 2008/2011 air surveys indicated that the area occupied by elk on the Lovett Ridge outside of the CVM MSL has been reduced since the 1996 survey (CR #14, Figure 5.2). Elk have maintained use of Coal Valley Base Mine since 1996 but distribution on the Lovett Ridge area outside the mine has changed and become less extensive. Several reasons for this may include: increased access on the northeast side of the ridge allowing for increased harvest pressure, increased human activity, and continued predation. The Coal Valley Base Mine appears to be providing a refuge for elk from increased access and related human activity. The presence of ponds and lakes appears to have not inhibited elk use of the MSL.

Elk, white-tailed deer, mule deer and moose have specific life strategies, habitat needs, seasonal requirements, anti-predator behaviour, and harvest pressure. These and other factors influence wildlife response to reclamation and colonization of new habitats. The results of the most recent air survey of the Lovett Ridge area (CR #14, Figure 5.1, 5.2, 5.3 and 5.4) indicates the continued presence and use of the Coal Valley Base Mine by elk, white-tailed deer, mule deer and moose. CVRI's wildlife monitoring program that includes the Coal Valley Base Mine will continue to provide insight on wildlife occupation and response to reclaimed landscapes.

The planned lake development for the Project possesses different characteristics than those present on the Coal Valley Base Mine. CVRI's reclamation plan for the Project includes 12 lakes of which:

- four are between 1.0 and 2.0 km long;
- six are between 2.0 and 4.0 km long; and
- two lakes are approximately 8 km (7.8 and 8.5 km) long.

A GIS exercise identifying water bodies on the Coal Valley Base Mine indicates there are about 51 ponds and lakes of which (ESRD Figure 146-1):

- 12 are between 0.05 and 0.09 km long;
- 21 are between 0.1 and 0.49 km long,
- 16 are between 0.5 and 1.49 km long; and
- 2 are between 1.5 and 3.0 km long. These are Pit 25 South (2.35 km) and Pit 11/12 (2.95 km).

These 51 water bodies with a total length of about 24.7 km are found within a 19.5 km stretch comprising the Coal Valley Base Mine. Lakes are separated by one or two ridges and the longer pits are interrupted by land bridges of variable widths CR #14 (Page 98) recommended the following as a mitigation measure for the Project development:

15) *Variable contouring of dump slopes will help to reduce line of sight and promote movement of wildlife across reclaimed areas. Continuous pit disturbances should be broken at intervals by "land bridges" or by variable slope angles as is currently done on the CVM. This is particularly important in areas of lengthy pit disturbance.* (CR #14)

Intervals for creating land bridges to break up continuous pit disturbances can be guided by current conditions at the Coal Valley Base Mine. Lovett and Silkstone Lakes are about 1.35 and 1.15 km long. Fairfax Lake, a natural lake located south of the Coal Valley Base Mine, is 1.38 km long. The longest lakes or water filled pits on the Coal Valley Base Mine are Pit 25 South (2.35 km) and Pit 11/12 (2.95 km). A reasonable interval to break up lengthy pits would be every 1.0-1.5 km with occasional lengths of up to 2.0 km.

The width of land bridges separating water bodies can be variable depending on the end land use priority for that specific part of the Project development (*i.e.,* a higher percentage of the pit length be sloped and reclaimed as terrestrial habitat if located in Critical Wildlife (Zone 2) or area of mixedwood reclamation). End land uses for the Project are identified as forestry, watershed protection, riparian, wetland and wildlife (Section F.3.1, Page F-21). The intent of Zone 2 (CR #14, Page10) is to:

- protect regionally-significant wildlife movement corridors;
- protect areas with rich habitat diversity and regionally-significant habitat types;
- protect critical hiding and thermal cover for ungulates; and
- protect the complex structure and processes of riparian areas.

Measures in ESRD Figure 146-1 are taken from Table F.4-2 Robb Trend Conceptual End Land Use Plan and a SPOT satellite image overlaid with the Coal Valley Base Mine boundary and are shown in ESRD Table 146-1.

Table 146-1 Comparison of Lake Characteristics in Robb Trend LSA and the Coal Valley Base Mine

Parameter	Proposed Robb Trend Project	Coal Valley Base Mine
Length of the Permit Area	48.1 km	19.5 km
Length of All End Pit Lakes	41.5 km	25.4 km
% of length all lakes to the Permit Area	86 %	130 %
Average Length of all End Pit Lakes	3.5 km	0.5 km

147. Volume 3, CR#7, Section 6.6.1. Page 86

a. Did CVRI consider a scenario 3 which is a combination of scenario1 and scenario 2 in which a reduction in high quality habitat leads to a reduced regional population of marten and that trappers would be forced to concentrate trapping effort in these remaining high quality habitat areas resulting in a higher percentage of mortality within the reduced population? If not, what would be the effects on marten populations given this scenario 3?

In scenario 1, CVRI suggests that natural forest succession will continue to age forests and improve marten habitat quality. High and very high quality habitat consists largely of mature and old growth forests, however, logging occurs within a 2 pass system with the second pass taken before the 1st pass reaches a mature stage or old growth stage. As well, CVRI has not considered likely future mine developments within the RSA.

Response:

There are two reasons why this combined impact scenario wasn't considered. First, our regional habitat impact analysis indicated that cumulative land uses in the next 50 years would not exceed published thresholds in terms of forcing marten population declines. Most of the studies reporting on these thresholds experienced trapping in addition to habitat loss and fragmentation. Second, best available science (and science from west-central Alberta) indicates that trappers reduce their use of marten trapping areas as industrial activity increases and the amount of closed conifer decreases. Webb and Boyce (2009) found no traplines with consistent marten harvests through time that had 20% closed-conifer forest cover or >36% of the trapline developed, indicating reduced trapping success associated with increased industrial activity or in areas with greater amounts of open cover. The likelihood of a combined scenario 1 and 2 occurring is very low.

Figures 20 and 21 of CR #7 show the changes in the distribution and supply of marten and fisher habitat suitability (respectively) from baseline to 10, 25 and then 50 years post-mining. These time snap-shot Figures take into account the Project as well as other planned and reasonably foreseeable land uses in the RSA. One of these land uses is planned timber harvest, some of which is first pass and some of which is second-pass. Natural aging of forests is also factored in to the marten habitat supply projections shown in Figure 20 of CR #7.

Reference:

Webb, S.M. and M.S. Boyce. 2009. Marten fur harvests and landscape change in west-central Alberta. Journal of Wildlife Management 73(6):894-903.

b. Given the above, how much high and very high quality marten habitat do you estimate will be produced in the RSA within the 50 year time frame?

Response:

This information is provided in Section 6.6.1 (p. 87) for the two sub-watersheds or BMUs (Lendrum and Embarras) that are intersected by the proposed Project. Figure 20 of CR #7 shows the predicted distribution of marten habitat over time with the Project and other planned and reasonably foreseeable projects in the RSA. Very high and high quality marten habitat will be reduced and replaced with dominantly moderate quality habitat over 50 years in the Lendrum and Embarras BMUs. Reductions of high and very high suitability marten habitat of 25.4% and 6.9% are projected for the Embarras and Lendrum BMUs respectively from baseline to T50. ESRD Table 147-1 summarizes changes in the supply of the five classes of marten habitat suitability from baseline to T50 in the RSA as a whole. The amount of very high suitability marten habitat predicted to occur after 50 years in the RSA is 68,737 ha. This represents an increase of 9.8% from baseline. The amount of high suitability marten habitat predicted to occur after 50 years in the RSA is 75,767 ha. This represents a decrease of 81.4% from baseline. Moderate quality habitat is predicted to increase from 56,337 ha to 168,603 ha from baseline to T50.

Table 147-1 Marten Habitat Supply Changes in RSA - Cumulative Land Use

Habitat Suitability Class	Habitat Supply (hectares)			
	Baseline	T10	T25	T50
Very High	62,608	50,732	45,057	68,737
High	137,431	95,703	59,879	75,767
Moderate	56,337	143,159	149,508	168,603
Low	55,007	43,716	77,600	23,716
Very Low	47,349	24,231	25,496	20,727

c. Reply to the above question but with respect to fisher.

Response:

Very high suitability fisher habitat is predicted to increase by 6.2 times from baseline to T50 while High quality fisher habitat is predicted to decrease by 71.9% (ESRD Table 147-2).

Table 147-2 Fisher Habitat Supply Changes in RSA - Cumulative Land Use

Habitat Suitability Class	Habitat Supply (hectares)			
	Baseline	T10	T25	T50
Very High	7,146	14,329	22,424	43,983
High	6,010	3,748	3,215	3,496
Moderate	159,750	127,612	154,665	134,393
Low	161,391	188,679	154,359	154,942
Very Low	24,434	23,172	22,876	20,727

Reference:

Webb, S.M. and M.S. Boyce. 2009. Marten fur harvests and landscape change in west-central Alberta. Journal of Wildlife Management 73(6):894-903.

148. Volume 3, CR#7, Section 6.4.2, and Section 6.6, Pages 85-92
Volume 5, CR#14, Section 13.0, Page 107

Cumulative effects assessment must have regard for reasonable foreseeable projects, activities and natural events that could affect the magnitude, duration or significance of a project's cumulative effects. As well, any overlap among multiple projects with respect to temporal and spatial scales must be considered and discussed. Several other coal mining and quarrying projects have been announced, approved, are undergoing regulatory review, or are directly associated with the Project.

a. Provide a summary of all mining, quarrying, oil and gas and other industrial projects within the RSA that may have the potential to affect the predicted results of the wildlife cumulative effects assessment.

Response:

A general summary of major industrial activities (Mining, Forestry, Oil and Gas, Summary) in the Edson –Hinton region that contains the cumulative effects assessment area is found in the previously submitted Socio-Economic report (CR #9, Section 4.0, pages 40 and 41) of the Application.

A map of the RSA used for cumulative effects assessment for wildlife is found in the vegetation report CR #13; Figure 1-1). Note that a description of the Regional Study Area in the Vegetation report (CR #13, page 2) describes the RSA within a larger context in the Hinton-Edson region. Reference to the Coalspur railway is a reference to the Coal Branch Spur Line to Leyland and the CVM.

CR #13 (pages 22-27) contains a section describing the predictive mapping used for the Planned Development Case (PDC). The predictive mapping was derived from raster satellite data from the Foothills Research Institute (FRI 2009) and incorporates all identified planned future development and related activities in the RSA. Future development activities include future forest harvesting plans and any projects that are expected to be developed in the RSA within the next 50 years. Baseline used for the predictive mapping starts at Year 0 in 2014. Additional assessment time periods are: T10 in 2024, T25 in Year 2039 and T50 in Year 2064.

A description of the rules and assumptions for the predictive mapping exercise is discussed in CR #13, pages 22-27. Millennium (2012, page 47) lists existing and planned developments in Table 3.12. The following disturbances were included in the cumulative effects assessment:

- forest harvesting;
- mountain pine beetle;
- petroleum industry disturbances;
- mining; and
- linear disturbance (utility corridors and roads).

ESRD Table 148-1 is a summary of Industrial and other projects in the RSA that affect wildlife cumulative effects assessment, Year 0 to Year 50.

Table 148-1 Summary of Industrial and Other Project that Affect Wildlife Cumulative Effects Assessment, Year 0 to Year 50

	Description	Year 0 (2014)	Year 10 (2024)	Year 25 (2039)	Year 50 (2064)
Mining	Coal Valley Mine (CVM)	Active	Active	Active	Not Active
	CVM –South Block	Active	Not Active	Not Active	Not Active
	CVM – West Extension	Active	Not Active	Not Active	Not Active
	CVM – Mercoal East	Active	Not Active	Not Active	Not Active
	CVM – Mercoal West	Active	Not Active	Not Active	Not Active
	CVM – Yellowhead Tower	Active	Not Active	Not Active	Not Active
	Coalspur Mine Ltd. Vista	Active	Active	Not Active	Not Active
	Lehigh Quarry	Active	Active	Not Active	Not Active
	Teck Coal, Cardinal River Operations, Cheviot Mine; future developments west of Mackenzie Creek	Not Active	Active	Not Active	Not Active
Oil and Gas	Hanlan – Robb gas plant (Suncor)	Active	Active	Active	Active
	Suncor – operates a number of wells in the region	Active	Active	?	?
	Tourmaline Oil Corp. – operates one gas plant in the Robb region	Active	Active	?	?
	Tourmaline Oil Corp. – operates a number of wells in the Robb region	Active	Active	?	?
	Manitok Energy Inc. – operates a number of wells in the Robb region	Active	Active	?	?

Table 148-1 Summary of Industrial and Other Project that Affect Wildlife Cumulative Effects Assessment, Year 0 to Year 50

	Description	Year 0 (2014)	Year 10 (2024)	Year 25 (2039)	Year 50 (2064)
Forestry	West Fraser Hinton Wood Products	Active	Active	Active	Active
	Sundance Forest Industries	Active	Active	Active	Active
	Weyerhauser Company Limited (Edson)	Active	Active	Active	Active
Roadways	Highway (HWY) 40 – proposed paving from junction of HWY 47 to CVM	Active	Active	Active	Active
	Highway 40 – gravel south of CVM	Active	Active	Active	Active
	HWY 47 – paved	Active	Active	Active	Active
	Denison Road, Denison South Road and Denison West Road	Active	Active	Active	Active
	Wagner Road	Active	Active	Active	Active
	Johnsons Road South and Johnsons Road North	Active	Active	Active	Active
	Corsers Road	Active	Active	Active	Active
	Centre Creek Road	Active	Active	Active	Active
	Bailey Creek Road	Active	Active	Active	Active
	Rainbow Creek Road	Active	Active	Active	Active
	Mercoal Main Road	Active	Active	Active	Active
	Pembina River Road	Active	Active	Active	Active
	Mitchell Creek Road	Active	Active	Active	Active
	Gregg River Road	Active	Active	Active	Active
	Lund Creek Road	Active	Active	Active	Active
	Thistle Creek Road	Active	Active	Active	Active
	Cardinal River Road	Active	Active	Active	Active
	Sundance Road	Active	Active	Active	Active
	Petrocan Road	Active	Active	Active	Active
	Prest Creek Road	Active	Active	Active	Active
	White Creek Road	Active	Active	Active	Active
	Tri-Creeks Road	Active	Active	Active	Active
	McPherson Creek Road	Active	Active	Active	Active
	Cold Creek Road	Active	Active	Active	Active
Railways	CN Spur Line – Leyland	Active	Active	Active	Active
	CN Spur Line - CVM	Active	Active	Active	Active
Campgrounds	Lovett River PRA	Active	Active	Active	Active
	Lovett River Snowmobile Staging Area	Active	Active	Active	Active
	Fairfax Lake PRA	Active	Active	Active	Active
	Pembina Forks PRA	Active	Active	Active	Active
	McLeod River PRA	Active	Active	Active	Active
	McLeod Group PRA	Active	Active	Active	Active
	Weald Group PRA	Active	Active	Active	Active
Residential	Robb (Hamlet consists of approx. 190 full time and seasonal residences)	Active	Active	Active	Active
	Mercoal (Hamlet consist of approx. 25 residences)	Active	Active	Active	Active

b. Discuss how CVRI defines insignificant/negligible impacts, with respect to impacts on wildlife and wildlife habitat.

Response:

A cumulative effects assessment involves three stages – quantification of inherent habitat, modification of this habitat due to human disturbance, and determining the increment of disturbance that will be caused by the Project development. Cumulative effects assessment of the Project development incorporated all three components in CR #14, Section 13.0, Page 106 – 143, and in ESRD SIR #69.

CR #7, Section 6.6 (p.86) defines what constitutes a significant cumulative effect on mammalian carnivores. All other effects were rated as insignificant.

"An effect was determined to be significant if the Project impacts, when added to effects of other existing and proposed land uses, were likely to exceed the assimilative capacity of a species. A significant cumulative effect is one that has already or would exceed established criteria of scientific effects thresholds associated with potential adverse effects, and as such result in a detectable change in biological, social or economic parameters beyond the range of natural variability."

c. Discuss what methodology, with respect to impacts on wildlife and wildlife habitat, was used to determine that impacts to these VEC's were insignificant.

Response:

CVRI used a quantitative approach to predict the change in suitability of habitat for elk and moose in the RSA for Year 0 (baseline) and for 10, 25 and 50 years following Year 0. A winter foraging model developed by the Foothills Model Forest (version 5) was used for elk, and a winter habitat model also developed by the Foothills Model Forest (version 5) was used for moose. The predictive mapping used for the habitat models was derived from raster satellite data from the Foothills Research Institute (FRI 2009) and incorporates all identified planned future development and related activities in the RSA (see ESRD SIR #148a)). A table showing changes in habitat supply (HU) and effectiveness (%) for 10 years, 25 years and 50 years after Year 0 (Project Initiation) for elk is found in CR #14 on Page 112 (Table 13.3) and for moose in CR #14 on Page 117 (Table 13.5).

A qualitative approach to cumulative effects assessment was used for the 27 listed bird species in the Project LSA. Listed species are those identified by SARA, COSEWIC, and SRD general status including Sensitive species as identified in the Project Terms of Reference. Species habitat requirements for the 27 bird species and time step modeling (0, 10, 25 and 50 years) of 17 Land Cover Classes were used to project habitat change into the future caused by the Project and existing natural and disturbed vegetation. Further quantitative analysis was completed for all the listed species in the LSA including the 27 listed bird species. This analysis resulted in a series of maps depicting habitat change for the listed species for time steps Year 0,10, 25 and 50.

A cumulative effects assessment must link habitat quality with population viability. Population trends for elk are discussed in CR #14, Page 113, for moose on CR #14, Page 118 and for birds in CR #14, Table 13.8 and 13.9, Pages 121 and 122 respectively and discussed in the account for each species.

Tables indicating the % difference in habitat With the Project and Without the Project were assembled to identify the significance of the effect. These are found in CR #14, Table 13.2 on Page 111 (elk), CR #14, Table 13.6, Page 118 (moose) and in ESRD SIR #148, ESRD Table 148-1 (listed species).

For mammalian carnivores please see CR #7, Section 6.6. An excerpt from page 86 follows:

"This section provides the technical information necessary to assess whether Project effects interacting with effects of past, present and future land uses are likely to result in significant cumulative impacts on mammalian carnivore VECs. Information sources relied upon for this analysis included:

- *Futures projections of habitat/land use change resulting from Project and cumulative land uses as described in Section 6.4 of the report;*
- *Scientific information on response of carnivore VECs to similar landscape-level human activities from region-specific studies or analogous studies from other regions; and,*
- *Scientific information on the natural range of variability of landscape-level natural disturbances that are similar to the effects of human land uses.*

An effect was determined to be significant if the Project impacts, when added to effects of other existing and proposed land uses, were likely to exceed the assimilative capacity of a species. A significant cumulative effect is one that has already or would exceed established criteria of scientific effects thresholds associated with potential adverse effects, and as such result in a detectable change in biological, social or economic parameters beyond the range of natural variability."

All effects that do not meet the above criteria for significance were deemed insignificant which is the same as "not significant".

d. Discuss what methodology was employed to determine that the Robb Trend project will not contribute to cumulative effects on wildlife resources.

Response:

Industrial practices and management systems applicable to the Project and at the regional scale were researched and discussed with respect to mitigation of effects at the Project level and at the regional level.

Reclamation is the primary means to mitigate the impacts of the Project on wildlife. Specific mitigation actions involving reclamation and best practices were identified for:

- elk (CR #14, Section 13.2.2, 1st and 2nd Para, Page 113 and the first bullet Page 120);
- moose (CR #14, Section 13.3.2, 1st, 2nd, 3rd Para, Page 119 and the 1st and 2nd bullets, Page 120); and
- birds in the individual species accounts (CR #14, Page 125 – 139), as well as in CR #14, Section 13.5.1, Page 140 and 141) and in ESRD SIR #69.

Coordination and cooperation of the major land users and use of best practices to ensure long term viable populations in the region are the primary means to reduce the impact of the Project on wildlife at the regional level. This and other mitigation were discussed for:

- elk (CR #14, Section 13.2.2, 1st and 2nd Para, Page 113 and the first bullet Page 120);
- moose (CR #14, Section 13.3.2, 1st, 2nd, 3rd Para, Page 119 and the 1st and 2nd bullets, Page 120); and
- birds in the individual species accounts (CR #14, Page 125 – 139), as well as in CR #14, Section 13.5.1, Page 140 and 141 and in ESRD SIR #69.

The Project will contribute to cumulative effects just as every other existing and future land use in the region does and will. The test is as to whether these effects are significant or not. The criteria for significance is provided in response to ESRD SIR #148c.

e. Discuss how CVRI has accounted for the following impact of the Project in terms of immediate and cumulative effects on wildlife and wildlife habitat:
   i. fragmentation of habitat, and
   ii. connectivity of landscapes.

Response:

Fragmentation of habitat and connectivity of landscapes were embedded within the predictive vegetation mapping used for wildlife habitat modeling. Analysis is found in CR #13, Section 5.6, Pages 114 – 149.

For mammalian carnivores analysis of the cumulative effects of fragmentation and movement obstruction are discussed in CR #7, Sections 5.1.3 and 5.1.5 (general considerations), 5.3.1.4 and 5.3.1.5 (marten), 5.3.2.4 and 5.3.2.5 (fisher), 5.3.3.4 and 5.3.3.5 (lynx), 5.3.4.4 and 5.3.4.5 (wolf) and 5.3.5.3 (grizzly bear). Figures 20 to 23 in CR #7 project changes in habitat suitability for marten, fisher, lynx and wolf based on the Project added to other reasonably foreseeable land uses.

f. Provide discussion on how the cumulative effects assessment has changed for wildlife components at a project, local and regional scale and provide how any impacts will be mitigated.

Response:

Table 13.2 (CR #14, Page 111) indicates that by Year 10, elk habitat effectiveness in the RSA will be reduced by 12.9% but less so in the LSA (3.6%). Reduction in the LSA will largely be because Year 10 is the maximum disturbance case for the Project. By Year 25 elk habitat effectiveness in the RSA will be reduced by 13.8% but will increase in the LSA by 1.1% over baseline because of reclamation efforts on the Project. Year 25 is the maximum disturbance case within the RSA from all activities. By Year 50 maturing forests on both the RSA and LSA will decrease habitat effectiveness in the RSA by 22.3% and in the LSA by 5.6%.

Similarly Table 13.6 (CR #14, Page 118) indicates that by Year 10, moose habitat effectiveness in the RSA will be reduced by 3.7% and 3.9% in the LSA. Reduction in the LSA will largely be because Year 10 is the maximum disturbance case for the Project. By Year 25 moose habitat effectiveness in the RSA will be reduced by 8.2% and by 2.3% in the LSA. Year 25 is the maximum disturbance case within the RSA from all activities. By Year 25 reclaimed forest and shrublands on the Project should be providing some cover and forage for moose. By Year 50 maturing forests on both the RSA and LSA will decrease habitat effectiveness in the RSA by 13.6% and in the LSA by 2.8% over baseline conditions.

The effect of habitat changes at the RSA and Project level are variable for birds depending on specific habitat requirements. ESRD Table 148-1 (ESRD SIR #148) indicates habitat change for the federal and provincial listed species in the Robb Trend RSA and LSA from Year 0 (baseline) through Year 50. Change is discussed for each species in CR #14, Section 13.4.1 (Page 125 – 139) and again in more detail in ESRD SIR #148.

Generally by Year 50 habitats which contain mixed wood forests will decrease both in the RSA and LSA. This will be mitigated on the LSA by reclamation activities on the Project. The CVRI reclamation plan indicates that mixed wood forest types will increase on the Project from 21.4% to 25.2% (Section F, Table F4-4, Page F-44). Habitats containing dense coniferous forest will increase on the RSA and the LSA. CVRI's reclamation plan will decrease dense coniferous forest by Year 50 from 62.3% pre mine to 47.2% post mine. This is thought not to be significant because of the increase of coniferous forest on the RSA without the LSA (60% increase). Water habitat will increase both on the RSA and the LSA by Year 50 (ESRD SIR #148, ESRD Table 148-1). Reclamation activities on the Project will result in a similar amount of wetlands pre and post mining (Section F, Table F4-4, Page F-44).

A summary of mitigation of the impacts on wildlife of the project and other activities in the RSA is found in CR #14, Page 114 (elk), 120, (moose) 140 and 141 (birds) and in ESRD SIR #148 (listed species). Mitigation includes but is not limited to:

- identification of wildlife habitat as a primary end land use in the Project Zone 2 areas and areas;
- implementing reclamation techniques and best practices appropriate for wildlife on the Project;
- aligning reclamation and other revegetation efforts to maintain and improve wildlife habitat;
- taking steps to ensure core security areas are provided for wildlife;
- implementing appropriate monitoring; and
- cooperation with the province and other industry on access management and other relevant management issues.

Figures 20, 21, 22 and 23 in CR #7 visually represent the cumulative effect of the Project in addition to planned and reasonably foreseeable projects on habitat suitability in the LSA and RSA. For each of these species the amount of high and very high suitability habitat change over time is discussed in CR #7, Sections 6.6.1 (marten), 6.6.2 (fisher), 6.6.3 (lynx) and 6.6.4 (wolf). Regional cumulative impacts are discussed in the context of the two watersheds (Embarras and Lendrum) in which the Project occurs and will impact.

149. Volume 5, CR#14, Section 9.1.2. Page 68

The Fisheries and Wildlife Management Information System (FWMIS) database indicates that a long-toed salamander pond has been identified within 3 km of the West Block and 5 km of a similarly sized pond within the West Block. Long-toed salamanders are considered a species at risk and they cannot be identified using a standard call survey used for frogs and toads.

a. Was a long-toed salamander specific survey conducted within the LSA?

The response to this question requires an understanding of the location of the Project Local Study Area (LSA) as well as the areal extent of long-toed salamander (LTSA) distribution in Alberta.

Response:

Robb Trend Local Study Area Location - The LSA extends 40.7 km in a northwest direction beginning on the north side of the Pembina River to the Hamlet of Robb. The Project skips over Robb and Hwy 47 and extends a further 7.8 km into Robb West. The Project is bordered by the Pembina River to the south, and the Lovett Ridge to the west.

The Embarrass River breaches the Lovett Ridge at the former mining town of Coalspur and flows past Robb to eventually flow into the McLeod River. The headwaters of the Embarrass River begin in a large fen complex located southeast of Mercoal at elevation 1,189 m (3,901 ft). The headwaters of the Lovett River flowing into the Pembina River, and Chief Creek and Erickson Creek both flowing into the McLeod River also originate in this wetland.

The Pembina River originates in the foothills, south of Cadomin. It flows eastward from Redcap Mountain for 547 km before it merges with the Athabasca River 64 km west of the town of Athabasca.

Long-toed Salamander Occurrence in Alberta - Long-toed Salamanders are found in Alberta in mountain passes and associated river valleys in the Rocky Mountain Natural Region, with peripheral populations in the Foothills and Boreal Natural Regions, and a small population near Peace River. There are nine distinct population groupings in Alberta including the Athabasca Valley in Jasper (Graham and Powell 1999):

1. Waterton Lakes;
2. Castle River;
3. Crowsnest Pass;
4. Stavely;
5. Kananaskis Valley;
6. Spray lakes;
7. Bow Valley;
8. Athabasca Valley; and
9. Peace River.

Long-toed Salamanders typically spend most of their lives in terrestrial habitat; they travel to ponds to breed. Breeding ponds are usually permanent, shallow and lacking fish. These salamanders are not often seen as they are nocturnal and secretive. Distribution in the mountains is likely controlled by the number of possible breeding ponds and dispersal routes (Alberta Fish and Wildlife web site; ESRD Figure 149-1).

* In Alberta, the long-toed salamander is limited to the western margin of the province.
* It is found in subalpine to alpine areas below an elevation of roughly 2,800 metres (almost 9,200 feet) above sea level.
* Distribution in the mountains is likely controlled by the number of possible breeding ponds and dispersal routes.
* Despite restricted distribution in Alberta, long-toed salamanders are widely found in British Columbia.

From: http://www.srd.alberta.ca/FishWildlife/WildSpecies/Amphibians/Salamanders/LongtoedSalamander.aspx [Retrieved January 27, 2012]

LTSA Evaluation for the Robb Trend Project - In the application, LTSA were identified as possibly occurring in the regional study area (RSA) however they were not expected to occur in the local study area (LSA). Bighorn (2012) briefly lists the rationale for this conclusion on page 67 of CR# 14. These reasons are explained in more detail here:

1. Distribution

Current distribution of the Long-toed Salamander in Alberta suggests it is unlikely to occur in the LSA. The two mountain passes closest to the Project are: 1) the Athabasca valley to the north and 2) the North Saskatchewan to the south. The Athabasca valley is one of nine known concentration areas in the province. LTSAs have not been observed in the North Saskatchewan area.

The headwaters of the major rivers flowing through or near the Project (Pembina on the south, Embarrass through Robb, and the McLeod to the north) all originate on the Front Ranges on the east side of the Canadian Rockies. These streams do not have a direct connection through the Rockies. It is difficult to see how LTSAs would colonize the Project from the west.

2. Lack of Evidence

No evidence of Long-toed Salamanders was found during amphibian surveys that were conducted for the Project. Note that these were standard amphibian call surveys and are not specific for identifying salamander presence. However much additional time was spent in the area in April and May when adult salamanders are moving to breeding ponds. Winter/spring bird surveys and overwinter pellet-group counts are labour intensive and occurred throughout the LSA. No evidence of long-toed salamander presence was observed during this or other field work associated with ponds and riparian areas. Additionally no reports have been made by residents of Robb nor have any observations been reported by Fish and Wildlife for the Robb area with the exception of the one observation within 3 km of the LSA mentioned in ESRD SIR #149. This observation is FWMIS record #216 and is suspect.

3. Suspect Observation (FWMIS record #216)

L. Wilkinson, AFWD provided FWMIS records (hazed) to BWT on December 9, 2010 and a list of known salamander ponds in the Hinton area on July 14, 2011. FWMIS record #216 is of 21 Long-toed Salamander eggs reported June 21, 2000 in a pond located in Sec 35 Rge 22 Twp 49 W5. This pond lies immediately adjacent to the Robb Road on the north side. It was surveyed by Karen Graham during her work for the University of Guelph on long-toed salamanders in the Hinton area (Graham 1997). Graham surveyed this pond prior to the June 21, 2000 observation and again after the observation in the spring of 2001. She found no Long-toed Salamander evidence but did find Wood Frog and Boreal Chorus Frog eggs. She considers the June 21, 2000 observation to be questionable (pers. comm. August 15, 2012). The pond with FWMIS record #216 is far from other known LTSA ponds all of which are located north of the McLeod River in the McPherson watershed and in various locations of the Athabasca River valley.

4. Survey 2012

BWT conducted a Long-toed Salamander egg survey of the pond containing FWMIS record #216 on May 18, 2012 as well as a survey of a similar sized pond on Robb West located east of the Prest Creek Road and north of the Robb Road (Sec 29 Twp 49 Rge 21 W5). Spring egg count methods were from Alberta protocols (Pretzlaw *et al.* 2002). Results are summarized in the attached two pages (Attachment 1 and 2). No salamanders were found in either pond.

Salamanders appear to have a better chance of occupying ponds between 0.3 to 0.6 m in depth within 2 m of the shoreline, with either sparse aquatic vegetation or submerged twigs and branches of dead trees for egg-laying. Salamander eggs do not seem to be associated with dense mats of aquatic vegetation. Shorelines comprised of mineral soils appear to enhance salamander egg presence.

The pond with the FWMIS record #216 is surrounded by mineral soil and has other attributes that may be suitable for salamander occupation but most of the pond is filled with heavy aquatic vegetation extending out 1-2m from the shoreline which appears to be not suitable for egg deposition. The pond in Robb West has deeper water, little or no substrate for placing eggs, and is surrounded by a floating vegetation and organic mat. It is not suitable salamander habitat.

b. If not, complete the survey using approved ESRD protocols and update the assessment accordingly.

Response:

For the reasons listed above in answer to ESRD SIR #149b), it was concluded that Long-toed Salamanders would be unlikely to occur in the Project LSA and the decision was made to not do a salamander specific survey for the application.

Attachment 1 – Field Survey of Pond - FWMIS record #216

Location Description:

East side of Robb Road south of McLeod River and north of the Prest Creek Road (ESRD Photo 149-1)

Location:

UTM Zone 11 492540E 5902012N NAD83

Date/Time:

May 18, 2012 / 10:35am – 11:03am

Conditions:

Air Temperature = 4^{o}C; Wind = Still; Cloudy; No Precipitation; Water Temperature = 10^{o}C; Water Depth = <1m; Water Visibility = Very Good; Water pH = 5.5

Pond Description (picture below):

This small pond is roughly 300m in circumference. It is entirely surrounded by emergent sedge vegetation extending 1.5-3.0m into water from the shore. The shoreline is comprised of mineral soil and is bordered by tall willow (40%).

Amphibian Species Observed:

Wood Frog – 98 egg masses in four locations around pond. Water level may have dropped recently as a number of Wood Frog eggs were exposed on shore at one location. Eggs were round and kidney shaped.

Other Species Recorded:

Greater Yellowlegs (2) – One on a tree top adjacent the pond, one at the edge of the pond; Ruffed Grouse – heard drumming; Solitary Sandpiper – observed feeding at the edge of the pond

ESRD Photo 149-1 Field Survey of Pond - FWMIS record #216

Surveyors: Beth MacCallum, Lars Benson, Andrew Godsalve.

Attachment 2 – Field Survey of the Robb West Pond near the Prest Creek Road

Location Description:

Approximately 0.5km southeast of the junction of the Robb Road and Prest Creek Road (ESRD Photo 149-2)

Location:

UTM Zone 11 496910E 5901100N NAD83

Date/Time:

May 18, 2012 / 11:40am – 12:25pm

Conditions:

Air Temperature = 4°C; Wind = Gentle; Cloudy; No Precipitation; Water Temperature = 11°C; Water Depth = >1m; Water Visibility = Fair; Water pH = 7.0

Pond Description (picture below):

This pond is roughly 1,000m in circumference. It is surrounded by organic soils, a floating sedge mat and black spruce vegetation. Water depth is 1m or greater. There is very little aquatic vegetation or larger debris like logs, branches and sticks that may provide a surface for LTSA to attach eggs in this pond. It is classed as a FONG wetland (graminoid fen surrounding open water) by Alberta wetland inventory standards.

Amphibian Species Observed:

Wood Frog –156 egg masses in three locations around the pond. Eggs were round and kidney shaped.

Other Species Recorded:

Common Raven (1) – Flies over pond; Gray Jay (1) - perched on a tree; Greater Yellowlegs (2); Ruby-crowned Kinglet (1) singing from forest; Tree Swallow (5) – foraging over the water; Yellow-rumped Warbler (5) – hawking insects over the water

ESRD Photo 149-2 Field Survey of the Robb West Pond near the Prest Creek Road

Surveyors: Beth MacCallum, Lars Benson, Andrew Godsalve

7. HEALTH

150. Volume 2, CR #1, Section 2.1.1, Page 4.
Coal Valley Resources Inc. (CVRI) states *The Planned Development Case, including all sources in the Application case and any foreseen new developments. As no planned projects have been identified in the RSA, the Planned Development Case is identical to the Application Case.*

a. Confirm that any facilities proposed beyond the RSA boundaries would result in a negligible impact on the air quality within the RSA.

Response:

To account for existing industrial facilities outside the RSA, modelling included a background concentration which was added to model predictions of RSA sources. In response to ESRD SIR #17, CVRI investigated the effect of recently announced planned projects on predicted concentrations near Robb. Considering the conservative nature of the investigation, the contributions of planned developments outside the RSA to concentrations near Robb are expected to be negligible.

b. If non-negligible impacts could occur, include a Planned Development Case that includes emissions from the proposed facilities and revise the Health Section of the EIA accordingly.

Response:

Impacts of planned projects outside the RSA are expected to be negligible; therefore, CVRI considers an HHRA update to be unnecessary.

151. Volume 2, CR #1, Section 2.5.2, Page 11.
CVRI states *While emissions will occur for the full duration of the Project, changes in air quality will have temporal variability due to the natural fluctuations in meteorology (wind speed, wind direction, temperature), and also to short and long-term variability in emissions. In addition, the highest concentrations typically occur for very short durations and there may be infrequent upset conditions.*

a. Describe how air concentrations and odours during upset conditions were evaluated.

Response:

CVRI's initial assessment was that there are no upsets during mining operations that are of the same nature as upsets at plants or facilities, where emission control units may be bypassed in emergencies. As the plant is not part of this application, upsets of this nature do not apply to the Project.

b. If not evaluated, include an assessment of air quality and odour as a result of upset conditions and revise the Health Section of the EIA accordingly.

Response:

See response to ESRD SIR #151a).

152. Volume 2, CR #1, Section 5.9, Page 67.

CVRI states *Effects from a longer list of COPCs are considered in the human health risk assessment included with this Application. For most chemicals, the Project contribution is negligible at all locations.*

a. Explain why there is a discrepancy between the list of COPCs identified in the Air section and the list of COPCs considered in the human health risk assessment.

Response:

There is no discrepancy between the Air Quality (CR #1) assessment and the HHRA (CR #5). The COPCs listed in the HHRA report are also listed in Section 4.1.2 of the Air Quality assessment between Table 4.1-5 to Table 4.1-18. The differences between the lists are limited to the following:

- aromatic C_{17}-C_{34};
- aromatic C_9-C_{16};
- benzo(a)pyrene equivalent; and
- chromium VI.

These 4 COPC's are not new but derived from the original COPCs list described in the Air Quality assessment. The addition of the chemical groups to the HHRA was necessary to accommodate the available toxicological information. Details regarding the constituents of the COPC groups and exposure limits are provided in Section 3.2.1.1 and Section 3.2.3 in the HHRA, respectively.

153. Volume 3, CR #5, Section 3.2.1.1, Page 9.

CVRI states *Because of the potential influence of the mining activities on the surface water quality, water collection and impoundment structures will be used to attenuate the potential impacts of the mining activities on the local water courses, including increased sediment loads and deposition of those sediments.*

a. Conduct an evaluation of potential human health risks in the event of a failure in the water collection and impoundment structures, or provide evidence to show that such an assessment is not required.

Response:

The Project will have impoundments designed for storage and settlement of incidental water collecting in sumps, drained from mine pits, runoff from roads, and runoff from exposed areas. The Project will implement a number of mitigation measures (CR #11; Section 4.3) to reduce impacts on the environment. The human health risk in the event of a failure in the water collection and impoundment structures is judged to be very low based on the probability and consequence of a failure. All impoundments will be designed to safely pass the 1:100 year flood event (CR #6; Section 4.1). This is achieved with open channel outlets constructed in natural ground and as a result will have capacities much greater than the 100 year flood event. In addition, all water impoundments are inspected routinely by CVRI to minimize the probability of a failure and dramatically reduces the risk of washout or overtopping failure.

154. Volume 3, CR #5, Section 3.2.1.1, Page 9.

CVRI states *Based on the conclusion that impacts, due to the Project, on surface water quality are negligible or not significantly different than Baseline conditions, it was assumed that there were no changes in surface water quality for the Application Case.* An assessment of COPC deposition onto surface water bodies and the potential effect of this deposition on surface water quality and sediment quality was not conducted.

a. Provide an assessment of the deposition of air contaminants to surface water and evaluate the potential effects on surface water quality and sediment quality.

Response:

The Air Quality Assessment (CR #1) provides an assessment of COPC concentrations into the air as a result of the Project; these results are summarized in CR #1, Section 5.9, Page 66 and in CR #1, Table 5.9-1 to Table 5.9-6, starting on Page 67. The assessment of COPC concentrations was conducted for the maximum point of impingement (MPOI) and various community and receptor locations near the Project. The assessment predicted, for all species and averaging periods, similar or a decrease in concentration of all modeled COPCs from the Baseline to Application Case. Based on the results of this assessment, the potential residual effects of the deposition of COPCs to surface water are predicted to be negligible.

In addition, the surface water quality assessment concluded that impacts due the Project are negligible or not significantly different than Baseline conditions; therefore, no changes in sediment quality are expected for the Application Case.

b. If the potential effects on surface water quality and sediment quality are not shown to be negligible, provide an assessment of potential human health impacts associated with exposure to and consumption of surface water and consumption of fish from affected water bodies.

Response:

Because potential effects on surface water and sediment quality are assessed as negligible, an update to the HHRA is not required.

155. Volume 3, CR #5, Section 3.2.1.2, Page 11.
CVRI states *Eighteen discrete locations within the RSA were selected for consideration in the HHRA, with six falling inside the LSA. The discrete receptor locations within the LSA primarily consist of recreational locations and the Hamlet of Robb.*
Four of the 18 locations listed on Page 11 are missing from Table 3-2 (i.e., R10, R11, R12 and R13).

a. Comment on whether these locations were included in the HHRA.

Response:

The missing receptors (*i.e.,* R10, R11, R12 and R13) were included in Table 3-2 and were included in the HHRA (CR #5). These receptors were included in the HHRA and are listed as R9 to R14 in Table 3-2, which includes R10, R11, R12 and R13.

b. If not included, explain why.

Response:

No update is necessary please see ESRD SIR #155a).

156. Volume 3, CR #5, Section 3.2.1.2, Pages 11-12.
CVRI states *The HHRA assumed that people may be exposed at the MPOIs on an infrequent basis. As people will not be living at these locations, the MPOIs were evaluated only for inhalation exposure, and only on an acute basis.*

a. Confirm whether any of the designated receptor locations for chronic exposure are located at or close to the MPOI.

Response:

Instead of providing a discussion of the location where the RSA-MPOI is predicted and if receptors are located at this location, this response presents the predicted chronic inhalation risks at the RSA-MPOI and LSA-MPOI. ESRD Table 156-1 and ESRD Table 156-2 present the chronic inhalation RQ values predicted at the RSA-MPOI and LSA-MPOI, respectively. All chronic RQ values were less than 1, suggesting that the predicted long-term air concentrations of the COPCs are not expected to result in adverse health effects. The predicted RQ values for the Baseline and Application Cases were generally very similar suggesting that the contributions of the Project with respect to air emissions will likely have a negligible impact on health.

ESRD Table 156-3 and ESRD Table 156-4 present the chronic inhalation ILCR values predicted at the RSA-MPOI and LSA-MPOI, respectively. All ILCR values represent predicted incremental lifetime cancer risks per 100,000 individuals in the population. All predicted ILCR values were predicted to be less than 1 in 100,000, indicating that the incremental contributions from the Project emission sources are associated with an essentially negligible degree of risk.

