Expert Comments on the Environmental Impact Assessment Report for the Sisson Project (Tungsten and Molybdenum Mine), New Brunswick
CEAR #11-03-63169

re: EIA Report Section 8.2 – Atmospheric Environment

re: EIA Report Section 8.9 – Public Health

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Table of Contents (Sections in red are in this shortened version of the CCNB Action report)

1. Introduction

1.1 Background to CCNB Action Inc.'s comments on the Environmental Impact Assessment Report for the Sisson Project

Northcliff Resources Ltd. (the proponent) has proposed to construct and operate a 30,000 tonnes per day tungsten and molybdenum mine approximately 60 kilometres northwest of Fredericton, New Brunswick (the Sisson Project). As described in the project's environmental impact assessment (EIA) report, the project would consist of a 145 hectare open pit mine, a 751 hectare tailings impoundment, numerous water management ponds, an ore crushing and processing plant, a water treatment plant, an ore storage area(s), a transmission line to bring power to the project site, and use of provincial roads. As proposed, the construction and operation of the mine will require the destruction of portions of streams that are headwaters of the Nashwaak River. The Nashwaak River, a tributary of the St. John River, is a main refuge for the endangered St. John River population of Atlantic salmon. The Villages of Napadogan and Stanley are located approximately 10 km and 20 km respectively from the proposed mine.

As the Sisson Project will have environmental impacts on areas of both federal and provincial constitutional jurisdiction, it is subject to two environmental assessment processes, one under the *Canadian Environmental Assessment Act* (*CEAA*), and another under the New Brunswick *Environmental Impact Assessment Regulation - Clean Environment Act* (*NB EIA Reg.*). Because the project commenced under the *CEAA,* the federal environmental assessment of the project will continue under that act rather than the *Canadian Environmental Assessment Act, 2012,* which repealed and replaced the *CEAA.* Due to the amount of ore to be processed, the Sisson Project is subject to a "comprehensive study" type of environmental assessment under the *CEAA* (rather than a "screening"). Provincially, the Minister of Environment has determined the Sisson Project is subject to a "comprehensive review" under the *NB EIA Reg*. A provincial comprehensive review sets out a number of steps in the environmental assessment process, such as the development of terms of reference for the EIA report, the writing and filing of the EIA report, and the holding of a public meeting(s) by the Minister of Environment.

The provincial and federal governments have agreed to conduct a "harmonized" environmental impact assessment process for the Sisson Project. The EIA report describes the harmonized process as being:

> "Under this approach, both levels of government have agreed to cooperate in the carrying out of the EIA to meet the requirements of their respective legislation, beginning with Terms of Reference being issued jointly to define the scope of the EIA federally and how Northcliff will meet the Final Guidelines provincially. They have also agreed that a single EIA Report prepared by the Proponent to meet the requirements of the Terms of Reference would suffice to fulfill the respective provincial and federal EIA requirements. The CEA Agency will then prepare its comprehensive study report (CSR), relying upon the EIA Report and the results of the review process." (at p. 4-4).

On August 30, 2013, the Canadian Environmental Assessment Agency (CEA Agency) released the proponent's EIA report for the Sisson Project to the public for review and comment. The public has 45 days (to October 14, 2013) to submit its comments to the Agency, after which the Agency will consider them before writing its CSR for the project. At present, there is no official period of public review and comment under the provincial process although it is expected that comments made under the federal environmental assessment process will be forwarded to New Brunswick regulators for consideration.

The CEA Agency sometimes provides participant funding to individuals, not-for-profit organizations, and Aboriginal groups, to assist them in participating in a federal environmental assessment process, such as the comprehensive study for the Sisson Project. CCNB Action Inc. applied for and received participant funding. The main purpose of this funding was for CCNB Action to hire experts to review and provide comments on sections of the Sisson Project EIA report and later, the comprehensive study report for the project written by the CEA Agency. Funding is not available under the New Brunswick environmental assessment process to assist groups in their review of EIA Reports. *The purpose of this report is to document the findings of CCNB Action's expert reviewers about the EIA report for the Sisson Project and to detail CCNB Action's position as to whether the construction, operation, and closure of the project should receive federal approval.*

1.2 Expert reports commissioned by CCNB Action Inc.

CCNB Action Inc. had experts review and comment on various sections of the EIA report and on some of the different technical studies completed by the proponent in support of the EIA report. The reviewers were asked to focus their reviews primarily on:

- the methods used by the proponent to gather baseline information,
- the methods used by the proponent to conduct environmental effects analyses for the project alone and cumulatively,
- conclusions reached by the proponent, in particular those dealing with the significance of the environmental effects of the project, and
- various technical aspects of the project such as the design of the tailings dam.

Reviewers were asked *not* to comment on the merits of the project.

In order of their appearance in this final report, the experts' reports are:

1. Impacts of the project on the VEC - Atmospheric Environment, re: air quality.
   - Ms. Inka Milewski and Mr. Lawrence Wuest

2. Impacts of the project on the VEC - Public Health with a focus on the methodology used for the baseline public health assessment.
   - Ms. Inka Milewski

3. Impacts of the project on the VEC – Water Resources, re: ground water and ecological water availability.
   - Dr. André St.-Hilaire

4. Impacts of the project on the VEC – Water Resources,
   The VEC – Aquatic Environment (focus on fish and fish habitat),
   The VEC - Accidents, Malfunctions and Unplanned Events, and
   General comments on Executive Summary, Project Description, Summary of Key Predictive Studies.
   - Dr. Allen Curry

5. Comments on Section 3 Project Description (particularly water management and the design of the tailings storage facility),
   Impacts of the project on the VEC – Aquatic Environment,
   The VEC - Accidents, Malfunctions and Unplanned Events,
   Comments on the proposed Follow-Up and Monitoring Program, and
   Comments on the Conceptual Decommissioning, Closure, and Reclamation Plan.
   - Dr. David Chambers and Mr. Stu Levit, M.S., J.D. (Center for Science in Public Participation (CSP2))
   - Note: The report from CSP2 was commissioned by CCNB Action. CSP2 submitted their review directly to the CEA Agency on October 7, 2013, but it has also been included in this report for convenience.

6. Impacts of the project on the VEC – Terrestrial Environment.
   - CCNB Action (primarily the project's impacts on birds)
   - Ms. Tracy Glynn, M.E.S. (primarily the project's impacts on rare forests and wildlife)
   - Mr. Lawrence Wuest (primarily the project's impacts on protected natural areas)

7. Impacts of the project on the VEC – Vegetated Environment.
   - Ms. Tracy Glynn, M.E.S. (primarily the project's impacts on rare forests)

8. Impacts of the project on the VEC – Wetland Environment.
   - Ms. Stephanie Merrill, M.Sc.F. (primarily the project's impacts on regulated wetlands)

9. Impacts of the project on the VEC – Labour and Economy.
   - Dr. Rob Moir

10. General comments on the proposed water management plans for the project during operation and closure.
    - Mr. Roy Parker, M.E.S.

Finally, this report also includes comments on general EIA report requirements such as a discussion of the need for the project and its role in sustainability. These comments were provided primarily by Mr. Ramsey Hart, M.Sc.

1.3 Summaries of experts' main concerns about the EIA report

1.3.1 Summary of the reviewers' main comments about the EIA report: Atmospheric Environment

- Not enough data/information has been collected to say accurately what is the trace metal content of the ore, pit walls, waste rock, overburden, etc. Without this information, the types and amounts of air contaminants released by the project cannot be determined.
- Using the limited trace metal data that is provided in background studies for the EIA report, the reviewers calculate there is more arsenic in the project's ore than what is reported (EIA report = 41 mg/kg of arsenic; Reviewers = 64.8 mg/kg of arsenic).
- The use of 41 mg/kg of arsenic (vs. 64.8 mg/kg) in modeling for predicted air quality results in the under-estimation of the release of this contaminant. Also, the EIA report only uses arsenic concentrations from the ore in its modeling. This is the lowest concentration of arsenic for any of the potential pathways of air contaminants, other than soil. For example, the EIA report provides the mean arsenic concentration in the overburden as 143.3 mg/kg, which was not used in the report's calculation of trace metal air emissions. Arsenic concentrations are significantly higher in all emission pathways than the value used to estimate arsenic releases from the project.
- The drill core assays used to calculate trace metal content were not taken from random locations or locations that are representative of the entire mine site.
- Wind data provided in the EIA report does not reflect prevailing conditions and it was not collected from the highest point of the mine where tailings beaches will be located.
- Emissions of particulate matter (dust) from the site are under-estimated.
- The EIA report does not provide information on how much hydrogen sulfide and other pollutants the ammonium paratungstate (APT) plant will emit. Based on the reviewers' investigation of the predicted releases from an ATP plant in New York, it is clear the Sisson Project ATP plant will be a significant source of air pollutants.
- The Sisson Project will not contribute to the Canadian Council of Minister of the Environment's nationally-supported goal of "keeping clean areas clean".
- No environmental monitoring for future air quality is proposed for the project despite evidence that mines can release annually 5 to 30 times more dust than predicted in an EIA report.

1.3.2 Summary of the reviewer's main comments about the EIA report: Public Health

- The main concerns raised about the EIA report's section on the Atmospheric Environment are also applicable to the Public Health section. Additional concerns follow below.
- The most serious deficiency is that the EIA report did not evaluate the non-cancer health risk of the most common route of exposure to arsenic - ingestion of soil, water and food and dermal contact with soil. The human health risk assessment (HHRA) has incorrectly assumed that the health risks related to ingesting or inhaling arsenic are cancer-related only and that there are no toxicological reference values for non-cancer health effects via the oral or dermal route for adults or toddlers. As a result, the baseline (and project-related) human health risk assessment via ingestion of soil, water and food and dermal contact with soil has not been assessed for arsenic.
- The HHRA modeling domain is too small and does not cover the entire project Local Assessment Area (LAA). As a result, HHRA receptor locations in the community of Napadogan, and other locations at the edges of the LAA where people from Williamsburg, Currieburg, Boyds Corner, Fredericksburg and Stanley may spend recreation time, are not covered by the HHRA.

- Emissions of particulate matter and metals during the construction phase of the project and the potential seepage of metals from overburden piles during the construction phase have been excluded from the assessment.
- The Project + Baseline assessment of maximum acute and chronic human health risks from inhaling PM_{10} emissions are incomplete and inaccurate.
- Particulate emission estimates during the operational phases of the project are significantly underestimated.
- Arsenic emission estimates during operational phases of the project are significantly underestimated.
- Sulphur dioxide (and other) emission estimates from the Project's ammonium paratungstate (APT) facility are significantly underestimated.
- Characterization of health risks for on-site workers are not reported or discussed.
- A sensitivity analysis of the HHRA results has not been done.
- Public and occupational health follow-up or monitoring will not be done.

1.3.3 Summary of the reviewer's main comments about the EIA report: Water Resources

- In spite of the fact that the analyses could benefit from some potential methodological improvements and specifications mentioned above, the assessments provided appear to be technically and scientifically sound. Some (probably small) risks associated with local, perhaps short term, changes in the hydrological budget and water routing for wetlands and aquatic life are scarcely treated.

1.3.4 Summary of the reviewer's main comments about the EIA report: Water Resources

- The EIA report is incomplete in many critical areas. For example, the EIA report was written before the all-important Metal Leaching/Acid Rock Drainage Potential Report (ML/ARD Report) was completed. The EIA report was submitted to the CEA Agency on July 31, 2013, while the ML/ARD was not completed until August 2013.
- This mine will need a water treatment plant (WTP) and this plant is the core of the mine's water management plan. However, the WTP is poorly described and the plans for it are not in the actual EIA report.
- The WTP was designed to deal with arsenic and antimony only, not the other many chemicals that will be in the tailings pond.
- Details for all water management at the mine site are not provided. For example, water management ponds are to collect and pump back any seepage or other surface water to the tailings pond. How will this be managed (e.g., secure pumping when required, overflow conditions) is not made clear in the EIA report.
- There are no plans to put a liner in the tailings pond to prevent seepage. Tailings pond seepage is a major source of acid rock drainage.
- Models used by the proponent do not model natural variability. The proponent uses averages where it has some information, yet the proponent knows and discusses variability in several places. Confidence limits are best estimated to be +- 100% of the average.
- The EIA report speaks to potential outcomes, but gives no probability values of such as would be expected in an objective report on such an operation. Where risk is presented, it is consolidated into just a few categories. These risks are also the proponent's "judgment"; probabilities (%) need to be presented.

- There is no adequate proposal of environmental funding to deal with the water issues for such massive landscape features of the open pit and TSF post-operations. $50M may clean up the site (no details are provided for how this figure was arrived at), but it will never come close to handling the volumes of water in perpetuity.
- A breach of the tailings dam is not assessed in the EIA report. Although the chances of such may be small, they are not insignificant, and the impacts of such a breach on downstream water quality could be catastrophic. This needs to be assessed.

1.3.5 Summary of the reviewer's main comments about the EIA report: Aquatic Environment

- The main concerns raised about the EIA report's section on Water Resources are also applicable to the Aquatic Environment section. Additional concerns follow below.
- Not enough basic field work was done and where done, not always interpreted properly.
- Atlantic salmon in the St. John River are soon to be an endangered species and the Nashwaak River is officially recognized as the critical river for their survival, yet there is no planning for the risk of loss if any/some/all of the water management plans fail.
- The toxicity of water releases from the tailings pond to Sisson Brook has not been addressed fully.
- The EIA report says that fish habitat loss will be compensated by the removal of the Lower Lake Dam. The proponent has been told repeatedly by locals and scientists that this is not needed and as such it should not be proposed as the most likely habitat compensation scenario.
- A breach of the tailings dam is not assessed in the EIA report. Although the chances of such may be small, they are not insignificant, and the impacts of such a breach on downstream water quality could be catastrophic. This needs to be assessed.

1.3.6 Summary of the Center for Science in Public Participation's (CSP2) main comments and recommendations on the EIA report and proposed mine plans

Note: CSP2 submitted their comments on the project directly to the Agency on October 7, 2013, and are reproduced in Section 2.5 below for convenience.

- Regarding design of the tailings storage facility (TSF), CSP2 recommends "*A more sound approach in terms of controlling seepage would be to remove the native soils for use in reclamation, and to compact the remaining material to a specified density.*"
- CSP2 raises concerns about how the tailings dam response to earthquakes has been modeled. They recommend "*If pseudo-static modeling was used to test for seismic stability, then a numerical model should be used to test the dam under seismic loading.*" Their reason for this recommendation is that "It is especially important that dynamic modeling be performed since the dam design has incorporated a modified centerline-type construction (which has an upstream-type component built on seismically unstable tailings). Today, few US regulatory agencies accept pseudostatic methods for seismic design of new dam projects."
- Regarding the issue of alternatives for the design of the tailings dam, CSP2 states, "The EIA does not explain whether the use of cycloned tailings for dam construction, which would probably require downstream-type construction, would provide better seismic stability than for the modified centerline design chosen as the preferred alternative." It subsequently recommends "*It would be appropriate to have a full explanation of why a modified-centerline rockfill dam is better than a downstream dam constructed of tailings.*"

- Like other reviewers, CSP2 discusses the incompleteness of the acid base accounting for the project: "*The overburden should be sampled for sulfur and carbonate to insure that no acid drainage will emanate from the overburden."*
- The EIA report is not clear about how much surplus water will need to be treated. "The TSF will have approximately 2 million m3/year of surplus water starting at about Year 8." (p.3-123) and; "Approximately 6 million m3/year of TSF pond water will be pumped to the WTP during Operation starting in Year 8 under average conditions." (p. 7-80) This is a discrepancy of 4 million m3/year."
- Like other reviewers, CSP2 discusses the cost of future water treatment. "… the volumes possible at Sisson Brook could require a financial surety in the $100's millions. … By failing to declare, whether through lack of information or analysis, it must be assumed that a financial surety for water treatment in perpetuity needs to be established. However, the financial analysis of this outcome is also not addressed in the EIA. Because of the financial risk it places on the public, this is a major omission in the EIA."
- CSP2 is particularly critical of the EIA report's failure to assess the impacts of a tailings dam breach. "Tailings dam failure is a low probability event, but also an event with high consequences. These consequences have never been ignored in any other EIS/EIA I have reviewed. To in essence assert that 'my engineering' could not possibly fail, in light of existing statistics, is arrogantly assuming that it is always the other guy (or gal) that will make a mistake – but not me. This is exactly the attitude that leads to accidents…"
- Regarding the proponent's plan for quarterly water quality monitoring, CSP2 states "Quarterly monitoring is not adequate to capture surface water variations. Weekly sampling is typical at most mines."
- "The [Conceptual Decommissioning, Reclamation and Closure Plan] should be completed at the mine-proposal stage, and certainly prior to permitting, to a sufficient degree to reasonably determine water treatment costs, reclamation costs, and assess the short and long term social, health, and economic impacts from the mine (including post-closure)."
- The CSP2 review contains other recommendations, such as those dealing with groundwater monitoring, determining the cost of the closure bond, and steps for reclaiming the site.

1.3.7 Summary of the reviewer's main comments about the EIA report: Terrestrial and Vegetated Environments

- Overall, sampling for wildlife other than birds is inadequate.
- From the bird surveys done, there are several Threatened Species in the project area whose protection needs to be addressed before the project proceeds: Common Nighthawk, Olive Sided Flycatcher, and Canada Warbler.
- The EIA report does not discuss the importance of insects to the ecosystem and makes no mention of rare butterfly species such as the early hairstreak, hoary elfin and hoary comma.
- How the project will affect the national recovery strategy for long eared bats (Myotis spp.) is not discussed in the EIA report.
- The impacts of habitat fragmentation are downplayed in the EIA report, especially when one considers the cumulative impacts of human activity in that area, the overall declining health of the Acadian forest type in New Brunswick, and the large vegetated area that the project is impacting.
- The project`s impacts on lynx cannot be rated as "not significant" when no numbers are provided about how many lynx may die because of the project and the number of lynx in NB is not provided.

- The EIA report fails to acknowledge how the cumulative environmental effects of the project will contribute to deforestation and forest degradation at a time when the diversity of the Acadian forest should be restored.
- The EIA report fails to describe the potential effects of ecosystems and changes in the biota of terrestrial and freshwater ecosystems as a result of climate change in the future.
- The EIA report fails to develop a systematic approach to documenting how the project's environmental effects, such as to the atmospheric or aquatic environment, overlap with, and consequently impact on, candidate protected natural areas (PNAs). Many of the project's environmental effects will travel outside of the 1.5 km local assessment area chosen by the proponent to predict the impacts of the project on candidate PNAs.
- The EIA report does not assess the economic benefits of candidate PNAs as economic alternatives to the project, or the impact of PNAs as part of the environment's impact on the project.

1.3.8 Summary of the reviewer's main comments about the EIA report: Wetland Environment

- There is an over reliance on adhering strictly to the current provincial wetlands management policy which (as the proponent clearly states) does not regulate a large proportion of wetlands in the project development area, the local assessment area, and the regional assessment area. This leads to an underestimation of impacts due to a lack of requirements for compensation for this loss and an underestimation of the cumulative impacts, particularly when considered with future forestry activity which has the most impact on the unregulated wetlands (forested wetlands).
- The proponent does not go into detail about their proposed wetland compensation approach for mitigating the loss of wetlands functions of government regulated wetlands.
- The proponent relies heavily on future work to identify compensation measures. With a lack of detail it is impossible to comment on such things as watershed thresholds for wetland function loss and appropriate compensation to reflect the watersheds thresholds. This modeling should be undertaken.

1.3.9 Summary of the reviewer's main comments about the EIA report: Labour and Economy

- The EIA report is only dedicated to describing the economic benefits of mine, not its costs.
- The reviewer questions the use of an economic impact model (EIM) used to calculate the benefits of the project. Under EIMs, all expenditures by the project are a benefit. This includes the money spent to clean-up spills and floods of tailings.
- Even if one accepts the use of an EIM in the EIA report, the economic benefits of the mine have likely been over-estimated.
- A traditional cost-benefit analysis should have been used to improve our knowledge about the economic impacts of the mine.
- No details are provided about how the $50 million in closure costs were estimated. The reviewer believes this amount to be a serious under-estimation.
- Based on the proponent's sensitivity analysis, the reviewer states that mineral price movements, especially in the price of APT, will have a significant effect on the viability of this project. He also notes that current prices for molybdenum are far below the proponent's assumed price of $15/lb.

1.3.10 Summary of the reviewer's main comments about the EIA report: comparing the project to other mines

- From the parts of the EIA report the reviewer read, it is his view that overall the EIA report was very thorough and quite well done. He did raise some concerns about the project's plans for water management and the tailings storage facility (TSF). These follow below.
- A condition for allowing the project to proceed should be the requirement of a detailed plan to deal with emergencies such as a power failure, a pump(s) malfunction, and excessive precipitation.
- The EIA report does not provide a description of the spillway on the TSF or describe the design criteria for that spillway.
- It is not clear from the EIA report whether all of the water management components (WMP, pumps, pipes, and spillways) are designed to deal with these types of extreme rainfall events.
- Annual or at a minimum biannual inspections should be carried out to ensure the integrity of the dams surrounding the TSF versus the five year inspection period proposed by the proponent.
- It is not clear to the reviewer whether $50 million is adequate to properly close the mine.
- The reviewer notes that very few mines commence operation and run uninterrupted for the predicted full operational life of the mine. Metal prices, technical problems and labour disputes can all result in temporary or premature closure of a mine. This issue is not discussed in the EIA. The reviewer asks that should an interruption in production occur, how will that affect the water management plan, the operation of the TSF and the treatment of the waste water?

1.3.11 Comments on the failure of the EIA Report to address Need for and Sustainability of the Project

- The business case for the mine is weak, therefore the proponent has failed to demonstrate a clear need for the project in its basic purpose – supplying tungsten.
- The EIA report does not explain how the project supports sustainable development today and meets the needs of future generations.
- The proponent's, Northcliff Resources, relationship with HDI is unclear, i.e., it seems as though HDI is the proponent. Other environmental assessments have raised serious concerns about the quality of the EIA reports for different HDI projects, such as the Prosperity Mine in BC.

1.4 Five significant shortcomings of the EIA report

CCNB Action's reviewers identified many ways the EIA report needs to be improved. However, after CCNB Action's own review, after reading our experts' reports and discussing the EIA report with them, and hearing from the public, CCNB Action has identified five overarching "themes" about the inadequacy of the EIA report. (Many of these same concerns were raised during the federal review panel's hearing for the EIA report for the New Prosperity Mine in B.C., an HDI (the partner of Northclfiff Resources in the Sisson Project) project (see **Appendix F** of this report)).

1.4.1 The EIA report is fundamentally incomplete

There are many examples of how the Sisson Project EIA report is incomplete and as such needs to be revised before any further consideration of approving the project can take place. Some of the most glaring and vital are discussed below.

1.4.1.1 Acid Base Accounting for many potential sources of metal leaching and acid rock drainage were not complete at the time the EIA report was written

Metal leaching and acid rock drainage are two of the biggest and most obvious environmental effects of a metal mine. The assessment of these effects is fundamental to understanding the impacts of the Sisson Project. As such, they should have been top of mind when it came to completing the EIA report. Clearly they were not as the SRK 2013 ML/ARD Potential Characterization Report was not completed until August 2013, while the EIA report was submitted to the Agency on July 31, 2013. How any work or information from the ML/ARD report could have been included in the EIA report is unclear.

Further to this point, even the acid base accounting work in the ML/ARD report is incomplete. For example:

- **SRK ML/ARD Sec. 3.5:** "Additional overburden sampling is planned as part of geotechnical investigations in early fall 2013 and acid-base accounting analyses will be performed at that time."

- **SRK ML/ARD Sec. 4.5:** "Additional geotechnical investigations are planned for the fall of 2013 and ARD characterization is expected to occur at that time."

  "Additional work will be required to understand the mobility of arsenic from overburden. These studies are planned for the fall of 2013. "

Regarding ML/ARD, the Terms of Reference for the EIA Report required that:

> *The discussion of ML/ARD should demonstrate that Northcliff has the necessary understanding, site capacity, technical capability and intent to identify, avoid, mitigate and/or manage ML/ARD in a manner which protects the environment through the life of the mine and after closure of the mine.*

Given the proponent's cavalier treatment of the issue of ML/ARD in the EIA report, it is clear Northcliff has done none of this.

1.4.1.2 Details and statements regarding seepage from the tailings storage facility are either lacking or unsupportable

At pages 7-79 and 7-80, the EIA report states:

> **7.6.2.2.1.3 TSF Embankment Drainage and Seepage Collection**
>
> Steady-state seepage analyses were completed using the finite element computer program SEEP/W to estimate the amount of seepage through the TSF embankments. It was assumed that a portion the embankment drainage and seepage will be captured by the embankment seepage collection system or intercepted and collected by groundwater pump-back wells downstream of the TSF. A small fraction of the total seepage was assumed to bypass the seepage collection systems and be lost to the environment downstream of the TSF.

Nowhere in the EIA report or supporting studies are the results of these analyses or actual rates of seepage provided. What is a "small fraction" is not quantified. Evidence that this information is not shared with the public or decision-makers can be seen in EIA report Figure 3.4.9 (at page 3-124) "Schematic of Mine Operational Water Balance". The legend figure states the source of the figure is Samuel Engineering 2013. However, closer inspection shows the figure was supplied on March 27 to the proponent by Knight Piesold. While similar, Samuel Engineering did not use this figure. Rather, this figure comes from the reference Knight Piésold 2013b. (Sisson Project – Feasibility Study Monthly Operational Water Balance. Prepared for Northcliff Resources Ltd. dated March 27, 2013.) This Feasibility Study was not placed on the CEAR website for this project.

Dr. Chambers (CSP2) 1-2 highlights the need for this information:

> It is noted in the Knight Piesold Baseline Hydrogeology Report that:
>
> "● Till: Surficial geology mapping has identified basal and ablation tills up to about 10 m in the project area. The till is comprised of varying composition of sand, silt, gravel and clay. The ablation till may be more permeable than the basal till.
> ● Shallow, weathered bedrock: The presence of this zone in the upper 10 m to 20 m of rock is based on regional mapping as well as drilling in the project area."
>
> With up to 10 m of till, potentially on top of fractured bedrock that could be an additional 20 m in depth, the likelihood of seepage under the starter (and fully constructed) tailings dam seems probable in some locations.

1.4.1.3 Hydrometeorology data is missing or seemingly ignored

- **Baseline Hydrometeorology Report Sec. 6.0:** A reasonable amount of hydrological and meteorological data has been collected at the project site. However, periods of limited or missing data exist within the records. The most notable of these is the lack of winter precipitation data at the Sisson climate station, as well as limited May freshet runoff data and winter discharge data. It is therefore suggested that ongoing data collection be continued and that the estimated values in this report be reviewed and updated once additional data become available.

- **Baseline Studies: KP hydrogeology Sec. 4:** The rate of groundwater recharge was estimated as about 8 % of the MAP (1350 mm) based on a watershed model for the project that was calibrated to regional streamflows at Narrows Mountain Brook (KP 2012e). The regional stream flow data currently provides the best approximation of the long-term distribution and volume of flow at the site. As additional precipitation and streamflow measurements (especially low flow measurements) are collected on site, the modelling work may be revised to use site data for calibration. Short warming periods in the winter result in a component of the winter snowmelt and therefore winter low flows may reflect both surface runoff and groundwater discharge.

  This flow condition observed during this packer test indicates that the higher take is likely not indicative of the bulk permeability of the test interval. Given the uncertainty with the high take tests, the following was recommended:
  o Identify the packer tests as high take without assigning an actual hydraulic conductivity value, until there is greater certainty regarding the validity of the testing.
  o If required, carry out additional and more than one type of hydraulic testing (e.g. constant head, falling head, lugeon) to better constrain whether the high take results are indicative of the site conditions or were influenced by the testing tool or method.
  o Recognize the implications of potentially high hydraulic conductivity values within the deposit area on engineering and environmental studies until additional testing is completed to gain a better understanding of the hydraulic conductivity values.

From the above quote, is appears as though the proponent chose to ignore results it didn't like and wait for better data. There is no evidence that further testing was done to determine the mine site's hydraulic conductivity values and as such it is unclear how the proponent reached conclusions regarding the rate of groundwater flow for the project.

1.4.1.3 Understanding the toxicity of water released to Sisson Brook

In the EIA report, the water quality at a node for Sisson Brook is not discussed (at page 7-92) despite it being the receiving waters for the water from the TSF and later, open pit. Instead, the closest water quality node that is discussed is at Napadogan Brook 5 (NAP 5), which is below the confluence of Sisson and Napadogan Brook. At NAP 5, the toxicity of Sisson Brook is diluted by Napadogan Brook, thereby not providing the public and decision-makers of what is the final water quality of Sisson Brook. This information is key if we are to understand the impacts of the project on water quality and fish and fish habitat.

The failure to discuss a water quality node at Sisson Brook provides another example of the poor quality of the background work done for the EIA report. The Predictive Water Quality study treats NAP 5 as an effluent discharge point. For example (at Predictive Water Quality Study page 5):

> Beginning in Year 8, 6,000,000 m^3/yr of excess water from the TSF is pumped to a water treatment plant (WTP) and discharged post-treatment to Napadogan Brook at the confluence with Sisson Brook. The WTP discharge rate is generally proportional to the baseline hydrograph of at the point of discharge. The discharge is further reduced during low flow months in late summer and mid-winter.

Everywhere else in the EIA report it is made clear that water will be discharged to Sisson Brook. Why the Predictive Water Quality Study used a different discharge is unclear. This lack of consistency results in vital information being lost to the EIA report.

Finally, the proponent's assertions that it will do future work to address gaps in data and analyses are not in keeping with the Agency's own guidelines regarding the completion of an EIA report:

> "A commitment to implementing adaptive management measures does not eliminate the need for sufficient information regarding the environmental effects of the project, the significance of those effects and the appropriate mitigation measures required to eliminate, reduce or control those effects. Where additional information collection or studies are needed over the life-cycle of the project, such studies in themselves should not be considered "mitigation measures"." (CEA Agency's 2009 Operational Policy Statement, *Adaptive Management Measures under the Canadian Environmental Assessment Act* at page 4, emphasis added)

The spirit of the 2009 OAP is that EIAs are not complete until all necessary baseline data is collected. Without this, the effects of a project cannot be fully assessed.

Recommendation:

- That the CEA Agency require the proponent to revise the EIA report to address all the concerns identified by CCNB experts and in this report.

1.4.2 No economic cost-benefit analysis

Common sense tells us that large open pit mining operations that dig up acid generating and metal leaching rock, emit contaminated dust, destroy the headwaters of clean and ecologically important rivers, fragment terrestrial landscapes, and have massive tailings ponds and dams, cause harm to the environment. These negative environmental effects also impact communities located near these mines. If these impacts and harm are significant, then these projects should not be approved by the public and environmental assessment decision-makers. However, sometimes they are when it is believed the economic benefits of a mine outweigh or justify the damage it causes to the environment and communities. Implicit in these decisions though is that the economic benefits of a mine are large enough to outweigh its environmental and social costs.

As has been detailed by Dr. Moir (see Section 2.9 below), without a cost-benefit analysis we don't have an accurate picture of the economic benefits, if any, of the Sisson Project. As Dr. Moir notes, the use of an economic impact model, like the one used by the proponent, for a different project showed that the project created a positive economic benefit, while using a true cost-benefit analysis showed this same project generated a negative economic loss to the community. Therefore, without an economic cost-benefit analysis for the Sisson Project, the public and decision-makers cannot make an informed decision about whether the economic benefits of the project justify the damage it will cause to the environment. Making this determination becomes even more difficult when the true closure costs of the Sisson Project are not known.

Recommendations:

- In consultation with Dr. Moir, have the proponent prepare an economic cost-benefit analysis for the Sisson Project for inclusion in a revised EIA report.

- Have the proponent provide a fully costed estimate of the long term closure costs of the Sisson Project for inclusion in a revised EIA report.

1.4.3 No assessment of the failure of the tailings dam

As will be detailed more fully below, and as much as the proponent would like this fact to go away, tailings dams fail! The failure of the Sisson tailings dam could release millions of tonnes of tailings and millions of cubic metres of supernatant water into the ecologically valuable Nashwaak watershed. While understated, the EIA Report does recognize the harm such a failure would cause. "At Sisson, a failure of the TSF embankment and resultant tailings or process water release could significantly affect downstream watercourses and habitats that have substantial ecological and societal value …" (EIAR page 3-25, emphasis added). Despite a tailings dam failure posing the project's biggest acute threat to the environment, the proponent chose not to assess its impacts.

> 8.17.2.1.1 Loss of Containment from Tailings Storage Facility (TSF)
>
> "With the application of these standards and rigorous construction methods to ensure the structural integrity of the TSF embankments and components, the implementation of adaptive management measures as necessary over the life of the mine, and the legislated regulatory oversight, the possibility of a structural failure of a TSF embankment is so unlikely that it cannot reasonably be considered a credible accident or malfunction, and is thus not considered further in this EIA Report." (EIAR page 8-698, emphasis added)

In his review of the EIA report for the Sisson Project (see Section 2.5 below), Dr. Chambers, who has 20 years of experience as an advisor on the environmental effects of mining projects both nationally and internationally, clearly explains why the above thinking is flawed.

> This is the first time I have seen this glaringly overconfident statement made in an EIS/EIA.
>
> In the 10 years since the ICOLD 2001[1] report the failure rate of tailings dams has remained at roughly one failure every 8 months (i.e. three failures every two years).[2] These dam failures are not limited to old technology or to countries with scant regulation. Previous research pointed out that most tailings dam failures occur at operating mines, and that 39% of the tailings dam failures worldwide occur in the United States, significantly more than in any other country.[3]
>
> Tailings dam failure is a low probability event, but also an event with high consequences. These consequences have never been ignored in any other EIS/EIA I have reviewed. To in essence assert that 'my engineering' could not possibly fail, in light of existing statistics, is arrogantly assuming that it is always the other guy (or gal) that will make a mistake – but not me. This is exactly the attitude that leads to accidents – as has been proven many times in the aviation world. (emphasis added)

[1] Tailings Dams, Risk of Dangerous Occurrences, Lessons Learnt from Practical Experiences, Bulletin 121, International Commission on Large Dams, 2001.

[2] Data from http://www.wise-uranium.org/mdaf.html "Chronology of major tailings dam failures" as of March 22, 2011.

[3] Reported tailings dam failures, A review of the European incidents in the worldwide context, M. Rico, G. Benito, A.R. Salgueiro, A. D´ıez-Herrero, H.G. Pereira, Journal of Hazardous Materials 152 (2008) p. 848.

Recommendation:

- Have the proponent complete a detailed environmental effects analysis of the failure of the tailings dam for the Sisson Project for inclusion in a revised EIA report. The assessment would include a modeling of the most likely worst case disaster scenario for such a failure describing, for example, the toxicity of the tailings and supernatant water, how much tailings and supernatant water would escape from the tailings storage facility, how far and to what depth the tailings and supernatant water would travel downstream, and what damage this would cause to communities in the watershed and the environment, including Atlantic salmon habitat, and for how long.

1.4.4 The closure plan is missing significant details

Several CCNB Action reviewers discussed the serious deficiencies of the proponent's closure plan. Mines with acid rock drainage and metal leaching leave long term environmental liabilities that must be managed. Without an understanding of the long term future environmental, social, and economic costs of the Sisson Project, we cannot make a fair determination of whether the project is sustainable, i.e., does it meet the needs of today without damaging the opportunities of future generations. Several of the key deficiencies of the closure plan are discussed below.

1.4.4.1 There is no accurate description of how much contaminated water will have to be managed after closure

The EIA report first states "the TSF will have approximately 2 million m^3/year of surplus water starting at about Year 8" (EIAR page 3-123). It then reports, "Approximately 6 million m^3/year of TSF pond water will be pumped to the WTP during Operation starting in Year 8 under average conditions" (EIAR page 7-80). Finally, the SRK (2013) Metal Leaching and Acid Rock Drainage Potential Characterization then describes in Appendix I (conceptual water treatment plant design) that the TSF, and after closure, the open pit will have an annual discharge of 1,280 m^3/hr (or 11 million m^3/year). This wide variation in water that will have to be treated after closure is never explained.

1.4.4.2 There is no accurate description for how long contaminated water will have to managed after closure

The EIA report provides no details about how long post-closure that water will need to be treated, only that it will be treated for "as long as necessary" (EIAR page 143). Is this 1 year, 10 years, 100 years, or more? This is not an idle question, for as Mr. Parker points out (Section 2.10 below), we already have closed mines in New Brunswick whose waste water requires long-term treatment. The lack of detail in the EIA report obviously does not assist in decision-making about the project.

1.4.4.3 Significant details about the conceptual water treatment plant are missing

The water treatment plant (WTP) is the key component of the closure plan for the mine, yet it is not described in any detail in the actual EIA report. Without the WTP, the environmental effects of the project post-closure on the aquatic environment will not be mitigated, in turn increasing their significance. Given the limitations of the conceptual design for the WTP, at present there is *no water treatment plant* for the Sisson Project. As the SRK 2013 report states:

> In the event that water treatment for sodium or fluoride is required … then the water treatment process proposed here will not be adequate. (SRK 2013 Appendix I, emphasis added)

The EIA report shows (at page 7-98) that post-closure, fluoride levels in water from the mine will be 2 to 3 times the CCME FAL guidelines (for the protection of aquatic life). The proponent can have no expectation that this continual exceedence, amongst others, will be permitted in the future. As a result, there is no actual plan for a WTP in the EIA report and a new conceptual WTP needs to be designed. The consequence of this is that any of the proponent's environmental effects analysis that relied on the existence of the flawed conceptual WTP much be redone, and if not redone, then without the mitigation of a WTP, the adverse environmental effects of the project on the aquatic environment must be considered to be significant.

1.4.4.4 The Terms of Reference regarding closure have not been met

> At a minimum, the discussion of alternative means of carrying out the Project shall include a consideration of the following: …
> • alternative options for reclamation and closure. (TOR at page 22-23)

In response to this requirement, the EIA report (at page 3-77) states, "Northcliff has considered various options to achieve decommissioning, reclamation and closure of the Project site at the end of mine life." No details of these other options are provided. Clearly this is not enough information for the public and decision-makers to weigh these alternatives. It is also not in keeping with Environment Canada's 2011 *Guidelines for the Assessment of Alternatives of Mine Waste Disposal*:[4]

> The alternatives assessment should objectively and rigorously consider all available options for mine waste disposal. It should assess all aspects of each mine waste disposal alternative throughout the project life cycle (i.e., from construction through operation, closure and ultimately long-term monitoring and maintenance). (at page 7)

Recommendations:

- Any plan for the decommissioning and closure of the project should be completed at the mine-proposal stage, and certainly prior to permitting, to a sufficient degree to reasonably determine water treatment costs, i.e., how much water and what is in the water, reclamation costs, and assess the short and long term social, health, and economic impacts from the mine (including post-closure).
- Prior to permitting the proponent should identify what long term and permanent water quality treatment may be necessary at the mine site. This includes but not be limited to discharges from the pit (including from pit walls that will not be submerged and pit discharges to groundwater).
- Permanent treatment should be avoided. The closure plan should more fully evaluate this and identify alternatives to perpetual treatment.

[4] Available at: http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=5ECBCE8B-7E50-49E3-B7AD-8C21A575E873.

1.4.5 Costs of closure are not explained

Regarding this issue, Dr. Chambers writes

> If there is surplus pit water that will require treatment it is reasonable to anticipate that this treatment will be required in perpetuity - forever. That presents clear long-term liabilities and costs to the Crown, Province, and public. These liabilities and costs should be fully evaluated and discussed … (Section 2.5 below).

Similar concerns are raised by Dr. Curry (Section 2.4), Dr. Moir (Section 2.9), Mr. Parker (Section 2.10), and Mr. Hart (Section 3.0 Sustainability).

The proponent provides no details about how it arrived at a figure of $50 million to cover the costs of decommissioning, reclamation, and closure of the project. In addition, all of the above reviewers believe this amount to be very inadequate for a project of this size. The average operational costs of water treatment for mines are estimated to be $1.54 per m^3.[5] Accepting the proponent's figure of the project having 6 million m^3 of surplus water/year, one arrives at roughly $9 million/year being required to treat this water. The proposed $50 million would be depleted in less than 6 years, without including reclamation costs such as for revegeatating the site.

Recommendation:

- Have the proponent provide a fully costed estimate of the long term closure costs of the Sisson Project for inclusion in a revised EIA report.

[5] Zinck, J. and W. Griffith. 2013. Review of Mine Drainage Treatment and Sludge Management Operations. MEND Project: 603054. Report: CANMET-MMSL 10-058(CR).

1.4 CCNB Action's position on the EIA report and adverse environmental effects of the Sisson project

CCNB Action's report below shows that the need for the proposed tungsten and molybdenum mine has not been proven adequately. In addition, CCNB Action's expert reviewers collectively are of the opinion that because of missing vital data or data of poor quality, and inadequate sampling, methodology, and modeling done by the proponent, a large number of the Sisson Project's environmental effects cannot actually be determined. As a result, the EIA report does not fulfill the requirements for the conducting and reporting of the environmental assessment for the project as set out in the project's EIA terms of reference. CCNB Action experts are also of the opinion that based on the data that is available in the EIA report, in many instances the proponent has under-estimated the environmental effects of the project and mischaracterized the significance of these impacts, i.e., CCNB Action experts believe these adverse environmental effects of the project should be rated as significant.

From a reading of our report below, it is evident the presently inadequate and incomplete EIA report for the project must be redone so that fundamental questions about the project can be answered, such as what is the actual trace mineral content of the ore, what is the acid generating potential of the mined rock, and what are the true economic benefits of the project? Based on the fact the EIA report is incomplete, our experts' findings that many of the project's adverse environmental effects are significant, and the application of the precautionary principle, it is CCNB Action's position that the adverse environmental effects of the project must be accepted as being significant. Given all of this, it is clear that at present the obvious risks posed to the environment by the proposed mine, such as the release of air contaminants, the physical destruction of valuable fish habitat, and metal leaching and acid rock drainage, substantially outweigh the unsubstantiated need for or benefits of the project. For this reason, it is the position of CCNB Action the project should not receive the approval of decision-makers until such time as fundamental errors and oversights in the EIA report are adequately addressed. It is only after the EIA report is properly completed that the public and regulators can return to the question of whether the project should receive approval.

Following from the above, we will be requesting that the Minister use her authority under s. 23(2) of the old *CEAA* and/or the CEA Agency use its authority under s. 23(2) of *CEAA 2012* to require the proponent, Northcliff Resources Inc., to redo and revise the EIA report so that the information gaps in it identified by CCNB Action's experts are filled. We will also ask that the current public comment period not be ended and that it be extended for 45 days following the submission of a revised EIA report by the proponent. If these revisions are not made, then CCNB Action will stand by its position that the adverse environmental effects of the Sisson Project must be deemed to be significant and because of the unsubstantiated need for the project, that these effects cannot be justified. As such, we will ask the CEA Agency to conclude in its comprehensive study report (CSR) for the project, "That even with the implementation of mitigation measures, the Sisson Project is likely to cause significant adverse environmental effects and that these effects cannot be justified."

2. Experts' Reports

2.1 Review of EIA Report for the Sisson Project (Tungsten and Molybdenum Mine) - New Brunswick, CEAR #11-03-63169

Valued Environmental Component: Atmospheric Environment
Subject Area: Air Quality
EIA Report Section: 8.2
Date: September 30, 2013

Inka Milewski
Conservation Council of New Brunswick
and
Lawrence Wuest
Consultant in Quantitative Ecology

1. Summary

This review examined EIA Report (EIAR) Section 8.2 Atmospheric Environment, EIA Report Section 7.1 Summary of Key Predictive Studies (Air Quality Monitoring), and the Baseline Ambient Air Quality Technical Report (AQTR). In addition, information from portions of the Metal Leaching and Acid Mine Drainage Characterization Report (ML/ARD Report) and the Canadian National Instrument 43-101 Technical Report (Samuel Engr. 2013) were accessed.

Overall, the study's conclusion that air quality will not be significantly impacted by the project is not credible and cannot be supported by the proponent's dispersion and deposition modeling which used inaccurate estimates of particulate and trace metal emissions and site-specific meteorological data. Once operational, the project will release an estimated 1563.8 metric tonnes (mt) of total particulate matter (dust of all particle sizes) into the atmosphere annually (EIAR). The large quantity of particulate matter (PM) generated by the project will not meet the nation-wide goal of "keeping clean areas clean" as defined for PM by the Canadian Council of Ministers of the Environment. The project will emit nearly 3 times the particulate matter of any existing industrial project in the province.