Table 156-1 Chronic Inhalation RQ Values for the RSA-MPOI (Non-Carcinogens)

COPC	Assessment Case	
	Baseline	Application
Acrolein	5.2E-01	5.1E-01
Aluminum	2.0E-02	2.0E-02
Aromatic C_9-C_{16} (1)	2.0E-03	1.3E-03
Barium	2.1E-03	2.1E-03
Chromium	1.7E-02	7.3E-03
Cobalt	1.5E-02	1.5E-02
Copper	9.0E-03	5.4E-03
Formaldehyde	4.1E-01	4.1E-01
Lead	4.9E-03	1.8E-03
Manganese	7.8E-02	7.8E-02
Mercury	7.5E-05	7.5E-05
Molybdenum	1.5E-05	1.5E-05
Naphthalene	3.0E-02	2.0E-02
NO_2	9.3E-02	1.5E-01
$PM_{2.5}$	1.4E-01	1.6E-01
Propylene	2.1E-04	1.8E-06
Selenium	7.2E-06	7.2E-06
Thallium	1.5E-05	1.5E-05
Toluene	3.8E-04	3.7E-04
Uranium	2.5E-04	2.6E-04
Vanadium	5.2E-02	4.1E-03
Xylenes	5.6E-04	4.9E-04

(1) Consists of the following COPCs: acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene and pyrene.

Table 156-2 Chronic Inhalation RQ Values for the LSA-MPOI (Non-Carcinogens)

COPC	Assessment Case	
	Baseline	Application
Acrolein	5.2E-01	5.1E-01
Aluminum	1.9E-02	1.9E-02
Aromatic C_9-C_{16} (1)	1.4E-03	1.3E-03
Barium	1.7E-03	2.0E-03
Chromium	8.1E-03	7.3E-03
Cobalt	1.4E-02	1.5E-02
Copper	5.9E-03	5.4E-03
Formaldehyde	4.1E-01	4.1E-01
Lead	2.2E-03	1.8E-03
Manganese	5.9E-02	7.3E-02
Mercury	7.2E-05	7.4E-05
Molybdenum	1.3E-05	1.3E-05
Naphthalene	2.2E-02	2.0E-02
NO_2	4.1E-02	1.5E-01
$PM_{2.5}$	1.4E-01	1.6E-01
Propylene	3.3E-05	1.8E-06
Selenium	7.1E-06	7.2E-06
Thallium	1.3E-05	1.4E-05
Toluene	3.7E-04	3.7E-04
Uranium	1.9E-04	2.4E-04
Vanadium	1.0E-02	4.1E-03
Xylenes	5.0E-04	4.9E-04

(2) Consists of the following COPCs: acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene and pyrene.

Table 156-3 Chronic Inhalation ILCR Values for the RSA-MPOI (Carcinogens)

COPC	Incremental Lifetime Cancer Risks (per 100,000)
	Project (Application minus Baseline)
Acetaldehyde	4.5E-06
Arsenic	5.0E-02
Benz(a)pyrene	1.1E-03
Benzene	4.0E-03
Benzo(a)pyrene Equivalent[(1)]	5.6E-06
Beryllium	4.3E-04
Cadmium	1.2E-03
Chromium VI	7.0E-02
Nickel	1.5E-01

(3) Consists of the following COPCs: benz(a)anthracene, benz(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perlyne, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(123cd)pyrene and phenanthrene.

Table 156-4 Chronic Inhalation ILCR Values for the LSA-MPOI (Carcinogens)

COPC	Incremental Lifetime Cancer Risks (per 100,000)
	Project (Application minus Baseline)
Acetaldehyde	3.6E-06
Arsenic	5.0E-02
Benz(a)pyrene	1.1E-03
Benzene	4.0E-03
Benzo(a)pyrene Equivalent[(1)]	5.6E-06
Beryllium	4.3E-04
Cadmium	1.2E-03
Chromium VI	7.0E-02
Nickel	2.0E-02

(1) Consists of the following COPCs: benz(a)anthracene, benz(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perlyne, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(123cd)pyrene and phenanthrene

b. If none of the selected receptor locations for chronic exposure are at or close to the MPOI, provide an assessment of potential risks for a receptor who obtains food from locations with higher deposition, such as the MOPI or the project fenceline, or provide rationale as to why such an assessment is not required.

Response:

Instead of providing a discussion of the location and likelihood of a receptor present where the RSA-MPOI is predicted in the multiple pathway assessment, this response presents the predicted chronic multiple pathway risks at the RSA-MPOI. Note that predicted multiple pathway risks at the LSA-MPOI would be similar or lower than those predicted at the RSA-MPOI.

Risk quotient (RQ) values for the non-carcinogenic COPCs are provided for the most sensitive life stage at the RSA-MPOI (ESRD Table 156-5). All multiple pathway RQ values for the Baseline and Application Cases at the RSA-MPOI were less than 1.0, with the exception of manganese and methyl mercury. For all of the COPCs, negligible changes in RQ values were predicted between the Baseline and Application Cases, indicating that the incremental change associated with the Project is negligible. Overall, the potential for adverse non-carcinogenic health impacts is anticipated to be low. Further discussion of manganese and methyl mercury risk estimates are provided in the HHRA (Section 4.3.1; CR #5). Finally, the predicted RQ values at the RSA-MPOI are very similar to the predicted risks for the Resident group (Table 4-10; CR #5).

The estimated carcinogenic ILCR values for the RSA-MPOI are presented in ESRD Table 156-6. The predicted ILCR values at the RSA-MPOI are higher (i.e., ~ 3-4 times) than the predicted risks at the Resident group (Table 4-13; CR #5). Results are presented only for the incremental Project scenario (Application minus Baseline). All values represent ILCR per 100,000 people. All ICLR values were less than 1.0, indicating that the Project is associated with negligible incremental cancer risks (*i.e.,* less than 1 in 100,000) for the RSA-MPOI.

Table 156-5 Chronic Multiple Exposure Pathway RQ Values for Non-Carcinogens for the RSA MPOI

COPC	Assessment Case	
	Baseline	Application
Aluminum	4.7E-01	4.7E-01
Antimony	1.6E-01	1.9E-01
Barium	4.1E-02	4.2E-02
Beryllium	4.1E-02	3.1E-02
Cadmium	5.2E-02	4.2E-02
Chromium	5.4E-04	5.7E-04
Chromium VI	4.8E-01	4.8E-01
Cobalt	7.8E-01	8.7E-01
Copper	8.4E-02	9.6E-02

Table 156-5 Chronic Multiple Exposure Pathway RQ Values for Non-Carcinogens for the RSA MPOI

COPC	Assessment Case	
	Baseline	Application
Lead	1.5E-01	1.7E-01
Manganese	**2.5E+00**	**2.5E+00**
Mercury	1.1E-01	1.1E-01
Methyl mercury	**1.3E+00**	**1.3E+00**
Molybdenum	5.7E-01	5.7E-01
Nickel	4.0E-02	5.7E-02
Selenium	1.8E-01	1.8E-01
Uranium	2.3E-01	2.3E-01
Vanadium	3.2E-01	3.2E-01
Zinc	1.9E-01	1.9E-01
Aromatic C_9-C_{16} (1)	9.8E-06	7.2E-06
Formaldehyde	7.0E-06	6.9E-06
Pyrene	2.0E-05	8.6E-06

(1) Consists of the following COPCs: acenaphthene, acenaphthylene, anthracene, fluorene and pyrene.

Table 156-6 Chronic Multiple Exposure Pathway ILCR Values for Carcinogens for the RSA-MPOI

COPC	Incremental Lifetime Cancer Risks (per 100,000)
	Project (Application minus Baseline)
Arsenic	8.3E-02
Benzo(a)pyrene equivalent (a)	7.8E-03

(1) Consists of the following COPCs: benz(a)anthracene, benz(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perlyne, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(123cd)pyrene and phenanthrene.

157. Volume 3, CR #5, Section 3.2.1.2, Page 12.

CVRI states *There are no work camps planned for the Project where people would live during construction and operation. Therefore, the HHRA did not include a Worker group.*

a. Provide evidence to support that an assessment of human health risks for mine workers present at the mine during mine operations was not necessary.

Response:

The human health risk assessment focused on the potential impacts to public health. Risks to workers are addressed through the occupational health and safety program that CVRI has developed, as required by the Government of Alberta Human Services.

b. Provide evidence to support that an assessment of human health risks for workers exposed to air emissions predicted during the construction phase of the Project was not necessary.

Response:

CVRI will meet Alberta's Occupational Health and Safety Act, Regulation and Code, that defines the minimum requirements for health and safety in Alberta workplaces.

c. In the absence of evidence for a. and b., complete an evaluation of human health risks for workers and/or construction workers exposed to air emissions predicted during the operation and/or construction phase of the Project.

Response:

An evaluation of human health risks for workers was not necessary since CVRI will meet Alberta's Occupational Health and Safety Act, Regulation and Code, that defines the minimum requirements for health and safety in Alberta workplaces.

158. Volume 3, CR #5, Section 3.2.1.2, Page 12.
The HHRA receptor groups do not include an agriculture receptor.

a. Provide evidence to support that an assessment of human health risks for agricultural receptors within the RSA was not necessary.

Response:

Land within the RSA is not suitable for agricultural purposes because the growing season and climate is quite limited. Overall the capability of soils for measureable agricultural production (*i.e.*, growth of a crop for commercial production purposes – livestock feed or sales) within the region (terrestrial and LSA and RSA) is considered to be low. Climate is the first and major factor limiting the capability of lands within the LSA and RSA. Based on the Land Suitability Rating System for Agricultural Crops (AIWG, 1995) this area has a climate rating of 5H (very severe limitations that restrict their capability in producing perennial forage crops). The Alberta Soil Correlation Area map (AAFC 2006) indicates that the LSA is located in the upper foothill area of west-central Alberta (*i.e.*, Soil Correlation Area 14) and also rates the agro-climate as being 5H.

A Class "5" capability is defined as the following (AIWG 1995): "Land in this class has very severe limitations for sustained production of the specified crops. Annual cultivation using common cropping practices is not recommended". The subclass "H" is defined as the following (AIWG 1995): "This subclass indicates inadequate heat units for the optimal growth of the specified crops".

b. In the absence of this evidence, complete an evaluation of human health risks for agricultural receptors.

Response:

There is no need to update the HHRA with an agricultural receptor. Please see ESRD SIR #158a.

References:

Agriculture and Agri-Food Canada (AAFC). 2006. Alberta Soil Names File (Generation 3) User's Handbook. Prepared by Land Resource Unit, Research Branch, Agriculture and Agri-food Canada. Edited by M.D. Bock, J.A. Brierley, B.D. Walker, C.J. Thomas and P.E. Smith. June 2006.

Gronomic Interpretations Working Group (AIWG). 1995. Land Suitability Rating System for Agricultural Crops: 1. Spring-seeded small grains. Edited by W.W. Pettapiece. Tech. Bull. 1995-6E. Centre for Land and Biological Resources Research, Agriculture and Agri-Food Canada, Ottawa. 90 pages, 2 maps.

159. Volume 3, CR #5, Section 3.2.1.3, Page 16.

In this section CVRI lists the exposure pathways included in the HHRA.

a. Confirm whether ingestion of surface water and dermal contact with surface water while swimming were considered in the HHRA.

Response:

Section 3.2.1.2 of the HHRA (CR #5) states the following:

"*It was assumed that the Resident group would be exposed to the COPCs via direct inhalation and that they obtained a high proportion of their daily foods locally (e.g., traditional plants, vegetables, wild game, and fish). It was also assumed that groundwater within the Hamlet of Robb would be their primary source of drinking water, and that they would be exposed to local surface water via dermal contact and incidental water ingestion while swimming.*"

b. If these pathways were considered, which water bodies were receptors assumed to swim in?

Response:

The HHRA did not assume a specific water body where receptors are assumed to swim. Rather the HHRA assumed worst case concentrations at surface water sampling locations within the water quality LSA. The greatest value between the 95UCLM calculated from the measured concentrations of the LSA watercourses and the maximum concentrations measured from the end-pit lakes were used. The concentrations used in the HHRA for predicting swimming ingestion and dermal pathways of exposure are provided in Table D10 (Appendix D; CR #5) and described in greater detail in Appendix B (CR #5).

c. If not considered, explain why not.

Response:

Ingestion of surface water and dermal contact was considered; therefore, an update of the HHRA is not required.

160. Volume 3, CR #5, Section 3.2.2, Page 16.

a. Describe the oral, inhalation and dermal bioavailability assumed in the exposure and toxicity assessments for each COPC assessed in the HHRA.

Response:

The oral and inhalation bioavailability assumed for each COPC assessed in the HHRA was 100%, as recommended by Health Canada (2009) for a screening level human health risk assessment. Table D32 (Appendix D; CR #5) presents the relative dermal absorption factors that were assumed for each COPC in the multiple pathway exposure assessment. The relative dermal absorption factors are based Health Canada (2009) guidance for a screening level human health risk assessment.

Reference:

Health Canada. 2009. Federal Contaminated Site Risk Assessment in Canada. PART II: Health Canada Toxicological Reference Values (TRVs) and Chemical-specific Factors. Prepared by Contaminated Sites Division Safe Environments Program. Draft for Comment. May 2009.

161. Volume 3, CR #5, Section 3.2.3.1, Tables 3-14 and 3-16, Pages 32 and 34.
Several reputable scientific agencies have identified naphthalene and formaldehyde as carcinogens.

a. Provide an assessment of potential health effects from chronic oral and/or chronic inhalation exposures to these carcinogens.

Response:

In order for an exposure limit to be selected, it had to meet the following criteria:

- Established or recommended by reputable scientific authorities;
- Protective of the health of the general public based on the current scientific understanding of the health effects known to be associated with exposures to the [chemical];
- Protective of sensitive individuals through the use of appropriate uncertainty factors; and,
- Supported by adequate and available documentation.

In those cases where the above criteria were supported by more than one exposure limit, the most relevant and scientifically defensible limit was generally selected.

For chronic naphthalene exposure via inhalation, the most relevant exposure limit was determined to be the RfC of 3 µg/m³. This value was selected based on the following rationale:

- As of September 13, 2012, the U.S. EPA still had not finalized its external review draft of the reassessment of the inhalation carcinogenicity of naphthalene. Because the cancer unit risk value remains in draft form, it was not considered in the HHRA. In fact, the external reassessment clearly states that the draft is not to be cited or quoted. As such, the HHRA relied on the carcinogenicity information that is currently presented in the U.S. EPA's Integrated Risk Information System (IRIS). In its carcinogenicity assessment on IRIS, the U.S. EPA states that "*available data are inadequate to establish a causal association between exposure to naphthalene and cancer in humans*." Further, "*an inhalation unit risk estimate for naphthalene was not derived because of the weakness of the evidence (observations of predominantly benign respiratory tumors in mice at high doses only) that naphthalene may be carcinogenic in humans.*"
- In a recent review of the potency equivalency factors for carcinogenic polycyclic aromatic hydrocarbons (PAHs), the carcinogenic potential for naphthalene was noted as being "*nil*" due to it being non-genotoxic and exhibiting low tumour initiating potential (EEI 2006). The authors of the review state that "*for PAHs assigned a PEF of 0, it is*

recommended that available non-cancer endpoint regulatory guidelines be used to assess their potential toxicity".

The health risks for naphthalene were characterized appropriately in the HHRA based upon information available at the time of filing. However, in an attempt to further address the question, a carcinogenicity assessment of chronic naphthalene inhalation is presented below using the draft U.S. EPA value.

According to the revised draft toxicological review of naphthalene (U.S. EPA 2004), there are insufficient data available to determine the oral carcinogenicity of naphthalene, and a revised value was not derived. For this reason, and the fact that naphthalene did not meet the physical-chemical screening criteria for inclusion in the multiple exposure pathway assessment (see Volume 2, Section 4.4.5.3 of the HHRA), the carcinogenicity assessment focused only on the inhalation route.

The U.S. EPA's draft inhalation unit risk of 0.0001 per µg/m³ was selected for the cancer risk assessment. This value is more conservative than the one presented by the California Office of Environmental Health Hazard Assessment (OEHHA 2009). The draft U.S. EPA unit risk equates to a risk-specific concentration of 0.1 µg/m³ (based on an acceptable incremental lifetime cancer risk of 1 in 100,000).

The carcinogenic assessment of naphthalene (ESRD Table 161-1) does not change the original findings of the HHRA, in that all relevant incremental lifetime cancer risks (ILCR) are less than 1 in 100,000. This suggests that the incremental cancer risks from the Project emission sources are essentially negligible.

Table 161-1 Incremental Lifetime Cancer Risks to Naphthalene Calculated Using the Draft Inhalation Risk-specific Concentration

Receptor Group	Incremental Lifetime Cancer Risks (per 100,000)
	Project (Application minus Baseline)
LSA-MPOI-	2.4E-03
RSA- MPOI	2.4E-03
RECR	4.8E-04
RESI	5.8E-04

CR #5 (Appendix A, Section A23.1.2) presents chronic inhalation exposure limits for formaldehyde from regulatory agencies. The lowest carcinogenic exposure limit was selected for the assessment of potential human health risks (*i.e.*, US EPA RsC 0.8 µg/m³). The RsC is based on an incremental lifetime cancer risk (ILCR) level of 1 in 100,000 or 0.00001. ESRD Table 161-2 presents the ILCR values for formaldehyde at receptor groups. All ILCR values represent 1 in 100,000 risk level and all ILCR values were less than 1.0, indicating that the Project is associated with negligible degrees of incremental cancer risks (*i.e.*, less than 1 in 100,000) RSA-MPOI, LSA-MPOI, Resident and Recreational group.

Table 161-2 Summary of Inhalation ILCR Values for Formaldehyde at Receptor Groups and the MPOI

Receptor Group	Incremental Lifetime Cancer Risks (per 100,000)
	Project (Application minus Baseline)
LSA-MPOI-	2.1E-04
RSA- MPOI	2.1E-04
RECR	4.2E-05
RESI	5.1E-05

References:

Equilibrium and URS (Equilibrium Environmental and URS Canada Inc.) 2006. Potency Equivalency Factors for Carcinogenic Polycyclic Aromatic Hydrocarbons. Prepared for: Health Canada, Contaminated Sites Division.

OEHHA (California Office of Environmental Health Hazard Assessment). 2009. Technical Support Document for Cancer Potency Factors: Methodologies for derivation, listing of available values, and adjustments to allow for early life stage exposures. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology Branch. May 2009. Available at: http://www.oehha.ca.gov/air/hot_spots

US EPA. 2004. External Peer Review for the IRIS Reassessment of the Inhalation Carcinogenicity of Naphthalene FINAL REPORT. Prepared for Integrated Risk Information System (IRIS) Program Office of Research and Development National Center for Environmental Assessment U.S. Environmental Protection Agency. Prepared by ORISE IRIS Technical Assistance Team Oak Ridge Institute for Science and Education Oak Ridge Associated Universities. August 2004

162. Volume 3, CR #5, Section 3.2.3.1, Table 3-17, Page 35.

This table provides a summary of the toxic endpoint identified for each COPC and the potential additive interactions of COPC. Chronic inhalation and chronic oral exposure can produce similar health effects, as outlined for aluminum, lead, manganese, selenium, uranium, and aromatic C_9-C_{16}.

a. Explain how the HHRA accounted for additive effects on target organs following combined oral and inhalation exposures.

Response:

The HHRA did not combine oral and inhalation exposures to derive additive effects. Instead, the HHRA reported risks for the oral and inhalation route separately. However, the oral risks predicted in the multiple pathway exposure assessment included dermal exposures.

Predicted RQ values for different routes (*i.e.,* inhalation, oral and dermal) of exposure cannot be summed to calculate a total RQ value without consideration of the basis of the exposure limit. Route-specific toxicity reference values (TRVs) can only be summed if the basis of the TRVs are similar or target the same organ or tissue with similar adverse effects (Health Canada 2009). ESRD Table 162-1 presents the basis of the route-specific TRVs used in the HHRA for the inhalation and oral route of exposure. For most COPCs the route-specific RQ values cannot be added on the basis that a TRV is missing for one of the routes or the basis of the route-specific TRVs are not similar. Only the inhalation and oral route-specific RQ values for the aluminum, aromatic C_9-C_{16}, arsenic, benzo(a)pyrene equivalent, lead, manganese, uranium and selenium are considered additive.

ESRD Tables 162-2 to 162-9 present the total RQ values for aluminum, aromatic C_9-C_{16}, arsenic, benzo(a)pyrene equivalent, lead, manganese, uranium and selenium, respectively. The predicted RQ values for the Baseline and Application Case with the inclusion of inhalation RQ values were identical to those predicted in the HHRA. Therefore, the inclusion of inhalation risks for aluminum, aromatic C_9-C_{16}, arsenic, benzo(a)pyrene equivalent, lead, manganese, uranium and selenium are not expected to have a material impact on the conclusions of the HHRA.

Table 162-1 Summary of Route-specific TRVs for COPCs Assessed in the Multiple Pathway Assessment

COPC in the Multiple Pathway Assessment	Basis of Exposure Limit for the Route of Exposure		Comment
	Inhalation	Oral (including dermal contact)	
Non-Carcinogens			
Aluminum	Neurological	Reproductive and developmental effects, neurological effects, kidney and liver effects.	Routes are considered additive
Antimony	No limit available	Liver effects	Routes are not additive
Barium	Cardiovascular	Kidney effects	Routes are not additive
Beryllium	Lung cancer	Gastrointestinal lesions	Routes are not additive
Cadmium	Lung cancer	Kidney effects	Routes are not additive
Chromium	Respiratory effects	Toxicological endpoint unclear	Routes are not additive
Chromium VI	Lung cancer	Gastrointestinal effects	Routes are not additive
Cobalt	Respiratory effects	Cardiac effects	Routes are not additive
Copper	Respiratory and immunological effects	Liver effects	Routes are not additive
Lead	Nervous system effects	Toxicological endpoint unclear, but lead is a known development neurotoxicant	Routes are considered additive
Manganese	Neurological effects	Central nervous system effects	Routes are considered additive
Mercury	Central nervous system effects	Kidney effects	Routes are not additive
Methyl mercury	Not applicable	Developmental and neurotoxic effects	Routes are not additive
Molybdenum	Changes in body weight	Blood effects (*i.e.,* increased serum uric acid levels)	Routes are not additive
Nickel	Lung cancer	Development effects	Routes are not additive
Selenium	Neurological effects and liver dysfunction	Selenosis (includes neurological effects and changes in blood parameters symptomatic of liver dysfunction)	Routes are considered additive
Uranium	Kidney effects	Kidney effects	Routes are considered additive
Vanadium	Respiratory effects	Development effects	Routes are not additive

Table 162-1 Summary of Route-specific TRVs for COPCs Assessed in the Multiple Pathway Assessment

COPC in the Multiple Pathway Assessment	Basis of Exposure Limit for the Route of Exposure		Comment
	Inhalation	Oral (including dermal contact)	
Zinc	No limit available	Blood effects (decreases in erythrocyte copper zinc-superoxidase dismutase (ESOD) activity)	Routes are not additive
Aromatic C_9-C_{16} group	NOAEL (*i.e.*, increased liver and kidney weights)	NOAEL (*i.e.*, increased liver and kidney weights)	Routes are considered additive
Formaldehyde	NOAEL (*i.e.*, eye, nasal and respiratory irritation)	NOAEL (*i.e.*, pathological changes in the stomach and renal papillary necrosis)	Routes are not additive
Pyrene	No limit available	NOAEL (*i.e.*, kidney effects)	Routes are not additive
Carcinogens			
Arsenic	Lung cancer	Bladder, liver and lung cancer	Routes are considered additive
Benzo(a)pyrene equivalent	Pharynx, esophagus and fore stomach tumours	Stomach tumours	Routes are considered additive

Table 162-2 Predicted Route-specific and Total RQ Values for Aluminum and the Resident Group

Route-specific RQ Value	Assessment Case	
	Baseline	Application
Inhalation	1.9E-02	1.9E-02
Oral (including dermal contact)	4.7E-01	4.7E-01
Total	4.9E-01	4.9E-01

Table 162-3 Predicted Route-specific and Total RQ Values for Aromatic C_9-C_{16} and the Resident Group

Route-specific RQ Value	Assessment Case	
	Baseline	Application
Inhalation	1.3E-03	1.3E-03
Oral (including dermal contact)	7.9E-06	7.2E-06
Total	1.3E-03	1.3E-03

Table 162-4 Predicted Route-specific and Total ILCR Values for Arsenic and the Resident Group	
Route-specific RQ Value	Incremental Lifetime Cancer Risks (per 100,000)
	Project Case
Inhalation	1.2E-02
Oral (including dermal contact)	2.2E-02
Total	3.4E-02

Table 162-5 Predicted Route-specific and Total ILCR Values for Benzo(a)pyrene equivalent and the Resident Group	
Route-specific RQ Value	Incremental Lifetime Cancer Risks (per 100,000)
	Project Case
Inhalation	2.7E-04
Oral (including dermal contact)	2.3E-03
Total	2.6E-03

Table 162-6 Predicted Route-specific and Total RQ Values for Lead and the Resident Group		
Route-specific RQ Value	Assessment Case	
	Baseline	Application
Inhalation	1.8E-03	1.7E-03
Oral (including dermal contact)	1.5E-01	1.7E-01
Total	1.5E-01	1.7E-01

Table 162-7 Predicted Route-specific and Total RQ Values for Manganese and the Resident Group		
Route-specific RQ Value	Assessment Case	
	Baseline	Application
Inhalation	4.1E-02	4.5E-02
Oral (including dermal contact)	2.5	2.5
Total	2.5E+00	2.5E+00

Table 162-8 Predicted Route-specific and Total RQ Values for Selenium and the Resident Group

Route-specific RQ Value	Assessment Case	
	Baseline	Application
Inhalation	7.0E-06	7.0E-06
Oral (including dermal contact)	1.8E-01	1.8E-01
Total	1.8E-01	1.8E-01

Table 162-9 Predicted Route-specific and Total RQ Values for Uranium and the Resident Group

Route-specific RQ Value	Assessment Case	
	Baseline	Application
Inhalation	1.4E-04	1.4E-04
Oral (including dermal contact)	2.3E-01	2.3E-01
Total	2.3E-01	2.3E-01

References:

Health Canada. 2009. Federal Contaminated Site Risk Assessment in Canada. Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Prepared by Contaminated Sites Division Safe Environments Program. Draft for Comment. May 2009.

163. Volume 3, CR #5, Section 4.1, Tables 4-1 to 4-4 pages 40-42.

a. Define the averaging period assumed for the EPA statistic in these tables.

Response:

The definition of the “EPA Statistic” for NO_2 is as follows – the maximum of the 98th percentile of the annual distribution of daily maximum 1-hour concentrations (US EPA 2011). Similarly, the definition of the “EPA Statistic” for SO_2 is as follows – the maximum of the 99th percentile of the annual distribution of daily maximum 1-hour concentrations (US EPA 2010).

References:

US EPA 2011. Memorandum. Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard. From Tyler Fox Air Quality Modeling Group to Regional Air Division Directors. March 1st 2011.

US EPA 2010. Memorandum. Application of Appendix W Modeling Guidance for the 1-hour SO_2 National Ambient Air Quality Standard. From Tyler Fox Air Quality Modeling Group to Regional Air Division Directors. April 23rd 2010.

b. Provide a table or reference to a table that summarizes the air concentrations for the acute RQ values in these tables.

Response:

ESRD Table 163-1 to Table 163-4 presents the acute air concentrations used in the HHRA to predict RQ values for the LSA-MPOI, RSA-MPOI, Recreational Group and Resident Group.

Table 163-1 Summary of Maximum Acute Concentration Values Used in the HHRA for the LSA-MPOI [μg/m^3]

Chemical	Averaging Period	Assessment Case	
		Baseline	Application
Acetaldehyde	1h-max	2.4E+01	2.3E+01
Acrolein	1h-max	6.3E-01	6.0E-01
Aromatic C_9-C_{16}	1h-max	1.1E+00	2.1E-01
Arsenic	1h-max	1.2E-01	6.0E-03
Benzene	1h-max	5.4E+00	2.5E+00
Cadmium	24h-max	1.1E-03	4.1E-04
Chromium	1h-max	3.2E-02	2.1E-02
CO	1h-max	1.3E+03	1.7E+04
CO	8h-Max	7.2E+02	2.9E+03
Copper	1h-max	9.7E-02	4.1E-02
Formaldehyde	1h-max	2.8E+01	2.8E+01
Mercury	1h-max	6.3E-05	8.5E-05
Nickel	1h-max	7.5E-02	7.5E-02
NO_2	8th highest 24h max - max of 5 years	1.3E+02	2.5E+02
$PM_{2.5}$	24h-98 percentile	8.4E+00	8.7E+00
SO_2	10-min (1h-max)	3.4E+02	4.0E+02

Table 163-1 Summary of Maximum Acute Concentration Values Used in the HHRA for the LSA-MPOI [μg/m^3]

Chemical	Averaging Period	Assessment Case	
		Baseline	Application
SO_2	4th highest 24h max - max of 5 years	8.8E+01	1.0E+02
Toluene	1h-max	1.2E+01	1.1E+01
Vanadium	1h-max	9.4E-02	2.2E-02
Xylenes	1h-max	1.4E+00	5.8E-01
Zinc	1h-max	6.6E-01	6.2E-02

Table 163-2 Summary of Maximum Acute Concentration Values Used in the HHRA for the RSA-MPOI [μg/m^3]

Chemical	Averaging Period	Assessment Case	
		Baseline	Application
Acetaldehyde	1h-max	2.4E+01	2.3E+01
Acrolein	1h-max	7.1E-01	6.1E-01
Aromatic C_9-C_{16}	1h-max	3.3E+00	2.2E-01
Arsenic	1h-max	4.1E-01	7.8E-03
Benzene	1h-max	1.4E+01	2.5E+00
Cadmium	24h-max	2.7E-03	4.2E-04
Chromium	1h-max	9.6E-02	2.1E-02
CO	1h-max	4.3E+03	1.7E+04
CO	8h-Max	2.0E+03	2.9E+03
Copper	1h-max	2.6E-01	4.1E-02
Formaldehyde	1h-max	2.9E+01	2.8E+01
Mercury	1h-max	6.7E-05	8.5E-05
Nickel	1h-max	2.4E-01	2.4E-01
NO_2	8th highest 24h max - max of 5 years	1.4E+02	2.5E+02
$PM_{2.5}$	24h-98 percentile	8.4E+00	8.9E+00
SO_2	10-min (1h-max)	1.2E+03	1.2E+03
SO_2	4th highest 24h max - max of 5 years	9.0E+01	9.0E+01
Toluene	1h-max	1.5E+01	1.1E+01
Vanadium	1h-max	3.2E-01	2.2E-02
Xylenes	1h-max	3.3E+00	5.9E-01
Zinc	1h-max	2.2E+00	6.2E-02

Table 163-3 Summary of Maximum Acute Concentration Values Used in the HHRA for the Recreational Group [µg/m³]			
Chemical	Averaging Period	Assessment Case	
		Baseline	Application
Acetaldehyde	1h-max	2.4E+01	2.3E+01
Acrolein	1h-max	6.6E-01	6.0E-01
Aromatic C_9-C_{16}	1h-max	1.7E+00	1.7E-01
Arsenic	1h-max	2.1E-01	2.4E-03
Benzene	1h-max	8.1E+00	2.4E+00
Cadmium	24h-max	1.4E-03	3.9E-04
Chromium	1h-max	5.1E-02	9.5E-03
CO	1h-max	7.5E+02	1.2E+03
CO	8h-Max	6.5E+02	6.8E+02
Copper	1h-max	1.5E-01	3.2E-02
Formaldehyde	1h-max	2.8E+01	2.8E+01
Mercury	1h-max	3.1E-05	3.9E-05
Nickel	1h-max	8.4E-02	8.4E-02
NO_2	8th highest 24h max - max of 5 years	4.6E+01	1.0E+02
$PM_{2.5}$	24h-98 percentile	6.9E+00	7.6E+00
SO_2	10-min (1h-max)	5.0E+02	5.0E+02
SO_2	4th highest 24h max - max of 5 years	8.1E+01	8.3E+01
Toluene	1h-max	1.3E+01	1.1E+01
Vanadium	1h-max	1.6E-01	7.7E-03
Xylenes	1h-max	2.0E+00	5.5E-01
Zinc	1h-max	1.1E+00	3.2E-02

Table 163-4 Summary of Maximum Acute Concentration Values Used in the HHRA for the Resident Group [µg/m³]			
Chemical	Averaging Period	Assessment Case	
		Baseline	Application
Acetaldehyde	1h-max	2.3E+01	2.3E+01
Acrolein	1h-max	6.2E-01	6.0E-01
Aromatic C_9-C_{16}	1h-max	6.6E-01	1.8E-01
Arsenic	1h-max	6.9E-02	3.5E-03

Table 163-4 Summary of Maximum Acute Concentration Values Used in the HHRA for the Resident Group [μg/m^3]

Chemical	Averaging Period	Assessment Case	
		Baseline	Application
Benzene	1h-max	3.9E+00	2.4E+00
Cadmium	24h-max	6.6E-04	3.9E-04
Chromium	1h-max	2.0E-02	1.3E-02
CO	1h-max	6.6E+02	9.3E+03
CO	8h-Max	6.1E+02	1.9E+03
Copper	1h-max	6.6E-02	3.5E-02
Formaldehyde	1h-max	2.8E+01	2.8E+01
Mercury	1h-max	3.2E-05	5.4E-05
Nickel	1h-max	7.4E-02	7.4E-02
NO_2	8th highest 24h max - max of 5 years	2.0E+01	1.8E+02
$PM_{2.5}$	24h-98 percentile	7.0E+00	7.8E+00
SO_2	10-min (1h-max)	2.2E+02	2.2E+02
SO_2	4th highest 24h max - max of 5 years	6.2E+01	8.0E+01
Toluene	1h-max	1.2E+01	1.1E+01
Vanadium	1h-max	5.3E-02	1.2E-02
Xylenes	1h-max	1.0E+00	5.6E-01
Zinc	1h-max	3.7E-01	4.1E-02

164. Volume 3, CR #5, Section 4.2, Tables 4-8 and 4-9, Pages 47-49.
The air concentration data provided in Appendix D (Table D14 Summary of Air Concentrations Used to Estimate Human Exposures) does not include all of the COPCs listed in these tables.

a. Provide a table or reference to a table that summarizes the air concentrations for the chronic RQ values reported in these tables.

Response:

ESRD Table 164-1 and Table 164-2 present the maximum chronic air concentrations used in the HHRA to predict non-carcinogenic RQ values and carcinogenic ILCR values for the Resident Group, respectively.

Table 164-1 Summary of Chronic Maximum Annual Average Air Concentrations Used in the Inhalation Assessment for Non-carcinogens and the Resident Group[µg/m^3]		
COPC	**Assessment Case**	
	Baseline	**Application**
Acrolein	1.8E-01	1.8E-01
Aluminum	9.6E-02	9.6E-02
Aromatic C_9-C_{16}	6.4E-02	6.3E-02
Barium	1.4E-03	1.5E-03
Chromium	9.5E-04	9.4E-04
Cobalt	1.4E-03	1.4E-03
Copper	5.4E-03	5.4E-03
Formaldehyde	4.5E+00	4.5E+00
Lead	8.9E-04	8.6E-04
Manganese	2.0E-03	2.2E-03
Mercury	4.1E-06	4.2E-06
Molybdenum	1.5E-04	1.5E-04
Naphthalene	6.1E-02	6.0E-02
NO_2	2.3E+00	1.1E+01
$PM_{2.5}$	1.6E+00	1.7E+00
Propylene	2.1E-02	1.6E-03
Selenium	1.4E-04	1.4E-04
Thallium	9.3E-06	9.3E-06
Toluene	1.9E+00	1.9E+00
Uranium	5.6E-06	6.1E-06
Vanadium	4.0E-04	2.9E-04
Xylenes	3.0E-01	3.0E-01

Table 164-2 Summary of Chronic Maximum Annual Average Air Concentrations Used in the Inhalation Assessment for Carcinogens and the Resident Group[µg/m^3]	
COPC	**Project Case**
Acetaldehyde	1.8E-05
Arsenic	1.9E-05
Benzene	3.5E-04
Benzo(a)pyrene	1.2E-07

Table 164-2 Summary of Chronic Maximum Annual Average Air Concentrations Used in the Inhalation Assessment for Carcinogens and the Resident Group[µg/m^3]	
COPC	**Project Case**
Benzo(a)pyrene equivalent	4.2E-07
Beryllium	3.9E-07
Cadmium	5.6E-07
Chromium VI	2.2E-06
Nickel	2.2E-04

165. Volume 3, CR #5, Section 4.3.1, Table 4-11, Page 51.

a. Explain the value of 0% for dermal uptake during swimming when, in Appendix B - Section B3.2, manganese was above detection in all surface water samples collected.

Response:

A maximum manganese concentration of 1.8 mg/L was used in the HHRA to predict exposures from fish consumption and swimming (*i.e.*, dermal and inadvertent surface water ingestion). The maximum concentration was measured in one of the pit lakes (*i.e.*, Silkstone Lake in 2010) and surface water concentrations measured in rivers and creeks are much lower ranging from 0.0038 to 0.2 mg/L. The 95UCLM concentration in streams was estimated to be 0.036 mg/L based on a sample size of 49 from 10 rivers and creeks in the LSA.

The HHRA predicted a value of 0% for dermal uptake during swimming because other pathways (*e.g.*, consumption of fish, plants and moose meat) contributed a much larger portion to the overall exposure. Dermal uptake during swimming is based on the following equation (Appendix C in CR #5 provides additional details):

$$EDI_{derm+swim} = C_{sw} \times Kp \times SEF \times SAT \times CF1 \times CF2$$

Where:

$EDI_{derm+swim}$ = estimated daily intake of chemical from dermal contact with surface water (µg/d)

C_{sw} = chemical concentration in surface water (mg/L)

Kp = dermal permeability coefficient in water (cm/hr)

SEF = swim exposure factor (hr/d)

SAT = surface area total (cm^2)

CF1 = conversion factor from mg to µg (1,000 µg/mg)

CF2 = conversion factor from L to cm³ (0.001 L/cm³)

Example: Estimated daily intake of manganese by a toddler resident from dermal uptake during swimming

$$EDI_{derm+swim} = 1.8 \times 1.0E-03 \times 0.255 \times 6{,}130 \times 1{,}000 \times 0.001$$

$$EDI_{derm+swim} = 2.8\ \mu g / d$$

The predicted exposure from dermal uptake during swimming (*i.e.*, 2.8 µg/day) is substantially lower than total exposure (*i.e.*, 5,800 µg/day) for the toddler in the Application Case.

Comparatively dermal uptake during swimming is 0.05% (*i.e.*, 2.8/5,800 x 100) of total exposure to manganese from the remaining pathways (*i.e.*, oral exposures).

b. Explain why incidental ingestion of surface water during swimming was not considered in this table.

Response:

Incidental ingestion of surface water during swimming was included and Table 4-11 should have provided a clearer explanation that dermal uptake and ingestion during swimming was included.

The following equation was used to estimate ingestion exposure from swimming (Appendix C in CR #5 provides additional details):

$$EDI_{ing+swim} = C_{sw} \times SEF \times SWIR \times CF1$$

Where:

$EDI_{ing+swim}$ = estimated daily intake of chemical from ingestion of surface water during swimming (µg/d)

C_{sw} = chemical concentration in surface water (mg/L)

SEF = swim exposure factor (hr/d)

SWIR = swimming ingestion rate (L/hr)

CF1 = conversion factor from mg to µg (1,000 µg/mg)

Example: Estimated daily intake of manganese by a toddler resident from ingestion of surface water during swimming

$$EDI_{ing+swim} = 1.8 \times 0.255 \times 0.05 \times 1{,}000$$

$$EDI_{ing+swim} = 23\ \mu g / d$$

Combined, swimming exposures through dermal uptake and ingestion pathways predicted a total swimming exposure of 25 µg/day. This predicted total exposure level from swimming is presented in Appendix D, Table D15, Page D22 (CR #5) for the Application Case and toddler life stage. Comparatively, total exposure during swimming is 0.4% (*i.e.*, 25/5,800 x 100) of total exposure to manganese from the remaining pathways (*i.e.*, oral exposures).

166. Volume 3, CR #5, Section 4.3.1, Page 51.
CVRI states *In the current assessment, the estimated daily intake of manganese for the toddler is predicted to be 5.8 mg/day. This intake level is below the recognized NOAEL of 10 mg/day (Health Canada 2009b; U.S. EPA 1996; WHO 2000).*

a. Did this estimated daily intake for manganese include chronic inhalation exposure?

Response:

The estimated daily intake for manganese in the multiple pathway exposure assessment did not include inhalation exposures.

b. If not, recalculate a daily intake for manganese that includes inhalation exposure.

Response:

ESRD Table 166-1 presents the predicted oral and oral + inhalation exposures to manganese for all life stages in the Application Case. ESRD Table 166-1 indicates that the addition of manganese inhalation exposures to oral exposures has no material impact on predicted total exposures. This signifies that oral exposures are predicted to be the dominant pathway for manganese exposure in the HHRA.

Table 166-1 Predicted Oral and Oral + Inhalation Exposures to Manganese in the Application Case [µg/kg/day]

Life Stage	Exposure [µg/day]	
	Oral Pathways Only	Oral + Inhalation Pathways
Infant	37	37
Toddler	5,800	5,800
Child	9,190	9,190
Adolescent	11,600	11,600
Adult	12,600	12,600

8. FEDERAL

The responses to questions in this Approvals section will not be considered as part of the EIA completeness decision made by Alberta Environment.

8.1 Department of Fisheries and Oceans (DFO)

167. Volume 1, Section E, Table E.2-5, Page E-27.
Table E.2-5 describes planned diversions and associated habitat impacts. The table provides linear and area measurements to describe watercourses that will be diverted as part of mining practices.

a. Discuss what method CVRI has used or will use to define the quality of fish habitat that will be harmfully altered, disrupted or destroyed when these watercourses are diverted. How will the data used to define the quality of fish habitat be applied to a no-net-loss plan? (i.e.-how the quality of removed habitat will be incorporated into the development of a no-net-loss plan).

Response:

As previously noted, mine plans and water management plans will be refined during detailed planning and design phases. As such, the impacts identified in Table E.2-5 should be considered preliminary and are likely subject to change.