The key issues identified in this review are:

- discrepancies and inconsistencies in the meteorological data used in the air dispersion model;
- the improper location of the meteorological station at the proposed project site;
- a lack of data on background ambient air concentrations for PM_{10};
- missing and inaccurate emission estimates for some project sources;
- missing geo-referenced data required to validate the concentration and spatial distribution of trace metals at the project site;
- higher average arsenic concentration in all pathways (except topsoil) than the arsenic value used in the dispersion and deposition model;
- emission estimates from the APT plant are not supported by available data or calculations;
- the spatial domain for the air quality model is too small; and
- no environmental monitoring for future air quality is proposed for the project.

The accuracy of emission estimates and the reproducibility of air dispersion modeling results are central components in the assessment of the project's impact on ecological and human health. Deficiencies in the air quality assessment for this project need to be remedied in order for regulators and reviewers to have any confidence in the predictions generated by the EIA report. A detailed review of the deficiencies and recommendations to remedy them are presented below.

2. Review of methods and results used by the proponent to study existing conditions (EIA Report: Section 8.2.2 and Baseline Ambient Air Quality Technical Report)

The proponent's study of existing ambient air quality reviewed data from existing provincial monitoring networks, compared and assessed existing climate and meteorological data and examined meteorological data and dustfall data previously collected by RESCAN for the Sisson Project. The study identified several gaps in earlier efforts to collect baseline air quality data, resulting in an incomplete, six-month collection of baseline ambient air quality monitoring data at a single monitoring station located in Napadogan, approximately 10 km east of the project.

2.1 Meteorological Data

The study compiled data from a meteorological station operated by Northcliff Resources at the site of the Sisson Project site from "spring 2011 to winter 2012" (EIAR). The study is unclear whether this constitutes a full year of data collection. The study concluded that winds at the project site were dominant from the southwest direction (AQTR page14). RESCAN-Geodex operated a meteorological station at the site of the Sisson Project from 2007-2011 (AQTR page 14). In a summary of the period Nov. 2007 to Mar., 2008, RESCAN reported dominant winds were from the northwest (RESCAN 2008, page 3-23). In Figure 1, we compare the study's wind rose (EIAR Figure 8.2.3) to that reported by RESCAN (Rescan 2008, Figure 3.2-10) and illustrates the discrepancies between the two sets of data.

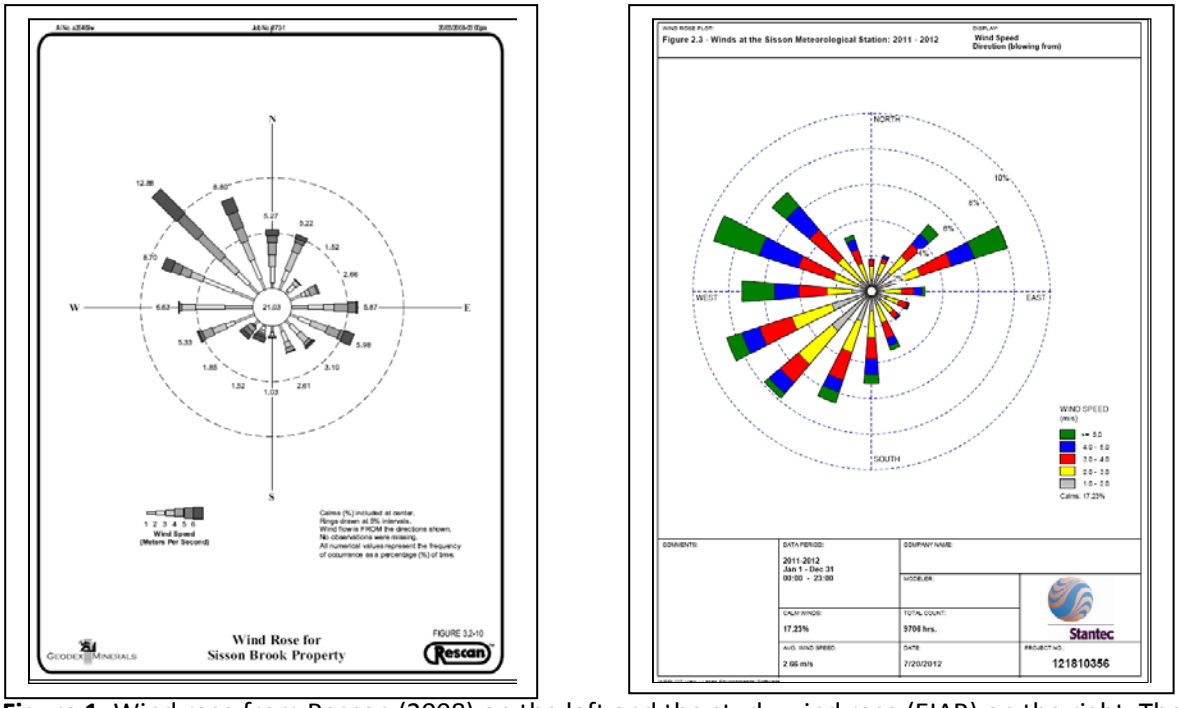

Figure 1. Wind rose from Rescan (2008) on the left and the study wind rose (EIAR) on the right. The meteorological station was in the same location for both recordings.

The study referred to "uncertainties" in the quality of the meteorological wind data collected and reported by Rescan (2008) at the open-pit site (AQTR page 14, Sec. 2.3.1). The study suggested that a lack of evidence of station maintenance and quality assurance precluded the use of the RESCAN data (EIAR page 8-14). The study did not elaborate or provide any further discussion as to why the RESCAN data would not be used.

There appears to be a lack of precision (reproducibility) in the meteorological data and considerable uncertainty as to exactly what is being measured. For example, 5 year summaries in two different wind rose plots for the Fredericton Airport, 60 km south of the project area, are presented in the study. One appears on page 8-15 of the EIA report and the other on page 9 of the Baseline Ambient Air Quality Technical Report (Figure 2).The study has suggested that the climate conditions at the project site are comparable to climate conditions in Fredericton. However, neither Fredericton airport 5 year wind rose matched the RESCAN wind rose or the EIA report wind rose for the project site.

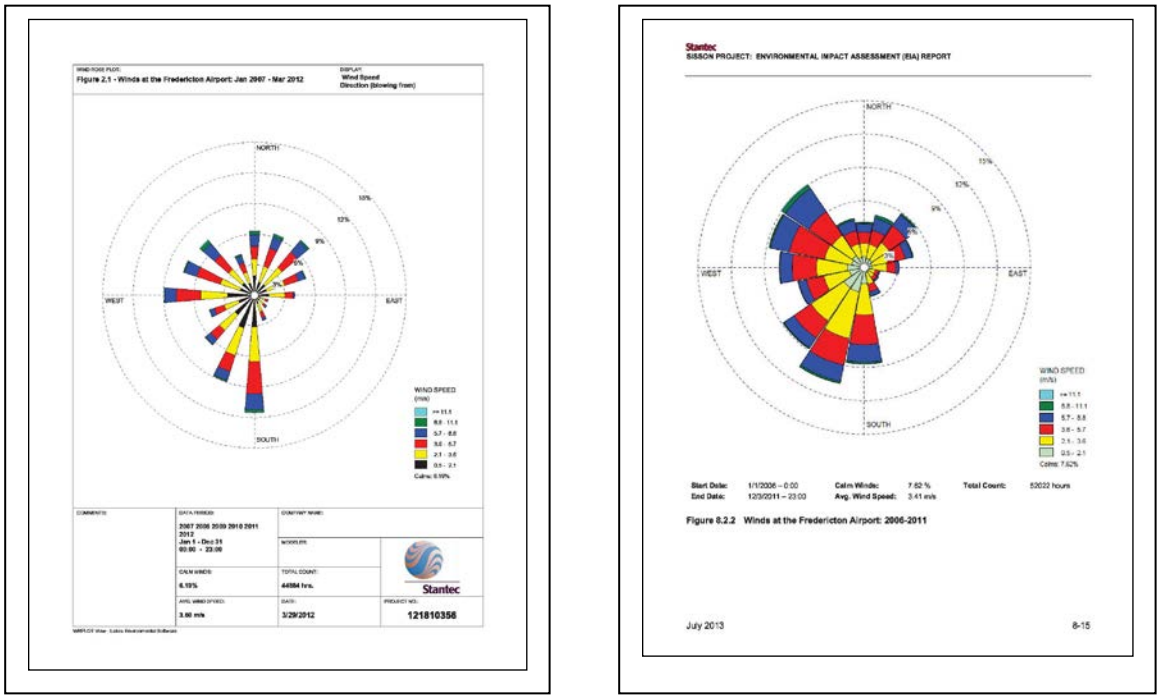

Figure 2. Wind rose for Fredericton Airport Jan 2007 – Mar 2012 on the left and for 2006-2011 on the right.

In Figure 3, we present 5-year summary wind rose plots for Saint Leonard and Edmunston (New Brunswick), communities in the central and northern regions of New Brunswick. Wind direction and speed for St. Leonard and Edmundston are more consistent with the RESCAN plot than the proponent's plot, suggesting the regional trend appears to be contradictory to the Fredericton data used in the study.

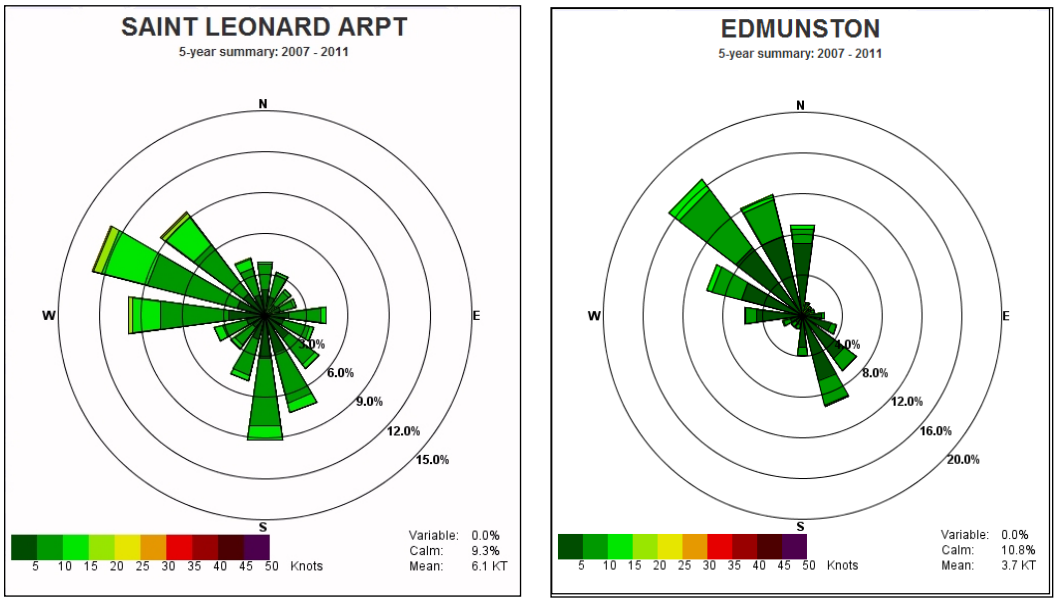

Figure 3. Five-year wind rose summary for Saint Leonard and Edmundston, New Brunswick. Data Source: NOAA's National Climatic Data Center (NCDC) 2013, http://cdo.ncdc.noaa.gov/pls/plclimprod/poemain.accessrouter?datasetabbv=DS3505

The meteorological station monitored by both RESCAN and Northcliff Resources for the EIAR was located at the most southerly end of the proposed open-pit at Sisson (AQTR page 15). This location is roughly positioned at 305m above mean sea level. The processing plant, Tailings Storage Facility (TSF), quarry and ammonium paratungstate (APT) plant are located at elevations 385m-400m, an 80 metre differential. Looking at a topographical map, it is clear the meteorological station was located in a localized basin surrounded on three sides by upland terrain. A large fraction of dust emissions from the project will emanate from sources above the open-pit, e.g. the TSF, quarry, processing plant and APT plant. Placing the meteorological station in a relatively sheltered location and below the maximum sources of emissions fails to capture the wind conditions that are critical to assessing the predictions of contaminant dispersion from the project.

Accurate characterization of wind patterns is central to producing valid and reasonable estimates of contaminant dispersion and deposition. Wind erosion is the most important factor influencing dust emissions and deposition which, in turn, have important environmental consequences (Csavina *et al*. 2012).

The discrepancy and uncertainty of wind patterns reported by Rescan (2008) and the EIA report, and the rationale for locating the meteorological station below the maximum sources of dust emission must be properly explained. The proponent must examine the implications for modeling resulting from the use of uncertain and incomplete site meteorological wind data. The proponent must also defend the use of Fredericton airport wind data as opposed to the Saint Leonard and/or Edmundston wind data, and speak to the uncertainties in emission patterns resulting from that choice. The proponent should also be required to re-measure over an appropriate period of time, site meteorological data at project sites appropriate to individual project emission sources. These measures are required before recompiling model dispersion and deposition patterns of mine emissions. Adequately representative wind pattern

data are essential to making informed assessments of ecological and human health risks associated with project contaminants.

2.2 Ambient baseline air quality monitoring

The study collected ambient air quality data for a six-month period (August 2011 - February 2012) at a monitoring station located in Napadogan, approximately 10 km northeast of the project area. The rationale for placing the monitoring station in Napadogan is reasonable, (e.g., close to residential area, open and away from building, distance from heavy industry and traffic, etc.).

The baseline ambient air quality monitoring results indicate that air quality in the vicinity of Napadogan is representative of that found in a rural, sparsely populated area with no significant source of industrial emissions (AQTR page 38). This is a reasonable conclusion.

Ambient baseline air quality monitoring did not include monitoring for particulate matter (PM) less than 10 microns (PM_{10}) except $PM_{2.5}$. No explanation was provided as to why PM_{10} were not monitored. Sources of PM_{10} are dust from roads, quarries and to a lesser extent diesel exhaust and NOx and SO_2 emissions (NB DELG 2013). These sources of particulates have been identified and associated with the construction and operational phases of the Sisson Project.

The potential for the project to release large quantities of PM_{10}, as well as PM and $PM_{2.5}$, is significant as fugitive dust emissions are the largest source of air contaminants from open pit mining projects (Huertas *et al.* 2012; Silvester *et al*. 2009; Lowndes *et al.* 2008). The potential for the project plus the background levels of PM_{10} to exceed air quality objectives, guidelines or standards are not quantified or assessed because data for background levels were not collected by the proponent.

Given the known health impacts of PM_{10} as well as $PM_{2.5}$, the absence of background PM_{10} data creates gaps and uncertainties in the results of air dispersion and deposition modeling. It also compromises any health risk assessment and provides a low level of confidence in the predictions generated by the models as presented in the EIA report.

3. Review of Potential Project-VEC Interactions (Atmospheric Environment) EIA Report Section 8.2.3)

The Air Quality Predictive Study (EIAR Sec. 7.1) acknowledged that changes to the atmospheric environment could occur due to emissions from the project's construction, operation, decommissioning, reclamation and closure. According to the study's emissions inventory, one of the major air contaminants from the project will be dust emissions in the form of PM, PM_{10} and $PM_{2.5}$. The study predicted that the project effects on the atmospheric environment would not be significant and confidence in the prediction was high (EIAR pages 8-24 to 8-25).

The conclusions of the air quality study were based on estimates of air contaminants from the construction (EIAR pages 3-94 to 3-101) and operation (EIAR pages 3-127 to 3-134) phases of the project. Emission inventories were developed based on information provided by the proponent. No emissions were predicted from the decommissioning, reclamation and closure of the project.

A dispersion model (AEROMOD) was used to estimate the dispersion and deposition of selected air contaminants from the project. Key model inputs were estimates of project emissions, meteorological data from the Fredericton airport and receptor grid and terrain data.

3.1 Air Emissions Inventories

Open pit mining operations present special challenges in measuring air emissions and determining emission factors, particularly for particulate (dust) emissions (Huertas *et al.* 2012a; Huertas *et al*. 2012b; Lowdnes *et al.* 2008). These challenges include estimating appropriate emission factors for non-point sources such as loading and unloading of material, topsoil and overburden handling and drilling. The Sisson Project EIA report did not acknowledge these challenges and, as a result, did not identify or address uncertainties in emission estimates.

The EIA report referenced the US EPA Compilation of Air Pollutant Emission Factors as the source of the project's emission estimates. Each emission factor has a rating from A to E with A being the best to indicate the reliability and robustness of a factor. The Sisson Project EIA report did not rate the reliability of emission estimates from the various sources.

The following is a review of the key air contaminant emissions presented in Sec. 3.4.1.6 and Sec. 3.4.2.5.1 of the EIA report.

3.1.1 Particulate Emissions

Apart from carbon dioxide, particulate emissions (dust) will be the single largest criteria air contaminant (CAC) released from the project. Particulate releases will occur from mobile (vehicles), fixed (concrete plant, APT plant) and fugitive (top soil and overburden handling, loading and unloading ore, quarrying, drilling, blasting, haulage over unpaved roads, etc.) sources. A summary of these emissions does not appear in the EIA report but has been prepared by the reviewers (Table 1).

Table 1. Selected Criteria Air Contaminants (CAC) Emission for the Sisson Project[a]

	Total Particulates metric tonnes/year	**Particulate Matter (PM_{10})** metric tonnes/year	**Particulate Matter ($PM_{2.5}$)** metric tonnes/year
Project - Construction Phase			
On-site Fuel Combustion - Construction Equipment	5.54	-[b]	-[b]
Vehicle Fuel Combustion	0.05	0.05	0.03
Site Preparation	40.0	7.6	4.2
Quarry- blasting	0.02	-[b]	-[b]
Unpaved roads	851.0	226.0	22.6
Topsoil and overburden piles	-[c]	-[c]	-[c]
Material Transfer	-[c]	-[c]	-[c]
Concrete plant	3.3	0.98	-[b]
Sub total	**899.91**	**234.6**	**26.83**
Project - Operation Phase			
Fuel Combustion in mining and support equipment	20.2	20.2	20.2
Vehicle Fuel Combustion	0.07	0.07	0.04
Primary Crusher	32.0	3.20	0.48
Ore Concentrator Plant	-[c]	-[c]	-[c]
APT Plant	-[d]	-[d]	-[d]
Package Boiler	1.0	1.0	0.65
Drilling	-[c]	-[c]	-[c]
Blasting	3.96	2.06	0.12
Material Handling and Transfer	19.9	8.02	1.21
Unpaved roads	1397.0	370.0	37.0
Crushed Ore Stockpile	0.013	0.12	0.002
Beaches	89.7	0.000135	0.0000202
Sub-total	**1563.84**	**404.67**	**59.7**

Notes:
[a] Data source: EIAR pages 3-94 to 3-98 and pages 3-127 to 3-134.
[b] No data provide in report
[c] Assumed negligible
[d] Identified but no data provided

As indicated in Table 1, data for some sources were simply assumed by the proponent to be negligible (topsoil and overburden stockpiling, drilling, the ore concentrator and the APT plant). Published emission factors are available for these sources and should have been applied to generate estimates of particulate emissions. Any emission control measures identified by the proponent could have been accounted for by applying percentage emission reduction efficiencies in the calculation of emissions (US EPA 1995; Environment Canada 2013).

Unpaved roads can include site access (SSA) roads, forest roads and internal site (PDA) roads. The emissions from SSA and PDA have different maintenance standards, different emission factors and different dust suppression capabilities, all factors affecting the level of emissions. The proponent has failed to itemize roads to an acceptable level of differentiation for validation of the reported emissions.

The EIA report's analysis, characterization and reporting of particulate emissions from the Sisson Project are inadequate and incomplete. The likelihood that particulate emissions are underestimated is high because the details of emission source estimates are missing and there is a lack of reproducibility of the emissions data.

3.1.2 Metals Emissions

The proponent reports that 304 drill cores were collected at Sisson from 1979 to 2011 (Table 10.1, Samuel Engr. 2013). The spatial distribution of these drill cores is shown in Figure 10-1 of Samuel Engr. (2013)

For the EIA report, estimates of trace metal content of fugitive dust emissions were determined from assays of 61 trace elements in 184 samples at various depths from 39 of the 304 drill cores as selected by SRK Consulting for ML/ARD studies. The location of the samples in the project area are shown graphically in Figure 5 of SRK (2013).The samples were primarily selected on the basis of sulfur content (SRK 2013 Sec.3.3.5).

The assay results were used to estimate trace metal content of Particulate Matter resulting from truck loading at the crusher, the primary, secondary and tertiary crusher operations, material transfer onto the conveyor, material transfer onto the crushed ore stock pile, haul road emissions, and stock pile wind erosion(EIAR page 3-134, Table 3.4.31). No rationale is given for using the results of trace element analyses of samples selected on the basis of sulfur content, nor is there any discussion of the possible bias injected into the trace element results due to non-random sampling of underlying rock strata (see "stratified random sampling"; SRK 2013 at Sec.3.2.1).

Emission rates for each trace metal by source (e.g., unpaved roads, primary crusher operation, overburden piles) were not provided. The study did not include trace metal emissions during the construction phase of the project or in the overall calculation of trace metal emission rates.

It bears repeating that the study's discussion of trace metal emissions from the project was restricted to the presentation of a table of average trace metal concentrations in samples classified as "ore" (EIAR page 3-134, Table 3.4.31). The only other location in the EIA report where these average trace element values appear is in Appendix E5 - Trace Metal Results for Tailings (ML/ARD report Appendix E5).

The trace metal values in Appendix E5 were drawn from the analysis of 184 drill core composite samples of barren rock (defined as waste rock and mid-grade ore) used to characterize element leaching potential from the project's waste rock (SRK 2013 page 12). According to the SRK ML/ARD report, mid-grade ore was used in the mine leaching/acid rock drainage experiments (ML/ARD report page 26 Sec. 4.2.3).