CR#2, Tables 4.1.3, 4.14, 4.15, 4.16 provides general habitat utilization information and rankings for streams potentially affected by the Project. The system relies on using habitat inventory information and fish presence/distribution data to rank the habitat in terms of its potential to support various life cycle phases of fish species known to occupy the streams. These rankings are relied on during detailed design so that mine plans can be developed to avoid direct impacts to critical habitat whenever possible. A description of the ranking system is provided in CR#2, Table 4.12.

CVRI is committed to implementing a No Net Loss Habitat Compensation Plan (NNLP). As indicated in CR#2, Section 5.4.6, the NNLP will be developed and refined during subsequent planning phases as additional mine plan details become available and following consultation with regulators and stakeholders. CVRI has utilised habitat suitability indices (HSI) models in the past as part of their habitat compensation planning and will likely employ this approach as part of the habitat compensation strategy for the Project. However, other potential benefits to fish and fish habitat (not necessarily quantifiable using HSI modelling) will also be considered during habitat compensation planning. Examples of such concepts are included below:

- Potential benefit to local and regional fish populations as a result of the increase in available overwintering habitat (due to end pit lakes).
- Potential benefit of general habitat improvement (specifically for salmonids) as a result of sediment retention in end pit lakes.
- Potential benefit of increased fish production due to increase in available lacustrine habitat. As indicated in the response to ESRD SIR #94, the amount of available habitat provided by the end pit lakes will be approximately 35 times greater than the preliminary estimate of habitat altered or lost. In addition, studies of other end pit lakes in the region indicate that Athabasca Rainbow Trout densities in streams downstream of end pit lakes are than they were prior to development of the end pit lake (see response to ESRD SIR #86).
- Potential benefit of providing opportunity for specific species management/recovery/research programs (see response to ESRD SIR #104).
- Potential benefit of improving fish passage at existing watercourse crossings in the region that have been identified as barriers or impediments to fish passage.

b. Discuss how CVRI will ensure that the fish habitat lost will be replaced with equally productive fish habitat for the species that are native to the area.

Response:

As indicated in the responses above there are a number of concepts that will be considered during the development of the no net loss plan. Discussion regarding habitat compensation planning is provided in the responses to ESRD SIR #171 and ESRD SIR #174.

In addition, CVRI will implement specific monitoring plans, as included in the approved compensation plan, to assess the effectiveness of any habitat compensation/enhancement work that is implemented. Additional compensation/enhancement would be completed as needed depending on results from the monitoring.

168. Volume 1, Section E, Page E-29.

CVRI states *Some of the [pit] lakes may be constructed to preclude fish access but conceptually, the lakes will be designed to maximize habitat and biological diversity and use by native fish population…*

a. Discuss examples of the types of fish habitat features that will be incorporated into the "lakes" that will help maintain native fish populations.

Response:

The development plan for each lake will be unique and will consider existing and target fish use of existing habitat, regional management objectives, as well as desired end use.

The Guidelines for End Pit Lake Development at Coal Mine Operations (EPLWG 2004) identify key design factors that will be used in the development of lakes for the Project. Design features that were considered to have a high degree of importance in the Guideline Document (EPLWG 2004) will be prioritized. Specific habitat features that may be incorporated include but are not limited to:

- littoral zone enhancement and cover placement maximizing diversity;
- littoral substrate enhancements maximizing habitat diversity;
- lake orientation to maximize wind exposure;
- shoreline sloping maximizing diversity, irregularity, length, and stability ;
- maximize connectivity to adjacent lakes, streams, and wetlands;
- woody cover plantings along shorelines, inlets, and outlets;
- cover enhancement in inlet and outlet channels;
- spawning enhancement in inlet and outlet channels; and
- inoculation of littoral areas with aquatic macrophytes and invertebrates.

b. Discuss how CVRI will maximize habitat and biological diversity when lotic (flowing water) habitat is changed to lentic (still water) habitat?

Response:

As indicated in CR #2, the final design of end pit lakes will be completed at the licensing stage of the development. Final design will incorporate guiding principles (to maximize habitat and biological diversity) that are described in the draft guidelines for end pit lake development at coal mine operations (EPLWG 2004) and/or procedures provided in similar guideline documents that may be available in the future (see response to ESRD SIR #168a). In general, the end pit lakes will increase the amount of overwintering habitat that is available in the upper Erith River drainage.

Habitat and biological diversity of lotic habitats that are linked to lakes can be maximized with site-specific habitat enhancement. Sonnenberg (2011) described successful use of lotic habitats adjacent to reclaimed pit lakes in west-central Alberta and found native fish populations increased following reclamation.

c. Discuss how CVRI will maintain salmonid fish communities when portions of lotic habitat are changed to lentic habitat because of the creation of pit lakes within a lotic system.

Response:

Salmonids occupy both lentic and lotic habitats in Alberta and are expected to occupy the end pit lakes. Lac Des Roches, Sphinx Lake, and CD Pit Lake are all end pit lakes, located in the region, which provided for viable, self-sustaining salmonid populations (Sonnenberg 2011, Schwartz 2002). More recently, initial research on the Embarras Lakes (developed on the CVRI mine lease) indicates that Rainbow Trout are occupying the habitat and suggests that reproduction may already have occurred (see ESRD SIR #174). In addition, constructing lentic habitats will increase overwintering capacity in the upper Erith River drainage, which currently may be a limiting factor for some species (*i.e.,* Bull Trout).

In order to establish salmonid populations in lentic systems, certain physical and/or biological parameters may require manipulation. These strategies would be developed as mine plans progress on a case-by-case basis (each lake system) while taking into consideration regional management objectives. The following provides examples of potential strategies that could be employed for the upper Erith River end pit lake system to maximize the potential for the establishment of salmonid communities.

- If cool water species such as Suckers and Northern Pike are not desirable on the reclaimed landscape then installation of fish barriers may be considered. Complete barriers similar to those previously constructed on the Embarras River and Chance Creek (by CVRI) may be considered while partial barriers that restrict or impede the movements of certain species (*i.e.,* Northern Pike, Suckers) while allowing other species to move (*i.e.,* Rainbow Trout, Bull Trout) may also merit consideration.

- Under certain conditions (*i.e.,* presence of a downstream barrier) it may be possible to remove species that are deemed to be undesirable in the post mining end pit lake system. Suckers and Northern Pike occur at low densities in the LSA and populations may not persist if isolated from downstream populations during mining, particularly if habitats are electrofished extensively and captured fish are transferred downstream of the barrier. Though this may represent a reduction in species diversity in the end pit lake system there may be some benefit to salmonid populations over the long term. Again, this type of management strategy would rely on regional management objectives. Alternatively, if Sucker populations were to become established in the pit lakes, it is possible that they would provide a food resource for a potential Bull Trout population. Bull Trout will feed on suckers and have been known to reduce Sucker densities in other Alberta lakes (Rees *et al.* 2012).
- Following reclamation, introduction of native fish species within the lake could be coordinated with habitat enhancements upstream and downstream to facilitate population development. Attempts could be made to establish spawning areas suitable for Rainbow Trout, Bull Trout, and/or Arctic Grayling throughout the system (even a considerable distance upstream of the reclaimed lakes).

d. Discuss the perceived impact on fish communities when constructing lentic habitat in the middle of a lotic system.

Response:

Impacts to fish communities (in general) were discussed in CR #2, Section 5.0. Specific analysis of the potential impacts of creating lentic habitat in the middle of a lotic system will be conducted as mine plans progress and will depend on a number of factors including the location of the lake, features that are incorporated into the lake design, the species that inhabit the existing habitat, the target species that the lake system will be developed for, and the desired end use for the lake.

CVRI believes that there is a growing pool of information that suggests that end pit lakes can be used to facilitate the development of self-sustaining native fish populations and ultimately provide a benefit to fisheries resources in the region. Factors contributing to this opinion include:

- The end pit lakes (as proposed) will provide as much as 35 times more habitat than is currently available which suggests an overall net increase in fish production for the area (see ESRD SIR #94).
- The end pit lakes will provide overwintering habitat in the upper Erith River watershed and may provide an opportunity to establish Bull Trout and/or Arctic Grayling populations in the upper Erith drainage (baseline investigations suggest that both species were relatively uncommon in the LSA).
- The attenuation of peak flows and retention of sediment due to end pit lakes may directly benefit Athabasca Rainbow Trout by reducing adverse impacts during sensitive spawning periods (see ESRD SIR #104).
- Sediment retention provided by end pit lakes may result in a direct improvement to downstream salmonid habitat as baseline investigations indicated that fine substrates were prevalent in the Erith River (comprised >50% of streambed composition) (see ESRD SIR #182).
- The end pit lakes will provide opportunities to conduct research and/or management initiatives to provide answers to specific questions or contribute to general knowledge base (see ESRD SIR #104).
- Recent studies of end pit lakes in the region indicate that the establishment of self-propagating salmonid populations is possible (see ESRD SIR #185).

e. Discuss what the criteria are that will determine whether fish will be allowed to access pit lakes or be denied access to pit lakes.

Response:

As previously stated it is CVRI's intent to develop self-sustaining native fisheries within the end pit lakes. However, CVRI will consider installing barriers to limit fish access to lakes if precluding fish access is preferred by AESRD. Final reclamation plans, post reclamation drainage patterns, and historical fish distribution will also be considered.

f. Provide an update on the development of a monitoring plan that will assess the effects of the mine on fish communities, species compositions and other impacts on fish and fish habitat.

Response:

An aquatic monitoring plan will be developed and implemented as mine plans progress. Key elements of the program are as follows:

- Fish population monitoring to obtain data on fish populations to reveal trends in fish numbers and also to monitor fish community structure and population health.
- Turbidity monitoring and turbidity logging programs will be implemented as described in the response to ESRD SIR #87.
- Inspection and/or assessment of habitat downstream of mine activity will be conducted if turbidity monitoring and/or turbidity logging data indicate that a sediment introduction may have occurred. The information will be used to assess impact and determine remedial action.
- Regular inspection of all drainage works.
- Benthic invertebrate biomonitoring. As indicated in CR #2, Section 6.0, the existing monitoring program will be expanded to include sample sites on potentially impacted watercourses as mining progresses.
- Monitoring of end pit lake systems including physical, chemical and biological parameters.
- Monitoring of habitat enhancement measures constructed in lotic habitat to document the stability and use of the habitat and to identify modifications that will be made (if necessary).
- As indicated in CR #2, Section 6.0, long term monitoring of flow will be conducted in each main creek to document critical low flow conditions during pit filling periods and to define the need for to augment flows.

References:

End Pit Lake Working Group. 2004. Guidelines for lake development at coal mine operations in mountain foothills of northern east slopes, Report #ESD/LM/00-1, Alberta Environment, Environmental Science.

Schwartz. 2002. Fish populations, biomass, and growth in Lac Des Roches, Alberta. Red Deer, Alberta, Canada, Prepared by Pisces Environmental Consulting Services for Cardinal River Coals Ltd.

Sonnenberg, R. 2011. Development of Aquatic Communities in High-Altitude Mine Pit Lake Systems of West-Central Alberta. A thesis submitted to the school of graduate studies of the University of Lethbridge. Lethbridge, Alberta. 163 pp +App

169. Volume 1, Section E, Page E-31.
CVRI states *Well established mitigation measures will be implemented to reduce potential sediment effects to a minimum.*

a. Provide an outline of specific well-established mitigation measures and their application and efficacy in relation to mitigating the impact of coal mining on the aquatic environment, using other mines operated by CVRI as examples.

Response:

Numerous ‘erosion control’ and ‘sediment collect’ practices are utilized throughout the CVM. Examples of these practices are described below:

Sediment Ponds

Waste Water Ponds

All mine waste water is directed to ‘waste water ponds’ for treatment prior to discharge to the environment. These ponds provide a storage capacity and treatment opportunity to remove sediment. Discharge is monitored to determine effectiveness of the treatment.

Flocculation

Flocculation treatment is provided in conjunction with sedimentation ponds to manage suspended sediment. “Floc’ is added to pond inflows as required. Outflow of ponds are monitored for measurement of effectiveness.

Dredging

Sediment collected in ponds is removed by dredging in order to maintain pond capacity. Material removed is discarded in appropriate waste dumps.

Erosion Control

Silt Fence

Silt fence is typically installed below small disturbance areas that are close to water courses. Drainage from larger disturbance areas is controlled by other means.

Straw Bales

Straw bales are installed below small disturbance areas or within small drainage channels in order to slow water velocity and trap sediment. Drainage from larger areas is controlled by other means.

Cocoa Matts

Cocoa matts (or similar products) are utilized on slopes with small disturbance footprints to control erosion off slopes. The areas are seeded for a more permanent control.

Ditch Armour

Permanent steep and long ditches are armoured with rock or rip rap to minimize erosion. Larger rip rap also traps bedload.

Liners

Plastic and geo-fabrics are installed on short, steep ditch sections or in ditches through silty or muskeg areas in order to provide a stable ditch profile and minimize erosion.

Rip Rap

Heavy rip rap is installed in ditches or outfalls were large volumes or high velocity flows occur. This minimizes erosion by protecting channel beds and walls.

<u>Downstream Monitoring</u>

Water Quality

CVRI monitors downstream water quality on a regular basis to measure effectiveness of overall minesite sediment control.

Benthic Monitoring

CVRI monitors downstream benthic health on a regular basis to measure effectiveness of overall minesite sediment control.

<u>Vegetation</u>

Topsoil Stockpile Management

Topsoil salvage stockpiles are groomed and seeded to minimize soil loss and provide erosion control.

Seeding on Reclamation

Seeding on and new ‘placed topsoil’ is completed in the spring of each year in order to quickly establish a vegetation cover to minimize erosion.

Road Construction

Soil salvage in newly constructed haul roads is stripped and placed as windrows on either side of the road. These piles are groomed and seeded as are the margins on the side of the roads. Ditches are provided as needed to direct road runoff to water management facilities.

Drainage Management

Sumps

Sumps are established along roads, beneath dumps slopes and in pit to collect runoff and provide catch basins for sediment. Sumps are often used as points for pump stations.

Coffer Dams

Small 'coffer dams' or windrows are provided on slopes to provide erosion control by slowing drainage flows and providing opportunity for sediment collection. Silt fence or straw bales may be used in conjunction with earthen windrows.

Ditching

Ditches are installed to collect and direct drainage flows. 'Interceptor' ditches are placed above and below pits or dumps to direct water. Ditches may be lined. Gradient of ditches are keep to a minimum. Often native vegetation is kept in the ditch banks to promote grow. Disturbed ditch alignments are seeded.

Ditch Checks

'Check dams' are placed in ditches to lower flow velocity and catch sediment. Straw bales are often used in conjunction with earthen check dams.

Cross Ditching

Exploration roads and 'drill lines' are reclaimed with incorporation of cross ditches on slopes to minimize erosion. Soil and slash is pulled back to the corridor.

Ditch Maintenance

Interceptor ditches and road ditches are monitored and maintained as needed. Repairs include removing slumped material, rebuilding channel profiles, placing sediment traps and removal of sediment. Vegetation cover is inspected and additional seeding provided as needed.

Road Berms

Haul roads have 'side berms' placed on either side to hold runoff on the road and direct drainage to water management facilities. Routine maintenance of the berms is performed to effectively control runoff flow routes.

Outflows, Pump discharge

Pond, ditch and pump discharge points are protected by rip rap or 'stilling basins'.

170. Volume 1, Section E, Page E-31.
CVRI states *During the filling period, downstream flows in receiving watercourses will decrease. Impacts to fish habitat as a result of pit filling is expected to be minimal since it is assumed that lake filling will be gradual in order to maintain downstream flows and instream flow guidelines (AENV 2011).*

a. Discuss how CVRI will mitigate the effect of a decrease in downstream flow on the fish species that inhabit watercourses subject to diversion during critical life-cycle periods like spawning seasons and over-wintering periods.

Response:

A detailed description of proposed diversions is described in ESRD Appendix 86. As described in ESRD Appendix 86, all lakes, except for Lake 3 on Hay Creek, will be filled by gravity overflows from diversion ditches. Downstream habitat will be maintained by natural flows while the end pit lakes will be filled via controlled overflows.

The guidelines referenced in the question will be relied on for planned diversions. The guidelines provide a science-based approach to establishing flow recommendations and are intended to provide full protection of rivers and streams (ESRD 2011). The method described in the guideline document includes a percent of natural flow component and an ecosystem base flow component to ensure that aquatic ecosystems are protected. CVRI remains committed to adhering to these guidelines during the filling of end pit lakes.

As described in ESRD Appendix 86, Hay Creek would require long term pumping to maintain flows while the end pit lake filled. This could be mitigated by pumping water from the Embarras River (during high flows) to fill the lake more quickly. However, there is potential for long-term reduction in flows in Hay Creek if these measures are not feasible. Under this scenario the impacted section of habitat (from the lake to the mouth of Hay Creek) would be assessed and quantified to determine impacts to fish and fish habitat and a specific mitigation/habitat enhancement plan would be developed to ensure no net loss of fisheries productivity.

References:

Alberta Environment and Sustainable Resource Development (AENV) 2011. A desk-top method for establishing environmental flows in Alberta rivers and streams. ISBN: 978-0-7785-9979-1.

b. Discuss how CVRI will ensure the maintenance of downstream flow in these diversion zones during the winter season.

Response:

Operations during winter conditions are discussed in ESRD SIR #78c, 81, and 180e. Due to critical winter low flow conditions; individual diversion management frameworks will be developed to ensure that winter flows are maintained in compliance with the criteria described above. In some cases diversions of flows into lakes may be completely suspended during the winter.

c. Discuss how CVRI has accounted for changes to fish habitat because of reduction in downstream flows.

Response:

Temporary reduction in flows during mining will be mitigated through use of open channel diversions (to maintain natural flow across mine areas) and through judicious pumping (to meet in flow needs guidelines provide by Alberta Environment). Impacts to habitat in Hay Creek that may occur, depending to the logistics and feasibility of long term pumping, will be addressed as described in response to ESRD SIR #170a.

Impacts to fish habitat as a result of permanent changes to surface drainage patterns are expected to occur in Bacon Creek, Lendrum Creek, Lund Creek, and the unnamed tributary to the Pembina River (as summarized in CR #2 Section 5.2.2 and further explained in ESRD Appendix 86. These impacts will be assessed and quantified to determine impacts to fish and fish habitat and a specific mitigation/habitat enhancement plan will be developed to ensure no net loss of fisheries productivity. It is anticipated that the enhancement/compensation plan would include a post construction monitoring component as part of the adaptive management process.

171. Volume 1, Section E, Page E-32.
CVRI states *A detailed compensation plan will be developed and refined in subsequent planning phases as further mine plan details become available and following consultation with regulators and stakeholder.*

a. Provide examples of how CVRI plans to incorporate successes and/or challenges of past fish habitat compensation projects into the development of a fish habitat compensation plan for Robb Trend (i.e. - the use of adaptive management).

Response:

A discussion regarding fish habitat compensation and how adaptive management will be implemented in the course of no-net-loss planning is provided in the response to ESRD SIR #174c).

b. Discuss how CVRI plans to develop a successful fish habitat compensation plan incorporating adaptive management and provincial fish management objectives when changing lotic habitat to lentic habitat because of mining practices, using examples from other mining operations in the vicinity.

Response:

A discussion regarding fish habitat compensation, adaptive management, and incorporation of fish management objectives is provided in the response to ESRD SIR #174c). Examples of other end pit lake systems that have resulted in a transition from lotic habitat to lentic habitat are discussed in the response to ESRD SIR #185.

c. Provide an update on the status of the development of the fish habitat compensation plan including, but not limited to: timelines, objectives and considerations.

Response:

A discussion regarding the status of habitat compensation planning as well as a description of the general compensation concepts that are currently being considered are provided in the response to ESRD SIR #174.

172. Volume 1, Section E.2.4, Page E-38.
CVRI states *TSS is not expected to change significantly in the Embarras River or Erith River downstream of the project.*

a. Discuss what CVRI's plan is for TSS monitoring of watercourses other than the Embarras and Erith Rivers because of impacts associated with the Robb Trend development. (i.e.- impacts to water quality on Erith tributaries, Bacon Creek, Bryan Creek, Hay Creek, Halpenny Creek and tributaries, Lendrum Creek and tributaries, Lund Creek and tributaries, Mitchell Creek, Pembina River Tributary, Jackson Creek, White Creek).

Response:

CVRI will conduct all monitoring required by and specified in all Project approvals. CVRI is anticipating the EPEA Amendment for the Project would define surface water monitoring requirements both upstream and downstream as it does for the current operation. During the operational phase of the development monitoring for fish populations and benthics will also be developed.

b. Provide a copy of this plan or if the plan is not ready, provide objectives and timelines associated with the development of this plan.

Response:

CVRI will conduct all monitoring required by and specified in all Project approvals. CVRI is anticipating the EPEA Amendment for the Project would define monitoring requirements both upstream and downstream as it does for the current operation.

173. Volume 1, Section E.2.5, Page E-39/40.

CVRI references an adaptive approach throughout the EA.

a. Discuss how CVRI has incorporated adaptive management in the development of mitigation strategies for the Robb Trend Mine. Provide examples from other mines operated by CVRI.

Response:

CVRI has utilized ‘adaptive management’ practices since mine opening. CVRI will continue to evaluate and innovate during operation of the Project.

The ‘adaptive management’ approach focuses on potential continuous improvement through testing and evaluating new ideas and techniques. The ‘status quo’ of long term ‘standard practice’ is subject to ongoing refinement by experimenting with parameter changes.

CVM continues to exhibit ‘adaptive management’ within the reclamation and environmental aspects of the operation. Various examples are described below:

Blasting

Over the past 30 years CVM has used a number of blasting methods such as electric blasting and most recently detonating cord. Starting January 1, CVM has switched to a mix of T&D and Ikon products. These new techniques are very quiet and produce no surface air blast. Ground vibrations can be reduced significantly through more precision in blast hole delays. While more expensive, the new technique results in improved fragmentation, less noise and reduced air blast impacts.

Seed Mixtures

The CVM has developed a 'Standard Seed Mix' for use on reclaimed landscapes, or disturbed areas requiring vegetative cover. The components in the seed mix are chosen to provide a quick cover crop to stabilize the soil from water and wind erosion. Other components are chosen for their forage benefits. ESRD Table 173-1 provides a summary of recent seed mix variations.

Table 173-1 Seed Mix Variations

Species	1983 %	1984 %	1985 %	1986-88 %	89-02 %	2003-04 %
red top	5	10	10	10	10	
creeping red fescue	5	10	10	10	15	15
smooth brome grass					10	
timothy	20	5	5	5	10	
annual rye grass			30	30	20	20
hard fescue			5	5	5	5
sweet clover		5	5	8	5	5
white clover	10	15	15	17	15	15
sainfoin					10	10
slender wheatgrass				15		10
crested wheatgrass		20	20			
barley	15	25				
meadow foxtail		10				
Russian wild rye	15					
winter wheat	10					
northern wheatgrass						10
mountain brome						10
sheep fescue	10					
streambank wheatgrass	10					
Total	**100**	**100**	**100**	**100**	**100**	**100**

A native seed mix, "Foothills Native Seed Mix", was developed in 2010. This mix has been seeded in the Pit 28 area in 2010 and Mercoal West area in 2012. Results are being monitored and evaluated by a Professional Agrologist. The CVM Foothills Native Seed Mix will be revised based on this evaluation and will be finalized in 2013.

A 'Native Wetland Mix' has been tested by CVM in 2010. This was applied in the Mercoal West creek diversion area which is a wet site. Only visual checks on the results have been made thus far.

Fertilizer Rates

Variations in fertilizer types and application rates have been made over the past years. A standard application of 180 kg/ha has been in effect for many years. Fertilizer is applied at the same time as seeding through helicopter application.

During 2012, tests were undertaken to reduce the fertilizer rate to 130 kg/ha. Applications were made in Mercoal West, Pit 29, 28 and 27. After application visual inspection was made of the areas. Emergence appeared similar to other sites.

Plans for 2013 include nutrient testing of the soil area prior to seeding to help determine what fertilizer is required. Adjustments will be made during seeding to specific field conditions.

Seeding Methods

Early reclamation at the CVM utilized dozers with broadcast seeders and harrows for grass seed application. The process was slow and expensive and produced an overly smooth land surface. It was felt that harrowing was necessary for proper sowing within the soil.

Tests were undertaken with helicopter seeding on some large areas. Various hoppers were employed to determine the best methods. Today helicopter seeding is the primary method for seeding at CVM. Seed and Fertilizer are generally applied separately but a mixture of seed and fertilizer may be applied to aid in proper dispersal from the hopper (in the case of small/fine seed mixes which may cause bridging in the hopper).

Hand seeding with 'belly' spreaders and quad mounted spreaders are used for small area applications.

As different seed mixtures and fertilizer rates continue to be tested attention is also focused on the mechanical operation of the hopper to ensure proper results are maintained.

Typical seeding schedule at the CVM is focused on periods just after the spring melt but before the start of the spring rainy season. Soil must be well thawed. Seed must be sown before heavy rain occurs to wash the seed away. The rougher texture of the soil placed in the previous year is an advantage to keep seed in place.

Erosion Control

CVRI has begun a program of armouring ditches in order to reduce erosion and addition of extra sediment to waste water control ponds.

Soil Placement

Direct placement has been attempted at various times and locations throughout the CVM area. The most recent plot was attempted in 2011 in Pit 28 on dump slopes. Salvaged soil was dumped and dozer spread on dump slopes.

A trial area in Yellowhead Tower was developed in 2012 to test various soil placement techniques. An 11 ha plot was subject to 'direct placement' of soil where the soil was salvaged and immediately spread on the sloped reclaim slope. The objective is to maintain the seed and plant matter within the soil so that no seeding will be necessary.

Portions of the soil were placed as 'rough placement' where dozers left small humps' and 'ruts' in the surface soil. Large, woody debris was also incorporated in the soil and on the slope to aid in the creation of biodiverse 'microsites'. 'Mounding' was attempted in other areas where dozers attempted to dig 'slots' to produce larger 'mounds' for greater surface variation. In practice it was found that the material was too wet and that a greater degree of mixing with subsoil occurred.

The test plot area will not be seeded next year. Results will be monitored to check the level of vegetation establishment.

Additional plots will be tested in 2013.

Reforestation

The standard practice for tree planting at the CVM has evolved over several years. Lodgepole pine and spruce cones are collected locally as required. A commercial greenhouse operation is contracted to provide seedlings. Seedlings are kept in cold storage and thawed only prior to delivery.

Seedlings are planted at a density of 2000 stems/ ha on reclaimed areas and 1500 stems/ha on cut-block or timber-only removed areas. The CVM plants in April/May when the ground has thawed and prior to the spring rainy season.

<u>Native Vegetation – Shrubs</u>

Vegetation Trails, 1975

Experimental programs to re-establish vegetation on mined lands were being undertaken in the mid 1970's. One example was undertaken by the Canadian Forestry Service (CFS) in the Luscar, Alberta area, home of Cardinal River Coals Ltd. Such studies were considered by the CVM in early stages of the mine operation which started in 1978 and soon started reclamation activities. A CFS report, *Species Selection, Seedling establishment and early growth on coal mine spoils at Luscar, Alberta, July 1975*, is provided for reference.

Vegetation Survey 1996

W. Strong completed a vegetation survey in 1996 on sites that had been reclaimed between 1970 and 1994. Strong (2000) found that there were 95 locally common, native species growing on the reclaimed land. However, these native species covered less than 5% of the surface area. Older areas with tree canopy tended to have the higher cover of native species which suggested that succession and infill was occurring but at a very slow rate.

Vegetation Survey 2007

P. Longman completed a vegetation survey within reclaimed areas in 2007. Lognman (2007) found that native vegetation showed a higher establishment correlation with lodgepole pine.

Huckleberry Program

The CVM has recently started a test planting program for Huckleberry. Navus Environmental (Navus) has been contracted for a planting program to attempt various seeding techniques and monitor establishment success. The program was started in 2010 and has carried through into 2012. A Navus report, *Proposal for the Continuation of the Native Shrub Establishment Program At Coal Valley Mine, April, 2012*, is provided for reference (ESRD Appendix 173).

Willow Cuttings

CVM summer staff have attempted plantings of willow cuttings in various wetland areas within the mine area. A 2012 summer test program was completed with monitoring planned for 2013.

b. Discuss how CVRI will incorporate adaptive management in the development of a water quality monitoring program to assess whether or not the Robb Trend development is having a negative impact on downstream water quality in the local and regional study area. Provide context using other mines as examples.

Response:

CVRI is currently engaged in 'water quality' monitoring with respect to the current operation and will expect to continue such programs for the Project. These programs deal with water quality, sediment, flows and fish habitat.

CVRI will undertake various monitoring programs in order to identify environmental impacts due to the Project. ESRD Figure 173-1 is provided to illustrate the range of monitoring that will be considered during and post mining. Stages of monitoring will include:

- *Pre-mining*
  Various studies have been conducted throughout the Project area and in the general region to establish a baseline description of existing conditions. This information identifies 'pre-mining' conditions which can be utilized as a 'datum' for future comparisons.
- *Operations*
  During operations within the Project monitoring of various elements will be continued or initiated as part of the operational controls. Locations of monitoring will involve:
  - *Upstream*
    Basic monitoring of 'upstream' conditions will continue in order to extend the 'baseline' data and to provide direct 'time oriented' comparisons.
  - *Project*
    On site monitoring of operations will be undertaken to assist operational controls and identify direct impacts.
  - *Downstream*
    Basic monitoring of 'downstream' conditions will continue in order to identify changes relative to 'upstream' and 'baseline' conditions.
  - Comparisons of 'results' (downstream) to 'upstream' and 'baseline' will identify impacts due to operations. Evaluations of the trends and nature of impacts can be utilized to identify areas requiring adjustment or remediation. Remediation action can be implemented and results identified.
- *Post Mining*
  As reclamation occurs over time monitoring will be continued until complete reclamation activity is reached. The same 'upstream' and 'downstream' elements will be extended through this period. In addition 'end pit lake' monitoring will be added to identify specific lake conditions. As results become evident a process of evaluation can identify

necessary modification that can be applied to the reclamation planning for the next phase of mining.

The overall strategy is to continually gather relevant data that can be utilized to identify what is happening so that proper changes can be made to bring about improvements for continued operations or reclamation. Such a process meets the objectives of 'adaptive management'.

174. Volume 1, Section E, Page E-32.

CVRI states *They will work with Fisheries and Oceans Canada (DFO) in developing a habitat compensation plan with the goal of maintaining productive fish habitat and addressing potential habitat disturbance, alteration, or destruction resulting from the project*".

a. Provide the timeline for the development of fish habitat compensation plans.

Response:

Fish habitat compensation plans will be developed at the mine licensing stage once detailed mine planning has been completed. At present it is expected that compensation planning for the initial stages of development in the Robb Main Area will begin in 2013. Subsequent habitat compensation planning will be conducted as mine planning progresses.

b. Discuss the concept that CVRI is working on with respect to the development of a fish habitat compensation plan.

Response:

The general concepts that will be considered during habitat compensation planning were described in CR #2, Section 5.4.6.2.

The development of end pit lakes will be a key component in CVRI's No Net Loss Plan (NNLP). CVRI has committed to using existing guideline/criteria to develop these lakes to maximize habitat and biological diversity and use by native fish populations. In general, Athabasca Rainbow Trout, Bull Trout, and Arctic Grayling will be the target species for which end pit lake systems will be designed. Additional discussion regarding end pit lake design and rationale for developing end pit lakes as part of the NNLP is provided in the response to ESRD SIR #168. As indicated in the response to ESRD SIR #94, the amount of available habitat provided by the end pit lakes will be approximately 35 times greater than the preliminary estimate of habitat altered or lost. Additional benefits of the end pit lakes include provision of overwintering habitat, attenuation of peak flows during Athabasca Rainbow Trout spawning, and retention of sediments. In addition, studies of other end pit lakes in the region indicate that Athabasca

Rainbow Trout densities in streams downstream of end pit lakes were higher than they were previous to the development of the lake (see response to ESRD SIR #86).

Enhancement of permanent diversion channels is another key component of the NNLP. This will involve design and construction of channels to maximize habitat potential/suitability/utilization for native fish species. In general, Athabasca Rainbow Trout, Bull Trout, Arctic Grayling will be the target species for which the channels will be designed.

Habitat enhancement of existing habitat to improve suitability for Athabasca Rainbow Trout, Bull Trout, Arctic Grayling will also be considered in the development of the NNLP. Given that Arctic Grayling and Bull Trout were found to be relatively rare within the LSA, one aspect of NNL planning could involve research into the possibility and feasibility of enhancing existing habitat to specifically address the requirements of these species. The transfer of fish from downstream in the Erith drainage to locations in the LSA (once habitat enhancement have been constructed) could also be considered in consultation with ESRD.

Implementation of remedial/corrective actions to ensure fish passage at existing watercourse crossings in the region that have been identified as barriers to fish movements may also be considered as part of habitat compensation planning.

Research studies and/or management initiatives will also be considered during NNL planning. The specifics of such a program would be developed in consultation with regulators. A list of potential initiatives was included in the response to ESRD SIR #104 as follows:

- Creation of self-sustaining Athabasca Rainbow Trout populations that are isolated from Brook Trout.
- Installation of barriers that limit the upstream movement of Brook Trout and other selected species.
- Implementation of Brook Trout removal programs.
- Construction of habitat enhancements that specifically target the requirements of Athabasca Rainbow Trout.
- Implementation of specific research programs (*i.e.*, further research into the biotic interactions between Brook Trout and Athabasca Rainbow Trout).

The improvement of habitat conditions for the target species (Athabasca Rainbow Trout, Bull Trout, Arctic Grayling) is the guiding theme for habitat enhancement/compensation initiatives under the NNLP. As such, and considering the extended timeline of the proposed mine development (>30years), it is likely that other concepts (it addition to those described above) will be explored in the course of NNL planning.

c. Discuss what methodology will be used to calculate losses and gains of fish habitat.

Response:

Physical losses will be quantified (footprint determined) as described in the previously submitted CR #2, Section 5.4.6.1. This involves using habitat inventory data to determine the extent (footprint) of an impact based on mine plans. An evaluation of habitat utility/quality/suitability will also be used to calculate habitat losses and gains as described in the response to ESRD SIR #167.

d. Provide examples of fish habitat compensation concepts that have been constructed in other mines that are operated by CVRI and/or other mining operations that have prepared, constructed and monitored fish habitat compensation projects for salmonid species.

Response:

A description of recent compensation initiatives undertaken by CVRI is provided below.

Yellowhead Tower Mine Extension

- Creation of 3 end pit lakes with combined surface area of approximately 30 hectares.
- Reconstruction of 1.3 km of Chance Creek to provide Rainbow Trout spawning habitat.

These compensation works have not been constructed yet. Construction and post-construction monitoring including assessment of the fish community and habitat of the lakes and constructed channel will be completed once the compensation works have been constructed. It is expected that these monitoring results will provide critical information that can be used in the development of end pit lakes systems on the Project.

Mercoal West Mine Extension

- Construction of habitat features in restored channels on two tributaries to Mercoal Creek
- Assessment and inventory of existing culverts in the Mercoal Creek area to identify watercourse crossings that may impede fish movements. Identification of measures to improve fish movements in the area.

The tributary channels are currently undergoing re-construction and it is expected that monitoring of the habitat and fish use of the channels will be initiated in 2013 (and conducted for

5 years). CVRI commissioned a culvert inventory and identified several culvert crossings where remedial work, through repair or replacement, would result in an improvement to the regional fishery. Les may need to comment where this stands right now as I know he has had contact with other agencies regarding the next step.

Mercoal East Mine Phase 2 Extension

- Construction of a diversion channel with enhanced fish habitat quality (compared to pre-disturbance). Habitat suitability modelling (Rainbow Trout) of the pre-disturbance habitat found that both the percent pools and pool class rating variables were limiting factors. As a result, habitat compensation efforts included the construction of pools on every meander and the placement of large woody debris within the constructed pools.

CVRI constructed an enhanced diversion channel in 2009. Monitoring, including visual assessment and sampling of the habitat in 2010 found that the channel was stable and riparian vegetation was becoming established (Pisces 2011). The inventory found that the compensation habitat provided an additional 750m^2 of habitat compared to pre-disturbance and habitat was more diverse. Pool habitat accounted for over 50% of available habitat post-construction compared to approximately 2% pre-construction. Fish use of the compensation habitat was not confirmed in 2010, however fish were also absent in the natural channel downstream of the habitat compensation which suggest that fish densities in the headwaters of Mercoal Creek remain low (as was found during baseline investigations).

Reference:

Pisces. 2011. Post-construction monitoring of the permanent diversion channel on upper Mercoal Creek for the MP2 development. Prepared for Coal Valley Mine, Edson, Alberta.

Mercoal East Mine Phase 1 Extension

- Completion of a study to assess the viability of end pit lakes. As a part of this study, an attempt will be made to produce self-sustaining fish populations within the lakes which will be done, in part, through creation of interconnecting channels between lakes.

CVRI initiated preliminary studies of the end pit lake system in fall 2011 and will continue to monitor through 2016. A monitoring report for the first year of monitoring is currently in preparation. The monitoring includes assessment of assessment of lentic habitat (4 reclaimed lakes) and lotic habitat interconnecting channels and the Embarras River upstream and downstream of the end pit lake system. The project involved installation of a barrier downstream of the lake system and a Brook Trout removal program was implemented in the area upstream of the barrier prior to construction of the lakes. In 2011 AESRD transferred approximately 200

Athabasca Rainbow Trout (comprised mainly of yearling fish with a few young-of-the-year) into the lake system

Preliminary results suggest that the lake system is providing suitable if not good quality fish habitat and all three lakes and the connecting channels are occupied by Rainbow Trout. Sampling has confirmed that some Rainbow Trout were present in the system prior to stocking and the presence of Trout as small as 31 mm suggests that some reproduction is occurring.

e. Explain how previously constructed fish habitat compensation projects in mining zones have been successful and to what degree, and/or explain deficiencies in previously constructed fish habitat compensation projects. Relative to the assessment of known deficiencies in previously constructed fish habitat compensation projects, incorporate a framework for adaptive management in the discussion and outline areas that require improvement.

Response:

As described in the response to ESRD SIR #174d), most of the recent habitat compensation programs implemented by CVRI are in the initial stages of monitoring and the degree of "success" is still to be determined. Typically annual monitoring reports will be generated and the conclusions and/or recommendations provided in the reports will used in the development and implementation of future compensation projects. Further discussion regarding adaptive management employed by CVRI is provided in the responses to ESRD SIR #87, #93, and #99. A discussion of potential issues and as well as lessons learned during past work (diversions, channel construction *etc.*) is provided in the response to ESRD SIR #89. Areas that have been identified for improvement relate primarily to construction practices and include:

- timing instream work to avoid periods when flows may be high;
- timely implementation of erosion control measures (minimize lag time) and regular inspection of the measures to ensure they are functioning properly;
- timely installation of habitat enhancement features (minimize lag time); and
- increased consultation with technical team during construction (hydrologists, biologists).

A discussion regarding fish populations and their use of end pit lakes in the region (*i.e.,* other mines) is provided in the response to ESRD SIR #185.

f. Discuss how the no-net-loss plan will align with provincial fish management objectives for the species known to inhabit the watercourses that will be impacted by Robb Trend.

Response:

As indicated in the responses to ESRD SIR #174b) the improvement of habitat conditions for the target species (Athabasca Rainbow Trout, Bull Trout, Arctic Grayling) is the guiding theme for habitat enhancement/compensation initiatives under the NNLP. As indicated, CVRI has identified a number of concepts that will be considered during NNL planning and has indicated a willingness to develop these concepts in concert with regional fish management objectives.

g. Discuss how the no-net-loss will plan align with the recovery planning strategy that is currently being developed by the province for native Rainbow Trout.

Response:

As indicated in the response to ESRD SIR #104, CVRI recognizes that native Athabasca Rainbow Trout populations are "At Risk" and that a "Threatened" designation has been recommended by Alberta's Endangered Species Conservation Committee. This information was considered during the environmental impact assessment process that was presented in the Application. CVRI recognizes that a Rainbow Trout recovery plan will be developed if/once the "Threatened" designation is in place and is committed to participating with the implementation of this plan. CVRI currently has a representative on the Athabasca Rainbow Recovery Committee.

As indicated in the response to ESRD SIR #104, the proposed end pit lakes may result in a direct benefit to Athabasca Rainbow Trout populations by attenuating peak flows and retaining sediment. In addition, the proposed project could provide the opportunity to implement specific recovery initiatives such as:

- Creation of self-sustaining Athabasca Rainbow Trout populations that are isolated from Brook Trout.
- Installation of barriers that limit the upstream movement of Brook Trout and other selected species.
- Implementation of Brook Trout removal programs.
- Construction of habitat enhancements that specifically target the requirements of Athabasca Rainbow Trout.
- Implementation of specific research programs (*i.e.,* further research into the biotic interactions between Brook Trout and Athabasca Rainbow Trout).

175. Volume 2, CR #2.

CVRI states that *Impacts to the aquatic environment including, but not limited to fish and benthic invertebrates are insignificant. CVRI indicates that the project is not expected to contribute to cumulative effects because mitigations will be in place.* However, it is not clear what methodology CVRI used to come to these conclusions.

a. Discuss what methodology, with respect to impacts on fish and fish habitat, was used to determine that impacts to these VEC's is insignificant.

Response:

The general approach used for the aquatic resources environmental impact assessment was described in CR#2, Section 1.3.2. Key components of this approach included:

- Existing fisheries information, baseline data, conclusions from surface hydrology and surface water quality impact assessments were the primary sources of information for assessing impacts to aquatic resources.
- Primary focus on aquatic resources issues that were identified in the EIA Terms of Reference issued for the Project.
- Cumulative effects assessment whereby impacts potentially arising from the Project were assessed in terms of their significance when combined with other past, present, and reasonable foreseeable projects within the RSA.

Detailed methods for the aquatic resources EIA were described in CR#2 Section 3.2. Key components of the assessment process included:

- Issue scoping;
- Identification of study areas (LSA and RSA);
- Selection of Key Aquatic Indicators (rationale for selection was described);
- Description of approach to assessing impacts and significance of effects including:
  - Project specific effects;
  - Mitigation;
  - Determination of cumulative impact; and
  - Determination of significance of effects.

b. Discuss how CVRI defines insignificant/negligible impacts, with respect to impacts on fish and fish habitat.

Response:

The CEA Agency has prepared a reference guide to assist proponents and project reviewers in determining whether a project is likely to cause significant adverse environmental effects (FEARO, 1994b). As indicated in Section D.2.6 of the Project Application, this reference document was used for the EIA to assist in determining whether or not an environmental impact was deemed to be significant.