Average trace metal values in waste rock and mid-grade ore used to determine trace metal emissions to air are not representative of trace elements in the high-grade ore that will be processed in the APT plant and are not representative of the metal emissions from other potential emission pathways such as

overburden removal or waste rock storage. If, arsenic concentrations in ore were derived from the analysis of 184 drill core samples, then there is a discrepancy between the average concentration of arsenic in ore reported in the EIA report (41 mg/kg) and the actual value (64.8 mg/kg) calculated by the reviewers from available drill core data (SRK 2013 Appendix B2).

Table 2 provides a summary of arsenic concentrations measured in various potential pathways of metal releases to the atmosphere through the project's activities such as overburden removal, loading and dumping, crushing, haulage roads, and storage piles. The mean arsenic concentration in the overburden (143.3 mg/kg), which was not used in the study's calculation of trace metal emissions, is more than 250% higher than the concentration of arsenic identified for ore (41 mg/kg) which was used to calculate arsenic emission to air. In fact, arsenic concentrations are significantly higher in all emission pathways than the value used to estimate arsenic releases from the project.

Table 2. Arsenic concentrations in various project pathways

Statistical Value	**Baseline Surface Soil**[a] ppm (mg/kg)	**Overburden**[b] ppm (mg/kg)	**Sub-soil**[c] ppm (mg/kg)	**Pit Walls**[d] ppm (mg/kg)	**Waste-Rock/Mid-grade Ore**[e] ppm (mg/kg)	**Ore**[f] ppm (mg/kg)
Mean	**10.7**	**143.3**	**66.4**	**83.5**	**64.8**	**41**
Number of Samples	51	300	667	58	184	-[g]
Standard Deviation	17.0	612.7	113.3	349.7	287.1	-[g]
Margin of Error	-[g]	69.3	8.6	83.1	41.5	-[g]
95% Upper Confidence Limit	20.8	212.67	75	166.6	106.3	-[g]
95% Lower Confidence Limit	-[g]	74.0	57.8	0.5	23.3	-[g]
Maximum Value	103	10200.0	1470	2490	2917.6	-[g]
Minimum Value	1	6.8	10	0.9	<0.1	-[g]
No. of samples below detection limit	1	0	0	8	4	-[g]

Notes:

[a] Data Source: Baseline Metal in Soil Technical Report Table 3.1, page 17 and Appendix B -ProUCL Outputs for Samples from Key and Soil Sites. Baseline soil samples restricted to the top 30 cm of soil.

[b] Data Source: MRARD Report, Appendix G Overburden Results, G1:Overburden trace element data

[c] Data Source: 2008 Geodex Mineral Report No. 476311

[d] Data Source: ML/ARD Report, Appendix D Pit Wall Results, D2: Trace element analysis

[e] Data Source: ML/ARD report, Appendix B:Barren rock Static Test Results, B2: Trace element analysis results

[f] Data Source: Sisson Project EIA Report, Table 3.4.31, page 3-134. Value used to estimate project trace metal emissions

[g] Data not provided

During the construction phase of the project, an estimated 28 million cubic meters (74.5 million mt@specific gravity 2.66 [Rambøll Arup. 2011]) of overburden will be removed, transported, stored and subject to wind erosion until mitigation measures are put in place. The source of the overburden will be the pit area, the tailing storage facility (TSF) embankment foundations, and the on-site quarry. Clearly, arsenic from overburden removal during the construction phase will be a significant source of arsenic emissions to the atmosphere.

The SRK 2013 ML/ARD report acknowledged that arsenic concentrations in the project area, particularly in the overburden, were high and that it was unclear from the work done to date as to its source. According to the SRK ML/ARD report, further studies were being planned for the fall of 2013 to understand the source and mobility of arsenic in the overburden (SRK 2013 ML/ARD Report page 40).

Drill core and trace metal analyses performed by the previous proponent of the project and reported to New Brunswick Department of Energy and Mines also indicated high concentrations of arsenic and other trace metals in the project area (Geodex 2008 - Mineral Report of Work 476311).

Northcliff Resources has reported the existence of many more geo-referenced drill cores and mineral assays but those data were not part of the EIA report. The geo-location of all drill cores and accompanying mineral assays are necessary to properly assess and estimate trace metal emissions from the project. The EIA Report failed to provide the data necessary to estimate the concentration and spatial distribution of trace metals at the project site.

The study's analysis, characterization and reporting of trace metal emissions from the Sisson Project are incomplete. The likelihood that trace metal emissions, in particular arsenic, are underestimated is high because, as demonstrated, concentrations of arsenic are significantly higher in all potential pathways/sources than the value used in the EIA report to estimate arsenic emissions.

3.1.3 Hydrogen Sulphide

The Sisson Project will operate an ammonium paratungstate (APT) plant. The APT plant will operate year-round, with two 12-hour shifts per day, processing approximately 2 to 3 metric tonnes (mt) per hour of tungsten trioxide (WO_3) concentrate (EIAR page 3-116). The principle point source air emissions from the APT plant have been identified as hydrogen sulfide (H_2S), ammonia (NH_3), sulfur dioxide (SO_2), decane, ethylbenzene, naphthalene and tri-isoocytlamine (TIA) (EIAR page 3-131).

The study failed to provide an audit trail for estimates of APT plant emissions of hydrogen sulfide (H_2S), ammonia (NH_3) and sulfur dioxide (SO_2). The lack of an audit trail of these pollutants is a major deficiency in the EIA report. It presents problems for reviewers and regulators attempting to assess the potential impacts of this project because the estimates of these emissions directly impact the outcomes of the project's air quality modeling, water treatment design, air and aquatic impacts, and reclamation design and bonding.

In the absence of an audit trail detailing the calculations of emission rates and efficiencies, information on emissions from an APT facility operating in New York State was obtained by the reviewers. This information was used to estimate emissions at the Sisson Project APT Plant and compare them to the stated emissions in the Sisson Project EIA report.

In 2012, Niagara Refining LLC (NRL) applied for a permit to operate an APT plant in Depew (New York State). A copy of the permit application containing the calculations of emissions upon which the New York State Department of Environmental Conservation (NYSDEC) based their decision to issue a permit to operate the NRL plant was obtained by the reviewers from the NYSDEC. These calculations were provided to NYSDEC by Conestoga-Rovers & Associates (CRA), consultants to NRL (Appendix A; NRL, 2012). The Permit Conditions issued by the NYSDEC for the New York-based APT facility are shown in **Appendix F**: NYSDEC (2012) of this review. Relevant statements in the permit conditions on the NRL plant include:

Page 1 Item 3

- "….captured ammonia emissions are controlled by 94 percent using a two stage sulfuric acid ammonia scrubbing system. "
- The ammonia scrubbing system reduces the projected potential ammonia emissions to less than 15 [Imperial] tons per year (tpy).
- The captured hydrogen sulfide emissions are controlled to 99 percent by utilizing a sodium hydroxide and sodium hypochlorite scrubbing system.
- The hydrogen sulfide scrubbing system reduces the projected potential hydrogen sulfide emissions to less than 10 tpy.

Page 16 and page 17

- If the combined total production of APT and tungsten oxides exceeds 2,750 tons per year, you shall demonstrate the control equipment is designed to process the additional load.

Reporting of tungsten inputs to the NRL APT plant in New York and the Northcliff Sisson Project APT plant differ slightly. Inputs to the Sisson APT Plant are reported as Scheelite $CaWO_4$. The inputs to the New York-based facility are reported as pre-processed scheelite in the form of $(NH_4)_2WO_4$, obtained after crushing of the scheelite, ball milling, alkali digestion, dilution and filtration. The mass balance of the emissions of concern, hydrogen sulfide (H_2S), ammonia (NH_3) and sulfur dioxide (SO_2) are not affected by this difference.

Northcliff has provided estimates of the WO_3 resource in the EIA report and in NI 43-101 document (Samuel Engr. 2013). The average grade of the ore at Sisson is .067% (EIAR Sec. 3.1.3.3, page 3-7). The expected input to the Sisson Project APT plant is projected to be 15.5 mt per day of WO_3 based on 30000 mt per day of ore processed at 0.77 tungsten recovery.

At the Niagara Refining facility, the input of $(NH_4)_2WO_4$ is expected to be 8212 pounds (lb) per batch at 2.4 batches per day translating into 9.0 mt per day. The molecular weight of $(NH_4)_2WO_4$ is 284. The molecular weight of WO_3 is 232. The WO_3 input into the Niagara Refining APT plant is projected to be 232/284 x 9.0 mt per day or 7.3 mt per day.

Based on these calculations, the scale of operations at Sisson will be roughly twice that of the New York APT facility. It is expected that the emissions at the Sisson Project APT plant will scale similarly at twice the Niagara Refining facility emissions.

After APT processing, the scrubber inputs at the Niagara Refining plant include 40.1 imperial tons per year (imp.tpy) of H_sS, 316.5 imp.tpy of SO_2, and 157.0 imp.tpy of NH_3 (NRF 2012 attachment A2; Table 1.0). Scaling the scrubber inputs for the Sisson Project facility by a factor of 2, the scrubber inputs at Sisson can be projected to be 72.9 mt per year of H_sS, 575.4 mt per year of SO_2, and 285.4 mt per year of

NH_3. The scrubber efficiencies at the New York facility are projected to be 99% for H_2S, 94% for SO_2, and 94% for NH_3.

Table 3 presents calculations for the scrubber outputs at the Sisson Project APT facility based on estimated scrubber inputs, and assuming efficiencies similar to the Niagara Refining plant. The calculated emissions differ sharply with the projections provided in the EIA report for the Sisson Project APT facility (EIAR page 3-131 Table 3.4.22 Point Source Emissions – APT Plant – Operation). Air emissions are estimated to be one to two orders of magnitude higher than estimated in the Sisson EIA report. The magnitude of the underestimations of emissions has serious implications on the number of times air and odour quality standards will be exceeded on and off the project site.

Table 3. Calculation of Selected Point Source Emissions - Sisson Project APT Plant

Emission Type	**Calculated Emission Estimates**[a] metric tonnes per year (mtpy)	**EIAR Emission Estimates**[b] metric tonnes per year (mtpy)
Hydrogen Sulphide (H_sS)	**0.73**	**0.05**
Sulphur Dioxode (SO_2)	**34.5**	**0.00**
Ammonia ($NH_{3)}$	**17.1**	**0.2**
Notes: [a] Base on emission rate calculations and efficiencies for the Niagara Refining APT plant [b] As presented in Table 3.4.22 EIAR page 3-131		

The emission estimates from the APT plant identified in the EIA report are questionable and not supported by available data, calculations or references. Based on the calculations in this review, the likelihood that emissions from the APT plant are underestimated is high.

4.0 Characterization of Residual Project Environmental Effects (of a Change in Air Quality) (EIA Report Section 8.2.4.3)

The evaluation of changes to air quality resulting from the Sisson Project's emissions were based on estimates of air contaminants during the construction and operation phases of the project and the application of the AEROMOD dispersion and deposition model . The study did not acknowledge or discuss the special challenges of modeling dust emissions from open pit mining operations where the lack of emissions data is a main source of uncertainty (Huertas *et al*. 2012a).These challenges include estimating appropriate emission factors for non-point sources such as loading and unloading of quarry material, topsoil, and overburden and drilling.

There was also no discussion or evaluation of the relative pros and cons of using the AERMOD model versus other models such as CALPUFF which is believed to offer a better treatment of the dispersion and transformation of emissions than AERMOD (BC Department of Environment 2005). Gaussian plume (straight line) dispersion models like AERMOD are limited in their ability to account for the complex particle movement associated with large open pit operations (Lowndes *et al.* 2008). Alternative modeling of emissions from open pit mines use a combination of AERMOD and computation fluid dynamic (CFP) models (Huertas *et al.* 2012b).

The accuracy and precision of the dispersion and deposition model for the Sisson Project depend on the accuracy and precision of the meteorological, terrain and emission input data used in the model. As discussed in earlier sections of this review, there are discrepancies and inconsistencies in the

meteorological data used in the model. As also shown in this review, the emissions data for the project are incomplete and unreliable. As a result, the findings of dispersion and depositional modeling for the project lack accuracy and precision.

As summarized in Table 4 below from data in the EIA report, once operational, the Sisson Project will release 1563.8 mt of total particulate matter annually. In 2011, 33 New Brunswick industrial operations reported their emissions to the National Pollutant Release Inventory (Environment Canada 2013). Their cumulative emission of total particulate matter to air was 3,794 mt (Environment Canada 2013b). The Sisson Project will release ten times the particulates emitted by the Potash Corp. mining operation in Sussex and seven times the emissions of the Xstrata zinc mine (now closed) in Bathurst and four times the emissions of the largest oil refinery in Canada, JD Irving in Saint John (Table 4).

Table 4. Total Particulate Emissions Releases - Sisson Project[a] compared to Selected New Brunswick Industries[b]

Facility	Total Particulate Emissions (metric tonnes)	Stack Air Release (metric tonnes)	Fugitive (metric tonnes)	Road Dust (metric tonnes)	Storage and Handling (metric tonnes)	Other (metric tonnes)
Sisson Project Construction Phase	**899.77** (Estimate)	-	-	**851.0**	-	**48.77**
Operation Phase	**1563.84** (Estimate)	-	-	**1397.0**	**19.9**	**146.94**
Xstrata Mine (Bathurst)	**214.87**	115.87	-	99	-	-
Potash Corp (Sussex)	**151.88**	116.7	18.51	5.7		10.97
JD Irving Scierie Grand Riviere (Saint Leonard)	**553.9**	72.5	451.3	-	30.1	-
Irving Oil Refinery (Saint John)	**381.25**	381.25	-	-	-	-
Twin River Paper (Edmundston)	**128.69**	128.69	-	-	-	-
JD Irving/Russell and Swim Sawmill and White Pine Value-added (Doaktown)	**186.1**	49.2	132.1		4.8	

Notes:
[a] Data source: EIA Report pages 3-94 to 3-98 and pages 3-127 to 3-134. For a detailed summary see Table 1 of this review.
[b] Data source: 2011 National Pollutant Release Inventory (Environment Canada 2013).

Given the large quantity of particulate releases during both construction and operational phases, it is simply not credible that the annual average ground-level concentration of total particulates during the construction phase will be six times lower, and during the operation phase only slightly higher, than the annual average in the rural, sparsely populated village of Napadogan which has no significant source of industrial emissions (AQTR page 38) (See Table 5). If a five-week period of road construction in Napadogan could raise ground-level concentration of total suspended particulate matter above annual average baseline concentrations(AQTR page 38 and Table 3.3, page 32), the removal of an estimated

74.5 million mt of overburden, and the annual quarrying and mining of 23.7 million mt of material (Samuel Engr.2013 page 200, Table 16.12) will likely raise the ground-level concentration of particulate emissions significantly more than were raised during the resurfacing of one section of highway.

Table 5. Selected Dispersion Modeling Results for the Sisson Project[a]

Contaminant	Averaging Period	Background Concentration ($\mu g/m^3$)	Maximum Overall Predicted Ground-Level Concentration from the Project - **Construction Phase** ($\mu g/m^3$)	Maximum Overall Predicted Ground-Level Concentration from the Project - **Operation Phase** ($\mu g/m^3$)
SO_2	1-hour maximum	**5.5**	**0.16**	**0.12**
	24-hour maximum	**2.3**	**0.02**	**0.03**
	annual average	**1.1**	**0.002**	**0.01**
PM	24-hour maximum	**23**	**22.5**	**526**
	annual average	**11**	**1.82**	**14.9**
PM_{10}	24-hour maximum	**-**	**6.83**	**38.8**
$PM_{2.5}$	24-hour maximum	**6.1**	**1.01**	**6.05**
Notes: [a] Data Source: EIA Report Vol 1. Sec. 7. Table 7.18 page 7-13 and Table 7.1.10 page 7-16				

It is also not credible that the 1-hour, 24-hour and annual average concentrations of SO_2 during the operational phase of the project will be 45,76 and 110 times respectively lower than ambient levels given that the APT plant is estimated to release 34.5 mt of SO_2 annually (Table 5).

The study had an opportunity and should have evaluated the accuracy and precision of the AERMOD model results by using the dustfall data collected by Rescan (2008) to check the model's predictions of ground-level concentrations of particulates. The AQTR indicated dustfall data was available and reviewed but it was not presented in the AQTR (AQTR page 1).

The receptor grid for the air quality modeling covered the project's defined Local Assessment Area (LAA), a 25 km by 25 km domain area (EIAR page 8-7). The contour plots illustrating predictions of ground-level, 24-hour total and fine particulates ($PM_{2.5}$) and 1-hour NO_2 during the construction phase of the project (EIAR Sec. 7 Figures 7.1, 7.3 and 7.5) extend beyond the LAA but are not reported because they are constrained by the domain area set in the model. Similarly, the contour plots for 24-hour ground-level total PM and NO2 extend beyond the defined receptor grid (EIAR Sec. 7 Figures 7.1.6 and 7.1.7).

For a proper assessment of the environmental impacts of the project, air quality modeling should be re-done and the model domain set to cover an area of 50 km by 50 km. The larger domain area is justified given that transportation routes to and from the project area extend beyond 25 km, fugitive dust emissions along road and from mining operations are a widely acknowledged problem (Csavina *et al*. 2012; Petavratzi *et al*. 2005), and research indicates that fugitive emissions associated with mining operations can be measured at least 20+km from the source (Berryman *et a*l. 2009; Hasselbach *et al*. 2005).

5. Review of assessment of project related effects on air quality (EIA Report Section 8.2.4)

The EIA report has ranked the change in air quality as a result of the project's activities at N - "not significant" due to the proposed mitigation measure (e.g., idling reduction program, dust suppression using water, seeding and re-vegetating topsoil and over burden piles) (EIAR page 8-24). No evaluation of the efficacy of these mitigation measures was provided and no air quality or dust monitoring is proposed to validate claims of "not significant".

The EIA report acknowledged that, based on dispersion modeling, air quality within the project's LAA would change compared to pre-project background levels but because these changes were within various provincial and national standards, guidelines or objective, these changes were not significant.

The Canadian Council of Minister of the Environment (CCME) has produced a guidance document for jurisdictions to assist them in designing and implementing their Continuous Improvement/ Keeping Clean Areas Clean (CI/KCAC) programs as it pertains to the Canada-wide Standards (CWS) for PM and ozone. The CI/KCAC program was established for CWS relating to PM and ozone because it was acknowledged that current CWS numerical targets 'may not be fully protective' of human health and the environment and that these pollutants have no apparent lower threshold for adverse health effects

The CCME guidance document is clear - polluting "Up to a Limit" is not acceptable and has stated that" allowing PM and ozone ambient levels to increase up to the current numerical CWS targets is counter-productive, and unacceptable in light of the absence of any apparent lower threshold for adverse effects and the knowledge that the numerical CWS targets may not be fully protective" (CCME 2007 page 4). The CCME guidance document also states that proponents of development should not regard the current CWS numerical targets as a permissive maximum. The clear intent of CI/KCAC is to ensure air quality is not significantly degraded and to ensure improvement in air quality whenever feasible.

The assessment method used in the Sisson Project EIA report to determine the significance of the project's impacts on air quality is the same method of which the CCME is critical in their guidance document. The Sisson Project will not contribute to the nationally-supported goal of "keeping clean areas clean".

6. Mitigation of Project Environmental Effects (EIA Report Section 8.2.4.2)

The EIA report indicated the project will rely on water spraying to suppress dust on the site access road connecting the project site to the fire road as well as other onsite roads within the project area but not on the forest resource roads. The study does not indicate how much water will be required and whether the fresh water wells developed for the project will have sufficient capacity to meet all the project needs (drinking water, sanitary facilities, fire protection, ore processing as well as dust suppression) (EIAR Sec. 3.4.4.3.8). The freshwater system for the project will produce 21 m^3/hour (EIAR Sec. 3.2.5.4.2).

The proponent reports that the mill will require 14 m^3/hour (EIAR Sec. 7.6.2.2.1.6), leaving 7 m^3/hour for dust suppression, drinking water, sanitary facilities and fire protection. Based on findings in Cecala *et al.* (2012) and Howard and Cameron (1998), site roads will require approx 0.63 l/hour/m^2 of road surface to achieve the proponents 70% dust suppression target (EIAR Table 3.4.28) for 115 dry days. Assuming a 20m-wide right-of-way for site roads, a maximum of 1750m of haul road could be effectively watered if no other demands were being made on the freshwater supply (e.g., drinking and sanitary purposes, fire protection). The proponent has reported 1.2 km of haul roads from the pit to the TSF, 1.2 km of roads

from the quarry to the TSF (EIAR Vol. 1 Table 7.1.2), and an embankment crest length of 8.8 km (EIAR Sec. 3.2.4.3.2.1) requiring service roads. Fresh water dust suppression on this length of site roadways is not possible under the current fresh water system design.

The proponent should be required to file a revised haul road dust suppression plan, complete with detailed haul road usage and fresh water demands to confirm that the current design of the freshwater supply system is adequate to meet project objectives. This requirement is crucial because it has been noted by Cecala (2012) that *''water to be used for spray systems at most mineral processing operations is drawn from settling ponds''*. Given ML/ARD conditions, and given the reagents used in the processing plant and APT plant at the Sisson Project, the use of recycled water for dust suppression cannot be an option. The current fresh water system design and the current dust suppression plans put forward by the proponent are neither feasible nor credible.

7. Review of Follow-up and Monitoring (EIA Report Section 8.2.7)

The study has indicated that no follow-up monitoring will be done to verify the environmental effects predicted, or the effectiveness of mitigation measures with regard to the VEC – air quality. Given that the project will release particulate emissions four times higher than the largest oil refinery in Canada, and that predictions of trace metal emissions, many of which are toxic to human and environmental health, are largely unknown, a monitoring program must be put in place.

Environmental monitoring programs are a cornerstone of mining operations in Canada. These programs confirm whether pre-estimates of emissions were accurate, whether assumptions and predictions made by dispersion and deposition models rates were valid, whether the impact of contaminant deposition on vegetation (habitat), wildlife, water and air quality were accurately predicted and whether provincial and national standards/guidelines for air and water are being met.

The Rio Tinto Diavik Diamond Mine in the Northwest Territories serves as an example of the value of conducting environmental monitoring. According to the 2011 Diavik Mine Environment Agreement Annual Report, the overall amount of dust measured since 2001 (including 2011) had exceeded predictions (by 5 to 30 times depending on the year) made by initial depositional modeling, the zone of influence (area in which animals may be affected by mine activities) around the mine was larger than originally predicted, small changes in water chemistry (quality), sediment chemistry (quality) and benthic invertebrates were measured, and several seepage events were reported from collection ponds (Rio Tinto 2011).

Given the scale of the Sisson Project and the deficiencies and uncertainties in emissions and air quality model predictions identified by this review, it is essential that an environmental monitoring program be developed for the Sisson Project. Key elements of the monitoring program must include (but are not restricted to) the following:

- establishment of a more appropriately located meteorological station to confirm assumptions of, and validate predictions about wind speed and direction;
- establishment of no less than three air quality monitoring stations with the capability of monitoring total particulates, PM-10 and PM-2.5 as well as other criteria contaminants identified by the project;
- trace metal monitoring in dustfall;
- a baseline survey and monitoring program for lichen and moss metals levels; and

- an expanded vegetation survey to obtain more complete baseline information on plant communities in order to monitor the effects of dust on plant communities.

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9. CVs and Biographies of Reviewers

CV of Inka Milewski – see Appendix A.

Biography and Publications of Lawrence Wuest – See Appendix B.

Appendix F: Details of Niagara Refining LLC APT Plant (New York), NYSDEC *DEC ID: 9145200327:* Permit Application

See below.

2.2 Review of EIA Report for the Sisson Project (Tungsten and Molybdenum Mine) - New Brunswick, CEAR #11-03-63169

Valued Environmental Component: Public Health and Safety
Subject Area: Public Health
EIA Report Section: 8.9
Date: October 3, 2013

Inka Milewski
Conservation Council of New Brunswick

1. Summary

This review examined EIA Report (EIAR) Section 8.9 Public Health and Safety, EIA Report Section 7.7 Human Health and Ecological Risk Assessment, EIA Report Section 7.1 Air Quality Modeling, and the Baseline Ambient Air Quality Technical Report (AQTR). In addition, information from portions of the Metal Leaching and Acid Rock Drainage Characterization Report (SRK 2013 ML/ARD Report) and the Knight Piésold 2013 Predictive Water Quality Monitoring Report were accessed.

Overall, the study's conclusion that human health will not be significantly impacted by the project is not credible and cannot be supported by the proponent's human health risk assessment (HHRA). There are serious deficiencies in the methods and data used to estimate the project-related human health risks that compromise the validity and precision of the results generated from the HHRA. They are as follows:

- the HHRA modeling domain is too small and does not cover the entire project Local Assessment Area (LAA);
- emissions of particulate matter and metals during the construction phase of the project and the potential seepage of metals from overburden piles during the construction phase have been excluded from the assessment;
- the Project + Baseline assessment of maximum acute and chronic human health risks from inhaling PM_{10} emissions are incomplete and inaccurate;
- particulate emission estimates during the operational phases of the project are significantly underestimated;
- arsenic emission estimates during operational phases of the project are significantly underestimated;
- sulphur dioxide (and other) emission estimates from the Project's ammonium paratungstate (APT) facility are significantly underestimated;
- characterization of health risks for on-site workers are not reported or discussed; and
- public and occupational health follow-up or monitoring will not be done.

The most serious deficiency in the HHRA is that it did not evaluate the non-cancer health risk of the most common route of exposure to arsenic - ingestion of soil, water and food and dermal contact with soil. Non-cancer oral and dermal exposure limits for arsenic have been identified and are available. They have been used in previous heath risk assessments in New Brunswick and worldwide to evaluate non-cancer risks from ingestion of soil, water and food and dermal exposure to soil.

The HHRA stated that conservative assumptions were used in air and predictive water quality models and, therefore, risk estimates tend to overestimate rather than underestimate health risk. Given the significant uncertainties in the project's estimate of dust and arsenic emissions and the yet-to-be estimated seepage of arsenic from sources (e.g., overburden) other than the TSF, the Sisson HHRA should have conducted a sensitivity analysis to identify how variations in the model inputs influence the outputs of the model.

Lastly, the Canadian Handbook on Health Impact Assessment, a Report of the Federal/ Provincial/ Territorial Committee on Environmental and Occupational Health and published by Health Canada, is explicit regarding the need for follow-up monitoring for development projects such as Northcliff's Sisson Project. At the very least, the public and worker physical health and socio-cultural well-being indicators outlined in the Canadian Handbook on Health Impact Assessment should form the basis of a health monitoring program for the Sisson Project.

A detailed review of the deficiencies and recommendations to remedy them are presented in the following sections.

2. Review of methods used by the proponent to study existing conditions (EIA Report Section 8.9.2)

The method use by the proponent to examine the current public health and safety status from existing conditions relied on two approaches:

- reviewing current health and other data for residents in the Regional Assessment Area (RAA) which was spatially defined as the former Health Region 3; and
- predicting the health risks associated with human exposure to existing contaminants of potential concern (COPCs) in the environment within the project's Local Area Assessment (LAA).

2.1 Current Health Status (EIA Report Section 8.9.2.1)

The presentation of information on the current health status of Health Region 3 residents (EIAR Sec. 8, pages 8-443 to 8-448) and the description of the socio-economic setting for New Brunswick and York and Carlton Counties (EIAR Sec. 6, pages 6-43 to 6-49) has no statistical relevance in evaluating the potential health or socio-economic changes that may occur as a result of the project's activities for residents who live, work or spend leisure time around and within the LAA. The health information provided in the EIA report is not (and statistically cannot be) linked to any future monitoring or health assessment of the project's impacts.

A more appropriate approach to documenting current health status of residents in the LAA, but still not ideal, would have been to gather health and socio-economic data for the principal Statistics Canada census subdivision (CSD) that encompass the project's LAA (Stanley and Douglas Parishes) (Statistics Canada 2013). At a very minimum, this geographic area should be the basis for assessing changes to health and socio-economic status from the project's activities.

The presentation of statistics on general workplace injuries in New Brunswick and injuries in the construction, mining or quarrying sectors in Canada as a whole (EIAR Sec. 8, page 8-448) are also not useful or relevant to understanding the workplace health and safety issues associated with the Sisson project. The EIAR should have presented New Brunswick-specific information on workplace injuries and

illness reported in the construction, quarrying and mining industries. Presumably WorkSafe New Brunswick maintains a database on injuries and illness by industrial sector which should have been accessed for this information.

Numerous studies have statistically linked occupational exposure to arsenic and dust with a wide range of cancer and non-cancer diseases. A review of workplace diseases linked with arsenic and other metals associated with the molybdenum/tungsten mining industry would have been useful to regulators and the public. The review would have provided regulators and the project proponents with information on successful prevention measures and best practices that could improve workplace conditions.

- **2.2 Predicted Baseline Human Health Risks - Existing Environmental Contaminant Concentrations (EIA Report Section 8.9.2.2)**

There are deficiencies in the data used to characterize the baseline human health risks for the LAA that seriously compromise the validity and precision of the results generated from the human health risk assessment (HHRA) overall. They are as follows:

- Portions of the LAA are not covered by the Public Health and Safety assessment because the receptors defined for the HHRA cover a smaller spatial (20 by 20 km) (EIAR Sec. 8.9, page 8-439) than the area used to gather baseline line information (25 by 25 km) (EIAR Sec. 7.1, page 7-5). As a result, HHRA receptor locations in the community of Napadogan, and other locations at the edges of the LAA where people from Williamsburg, Currieburg, Boyds Corner, Fredericksburg and Stanley may spend recreation time, are not covered by the HHRA. No explanation is provided in the HHRA for the decision to use the smaller domain area. The spatial modeling domain of the HHRA should be expanded to cover, at the very least, the entire LAA area (25 by 25 km).

- Coarse particulate matter (PM_{10}) is identified as a COPC in the project HHRA but was not measured in the baseline air quality assessment (EIAR; AQTR page 19). No explanation is provided as to why baseline PM_{10} was not monitored. Numerous epidemiological studies have made a statistical link between the concentration of PM_{10} in ambient air and health effects. These effects include mortality, increased hospital admissions and emergency room treatment, increased incidence of pneumonia and exacerbation of chronic obstructive pulmonary disease, exacerbation of asthma attacks and broncho-dilator use, increased respiratory symptoms, such as coughs, and decreased lung function (UK Environmental Agency 2012).

  The baseline health risks associated with exposure to PM_{10} from the project were not examined or assessed (EIAR Sec. 7.1, page 7-153). As a result, the Project + Baseline assessment of maximum acute and chronic inhalation human health risk is not only inaccurate as it only reflects the project's contribution to risk but it underestimates the overall health risks from PM_{10} emissions (EIAR Sec. 7.1, page 7-153). Ambient baseline monitoring for PM_{10} must be undertaken and, once completed, the estimated health risks associated with PM_{10} re-calculated.

- The HHRA has incorrectly assumed that the health risks related to ingesting or inhaling arsenic are cancer-related only and that there are no toxicological reference values for non-cancer health effects via the oral or dermal route for adults or toddlers (EIAR Sec. 7.7, pages 7-148, 7-149). As a result, the baseline (and project-related) human health risk assessment via ingestion of soil, water and food and dermal contact with soil has not been assessed for arsenic (EIAR Sec. 7.7, page 7-156). This is a serious omission in the HHRA and must be remedied.

Oral and dermal exposure limits for arsenic are available and the non-cancer health endpoints for arsenic via the oral route are hyperpigmentation, keratosis and vascular complications (CalEPA OEHHA 2000; US EPA 1998). Heath risk assessments in New Brunswick (Cantox Environmental Inc. *et al.* 2006; New Brunswick Department of Health 2005; Jacques Whitford 2003), Ontario (SARA Group 2008) and worldwide (Kar *et al*. 2011; Ordóñez *et al.* 2011; De Miguel *et al.* 2007; Obiri *et al.* 2006) have evaluated the non-cancer health risks from ingesting arsenic in soil, water and food as well as from dermal contact.

3. Review of Potential Project-VEC Interactions re: Public Health (EIA Report Section 8.9.3.1)

The HHRA has indicated that during the Construction and Decommissioning, Reclamation and Closure phases the mine would not be producing, processing or handling ore and hence there would be no atmospheric deposition of ore dust (EIAR Sec. 7.7, page 7-129). The EIAR has stated that during construction, there would be no mining activity and thus no seepage or surplus water from the tailing storage facility (TSF) (EIAR Sec. 8, page 8-453). As a result, the HHRA concluded that a Change in Public Health during these phases of the project are rated as not significant and are not part of the HHRA. This conclusion is inaccurate and not supported by the available evidence in the EIA report.

- **Particulate emissions during the <u>construction phase</u> are significant**

During the construction phase of the project, an estimated 28 million cubic meters or 74.5 million mt (at a specific gravity of 2.66 [Rambøll Arup. 2011]) of overburden will be removed, transported, stored and subject to wind erosion until mitigation measures are put in place. The sources of overburden material will be the pit area, the tailing storage facility (TSF) embankment foundations, and the on-site quarry (EIAR; SRK 2013 ML/ARD page 11). A summary of these emissions does not appear in the EIA report but has been prepared by reviewers (Table 1).

Table 1. Selected Criteria Air Contaminants (CAC) Emissions during the Construction Phase of the Sisson Project[a]

	Total Particulates metric tonnes/year	**Particulate Matter (PM_{10})** metric tonnes/year	**Particulate Matter ($PM_{2.5}$)** metric tonnes/year
Project - Construction Phase			
On-site Fuel Combustion - Construction Equipment	5.54	-[b]	-[b]
Vehicle Fuel Combustion	0.05	0.05	0.03
Site Preparation	40.0	7.6	4.2
Quarry- blasting	0.02	-[b]	-[b]
Unpaved roads	851.0	226.0	22.6
Topsoil and overburden piles	-[c]	-[c]	-[c]
Material Transfer	-[c]	-[c]	-[c]
Concrete plant	3.3	0.98	-[b]
Sub total	**899.77**	**234.6**	**26.83**

Notes:
[a] Data source: EIAR pages 3-94 to 3-98.
[b] No data provide in report
[c] Assumed negligible
[d] Identified but no data provided

As indicated in Table 1, data for some sources were simply assumed to be negligible (topsoil and overburden stockpiling and material handling). Research indicates that PM_{10} emissions from construction operations involving earth-moving (scraping operations) are up to an order of magnitude greater than US AP-42 generic equation factors because these factors under-predict the emissions from loading, unloading and transporting (Muleski *et al*. 2005). PM_{10} emissions from material handling are reported to be 10% of the amount generated from transportation on unpaved roads and the efficiency of watering to suppress dust begins to decrease by 3-14% per hour (Muleski *et al.* 2005). If this relationship between emissions from transportation and material handling was applied to the Sisson Project, PM_{10} emissions for material transfer would be 85 mt and not "negligible" as suggested in the EIAR (EIAR Sec. 3, page 3-98).

Given that the EIA report referenced the same US AP-42 equation factors to predict emissions during construction and operation phases of the Sisson Project (EIAR Sec. 3, pages 3-94 to 3-98 and pages 3-127 to 3-134) and that these factors have been found to under-predict emissions by a factor of 10, particulate emissions from the construction phase of the project have likely been significantly underestimated.

- **Arsenic emissions and deposition modeling estimates during the project's <u>construction phase</u> are missing**

An estimated 28 million cubic meters of overburden will be scraped, moved and stored in the project area during the construction phase of the project. The EIA report failed to characterized the concentration, volume, dispersion and deposition of metals, in particular arsenic, emissions from loading, transporting and unloading overburden from the pit area, the tailing storage facility (TSF) embankment foundations, and the on-site quarry.

SRK Consulting analyzed 300 overburden samples for mine leaching/acid rock drainage (ML/ARD) studies for the EIA Report (SRK 2013 MR/ARD Report Appendix G). Based on data in Appendix G1 of the MR/ARD report, the mean arsenic concentration in the overburden was calculated by the reviewer to be 143.3 mg/kg (95% upper confidence limit = 212.7 mg/kg.). Arsenic concentrations in overburden were more than 250% higher than the value of arsenic in ore (41 mg/kg) used to calculate arsenic emission to air (EIAR Sec 3, page 3-134). Failure to incorporate arsenic emissions, which are likely to be significant, from overburden removal and handling will result in under-predictions of arsenic deposition and, subsequently, under-predictions of the human health risks associated with arsenic.

- **Arsenic seepage from topsoil/overburden piles during the construction and operational phases are unknown**

The SRK 2013 ML/ARD report acknowledged that arsenic concentrations in the overburden were high and that it was unclear from the work done to date as to its source (SRK 2013 ML/ARD page 40). According to the SRK 2013 ML/ARD report, further studies were being planned for the fall of 2013 to understand the source and mobility of arsenic in the overburden and it's metal leaching potential (SRK 2013 ML/ARD page 40).

The EIA report indicated that overburden would be stockpiled and used during reclamation and closure and that stockpiles would not be located within 30 m of a watercourse or wetland to minimize environmental effects through erosion and sedimentation (EIAR Sec 3.4.1.2.4, page 3-85) However, management of seepage from the stockpiles is not outlined in the EIA report other than suggesting that

water contacting this material could easily be collected and directed to the water treatment plant if required (SRK 2013 ML/ARD Sec. 5.4, page 46).

The Knight Piésold Predictive Water Quality Modelling (PWQM) study, completed in July 2013, could not account for the contribution of arsenic from overburden to water seepage because the data were not available at the time of their study. The PWQM for the Sisson project will need to be redone once this data is available. Any changes in the outputs of the PWQM will have implications for the HHERA model outputs.

The emissions of dust and metals during the **construction phase of the project** and the potential seepage of metals from overburden piles during the construction and operational phases should have been included in the HHRA.

4. Review of environmental effects assessment re: Characterization of Residual Project Environmental Effects (of a Change in Public Health) (EIA Report Section 8.9.4.3)

The project HHRA used predicted or measured levels of COPCs provided in other studies conducted for the project's EIA report to estimate, describe and evaluate the health risks associated with the project (EIAR Sec 7.7, page 7-140). These studies included project-related emissions and waste estimates (EIAR Sec. 3.4.1.6), baseline soil and biota sampling (EIAR Baseline Reports), deposition modeling (EIAR Sec. 7.1), water quality modelling (EIAR; Knight Piesold 2013, WQMR) and metal analyses in the metal leaching/acid release drainage (SRK 2013 ML/ARD). The HHRA has assumed the estimate of emissions and predictions of releases and deposition provided by these studies were complete and accurate.

The HHRA has concluded that, overall, the projects activities are not expected to affect the health risk for long-term inhalation exposures, exposure to soil, or ingestion of water. The project will affect the future concentrations of arsenic, boron, cobalt and thalium in fish and increase cancer-related health risks for people who consume those fish (EIAR Sec 8, page 8-462). The HHRA views this risk to be low or moderate due to the degree of conservatism in the assessment (EIAR Sec 8, page 8-462).

There are serious deficiencies in the methods and data used to estimate the human health risks associated with the project's COPCs that compromise the validity and precision of the predictions generated from the HHRA. They are as follows:

- **The HHRA modeling domain does not cover the entire LAA**

As previously discussed in section 2.2 of this review, sections of the LAA are not covered by the Public Health and Safety assessment because the receptors defined for the HHRA cover a smaller spatial (20 by 20 km) (EIAR Sec. 8, page 8-448) than the area used to gather baseline line information (25 by 25 km) (EIAR Sec. 7.1, page 7-5). As a result, HHRA receptor locations in the community of Napadogan and other locations at the edges of the LAA where people from Williamsburg, Currieburg, Boyds Corner, Stanley, and Fredericksburg may spend recreational time are not covered by the HHRA. No explanation is provided in the EIA report for the decision to use the smaller domain area. The spatial area of the HHRA must be expanded to cover, at the very least, the entire LAA area (25 by 25 km).

- **Particulate emissions and deposition from the operational phase of the project are underestimated**

Apart from carbon dioxide, particulate emissions (dust) will be the single largest criteria air contaminants (CACs) released from the project during the operational phase. A summary of these emissions does not appear in the study but has been prepared by this reviewer (Table 2).

Table 2. Selected Criteria Air Contaminants (CAC) Emission from the Operation Phase of the Sisson Project[a]

	Total Particulates metric tonnes/year	**Particulate Matter (PM_{10})** metric tonnes/year	**Particulate Matter ($PM_{2.5}$)** metric tonnes/year
Project - Operation Phase			
Fuel Combustion in mining and support equipment	20.2	20.2	20.2
Vehicle Fuel Combustion	0.07	0.07	0.04
Primary Crusher	32.0	3.20	0.48
Ore Concentrator Plant	-[b]	-[b]	-[b]
APT Plant	-[c]	-[c]	-[c]
Package Boiler	1.0	1.0	0.65
Drilling	-[b]	-[b]	-[b]
Blasting	3.96	2.06	0.12
Material Handling and Transfer	19.9	8.02	1.21
Unpaved roads	1397.0	370.0	37.0
Crushed Ore Stockpile	0.013	0.12	0.002
Beaches	89.7	0.000135	0.0000202
Sub-total	**1563.843**	**404.67**	**59.7**

Notes:
[a] Data source: EIAR 2013 pages 3-127 to 3-134.
[b] Assumed negligible
[c] Identified but no data provided

As indicated in Table 2, particulate emissions data for some sources were simply assumed by the proponent to be negligible (drilling, the ore concentrator and the APT plant). Published emission factors are available for these sources and should have been applied to generate estimates of particulate emissions. Any emission control measures identified by the proponent could have been accounted for by applying percentage emission reduction efficiencies in the calculation of emissions (US EPA 1995; Environment Canada 2013).

Unpaved roads can include site access (SSA) roads, forest roads and internal site (PDA) roads. The emissions from SSA and PDA have different maintenance standards, different emission factors and different dust suppression capabilities, all factors affecting the level of emissions. The proponent has failed to itemize roads to an acceptable level of differentiation for validation of the reported emissions.

In addition, research has shown that the US AP-42 generic equation factors used to calculate material handling and transfer significantly under-predict the emissions from loading, unloading and transporting

of material (Muleski *et al.* 2005). PM_{10} emissions from material handling are reported to be 10% of the amount generated from transportation on unpaved roads and the efficiency of watering to suppress dust begins to decrease by 3-14% per hour (Muleski *et al.* 2005).

It is instructive to note that predictions of dust emissions from at least one open pit mine in Canada were found to be five to 30 times higher (depending on the year) than estimates made by initial depositional modeling for the mine (Rio Tinto 2011).

The EIA report's analysis, characterization and reporting of particulate emissions from the Sisson Project lack transparency in how emissions were calculated and the emission inventory is incomplete. The likelihood that particulate emissions are underestimated is high because the details of emission source estimates are missing and there is a lack of reproducibility of the emissions data. As a result, human health risks associated with exposure to particulate matter are likely underestimated.

- **The Baseline + Project assessment of maximum acute and chronic human health risks from inhaling PM_{10} emissions are inaccurate**

As previous discussed in section 2.2 of this review, the baseline health risks associate with exposure to PM_{10} from the project were not examined or assessed (EIAR Sec. 7.1, page 7-153) because baseline PM_{10} was not monitored. Consequently, the combined Baseline + Project health risks from inhaling PM_{10} are inaccurate and the risks, as presented in the HHRA, are underestimated.

- **The project's sulphur dioxide emissions are underestimated**

The estimated emissions of sulphur dioxide (SO_2) from the Sisson Project's ammonium paratungstate (APT) plant were re-calculated as part of the review of the project's impact on air quality. These calculations indicated that SO_2 emissions would be 34.5 metric tonnes per year. The EIA report stated there would be no SO_2 emissions from the plant (EIAR Sec. 3, page 3-131).

The EIA report failed to provide an audit trail for estimates of APT plant emissions of hydrogen sulfide (H_2S), ammonia (NH_3) and sulfur dioxide (SO_2). The lack of an audit trail of these pollutants is a major deficiency in the EIA report. The emission estimates from the APT plant are questionable and not supported by available data, calculations or references. The likelihood that emissions from the APT plant were underestimated is high and, therefore, the likelihood that the project's inhalation human health risks for SO_2 were underestimated is also high.

- **Arsenic emissions and deposition during the construction phase of the project are underestimated**

The HHRA has assumed that arsenic and other metals in ore dust are correctly characterized and that dust from ore represents the only source of arsenic and other metal emissions from the project (EIAR Sec. 7.7, page 7-129). No deposition concentration contours for arsenic (or other metals) were presented in the air quality modeling study (EIAR Sec 7.1)

There is no explanation in either the EIA report's air quality modeling study or in the HHRA to indicate how and where the value for arsenic in ore (41 mg/kg) were obtained. The only reference to this value, other than a table of average trace metal concentrations in samples classified as "ore" (EIAR Sec 3., page

3-134, Table 3.4.31), is in Appendix E5 - Trace Metal Results for Tailings (SRK 2013 ML/ARD report Appendix E5).