For the aquatic resources assessment significance was determined for predicted effects that were deemed to be remaining after the incorporation of the planned environmental mitigative measures (including habitat enhancement and compensation) proposed for the Project. Predicted residual environmental effects were characterized in terms of the criteria listed in CR #2, Section 3.2.4, Table 3.5.

Generally, impacts to aquatic resources were rated as insignificant when the residual Project effect occurred to a population or species in a localized manner, over a short period of time, and/or similar to natural variation, and/or which was reversible and have no measurable effects on the integrity of the population as a whole.

Reference:

Federal Environmental Assessment and Review Office (FEARO). 1994b. A Reference Guide for the Canadian Environmental Assessment Act: determining whether a project is likely to cause significant adverse environmental effects. Ottawa, ON.

c. Discuss what methodology was employed to determine that the Robb Trend project will not contribute to cumulative effects on aquatic resources.

Response:

As indicated above, EIA assessment methodology for the aquatic resources assessment was provided in CR #2 Sections 1.3.2, and 3.2.4. As indicated in Section 3.2.4:

"*Cumulative effects were defined as those Project specific impacts that were neither reversible nor mitigable, were medium to long in duration and operated cumulatively with similar impacts resulting from existing or planned developments in the RSA. Potential cumulative impacts were identified by reviewing Project specific impacts to determine potential pathways of cumulative effects on the selected KAI's and assessed in terms of their contribution to cumulative impacts in combination with other existing and reasonably foreseeable projects in the RSA.*"

d. Discuss how CVRI has accounted for the following impact of the Project in terms of immediate and cumulative effects on fish and fish habitat:

i. long term alteration of flows in watercourses affected directly and indirectly (downstream reaches) by the Project,

ii. alteration of overland drainage,

iii. elimination of lotic environment and replacing it with lentic,

iv. fragmentation of fish habitat, and

v. potential degradation of water quality including upsets and accidents

Response:

i. Impacts to flows and drainage patterns were assessed in CR #6. As indicated in CR #2, the conclusions from the surface hydrology assessment were relied on for the assessment of impacts to aquatic resources as a result of changes in surface flows. Potential impacts to aquatic resources as a result of changes in surface flows were described in CR #2 Sections 5.1.2, 5.2.2, 5.3.1.2, 5.3.2, 5.3.3.2, 5.8.2. Mitigation for potential impacts to surface hydrology was provided in CR #6 Section 4.0 and CR #2 Section 5.4.

ii. See response to i.

iii. A preliminary summary of habitat alterations and/or losses was provided in CR #2, Table 5.19. However, as described in CR #2 and discussed further in ESRD Appendix 86, the actual amount of lotic habitat that will be lost as a result of the Project is still to be determined (based on future mine planning, detailed design, and discussion with regulators and stakeholders). However, as described in CR #2, Section 5.4.6, CVRI is committed to satisfying the federal government no net loss principle in terms of maintaining productive fish habitat. The no net loss plan will be developed and refined as subsequent planning phases and further mine plan details become available and following consultation with regulators and stakeholders. The plan will consider the hierarchy of compensation preferences as outlined in the Fisheries and Oceans Canada Practitioners Guide to Habitat Compensation (2006) and the Policy for Management of Fish Habitat (DFO 1986). As such, the NNLP may include the enhancement/construction of lotic habitat (*i.e.,* the creation or increase in productive capacity of like-for-like habitat in the same ecological unit) but may also include the creation of lentic habitat (*i.e.,* creation or increase in productive capacity of unlike habitat in the same ecological unit). Other compensation options including off-site compensation and/or use of artificial production techniques will also be considered.

References:

Department of Fisheries and Oceans (DFO). 1986. Policy for the Management of Fish Habitat. Department of Fisheries and Oceans. Ottawa. Ontario.

Department of Fisheries and Oceans. 2006. Practitioners Guide to Habitat Compensation. Department of Fisheries and Oceans, Ottawa, Ontario.

iv. Impacts to fish populations associated with direct habitat impacts (such as barriers or impediments to fish movements) were described in CR #2, Sections 5.1.2, 5.3.1.1, 5.3.2, 5.8.2; mitigation measures to address these impacts were described in CR #2, Section 5.4.

v. Impacts to water quality were assessed in CR #11. As indicated in CR #2, the conclusions from the water quality assessment were relied on for the assessment of impacts to aquatic resources as a result of changes in water quality. Potential impacts to aquatic resources as a result of changes in water quality were described in CR #2, Sections 5.1.2, 5.2.3, 5.3.1.3, 5.3.2, 5.3.3.3, 5.8.2 Mitigation for potential impacts to water quality was provided in CR #11, Section 4.0 and CR #2 Section 5.4.

176. Volume 2, CR #2, Section 5.4.6.2, Pages 79-80

a. Explain how traditional ecological knowledge (TEK) and traditional land use information (TLU) will be included in the fish habitat assessment and in developing the No Net Loss Plan

Response:

As indicated in Section CR#2, Section 3.2.3 the TEK and TLU assessment for the Project did not indicate substantial use of fisheries resources for subsistence or traditional use in the aquatics LSA or RSA. General mitigation proposed by CVRI as a result of TEK and TLU studies are provided in CR#12, Section 4.4. Consultation with Aboriginal groups on specific impacts and mitigation measures will be ongoing as mine plans progress.

b. Outline the impacts of the Project on fishery resources from Aboriginal groups perspective and the Proponent's strategies to address these impacts.

Response:

As indicated in the response above the TEK and TLU assessment for the Project did not indicate substantial use of fisheries resources for subsistence or traditional use in the aquatics LSA or RSA. CVRI has consulted with various Aboriginal groups as outlined in CR#12 and has committed to having an ongoing dialogue with regards to specific impacts and mitigation measures that may occur as mine plans progress.

177. Volume 2, Section CR#2, Tables 5.4, 5.8, 5.15 Page 54, 55, 58, 63, 64.

a. Provide the method that will be used to determine fish passage ability through proposed culverts for the species that are known to be, or may be in the watercourses that will have watercourse crossings on them.

Response:

Culvert crossing designs for fish passage will incorporate the following designs:

- Culverts will be sized to be larger than the bankfull width of the channel.
- Culverts will be recessed below the natural bed level by at least 30% of the effective diameter of the culvert with a minimum depth of 0.6 m at both ends.
- The mean velocity through the culvert length will be assessed to be below the sustained swimming mode velocity for 100 mm sized subcarangiform fish species (Katapodis and Gervais 1991 or latest criteria) at the 1:10 year, 3-day peak discharge.
- Natural sized substrate material with large rock checks will be provided inside large culverts to provided resting areas, control velocities and increase flow depths.
- Inlet and outlet transition pools will be provided with instream rock and/or woody debris cover features.

Reference:

Katapodis, C. and R. Gervais. 1991. *Ichthyomechanics*. Working Document. Department of Fisheries and Oceans. June 1991.

178. Volume 2, Section CR#2, Page 72.

CVRI states *Sediment and certain chemical contaminants that may have chronic or lethal effects on aquatic biota have the potential to enter the aquatic ecosystem during mining operations.*

a. Discuss potential contaminants that may pose a threat to the aquatic environment, using data obtained from existing coal mining operations.

Response:

CR #11 provides an assessment of the potential impacts of the Project on surface water quality and as indicated in CR #2, Section 1.3.2, the conclusions from CR #11 were relied on to assess impacts to aquatic resources. CR #11 provides a detailed description of assessment methodology, which included the use of existing empirical data from annual monitoring conducted on existing mines from 2001 to 2010.

As indicated in CR #2, Section 5.3.1 the principal contaminants of concern include:

- sediment (during the construction, operation and reclamation phase);
- nitrogen explosive residual (leached from blasted waste rock)

b. Discuss the impact that these contaminants could have on fish and/or their habitat.

Response:

Potential impacts to aquatic resources as a result of potential changes in water quality are discussed in detail in CR #2, Sections 5.1.2, 5.2.3, 5.3.1.3, 5.3.3.3. Briefly summarized:

- Increased sediment deposition can result in infilling and/or degradation of fish habitat.
- Increased sediment loads can directly impact the health and behaviour of fish and can lead to the suffocation of eggs.
- Increased sediment can diminish benthic invertebrate habitat, impact the benthic community structure, and interfere with respiratory and feeding activities of benthic invertebrates.
- Chemical contaminants can have chronic or lethal effects on aquatic biota (if thresholds provided in Federal and/or Provincial guideline documents are exceeded).

c. Provide a list of mitigations that will be put into practice to eliminate/minimize the affect that these contaminants could have on fish and their habitat.

Response:

Mitigation for potential impacts to aquatic resources as a result of potential changes in water quality are discussed in detail in CR #2, Sections 5.4, CR #11, Sections 4.1.1.2, 4.2.1.2, 4.3.1.2. In addition, a conceptual water management plan (Section C of the Project Application) provides a description of water management strategies that will be implemented to eliminate or minimize potential adverse effects on aquatic resources that are associated with changes in water quality.

179. Volume 3, CR #6, Section 4.1.2, Page 33.
CVRI states *Additional safeguards and pond capacities including provisions for backup in ditches and sumps will be provided recognizing the risk of abnormal events such as extreme high pumped sediment loadings, ice/snow blockages and late manual response to events. In many instances, these types of events have led to previous exceedances at CVM.*

a. Provide best management practices or guidelines that have been adaptively developed in response to past exceedances and how these practices will be adaptively applied to the Robb Trend project.

Response:

CVRI is adding personnel and equipment to monitor and maintain water management infrastructure in view of the wet conditions experienced this summer (> 550 mm in June-July). Facilities were adequate in size but could not be cleaned out fast enough. Providing dedicated equipment and personnel to water management will be essential to the scale of the water management works required in the Project.

Other adaptive practices include:

- Fixing and enlarging runoff collection areas or adding more interim upstream controls.
- Shutting down mine operations and activities during wet conditions, when required. An established protocol will be developed, tested and adjusted to ensure that it is effective. Operations personnel and equipment might then be temporarily transferred to assist with water management activities.
- Minimizing the extent of disturbed land in advance of mining depending upon site specific conditions and timing in the year.
- Researching and testing new products on roads, flocculants for ponds, or erosion control materials.

180. Volume 3, CR #6, Section 4.4.4, Page 53.
Volume 3, CR #6, Section 4.4.3, Table 12, Page 52.

In Section 4.4.3, CVRI described the options for diversions for the watercourses that will be impacted. Table 12 describes the chosen option for each watercourse.

CVRI states *It is assumed that lake filling times following reclamation will be gradual in order to maintain downstream flows. The instream flow needs guidelines (AENV 2011b) are assumed to be applied, except possibly during high flow events where pumping cannot keep up with inflow rates. Applying this guideline means that only 15% of the inflow can be used to fill the lakes and no inflow can be used for lake filling when the flow is less than the natural Q80, value, i.e. below the flow that is normally exceeded 80% of the time for that time of year. Therefore, instream flow monitoring and pump bypasses will need to be established on the lakes during filling.*

a. Discuss the range of expected flows and the type of pump systems for each diversion.

Response:

A revised and more detailed diversion and water management plan is described in ESRD Appendix 86. Based upon this, all lakes, except Lake 3 on Hay Creek, will be filled by gravity overflows from diversion ditches. Expected pump system requirements, monitoring and controls required are discussed in ESRD SIR #77a) and b) and ESRD SIR #78.

b. Provide information on how the pump(s) capacity adequately addresses the potential seasonal and annual variability in flows that could be encountered for each watercourse.

Response:

The number of pumped diversions and how they will be managed are discussed in ESRD SIR #78 and #81. Only two streams will be expected to have long term (greater than one year) pumping – Hay Creek and upper Lendrum Creek above LET3 (its larger upstream tributary). Three other tributaries may have short term (4 months or less) pumped bypasses depending upon timing – HLT1, LET1 and LET3. Hay and upper Lendrum Creek flows will be regulated with several ponds and in pit storage. Multiple variable rate pumps of various sizes (from 4 inch to 12 inch with capacities from 15 to 400 L/s) would be installed with separate lines in places where natural streamflow bypasses are to be maintained.

c. Describe for each watercourse with a pump around diversion, how fish passage upstream of the diversion will be accommodated. If fish passage is not being accommodated, discuss the potential impacts of the barrier on productivity.

Response:

Upper Hay and Lendrum Creeks will be mined out and will not have fish present or will have to have fish removal prior to mining. SIR #77a) documents the sizing and timing of potential pumped diversions.

Temporary diversions (in place for up to 4 months) will be scheduled to avoid the spring when flows are at or near peak and when Rainbow Trout are spawning. Bull Trout were captured infrequently within the LSA during baseline investigations and historical records indicate a sporadic presence. However, diversions will be scheduled to avoid the late summer and fall period if local conditions suggest that there is some potential for Bull Trout spawning.

DFO is concerned that the fate of the downstream reaches of the potentially affected watercourses rests solely on pumping. For some watercourses, downstream flow will be dependent on pumping for several years. If the pumps should fail, downstream flow will essentially be nil, as all of the water will be flowing in to the end pit lake.

d. Discuss potential downstream impacts and mitigation measures to be employed in the event of a pump failure.

Response:

Multiple pumps will be utilized as discussed in ESRD SIR #180b) above and in ESRD SIR #78 g).

Most of the diversions will require pumping through winter months.

e. Discuss how flows will be maintained through the winter months given the challenges of winter conditions. Discuss if diverting 15% of the total river flow through the winter months is sustainable from an instream flow needs perspective.

Response:

Operations during winter conditions are discussed in ESRD SIR #78c and 81. As winter flows are minimal in terms of volumes for lake filling, taking off 15% of the flow from planned diversion channels running across or around lakes, may be more problematic than worth the fill volume provided. Therefore, diversion of flows into lakes may be completely suspended during winter low flow conditions. This would marginally increase lake filling times. Due to critical winter low flow conditions in some fish bearing streams, individual diversion management frameworks will need to be developed and applied for each stream such that the maximum diversion rate may range from 0% up to 15% depending upon the flow and time of year.

Discharging water in to downstream reaches in winter has the potential to impact the hydrology and temperature profile downstream, as well as result in frazil ice formation. There was no consideration of this in the Application Case.

f. Provide a discussion of these potential impacts.

Response:

Stored water from small end pit lakes, sumps created upstream of pits at diversions, or from settling ponds may be used for the pumped bypasses. As these stored volumes are relatively small, winter temperature differences from inflow waters to pumped water are expected to be minor and close to 0˚C at most times. Frazil icing conditions will be managed in transition outlet channels and with pumping variations as discussed in ESRD SIR #78c).

181. Volume 3, CR #6, Table 15, Page 66.
Volume 3, CR #6, Table 13, Page 55.

No. 2.1 of Table 15 states *Minimize lake depths where possible to less than 10 m with a littoral zones target of at least 20% where practical*. Table 13 shows that only 2 lakes have average depths at or below 10 m, while the maximum depths all exceed 10 m with the mean maximum depth being 45 m.

a. Provide clarification on the purpose of this statement as it seems it was not taken into consideration in the end pit-lake design.

Response:

Original early plans had a greater number of lakes of various depths which were reduced with planning refinements. By minimizing lakes in an effort to balance end land use, the remaining lakes ended up deeper than the 10 m average target depth. During detailed mine planning and design, efforts will be made to further reduce the number, size and depths to meet these targets wherever practical.

b. Discuss the feasibility of designing some or all of the lakes with shallower depths consistent with the statement in Table 15.

Response:

See response to ESRD SIR #181a). Refinements of materials handling and scheduling to minimize out of pit dumps and maximize in pit backfills are expected to reduce final lake depths from those presented in the application.

c. Discuss the limnological and biological implications of constructing long, narrow and very deep end pit lakes with respect to oxygen stratification and biological productivity.

Response:

Volume 4, CR #11, Section 4.4, beginning on Page 45, presents an assessment of the limnological implications of constructing end-pit lakes with respect to oxygen stratification. This assessment is based on a review of three sets of studies conducted on the CVM end-pit lakes, a number of which do not meet all the guidelines contained in Volume 3, CR #6, Table 15:

- the studies in the 1990s conducted on Lovett, Silkstone, and Stirling (Pit 24) lakes (Agbeti 1998, Mackay 1999);
- the 2006 studies conducted on Lovett, Silkstone, and Stirling (Pit 24) lakes plus Pit 35 and Pit 45 lakes (Hatfield 2008); and
- a detailed study of surface water quality conditions in existing Coal Valley Mine end-pit lakes (Appendix 9 of this Application).

A main conclusion of this assessment was that, while patterns of dissolved oxygen concentration with depth and changes in these patterns are likely to be the major water quality variable influencing amount of suitable aquatic habitat available for aquatic life in the end-pit lakes proposed for the Project, the relative amount of suitable aquatic habitat available for aquatic life in end-pit lakes proposed for the Project, as a proportion of total end-pit lake volume, is predicted to be similar across all end-pit lakes and generally independent of their turnover pattern or whether or not they exhibit chemoclines. In addition, while lake turnover is generally considered an important ecological process in most productive lakes (Hutchinson 1938, Effler and Perkins 1987 and Wetzel 2001) it is not a necessary process governing the ability of a lake to sustain healthy fish populations (Effler and Perkins 1987, Trimbee and Prepas 1988).

References:

Agbeti, M.D. 1998. Water quality of two end-pit lakes in relation to fishery sustainability. Prepared for: Luscar Ltd. Prepared by: Bio-Limno Research & Consulting. 80 pp.

Agbeti, M.D. 1999. Water quality of two end-pit lakes in relation to fishery sustainability. Prepared for: Luscar Ltd. Prepared by: Bio-Limno Research & Consulting. 80 pp.

Effler, S.W. and W.G. Perkins. 1987. Failure of Spring Turnover in Onondaga Lake, NY. Water, Air, and Soil Pollution, 34: 285-291.

Hatfield (Hatfield Consultants). 2008. Surface Water Quality EIA: Mercoal West and Yellowhead Tower Project.

Hutchinson, G.E. 1938. On the relationship between the oxygen deficit and the productivity and topology of lakes. Int. Rev. Hydrobiol. 36: 336-355.

Mackay, W.C. 1999. Coal Valley Mine Extension: Cumulative effects of reclaimed end-pit lakes on water quality and fisheries resources. Prepared for: Luscar Ltd. Prepared by: W.C. Mackay & Associates. 39 pp.

Trimbee, A.M. and E.E. Prepas. 1988. Dependence of lake oxygen depletion rates on maximum oxygen storage in a partially meromictic lake in Alberta. Can. J. Fish. Aquat. Sci. 45:571-576.

Wetzel, R.G. 2001. Limnology: Lake and River Ecosystems. Third Edition. Academic Press, San Diego, California. 1006 pp.

182. Volume 3, CR #6, Section 4.5.1, Page 59.

CVRI states with respect to the Erith River *Alternatively, gravel bed river relationships (Hey et al. 1982) based upon the 2-year flood peak would predict the following impacts with a 50% decrease in the mean annual flood: a 26% decrease in channel width, a 20% decrease in bankfull channel depth and a 25% increase in slope.*

a. Discuss the time frame these changes are expected to occur over and the distance downstream that is likely to be affected.

Response:

These are potential geomorphic changes that may gradually develop over an extended time frame (many decades). As mentioned in the same discussion in CR #6, these impacts may be more of an indication in direction and not actually occur or be measurable over time. The reduction in sediment load due to the lakes may have a greater and offsetting localized impact on channel regime. Other channel regime factors including bed and bank materials, vegetation cover and existing channel form will also influence actual potential changes. The extent of any potential changes will diminish progressing downstream with increasing inflows, thus the reach length of actual influence is limited on several streams (Hay, Bryan and Lund where they join larger streams). For the Erith River, it may extend downstream for 5 km to Halpenny Creek confluence and cumulatively as far as the confluence with Hanlon Creek where the impact on the 2-year flood peak is expected to be less than 5% (also see ESRD SIR #201).

Further specific hydrologic routing of lake outflows, as summarized in ESRD Table 77-1 (ESRD SIR #77), indicates the specific impacts on Erith River peak flows are expected to be less than previously indicated in Table 14 of Volume 3, CR #6. Simulated predictions are a 16% reduction in the 5-year peak discharge and a 19% reduction in the 2-year peak discharge. As indicated in ESRD Table 77-1 (last column), the hydrologic routing suggests the Erith River natural 2-year mean daily flushing flow is altered to a 2.3-year return period (see response in ESRD SIR #77d). Using the same gravel bed river relations discussed in CR #6, Section 4.5.1, Page 59, a predicted 19% reduction in the 2-year flood peak theoretically corresponds to: a 10% decrease in channel width, a 7% decrease in bankfull channel depth and a 7% increase in slope. These percentage differences, while significant numerically, are only indicators of potential change as predicted by the best fit equations applied here. They may not directly relate to actual channel changes that would develop over time, for some of the reasons discussed above and in CR#6.

It should be noted, the sizing and configuration of the lake outlets will have a significant impact on peak outflows. If greater lake level variation is desirable, then a narrower outlet would be constructed and reductions in peak outflows will be greater. The 2-year flood routing calculations, with the outlet sizes assumed, resulted in lake level rises from 0.2 m to 0.55 m and over 0.5 m on the outlet of Lake 5 to the Erith River.

b. Provide a short and long-term assessment of the potential impacts to downstream fish and fish habitat as a result of the channel morphological changes.

Response:

As indicated in the response to ESRD SIR#182a) these changes may be an indication in direction and may not actually occur. In addition, due to the additional hydrologic routing (as summarized in ESRD SIR #77 and explained in the response above), the impacts to channel width, bankfull channel depth, and slope are expected to be considerably lower than originally predicted (in the Project application). Under the new scenario, channel morphological changes are expected to be 10% or less. In addition, there are other factors (*i.e.*, such as the retention of sediment in lakes) that could offset the predicted changes. Given these factors it seems unlikely that there will be a quantifiable impact to fish habitat of the Erith River.

An advantage of the proposed end pit lake is the attenuating effect on high flows which could reduce impacts to Athabasca Rainbow Trout during early life stages (reduced potential for scouring of eggs and/or smothering of eggs). In addition, retention of sediments in the lake could result in a direct and measurable improvement to salmonid habitat downstream of the lake. Baseline investigations revealed that fines substrates comprised the majority of the streambed composition while gravels accounted for less than 25% of the streambed composition.

As indicated in CR #2, Section 5.4.6.2, habitat conditions downstream of the end pit lake will be assessed to determine if a measurable change (beneficial or detrimental) has occurred. In the event of a harmful impact CVRI will implement habitat enhancement/remediation measures to maintain habitat integrity.

c. Discuss any similar anticipated effects on the remaining impacted watercourses.

Response:

ESRD Table 77-1 (ESRD SIR #77) summarizes estimated impacts on changes in peak flows downstream from all the lakes. Hay Creek and Bryan Creek are the two streams where significant reductions in peak flows due to the lakes may be expected and could have the greatest potential impact on downstream channel regime (extending to their mouths). Lower Bacon Creek and Lund Creek above LDT3 will also have significantly reduced flow regimes, due to the planned upstream drainage redirections.

d. Provide CVRI's approach to calculate the fish habitat losses associated with the reduction in flows in watercourses affected by the construction of the mine.

Response:

The response to ESRD SIR #170 c) includes a discussion of how CVRI has accounted for changes to fish habitat that could occur as a result of reduction in flows. If it is determined that reduction in flows is adversely impacting fish and fish habitat then impacts will be assessed and quantified and specific mitigation/habitat enhancement measures will be developed and implemented to ensure no net loss of fisheries productivity.

183. Volume 3, CR #6, Section 4.4.4, Table 13, Page 55.
Volume 3, CR #6, Figure 28.
Table 13 outlines the physical and hydrologic characteristics of the 12 reclaimed end pit lakes. Figure 28 shows Erith Lakes 4 and 5 reclamation plan and profile.

a. Provide an overall figure encompassing all end pit lakes and their hydrologic connectivity to one another.

Response:

See ESRD Figure(s) 75-1 to 75a-7. In addition, ESRD Figure 183-1 provides an overview of the post-mine drainage plan.

184. Volume 3, CR #6, Section 4.5.2, Page 59.
CVRI states *Therefore, the lower 2.4 km long reach of Bacon Creek will be altered significantly with 70% of its basin lost. The percentage flow reduction on lower Bacon Creek can be expected to slightly exceed this 70% because of a higher proportional runoff contribution from the higher, steeper watershed section.*

a. Provide the rationale for diverting the upper Bacon Creek flow into McPherson Pit rather than pumping it downstream in to lower Bacon Creek to maintain flows.

Response:

Pumping to lower Bacon Creek could be provided as a temporary option to maintain flows in lower Bacon Creek during mining. However, as discussed in b. below, it is not considered a long term feasible plan to maintain flows in lower Bacon Creek.

b. Provide the rationale for ultimately diverting the upper Bacon Creek flow into Lake 4 and discuss the feasibility of creating an outlet from Lake 5 East to Bacon Creek as mitigation for the flow reduction.

Response:

As a permanent mine closure plan, maintaining gravity drainage to lower Bacon Creek would require cutting a 1.3 km long outlet channel from Lake 5 (East) with up to a 15 m deep cut in the Bacon Creek valley. This could be investigated as a closure scheme if the flow provided by this drainage scheme is adequate and the habitat value in the lower Bacon Creek is deemed warranted. Upper Bacon Creek might also be run around the east end of Lake 4 to drain into Lake 5 (East), however; this would be built on extensive backfill and depending upon final grading and backfill conditions, some amount of drainage would be lost from Lake 5 (East) to the middle portion of Lake 5 and the Erith River. For assessment purposes, a near complete loss of the habitat value of the lower reach of Bacon Creek was assumed.

185. Volume 3, Section CR#6, Figure 26.

a. Provide examples of watercourses in the upper Athabasca watershed that have a body of water similar in appearance to a watercourse that will have a pit lake on it and describe the fish communities on the up and downstream sides of the body of water as well as within the body of water itself. (i.e.-locate watercourses that look like a watercourse with a pit lake in the middle of it and conduct an analysis of the fish community).

Response:

Several end pit lakes that are linked to lotic habitat have been created in the Athabasca watershed. Physical, chemical and detailed biological characteristics of the lakes have been studied and documented. Although there are no natural lakes that resemble pit lakes in the immediate vicinity of the mine; the end pit lakes have compared favorably with natural subalpine lakes located in other regions (Sonnenberg 2011). A summary of end pit lake systems in the region is provided below.

Lac des Roches – Cardinal River Mine

Lac des Roches was a reclaimed end-pit lake located on the Cardinal River Mine approximately 30 km west of CVRI's existing mining areas. Lac des Roches was completed in 1987 and was connected to West Jarvis Creek until it was decommissioned in 1999 (Schwartz 2002). It is thought that Lac des Roches was the first man-made mountain lake in Alberta that was populated by naturally occurring fish from downstream waterbodies (Luscar 1994).

Lac des Roches contained populations of Athabasca Rainbow Trout, Brook Trout, and Bull Trout with spawning occurring in Jarvis Creek downstream of the lake (Schwartz 2002). Schwartz (2002) estimated there were 215 to 231 Rainbow Trout, 52 to 89 Brook Trout, and 23 to 40 Bull Trout resident to Lac Des Roches. Growth rates for fish in Lac Des Roches surpassed growth rates for trout in natural mountain lakes and fish biomass in the system increased following reclamation (Schwartz 2002).

CD Pit Lake - Gregg River Coal Mine

CD Pit Lake is located on the reclaimed Gregg River Mine, which is located approximately 30 km west of CVRI's existing mining areas. Falls Creek enters the CD Pit Lake out of a rock drain with the inlet consisting of an impassible waterfall; the lake filled with water in late 2002 with all flows out-letting into Falls Creek, which subsequently flows into the Gregg River.

Prior to mining, Falls Creek was generally considered a fishless system and had approximately 1.5 km of discernible habitat with no pools and excessive silt deposition (Slaney 1975). Slaney (1975) also noted that Falls Creek consisted entirely of riffle and froze completely in winter. Investigations following reclamation indicated significant improvements in the fisheries potential of the Falls Creek and CD Pit Lake system (Stemo 2005, Pisces 2011, Sonnenberg 2011). A population of native Athabasca Rainbow Trout (RNTR) have established themselves and successful reproduction has occurred in Falls Creek at the outlet of CD Pit Lake even though spawning habitat is limited (Sonnenberg 2011). Mark/recapture population estimates in Falls Creek revealed a population of approximately 105 RNTR in 2008 and 36 RNTR in 2009 (Sonnenberg 2011). Mark/recapture population estimates in CD Pit Lake ranged from 107 RNTR to 294 RNTR and, fish trapping information revealed that 132 RNTR entered CD pit in 2008 while 87 entered in 2009 (Sonnenberg 2011).

Sphinx Lake – Cardinal River Coal Mine

Sphinx Lake is a reclaimed mine pit on the Cardinal River Mine lease approximately 35 km from CVRI's existing mining areas. Sphinx Lake was completed in 2005 and was designed with connectivity to Sphinx Creek, allowing fish to move upstream and downstream of the Lake. Prior to mining, Sphinx Creek contained a population of Rainbow Trout and was used by Bull Trout resident to the Gregg River for spawning and rearing (Pisces 2006).

Sphinx Lake has developed a robust Athabasca Rainbow Trout population and also provides habitat for Bull Trout; supporting all life stages for both species (Pisces, 2008, Sonnenberg 2011, Brinker 2011). Adfluvial populations of both species have developed with Rainbow Trout generally spawning in Sphinx Creek downstream of the lake and Bull Trout spawning in Sphinx Creek upstream of the lake (Sonnenberg 2011). Rainbow Trout densities within Sphinx Creek downstream of Sphinx Lake have increased significantly since lake development (Pisces 2008, Sonnenberg 2011).

Embarrass End-Pit Lakes (Pit 142, 121, and 122)– Coal Valley Mine

The Embarras End Pit Lakes were developed on the CVRI mine as part of reclamation in the Mercoal East Phase 1 development area. The end pit lake system includes a number of small lakes connected by constructed channels. CVRI is in the initial stages of a 5 year monitoring plan.

Prior to mining, the upper Embarrass River was occupied by low numbers of Athabasca Rainbow Trout, and Brook Trout. During construction, the Embarras River was diverted through a man-made channel that became occupied by these species. Reclamation activities commenced in the fall of 2010 and extended into the winter of 2011. The primary objective for the development of lake system was to establish a self-sustaining Athabasca Rainbow Trout population within the lakes. As such, design plans included installation of a fish barrier (weir) downstream of the most downstream Lake and removal of all Brook Trout from the headwaters of the drainage. The success of the Brook Trout removal is still under evaluation but after several surveys none have been recorded upstream of the weir.

In 2011, Athabasca Rainbow Trout were stocked by ESRD from local sources. Fish sampling completed in 2011 and 2012 found that Rainbow Trout are occupying the three lakes and the connective channels. Sampling has also confirmed some Rainbow Trout were still present in the system prior to the stocking and it is suspected that some of these fish have successfully spawned (during sampling in August of 2012, substantial numbers of Rainbow Trout as small as 31 mm were captured).

Although research is ongoing, preliminary results suggest that the Embarras Lakes system is providing good quality fish habitat and it appears that the goal of establishing a self-sustaining Rainbow Trout population is achievable.

b. Describe the fish habitat characteristics associated with the example system(s) referenced in part “a” and critically assess the functionality of CVRI’s pit lake concept.

Response:

All of the end pit lake systems described above are able to support native salmonid fish populations. In general, the physical characteristics (*i.e.,* average depth, mean depth, % littoral habitat) of the existing end pit lakes are similar to the lakes proposed for the Project.

CVRI’s current end pit lake development concept is based on following the design criteria provided in Guidelines for Lake Development at Coal Mine Operations in the Mountains and Foothills of the Northern East Slopes (EPLWG 2004) and incorporating information gained from monitoring of existing end pit lakes. Prior to final design of the end pit lakes CVRI will establish a development strategy for each end pit lake system taking into consideration the following key factors:

- the habitat requirements of target species (Rainbow Trout, Bull Trout, Arctic Grayling);

- information obtained from monitoring existing end pit lakes;
- existing guidelines for lake development;
- desired end use of the lake; and
- regional fisheries management objectives.

Based on existing information (as described above), CVRI believes that physical characteristics of the proposed lakes will not be a limiting factor to self-sustaining fish populations. Furthermore, CVRI believes that potential adverse impacts to fish populations (*i.e.*, shift in community composition, change in temperature regime) can be mitigated (see CR #2, Section 5.4, and various SIR responses). However, CVRI recognizes that site-specific planning will be required to maximize the likelihood of successful creation of end pit lake systems. To that end, CVRI will prepare a "detailed end pit lake plan for the development of aquatic resources" for each proposed pit lake.

Additional discussion of CVRI's end pit lake concept is provided in the response to ESRD SIR #168.

c. Describe limiting factors to fish populations and communities associated with watercourses that resemble the types of systems proposed in figure 26 Using examples from other mines that are operated by CVRI.

Response:

The Embarras Lakes (as described in the response above) are the first linked (surface connection to lotic habitat) end-pit lakes to be developed on the CVM. Preliminary monitoring results suggest that potential limiting factors (shift in fish community composition, change in habitat composition/availability downstream of the lakes, changes in water quality) have been mitigated.

Limiting factors identified during the initial phases of monitoring relate primarily to problems with the implementation of recommended mitigation measures rather than issues with the physical design of the lakes:

- Riparian areas are not completely stabilized/vegetated which is leading to sediment laden run-off entering the lakes.
- Riparian establishment utilizing older/larger trees/shrubs, more diverse community, with an increased density.

- Additional habitat enhancement measures (*i.e.,* gravel placement and installation of instream object cover) should be completed to maximize habitat potential of the constructed connecting channels.

Other preliminary conclusions from the initial phases of monitoring are as follows:

- It appears that Brook Trout were effectively removed from habitat prior to establishment of the lakes.
- It appears that the exclusion weir is successfully limiting Brook Trout movements into the lake.
- No major changes in habitat composition are apparent in the natural channel downstream of the lake.
- Impacts to the temperature regime in the Embarras River downstream of the lakes appear to be limited (temperatures downstream of the lakes are similar to temperatures upstream of the lakes within a few hundred metres of existing the lakes).
- Athabasca Rainbow Trout appear to be reproducing within the connecting channels that were constructed as part of the end pit lake system.
- Water quality within the end pit lakes appears to be comparable to pre-disturbance condition.
- End pit lakes appear to mix completely (full turnover).

Additional research on lake development on connected systems is scheduled for the Yellowhead Tower Extension on the CVM and it is expected that information obtained during the development this system will be available to incorporate in the design and construction future end pit lake systems on the CVM.

References:

Brinker, C.J. 2011. Constructing habitat for a sustainable native fisheries in the Sphinx Lake end pit lake system. Mine Closure 2011, Alberta, Canada.

Luscar. 1994. Development of sport fisheries in lakes by coal mining operations in the eastern slopes. Final Report. Edmonton, Luscar Ltd., Luscar-Sterco (1977) Ltd., Cardinal Coals Ltd., Pisces Environmental Consulting Services Ltd., Bighorn Environmental Design Ltd :149 pp

Pisces. 2006. Fish population monitoring in streams on and adjacent to the Luscar and Cheviot Mines in 2005. Red Deer, Alberta, Canada, Prepared by Pisces Environmental Consulting Services Ltd. For Elk Valley Coal, Cardinal River Operation.

Pisces. 2011. Limnological surveys of five end pit lakes on the Gregg River Mine, 2009-2010. Report of Pisces Environmental Consulting Services Ltd. Prepared for Sherritt Coal, Hinton, AB.

Schwartz. 2002. Fish populations, biomass, and growth in Lac Des Roches, Alberta. Red Deer, Alberta, Canada, Report of Pisces Environmental Consulting Services Ltd. Prepared for Cardinal River Coals Ltd. Hinton, AB.

Sonnenberg, R. 2011. Development of Aquatic Communities in High-Altitude Mine Pit Lake Systems of West-Central Alberta. A thesis submitted to the school of graduate studies of the University of Lethbridge. Lethbridge, Alberta. 163 pp +App

Pisces. 2008. Assessment of fish populations, growth, and spawning in Sphinx Lake in 2007. Report of Pisces Environmental Consulting Services Ltd. Prepared for Cardinal River Operations, Hinton, AB.

Stemo, E. 2005. Limnological surveys of five end pit lakes on the Gregg River Mine, 2004-2005. Report of Pisces Environmental Consulting Services Ltd. Prepared for Sherritt Coal, Edmonton, AB. 39 pp. +App.

186. Volume 3, Section CR#6, Page 58.

CVRI states *When lakes 4 and 5 are filling, downstream flows will be maintained by pumping. Due to the large Erith River flows, this could mean pump flows of 20, 000 ipgm (1.52 m^3/s) will be required just to maintain 85% of mean flows in the high flow months of June to July in order to meet downstream instream flow need.*

a. Discuss what type of infrastructure will be required to pump volumes of water that could be 1.52 m^3/s or greater.
   i. Discuss impacts to fish and fish habitat resulting from the infrastructure required to pump the Erith River flows.
   ii. Discuss mitigations that will be introduced to prevent impacts to fish and fish habitat.

Response:

Please refer to ESRD Appendix 86 for additional discussion regarding pumping and general water diversion management. The Erith River diversion across Val d'Or pit in Step 3B on Figure 26 (Volume 3, Section 4.4.3, CR #6) would be left in place until Lake 5 is filled. During this period (for about 5 or 6 years) only 15% of the natural Erith River flow would be syphoned off to aid in filling Lake 5 (Note the 7.8 year filling time indicated for Lake 5 in Table 13 in Volume 3, CR#6, Page 55 includes the 2.2 years to initially fill Lake 4.) Initially, bypass flows and fish passage are maintained in the McPherson Pit channel while Lake 4 is filling such that fish passage and natural gravity drainage is maintained at all times.

Potential impacts associated with the open channel diversion plan will be refined as Project plans are developed and will include detailed plans to mitigate adverse effects to aquatic resources. General mitigation measures that will be employed are provided in CR#2, Section 5.4.3 and 5.4.4.

b. Identify other watercourses in the project area that may be subject to pumping for water management and/or maintenance of downstream flows and:

   i. Discuss impacts to fish and fish habitat resulting from the infrastructure required to pump on these systems;

Response:

ESRD SIR #78 summarizes the watercourses that may be subject to pumping for water management and/or maintenance of downstream flows and indicates the relative sizing and scheduling requirements. These streams are: Hay, Lendrum above LET3 and possibly short-term (2 to 4 months) for HLT1, LET1, and LET3. The expected infrastructure requirements are outlined in ESRD SIR #78h).

Impacts associated with potential reduction in flows associated with pumping are described in the response to ESRD SIR #170.

Impacts associated with potential impacts to fish movements are discussed in the response to ESRD SIR #180 c).

c. Discuss mitigations that will be introduced to prevent impacts to fish and fish habitat on these systems. Provide details on how CVRI plans to avoid entraining, impinging or killing fish when pumps draw water from one waterbody or watercourse and transfer it downstream.

Response:

For pump systems with fish present a screened intake box with 2.54 mm openings will be set below water or ice level to draw off near surface water and prevent entrainment of fish. The screen size would ensure intake approach velocities are below the 0.11 m/s guideline (DFO, 1995). Several (3 or more) suction lines would be inserted inside this box. Similar but smaller screened systems would be utilized on smaller capacity diversions. On channel diversions, intake forebays will be excavated to control inlet velocities and provided an early ice cover. During freeze-up, heat tracing and/or air compressor backwashing systems on parts of the screening will be employed to reduce the risk of frazil ice blockage. The low laminar intake velocities and significant oversizing of the screening will reduce the risk of blockages at the intake.

Reference:

Department of Fisheries and Oceans (DFO), 1995. Freshwater Intake End-of –Pipe Fish Screen Guideline.

d. Discuss how CVRI will mitigate the impact of pumping to maintain downstream flows on fish and fish habitat during critical life stages such as spawning and rearing if optimal flow is not present during these life stages.

Response:

See response to ESRD SIR #186 a). Additional discussion regarding changes in flow regime and associated impacts to fish and fish habitat is provided in the response to ESRD SIR #170.

8.2 Environment Canada

187. Volume 1, Section A4.4.3, Page A-31 and Volume 3, CR#6, Table 4.1-21, Page 40
EC notes a slight disparity in identifying values used to estimate the total GHG emissions during the construction phase. The main test formula on page 41 employs the value taken from table 4.1-21 of 357 kt CO2e/yr, while the formula on page A-32 intends to use the same value, but erroneously incorporates a value of 392 kt CO2e/yr.

a. Provide the correct calculation.

Response:

The calculation provided on page A-32 of Volume 1, Section A4.4.3 is incorrect. The correct calculation is provided on Page 41 of CR#6.

188. Volume 1, Section A.8.1 and E.1.3.7, Pages A-20 and E-9.
This section notes that nitrogen deposition is 4.8kg/ha/year (baseline) and 5.7 kg/ha/yr (application and planned development cases) but there is no indication of whether or not these levels are of concern.

a. Discuss how these numbers compare to regulatory or permitted levels for deposition.

Response:

There are no regulated levels of nitrogen deposition in Alberta.

WHO (2000) determined that critical loads for nitrogen depend on:

- the type of ecosystem;
- the land use and management in the past and present; and
- the abiotic conditions, especially those that influence the nitrification potential and immobilization rate in the soil.

5-10 kg N/ha/yr is the recommended threshold within an LSA given control of dispersal is not possible. Certain levels of nitrogen inputs reduce biodiversity.

Management should be focused on the most sensitive (to nitrogen inputs) vegetation communities which are very poor nutrient regime sites (poor bogs; aquatic environments). Nitrogen inputs have the greatest negative impact on very poor or poor nutrient regime vegetation communities. The reason is for this is when emissions are released, they are not selectively dispersed to land on any particular vegetation community, rather, they are dispersed wholesale into an area with many different types of vegetation communities (from very poor to very high nutrient regimes).

References:

Allen, E. 2007. Effects of Nitrogen Deposition on Forests and Peatlands: A Literature Review and Discussion of the Potential Impacts of Nitrogen Deposition in the Alberta Oil Sands Region. Submitted to: Wood Buffalo Environmental Association Nitrogen Deposition Literature Review. Pg 21.

World Health Organization (WHO). 2000. WHO Air Quality Guidelines. Chapter 14: Effects of airborne nitrogen pollutants on vegetation - critical loads. http://www.euro.who.int/air/activities/20050223_4.