The trace metal values in SRK 2013 Appendix E5 were drawn from the analysis of 184 drill core composite samples of barren rock (defined as waste rock and mid-grade ore) used to characterize element leaching potential from the project's waste rock (SRK 2013 page 12). According to the SRK 2013 ML/ARD report, mid-grade ore was used in the mine leaching/acid rock drainage experiments (SRK 2013 ML/ARD Sec. 4.2.3, page 26).

Average trace metal values in waste rock and mid-grade ore used to determine trace metal emissions to air are not representative of trace elements in the high-grade ore that will be processed in the APT plant and are not representative of the metal emissions from other potential emission pathways such as overburden removal or waste rock storage. If arsenic concentrations in ore were derived from the analysis of 184 drill core samples, then there is a discrepancy between the average concentration of arsenic in ore reported in the EIA report (41 mg/kg) and the actual value (64.8 mg/kg) calculated by reviewers from available drill core data (EIAR Appendix B2).

- **The non-cancer human health risks associated with arsenic via ingestion of soil, water and food and dermal contact with soil are missing**

The HHRA did not evaluate either the baseline or project-related human health risk for arsenic via ingestion of soil, water and food and dermal contact with soil (EIAR Sec. 7.7, page 7-156). This is a serious omission in the HHRA and must be explained and remedied.

As indicated in section 2.2 of this review, non-cancer oral and dermal exposure limits for arsenic have been identified and are available (CalEPA OEHHA 2000; US EPA 1998). They have been used in previous heath risk assessments in New Brunswick (Cantox Environmental Inc. *et al.* 2006; New Brunswick Health Department 2005; Jacques Whitford 2003) and Ontario (SARA Group 2008) to evaluate non-cancer risks from ingestion of soil, water and food and dermal exposure to soil.

- **Characterization of health risks for on-site workers are not reported or discussed**

The EIA report has indicated that the project will generate direct employment for up to 300 workers during the operation phase of the project, generally split between two 12-hour shifts per day (EIAR Sec 3.4, page 3-138). At any one time, there will be approximately 150 workers on site who will be working primarily in an area between the quarry and the mine pit. Four HHRA receptors (HHERA 21, 23, 25 and 43) were identified in this area (EIAR Sec 7.7; page 7-119). This area was also identified by depositional modeling to be the area of highest ground level concentration of NO_2 , total PM, PM_{10} and $PM_{2.5}$ (EIAR Section 7.1, Figures 7.1.2 to 7.1.8).

The HHRA reported that the 24-hour Project + Baseline health risk (CR = 7.0) associated with inhaling PM exceeded the Concentration Ratio (CR) benchmark (CR= 1.0) by seven times at the maximum ground level concentration for PM (EIAR Section 7.7, page 7-153). The Project-related risk (CR = 6.81) accounted for almost all of the risk.

The HHRA downplayed or dismissed this risk by stating there were no HHRA receptors at that location, an area at the edge of the quarry and the TSF area. In fact, a receptor location (HHERA25) was located less than 500 metres from the maximum ground level concentration point. It is simply not credible to

suggest that people working less than 500 meters from the precise point where air quality model predicted maximum concentrations of PM would not be affected by high concentrations of PM. Air quality modeling results predict maximum ground level concentrations of NO_2, total PM, PM_{10} and $PM_{2.5}$ encompass larger areas than just a single point of maximum concentration (EIAR Section 7.1, figures 7.1.2 to 7.1.8).

The HHRA also downplayed all the inhalation risks where aluminum, arsenic, cadmium and manganese exceeded CR benchmarks by stating that the location of the maximum ground level concentration was not at any of the HHRA receptor locations (EAIR Section 7.7., page 155). Air quality modeling results for metals were not provided in the EIA report's air quality modeling study (EIAR Sec. 7.1). Again, it is not credible that the area of maximum deposition is restricted to a single point.

Health risk values (CR, Health Quotients, and Lifetime or Incremental Cancer) were not reported for any individual HHRA receptor locations directly at the project site. No explanation is provided for this omission. This information would be useful to New Brunswick's occupational health and safety agency in ensuring that the correct and highest occupational health standards are imposed on the project to protect the health and well-being of workers. Specifically, occupational health and safety regulators will need to ensure that monitoring for tungsten metal and insoluble tungsten compounds are enforced in areas of the project where inhalation health risks for tungsten will be the greatest (e.g., the crusher areas, the APT plant). The current National Institute for Occupational Safety and Health (NIOSH) recommended exposure level (REL) and the American Conference of Industrial Hygienists (ACGIH) threshold limit value (TLV) 8-h time weighted average (TWA) are 1 mg tungsten/m^3 for soluble tungsten compounds and 5 mg tungsten/m^3 (Jackson *et al.* 2013).

The **Canadian Handbook on Health Impact Assessment**, a Report of the Federal/Provincial/Territorial Committee on Environmental and Occupational Health, makes the following case for worker health to be part of health risk assessments of development projects:

> "*In the past, workers have unintentionally played the role of the "mining canary," with their negative health outcomes serving as a warning for the rest of society. It behooves us to give prominent consideration to these individuals, who not only are responsible for societal productivity, but are most at risk by virtue of the dose response relationship that is fundamental to toxicology*." (Health Canada 2004c. Volume 3, Chapter 7, page 7-1)

- **A sensitivity analysis of the HHRA results has not been done**

The EIA report acknowledges that human health risk assessments are inherently uncertain and has indicated it has adopted conservative assumptions to account for these uncertainties (EIAR Section 7.7, page 7-164).

Risk assessments rely on at least 50 different assumptions regarding exposure, dose-responses, ingestion rates, bioavailability and toxicological reference values (TRV) (Raffensperger and Tichner 1999). Statistical sensitivity analyses are usually preformed to understand how risk estimates are dependent on variability and uncertainty in the factors contributing to risk.

This type of sensitivity analysis was performed for the Sudbury Area Risk Assessment (SARA) study (2008) to assess how variations in the soil risk management level were influenced by uncertainties in the health human risk assessment input variables. The sensitivity analysis revealed that by altering soil

ingestion rate, soil to dust ratio, food consumption rate, bioavailability of lead in soil and dust and the TRV, soil risk management levels varied substantially (-41% to +2200%) (SARA 2008 Vol II, Chapter 5, pages 5-40 to 5-41).

Given the significant uncertainties in the project's estimate of dust and arsenic emissions and the yet-to-be estimated seepage of arsenic from sources (e.g., overburden) other than the TSF, the Sisson HHERA should have conducted a sensitivity analysis to identify how variations in the model inputs influence the outputs of the model.

5. Review of Follow-up and Monitoring (EIA Report Section 8.9.7)

The HHRA study has indicated that no follow-up monitoring of either the general public or workers will be done to verify the effectiveness of mitigation for Public Health and Safety (EIAR Sec 8.9, page 8-465). This decision is unacceptable and unsupported by a 2004 report from a Canadian Federal/ Provincial/Territorial Committee on Environmental and Occupational Health.

The **Canadian Handbook on Health Impact Assessment**, a Report of the Federal/Provincial/Territorial Committee on Environmental and Occupational Health is explicit regarding the need for follow-up monitoring:

> "*Monitoring and follow-up are perhaps the most crucial steps to advance our understanding of the effects of development projects on our physical and social well-being. If we are to understand the health implications for future development projects, we must rely on an accurate depiction of health effects from similar previous development projects. This can only be obtained through follow-up monitoring*." (Health Canada 2004b, Volume 1, page 2-14)

Health Canada's Handbook on Health Impact Assessment provides guidance for public and occupational health monitoring. It states that the need for occupational health monitoring cannot be overemphasized because occupational levels of exposure are generally higher than environment levels (Health Canada 2004c), as the results of the Sisson Project HHRA have demonstrated (see review above).

At the very least, the public and worker physical health and socio-cultural well-being indicators outlined in Table 3.1 (Volume1, Chapter 3, page 3.2) of the Canadian Handbook on Health Impact Assessment should be monitored. For the public, these would include health indicators such as respiratory effects, noise, and cancer and socio-cultural well-being indicators such as crime rates and drug and substance abuse. Health monitoring of workers would include indicators such as respiratory effects, effects on skin and fertility, and cancer incidence. Socio-culture well-being indicators could include necessity for relocation or stress-related conditions.

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7. CV of Reviewer

CV of Inka Milewski – see Appendix A.

Appendix A – CV of Inka Milewski

Inka A. Milewski
Science Advisor and Director of Health Watch
Conservation Council of New Brunswick
(Miramichi Office)
254 Douglasfield Road
Miramichi, New Brunswick
E1N 4S5
Phone: (506) 622-0314
E-mail: milewski@nbnet.nb.ca

Positions:

2000 -	Science Advisor and Director of Health Watch Conservation Council of New Brunswick
1996-2000	Atlantic Coordinator, Marine Protected Areas Program World Wildlife Fund Canada
1993 - 1996	Free-lance researcher, St. Andrews, New Brunswick
1992	Quebec-Labrador Foundation, Montreal, Quebec Policy Analyst, Community Development Project
1991	Science Council of Canada, Ottawa Research Associate
1983-1990	Huntsman Marine Science Centre, St. Andrews, New Brunswick Director of Public Education and Development
1981	Fisheries and Oceans Canada, Halifax, Nova Scotia Research Assistant
1979-1980	Bedford Institute of Oceanography, Dartmouth, Nova Scotia Research Assistant
1977-1978	Pathology Department, Ontario Veterinary College University of Guelph, Ontario Research Assistant
1976	Biology Department, Dalhousie University, Halifax, Nova Scotia Research Assistant

Teaching

2012	Guest Lecturer, Biology Department, Dalhousie University (Halifax)
2007 - 2008	Guest lecturer, School of Journalism, St. Thomas University (Fredericton)

2007	Guest lecturer, Law School, University of Moncton (Moncton)
2006 - 2007	Guest lecturer, Biology Department, University of New Brunswick (Fredericton)
1999	Guest lecturer, Resource Management, St. Mary's University (Halifax)
1997	Guest Lecturer, School for Resource Management, Dalhousie University (Halifax)
1983 - 1990	Field and laboratory classes in marine biology and ecology to undergraduate students, secondary and elementary students and the public at the Huntsman Marine Science Centre, St. Andrews, New Brunswick

Other Professional Activities

2012	Featured speaker, 2012 Rachel Carson Lecture Series Marine Environmental Research Institute, Blue Hill, Maine
2011	Testified before the House of Commons Standing Committee on Fisheries and Oceans - Closed Containment for Aquaculture
2006	Testified before the House of Commons Standing Committee on Fisheries and Oceans - Bennett Environmental Toxic Waste Incinerator in Belledune, NB
2006	Invited to participate in the DFO National Science Peer Review on Aquaculture-Environment Interactions: Shellfish Aquaculture in the Marine Environment (Moncton, NB)
2006	Testified as an expert witness on behalf of Belledune Citizens Committee before the New Brunswick Assessment and Planning Appeal Board
2006	Testify before the House of Commons Standing Committee on Environment and Sustainable Development - *Canadian Environmental Protection Act* and Vulnerable Ecosystems and Vulnerable Populations
2005	Invited to participate in the DFO National Science Peer Review on Aquaculture-Environment Interactions: Effects of Finfish Cage Aquaculture on the Marine Environment (Sydney, BC)
2003	Testified as an expert witness before the State of Maine Board of Environmental Protection on proposed regulations for aquaculture
2002	Testified before the State of Maine Board of Environmental Protection on a proposed aquaculture site in Loring Cove, Maine.
2001	Testified before the Senate Standing Committee on Fisheries and Oceans - Aquaculture

2000	Testified before the House of Commons Standing Committee on Fisheries and Oceans - Aquaculture
1999	Testified before the House of Commons Standing Committee on Environment and Sustainable Development - Aquaculture and nutrient regulations under the *Canadian Environmental Protection Act*

Voluntary Service

1999 – present	Science advisor to community, environmental and conservation groups in New Brunswick (e.g., Association of the Preservation of the Bouctouche Watershed, Belledune Citizen's Committee), Nova Scotia (e.g., Stewards of St. Ann's Harbour; Friends of Port Mouton Bay; Friends of Shelburne Harbour), Prince Edward Island (e.g., Mill River Wildlife Federation), Quebec (e.g., Coalition Retour à l'expéditeur), Ontario (e.g., Concerned Citizens of Port Colborne, Sudbury Committee for Human and Environmental Health) and Maine (e.g., Concerned Citizens of Passamaquoddy Bay)
1995 - 1998	Conservation Council of New Brunswick, President
1996 - 2001	Fundy Community Foundation, St. Andrews, New Brunswick Advisor to the Board of Directors
1993 - 1996	Fundy Community Foundation, St. Andrews, New Brunswick co-founder, first voluntary executive director and member of the Board
1992 - 1995	Conservation Council of New Brunswick, Fredericton, New Brunswick Board of Directors, Vice - President, Policy
1991	National Capital Aquarium Education Committee, Member, Ottawa
1986 - 1988	Educators of Atlantic Science Teachers Vice - President, Board of Directors
1986 - 1988	Conservation Council of New Brunswick, Fredericton, New Brunswick Member, Board of Directors
1986 - 1987	Sunbury Shores Art and Nature Centre, St. Andrews, New Brunswick Member, Board of Directors
1984 - 1986	Gulf of Maine Marine Education Association, Maine Member, Board of Directors

Appointments

2001	Delegate - Government of Canada UN Conference on The Global Programme of Action on Action for the Protection of the Marine Environment from Land-based Activities, Montreal

1999	Environmental Coordinating Committee Canada-Nova Scotia Offshore Petroleum Board, Halifax
1994	Public Advisory Committee Environment Canada State of the Environment Report, Ottawa
1993	Delegate - Ocean Caucus of the Canadian Environmental Network UN Conference on High Seas Fishing, New York
1992	Delegate - Government of Canada UN preparatory meeting for the Conference on Biodiversity, Costa Rica

Publications

Milewski I. 2012 Identifying at-risk communities for action on cancer prevention: a case study in New Brunswick (Canada) Communities. ***New Solutions*** 22(1):79-107.

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Appendix B – Biography and Publications of Mr. Larry Wuest

Lawrence Wuest is a sculptor and forest ecologist specializing in Quantitative Ecology and Spatial Analysis. He has a B.S. in Physics from Washington University. He has been a researcher in environmental issues since 1975, and has contributed to research in high energy physics, cancer diagnostics, fire science, aquatic microbiology, geographic analysis and forest ecology. He has lived in the Upper Nashwaak for 35 years, and has a passion for the Acadian Forest of the Nashwaak Watershed. He was a participant in the New Brunswick Ecological Land Classification Working Group 1994-2004. He is also the designer and creator of the sculpture symbolic of the New Brunswick Human Rights Award.

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Miller, R., & Wuest, L. 1972. Volume Analysis of Human Red Blood Cells II - Nature of the Residue. Series Haematologica Vol. V,2 128-141.

Appendix F – Article from Vancouver Sun, September 6, 2013

Government experts raised red flags on proposal to build mine: summary of concerns

(Available at: http://www.vancouversun.com/business/2035/Government+experts+raised+flags+proposal+build+mine+summary+concerns/8880799/story.html.)

The following is a summary of the concerns raised by federal and provincial government experts during the Canadian Environmental Assessment Agency review of Taseko Mines' New Prosperity Mine proposal.

1. Deteriorating Fish Lake Water Quality & Unproven "Aquarium" Lake Recirculation

Environment Canada

"The Proponent's modelling suggests water quality in Fish Lake may be marginal for the protection of aquatic life." (EC Panel Submission, July 25, 2013, CEAR #738, p. 10).

"There are few, if any, examples of lake recirculation at the scale proposed by the Proponent" (EC Panel Submission, July 25, 2013, CEAR #738, p. 11).

"Environment Canada is concerned that the recirculation mitigation measure proposed to manage water quality and the biological productivity of Fish Lake is unproven at this scale … the high level of uncertainty regarding the Proponent's recirculation scheme is a particular concern given the stated goal of preserving Fish Lake." (EC Panel Submission, July 25, 2013, CEAR #738, p. 12).

Natural Resources Canada

"The Proponent has estimated from the base of the TSF [Tailings Storage Facility] during the post-closure period at 760 m3/day. NRCan considers this value to be unrealistically low for a 12 km3 impoundment … NRCan estimated seepage through the base of the TSF to be approximately 8250 m3/day or 11 times the value estimated by the proponent". (NRCan Panel Submission, July 4, 2013, CEAR #587, p. 27, confirmed in NRCan's closing remarks, CEAR #1123, August 21, 2013).

Department of Fisheries and Oceans

"The Proponent's mitigation and adaptive management plan to preserve the functioning of Fish Lake using a recirculated closed system uses unprecedented and untested technology … DFO is

not aware of any examples of wilderness lakes or watersheds that have been subject to a recirculation program." (DFO Panel Submission, July 23, 2013, p. 14, CEAR #691).

"The New Prosperity Mine configuration was modified by from the original plan to prevent the immediate destruction of Fish Lake to create a tailings pond. In the New Prosperity Mine configuration, the Fish Lake watershed could be extensively altered, requiring intensive engineering efforts to maintain flows and lake levels. While Fish Lake itself would not be directly destroyed, as noted by the Proponent in the 2012 EIS, the lake is predicted to experience eutrophication and contamination with development of the mine." (Supplemental DFO Panel Submission, August 4, 2013, CEAR #886, p. 15).

Ministry of Energy and Mines

"MEM believes that in the context of preserving Fish Lake and its tributaries there remain uncertainties around the ability to limit and collect the expected volumes of seepage from the TSF, and the ability to effectively treat water to maintain water quality in Fish Lake and its tributaries. This leads MEM to conclude that, as detailed in the EIS and supporting documents, the ability to prevent adverse effects to Fish Lake and its tributaries from a water quality perspective is uncertain." (MEM Panel Submission, August 6, 2013, CEAR #873, p. 3).

"Taseko has proposed relying on adaptive management including water treatment to mitigate adverse effects to Fish Lake water quality and to conclude no significant adverse effects to Fish Lake. Since the effectiveness of the proposed treatment processes to decrease metal concentrations to the design specifications has not been fully provided, MEM believes that Taseko's conclusion of their ability to prevent adverse effects to Fish Lake is also uncertain." (MEM Panel Submission, August 6, 2013, CEAR #873, p. 2).

"Recirculation of Fish Lake flows in an effort to preserve the ecological values of Fish Lake and its tributaries is a very significant commitment. Fresh water diversion and flow augmentation through pumping and piping are sometimes applied at BC minesites, however not typically at this scale or for this length of time." (MEM Panel Submission, July 19, 2013, CEAR #655, p. 16).

"The predicted average model results indicate BC fresh water aquatic life water quality guidelines will be exceeded in Fish Lake, Upper Fish Creek, and Tributary 1 for aluminum, cadmium, iron, lithium, selenium, silver and thallium. Predicted average pit lake concentrations also exceed guidelines for antimony, arsenic, cobalt, mercury and zinc." (MEM Panel Submission, July 19, 2013, CEAR #655, p. 20).

"MEM notes that the proposed membrane water treatment, sulphide reduction, and ion exchange water treatment technologies are not widely used in mining applications, and none are currently in use at British Columbia minesites. The information provided on water treatment in the supplemental response provides very high level concepts but does not provide design level information that demonstrates that target objectives can be met. Water treatment is a primary mitigation strategy for this project and it should be demonstrated to be feasible at the EA phase, especially since it is key to conclusions on project related effects." (MEM Comment on

Adequacy of June 5, 2013 Supplemental Information, Submitted June 14, 2013, CEAR #541, p. 2).

"Seepage from the TSF is a very significant management issue for the Prosperity project, given the directive to protect the integrity of Fish Lake. There is large uncertainty regarding the spatial extent and hydraulic conductivity of the TSF till foundation materials and the current assumptions of its effectiveness to limit seepage have not been justified are considered potentially not conservative. Sensitivity analyses show that significantly higher seepage rates than used in the water quality loading models could occur." (MEM Panel Submission, July 19, 2013, CEAR #655, pp 14-15).

Ministry of Environment (Forests, Lands and Natural Resource Operations)

"Concerns have been raised … over the possibility of deteriorating water quality in the Fish Lake system. This could result in the loss or reduction of the productive capacity of the lake and unsuitable water quality for other uses including wildlife habitat use. These concerns stem from the high degree of uncertainty surrounding the capability and feasibility of the water quality mitigation measures (i.e. mixed levels of success for treatment and the lack of previous experience combining treatments on a lake) to treat water so as to avert irreversible impacts to water quality and aquatic life. Should such a scenario play out, there is a substantially greater risk of irreversibly damage to the Fish Lake ecosystem and the wildlife use of the system either directly by exposure to algal bloom toxins or indirectly by avoidance of the area due to poor water quality." (BC Environmental Assessment Office Panel Submission, July 19, 2013, p. 16/56 of PDF, CEAR 654).

2. Long-term Liabilities to Taxpayers & Questionable Economics of the Project

Ministry of Energy and Mines

"While detailed costing is reviewed at the Mines Act permitting stage when setting the financial security requirements, the full costs of treatment should be fully evaluated by the Proponent at the EA stage as it has the potential to affect the economics of a project. MEM expects that the amount of financial security that could be required to fund this scale of long-term liability would be very high and are likely unprecedented in the province." (MEM Panel Submission, July 30, 2013, CEAR #787, p. 5).

"In addition to the requirements for Fish Lake water treatment, the open pit lake may require water treatment before spilling at Year 48. The potential additional treatment requirements and costs associated with it have not been scoped in the EA or in these review comments." (MEM Panel Submission, July 30, 2013, CEAR #787, p. 5).

"An assessment of the potential effects to predicted water quality in Fish Lake, Fish Lake Tributaries, and the pit lake are documented in the Impact Assessment starting on pages 761, 764, and 769, respectively. The summary water quality effects assessment for Fish Lake, Fish Lake tributaries, adjacent streams and rivers and adjacent lakes all conclude that water quality

conditions could become significantly adverse (pages 793-796) if left unmitigated." (MEM Panel Submission, July 19, 2013, CEAR #655, p. 21).

"MEM concludes it is reasonable to assume that TSF water will need to be relayed to the open pit in the long term and Fish Lake may require re-circulation for at least 100 years, and perhaps in-perpetuity." (MEM Panel Submission, July 19, 2013, CEAR #655, p. 21).

"Based on preliminary cost information submitted for project configuration T2 (IR#4a), it appears that the costs for water treatment and for some aspects of water management, may not have been fully factored into the project. Water treatment is a significant undertaking, and the current proposed water treatment systems are known to be very expensive. The proponent should consider the full costs of these environmental protection requirements, as they have the potential to significantly affect the economics of the project." (MEM Panel Submission, July 19, 2013, CEAR #655, p. 27).

3. Risks to Taseko River & Other Nearby Lakes

Environment Canada

"Environment Canada is concerned that the Proponent may have underestimated the potential impacts of the Project on water quality in Wasp Lake, Little Onion Lake and Big Onion Lake. Given that these lakes drain to the Taseko River, Environment Canada is also concerned that the Proponent may have underestimated impacts on water quality in the Taseko River." (EC Panel Submission, July 25, 2013, p. 19, CEAR #738).

Department of Fisheries and Oceans

"Natural Resources Canada recently expressed concern that Taseko's seepage rate estimates for the TSF [Tailings Storage Facility] may be 11 times higher than those modelled in the EIS [Environmental Impact Statement] … as a result, groundwater seepage estimates that were modelled in the EIS may be underestimated. If actual baseline groundwater seepage contributions into Taseko River are significantly higher than those modelled, then development of the Project could result in impacts to Taseko River that have not been considered by the Proponent." (DFO Panel Submission, July 23, 2013, p. 13, CEAR #691).

B.C. Ministry of Environment

"There are concerns regarding the modelling of groundwater movement and the lack of on-site monitoring wells. Furthermore the mitigation method of recycling the water back from intercepting wells downslope may not be effective because the pathways for groundwater movement are not completely understood. There exists the potential for the movement of contaminated groundwater from the mine site into other surrounding watersheds downslope including the Taseko River" (BC Environmental Assessment Office Panel Submission, page 7/56 of PDF, CEAR 654).

"Water from the seepage ponds are to be discharged to Big Onion Lake and Wasp Lake. These lakes are expected to see deteriorating water quality. Creeks leading from these lakes go to Beece Creek and Taseko River, highly valuable fish streams. Pit Water is expected to be discharged to Fish Creek long after the mining is completed. This water will receive little dilution in Fish Creek before it enters Taseko River" (BC Environmental Assessment Office Panel Submission, page 35/56 of PDF, CEAR 654).

*NOTE: This document does not try to provide a comprehensive list of comments on impacts to Tsilhqot'in culture, rights and use.

Read more:
http://www.vancouversun.com/business/2035/Government+experts+raised+flags+proposal+build+mine+summary+concerns/8880799/story.html#ixzz2hjpkxf1q

<u>Appendix G</u> - Details of Niagara Refining LLC APT Plant (New York), NYSDEC *DEC ID: 9145200327:* Permit Application

See next page

PERMIT
Under the Environmental Conservation Law (ECL)

IDENTIFICATION INFORMATION

Permit Type: Air State Facility
Permit ID: 9-1452-00327/00001
Effective Date: 09/10/2012 Expiration Date: No expiration date

Permit Issued To:NIAGARA REFINING LLC
5661 TRANSIT RD
DEPEW, NY 14043

Facility: NIAGARA REFINING LLC
5661 TRANSIT RD|(IN THE INDUSTRIAL PARK)
DEPEW, NY 14043

Contact: MICHAEL W LINDAMAN
NIAGARA REFINING LLC
5661 TRANSIT RD
DEPEW, NY 14043
(716) 683-9170

Description:

1. Niagara Refining, LLC is the owner and operator of an ammonium paratungstate and tungsten oxide production facility. The facility is located at 5661 Transit Road in the Village of Depew, Erie County, New York.
2. This new facility includes the processing of concentrated scheelite ore to produce a sodium tungstate solution by crushing, ball milling, alkali digestion, dilution and filtration. The sodium tungstate solution generated from the concentrated ore undergoes additional processing which includes purification, filtration, solution pH adjustment, ion exchange, vaporization/crystallization, and ammonium paratungstate drying.
3. The main emissions from the new facility include ammonia, hydrogen sulfide and particulates. The ammonia emissions are reused using an ammonia recovery system that utilizes purified water for absorption. In addition, captured ammonia emissions are controlled by 94 percent using a two stage sulfuric acid ammonia scrubbing system. The ammonia scrubbing system reduces the projected potential ammonia emissions to less than 15 tons per year (tpy). The captured hydrogen sulfide emissions are controlled to 99 percent by utilizing a sodium hydroxide and sodium hypochlorite scrubbing system. The hydrogen sulfide scrubbing system reduces the projected potential hydrogen sulfide emissions to less than 10 tpy. Particulate emissions are controlled using baghouses, filter cartridges and best management practices.

4. A performance test to demonstrate compliance with the required 99 percent control efficiency of hydrogen sulfide (H2S) emissions across the gas scrubber system must be completed within 60 days after achieving the maximum production rate but not later than 180 days after initial start-up.
5. A performance test to demonstrate compliance with the required 94 percent control efficiency of ammonia emissions across the ammonia gas scrubber system and the ammonia recovery system must be completed within 60 days after achieving the maximum production rate but not later than 180 days after initial start-up.
6. On-going compliance monitoring of the control equipment and established operating limits must be completed to ensure proper operation and maintenance practices are used to minimize the impact of excess emissions on ambient air quality, the environment and human health.
7. Best management practices shall be implemented to reduce the potential for fugitive dust emissions.
8. This project was evaluated using Screen3 procedures for comparison to the hydrogen sulfide NAAQS standard of 14 ug/m3 and the DAR-1 limits for hydrogen sulfide and ammonia. The results indicated the maximum impact from this source is not expected to exceed the SGC and AGC guidance limits for hydrogen sulfide and ammonia.

By acceptance of this permit, the permittee agrees that the permit is contingent upon strict compliance with the ECL, all applicable regulations, the General Conditions specified and any Special Conditions included as part of this permit.

Permit Administrator: DOUGLAS E BORSCHEL
270 MICHIGAN AVE
BUFFALO, NY 14203-2915

Authorized Signature: _____ Date: ___ / ___ / _____

Notification of Other State Permittee Obligations

Item A: Permittee Accepts Legal Responsibility and Agrees to Indemnification

The permittee expressly agrees to indemnify and hold harmless the Department of Environmental Conservation of the State of New York, its representatives, employees and agents ("DEC") for all claims, suits, actions, and damages, to the extent attributable to the permittee's acts or omissions in connection with the compliance permittee's undertaking of activities in connection with, or operation and maintenance of, the facility or facilities authorized by the permit whether in compliance or not in any compliance with the terms and conditions of the permit. This indemnification does not extend to any claims, suits, actions, or damages to the extent attributable to DEC's own negligent or intentional acts or omissions, or to any claims, suits, or actions naming the DEC and arising under article 78 of the New York Civil Practice Laws and Rules or any citizen suit or civil rights provision under federal or state laws.

Item B: Permittee's Contractors to Comply with Permit

The permittee is responsible for informing its independent contractors, employees, agents and assigns of their responsibility to comply with this permit, including all special conditions while acting as the permittee's agent with respect to the permitted activities, and such persons shall be subject to the same sanctions for violations of the Environmental Conservation Law as those prescribed for the permittee.

Item C: Permittee Responsible for Obtaining Other Required Permits

The permittee is responsible for obtaining any other permits, approvals, lands, easements and rights-of-way that may be required to carry out the activities that are authorized by this permit.

Item D: No Right to Trespass or Interfere with Riparian Rights

This permit does not convey to the permittee any right to trespass upon the lands or interfere with the riparian rights of others in order to perform the permitted work nor does it authorize the impairment of any rights, title, or interest in real or personal property held or vested in a person not a party to the permit.

LIST OF CONDITIONS

DEC GENERAL CONDITIONS

General Provisions

Facility Inspection by the Department

Relationship of this Permit to Other Department Orders and Determinations

Applications for permit renewals, modifications and transfers

Permit modifications, suspensions or revocations by the Department

Facility Level

Submission of application for permit modification or renewal-REGION 9 HEADQUARTERS

DEC GENERAL CONDITIONS
****** General Provisions ******
GENERAL CONDITIONS - Apply to ALL Authorized Permits.

Condition 1: Facility Inspection by the Department
Applicable State Requirement: ECL 19-0305

Item 1.1:
The permitted site or facility, including relevant records, is subject to inspection at reasonable hours and intervals by an authorized representative of the Department of Environmental Conservation (the Department) to determine whether the permittee is complying with this permit and the ECL. Such representative may order the work suspended pursuant to ECL 71-0301 and SAPA 401(3).

Item 1.2:
The permittee shall provide a person to accompany the Department's representative during an inspection to the permit area when requested by the Department.

Item 1.3:
A copy of this permit, including all referenced maps, drawings and special conditions, must be available for inspection by the Department at all times at the project site or facility. Failure to produce a copy of the permit upon request by a Department representative is a violation of this permit.

Condition 2: Relationship of this Permit to Other Department Orders and Determinations
Applicable State Requirement: ECL 3-0301 (2) (m)

Item 2.1:
Unless expressly provided for by the Department, issuance of this permit does not modify, supersede or rescind any order or determination previously issued by the Department or any of the terms, conditions or requirements contained in such order or determination.

Condition 3: Applications for permit renewals, modifications and transfers
Applicable State Requirement: 6 NYCRR 621.11

Item 3.1:
The permittee must submit a separate written application to the Department for renewal, modification or transfer of this permit. Such application must include any forms or supplemental information the Department requires. Any renewal, modification or transfer granted by the Department must be in writing.

Item 3.2:
The permittee must submit a renewal application at least 180 days before expiration of permits for Title V Facility Permits, or at least 30 days before expiration of permits for State Facility Permits.

Item 3.3:
Permits are transferrable with the approval of the department unless specifically prohibited by the statute, regulation or another permit condition. Applications for permit transfer should be submitted prior to actual transfer of ownership.

Applicable State Requirement: 6 NYCRR 621.13

Item 4.1:
The Department reserves the right to exercise all available authority to modify, suspend, or revoke this permit in accordance with 6NYCRR Part 621. The grounds for modification, suspension or revocation include:

a) materially false or inaccurate statements in the permit application or supporting papers;
b) failure by the permittee to comply with any terms or conditions of the permit;
c) exceeding the scope of the project as described in the permit application;
d) newly discovered material information or a material change in environmental conditions, relevant technology or applicable law or regulations since the issuance of the existing permit;
e) noncompliance with previously issued permit conditions, orders of the commissioner, any provisions of the Environmental Conservation Law or regulations of the Department related to the permitted activity.

****** Facility Level ******

Condition 5: Submission of application for permit modification or renewal-REGION 9 HEADQUARTERS
Applicable State Requirement: 6 NYCRR 621.6 (a)

Item 5.1:
Submission of applications for permit modification or renewal are to be submitted to:
NYSDEC Regional Permit Administrator
Region 9 Headquarters
Division of Environmental Permits
270 Michigan Avenue
Buffalo, NY 14203-2915
(716) 851-7165

Permit Under the Environmental Conservation Law (ECL)

ARTICLE 19: AIR POLLUTION CONTROL - AIR STATE FACILITY PERMIT

IDENTIFICATION INFORMATION

Permit Issued To:NIAGARA REFINING LLC
5661 TRANSIT RD
DEPEW, NY 14043

Facility: NIAGARA REFINING LLC
5661 TRANSIT RD|(IN THE INDUSTRIAL PARK)
DEPEW, NY 14043

Authorized Activity By Standard Industrial Classification Code:
3399 - PRIMARY METAL PRODUCTS, NEC

Permit Effective Date: 09/10/2012 Permit Expiration Date: No expiration date.

LIST OF CONDITIONS

FEDERALLY ENFORCEABLE CONDITIONS
Facility Level
2 6 NYCRR 202-1.1: Required Emissions Tests
1 6 NYCRR 201-6.5 (g): Non Applicable requirements
3 6 NYCRR 211.1: Air pollution prohibited
Emission Unit Level

EU=U-00APT
4 6 NYCRR Part 211: Compliance Demonstration
5 6 NYCRR 212.4 (c): Compliance Demonstration
6 6 NYCRR 212.6 (a): Compliance Demonstration
7 6 NYCRR Subpart 257-10: Compliance Demonstration

EU=U-00APT,EP=00001

8 6 NYCRR 212.4 (a): Compliance Demonstration
9 6 NYCRR 212.4 (a): Compliance Demonstration

EU=U-00APT,EP=00002

10 6 NYCRR 212.4 (a): Compliance Demonstration
11 6 NYCRR 212.4 (a): Compliance Demonstration

STATE ONLY ENFORCEABLE CONDITIONS
Facility Level
12 ECL 19-0301: Contaminant List
13 6 NYCRR 201-1.4: Unavoidable noncompliance and violations
14 6 NYCRR Subpart 201-5: Emission Unit Definition
15 6 NYCRR 211.2: Visible Emissions Limited
Emission Unit Level
16 6 NYCRR Subpart 201-5: Emission Point Definition By Emission Unit
17 6 NYCRR Subpart 201-5: Process Definition By Emission Unit

FEDERALLY ENFORCEABLE CONDITIONS
****** Facility Level ******

NOTIFICATION OF GENERAL PERMITTEE OBLIGATIONS
This section contains terms and conditions which are federally enforceable. Permittees may also have other obligations under regulations of general applicability

Item A: **Sealing - 6 NYCRR 200.5**

The Commissioner may seal an air contamination source to prevent its operation if compliance with 6 NYCRR Chapter III is not met within the time provided by an order of the Commissioner issued in the case of the violation. Sealing means labeling or tagging a source to notify any person that operation of the source is prohibited, and also includes physical means of preventing the operation of an air contamination source without resulting in destruction of any equipment associated with such source, and includes, but is not limited to, bolting, chaining or wiring shut control panels, apertures or conduits associated with such source.

No person shall operate any air contamination source sealed by the Commissioner in accordance with this section unless a modification has been made which enables such source to comply with all requirements applicable to such modification.

Unless authorized by the Commissioner, no person shall remove or alter any seal affixed to any contamination source in accordance with this section.

Item B: **Acceptable Ambient Air Quality - 6 NYCRR 200.6**

Notwithstanding the provisions of 6 NYCRR Chapter III, Subchapter A, no person shall allow or permit any air contamination source to emit air contaminants in quantities which alone or in combination with emissions from other air contamination sources would contravene any applicable ambient air quality standard and/or cause air pollution. In such cases where contravention occurs or may occur, the Commissioner shall specify the degree and/or method of emission control required.

Item C: **Maintenance of Equipment - 6 NYCRR 200.7**

Any person who owns or operates an air contamination source which is equipped with an emission control device shall operate such device and keep it in a satisfactory state of maintenance and repair in accordance with ordinary and necessary practices, standards and procedures, inclusive of manufacturer's specifications,

required to operate such device effectively.

Item D: **Unpermitted Emission Sources - 6 NYCRR 201-1.2**

If an existing emission source was subject to the permitting requirements of 6 NYCRR Part 201 at the time of construction or modification, and the owner and/or operator failed to apply for a permit for such emission source then the following provisions apply:

(a) The owner and/or operator must apply for a permit for such emission source or register the facility in accordance with the provisions of Part 201.

(b) The emission source or facility is subject to all regulations that were applicable to it at the time of construction or modification and any subsequent requirements applicable to existing sources or facilities.

Item E: **Emergency Defense - 6 NYCRR 201-1.5**

An emergency constitutes an affirmative defense to an action brought for noncompliance with emissions limitations or permit conditions for all facilities in New York State.

(a) The affirmative defense of emergency shall be demonstrated through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An emergency occurred and that the facility owner and/or operator can identify the cause(s) of the emergency;

(2) The equipment at the permitted facility causing the emergency was at the time being properly operated;

(3) During the period of the emergency the facility owner and/or operator took all reasonable steps to minimize levels of emissions that exceeded the emission standards, or other requirements in the permit; and

(4) The facility owner and/or operator notified the Department within two working days after the event occurred. This notice must contain a description of the emergency, any steps taken to mitigate emissions, and corrective actions taken.

(b) In any enforcement proceeding, the facility owner and/or operator seeking to establish the occurrence of an emergency has the burden of proof.

(c) This provision is in addition to any emergency or upset provision contained in any applicable requirement.

Item F: **Recycling and Salvage - 6 NYCRR 201-1.7**

Where practical, any person who owns or operates an air contamination source shall recycle or salvage air contaminants collected in an air cleaning device according to the requirements of 6 NYCRR.

Item G: **Prohibition of Reintroduction of Collected Contaminants to the Air - 6 NYCRR 201-1.8**

No person shall unnecessarily remove, handle, or cause to be handled, collected air contaminants from an air cleaning device for recycling, salvage or disposal in a manner that would reintroduce them to the outdoor atmosphere.

Item H: **Proof of Eligibility for Sources Defined as Exempt Activities - 6 NYCRR 201-3.2 (a)**

The owner and/or operator of an emission source or unit that is eligible to be exempt, may be required to certify that it operates within the specific criteria described in 6 NYCRR Subpart 201-3. The owner or operator of any such emission source must maintain all required records on-site for a period of five years and make them available to representatives of the Department upon request. Department representatives must be granted access to any facility which contains emission sources or units subject to 6 NYCRR Subpart 201-3, during normal operating hours, for the purpose of determining compliance with this and any other state and federal air pollution control requirements, regulations, or law.

Item I: **Proof of Eligibility for Sources Defined as Trivial Activities - 6 NYCRR 201-3.3 (a)**

The owner and/or operator of an emission source or unit that is listed as being trivial in 6 NYCRR Part 201 may be required to certify that it operates within the specific criteria described in 6 NYCRR Subpart 201-3. The owner or operator of any such emission source must maintain all required records on-site for a period of five years and make them available to representatives of the Department upon request. Department representatives must be granted access to any facility which contains emission sources or units subject to 6 NYCRR Subpart 201-3, during normal operating hours, for the purpose of determining compliance with this and any other state and federal air pollution control requirements, regulations, or law.

Item J: **Required Emission Tests - 6 NYCRR 202-1.1**

An acceptable report of measured emissions shall be submitted, as may be required by the Commissioner, to ascertain compliance or noncompliance with any air pollution code, rule, or regulation. Failure to submit a report acceptable to the Commissioner within the time stated shall be sufficient reason for the Commissioner to suspend or deny an operating permit. Notification and acceptable procedures are specified in 6 NYCRR Subpart 202-1.

Item K: **Open Fires Prohibitions - 6 NYCRR 215.2**
Except as allowed by section 215.3 of 6 NYCRR Part 215, no person shall burn, cause, suffer, allowor permit the burning of any materials in an open fire.

Item L: **Permit Exclusion - ECL 19-0305**
The issuance of this permit by the Department and the receipt thereof by the Applicant does not and shall not be construed as barring, diminishing, adjudicating or in any way affecting any legal, administrative or equitable rights or claims, actions, suits, causes of action or demands whatsoever that the Department may have against the Applicant for violations based on facts and circumstances alleged to have occurred or existed prior to the effective date of this permit, including, but not limited to, any enforcement action authorized pursuant to the provisions of applicable federal law, the Environmental Conservation Law of the State of New York (ECL) and Chapter III of the Official Compilation of the Codes, Rules and Regulations of the State of New York (NYCRR). The issuance of this permit also shall not in any way affect pending or future enforcement actions under the Clean Air Act brought by the United States or any person.

Item M: **Federally Enforceable Requirements - 40 CFR 70.6 (b)**
All terms and conditions in this permit required by the Act or any applicable requirement, including any provisions designed to limit a facility's potential to emit, are enforceable by the Administrator and citizens under the Act. The Department has, in this permit, specifically designated any terms and conditions that are not required under the Act or under any of its applicable requirements as being enforceable under only state regulations.

FEDERAL APPLICABLE REQUIREMENTS
The following conditions are federally enforceable.

Condition 2: **Required Emissions Tests**

Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable Federal Requirement:6 NYCRR 202-1.1

Item 2.1:
For the purpose of ascertaining compliance or non-compliance with any air pollution control code, rule or regulation, the commissioner may require the person who owns such air contamination source to submit an acceptable report of measured emissions within a stated time.

Condition 1: Non Applicable requirements
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable Federal Requirement:6 NYCRR 201-6.5 (g)

Item 1.1:
This section contains a summary of those requirements that have been specifically identified as being not applicable to this facility and/or emission units, emission points, processes and/or emission sources within this facility. The summary also includes a justification for classifying any such requirements as non-applicable.

40 CFR 60.380
Reason: 40 CFR 60 Subpart LL, New Source Performance Standards for Metallic Mineral Processing Plants, is applicable to facilities that process metallic mineral concentrates from ore. Niagara Refining reports Subpart LL is not applicable to this facility because the ammonium paratungstate is produced from metallic mineral concentrates that have been concentrated to approximately 50 percent prior to arrival on-site.

Condition 3: Air pollution prohibited
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable Federal Requirement:6 NYCRR 211.1

Item 3.1:
No person shall cause or allow emissions of air contaminants to the outdoor atmosphere of such quantity, characteristic or duration which are injurious to human, plant or animal life or to property, or which unreasonably interfere with the comfortable enjoyment of life or property. Notwithstanding the existence of specific air quality standards or emission limits, this prohibition applies, but is not limited to, any particulate, fume, gas, mist, odor, smoke, vapor, pollen, toxic or deleterious emission, either alone or in combination with others.

****** Emission Unit Level ******

Condition 4: Compliance Demonstration
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable Federal Requirement:6 NYCRR Part 211

Item 4.1:
The Compliance Demonstration activity will be performed for:

Emission Unit: U-00APT

Regulated Contaminant(s):
CAS No: 0NY075-00-0 PARTICULATES

Item 4.2:
Compliance Demonstration shall include the following monitoring:

Monitoring Type: RECORD KEEPING/MAINTENANCE PROCEDURES
Monitoring Description:
Uncontrolled particulate emissions from truck traffic, storage piles, transfer of materials, or other facility operations cannot create a nuisance or exceed ambient air quality standards. Niagara Refining shall implement best management practices to reduce the potential impact of fugitive dust emissions on ambient air quality, the environment and human health. Such measures may include, but are not limited to, paving dirt roadways, installing a tire wash for trucks traveling on dirt roads, sweeping and cleaning paved areas, and installation of windrows.