189. Volume 1, Section A.8.3, Page A-26.

The text states *It has been shown that the quality of groundwater in the two proposed mining areas are similar to groundwater chemistry in present and past mining areas in Coal Valley and of acceptable quality for discharge to surface water bodies*. However, there is no information included on how "acceptable quality" was defined and which information this is referring to.

a. Provide the specific studies and acceptable levels.

Response:

The current ESRD approval for the operation of the CVM specifies that surface water bodies will be monitored by grab sample once per year for "inorganic parameters" listed in "Canadian Water Quality Guidelines for the Protection of Aquatic Life 1999 (as amended). These parameters are listed in CR #3 Tables 3.4-2 and 3.4-3. This would therefore be the "acceptable quality (level)".

"Specific studies" have been shown in CR#3, Section 2.3.2 and 3.4.4.

190. Volume 1, Section C.1.5.2, Page C-13.
The text states: "*Coarse reject produced as a by-product from the Plant can also be used as an alternative to crushed rock*." However, there is no indication that the coarse reject has been characterised and determined to be of suitable geochemical composition for such a use.

a. Discuss the geochemical properties of the coarse rejects or testing for leaching.

Response:

Gravel must be imported to the site making it expensive for short term road surfacing. As a result, coarse reject has been utilized at the existing CVM site for road surfacing around the Plant area. A large fraction of the coarse reject is +2 inch hard rock which is adequate for road repairs.

Coarse reject will not be used at the Project due to the haulage distance. All coarse reject will be disposed in reject dumps adjacent to the Plant.

191. Volume 1, Section C.3.2, Page C-37.
The text states: "*The first competent rock will be utilized to build haul roads between pits and external dump areas*." However, there is no indication that the rock will be tested before use.

a. Discuss the testing to be done on the rock and whether it will be determined to be non-PAG and non-leaching before it is used in construction.

Response:

The 'competent rock' will be taken from the proposed mine pits and hauled to provide 'common fill' for the haul road construction. Solid, unweathered rock is preferred for construction. Therefore, it is the same 'overburden rock' that has been tested for the mine.

Overburden characteristics have been described in CR#10, Section 4.0.

192. Volume 1, Sections C.3.1 to C.3.9, Pages C-36 to C-46.
Insufficient details are provided on the design and functioning of the Ponds mentioned in the Project Development Plan.

a. Provide more details on the Ponds such as whether they are simply retention ponds, if sedimentation is achieved using chemical methods (and if so, which type of chemicals would be used) or if infiltration is expected to occur.

Response:

The ponds mentioned in the Project Development Plan are settling ponds and due to the regional geology the addition of approved flocculants for increased sedimentation most likely will be required, similarly to current settling ponds within the CVM. More specific design of these settling ponds will be produced and submitted to the regulators at the Licensing stage including overall size, release structures, flocculant requirements and maintenance plans.

193. Volume 1, Section C.3.9.4, Page C-45.
The text states that Bryant Creek will be diverted during mining of the Val d'Or seam and directed to flow through an old pit. However, there is no discussion on the potential impact this would have on the water quality in the creek.

a. Discuss the potential impact of the diversion on the quality of the water in Bryant Creek and

Response:

As clarification, Bryan Creek will be diverted within a constructed channel located inside an old pit. Various erosion control measures along with accommodation of fish passage will be incorporated. The effects of running water through a constructed diversion will be negligible.

It should be noted that the SIR question refers to "Bryant Creek" which is incorrect and should read "Bryan Creek".

b. Discuss measures that would be put in place should it be found to have detrimental effects.

Response:

The entire Project will be implemented under the environmental management system and program described in Volume 1, Section C.6, starting on Page C-57. This will include adaptive management to environmental risk assessment which will be achieved by: continually updating relevant environmental baseline information throughout the life of the operation; determining whether the impacts and risks identified prior to development were correct or whether all impacts and risks had been identified; and adjusting mine plans and operations to further reduce environmental risk and impact if environmental monitoring indicates such adjustments are warranted. Measures to limit potential surface water quality impacts of the diversion of Bryan Creek are part of this adaptive management approach, and CVRI will develop and implement such measures if detrimental impacts to surface water quality in Bryan Creek are detected through the results environmental monitoring programs specified in Project approvals.

194. Volume 1, Section C.4.2, Page C-49.

The text states that the proposed mining is expected to intersect abandoned underground mining areas, which contain an unknown volume of water. While the EIS states that "(m)ine waste handling facilities and practices in place at the CVM are expected to be able to adequately accommodate these volumes", there is no discussion of whether treatment might be needed and how it would be accomplished.

a. Discuss how the water from the underground mining areas would be tested (and for what) and how CVRI intends to manage it should it be found to be unfit for discharging.

Response:

Water samples will be collected from the dewatering wells installed to lower the water level in the mines. These samples will be submitted to a laboratory for analysis for the same parameters now required by the current approval as described in the response to ESRD SIR #189. CR#3, Table 3.4-2 and 3.4-3 present the average concentrations of various chemical constituents in groundwater from the Project. It may be assumed that the water in the underground mining areas will have a chemical composition close to these average concentrations.

Under this assumption, all parameters, with the exception of aluminum, meet the Guidelines referenced in response to ESRD SIR #189.

Water from underground mining areas will be treated prior to its release into receiving waters to reduce potential effects from loading of suspended sediments and potential effects of water quality variables typically associated with suspended sediments such as total aluminum. The analysis provided in the water quality report (Section 4.3, Page 36) indicates that there are expected to be: (i) relatively few instances of detectable increases in the concentration of water quality variables as a result of impoundment discharges; and (ii) even fewer instances of detectable increases in concentration coupled with concentrations being above surface water quality guidelines, as a result of the operation of impoundments and discharge of water from impoundments to natural watercourses.

195. Volume 1, Section E.13.5, Page E-204.

The proponent commits to mitigation and monitoring, i.e. implement a re-vegetation program, which aims at the establishment of ecosite equivalent to the pre-disturbed landscape. Avoidance is also one form of mitigation and the extent to which it was applied is unclear.

a. Provide the measures taken to avoid wetlands and ecologically significant wetlands.

Response:

The conceptual mine plan was established with an objective development of a plan for recovering economically recoverable coal reserves. Coal reserves beneath or adjacent to wetlands were included in the proposed pit plan. However, external dumps and haul roads where located to avoid additional disturbance to wetlands.

b. Describe (and show) areas where wetlands were avoided through modifications of the mine plan.

Response:

ESRD Figure 195-1 provides a plan view of the proposed mine plan and remaining wetlands adjacent and surrounding the disturbance footprint.

196. Volume 1, Section E.13.3.2, Pages E-199 and E-204.

The text in section E.13.3.2 discusses the amount, type and significance of wetlands that will be lost during the project. Section E.13.5 goes on to discuss possible mitigation measures including:

- implement a re-vegetation program which aims at the establishment of ecosite equivalent to the pre-disturbed landscape;
- implement a re-vegetation program which aims at the re-establishment of ecosites which are regionally limited in distribution;

a. Provide the measures the proponent will implement to restore bogs and fens.

Response:

At this stage of the Project, Permit level, CVRI does not have specific details on the reclamation of bogs and fens. At the Licencing stage of the Project, CVRI will have more detailed reclamation plans based on 10 year mine blocks. Table F.4-4, Areal Extent of Vegetation/Landscape Features found in Section F, Reclamation Plan, illustrates the reclamation objective of bringing back landscapes of equivalent capability. Overtime wetland features may develop into bogs and fens and CVRI will monitor wetland developments to adaptively manage for optimal success.

b. Discuss the appropriateness of recent techniques being applied in the oilsands area.

Response:

CVRI is aware of techniques being applied in the oilsands area and are always exploring new reclamation methods. CVRI not only looks to the reclamation developments occurring in the oil sands but also worldwide in many different industries for any potential technical advancement that could benefit reclamation activities at the CVM. Part of the adaptive management process is to monitor technological advancements in reclamation, assess applicability, incrementally implement and monitor results.

197. Volume 1, Section E.14.5.1, Page E-244.

The following measures are recommended to mitigate the potential impacts of the Project on wildlife:

- where possible vegetation clearing should be planned for outside of the May to July Breeding season;

A May 1 to July 31 restricted activity period is often acceptable for smaller areas. However when large areas are to be cleared, there is a greater likelihood of encountering migratory bird nests outside this time period. For larger areas, such as this project, Environment Canada typically recommends that at minimum April 1 to August 31 be used as the restricted activity period for clearing vegetation.

a. Clarify whether CVRI will comply with an April 1 to August 31 restricted activity period.

Response:

Environment Canada has developed region wide guidelines to help industry with their due diligence when dealing with the *Migratory Birds Convention Act*. A summary of the regulations and guidelines developed for the protection of migratory birds and their habitat is found further on in this response. The guidelines are developed for the northern Parkland and Prairie ecozones.

Environment Canada recommends that:

- Vegetation clearing for areas up to 50 hectares be avoided between May 1 and July 31
- Vegetation clearing for areas over 50 hectares be avoided between April 1 and August 31.
- Wetlands should not be cleared / destroyed at minimum between April 1 and August 31.
- As well, federally listed Species at Risk and COSEWIC listed species may have species specific timing restrictions.

Winter/spring bird surveys conducted mid-April through mid-May in the Project LSA (CR #14) indicate that terrestrial breeding activity in the Upper and Lower Foothills may be offset from the timing restrictions developed for the northern Parkland and Prairie ecozones. Typically breeding bird surveys in the foothills and subalpine areas of west central Alberta are not initiated until the first week in June as experience indicates that migration is occurring here even during the last week of May (pers. obs. B. MacCallum).

A bi-weekly abundance chronology for migratory birds present in the Project LSA between mid-April and mid-July was constructed from the results of bird surveys conducted to document the presence and abundance of winter residents and breeding birds. Surveys were conducted in 2007, 2008, 2009 and 2010 and consisted of 97 winter resident plots surveyed between mid-April and mid-May and 208 breeding bird plots surveyed between early June and mid-July. A graphic display of the abundance of 89 bird species throughout this period helps interpret spring arrival dates, migratory movements, and nesting activity (ESRD Appendix 197). Owls were surveyed separately on 79 listening stations surveyed between early March and early May in 2006 and 2007 (CR #14, page 20).

Excluding some waterfowl which tend to migrate through the area or nest early (*i.e.,* Canada Goose) these graphs show that few species are present in the LSA even in late April. Most bird species recorded on the Project LSA in the last two weeks of April are year round residents. There are few migrants. A number of residents and early arrivals begin nesting early, *i.e.,* Canada Goose, Gray Jay, Common Raven. The 28 species recorded in the Project in the last two weeks of April during the spring bird surveys are:

- Canada Goose
- Tundra Swan
- Ruffed Grouse
- Greater Yellowlegs
- Wilson's Snipe
- Yellow-bellied Sapsucker
- Downy Woodpecker
- Hairy Woodpecker
- American Three-toed Woodpecker
- Northern Flicker
- Gray Jay

- Common Raven
- Black-capped Chickadee
- Boreal Chickadee
- Red-breasted Nuthatch
- Brown Creeper
- Golden-crowned Kinglet
- Ruby-crowned Kinglet
- Townsend's Solitaire
- American Robin
- Varied Thrush
- Yellow-rumped Warbler
- Song Sparrow
- Dark-eyed Junco
- Pine Grosbeak
- White-winged Crossbill
- Common Redpoll
- Pine Siskin

Forty-one bird species were detected in the first two weeks of May on the Project LSA during spring bird surveys. First sightings of the year for 18 species occurred in the first two weeks of April. These species are:

- Mallard
- Northern Harrier
- Killdeer
- Solitary Sandpiper
- Pileated Woodpecker
- Tree Swallow
- Winter Wren
- Hermit Thrush

- Bohemian Waxwing
- Orange-crowned Warbler
- Chipping Sparrow
- Lincoln's Sparrow
- Swamp Sparrow
- White-throated Sparrow
- Red-winged Blackbird
- Brown-headed Cowbird
- Purple Finch
- Evening Grosbeak

First sightings of the year for an additional 28 bird species occurred in the first two weeks of June. Some of these birds may have arrived during the latter part of May. These species included the flycatchers, vireos, and most of the warblers.

In general practice CVRI schedules timber harvesting activities during fall and winter months while ground conditions are more favorable. Therefore, a May 1 to July 31 restricted activity period is a reasonable date for clearing vegetation in the Project LSA. An extended period restricting vegetation clearing in areas >50 ha may not be necessary in the Project LSA area because:

- Migratory birds found in the LSA in the last two weeks of April are travelling through (Tundra Swan) or are early arrivals just beginning territorial activity (American Robin, Yellow-rumped Warbler). Actual nest building wouldn't occur until later in May.
- Year to year variation in migration can be verified through the use of citizen science data sets like E-Bird.
- Vegetation clearing activities in April are likely a continuation from winter work. The noise of machinery and other activity would discourage birds from settling in the vicinity of the operations.
- Machinery or noise makers can be set up in areas prior to vegetation clearing activity to discourage birds from settling in the area.
- Many resident birds (non-migratory) initiate nesting early (*i.e.,* owls, Gray Jay, Common Raven). Operators are instructed to report the existence of a stick nest or other suspected nesting activity so that a plan can be developed to avoid disturbing these nests.

By mid-August in the Project region, fall migration is fully underway. Small headwater streams are characterized by an abundance of warblers, sparrows and other birds attracted to aquatic insect hatches associated with these streams. Raptors are attracted to the abundance of small avian prey. With the exception of a few species like the Barn Swallow, and perhaps White-winged Crossbill, nesting is completed.

- If vegetation clearing of areas >50 ha occurs in August, CVM will review the list of Species at Risk for which specific guidelines have been developed and will ensure these species are not nesting in the area to be cleared. If any of these species are found, a plan to avoid disturbing nests until the young have fledged will be developed.

With this information in mind, CVI is of the opinion that a restricted period of May 1 to July 31 is most appropriate for the LSA. Should an extension into August be required a bird survey will be undertaken to determine what species are still nesting at that time to determine if clearing should continue.

198. Volume 1, Section E.14.5.1, Page E-244.
The proponent has provided general mitigation measures for migratory birds, but the extent to which these may be applicable to at risk migratory bird species remains uncertain.

a. Clarify whether CVRI will target mitigation specifically for SARA and COSEWIC species (e.g. Barn Swallow, Olive-sided Flycatcher) that were confirmed as regular breeders in project area?

Response:

The reclamation plan accommodates conditions suited to the species noted below. Three species of birds that are listed by COSEWIC and SARA were identified on the Project LSA (CR #14, Table 13.7 Page 122). They are:

- Olive-sided Flycatcher (Threatened, Schedule 1, Threatened);
- Barn Swallow (Threatened, No Schedule, No Status); and
- Rusty Blackbird (Special Concern, Schedule 1, Special Concern).

CVRI conducted an impact assessment for breeding birds as well as a cumulative effects assessment for migratory birds including those 27 birds listed federally and provincially. Mitigation relevant to birds is found in CR #14, Page 101, and Pages 140-143). Additionally a more detailed discussion regarding habitat change for all listed species during the mining process is found in ESRD SIR #69. Primary factors which will reduce the impact of the Project on wildlife and specific mitigation measures are also discussed in ESRD SIR #69.

The Olive-sided Flycatcher is an Uncommon Summer Resident in the Project LSA (CR #14, Page 134 and 190). It breeds in semi-open coniferous and mixed wood forests with considerable height diversity or an open canopy that are often associated with riparian habitat. Tall, prominent trees and snags, which serve as singing and foraging perches, and unobstructed air space for foraging are common features of all nesting habitats. Factors contributing to population decline of the Olive-sided Flycatcher may be occurring elsewhere on the primary winter grounds where 85% of the forests have been altered (Boreal Songbird Initiative http://www.borealbirds.org/birdguide/bd0276_species.shtm), nonetheless a number of mitigation efforts on the Project LSA will target the Olive-sided Flycatcher.

- "Planting" snags in reclaimed landscapes and leaving large stumps in early succession open environments will offer perches for hunting raptors like the American Kestrel and the Northern Harrier and when the forest stand grows higher, snags will provide habitat for species like the Olive-sided Flycatcher.
- Reclamation is the primary tool to offset habitat losses and changes due to mining activities. CVRI's reclamation plan (Section F, Page F-44, Table F4-4) indicates that habitats providing edge will not change pre mining to post mining (Riparian/Wetlands). Other habitats providing edge will increase (Grasslands/ Shrublands, and Water). The amount of forested cover will decrease from 83.7% pre mine to 72.8% post mine but the increase in edge habitats from 12.3% pre mine to 27.1% post mine will provide more breeding habitat for the Olive-sided Flycatcher.
- Periodic bird surveys will indicate whether the Olive-sided Flycatcher is using the post mine habitats and indicate whether other management efforts may be needed later in the mine life as forests mature.

The Barn Swallow is an Uncommon Summer Resident in the LSA. Barn Swallows will nest in artificial structures around human activity but also use crevices in cliffs.

- CVRI's reclamation plan (Section F, Page F-44, Table F4-4) indicates that the amount of Riparian/Wetland will increase post mining. Larger bodies of water will provide foraging opportunities for the Barn Swallow.
- An inventory of cliffs associated with mining should be completed prior to sloping to identify which cliffs are used by swallows followed by an assessment whether these cliffs could be incorporated into the final reclaimed landscape.

One Rusty Blackbird was observed feeding in a roadside ditch near the Erith River in the Project during migration on April 7, 2007. The Rusty Blackbird is a Very Uncommon Migrant in the Project LSA. The Rusty Blackbird nests in the boreal forest and favours the shores of wetlands such as slow-moving streams, peat bogs, marshes, swamps, beaver ponds and pasture edges. In wooded areas, the Rusty Blackbird only rarely enters the forest interior. Breeding range of this species occurs primarily north of the Project RSA and COSEWIC indicates that "…*Known threats occur primarily on the winter range, and include habitat conversion and blackbird control programs in the United States.*"

- CVRI's reclamation plan (Section F, Page F-44, Table F4-4) indicates that the amount of Riparian/Wetland will be similar pre and post mining. A variety of ponds with differing emergent and shoreline vegetation and water depths will be established on the Project during the re-vegetation program. Provision of small waterbodies with a variety of depths and shoreline vegetation will provide habitat for use during migration for the Rusty Blackbird.

8.3 Transport Canada

199. Volume 3, CR #6

a. Provide information for any proposed works that are to be built or placed in, on, over, under, through or across any navigable water and that may require an approval by the Minister of TC under the Navigable Waters Protection Act (i.e. 15 watercourse diversions and 14 watercourse crossings).

Response:

The streams to be crossed or intercepted by mining that may be deemed as being navigable as per the Minor Waters User Guide (Transport Canada, 2010) are listed in ESRD Table 199-1 and ESRD Table 199-2 along with channel characteristics and expected details of the crossings and diversions. The navigable water characteristics are based upon observations of channel widths and depths conducted at various locations along the streams, as documented in CR#2, Figures 5 to 12, and are at not necessarily at specific crossing or diversion locations. Specific crossing locations may be expected to change during detailed planning and design stages. At that time formal applications for approval and detailed plans will be submitted for each specific navigable stream to be affected by the Project.

The other streams intercepted by mining or crossed by roads are considered minor waters because channel widths are less than 3 m and depths are typically less than 0.6 m. Other navigability characteristics: channel slope, sinuosity and frequent natural obstructions (typically extensive beaver dams) may also limit their navigability.

For safety reasons it is expected that access to the navigable streams will be restricted during the active mining periods indicated in ESRD Table 199-1 and ESRD Table 199-2 and until reclamation is complete. Where streams and final end pit lakes are deemed to be navigable, the lake outlets can be sized to restore navigability to these areas.

Table 199-1 Works That May Require Approval under the Navigable Waters Protection Act: Potential Navigable Watercourses Intercepted by the Mine

No.	Watercourse	Active Mine Period by Year	Draiange Area (km^2)	Discharge (m^3/s)			Diversion/ Stream Length Intercepted (m)	Preliminary Navigability Screening	Preliminary Navigability Screening				
				Mean Annual	2 Year Peak	20 Year Peak		Average Channel Width (m)	Average Channel Depth (m)	Channel Slope (%)	Sinuosity Ratio	Frequency of Natural Obstructions	Navigability
1	Erith River	1-13	54.6	0.43	8.1	29.7	5,000	12.5	>0.6	0.7	>1.2	N/A	Yes
2	Erith East Trib (ERT1)	2-13	15.5	0.12	2.3	8.4	700	3-5	0.5	0.7	>1.2	N/A	Yes
4	Halpenny West Trib (HLT1)	8-9	7.1	0.06	1.1	3.9	920	2.7	0.4-0.9	0.8	1.8-2	N/A	Yes
5	Halpenny Creek	3-13	25	0.2	3.7	13.6	270	2.6-6	>0.6	1.5	2	N/A	Yes
8	Lendrum Trib (LET3)	10-13	11.1	0.09	1.6	6	450	3.9	<0.6	1.8	1.3	N/A	No
11	Lund West Trib (LDT1)	12-14	7.6	0.06	1.1	4.1	625	3.2-4.1	<0.6	2.2	1.1	N/A	No
14	Upper Lund Creek	17 and on	8.3	0.07	1.2	4.5	2,200	1.3-6.5	na	2.3	>1.2	N/A	No
15	Pembina Trib (PET1)	17-24	7.9	0.06	1.2	4.3	300	2.9	<0.6	1.0	na	N/A	No
13	Bryan Creek	17-24	18.8-19.6	0.15	2.8	10.2	250	2.1	0.6+	1.6	>1.4	Numerous	No

Table 199-2 Works That May Require Approval under the Navigable Waters Protection Act: Potentially Navigable Main Corridor Haulroad Crossings

Watercourse	Active Period of Year	Location	Drainage Area (km^2)	2 Year Peak Flow (m^3/s)	Typical Culvert Diameter	Crossing Type[1]	Channel Width (m)	Channel Depth (m)	Channel Slope (%)	Sinuosity Ratio	Frequency Natural Obstructions	Navigability
Erith Road												
Erith River (ER-6)[2]	1-25	At E6/E7pond	32.6	4.63	3.6	3	11.9	>1.2	1.3	1.4	Woody debris	Yes
Halpenny Road												
HLT1	1-25	Above P7 pond	6.71	1.00	3	2	2.7	0.9	1.8	1.1	Few	Yes
Robb West Road												
Bryan Trib (BRT2A)	14-25	Above W6 pond	6.81	1.01	2	TBD	<3	<0.6	3.5	1.14	N/A	No
Bryan Creek[3]	14-25	Above East 7 pond	7.31	1.08	3	2	2.4	<0.5	2.1	1	N/A	No

[1]Crossing Type 3 = Navigable clear span arch; Type 2 = culvert with fish passage, Navigability to be determined; TBD = to be determined

[2]Erith crossing located at existing bridge crossing
[3]Lower Bryan Creek has non-navigable culvert at Highway 47 crossing and numerous beaver dams in lower reach between the highway and the mine area.

b. Provide information for each proposed work not covered by the Minor Works and Waters (Navigable Waters Protection Act) Order (available online at http://canadagazette.gc.ca/rp-pr/p1/2009/2009-05-09/html/notice-avis-eng.html#d103).

Appendix A outlines the information that Transport Canada requires a proponent to submit when applying for an approval under the Navigable Waters Protection Act. If final design information is not available, provide as much conceptual information as is possible.

Response:

The proposed works on potentially navigable streams are indicated in ESRD Table 199-1. Specific locations may be expected to change during detailed planning and design stages. At that time formal applications for approval and detailed plans will be submitted.

200. Volume 3, CR #6

a. Describe indirect effects of the project on navigation, and describe mitigation measures if warranted.

Response:

Indirect effects may be the reductions in downstream peak flows during mining, lake filling and following reclamation. The percentage reductions in high flows are outlined Volume 3, CR#6 Table 14. Estimated reductions in the 5-year and 100-year peak flows downstream of the proposed lakes following mining and changes in the occurrence of the equivalent 2-year return period peak flow are indicated in ESRD Table 77-1 (SIR #77). The estimated reductions in peak flows on the downstream navigable streams will have an estimated 5 to 10 cm reduction in water levels at the 2-year flood. This change is not expected to adversely affect the navigable use of these streams.

201. Volume 3, CR #6

a. Provide a cumulative environmental effects assessment of the impacts to navigation, which takes into account influences such as: overall water withdrawals, water diversion, natural river fluctuation, sand movement, and dredging.

Response:

Cumulative impacts to navigation as a result of the Project are expected to be as follows:

- Temporary restricted access to the upper portions of the navigable streams for periods from 2 to 15 years in duration for mining and reclamation. The streams affected and considered navigable and at this time are: Erith River and tributary ERT1, Halpenny Creek and possibly its tributary HLT1. Other streams are indicated as potentially navigable in ESRD Table 199-1 and will be assessed further in accordance with the Minor Works and Waters (*Navigable Waters Protection Act*) Order to define their classification.
- Reductions in downstream flows of up to 15% during lake filling periods. This reduction is expected to have less than a 10 cm impact on downstream water levels with this impact reducing progressing downstream.
- A residual reduction in peak flows due to flood peak attenuation by the end pit lakes, expected in the range of 15 to 25% on the Erith River and Halpenny Creeks, results in a 5 to 10 cm drop in water levels with this impact reducing progressing downstream.
- End pit lake creation will reduce downstream sediment and bed load transport which is offset in part by the reduction in peak flows. Downstream channel regime changes due to the potential flow and sediment regime changes are expected to be minor and localized, and reducing progressing downstream.
- Based upon the magnitude of the flow changes estimated from the Project, the downstream extent of potential 2 year peak flow (and related channel regime changes) reductions during and following mining are consider to be less than 5% on the Erith River below the Hanlon Creek confluence. This change is estimated to correspond to about a 2.5 cm decrease in water level at this return period flow. Net cumulative downstream impacts on low-average flows may be expected to be neutral to positive. Navigability of the other major downstream rivers (Pembina, Embarras and McLeod) will not be affected by the Project.
- The 12 proposed end pit lakes, as characterized in Volume 3, CR#6, Table 13, will become navigable water bodies. The Erith River may be navigable up through Lake 5 and Lake 4 with potentially navigable outlets on Lake 6 to Halpenny Creek and possibly Lake 7 to Lendrum Creek.

Cumulative impacts to navigation as a result of other industrial developments are expected to be as follows:

- Ongoing forest harvest and management will require construction of additional access roads which include watercourse crossings.
- Ongoing oil and gas development will require construction of additional access roads which include watercourse crossings.
- Reclamation at the CVM will result in removal of several existing watercourse crossings improving navigability.

202. Volume 4, CR #12

a. Describe Aboriginal consultation activities with Aboriginal groups in the area for specific concerns related to potential adverse impacts of TC's potential approval(s) (i.e. any works to be built or placed in, on, over, under, through or across any navigable water located at watercourse crossings – the watercourse crossings and diversions) on potential or established Aboriginal or treaty rights.

Response:

Aboriginal consultation activities for the Project were not undertaken solely with TC approvals in mind, but rather assumed a holistic approach to potential Project impacts. Therefore, no specific information regarding Aboriginal concerns at watercourse crossings is available. However, throughout the consultation process, general project elements were always discussed, and the specific field inspection of the three major transportation corridors was undertaken. Apart from general environmental concerns regarding water quality in the Project area, and concerns raised regarding fish habitat as outlined in ESRD SIR #10a), to CVRI's knowledge no Aboriginal group has indicated a specific concern related to potential impacts on established Aboriginal or Treaty Rights at navigable water crossings. Should these be raised they will be reported to TC.

b. Provide consultation records of any consultation with all Aboriginal groups in the area who may have an interest in the above-noted works. Provide information about Aboriginal consultations, including but not limited to any concerns raised by the Aboriginal groups in relation to Transport Canada's potential NWPA approval(s) as well as the measures taken or proposed to be taken to address those concerns.

In Table 2 of the TEK study, it indicates that the Alexis Nakota Sioux Nation raised concerns related to navigable waters on April 11, 2007 and that a response to the concerns was provided on May 3, 2007.

Response:

As noted in ESRD SIR #202a), no specific Aboriginal concerns related to water crossings has been submitted to CVRI. CR #12 provides a thorough review of Aboriginal consultation activities for the Project, during which all major elements of the Project were discussed. That report, others within the Project Application, as well as responses to the current set of SIRs (see response to ESRD SIR #10b) provide a thorough review of Aboriginal concerns, CVRI measures proposed to address them.

The concerns were outlined in a review of the TOR for the Mercoal West and Yellowhead Tower extension projects by an outside consultant, Martyn Glassman. Although consultation at that time included the Project, the TOR document under review was specifically related only to Mercoal West and Yellowhead Tower. As the document is a general review of the TOR, no specific concerns were tabled regarding impacts to Alexis Nakota Sioux Nation rights and traditional uses for the Project, or Mercoal West and Yellowhead Tower. Instead, the concerns were of a more generalized nature having to do with technical concerns about the regulatory process, particularly complaints about the Project being "split" from Mercoal West and Yellowhead Tower, the lack of direct consultation with Alexis Nakota Sioux Nation from representatives of the Government of Alberta, and general environmental concerns with the EIA process, including the need for a generalized "climate change" section with specific predictions for the Project area. The reviewer indicated his belief that the TOR should indicate how the proponent planned to consult specifically with the Alexis Nakota Sioux Nation on a number of issues including environmental management plans, monitoring, reclamation, and how compensation might occur to land users from any impacts that could not be mitigated, including those to First Nations current and traditional uses. The reviewer requested the inclusion of any Aboriginal recruitment and retention plans, and statistics on Aboriginal employment at the mine, and a table indicating commitments made to Aboriginal groups. The review indicated that the EIA should describe any potential effects to navigable waters (no specific note regarding how this might be related to Alexis Nakota Sioux Nation traditional uses was made).

The response to those concerns was of necessity also of a generalized format. Many of the concerns outlined by Martyn Glassman were regulatory issues that could not be addressed by CVRI, and many general environmental concerns were in fact to be addressed in the EIA. The response indicated that CVRI would continue to work with the Alexis Nakota Sioux Nation surrounding other concerns raised in the review document.

The fact that the Alexis First Nation was ultimately satisfied with the response to the concerns as related in the TOR review is documented in their withdrawal of the statement of concern filed on the Mercoal West and Yellowhead Tower projects and the consummation of a long-term agreement with CVRI that addresses Alexis Nakota Sioux Nation concerns, and was specifically drafted to address the Project, as well as Mercoal West, and Yellowhead Tower projects.

c. Provide further details in regards to the concerns about navigable waters as well as how these concerns were addressed.

Response:

As discussed above in ESRD SIR #202 a) and b), no additional details about Aboriginal concerns related specifically to navigable waters are available. Should such become available, they will be forwarded to TC.

8.4 Natural Resources Canada

203. Volume 1, Section A.4.3.4, Page A-10

a. Provide a section that adds Natural Resources Canada as a Responsible Authority under CEAA where required and reference the need for a license under s.7(1)(a) of the Explosives Act.

Response:

Volume 1, Section A.4.3.4 is amended to add:

- A licence to construct and operate an explosives manufacturing facility (factory) pursuant to the s.7(1)(a) of the *Explosives Act* administered by NRCAN.

The Project will include relocation of an existing bulk explosives 'manufacturing plant'. A licence for the facility will be required by the *Explosives Act*. A preliminary site location for the facility has been identified but is subject to further engineering evaluations. CVRI is progressing toward the appropriate applications for this licence.

204. Volume 1, Section C.1.5.5, Pages C13-15 & Section C.5.5, Pages C56-57

NRCan requests the proponent provide information about the presence of any temporary or permanent explosive facility that could be used on the Project site before the relocation of the manufacturing plant.

There will be no temporary or permanent explosive facility used on the Project site before the approval is gained for relocation of the existing manufacturing plant.

Materials required at the project prior to availability of the relocated plant will be transported from the existing site to the Project site. The access route will be included within the approved mine operating area. Appropriate equipment and operating procedures will be followed during such transport.

a. Confirm whether there is a plan to have any temporary/permanent maintenance/wash area on the site or to have any temporary/permanent 'magazine' on site for ancillary blasting items.

Response:

Maintenance/Wash Area

CVRI expects the explosive contractor to relocate the existing 'manufacturing facility' to the Project area. The facility will include bulk storage bins for prills, an office/shop building complete with a 'wash bay'.

The site will include parking areas and a water management plan including ditches and collection pond.

Magazine

CVRI expects to continue use of the existing magazine currently located at the CVM site. This facility will not be relocated to Project area. Therefore, no magazine will be provided within the Project area.

205. Volume 1, Section C.5.5, Pages C56-57

CRVI will use the existing explosive manufacturing plant and will relocate it following the beginning of the Project.

a. Confirm that the project and related explosives manufacturing and storage operations will meet the regulations and safety distances required by the Explosives Regulatory Division of Natural Resources Canada (Guidelines for Bulk Explosives Facilities and Quantity Distance Principles Manual).

http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca.minerals-metals/files/pdf/mms-smm/expl-expl/pdf/BulkRev51-eng.pdf
http://www.nrcan.gc.ca/minerals-metals/explosives/4283

Response:

CVRI expects to have the explosive contractor responsible for explosive supply to locate and establish the relocated explosive manufacturing plant. It is understood that this process will require prior approval(s) through NRCAN. CVRI confirms that such approvals and regulations will be met for the proposed facilities. Appropriate safety distances can and will be met at the proposed site.

206. Volume 2, CR#3, Section 3.4.2, Figure3.4.1
Cross-section 4000 East (Fig. 3.4.1) shows a buried valley (~17020N). Buried valleys have a considerable role in groundwater flow in some regions of Canada. NRCan could not find evidence in the EIS of inclusion of the buried valley in the groundwater baseline, project effect assessment and proposed monitoring program.

a. Provide an assessment of the importance of the buried valley for the groundwater flow.

Response:

It is assumed that the reference is to Cross-section 40,000 East.

Buried valleys may have hydrogeological importance in the prairies of Saskatchewan and Alberta. Buried valleys have not been identified in the foothills and mountains of Alberta. This is likely due to the continuing uplift taking place in these areas as compared to the prairies. Because buried valleys are rare no hydrogeological significance has been attached to them.

The feature specifically referenced is approximately 10 m deep. Such a feature has no hydrogeological significance in this setting.

207. Volume 2, CR#3, Section 3.4.3, Page 28.
The upper Robb ground water levels in Fig. 3.4.7 are not the same as noted in Section 3.4.3.

a. Clarify the discrepancy noted above.

Response:

The wording in Section 3.4.3 is incorrect. Water levels in the deeper piezometer are 2 to 3 m above those in the shallower piezometer.

It has been stated that there are approximately 150 water wells in the Hamlet of Robb. Fluctuations in groundwater levels would be expected and it may not be possible to determine the reason.

The water well data show unexplained spikes in water levels for June 11. Presumably, further monitoring will determine the meaning of these fluctuations e.g. potential periodic drainage of old underground mine works.

b. Confirm that CVRI will be conducting further monitoring to determine the meaning of the fluctuations noted above.

Response:

CVRI commits to further monitoring of these and additional observation wells for the purpose of assessing drawdowns due to mining operations. If fluctuations of a similar nature occur possible causes will be examined. CVRI makes no commitment to determining the causes unless they are clearly related to assessment of impact due to mining.

208. Volume 2, CR#3, Section 4.2.6, Page 35

In Section 4.2.6, it is stated that *There are no significant lakes, ponds or similar non-flowing water bodies in the study area*. However, a brief scan of the area shows at least 6 hectares of water bodies in the vicinity.

a. Clarify the above statement.

Response:

What is meant is that 6 ha of total standing water in 10,113 ha for the total Project is not significant.

209. Volume 2, CR#3, Section 4.2.8, Page 37

Section 4.2.8 states that drawdown of groundwater levels does not typically extend 100 m beyond a mine pit. The data show that drawdown effects extend to a least 250 m. Moreover, these drawdown measurements are across the geological strike. It is probable that drawdown along the strike (perpendicular to this direction) would be different.

a. Clarify the discrepancy noted above.

Response:

Section 4.2.8 was incorrect. It should have stated "….extend 200 m beyond….".

Drawdown Along Strike

It is not necessary to discuss drawdown along strike in the direction from which the mine approached because that area has been mined out. Similarly, the mine is moving forward along strike and therefore impact in that direction is irrelevant as that area will be subject to excavation. Therefore this response is directed toward the starting and ending situation of any mine pit, or series of pits since that drawdown would extend along strike into areas not disturbed by mining.

210. Volume 2, CR#3, Section 6.0, Page 41

Climate change scenarios for Edmonton were applied to the Robb Trend area. However, the current climate difference between these two places is greater now, than what the forecasted change is for Edmonton between now and 2039.

a. Explain why the climate change scenario for Edmonton was used, how it was used, and why this is the best scenario to use.

Response:

Climate change scenarios for Edmonton were used for the Project due to the following reasons:

- climate change is indifferent to ecosystem makeup;
- the minor spatial differences between Edmonton and Edson (CVM) are insignificant to climate change over the long term;
- Edmonton has the most robust and complete data set in close proximity to the Project; and
- Edmonton climate data has been referred to before in CVM applications.

Edmonton climate data was used to predict changes in temperature and precipitation which relate to groundwater levels and local water levels in general for the CVM area. Barrow and Yu (2005) predicted mean temperatures in Edmonton will rise by 1.1 degrees and precipitation will rise by 6.6mm. Increases in temperature may lead to an increase in evaporation and evapotranspiration but increases in precipitation would tend to off-set such an increase. The net change is insignificant over the life of the Project in relation to groundwater.

Reference:

Barrow & Yu (2005): Climate Scenarios for Alberta, Prairie Adaptation Research Collaborative, May.

211. Volume 2, Appendix 9, Section 4.2.1.

a. Provide a definition for and description of "Re-worked till".

Response:

Primary till deposits are those laid down directly by glacial action. Secondary deposits are those having undergone 'reworking' through actions such as fluvial transport or erosion.

212. Volume 2, Appendix 9, Section 4.2.2.

Section 4.2.2 describes mechanical properties of soils, but almost all the data are from outside the LSA. For example, only 2 points are from Robb Trend. In addition, the type of surficial material plotted is not given. It is stated however, that additional data will be obtained in the future.

a. Provide any existing geotechnical data for the Robb Trend area, and elaborate on future plans to obtain these data.

Response:

Soil Resources

Assessment of 'soil resources' is provided in CR #10. Figures 3 and 4 of CR #10 provided detailed maps of soil types.

Regarding geotechnical aspects, the soil descriptions and mapping provided in CR #10 provide a basic picture of the various soil conditions throughout the Project area. Soil types such as fluvial, glaciolacustrine and moraine materials are identified and located. Such patterns are of interest in considering mining and construction elements such as waste dump foundation conditions.

Existing Data

Volume 2, Appendix 9 provides a general description of geological and geotechnical aspects of the Project. The common theme is that conditions experienced at the existing operation are expected to be similar to those found in the Project. Therefore, design elements practiced at CVM should be transferable to the Project. This is expected to include experience with 'surficial materials' including geotechnical considerations for dump foundation.

Appendix 9, Figure 4.1 presents a compilation of test data from various mine site locations ranging over a large geographical area. Only two recent test results are available from the Project however, results are consistent with other areas.

Appendix 9, Table 4.1 provides a summary of results provided from an early report generated by Piteau in 1982. Shear strengths for colluvium, glacial till and lacustrine silt are provided. The investigation undertaken by Piteau included;

- A walk-over survey in 1981 during which surface exposures were logged and samples collected.
- Six geotechnical drillholes were drilled in 1981 where split spoon samples were obtained in coarse grained soils and Shelby tubes in fine grained materials.
- Three trenches were developed on coal seams allowing surficial soils to be logged and sampled.

- All soil samples were classified according to USC system. A hand penetrometer was used to estimate undrained compressive strength of cohesive soils. Atterberg limits and gradation tests were performed on representative samples

Additional Future Data

CVRI will undertake additional geotechnical testing for pit and dump design purposes.

A program of 18 coreholes in the Robb Main area has been completed in early 2012. This program was focused primarily on coal seam characterization. A report of the results is available (see response to ESRD SIR #44). Additional coring in the initial pit highwall region is proposed for 2012/2013. Testing of representative rock materials will be undertaken.

An initial phase of investigation of surficial materials was started in October, 2012. A program of 41 test pits located within dump footprints was undertaken (see response to ESRD SIR #49). Material samples were obtained and will undergo various laboratory testing.

Pit and dump licence applications for each proposed mining area will be prepared and submitted to regulatory review. Detailed geotechnical assessments for each pit and dump will be provided at that time supported by field investigation and laboratory results.

8.5 Health Canada

213. Volume 2, CR 1

Two project only cases were considered in the assessment approach for the air quality assessment. Project Case 1 was chosen for the assessment, as it is the worst-case air quality scenario (Section 2.1.1 Assessment Approach).

a. Discuss whether consideration has been given to situations where the Project Case 2 scenario yields higher predicted air emissions values than the Project Case 1 scenario. For example, Table 5.5-1 Predicted PM_{10} Concentrations shows higher values for Project Case 2 than Project Case 1 for receptor locations Overall Maximum (RSA-MPOI), Robb Area Maximum, and R1-SE Robb.

Response:

At some locations, for some compounds, results are higher for Project Case 2 (Main Mine in 2025) than for Project Case 1 (West Mine in 2034). ESRD Table 213-1 summarizes these occurrences. In the case of R1-SE Robb the particulate results for Case 2 are compared to results for Case 1 at R2-NW Robb. The SE receptor is closer to Robb Main and the NW receptor is closer to Robb West.

The largest difference is for annual predictions of NO2, where the predictions at the Case 2 MPOI (33 µg/m) are more than double the predictions at the Case 1 MPOI (14 µg/m). However, both predictions are lower than the ambient air quality objective of 45 µg/m3.

The differences for particulate are lower. For predictions that are mitigated by vegetation, the differences range from 5 to 15% and all results are below the ambient objectives.

For the majority of chemicals and averaging periods, Case 1 predicted concentrations are higher. In the few instances where Case 2 predictions were higher, the conclusions of the assessment are unchanged. Therefore, for consistency of approach, Case 1 predictions were referenced throughout the assessment.

Table 213-1 Comparison of Robb Trend Case 1 and Case 2 (µg/m3)

Compound	R1-SE (Case 2) OR R2-NW (Case 1) Robb			MPOI			Robb Area Maximum		
	Case 1	Case 2	% Diff	Case 1	Case 2	% Diff	Case 1	Case 2	% Diff
NO2 Annual	10	4	-60	14	33	136	14	14	0
Unmitigated Particulate Predictions									
PM2.5 - 2nd highest 24 hour	14	12	-14	21	26	24	21	21	0
PM10 - 2nd highest 24 hour	59	45	-24	117	140	20	107	117	9
TSP - 2nd highest 24 hour	117	83	-29	252	271	8	252	194	-23
Mitigated Particulate Predictions									
PM2.5 - 2nd highest 24 hour	8.3	7.2	-13	10	11	10	10	10	0
PM10 - 2nd highest 24 hour	27	23	-15	41	47	15	39	41	5
TSP - 2nd highest 24 hour	53	45	-15	87	92	6	87	73	-16

214. Volume 2, CR 1, Section 2.5.2, Table 2.5-2, Page 12
Table 2.5-2 details the evaluation criteria for characterizing residual effects.

a. Discuss why there is no difference in the criteria definitions for Neutral, Positive and Negative Project Contribution/Direction.

Response:

This was a typographical error and the relevant section of Table 2.5-2 should read as follows in ESRD Table 214 -1:

Table 214-1 Evaluation Criteria for Characterizing Residual Effects

Criteria	Criteria Definition	
Project Contribution / Direction	Neutral	No net change in air quality in the air quality LSA or immediate project area
	Positive	Improvement in the air quality in the LSA or immediate project area (reduced concentrations or deposition)
	Negative	Deterioration in air quality in the LSA or immediate project area (increased concentrations or deposition)

215. Volume 2, CR 1, Section 4.1.2, Page 26
According to the National Pollutant Release Inventory the following pollutants are emitted by this industrial sector/facility: benzo(e)pyrene, dibenz(a,h)acridine; indeno(1,2,3-c,d)pyrene, phosphorus, and sulphuric acid.

a. Discuss why emission calculations were not done for these pollutants.

Response:

Indeno(1,2,3-c,d)pyrene was assessed (in Table 4.1-17 in CR#1, this chemical is listed as Indo(1,2,3-cd)pyrene and is a typographical error. The remaining chemicals are not emitted from Project fugitive sources or from diesel combustion (U.S. EPA. 1998).

Reference:

U.S. EPA. 1998. Chapter 3 in AP42. http://www.epa.gov/ttn/chief/ap42/ch03/index.html.

216. Volume 2, CR 1, Section 4.1.2, Page 26
This section details the emissions summary and states that, "*haul roads will be regularly watered in summer, reducing dust from wheel entrainment by 80% (e.g., Luscar, 2999). Winter dust emissions from haul roads were reduced by 90% because roads will be covered by snow and/or frozen. Soil handling emissions were reduced in winter by 80% to account for wet and/or frozen ground.*"

a. Describe what is meant by 'regularly' when referring to road watering.

Response:

The water trucks would be deployed on a continuous basis during peak traffic periods and warm weather conditions with decreasing frequency as traffic is reduced or cooler weather prevails.

Unusual warm, dry, and snowless periods during the winter season, watering will be used to mitigate dust emissions.

> In Luscar, 1999, page 48, there is mention of a 70% (not 80%) reduction only in the Total Suspended Particulate (TSP emissions by applying water to mine haul roads, pits and dumps.
>
> b. Describe the mitigation measures to reduce the PM_{10} and $PM_{2.5}$, which will not be substantially mitigated by watering.

Response:

Road dust control by water applications is effective for all dust components.

According to Table 4.3-1 in CR#1, the largest Project sources of all three particulate sizes are the various haul roads. All other sources are an order of magnitude smaller.

In the assessment, watering reduced the fugitive component of $PM_{2.5}$ and PM_{10} from haul roads.

The basis for the 80% reduction used in assessment, as well as evidence for a consistent reduction by watering for $PM_{2.5}$, PM_{10} and TSP size ranges is presented in AP 42 Section 13.2.2 Unpaved Roads (U.S. EPA (1998b) and is summarized in ESRD Table 216-1. In the studies on which the emission reductions are based, the median reduction for $PM_{2.5}$ was 79%, for PM_{10} 91% and for TSP 81%, comparable to the 80% used in the assessment.

In addition, while not a clear indication of the effects of road watering, Cowherd *et al.* (2006) indicates the effectiveness of vegetation on dust mitigation is similar in all three size ranges. Therefore, in the Project modelling, watering mitigated the fugitive component of all three size ranges equally and thus was an effective way of reducing $PM_{2.5}$ and PM_{10} as well as TSP.

The use of vegetation (in particular, dense stands of trees) is effective in mitigation. CVRI plans to maintain vegetation between the West and Main mine pits and the community of Robb as discussed in the response to ESRD SIR #46b.

Table 216-1 Emission Reduction

Place/Industry	Equipment/ Control Method	Emission Reduction of PM2.5 (%)	Emission Reduction of PM10 (%)	Emission Reduction of TSP (%)
California(a) /Road Construction	Scraper / Watering	-	79	-
Wyoming(b) / Coal Mines	Haul Trucks / Watering	-	54	41
North Caroline(c) / Stone Quarry	Haul Trucks / Watering	-	94	-
Michigan(d) / Coal Yard at Power Plant	Scraper / Watering	79	80	80
Ohio(e) / Iron & Steel Plant	Haul Trucks / Watering	87	-	78
Ohio(e) / Iron & Steel Plant	Haul Trucks / Coherex	91	-	95
Indiana(f) / Iron & Steel Plant	Haul Trucks / Petro-Tac	79	91	81
Missouri(f) / Iron & Steel Plant	Haul Trucks / Watering	72	92	89
Missouri(f) / Iron & Steel Plant	Haul Trucks / Coherex	89	92	83
Wyoming, New Mexico, North Dakota(g) / Coal Mines	Haul Trucks / Watering	61	-	73
Wyoming, New Mexico, North Dakota(h) / Coal Mines	Haul Trucks / CaCl2	24	-	88
Median		79	91	81

(a) South Coast Air Quality Municipal District (AQMD, 1996).
(b) US EPA (1994).
(c) National Stone Association, (1994).
(d) Midwest Research Institute (MRI, 1985).
(e) US EPA (1983a). (f) US EPA (1983b).
(f) US EPA (1981) (poor quality data: average of controlled emissions measured at Wyoming and New Mexico over average of uncontrolled emissions measured at Wyoming, New Mexico, and North Dakota).
(g) US EPA (1981) (poor quality data: average of controlled emissions measured at North Dakota over average of uncontrolled emissions measured at Wyoming, New Mexico, and North Dakota).

No information on winter dust emissions from haul roads being reduced by 90% because of snow and/or freezing was found in Luscar, 1999.

c. Discuss how the 90% reduction of dust emissions from haul roads in the winter months was estimated.

Response:

As indicated in Section 3.6 of Appendix A to CR#1, frozen or snow-covered road surface in winter provides additional road dust emission reduction. This reduction was studied by comparing summer and winter data from the static dust fall station located on the west side of the Smoky River north of the Grande Cache Coal processing plant and the H.R. Milner generating plant areas, just off the Sheep Creek haul road. The average winter readings for were about 43% lower than for the rest of year (GCCoal, 2004). Occasionally this proportion was even lower, especially in December and January. For this reason, it was assumed that during winter months road dust emissions were suppressed by 90% (the result of multiplying the summer emission reduction to 20% by a further 43%). According to climatological data, periods of snow cover extend from November to April.

References:

Cowherd, C. Grelinger, M.A. and Gebhart, D.L. (2006): Development of an emission reduction tern for near-source depletion. 15th International Emission Inventory Conference, New Orleans.

Grande Cache Coal (GCCoal). 2004. EPEA Application for Amendment of Approvals No. 12 Mine South B2 Extension Pit.

Midwest Research Institute (MRI) 1985. Fugitive Emission Measurement of Coal Yard Traffic at a Power Plant – Confidential Client (Referred at US EPA, 1998).

National Pollution Inventory (NPI). 2012. Emission Estimation Technique Manual for Mining Version 3.1; January 2012 (First Published in March 1999).

National Stone Association (1994). PM-10 Emission Factors for a Haul Road at a Granite Stone Crushing Plant, , Washington, D.C., December 1994 (Referred at US EPA, 1998).

South Coast Air Quality Municipal District (AQMD 1996). Improvement of Specific Emission Factors (BACM Project 1), Contract No. 95040 (Referred at US EPA, 1998).

U.S. EPA. 1981 Improved Emission Factors for Fugitive Dust from Western Surface Coal Mining Sources, U. S. Environmental Protection Agency, Research Triangle Park, NC, EPA Contract No. 68-03-2924, Assignment 1, July 1981 (Referred at US EPA, 1998) (Referred at US EPA, 1998).

U.S. EPA. 1983a. Iron and Steel Plant Open Source Fugitive Emission Control Evaluation, EPA Contract No. 68-02-3177, Assignment 4, Research Triangle Park, North Carolina.

U.S. EPA. 1983b. Extended Evaluation of Unpaved Road Dust Suppressants in the Iron and Steel Industry, EPA Contract No. 68-02-3177, Assignment 14, Research Triangle Park, North Carolina (Referred at US EPA, 1998).

U.S. EPA. 1994. Surface Coal Mine Emission Factor Study, EPA Contract No. 68-D2-0165, Assignment I-06, Research Triangle Park, North Carolina (Referred at US EPA, 1998).

U.S. EPA. 1998. Emission Factor Documentation for Section 13.2.2 (Unpaved Roads), Fifth Edition (AP-42). EPA Purchase Order 7D-1554-NALX; MRI Project No. 4864, Prepared by MRI for US EPA. Office of Air Quality Planning and Standards Emission Factor and Inventory Group Research Triangle Park.

217. Volume 2, CR 1, Section 5.0, Pages 47-55

Air quality modeling predictions are presented and indicate a significant increase in SO_2/NO_2/CO levels. Health Canada advises that all projects attempt to minimize air emissions to the greatest extent possible, regardless of any upper limits referenced in the applicable criteria, guidelines or standards. Aside from the use of Tier 4 engines, mitigation measures presented in section 6.3 only address controls for the emission of particulate matter.

a. Discuss measures for air emission control of SO_2/NO_2/CO to determine if additional mitigation is feasible.

Response:

CVRI notes that the Project represents a continuation of mining in the region, from its current location in the Mercoal West and Yellowhead Tower mines. Thus it represents a shift in the location of operations rather than a new Project on the landscape.

Table 5.1-1 in CR#1 presents SO_2 predictions and indicates that absolute Project contributions are small at all locations. Near Robb, relative contributions are higher because the Project is located in a location where previously no industrial activity existed. A small Project source of SO_2 is sulphur in diesel fuel and emissions of this species are independent of engine tier, and only dependent on fuel quality over which CVRI has no control.

The largest source of SO_2 (and NO_2 and CO) emissions is blasting (see Tables 4.1-5 and 4.1-6 in CR#1). CVRI will investigate the potential for low-emission practices, including the use of greater setbacks and smaller but more frequent blasts. In particular, CVRI will review and apply to the extent feasible the code of practice developed by AEISG (2011) for reducing and managing NO_X emissions from blasting, which may also have some applicability to SO_2 and CO emissions.

Table 5.2-1 in CR#1 indicates there are no exceedences of air quality objectives for NO_2 at any location or over any averaging period, with maximum predictions at Robb about 60% or less of the objectives. Project NO_2 emissions are mainly the result of blasting, with secondary contributions from diesel combustion by the mine and haul fleet. Diesel emissions are controlled by engine and exhaust technology; at present Tier 4 technology is not commercially available but is expected to be during the period that the Project approaches the community of Robb.

Table 5.3-1 in CR#1 shows there are no exceedences of air quality objectives for CO at any location or over any averaging period, with maximum predictions at Robb less than 50%. Project CO emissions are the result of blasting and diesel combustion by the mine and haul fleet. Similar mitigation approaches would apply.

In addition to vehicle technology and blasting, CVRI has additional operational controls that could be applied should concentrations of these species be of concern. These include maintaining a larger buffer between the mine and the community and reducing the intensity of operations.

Reference:

Australian Explosives Industry and Safety Group Inc. (AEISG). *2011*. Code of Good Practice Prevention and Management of Blast Generated NOx Gases in Surface Blasting. https://www.oricaminingservices.com/uploads/Bulk%20Systems/COP%20NOx%20-%20Edition%201%20June%202011.pdf.

218. Volume 2, CR 1, Section 5.0, Pages 47-77

Section 2.1.1 describes the assessment approach and states that the Application Case includes both the Baseline Case and Project Case 1. Section 5.0 details the Air Quality Modeling Predictions in a series of tables.

Throughout the tables in Section 5.0:

a. Discuss why the Predicted COPC Concentrations for the Baseline Case are equal to the Application Case, when Project Case 1 values are not zero. For example, Table 5.1-1 Predicted Sulphur Dioxide Concentrations for receptor location R1-SE Robb, Baseline Case is 26 $\mu m/m^3$, Application Case is 26 $\mu m/m^3$, and Project Case is 11 $\mu m/m^3$. If Application Case includes both Baseline Case and Project Case 1, it would yield a value of 37 $\mu m/m^3$ and not 26 $\mu m/m^3$.

Response:

The explanation is that Baseline, Application and Project-only maximum predictions do not occur at the same location or the same time; therefore, the maximum predictions are not additive.

With respect to the SO_2 example cited, there is a sour gas plant within the RSA, which emitted about 7 t/d SO_2 in Baseline and Application cases. Maximum predictions of SO_2 at receptor R1-SE Robb are result of gas plant emissions in both emission cases that occur under meteorological conditions conducive to high concentrations. The gas plant and mine sources are on opposite sides of the community, and therefore plumes from the two sources cannot contribute to maxima at the same time.

219. Volume 2, CR 1, Section 5.4, Page 55
This section describes the mitigating influences of forested vegetation described in Pace, 2005, and used to reduce predicted PM10, PM2.5, and TSP emissions. The capture factors (CF) provided in Pace 2005 "*are only generalized defaults and should be modified by local data or as further research becomes available. Also, the estimated CF's herein are believed to be too high for windblown dust events because the wind's turbulence will usually lift particles higher more quickly, and the opportunity for vegetative removal is likely reduced".*

a. Discuss if these generalized defaults were modified by local data specific to this project or other references were considered prior to utilizing these mitigating factors to reduce predicted particulate emissions.

Response:

To our knowledge, there have been no local tests of the ability of forests in the area to mitigate windborne dust. Nonetheless, there are expected to be some differences between the vegetation considered by Pace and that in the Project area. In particular, we expect that the Robb-area confer stands are less dense than some considered by Pace and the branch or leaf density may also be less. At the same time, the wooded fetch in the Robb area may be longer than some considered by Pace, and certainly for some tests listed in other references. As a result of these differences, a capture fraction of 80% was used in the Project modelling, rather than the recommended 100%.

A number of other reports or papers were reviewed and considered. Many of these are referenced in the response to ESRD SIR #46.

220. Volume 1, Section D.2.4, Page D5
This section describes the Baseline Case, Application Case and Cumulative Effects Assessment Case. Application Case is defined as including, "Baseline Case plus the Project". Table D.2-1 provides a list of Existing, Approved and Planned projects. According to this table, Approved Activity (Application Case) includes the mining operations at Mercoal West and Yellowhead Tower Mine Areas.

a. Explain why the Robb Trend Mine Area (the Project) is not included in Table D.2-1 as the Application case.

Response:

Table D.2-1 contains two typographical errors. The corrected table is included as ESRD Table 220-1, with changes highlighted.

Table 220-1 List of Existing, Approved and Planned (Reasonably Foreseeable) Projects

Company	Project	Existing or Approved Activity (Baseline Case)	Project Activity (Application Case)	Planned Activity (Reasonably Foreseeable) (CEA Case)
Mining Operations				
CVRI	Coal Valley Mine	⊗		
	West Extension and South Block Areas	⊗		
	Mercoal East Phase 1 and 2 Areas	⊗		
	Gregg River Mine	⊗		
	Mercoal West and Yellowhead Tower Mine Areas	⊗		
	Robb Trend Mine Area		⊗	
Elk Valley Coal Corp.	Luscar Mine	⊗		
	Cheviot Mine	⊗		
Coalspur Mines Ltd.	Vista Coal Project			⊗
Timber Harvesting				
West Fraser Mills Ltd.	Operations from 1954 to mid 2007	⊗		
	Operations to 2017 (10 years)			⊗
	Operations to 2032 (25 years)			⊗
	Operations to 2057 (50 years)			⊗
Sundance Forest Industries	Operations to mid 2007	⊗		
	Operations to 2017 (10 years)			⊗
	Operations to 2032 (25 years)			⊗
	Operations to 2057 (50 years)			⊗
Other Projects				
Oil and Gas	Gas Plants	⊗		
	Wellsites	⊗		
	Access Roads	⊗		
	Pipelines	⊗		
	Misc.	⊗		
Linear Disturbances	Powerlines	⊗		

221. Volume 3, CR 5, Section 2.5, Page 3

The Human Health Risk Assessment (HHRA) indicates that at no time will mining coincide on both sides of the Hamlet of Robb. However, the project Description (section C, pg. C-30, Table C2-4) development schedule indicates that Robb East, Robb Main and Robb West mines will all be operational at the same time. The Air Quality Assessment Report (Millennium 2012) appears to address mining at Robb West and Robb East at the same time, with no mention of Robb Main (Project 1 scenario).

a. Confirm the mining schedule and that the appropriate air modeling data was used in the HHRA for the proposed Project.

Response:

Section 2.5 in the HHRA (CR #5) states the following:

"The order and method of mining is an important consideration for the Project in relation to the receptors in the Hamlet of Robb. The mine plan will start mining in the area to the east of Robb with both dragline and truck and shovel methods being implemented. Mining will shift to the west of Robb at a later date and at no time will mining coincide on both sides of Robb. The minimum proximity of the mine on the west and east side of the Hamlet of Robb is 450m and 2050m, respectively." ESRD Figure 221-1 presents the distance of mining areas adjacent to the Hamlet of Robb.

The description of the mine sequence in Section C, Table C.2-4 appears to conflict with Section 2.5 in the HHRA and highlights the development occurring concurrently in Robb East, Robb Main and Robb West between 2027 to 2036. However the Project area will be developed sequentially over the mine life. To illustrate this progression eleven development stages have been detailed showing the mine sequence over time. Development will utilize a combination of dragline and truck/shovel mining methods with multiple pits active simultaneously. The active pit development for each stage of mining are listed in Table C.3-1 and shown on the following figures:

- Figure C.3-1 - Stage 1A
- Figure C.3-2 - Stage 1B
- Figure C.3-3 - Stage 2A
- Figure C.3-4 - Stage 2B
- Figure C.3-5 - Stage 3
- Figure C.3-6 - Stage 4
- Figure C.3-7 - Stage 5

- Figure C.3-8 - Stage 6
- Figure C.3-9 - Stage 7
- Figure C.3-10 - Stage 8
- Figure C.3-11 - Stage 9

At any one time there will be several pits (Figure C.3-12) under various stages of development. This phasing of the development allows the rock removal and coal recovery to be scheduled allowing sufficient coal release to provide a steady feed of raw coal to the Plant and ensuring rail and port delivery schedules to customers.

The strategy for development follows a number of basic principles that are outlined in the Project Description (Section C) and of most interest are the following (Section C.3):

- mining will not occur immediately adjacent to both sides of the community of Robb at the same time; and
- mining nearest the community of Robb will be sequenced to minimize noise and air impacts.

222. Volume 3, CR 5, Section 3.2.1.1, Page 6

The HHRA states that since the project will not release any chemicals in to the groundwater or surface water, the COPCs are based on air emissions only. Based on the information in the Air Quality Assessment Report (Millennium 2012), it appears that the plant operations are considered as part of the project with respect to air emissions.

a. Clarify if the processing of the mined material at the plant is considered a part of the Project.

Response:

The processing of mined material at the Plant is not considered part of the Project, but the emissions from the Plant were included as part of the baseline emission inventory in the air quality assessment (Section 4.1.3; CR #1).

If the processing of mined material at the plant is considered as part of the project

b. Discuss potential COPC releases to surface water and/or groundwater (i.e. tailing and settling ponds associated with the coal process plant) and incorporate these releases into the HHRA as necessary.

Response:

As stated in the response to ESRD SIR #222 a), the Plant is not considered part of the Project.

The Plant and settling pond are approved facilities for the operation of the CVM and are not part of the application for the Project. However, the Plant and settling pond are included as part of the Baseline Case and included within the Hydrogeology assessment (CR #3). The potential for COPC releases to surface water and groundwater is very low due to the following:

- the Plant uses an insignificant amount of chemicals and creates a tailings stream that contains only rock particles and water;
- the rock particles have been approved for placement in various coal pits throughout the history of the Plant; and
- the water in the settling pond from the Plant is reused as makeup water in the Plant after fine particles have settled and the water is clean enough to reuse in the Plant.

Therefore, because COPC release rates are very low, the HHRA did not incorporate them.

223. Volume 3, CR 5, Section 3.2.1.1, Page 6

Health Canada generally advises that Particulate Matter with diameter of <10µm (PM_{10}) should be considered a COPC in the air quality assessment. PM_{10} poses a risk to human health as these particles can travel deep into the lungs and affect the human respiratory system to varying degrees based on penetration and deposition rates into the lungs (WHO 2003).

a. Discuss if PM_{10} was considered in the assessment or provide a rationale for its exclusion.

Response:

Particulate matter with diameter of <10µm (PM_{10}) was not considered in the human health risk assessment on the basis that particulate matter with a diameter <2.5µm ($PM_{2.5}$) provides a better predictor of adverse health effects. Specifically, Pope and Dockery (2006) have made the following comments in regards to adverse health effects between coarse (*i.e.*, PM_{10}) and fine (*i.e.*, $PM_{2.5}$) particles:

- in regard to $PM_{2.5}$, various toxicological and physiological considerations suggest that fine particles may play the largest role in effecting human health;
- fine particles are likely more toxic due to the various chemicals that adhere to their surfaces (*i.e.*, sulfates, nitrates, acids, and metals);

- fine particles can be breathed deeper into the lungs;
- fine particles can remain suspended in the air for longer periods of time;
- fine particles can penetrate more easily into indoor environments; and
- fine particles can travel longer distances.

In addition, more significant adverse associations are predicted with fine particulate matter. The multicity study by Zanobetti and Schwartz (2009) found a significant association between fine particulate matter and the risk of mortality for all causes, myocardial infarction, cardio vascular disease, stroke and respiratory disease. The study also found a significant association between coarse particulate matter and daily deaths. All other causes were found insignificant (*i.e.,* myocardial infarction, cardio vascular disease, stroke and respiratory disease) between coarse particulate matter and daily deaths.

Finally, the WHO (2005) PM_{10} guideline is actually based on $PM_{2.5}$ studies. WHO (2005) notes the following:

- "PM_{10} is suggested as an indicator with relevance to the majority of the epidemiological data and for which there is more extensive measurement data throughout the world. However, as discussed below, the numerical guideline value itself is based on studies using $PM_{2.5}$ as an indicator and a $PM_{2.5}/PM_{10}$ ratio of 0.5 is used to derive an appropriate PM_{10} guideline value."

Predicted daily maximum PM_{10} concentrations at the MPOI and receptor locations are presented in ESRD Table 223-1. In addition, ESRD Table 223-2 presents the predicted maximum annual average PM_{10} concentrations at the MPOI and receptor locations. For almost all circumstances, the predicted maximum daily concentrations are below the WHO guideline of 50 $\mu g/m^3$. Exceedances occurred at:

- R12, R2, and R6 for the unmitigated Application Case;
- R16 for both the unmitigated Baseline and Application Cases; and
- LSA and RSA for the un-mitigated and mitigated in both Baseline and Application Cases.

Recently, the U.S. EPA proposed to retain the current 24-hour PM_{10} standard (*i.e.,* 150 $\mu g/m^3$) to continue to provide protection against effects associated with short-term exposure to coarse particles (U.S. EPA 2012). In almost all circumstances, the predicted maximum daily average concentrations are below the U.S. EPA standard. The only exceedances occurred at the unmitigated Baseline and Application Cases for the LSA and RSA receptors.

For all circumstances, the predicted maximum annual average concentrations are below the WHO guideline of 20 µg/m^3.

Adverse effects are not expected based on the following:

- Mitigated predicted maximum daily PM_{10} concentrations at both the Baseline and Application cases are equal to or less than the WHO and EPA standards of 50 µg/m^3 and 150 µg/m^3, respectively.
- Mitigated predicted 2nd highest daily PM_{10} concentrations for both the Baseline and Application cases are less than WHO and EPA standards of 50 µg/m^3 and 150 µg/m^3, respectively.
- In the examination of potential human health risks associated with acute inhalation exposures to PM it is also important to recognize that particulate matter (PM) health effects are dependent on both exposure concentrations and length of exposure and that the short-term studies only capture a small amount of the overall health effects of PM exposure (Pope and Dockery 2006).
- Pope and Dockery (2006) concluded that long-term repeated exposures to pollution may have more broad-based impacts on long-term health and susceptibility, and suggest that the daily time series studies only capture a small amount of the overall health effects of long-term repeated exposure to PM. For this reason, results of the chronic inhalation assessment (*i.e.,* comparison of annual average exposure to chronic exposure limits) may be considered a better predictor of potential health effects associated with PM than acute assessment results.
- There are no exceedances of the annual standard from WHO, of 20 µg/m^3, for the unmitigated and mitigated predicted annual average maximum PM_{10} concentrations.

Table 223-1 Predicted Daily Maximum and 2nd Highest Daily PM_{10} Concentrations at Receptor Locations for the Baseline and Application Cases [µg/m^3]

Receptor ID	Receptor Group	Unmitigated(1)		Mitigated(2)	
		Baseline(3)	Application(3)	Baseline(3)	Application(3)
R1	Residence	21(20)	36(33)	17(17)	21(20)
R10	Recreation	31(27)	31(29)	20(19)	20(19)
R11	Recreation	26(23)	35(34)	18(18)	21(21)
R12	Recreation	35(34)	51(47)	21(21)	25(24)
R13	Recreation	21(20)	27(25)	17(17)	19(18)
R14	Recreation	20(20)	35(29)	17(17)	21(19)
R15	Residence	20(20)	41(37)	17(17)	22(21)

Table 223-1 Predicted Daily Maximum and 2nd Highest Daily PM_{10} Concentrations at Receptor Locations for the Baseline and Application Cases [μg/m^3]

Receptor ID	Receptor Group	Unmitigated[1]		Mitigated[2]	
		Baseline[3]	Application[3]	Baseline[3]	Application[3]
R16	Residence	82(70)	89(74)	32(30)	34(31)
R17	Residence	21(20)	29(29)	17(17)	19(19)
R18	Recreation	19(18)	27(21)	17(17)	19(17)
R2	Residence	23(22)	103(61)	18(17)	38(27)
R3	Recreation	20(19)	31(26)	17(17)	20(19)
R4	Recreation	18(18)	26(24)	17(16)	18(18)
R5	Recreation	20(19)	29(24)	17(17)	19(18)
R6	Recreation	31(28)	68(64)	20(19)	29(28)
R7	Recreation	45(38)	47(45)	23(22)	24(23)
R8	Residence	21(20)	28(27)	17(17)	19(19)
R9	Recreation	19(18)	23(21)	17(16)	18(17)
LSA	MPOI-LSA	151(113)	156(117)	50(40)	51(41)
RSA	MPOI-RSA	151(113)	161(117)	50(40)	52(41)

Notes:
(1) Unadjusted predicted daily maximum concentrations in the study area
(2) Predicted daily maximum concentrations have been reduced by 75% to account for the mitigating influences of forested vegetation since this vegetation can reduce particulate emissions by 80 to 100% (Pace 2005).
(3) Predicted 2nd highest daily concentration presented in parenthesis

Table 223-2 Predicted Annual Average Maximum PM_{10} Concentrations at Receptor Locations for the Baseline and Application Cases [μg/m^3]

Receptor ID	Receptor Group	Unmitigated		Mitigated	
		Baseline	Application	Baseline	Application
R1	Residence	6.6	7.4	6.4	6.6
R10	Recreation	7.3	7.5	6.6	6.6
R11	Recreation	6.7	7.5	6.4	6.6
R12	Recreation	7.5	8.1	6.6	6.8
R13	Recreation	6.6	7.1	6.4	6.5
R14	Recreation	6.6	7.3	6.4	6.6
R15	Residence	6.6	7.9	6.4	6.7
R16	Residence	8.5	9.5	6.9	7.1
R17	Residence	6.6	7.4	6.4	6.6
R18	Recreation	6.4	6.6	6.3	6.4
R2	Residence	6.9	10.2	6.5	7.3
R3	Recreation	6.6	7.1	6.4	6.5
R4	Recreation	6.4	7.0	6.3	6.5

Table 223-2 Predicted Annual Average Maximum PM_{10} Concentrations at Receptor Locations for the Baseline and Application Cases [µg/m^3]

Receptor ID	Receptor Group	Unmitigated		Mitigated	
		Baseline	Application	Baseline	Application
R5	Recreation	6.5	6.9	6.3	6.4
R6	Recreation	7.2	11.4	6.5	7.6
R7	Recreation	7.5	7.9	6.6	6.7
R8	Residence	6.6	7.2	6.4	6.5
R9	Recreation	6.4	6.6	6.3	6.4
LSA	MPOI-LSA	11	15	7.5	8.4
RSA	MPOI-RSA	13	15	8.1	8.4

References:

Pope C.A. and Dockery D.W. 2006. Health Effects of Fine Particulate Air Pollution: Lines that Connect. Critical Review. J. Air & Waste Manage. Assoc. 56:709–742.

WHO (World Health Organization). 2005. WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulphur dioxide. Global update 2005. Summary of risk assessment. World Health Organization.

U.S. Environmental Protection Agency (EPA). 2012. Environmental Protection Agency 40 CFR Parts 50, 51, 52, 53, and 58 [EPA–HQ–OAR–2007–0492; FRL–9682–9] RIN 2060–AO47. National Ambient Air Quality Standards for Particulate Matter. Federal Register; Vol. 77, No. 126; Friday, June 29, 2012.

Zanobetti, A. and Schwartz, J. 2009. The effect of fine and course particulate air pollution on mortality: a national analysis. Environ Health Perspect 117:898-903.

224. Volume 3, CR 5, Section 3.2.1.2, Pages 10-13 and Table 3-2

Currently recreational receptors are only assessed with respect to acute inhalation. However, the project scenario appears to be for a timeframe longer than an acute scenario. It is indicated that the recreational receptors may engage in camping, hunting and/or fishing for variable periods of time, which may require the assessment of other operable exposure pathways for this receptor group (e.g. local food consumption of foods collected from the area impacted by the site and eaten immediately or later).

a. Provide the multiple pathway assessment for the recreational receptors or provide a rationale as to why this was excluded.

Response:

The recreational group includes individuals who may visit local campgrounds or other sites for recreational purposes (*e.g.,* fishing or hunting) for various durations of time (days, months) but do not permanently reside in the area. Alternatively, it was assumed that the resident group lived permanently in the area, and practiced a lifestyle that involves a high level of consumption of local country foods, garden vegetables and traditional plants. It also includes individuals who may use the cabins located in the RSA as a temporary shelter while engaged in activities such as hunting, fishing or trapping. Table 3-2 in CR #5 lists the specific discrete receptor locations included in the multiple pathway assessment.

A chronic inhalation assessment was not provided for the recreational group; however, ESRD SIR #156 presents the chronic inhalation RQ and ILCR values predicted at the RSA-MPOI and LSA-MPOI, respectively. The assessment of chronic inhalation risks at the LSA-MPOI and RSA-MPOI is considered conservative, given that individuals will not remain at the MPOI on a chronic basis.

A multiple pathway assessment for the recreational group was not presented as the resident group provides a conservative assessment. The resident group is considered conservative due to a high level of consumption of local country foods, garden vegetables and traditional plants from the local environment. However, ESRD SIR #156 presents the non-carcinogenic and carcinogenic multiple pathway risks, respectively based on the air concentrations predicted at the RSA-MPOI.

Risk quotient (RQ) values for the non-carcinogenic COPCs are provided for the most sensitive life stage for the resident group (ESRD Table 156-5). All multiple pathway RQ values for the Baseline and Application Cases for the resident group at the RSA-MPOI were less than 1.0, with the exception of manganese and methyl mercury. For all of the COPCs, negligible changes in RQ values were predicted between the Baseline and Application Cases, indicating that the incremental change associated with the Project is negligible. In addition, comparison of RQ values in ESRD Table 156-5 to those presented in Table 4-10 (CR #5) indicates that multiple pathway risks at the RSA-MPOI location (*i.e.,* including recreational receptor locations) are not measurably different than those at resident locations. Overall, the potential for adverse non-carcinogenic health impacts is anticipated to be low. Further discussion of manganese and methyl mercury risk estimates are provided in Section 4.3 CR #5.

Carcinogenic results are presented only for the incremental Project scenario in the HHRA (Application minus Baseline). All values represent ILCR per 100,000 people. All ICLR values in ESRD Table 156-6 were less than 1.0, indicating that the Project is associated with negligible incremental cancer risks (*i.e.,* less than 1 in 100,000) from multiple pathway exposures at the RSA-MPOI.

225. Volume 3, CR 5, Section 4, Pages 43-46, 50-53

Acute inhalation risk quotient (RQ) exceedances: Baseline arsenic concentrations result in a RQ exceeding the target, but the application fleet will convert from Tier 1 to Tier 4 engines.

a. Clarify whether there is a plan to confirm this fleet change to validate the air quality monitoring prior to moving forward with the Project.

Response:

The Application and Planned Development Case assessments were chosen in part to examine worst-case impacts at the community of Robb which is the nearest community to mining in the Project. The assessments included the use of Tier 4 diesel engines because mining operations reach Robb no earlier than 2025 when Tier 4 engines are expected to be commercially available in Canada.

Acute arsenic RQ values were predicted to be above 1.0 at the RSA MPOI (RQ = 2.1) and R6 location (RQ=1.1) in the Baseline Case. RQ values were predicted to be below 1.0 in the Application Case at the RSA MPOI and R6 location. The probability of exceeding the arsenic exposure limit of 0.2 µg/m3 at the RSA MPOI and R6 location in the Baseline Case is 0.2% and 0.1% on an hourly basis, respectively. The location where the RSA MPOI RQ value exceeds 1.0 is predicted within an existing mine boundary (*i.e.,* Yellowhead Haul Road) where the likelihood of exposure is expected to be limited. Therefore, the HHRA predicted that adverse effects are not expected from acute inhalation exposure to arsenic.

By the time Project activities approach the community of Robb in the 2025 and 2034 timeframes modelled in the air quality assessment, CVRI plans to have in place engines meeting Tier 4 specifications. These engines will not be in place when the Project begins operations, which will occur at locations that are distant from the community. CVRI plans to replace its existing fleet with Tier 4 engines as the fleet is turned over, pending the commercial availability of the engines in Canada.

> *NO2 and SO2 RQ exceedances at maximum point of impingement (MPOI) are discussed as overly conservative and unlikely to result in negative health impacts. However, the predicted concentrations are unlikely to result in negative health impacts. However, the predicted concentrations may result in adverse impacts to people with respiratory sensitivities.*

At the same time, CVM recognizes that the existing fleet currently operating at the Yellowhead Mine with Tier 1 to Tier 3 engine characteristics will be used initially on the Project, and that engine emissions in the early years of operation will be higher than in the years chosen for Project Cases 1 and 2. It is also expected that the fleet turnover to Tier 4 diesel engines will be gradual over the initial stages of the Project.

CVRI anticipates the use of Tier 4 engines as they become available and as fleet turnover proceeds, but does not plan to further validate the air quality model results.

> NO_2 and SO_2 RQ exceedances at maximum point of impingement (MPOI) are discussed as overly conservative and unlikely to result in negative health impacts. However, the predicted concentrations are unlikely to result in negative health impacts. However, the predicted concentrations may result in adverse impacts to people with respiratory sensitivities.
>
> b. Discuss whether the project will include controls to prevent access or notify receptors that may be sensitive.

Response:

A recent meta-analysis of NO_2 exposure and airway hyper-responsiveness in asthmatics suggests that there is no evidence that NO_2 causes clinically relevant effects in asthmatics at concentrations up to 1,100 µg/m³ (Goodman *et al.* 2009). The predicted maximum hourly air concentration of 254 µg/m³ at the LSA and RSA location is substantially less than this threshold. As such, despite the predicted exceedances of the U.S. EPA standard, the potential for adverse effects to occur in asthmatics or sensitive individuals is considered to be low. In addition, the predicted probability of hourly exceedances of acute NO_2 health benchmarks at the LSA and RSA MPOI location are very low suggesting that the probability of adverse effects is not expected (Table 4-6; CR #5).

The maximum predicted hourly SO_2 concentration at the RSA MPOI (740 µg/m³) in the Baseline and Application Case are within the range of air concentrations where increased airway resistance and potential bronchoconstriction in asthmatic or sensitive individuals is observed when engaged in moderate exercise. Alternatively, clear respiratory responses were not observed in a study in which non exercising asthmatics were briefly exposed to SO_2 concentrations of 1,300 µg/m³ (Linn *et al.* 1983; Sheppard *et al.* 1981). All changes in airway resistance are reversible and shortness of breath or other clinical signs may be observed depending on severity of the asthmatic condition. The probability of exceeding the WHO 10-min SO_2 exposure limit of 500 µg/m³ at the RSA MPOI is less than 0.002% (*i.e.,* 1 hour in 5 years or 43,824 hours). Finally, the maximum concentration of SO_2 in the Application Case is predicted to occur within close proximity to the Project permit boundary (CR#1).

CVRI considers controls to prevent access or notify receptors to be unnecessary for the following reasons:

- The predicted probability of hourly exceedances of acute NO_2 and SO_2 health benchmarks at the LSA and RSA MPOI location are very low suggesting that the probability of adverse effects is not expected.
- A recent meta-analysis of NO_2 exposure and airway hyper-responsiveness in asthmatics suggests that there is no evidence that NO_2 causes clinically relevant effects in asthmatics at concentrations up to 1,100 µg/m³ (Goodman *et al.* 2009).
- Predicted SO_2 concentrations are within the range where increased airway resistance and potential bronchoconstriction in asthmatic or sensitive individuals is observed when engaged in moderate exercise. However, all changes in airway resistance are reversible and shortness of breath or other clinical signs may be observed depending on severity of the asthmatic condition.
- The maximum concentrations are predicted to occur within close proximity to the Project permit boundary where the likelihood of exposure is expected to be limited.

References:

Goodman, J.E., Chandalia, J.K., Thakali, S. and Seeley, M. 2009. Meta-analysis of nitrogen dioxide exposure and airway hyper-responsiveness in asthmatics. Critical Reviews in Toxicology 39(9):719-742

Linn W.S., Shamoo D.A., Spier C.E., Valencia L.M., Anzar U.T., Venet T.G. and J.D. Hackney. 1983. “Respiratory effects of 0.75 ppm sulphur dioxide in exercising asthmatics: influence of upper respiratory defenses.” Environmental Research 30: 340 348.

Sheppard D., Saisho A., Nadel J.A. and Boushey H.A. 1981. “Exercise increases sulphur dioxide induced bronchoconstriction in asthmatic subjects.” Am. Rev. Respir. Dis. 123: 486 491.

226. Volume 3, CR 5, Appendix D

The Application Case includes Baseline concentrations and project related concentrations. The Baseline concentrations include background exposure to soil, air, water and local foods.

For additional clarification on Health Canada’s guidance for human health risk assessment for chemicals, please refer to *Part V: Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals, Health Canada, 2010* http://www.hc-sc.gc.ca/ewh-semt/pubs/constamsite/chem-chim/index-eng.php

a. Clarify why commercial foods were not incorporated in the total background exposure as the incorporation of commercial foods into the total background exposure may alter the results of the risk assessment.

Response:

Commercial foods were not incorporated in the HHRA due the following reasons:

- Commercial foods were replaced with foods derived from the local environment.
- The HHRA focused on assessing risks to individuals who derive a large portion, if not all, of their diet from the LSA.
- A detailed estimation of background exposures to commercial foods is readily available from the Total Diet Study by Health Canada (2011).

The inclusion of commercial foods in the Baseline Case would have resulted in double counting exposures from food and over predicted risks. The HHRA assumed that the resident group lived permanently in the area, and practiced a lifestyle that involves a high level of consumption of local country foods (*i.e.,* game meat and fish), garden vegetables and traditional plants. The HHRA based these exposures on measured concentrations (*i.e.,* soil, water and fish) derived from the LSA where mining activity is absent. In addition, the air quality assessment modeled background sources in the Baseline Case and included background concentrations based on measured ambient data at air monitoring stations. Essentially, the predicted exposure a human receptor would experience in the Baseline Case is similar to if the site did not exist and the receptor practiced a lifestyle that involves a high level of consumption of local country foods, garden vegetables and traditional plants.

Canadian background dietary exposures to metals are available from Health Canada's Total Diet Study (2011), with data presented from 1993 to 2007 for major urban centers across Canada. The Health Canada data were used to estimate total exposures in combination with Baseline Case exposures predicted for the residential locations in the HHRA. The Baseline Case was used for two reasons:

- Application Case and Baseline Case metal exposures and risks are practically identical.
- The Baseline Case is likely the most appropriate case for comparison to the Health Canada data.

ESRD Table 226-1 summarizes Baseline Case metal exposures predicted in the Project HHRA for the residential toddler and adult. Information is presented for predicted exposures to dietary items alone ("food only") and for all pathways included in the HHRA ("total exposure"), but only for those metals for which Health Canada (2011) offers background estimates of exposure.

ESRD Table 226-2 presents the average and range of background exposures estimated by Health Canada (2011). The range is provided in ESRD Table 226-2 to show how exposures predicted in the Total Diet Study vary from year to year and city to city. Note that data from the Total Diet Study are based on metal concentrations only in the Canadian food supply, and therefore does not account for exposure from other sources such as soil, water, air, or consumer products.

Table 226-1 HHRA Predicted Base Case Exposure (Food and Total) for the Resident Toddler and Adult

COPC	Toddler Exposure (µg/kg-day)		Adult Exposure (µg/kg-day)	
	Food Only[1]	Total Exposure[2]	Food Only[1]	Total Exposure[2]
Aluminum (Al)	53.5	66.9	27.6	34.3
Arsenic (As)[3]	0.08	0.27	0.04	0.13
Barium (Ba)	7.18	8.27	3.58	3.70
Beryllium (Be)	0.07	0.08	0.03	0.04
Cadmium (Cd)	0.03	0.04	0.02	0.02
Cobalt (Co)	1.05	1.10	0.54	0.54
Copper (Cu)	7.45	7.59	3.92	3.97
Lead (Pb)	0.21	0.28	0.10	0.12
Manganese (Mn)	345	351	176	178
Molybdenum (Mo)	2.53	2.84	1.76	1.94
Nickel (Ni)	0.64	0.87	0.33	0.40
Selenium (Se)	0.84	0.88	0.40	0.42
Uranium (U)	0.12	0.14	0.06	0.06
Zinc (Zn)	55.1	55.5	23.8	23.9

NOTES:
1 Includes above-ground and below-ground plants, berries, Labrador tea, cattails, fish, moose, ruffed grouse and snowshoe hare
2 Includes food items and soil and water pathways
3 Represents exposures only to inorganic arsenic

Table 226-2 Background Dietary Exposure to Metals for the Toddler and Adult in Canada

COPC[1]	Toddler[2] Exposure (µg/kg-day) Average (Min to Max)	Adult[3] Exposure (µg/kg-day) Average (Min to Max)
Aluminum (Al)	247 (171 to 385)	137 (105 to 208)
Total Arsenic (As)	1.1 (0.83 to 1.4)	0.76 (0.51 to 0.97)
Inorganic Arsenic (As)[4]	0.41 (0.31 to 0.52)	0.28 (0.19 to 0.36)

Table 226-2 Background Dietary Exposure to Metals for the Toddler and Adult in Canada

COPC[1]	Toddler[2] Exposure (µg/kg-day) Average (Min to Max)	Adult[3] Exposure (µg/kg-day) Average (Min to Max)
Barium (Ba)	22 (19 to 25)	7.8 (6.4 to 9.3)
Beryllium (Be)	0.037 (0.004 to 0.13)	0.14 (0.002 to 0.046)
Cadmium (Cd)	0.56 (0.35 to 0.91)	0.21 (0.13 to 0.34)
Cobalt (Co)	0.61 (0.47 to 0.8)	0.22 (0.17 to 0.32)
Copper (Cu)	50 (46 to 57)	22 (20 to 25)
Lead (Pb)	0.27 (0.2 to 0.49)	0.12 (0.091 to 0.19)
Manganese (Mn)	106 (93 to 128)	53 (44 to 61)
Molybdenum (Mo)	8.2 (N/A)	2.7 (N/A)
Nickel (Ni)	11 (5.5 to 19)	4.3 (2.2 to 6.3)
Selenium (Se)	6.7 (5.7 to 8.7)	2.5 (2.2 to 3.2)
Uranium (U)	0.12 (0.11 to 0.13)	0.072 (0.063 to 0.09)
Zinc (Zn)	548 (519 to 594)	204 (190 to 227)

NOTES:
1 The following metals are not presented because background exposures are unavailable from Health Canada (2011): Antimony (Sb), Chromium (Cr and CrVI), Mercury (Hg and MeHg), and Vanadium (V)
2 Represents male and female toddlers aged 1 to 4 years
3 Represents male and female Canadians for all ages
4 Converted total arsenic to inorganic arsenic based on percentage inorganic content in foods of 37% (CCME 1995)
N/A = Not available
SOURCE: Health Canada 2011 Total Diet Study

Comparing the predicted "food only" exposure in the HHRA (ESRD Table 226-1) to the estimated dietary exposure from Health Canada (2011) (ESRD Table 226-2) indicates that:

- dietary exposures based on Health Canada's Total Diet Study exceed the dietary exposures predicted in the HHRA for almost all metals; and
- dietary exposures based on Health Canada's Total Diet Study are less than the dietary exposures predicted in the HHRA for beryllium (toddler only), cobalt, and manganese.

To evaluate the inclusion of the off-site exposure estimates from Health Canada's Total Diet Study, the background exposures from ESRD Table 226-2 were added to the predicted HHRA exposures from ESRD Table 226-1. Because of the uncertainty in the portion of background that contributes to total exposure in the HHRA, and in an attempt to avoid "double-counting", background estimates were added based on various assumed apportionment levels (*i.e.*, 0%, 10%, 25%, 50%, 75%, 90% and 100%). The following equation was used to calculate exposures:

$$E_T = (100\% - P) \times E_{HHRA} + P \times E_B$$

Where

E_T = Calculated weighted exposure based on HHRA plus off-site background (µg/kg-day)

P = Portion of off-site background that contributes to exposure (%)

E_{HHRA} = Predicted exposure from the HHRA (µg/kg-day)

E_B = Average background exposure estimated by Health Canada (µg/kg-day)

ESRD Table 226-3 presents the calculated exposures (E_T) for the residential toddler based on various assumptions of apportioned off-site background exposures. Because Health Canada's Total Diet Study presents data only for dietary exposures, the calculated exposures are based on the predicted exposures only to food and exclude other major pathways that were included in the HHRA (*i.e.,* soil, water and air). Predicted food exposures from the HHRA were used to provide a representative comparison to the Total Diet Study. Similarly, ESRD Table 226-4 provides the same information for the residential adult. In addition to the various levels of background contributing to exposure, ESRD Tables 226-3 and 226-4 present the estimates of combining the off-site background to exposures predicted in the HHRA (column identified as "sum"). In other words, the summed exposures represent a scenario where an individual would get 100% of their food from local sources and 100% of their food from off-site sources (*i.e.,* full "double-counting" scenario).

Comparison of predicted exposures from the local environment to background yields the following comments:

- Exposures to aluminum, arsenic, barium, cadmium, copper, manganese, molybdenum, nickel, selenium, and zinc are greater based on background than derived from the local study area for toddlers. For adults, exposures to aluminum, arsenic, barium, beryllium, cadmium, copper, molybdenum, nickel, selenium, uranium, and zinc are greater based on background than derived from the local study area.
- Exposures to beryllium, cobalt, and uranium are greater derived from the local study area than based on background for toddlers. For adults, exposures to cobalt and manganese are greater derived from the local study area than based on background.
- Exposure to lead remains relatively constant for both toddlers and adults whether it is based on background or derived from the local study area.

Table 226-3 Calculated Total Exposure for the Residential Toddler with Various Background Levels Contributing to Predicted Exposures in the HHRA

COPC	Total Exposure (µg/kg-day) Based on Various Apportionment (P) Values							
	0%	10%	25%	50%	75%	90%	100%	Sum
Aluminum (Al)	66.85	84.86	111.89	156.92	201.96	228.98	247.00	313.85
Arsenic (As)	0.27	0.28	0.30	0.34	0.37	0.39	0.41	0.67
Barium (Ba)	8.27	9.64	11.70	15.13	18.57	20.63	22.00	30.27
Beryllium (Be)	0.08	0.08	0.07	0.06	0.05	0.04	0.04	0.12
Cadmium (Cd)	0.04	0.10	0.17	0.30	0.43	0.51	0.56	0.60
Cobalt (Co)	1.10	1.05	0.97	0.85	0.73	0.66	0.61	1.71
Copper (Cu)	7.59	11.83	18.19	28.80	39.40	45.76	50.00	57.59
Lead (Pb)	0.28	0.28	0.28	0.28	0.27	0.27	0.27	0.55
Manganese (Mn)	351.47	326.92	290.10	228.73	167.37	130.55	106.00	457.47
Molybdenum (Mo)	2.84	3.37	4.18	5.52	6.86	7.66	8.20	11.04
Nickel (Ni)	0.87	1.88	3.40	5.93	8.47	9.99	11.00	11.87
Selenium (Se)	0.88	1.46	2.33	3.79	5.24	6.12	6.70	7.58
Uranium (U)	0.14	0.14	0.14	0.13	0.13	0.12	0.12	0.26
Zinc (Zn)	55.53	104.78	178.65	301.76	424.88	498.75	548.00	603.53

Table 226-4 Calculated Total Exposure for the Residential Adult with Various Background Levels Contributing to Predicted Exposures in the HHRA

COPC	Total Exposure (µg/kg-day) Based on Various Apportionment (P) Values							
	0%	10%	25%	50%	75%	90%	100%	Sum
Aluminum (Al)	34.32	44.59	59.99	85.66	111.33	126.73	137.00	171.32
Arsenic (As)	0.13	0.14	0.16	0.20	0.24	0.27	0.28	0.41
Barium (Ba)	3.70	4.11	4.73	5.75	6.78	7.39	7.80	11.50
Beryllium (Be)	0.04	0.05	0.06	0.09	0.11	0.13	0.14	0.18
Cadmium (Cd)	0.02	0.04	0.07	0.12	0.16	0.19	0.21	0.23
Cobalt (Co)	0.54	0.51	0.46	0.38	0.30	0.25	0.22	0.76
Copper (Cu)	3.97	5.77	8.48	12.98	17.49	20.20	22.00	25.97
Lead (Pb)	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.24
Manganese (Mn)	177.88	165.39	146.66	115.44	84.22	65.49	53.00	230.88
Molybdenum (Mo)	1.94	2.01	2.13	2.32	2.51	2.62	2.70	4.64
Nickel (Ni)	0.40	0.79	1.38	2.35	3.33	3.91	4.30	4.70
Selenium (Se)	0.42	0.63	0.94	1.46	1.98	2.29	2.50	2.92
Uranium (U)	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.13
Zinc (Zn)	23.93	41.94	68.95	113.97	158.98	185.99	204.00	227.93

References:

Health Canada. 2011. Health Canada. 2009. Total Diet Study. Bureau of Chemical Safety, Health Products and Food Branch. January 31 2011. http://www.hc-sc.gc.ca/fn-an/surveill/total-diet/index-eng.php

227. Volume 4, CR 8

The Noise Impact Assessment (NIA) provides a qualitative discussion of general noise nuisance issues including blasting noise and vibrations, low frequency noise (LFN) and back-up beepers. No quantitative noise assessment was conducted; rather the NIA states that mitigation measures will be investigated when the proponent receives noise complaints. Health Canada advises that a quantitative noise assessment (with applicable adjustments for sound characteristics such as tonal and impulsive noise), and separate consideration of construction and operation phases, would provide a more accurate prediction of noise levels and potential impacts to human health. Appropriate mitigation measures could then be identified.

a. Discuss, with respect to potential low-frequency noise (LFN), whether CVRI considered the advice given in the WHO (1999) *Community Noise Guidelines.*

Response:

CR #8 provides a quantitative assessment of the LFN for each Application Case Scenario (3 Scenarios in total). In each Scenario, the dBC and dBA sound levels were determined for all receptors based on octave-band sound power level noise sources for the noise producing equipment and the ISO 9613-2 sound propagation calculation algorithms. For Scenarios 1 and 2, all of the residential receptors will have dBC-dBA sound levels less than 20 dB. As prescribed by ERCB Directive 038 (the guideline used for assessing low frequency noise) if the dBC-dBA sound level is less than 20, there is minimal concern for LFN. For Scenario 3, all but 2 of the residential receptors will have dBC-dBA sound levels less than 20 dB. For the 2 locations with dBC-dBA sound levels greater than 20 dB, the broadband dBA sound levels were modeled to be very low (below 25 dBA). As such, even if there is a low frequency component to the noise, it will be at a very low level and the likelihood for annoyance is low.

An assessment relative to the WHO 1999 Community Noise Guidelines was not specifically performed. As mentioned in Section 4.3 of the WHO document:

"Noise measures based solely on LAeq values do not adequately characterize most noise environments and do not adequately assess the health impacts of noise on human well-being. It is also important to measure the maximum noise level and the number of noise events when deriving guideline values. If the noise includes a large proportion of low-frequency components, values even lower than the guideline values will be needed, because low-frequency components in noise may increase the adverse effects considerably. When prominent low-frequency components are present, measures based on A-weighting are inappropriate. However, the difference between dBC (or dBlin) and dBA will give crude information about the presence of low-frequency components in noise. If the difference is more than 10 dB, it is recommended that a frequency analysis of the noise be performed."

As such, the WHO document does not specify the recommended criteria for the broadband dBA sound level with a low frequency noise present nor does the document specify how to conduct or assess the frequency analysis if the dBC-dBA sound level is greater than 10 dB.

b. Discuss, with respect to blasting noise, if CVRI will use the US EPA's sonic boom criterion (US EPA 1974) as a blasting mitigation noise level for blasting that lasts less than one year. For blasting exposures of more than one year, Health Canada advises following the recommendations in ISO 1996-1:2003.

Response:

As detailed in Section 5.5.1 of CR #8:

...part of the mining operations involve use of explosive charges to loosen the raw materials for easier removal. The noise and vibration levels associated with blasting are typically a cause for concern by nearby residents and can disturb wildlife. It is important to note that there are no specific noise or vibration level limits for blasting in ERCB Directive 038. Nor are there any criteria on a Provincial level within Alberta or on a National level.

In an attempt to minimize the noise and vibration impacts from blasting, CVRI has indicated that the following methods and precautions will be used when nearer to the Robb area:

- Blasting is conducted on weekday afternoons typically between 14:00 – 16:00.
- Blasting is not normally conducted if there is cloud cover.
- Blasting is typically limited to smaller more localized blasts which reduces the amount of explosives.

If, upon commencement of blasting, nearby Robb residents express concern, alternative blasting procedures are available for additional mitigation. For example, it may be possible to schedule specific blasting days and times to reduce the "startle" effect. There are other mitigation measures that can be investigated specifically when the blasting is very near Robb.

Therefore, CVRI has specific procedures and methods already in place as well as other mitigation options available if required based on feedback from adjacent residential receptors.

ISO 1996-1 (2003) does not contain any specific recommendations for blasting noise. There are references to impulsive and high-energy impulsive sounds and measurement assessment methods, but no specific criteria are provided. There are also no specific or general mitigation recommendations contained within the document.

It should also be noted that since early 2012 CVRI has implemented a revised blasting procedure at the CVM operation. The operation has now implemented a surface initiating system which significantly reduces noise.

228. Volume 4, CR 8

The NIA does not provide any cumulative noise assessment. Cumulative effects assessments are required when other ongoing or future projects in the region may contribute to noise levels.

a. Provide a cumulative noise assessment, or provide a rationale as to why a cumulative noise assessment was excluded.

Response:

As discussed in Section 2.1 of CR #8 there are no other significant noise sources in the area beyond those associated with CVRI, nor are there any known planned projects within close enough distance to warrant inclusion in the noise assessment. All significant CVRI noise sources that will be in operation during the time of the CVRI Project have been included in the Application Case assessments. As such, a Cumulative Case noise assessment was not conducted.

229. Volume 4, CR 8, Section 2.1, Page 2

The NIA reports predicted noise levels at 48 receptors in and around the community of Robb.

a. Discuss whether any of these particular receptors may have heightened sensitivity to noise exposure (schools, childcare centres, hospitals, places of worship, etc).

Response:

All of the receptors considered in and around the community of Robb are permanent residential dwellings, as specified by ERCB Directive 038. Areas such as schools, childcare centres, hospitals, places of worship, *etc.* are not considered by ERCB Directive 038 to be permanently occupied dwellings and, as such, were not included in the assessment as receptors.

230. Volume 4, CR 8 – Noise Impact Assessment, Section 2.1, Page 2
The NIA states that all other trappers cabins, campsites, etc. that are 1.5 km beyond the mind pit boundary have not been included in the study; and that this meets the requirements of the Alberta Energy Resources Conservation Board Directive 038.

a. Confirm that project related transportation noise will not impact any human receptors 1.5 km beyond the mine pit boundary, and if there are potential impacts, and appropriate mitigation measures.

Response:

Project related transportation noise (*i.e.,* associated with the haul roads) was included in the noise modeling and results assessment, as specified in Section 3.4 of CR #8. The results indicate that the noise levels beyond 1.5 km from the mine permit boundary will be under the permissible sound level (PSL) of 40 dBA during the night-time, as specified by ERCB Directive 038. As such, all receptors beyond 1.5 km will be under the PSL and have not been included in the assessment.

231. Volume 4, CR 8, Section 3.5, Pages 6-7
Section 3.5 describes the 3 modeling scenarios for the NIA. No construction scenario is described.

a. Explain why no construction scenario was described. Is it assumed that construction and operational noise are similar for a coal mine project operating for an extended period.

Response:

Construction noise was included in the assessment. As detailed in Section 2.2 of CR #8, part of the mining operations involves using earth moving equipment to remove the initial vegetation and topsoil and transport it to a storage site for post-mining reclamation use. This is what would be considered the initial "construction" of the mine and is an ongoing process as the mine progresses. Noise from this process has been included in all of the noise modeling scenarios.

b. Provide the duration of exposure at each receptor location for either construction of operational noise.

Response:

Noise levels associated with the Mine will differ depending on the location of the receptor. In general, the noise from the mine will steadily increase over many years as the mine progresses until it reaches its maximum (as presented in the results section of CR #8), and then slowly decreases as the mine continues to progress and move away from the receptor. For receptor locations adjacent to a haul road, the noise levels will be at their maximum when the haul activity is underway and the mining activity is at its closest distance. As the mine moves further away, the noise levels will reach a sustained level for many years associated with the haul road.

232. Volume 4, CR 8, Section 5, Page 9

The results of the Application Case modeling indicated that operational noise results exceed the WHO (2009) *Night Noise Guidelines*.

The WHO (1999) *Community Noise Guidelines* recommendations for sleep, recommend that sound levels from discrete noise events should not exceed 45d BA Lmax inside sleeping quarters more than 10-15 times per night. With windows partially opened, this equates to an outdoor level of about 60 dBA Lmax.

a. Discuss what nighttime noise mitigation measures will be considered to ensure the annual average outdoor nighttime levels at the façade of each impacted receptor does not exceed 40dBA.

Response:

The only applicable criteria to which the noise from the Project has been compared are those detailed within ERCB Directive 038. These criteria specify a night-time permissible sound level (PSL) for each residential receptor based on the population density and the relative distance from a heavily travelled road or rail line. The results provided in Section 5 of CR #8 show adherence to the PSLs for all residential receptors for all noise modeling scenarios.

However, with respect to the WHO Guidelines, the modeling results also indicate night-time noise levels will be under 40 dBA at all residential receptors for all three noise modeling scenarios, with the exception of Robb Receptor - 40 in modeling scenario 1. The calculated value at this location for scenario 1 is 40.2 dBA which is only marginally above 40 dBA and below the ERCB Directive 038 PSL of 43 dBA. The modeling results are conservative and it is likely that the noise levels at this location will be under 40 dBA. Further, mitigation to reduce the noise level from 40.2 to 40.0 dBA will not result in a perceptible difference for the residents (a minimum of 2 - 3 dBA change is required before most people can perceive it). As such, no additional noise mitigation measures (other than those already described in CR #8) are required.

233. Volume 4, CR 8, Section 5.4, Page 32

There appears to be uncertainty about potential noise impacts on human receptors as the coalmine progresses towards the Hamlet of Robb and cabins.

a. Provide additional noise modeling to assess potential monitoring and/or mitigation that may be required.

Response:

It is unclear what additional information can be determined through additional noise modeling that will further assess the potential noise monitoring and/or mitigation that may be required. As stated in Section 5.4 of CR #8:

> *"For all residential areas CVRI has indicated that additional noise monitoring may be undertaken once mining begins to come close to the area at issue. With further measuring and evaluating encroachment of mining, CVRI would be able to further assess equipment and mine operational noise levels. Any necessary adjustments to equipment placement, frequency and scheduling of equipment use could then be made."*

b. Discuss whether a noise complaint/resolution line will be established for residents.

Response:

Community Relations

CVRI encourages local residents and recreational users to contact the operation regarding any observation or report of a detrimental environmental of operational incident. This would include adverse dust or noise. A telephone number for the operation is available in local directories. During regular office hours this telephone number is answered by CVM staff. Otherwise a voice message system is available for callers to leave information or request a ‘call back’. Any environmental or operation issue is directed to appropriate staff for follow-up.

9. ERRATA

234. Volume 1, Section E.2.3.7, Page E-35
Incorrect statement is made regarding fishing regulations: Correct to read – Commencing April 2012, in support of the pending re-designation of the status of rainbow trout resulting from increased habitat loss, habitat fragmentation and population declines, Alberta has implemented catch & release for rainbow trout in all waters.

Response:

Correction noted.

235. Volume 1, Section F.4.2.1, Table F.4-3 Page F-41-42
Robb West Pits - Post Reclamation Proportion values/figures are not expressed in % (appear to be ha from the previous column repeated).

a. Revise column figures.

Response:

A revised Table F.4.3 is provided listed as ESRD Table 235-1:

Table 235-1 (Revised Table F.4-3) Pre-Mining and Post Reclamation Terrain Features

Feature	Pre-disturbance		Post Reclamation		Change	
	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)
ROBB MAIN-CENTER-EAST PITS						
Near level (0-2%) (<1.1°)	499.9	11.7	830.2	19.4	330.2	7.7
North facing* >2-5 % (>1.1-3°)	504.7	11.8	188.6	4.4	-316.1	-7.4
North facing >5-10% (>3-5°)	982.3	22.9	319.9	7.5	-662.4	-15.5
North facing >10-15% (>5-8.5°)	608	14.2	255.1	6	-352.9	-8.2
North facing >15-30% (>8.5-16.5°)	431.5	10.1	414.3	9.7	-17.2	-0.4
North facing >30-51% (16.5-27°)	40.5	0.9	685.5	16	645	15.1
South facing* >2-5 % (>1.1-3°)	326.7	7.6	128.8	3	-197.9	-4.6
South facing >5-10% (>3-5°)	492.7	11.5	183.1	4.3	-309.6	-7.2
South facing >10-15% (>5-8.5°)	263.7	6.2	145	3.4	-118.7	-2.8
South facing >15-30% (>8.5-16.5°)	133.8	3.1	223.4	5.2	89.7	2.1
South facing >30-51% (16.5-27°)	1.7	0.04	442.9	10.3	441.2	10.3
Lakes/Littoral Zones	0	0	468.6	10.9	468.6	10.9
TOTAL	**4,285.40**	**100**	**4,285.40**	**100**	**-**	**-**
ROBB WEST PITS						
Near level (0-2%) (<1.1°)	139.3	14.5	260.7	27.2	121.4	12.7
North facing* >2-5 % (>1.1-3°)	111.8	11.7	47	4.9	-64.8	-6.8
North facing >5-10% (>3-5°)	177.1	18.5	43.3	4.5	-133.8	-14
North facing >10-15% (>5-8.5°)	111.2	11.6	28.1	2.9	-83.1	-8.7
North facing >15-30% (>8.5-16.5°)	116.2	12.1	62.8	6.6	-53.4	-5.6
North facing >30-51% (16.5-27°)	2.4	0.3	144.8	15.1	142.4	14.9
South facing* >2-5 % (>1.1-3°)	69.4	7.2	17.3	1.8	-52.1	-5.4

Table 235-1 (Revised Table F.4-3) Pre-Mining and Post Reclamation Terrain Features

Feature	Pre-disturbance		Post Reclamation		Change	
	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)
South facing >5-10% (>3-5°)	104	10.9	26.4	2.8	-77.6	-8.1
South facing >10-15% (>5-8.5°)	56.2	5.9	19.8	2.1	-36.4	-3.8
South facing >15-30% (>8.5-16.5°)	66.3	6.9	40.7	4.2	-25.6	-2.7
South facing >30-51% (16.5-27°)	4.7	0.5	111.2	11.6	106.5	11.1
Lakes/Littoral Zones	0	0	156.5	16.3	156.5	16.3
TOTAL	**958.5**	**100**	**958.5**	**100**	**-**	**-**

Notes:
North slopes include the following aspects; N, NW, NE, E
South Slopes include the following slope aspects: W, SW, S, SE
Above numbers reflect trends in comparison between pre-mine and post-reclamation topography
Numbers are estimates only; detailed calculations are required to confirm.

236. Volume 3, CR #5, Appendix C, Section C3.2, Page C26.

a. References to chemical concentration in surface water and ingestion of surface water should be changed to reflect exposure via groundwater.

Response:

Correct, Example C47 in Appendix C (CR #5) should read as follows:

Example C47:

Estimated daily intake of formaldehyde by a toddler resident from ingestion of groundwater

$$EDI_{water} = 0 \times 0.6 \times 1{,}000$$

$$EDI_{water} = 0\ \mu g / d$$

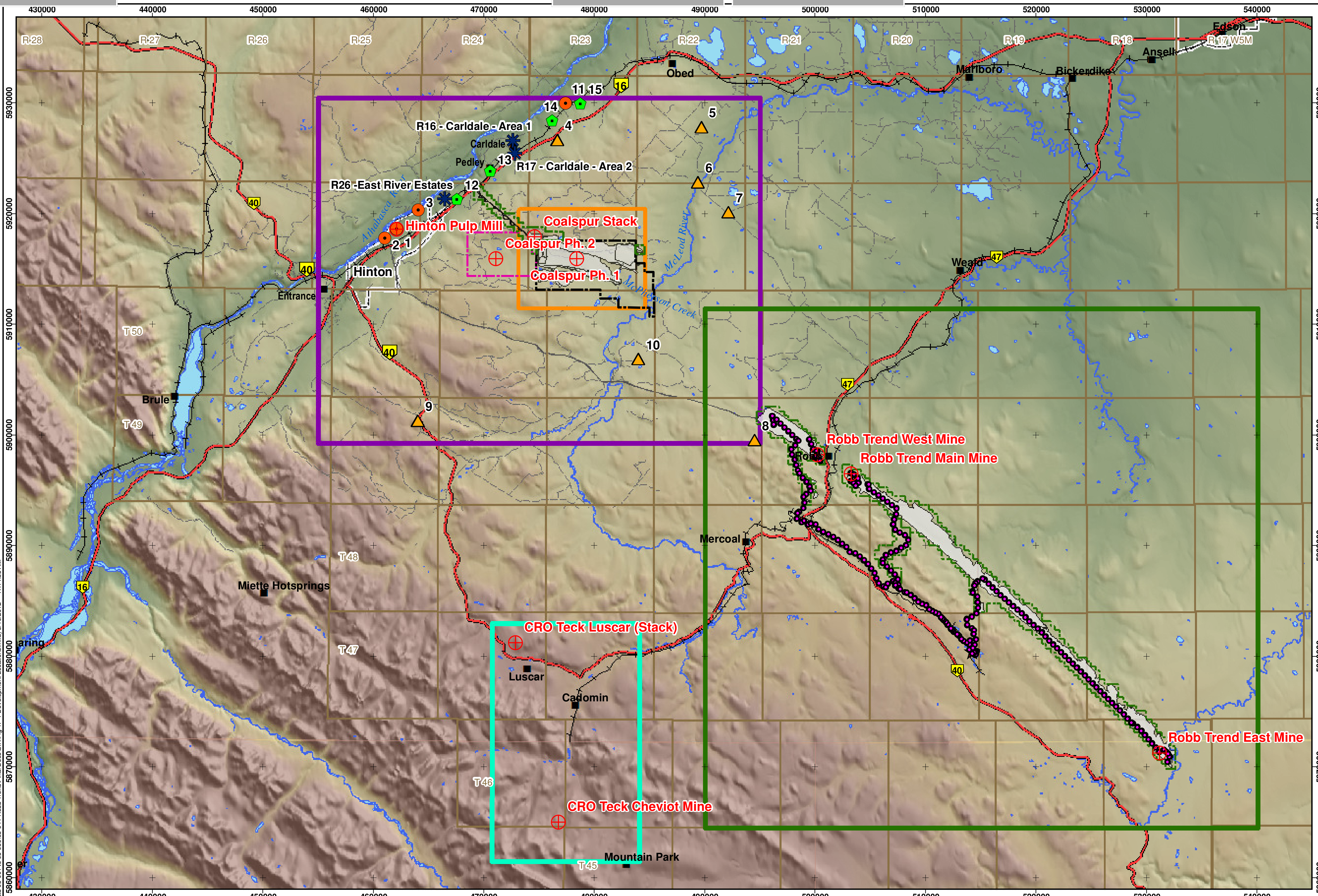
237. Volume 3, CR #6, Section 4.5.1, Page 59

a. Second line provides a reference to Table 11, but this reference should be to Table 14 instead.

Response:

Correction noted.

FIGURES



Baseline Emisson Sources

Label	Facility
1	West Fraser Mills – Hinton Pulp Facility
2	West Fraser Mills – Hinton Wood Products Sawmill Facility
3	Border Paving Ltd. – Hinton Batch Plant
4	Suncor Energy Oil and Gas Partnership – 07-17-52-23 W5M
5	Talisman Energy – Apetowun Compressor Station 02-22
6	Talisman Energy – Talisman Renata Apetowun 1-3
7	Suncor Energy Oil and Gas Partnership – 05-25-51-22 W5M
8	ConocoPhillips Canada Resources Corp. – Shaw Gas Battery 10-24
9	ConocoPhillips Canada Resources Corp. – Gregg Comp. Station 09-26
10	ConocoPhillips Canada Resources Corp. – Anderson Comp. Station 04-13
11	Obed – Loadout
12	CN Train #1
13	CN Train #2
14	Obed Train #1
15	Obed Train #2

Legend

- Development Locations
- Special Receptor

Baseline Emission Sources
- Train
- Facility
- Gas Plant or Compressor Station
- Robb Trend Sources

- Regional Study Area - Coalspur
- Local Study Area - Coalspur
- Regional Study Area - Robb Trend
- Regional Study Area - Tech Cheviot/Luscar Mines
- Proposed Footprint Disturbance

- Existing Mine Permit
- Proposed Mine Permit
- Assumed Mine Permit

- Highway
- Existing Gravel Road
- Railway

Topography (masl)
High : 1650
Low : 950

REF: Geobase, 2010; MEMS, 2012.

Map Document: (K:\Active Projects 2008\Projects 08-001 to 08-050\08-041 Robb Trend\Final Docs\SIR\Fig 17-1 Development Locations.mxd) 8/16/2012 -- 11:14:38 AM

PROJECT:
Coal Valley Mine
Robb Trend Project

cvri

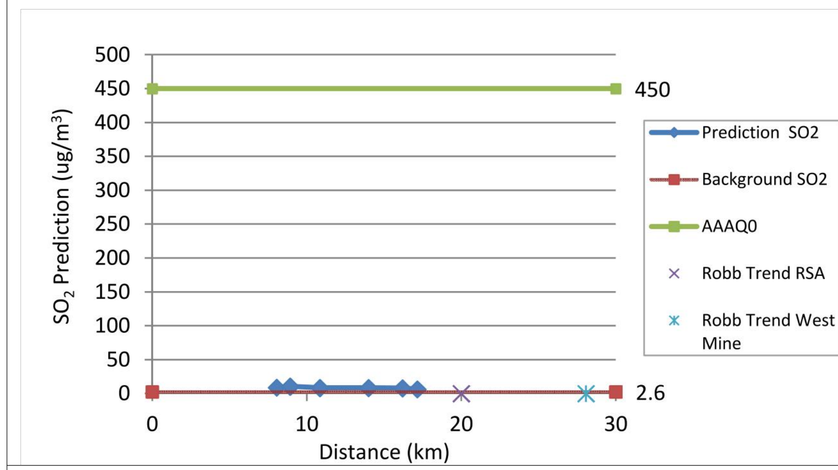
TITLE:
Development Locations

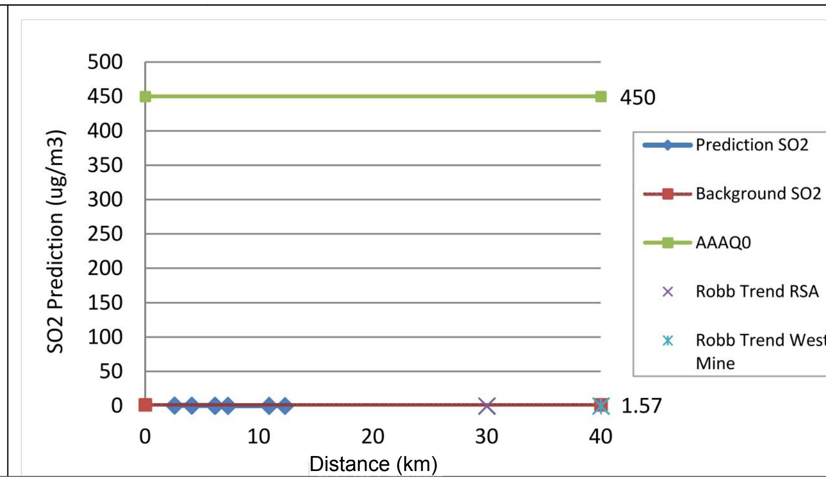
DRAWN: JG
CHECKED: PS
DATE: Nov 26/12
PROJECT: 08-041

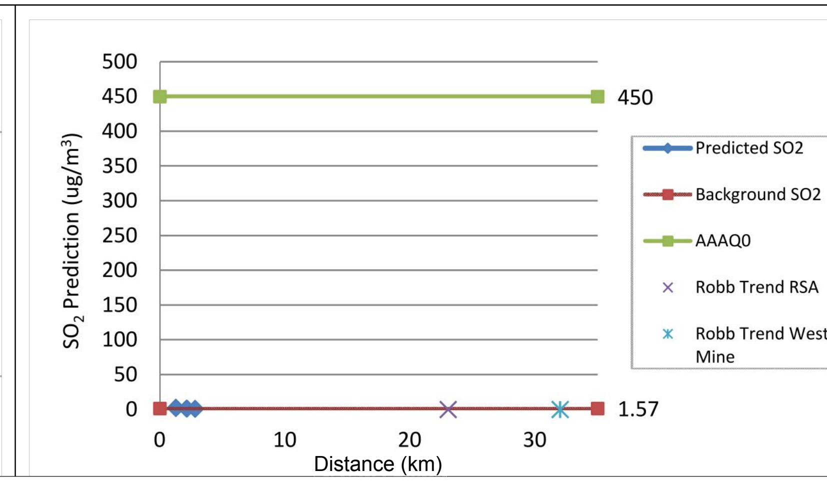
FIGURE: 17-1

Coalspur Vista	Cheviot	Cardinal River

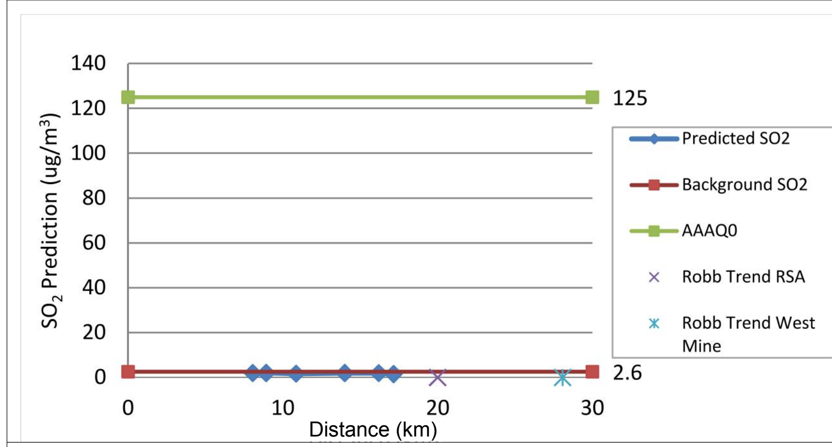
Hourly SO_2

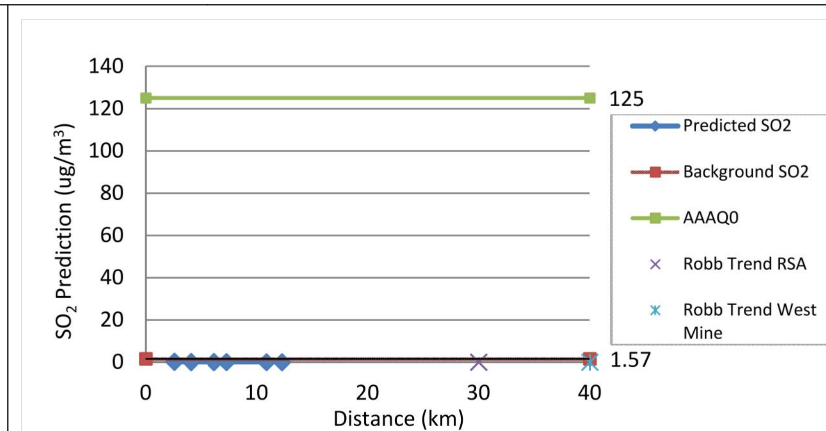


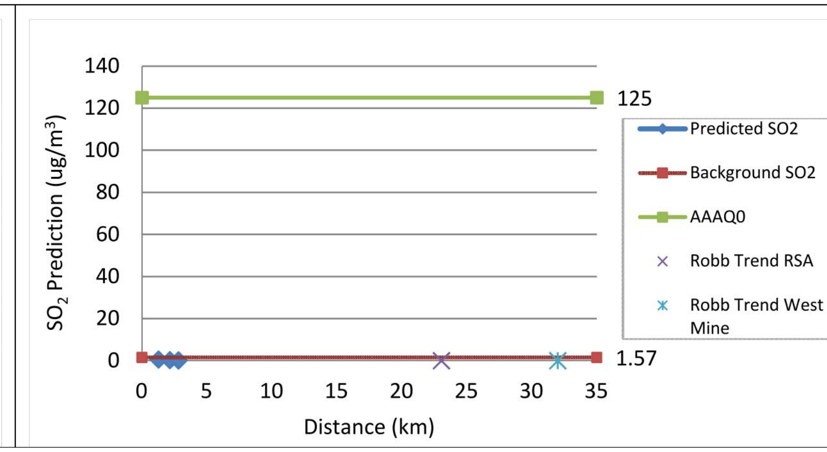




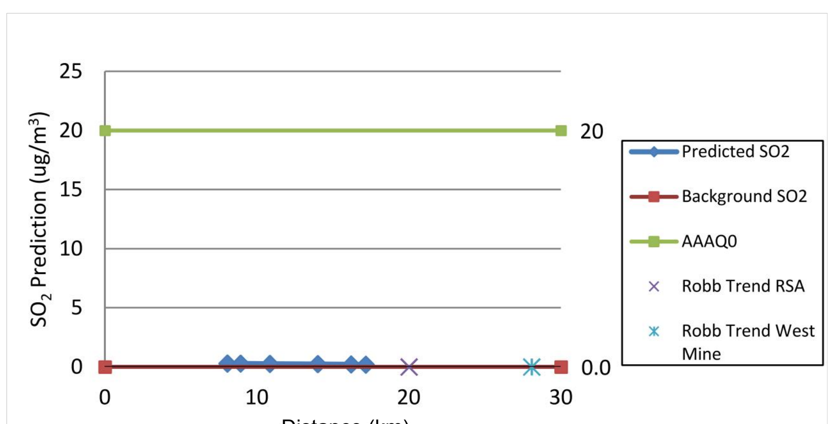
Daily SO_2

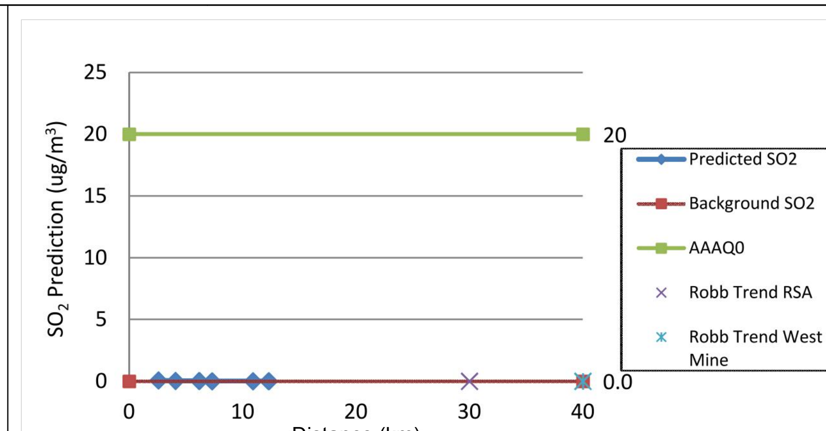


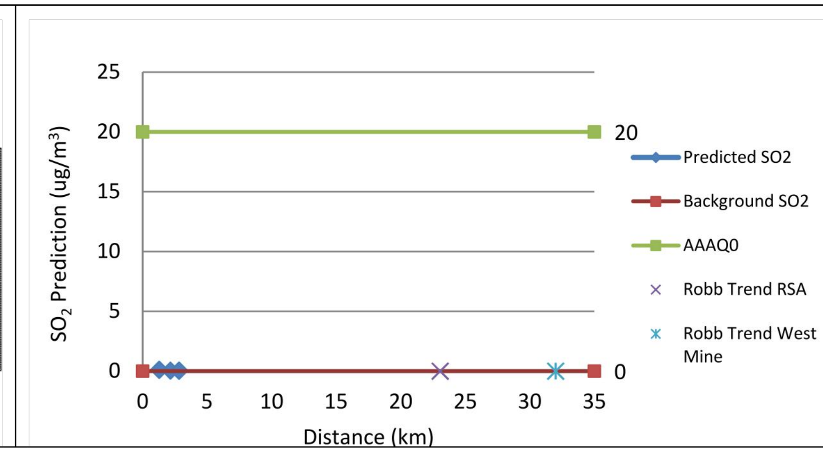




Annual SO_2







PROJECT:
Coal Valley Mine
Robb Trend Project

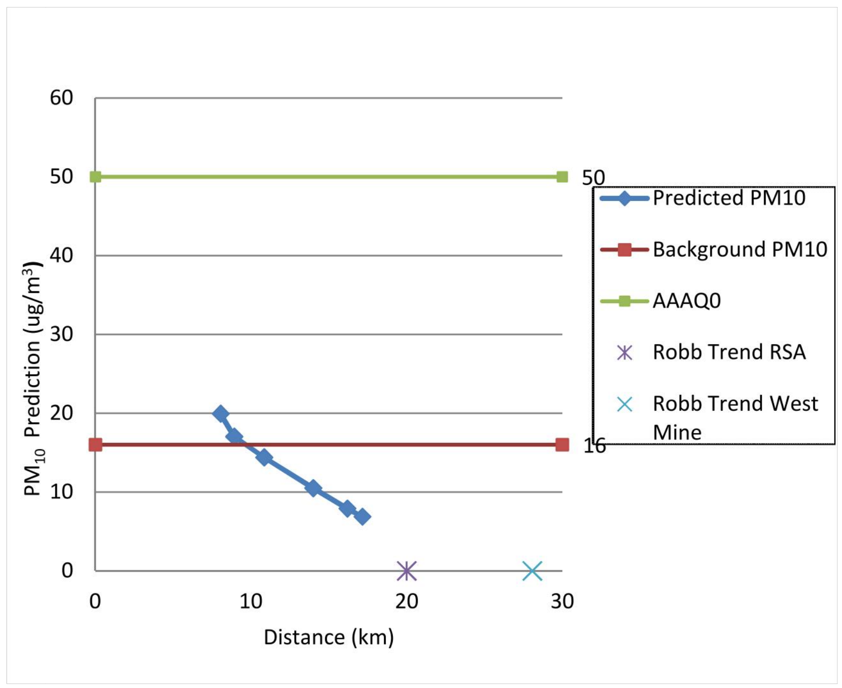
cvri

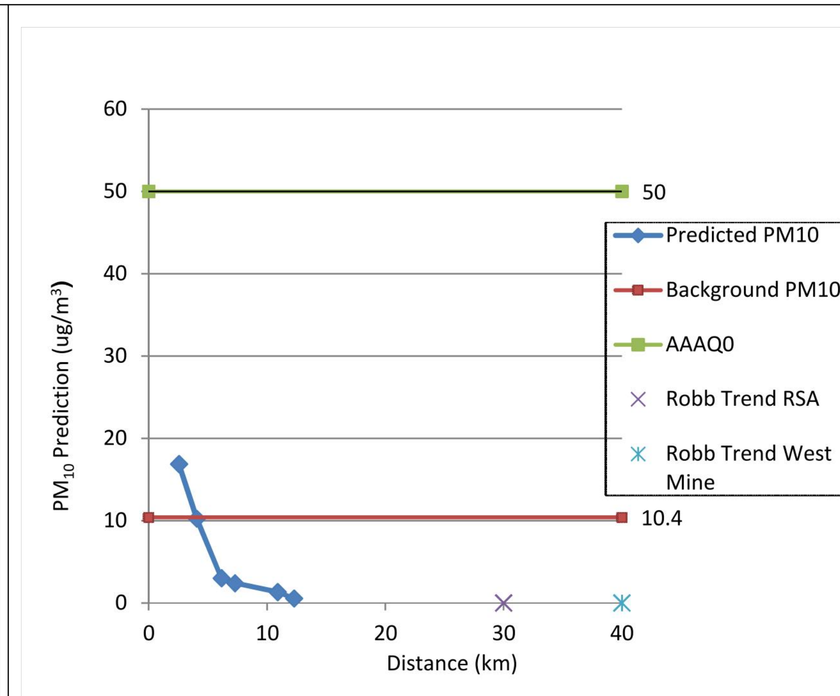
FILE: SIR Drawings.dwg

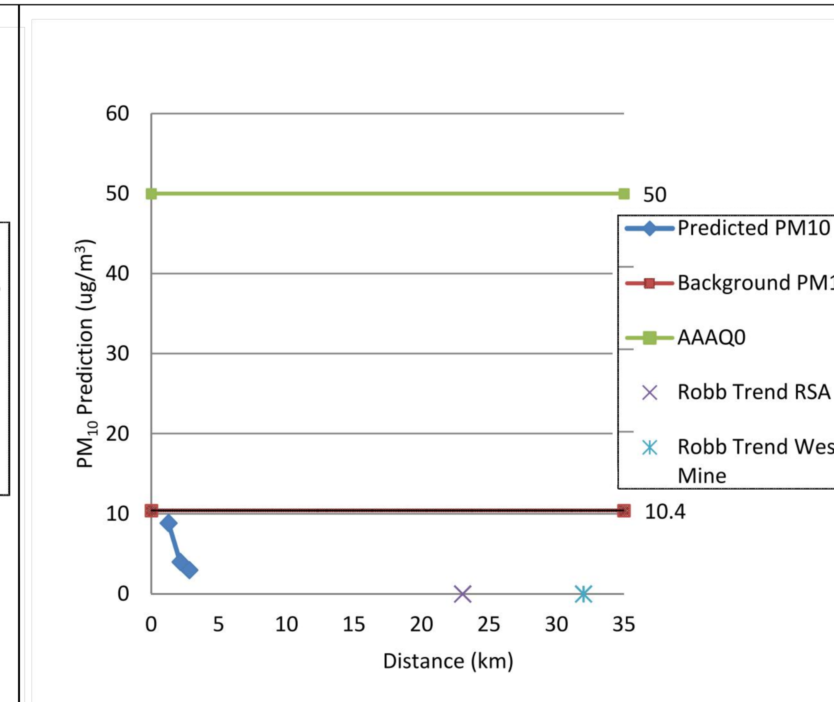
TITLE:
SO_2 Predictions from Three Mines toward the Robb Trend RSA Boundary and MPOI Locations

DRAWN:	RS	FIGURE:
CHECKED:	JT	**17-2**
DATE:	Nov 26.12	
PROJECT:	08-0□1	

Coalspur Vista	Cheviot	Cardinal River
Daily PM_{10}		







PROJECT:
Coal Valley Mine
Robb Trend Project

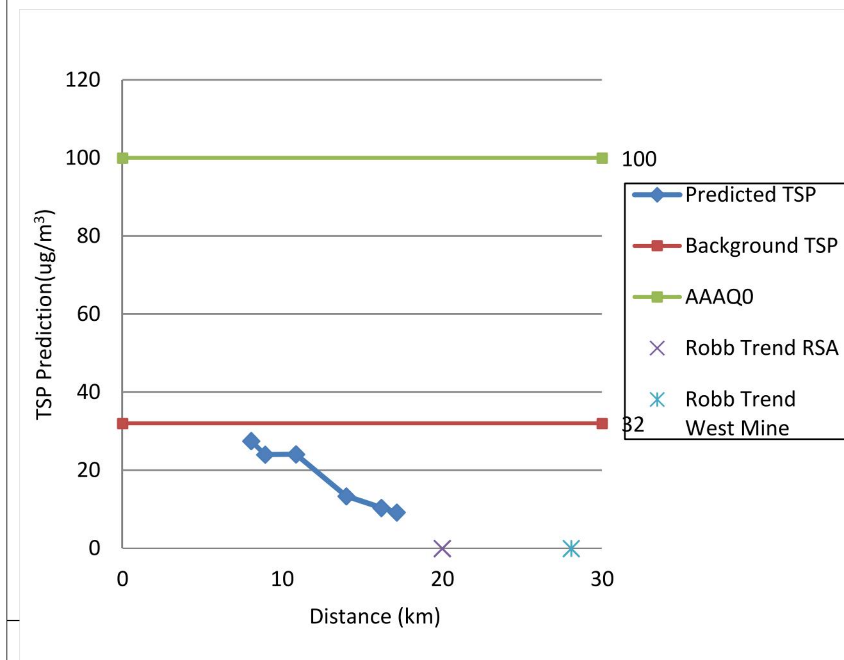
cvri

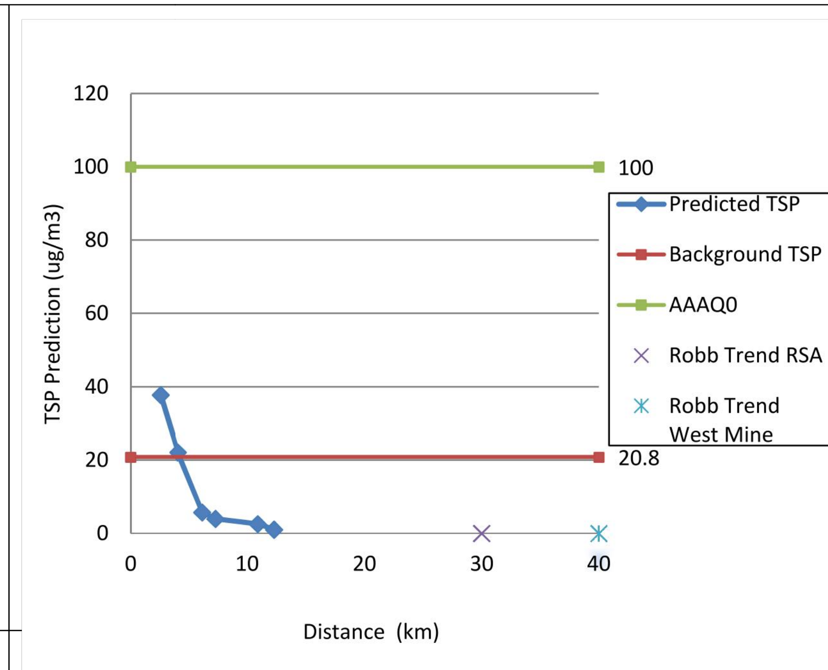
TITLE:
PM_{10} Predictions from Three Mines toward the Robb Trend RSA Boundary and MPOI Locations

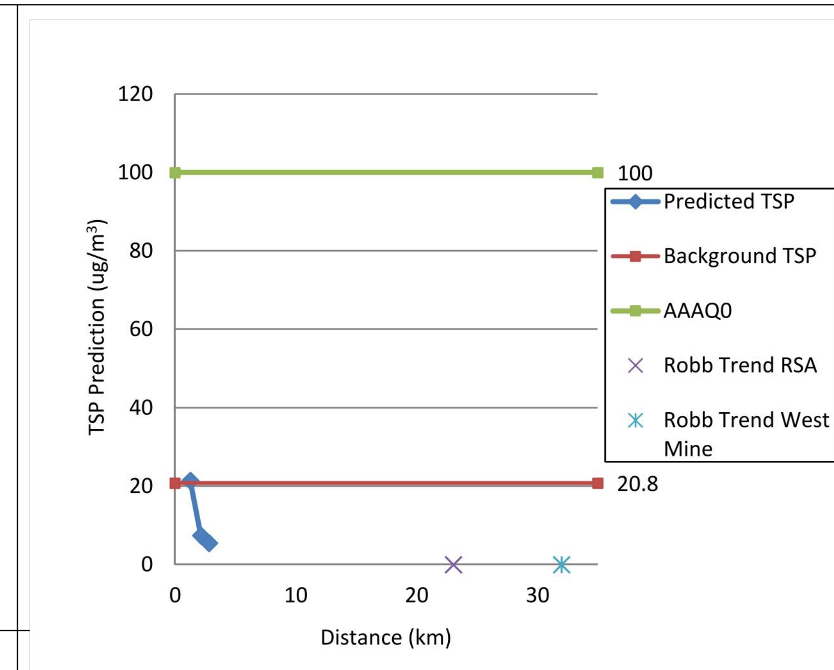
...Final Docs\SIR\SIR AESRD 11x17 Drawings.dwg
DRAWN: RS:JG
CHECKED: KP
DATE: Dec 5:12
PROJECT: 08-0:1
FIGURE: 17-3

Coalspur Vista | **Cheviot** | **Cardinal River**

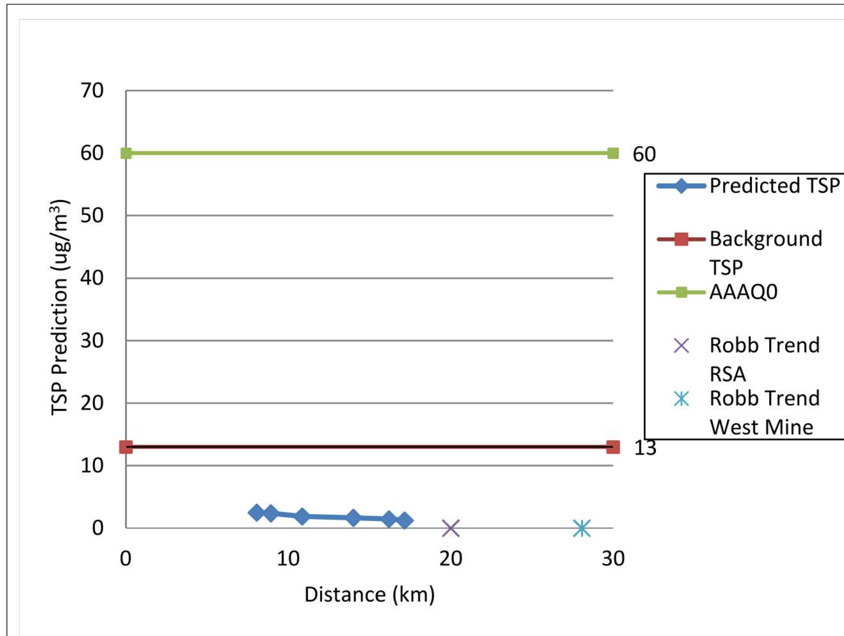
Daily TSP

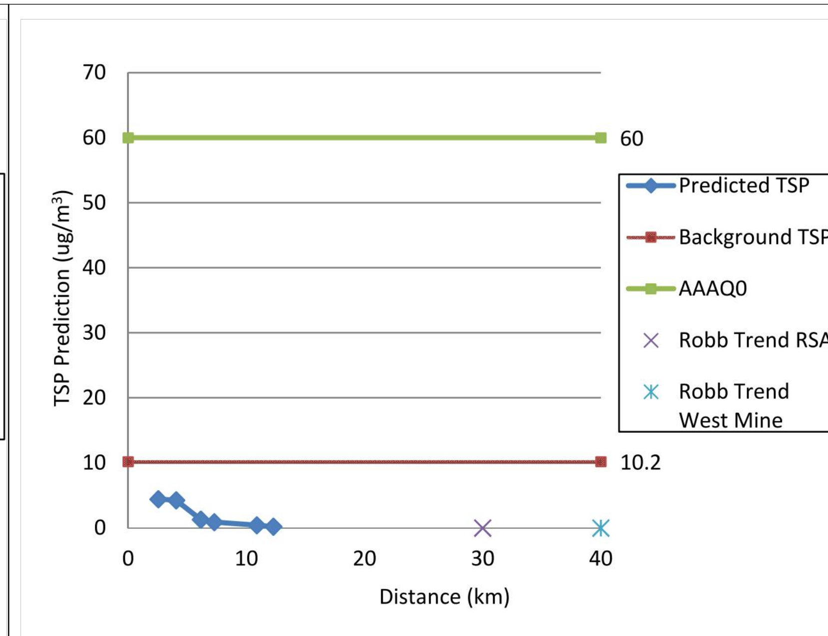


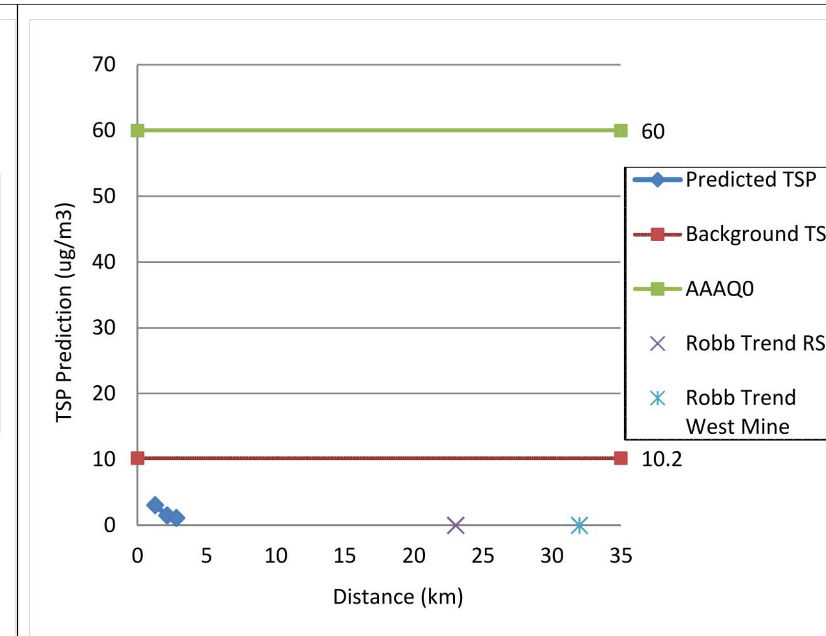




Annual TSP







PROJECT:
Coal Valley Mine
Robb Trend Project

cvri

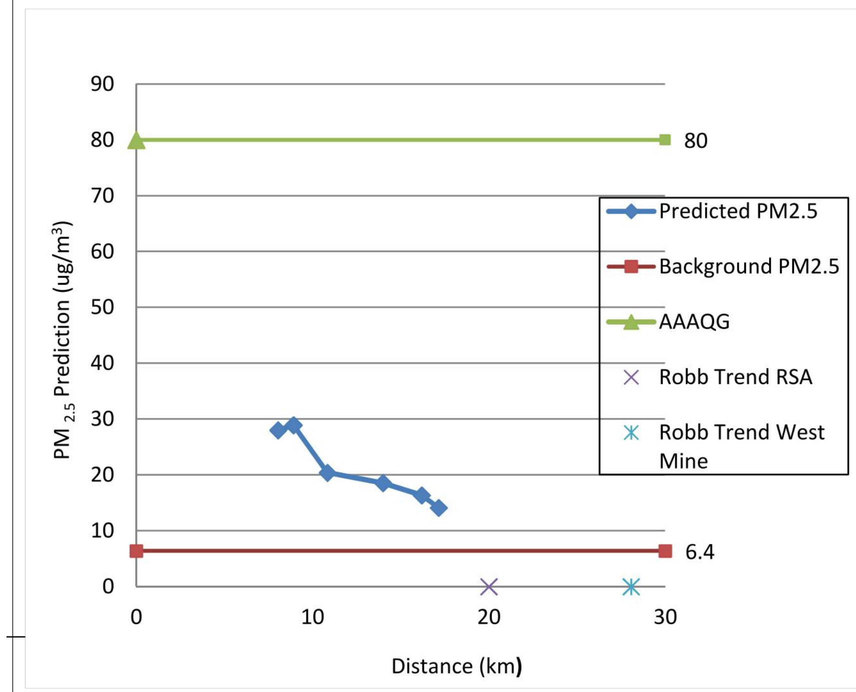
TITLE:
TSP Predictions from Three Mines toward the Robb Trend RSA Boundary and MPOI Locations

FILE: SIR Drawings.dwg
DRAWN: RS
CHECKED: JT
DATE: Nov 26:12
PROJECT: 08-0:1
FIGURE: **17-4**

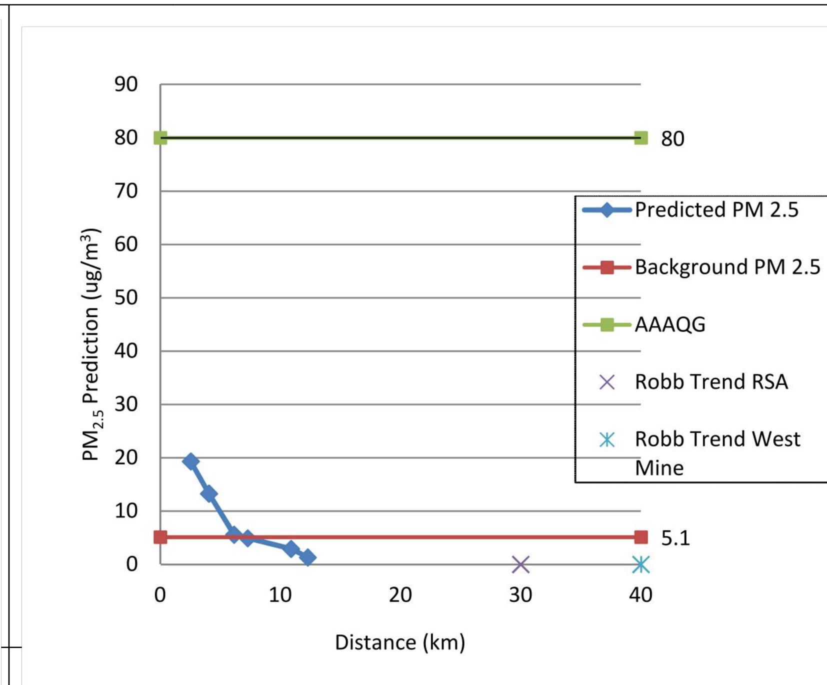
Coalspur Vista | **Cheviot** | **Cardinal River**

Hourly $PM_{2.5}$

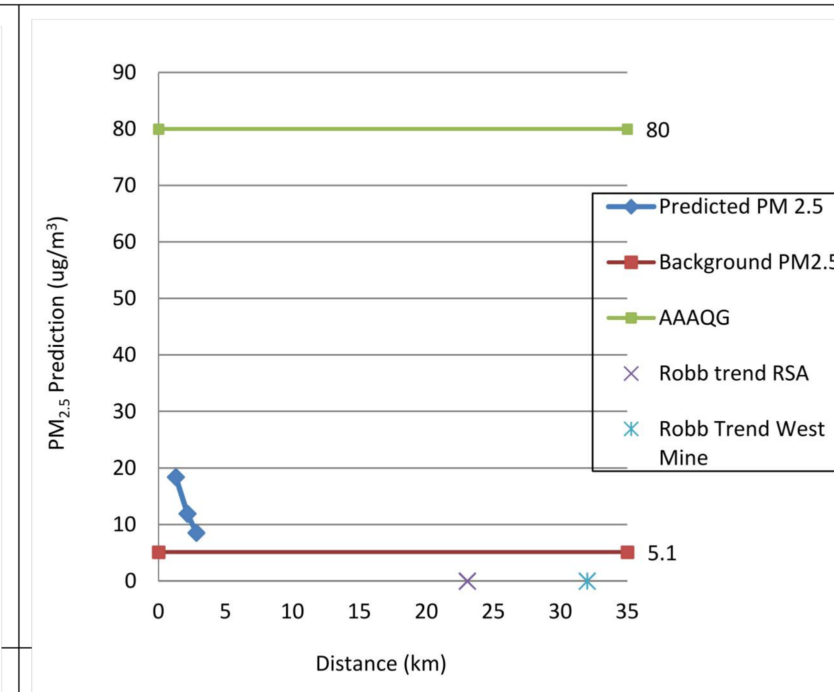
Coalspur Vista



Cheviot

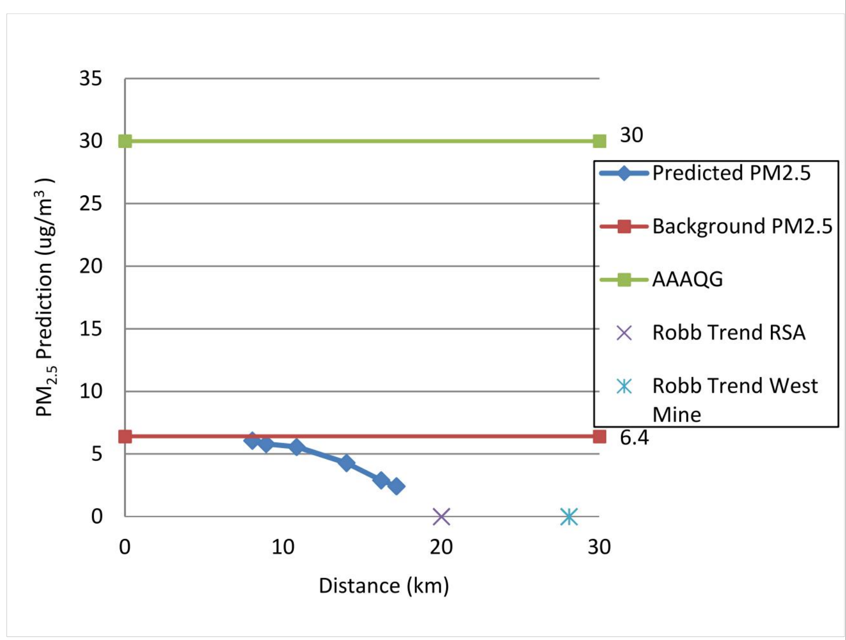


Cardinal River

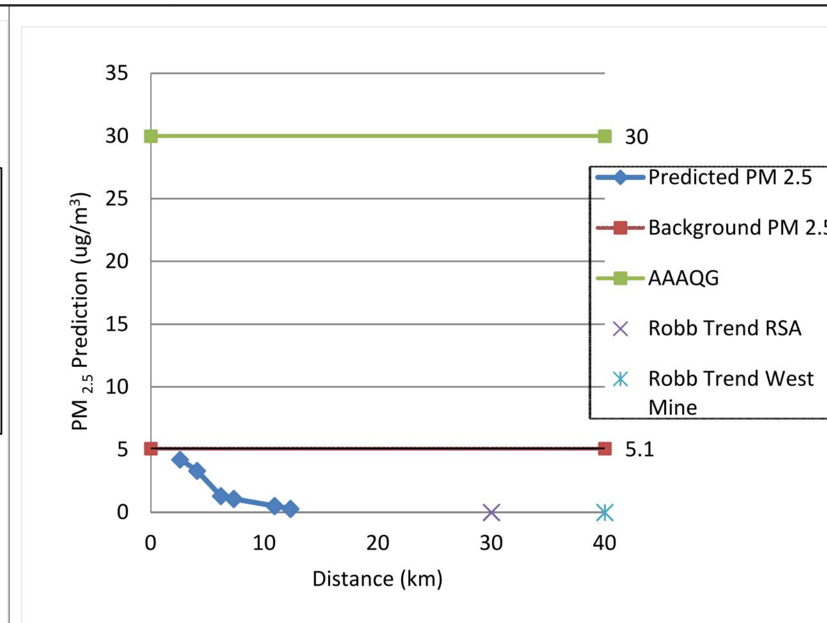


Daily $PM_{2.5}$

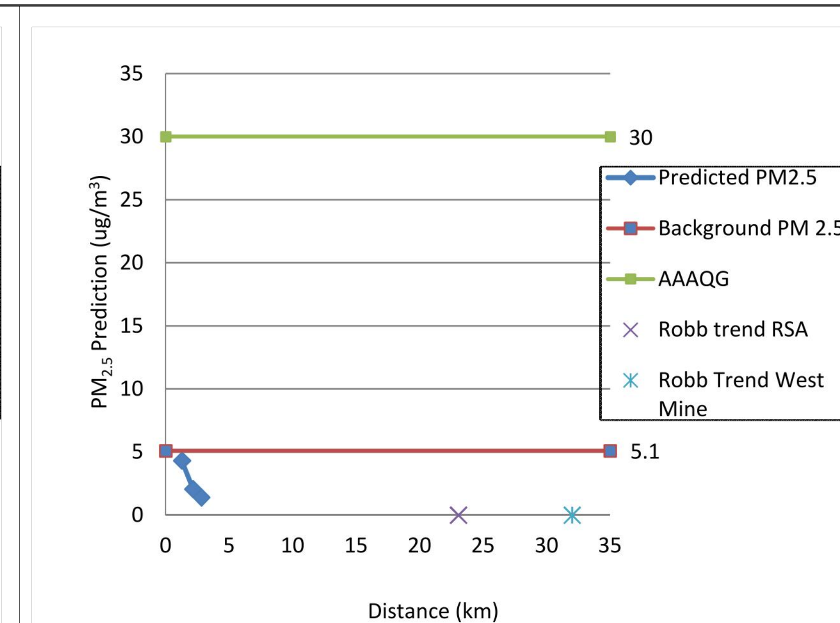
Coalspur Vista



Cheviot



Cardinal River



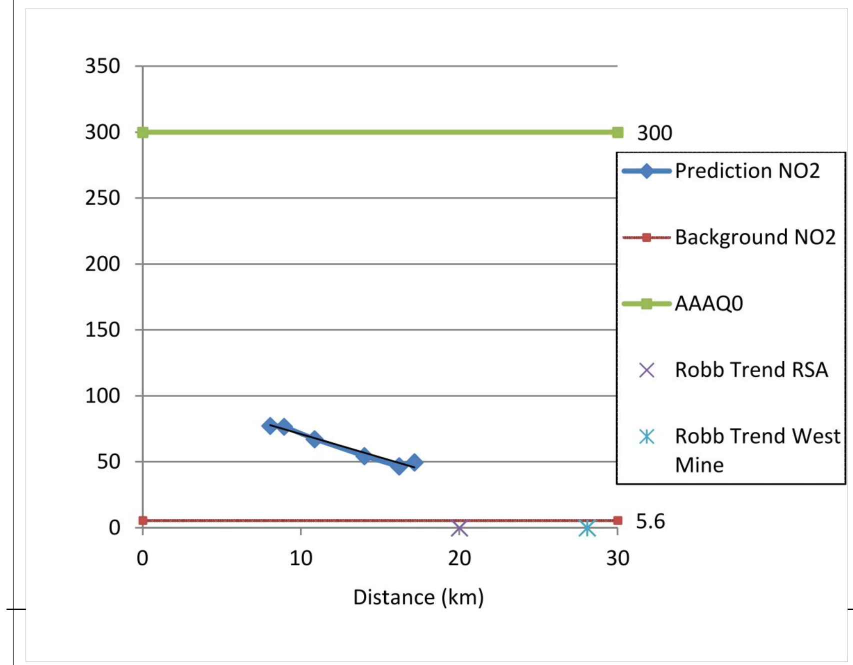
PROJECT:
Coal Valley Mine
Robb Trend Project

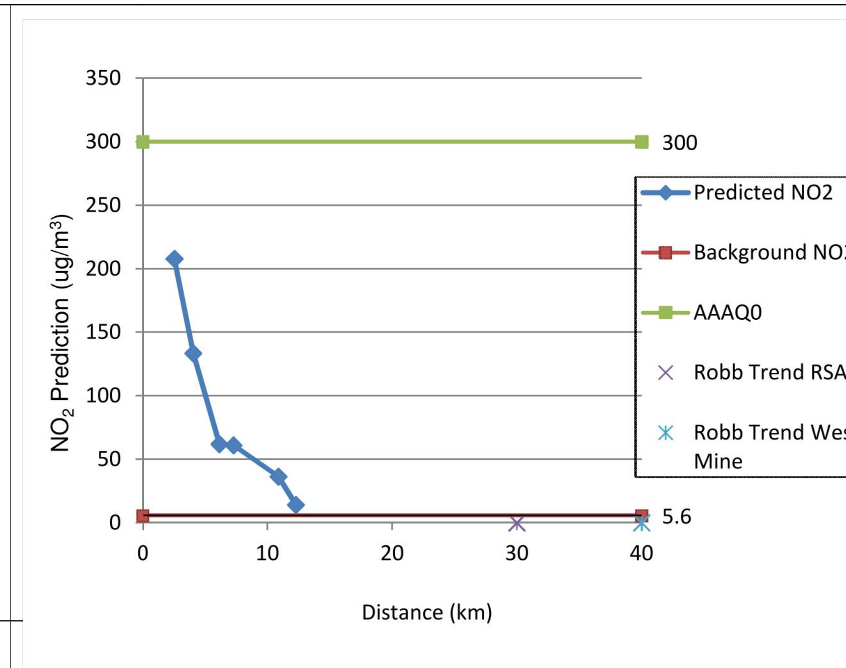
TITLE:
$PM_{2.5}$ Predictions from Three Mines toward the Robb Trend RSA Boundary and MPOI Locations

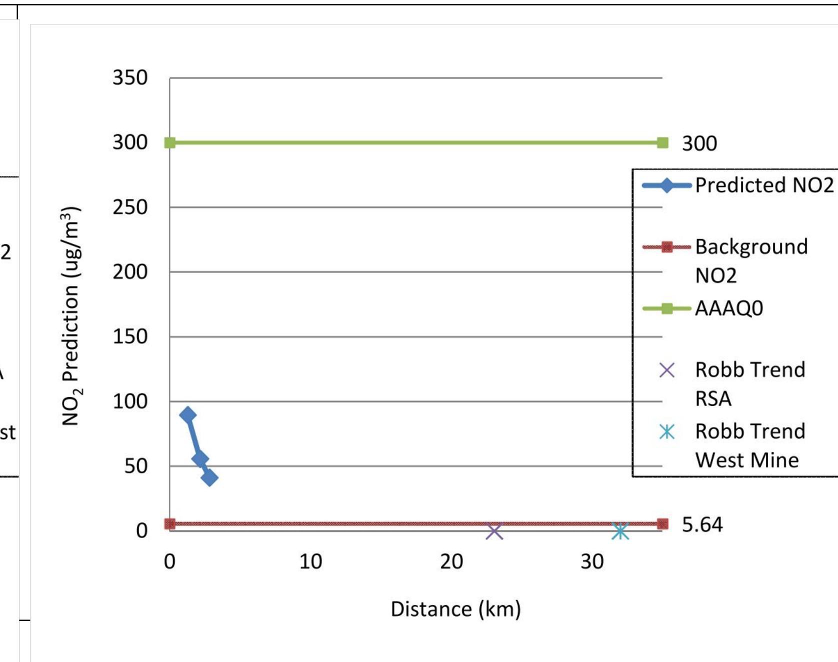
FILE: SIR Drawings.dwg
DRAWN: RS
CHECKED: JT
DATE: Nov 26:12
PROJECT: 08-0:1
FIGURE: **17-5**

Coalspur Vista	Cheviot	Cardinal River

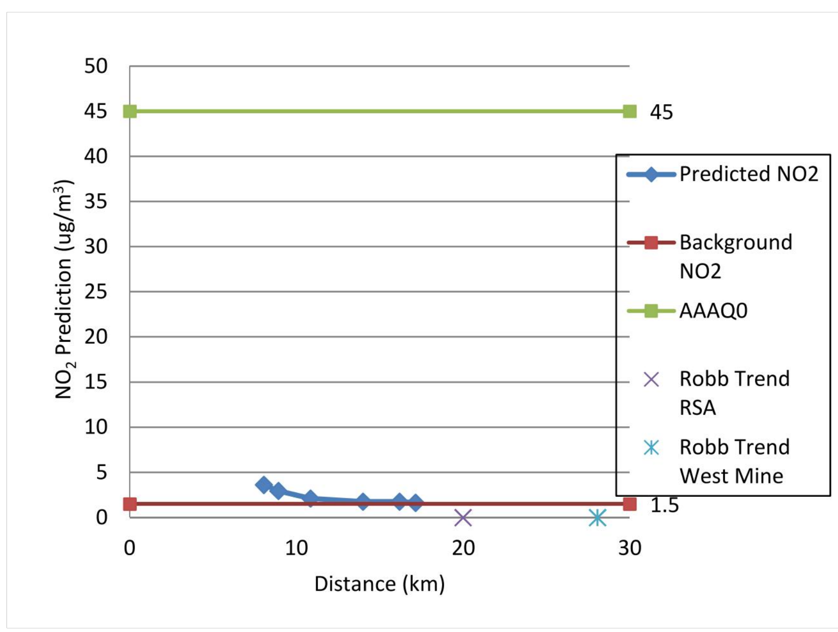
Hourly NO_2

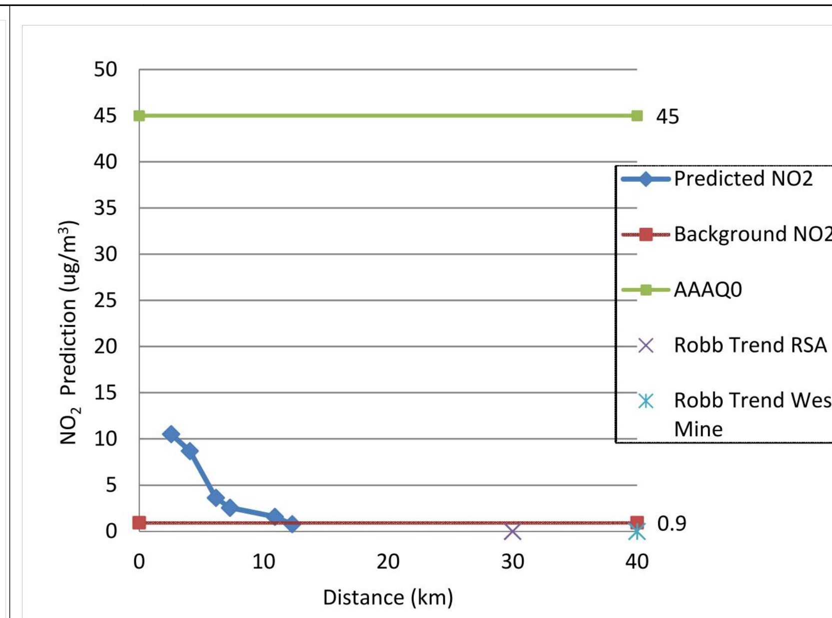


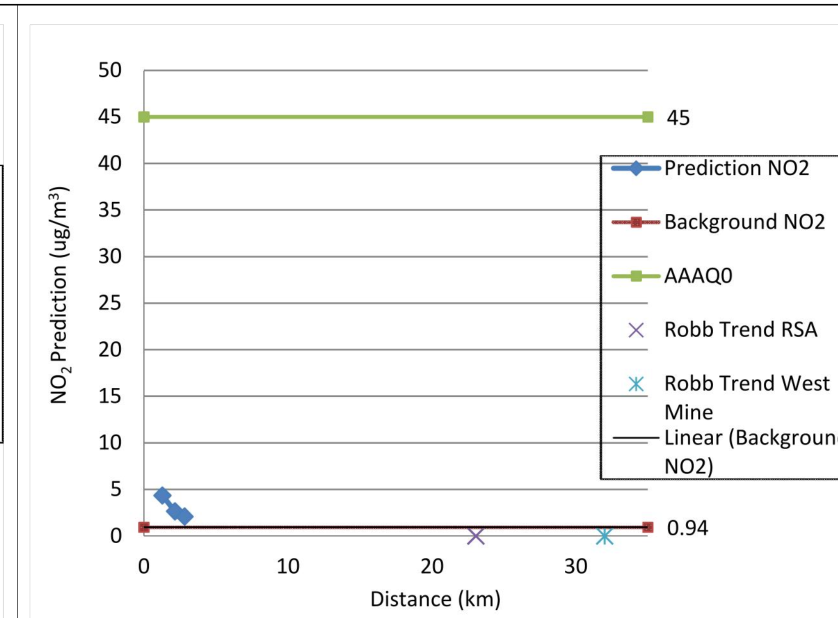




Annual NO_2





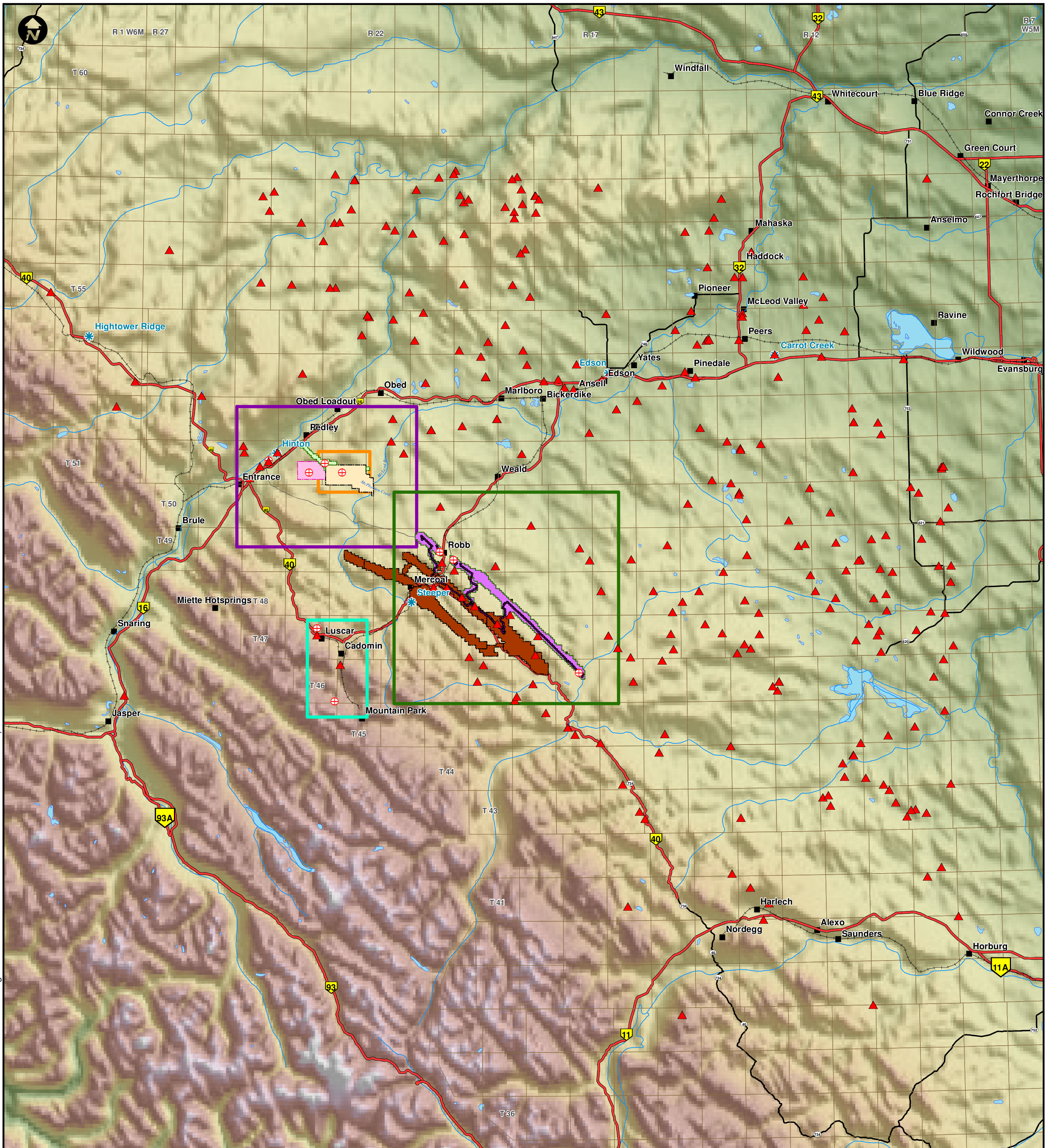


PROJECT:
Coal Valley Mine
Robb Trend Project

cvri

TITLE:
NO_2 Predictions from Three Mines toward the Robb Trend RSA Boundary and MPOI Locations

FILE: SIR Drawings.dwg
DRAWN: RS
CHECKED: JT
DATE: Nov 26.12
PROJECT: 08-0□1
FIGURE: **17-6**



Legend

- Development Locations
- Emission Sources
- Monitoring Stations
- Regional Study Area - Coalspur
- Local Study Area - Coalspur
- Regional Study Area - Tech Cheviot /Luscar Mines
- Regional Study Area - Robb Trend
- Existing Mine Permit Boundary
- Proposed Mine Permit Boundary
- Assumed Mine Permit

Topography (masl)
High : 3000
Low : 600

0 10 20 40
Kilometres

REF: GeoBase, 2011.

PROJECT:
Coal Valley Mine
Robb Trend Project

cvri

TITLE:
Emission Sources Within 100km of Robb Trend

DRAWN:	PS
CHECKED:	PS
DATE:	Dec 4/12
PROJECT:	08-041

FIGURE: 17-7

Map Document: (K:\Active Projects 2008\Projects 08-001 to 08-050\08-041 Robb Trend\Final Docs\SIR\Fig 17-7 Emission sources within 100 km of Robb Trend.mxd) 05/09/2012 -- 2:16:03 PM