Monitoring Frequency: AS REQUIRED - SEE PERMIT MONITORING DESCRIPTION
Reporting Requirements: AS REQUIRED - SEE MONITORING DESCRIPTION

Condition 5: Compliance Demonstration
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable Federal Requirement:6 NYCRR 212.4 (c)

Item 5.1:
The Compliance Demonstration activity will be performed for:

Emission Unit: U-00APT

Regulated Contaminant(s):
CAS No: 0NY075-00-0 PARTICULATES

Item 5.2:
Compliance Demonstration shall include the following monitoring:

Monitoring Type: MONITORING OF PROCESS OR CONTROL DEVICE PARAMETERS AS SURROGATE
Monitoring Description:
(1) No person will cause or allow emissions of solid particulates that exceed 0.050 grains of particulates per cubic foot of exhaust gas, expressed at standard

conditions on a dry gas basis.

(2) On-going compliance monitoring of the particulate emission limit for each particulate emission source, including but not limited to baghouses and particulate filter cartridges, shall be monitored as stated below. A particulate emission source shall include any equipment which emits particulate emissions to the outdoor atmosphere through any conduit, chimney, duct, vent, flue, stack, or opening of any kind. The identified sources at Niagara Refining include emission sources #00087, #08151, #08152, and several filter cartridges.

(a) Each baghouse and particulate filter cartridge must be operated and maintained according to manufacturer specifications. Within 180 days of startup, Niagara Refining shall submit to the Department a preventative maintenance plan designed such that the equipment is operated and maintained to limit particulate emissions or fall-out of material.

(b) Weekly inspection of any fall-out from the baghouses and filter cartridges shall be completed whenever a process is in operation.

(c) Weekly differential pressure measurements of each baghouse which vent to the outside atmosphere shall be completed whenever a process is in normal operation.

(d) Differential pressure shall be measured between the inlet and outlet to the dust collector. The dust collectors shall be operated within the differential pressure range specified by the manufacturer.

(e) The differential pressure transducer shall be calibrated annually or as required by the manufacturer.

(f) If any visible emissions, particulate fall-out or pressure measurement is recorded outside the manufacturer range, then Niagara Refining shall inspect the source, initiate corrective action, and restore operation of the dust collector and associated capture system to its normal operation as expeditiously as practicable.

(4) Records shall be maintained to include: (i) a daily log documenting whether any visible emissions or fall-out were observed, (ii) a log of the weekly pressure drop measurements with reference to the manufacturer differential pressure range, (iii) the date and time of

the observation or measurement, (iv) corrective action taken (if any), and (v) the cause of any visible emissions, fall-out or pressure measurements outside the manufacturer range (if known). The records shall be kept on-site and be made available to the Department upon request.

(5) At the discretion of the Department, an EPA Method 5 compliance test may be required to demonstrate compliance with the 0.05 grains/dscf emission limit.

Parameter Monitored: PARTICULATES
Upper Permit Limit: 0.05 grains per dscf
Reference Test Method: EPA Method 5
Monitoring Frequency: AS REQUIRED - SEE PERMIT MONITORING DESCRIPTION
Averaging Method: MAXIMUM - NOT TO EXCEED STATED VALUE - SEE MONITORING DESCRIPTION
Reporting Requirements: AS REQUIRED - SEE MONITORING DESCRIPTION

Condition 6: Compliance Demonstration
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable Federal Requirement:6 NYCRR 212.6 (a)

Item 6.1:
The Compliance Demonstration activity will be performed for:

Emission Unit: U-00APT

Regulated Contaminant(s):

CAS No: 007664-41-7	AMMONIA
CAS No: 007664-93-9	SULFURIC ACID
CAS No: 0NY075-00-0	PARTICULATES

Item 6.2:
Compliance Demonstration shall include the following monitoring:

Monitoring Type: MONITORING OF PROCESS OR CONTROL DEVICE PARAMETERS AS SURROGATE
Monitoring Description:

(1) No person will cause or allow emissions having an average opacity during any six consecutive minutes of 20 percent or greater from any process emission source, except only the emission of uncombined water.

(2) On-going compliance monitoring with this requirement shall be determined by the facility owner/operator conducting a daily survey of visible emissions whenever a process is in operation. A process shall include any equipment which emits air contaminants to the outdoor atmosphere through any conduit, chimney, duct, vent, flue,

stack, doorway or opening of any kind. The specific locations at Niagara Refining include emission points #00001, #00002, #0003A, #0003B, #00004, #00005, #00006, #00007, #00008, #00009 and any other general room ventilation exhaust or building opening through which air contaminants are emitted to the outdoor atmosphere.

(3) The daily survey does not require the determination of opacity levels. Rather the survey is used to document the presence or non-presence of visible emissions, excluding water vapor. Visible emission observations shall be performed, as best as possible, at a location to obtain the proper sun angle, background, and line of sight. The observer must be knowledgeable regarding the effects on the visibility of emissions caused by background contrast, ambient lighting, observer position relative to lighting, wind, and the presence of uncombined water (condensing water vapor).

(4) Upon detecting visible emissions, Niagara Refining shall inspect the source and restore operation of the emission unit (including the control devise, if any, and the associated capture system) to its normal operation as expeditiously as practicable.

(5) Records of the visible emission survey shall be maintained to include: (1) a check list of whether visible emissions were observed or not, (2) the date and time of the visible emission observation, (3) the corrective action taken (if any). The records shall be kept on-site and made available to the Department upon request.

(6) The Department reserves the right to perform or require the performance of a Method 9 or Method 22 opacity evaluation from any process emission source.

Parameter Monitored: OPACITY
Upper Permit Limit: 20 percent
Reference Test Method: EPA Method 9 and 22
Monitoring Frequency: AS REQUIRED - SEE PERMIT MONITORING DESCRIPTION
Averaging Method: MAXIMUM - NOT TO EXCEED STATED VALUE - SEE MONITORING DESCRIPTION
Reporting Requirements: AS REQUIRED - SEE MONITORING DESCRIPTION

Condition 7: Compliance Demonstration
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable Federal Requirement:6 NYCRR Subpart 257-10

Item 7.1:

The Compliance Demonstration activity will be performed for:

Emission Unit: U-00APT

Regulated Contaminant(s):
CAS No: 007783-06-4 HYDROGEN SULFIDE

Item 7.2:
Compliance Demonstration shall include the following monitoring:

Monitoring Type: AMBIENT AIR MONITORING
Monitoring Description:
A Screen3 impact analysis was completed using hydrogen sulfide emissions controlled to a 99 percent control efficiency. The modeling results demonstrated the impact of captured hydrogen sulfide emissions are less than the standard concentration of 14 ug/m3. If hydrogen sulfide odors are detected near the facility, the Department will require Niagara Refining to complete a program of assessment and remediation to correct the potential impacts. Niagara Refining will be required to complete ambient air quality monitoring using methods specified by the Department and install appropriate control measures.

§257-10.1 Definition

Hydrogen sulfide (H2S) is a colorless gas having a characteristic, disagreeable odor often described as that of rotten eggs. For the purpose of this Subpart the term hydrogen sulfide will include hydrogen sulfide and other sulfides as measured by the acceptable analytical method.

§257-10.2 Objective

Hydrogen sulfide can cause odors which unreasonably interfere with the comfortable enjoyment of life and property. Although tarnishing of metals and discoloring of paint may occur at higher ambient air concentrations the primary objective of this standard is to prevent disagreeable odors.

§257-10.3 Standard

Applicable in all levels. In any one-hour period, the average concentration of hydrogen sulfide shall not exceed 0.01 ppm (14 μg/m3).

§257-10.4 Measurement

(a) Hydrogen sulfide is determined by the Cadmium Hydroxide-Methylene Blue method and expressed as parts of hydrogen sulfide per million parts of ambient air (ppm) by volume.
(b) All measurements are corrected to a reference temperature of 25 degrees Centigrade and to a reference pressure of 760 millimeters of mercury.

Parameter Monitored: HYDROGEN SULFIDE
Upper Permit Limit: 14 micrograms per cubic meter
Reference Test Method: Cadmium Hydroxide-Methylene Blue method
Monitoring Frequency: AS REQUIRED - SEE PERMIT MONITORING DESCRIPTION
Averaging Method: MAXIMUM - NOT TO EXCEED STATED VALUE - SEE MONITORING DESCRIPTION
Reporting Requirements: AS REQUIRED - SEE MONITORING DESCRIPTION

Condition 8: Compliance Demonstration
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable Federal Requirement:6 NYCRR 212.4 (a)

Item 8.1:
The Compliance Demonstration activity will be performed for:

Emission Unit: U-00APT Emission Point: 00001

Regulated Contaminant(s):
CAS No: 007783-06-4 HYDROGEN SULFIDE

Item 8.2:
Compliance Demonstration shall include the following monitoring:

Monitoring Type: INTERMITTENT EMISSION TESTING
Monitoring Description:
ROUTINE HYDROGEN SULFIDE PERFORMANCE TESTING AND ESTABLISH OPERATING LIMITS

(1) A performance test to demonstrate compliance with the required 99 percent control efficiency of hydrogen sulfide (H2S) emissions across the gas scrubber system must be completed within 60 days after achieving the maximum production rate but not later than 180 days after initial start-up.

(2) The performance test must be conducted at the maximum normal operating process load.

(3) You must establish the control parameters including: (1) the scrubber effluent pH, (2) oxidation reduction potential (ORP), (3) scrubber liquid flowrate, and (4) pressure drop as your operating limits during the

three-run performance test.

(4) You must collect pH, ORP, pressure drop, and liquid flow-rate data every 15 minutes during the entire period of the performance tests.

(5) You must determine the average pH, ORP, pressure drop, and liquid flow-rate for each individual test run in the three-run performance test by computing the average of all the 15-minute readings taken during each test run. The hourly averages shall be used to establish the operating limits.

(6) The method used to measure H2S shall include EPA Method 15 from 40CFR60, Appendix A or another reference method approved by the Department.

(7) A performance test protocol shall be submitted to the Department for approval at least 60 days prior to completion of the test. The Department must be notified 10 days prior to the scheduled test date so a Department representative may be present during the test.

(8) The results of the performance test shall be submitted to the Department within 60 days following completion of the performance test.

(9) A permit modification application shall be submitted no later than 90 days upon receiving approval of the performance test report. The application shall contain the proposed compliance certification conditions for the established operating limits for the scrubber effluent pH, ORP, scrubber liquid flowrate and pressure drop.

(10) Subsequent performance test requirements will be at the discretion of the Department based on design, operation and maintenance practices used to minimize the impact of excess emissions on ambient air quality, the environment and human health.

Parameter Monitored: HYDROGEN SULFIDE
Lower Permit Limit: 99 percent degree of air cleaning or greater
Reference Test Method: EPA Method 15 or other approved method
Monitoring Frequency: AS REQUIRED - SEE PERMIT MONITORING DESCRIPTION
Averaging Method: MINIMUM - NOT TO FALL BELOW STATED VALUE AT ANY TIME
Reporting Requirements: AS REQUIRED - SEE MONITORING DESCRIPTION

Condition 9: Compliance Demonstration
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable Federal Requirement:6 NYCRR 212.4 (a)

Item 9.1:
The Compliance Demonstration activity will be performed for:

Emission Unit: U-00APT Emission Point: 00001

Regulated Contaminant(s):
CAS No: 007783-06-4 HYDROGEN SULFIDE

Item 9.2:
Compliance Demonstration shall include the following monitoring:

Monitoring Type: RECORD KEEPING/MAINTENANCE PROCEDURES
Monitoring Description:
DEMONSTRATING CONTINUOUS COMPLIANCE
HYDROGEN SULFIDE SCRUBBER SYSTEM

(1) You must install, operate, and maintain a flow, pressure, ORP and pH measurement device for the hydrogen sulfide wet scrubber system.

(2) The monitoring equipment must complete a minimum of one cycle of operation for each successive 15-minute period. You must have a minimum of four successive cycles of operation to have a valid hour of data.

(3) You must monitor and collect data at all required intervals at all times that the affected source is operating, except for malfunctions, associated repairs, and required quality assurance or control activities (including, as applicable, calibration checks and required zero and span adjustments).

(4) You must determine the 12-hour block average of all recorded readings, except as provided as follows. For purposes of calculating data averages, you must not use data recorded during monitoring malfunctions, associated repairs, out of control periods, or required quality assurance or control activities. You must use all the data collected during all other periods in assessing compliance. Any period for which the monitoring system is out-of-control and data are not available for a required calculation constitutes a deviation from the monitoring requirements.

(5) You must maintain the 12-hour average pressure drop, liquid flow-rate, ORP and pH within the operating limits established during the performance test.

(6) Operation not within the established operating limits

shall indicate a deviation from normal conditions. You must immediately complete an investigation of the source, determine and document the cause of the deviation and complete corrective action, if necessary.

(7) You must monitor and maintain records of the total combined production of ammonium paratungstate (APT) and tungsten oxide on a rolling 12-month total basis. If the combined total production of APT and tungsten oxides exceeds 2,750 tons per year, you shall demonstrate the control equipment is designed to process the additional load. In addition, you shall complete an air screening analysis to demonstrate any increase in hydrogen sulfide emissions do not exceed the impact levels.

(8) You must keep the records of all inspection and monitoring data. Your records must be in a form suitable and readily available for expeditious review. You must keep records of the occurrence and duration of each malfunction of the associated air pollution control and monitoring equipment. You must keep records of actions taken during periods of malfunction to minimize emissions, including corrective actions to restore the malfunctioning air pollution control, or monitoring equipment to its normal or usual manner of operation. You must keep each record for 5 years following the date of each recorded action.

Monitoring Frequency: AS REQUIRED - SEE PERMIT MONITORING DESCRIPTION
Reporting Requirements: AS REQUIRED - SEE MONITORING DESCRIPTION

Condition 10: Compliance Demonstration
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable Federal Requirement:6 NYCRR 212.4 (a)

Item 10.1:
The Compliance Demonstration activity will be performed for:

Emission Unit: U-00APT Emission Point: 00002

Regulated Contaminant(s):
CAS No: 007664-41-7 AMMONIA

Item 10.2:
Compliance Demonstration shall include the following monitoring:

Monitoring Type: RECORD KEEPING/MAINTENANCE PROCEDURES
Monitoring Description:
DEMONSTRATING CONTINUOUS COMPLIANCE
AMMONIA SCRUBBER SYSTEM

(1) You must install, operate, and maintain a flow, pressure and pH measurement device for the ammonia wet scrubber system and the ammonia recovery system.

(2) The monitoring equipment must complete a minimum of one cycle of operation for each successive 15-minute period. You must have a minimum of four successive cycles of operation to have a valid hour of data.

(3) You must monitor and collect data at all required intervals at all times that the affected source is operating, except for malfunctions, associated repairs, and required quality assurance or control activities (including, as applicable, calibration checks and required zero and span adjustments).

(4) You must determine the 12-hour block average of all recorded readings, except as provided as follows. For purposes of calculating data averages, you must not use data recorded during monitoring malfunctions, associated repairs, out of control periods, or required quality assurance or control activities. You must use all the data collected during all other periods in assessing compliance. Any period for which the monitoring system is out-of-control and data are not available for a required calculation constitutes a deviation from the monitoring requirements.

(5) You must maintain the 12-hour average pressure drop, liquid flow-rate and pH within the operating limits established during the performance test.

(6) Operation not within the established operating limits shall indicate a deviation from normal conditions. You must immediately complete an investigation of the source, determine and document the cause of the deviation and complete corrective action, if necessary.

(7) You must monitor and maintain records of the total combined production of ammonium paratungstate (APT) and tungsten oxide on a rolling 12-month total basis. If the combined total production of APT and tungsten oxides exceeds 2,750 tons per year, you shall demonstrate the control equipment is designed to process the additional load. In addition, you shall complete an air screening analysis to demonstrate any increase in ammonia emissions do not exceed the impact levels.

(8) You must maintain the two stage scrubbing system in accordance with manufacturer specifications.

(9) You must keep the records of all inspection and monitoring data. Your records must be in a form suitable and readily available for expeditious review. You must keep records of the occurrence and duration of each malfunction of the associated air pollution control and monitoring equipment. You must keep records of actions taken during periods of malfunction to minimize emissions, including corrective actions to restore the malfunctioning air pollution control, or monitoring equipment to its normal or usual manner of operation. You must keep each record for 5 years following the date of each recorded action.

Monitoring Frequency: AS REQUIRED - SEE PERMIT MONITORING DESCRIPTION
Reporting Requirements: AS REQUIRED - SEE MONITORING DESCRIPTION

Condition 11: Compliance Demonstration
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable Federal Requirement:6 NYCRR 212.4 (a)

Item 11.1:
The Compliance Demonstration activity will be performed for:

Emission Unit: U-00APT Emission Point: 00002

Regulated Contaminant(s):
CAS No: 007664-41-7 AMMONIA

Item 11.2:
Compliance Demonstration shall include the following monitoring:

Monitoring Type: INTERMITTENT EMISSION TESTING
Monitoring Description:
ROUTINE AMMONIA PERFORMANCE TESTING AND ESTABLISH OPERATING LIMITS

(1) A performance test to demonstrate compliance with the required 94 percent control efficiency of ammonia emissions across the ammonia gas scrubber system and the ammonia recovery system must be completed within 60 days after achieving the maximum production rate but not later than 180 days after initial start-up.

(2) The performance test must be conducted at the maximum normal operating process load.

(3) You must establish the control parameters including: (1) the scrubber effluent pH, (2) scrubber liquid flowrate, and (3) pressure drop as your operating limits during the three-run performance test.

(4) You must collect pH, pressure drop, and liquid flow-rate data every 15 minutes during the entire period of the performance tests.

(5) You must determine the average pH, pressure drop, and liquid flow-rate for each individual test run in the three-run performance test by computing the average of all the 15-minute readings taken during each test run. The hourly averages shall be used to establish the operating limits.

(6) The method used to measure ammonia shall be approved by the Department.

(7) A performance test protocol shall be submitted to the Department for approval at least 60 days prior to completion of the test. The Department must be notified 10 days prior to the scheduled test date so a Department representative may be present during the test.

(8) The results of the performance test shall be submitted to the Department within 60 days following completion of the performance test.

(9) A permit modification application shall be submitted no later than 90 days upon receiving approval of the performance test report. The application shall contain the proposed compliance certification conditions for the established operating limits for the scrubber effluent pH, scrubber liquid flowrate and pressure drop.

(10) Subsequent performance test requirements will be at the discretion of the Department based on design, operation and maintenance practices used to minimize the impact of excess emissions on ambient air quality, the environment and human health.

Parameter Monitored: AMMONIA
Lower Permit Limit: 94 percent degree of air cleaning or greater
Reference Test Method: Department approved method
Monitoring Frequency: AS REQUIRED - SEE PERMIT MONITORING DESCRIPTION
Averaging Method: RANGE - NOT TO FALL OUTSIDE OF STATED RANGE AT ANY TIME
Reporting Requirements: AS REQUIRED - SEE MONITORING DESCRIPTION

STATE ONLY ENFORCEABLE CONDITIONS
****** Facility Level ******

NOTIFICATION OF GENERAL PERMITTEE OBLIGATIONS
This section contains terms and conditions which are not federally enforceable. Permittees may also have other obligations under regulations of general applicability

Item A: **Public Access to Recordkeeping for Facilities With State Facility Permits - 6 NYCRR 201-1.10 (a)**
Where emission source owners and/or operators keep records pursuant to compliance with the operational flexibility requirements of 6 NYCRR Subpart 201-5.4(b)(1) , and/or the emission capping requirements of 6 NYCRR Subparts 201-7.2(d), 201-7.3(f), 201-7.3(g), 201-7.3(h)(5), 201-7.3(i) and 201-7.3(j), the Department will make such records available to the public upon request in accordance with 6 NYCRR Part 616 - Public Access to Records. Emission source owners and/or operators must submit the records required to comply with the request within sixty working days of written notification by the Department of receipt of the request.

Item B: **General Provisions for State Enforceable Permit Terms and Condition - 6 NYCRR Part 201-5**
Any person who owns and/or operates stationary sources shall operate and maintain all emission units and any required emission control devices in compliance with all applicable Parts of this Chapter and existing laws, and shall operate the facility in accordance with all criteria, emission limits, terms, conditions, and standards in this permit. Failure of such person to properly operate and maintain the effectiveness of such emission units and emission control devices may be sufficient reason for the Department to revoke or deny a permit.

The owner or operator of the permitted facility must maintain all required records on-site for a period of five years and make them available to representatives of the Department upon request. Department representatives must be granted access to any facility regulated by this Subpart, during normal operating hours, for the purpose of determining compliance with this and any other state and federal air pollution control requirements, regulations or law.

STATE ONLY APPLICABLE REQUIREMENTS
The following conditions are state only enforceable.

Condition 12: Contaminant List
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable State Requirement:ECL 19-0301

Item 12.1:
Emissions of the following contaminants are subject to contaminant specific requirements in this permit(emission limits, control requirements or compliance monitoring conditions).

CAS No: 007664-41-7
Name: AMMONIA

CAS No: 007664-93-9
Name: SULFURIC ACID

CAS No: 007783-06-4
Name: HYDROGEN SULFIDE

CAS No: 0NY075-00-0
Name: PARTICULATES

Condition 13: Unavoidable noncompliance and violations
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable State Requirement:6 NYCRR 201-1.4

Item 13.1:
At the discretion of the commissioner a violation of any applicable emission standard for necessary scheduled equipment maintenance, start-up/shutdown conditions and malfunctions or upsets may be excused if such violations are unavoidable. The following actions and recordkeeping and reporting requirements must be adhered to in such circumstances.

(a) The facility owner and/or operator shall compile and maintain records of all equipment maintenance or start-up/shutdown activities when they can be expected to result in an exceedance of any applicable emission standard, and shall submit a report of such activities to the commissioner's representative when requested to do so in writing or when so required by a condition of a permit issued for the corresponding air contamination source except where conditions elsewhere in this permit which contain more stringent reporting and notification provisions for an applicable requirement, in which case they supercede those stated here. Such reports shall describe why the violation was unavoidable and shall include the time, frequency and duration of the maintenance and/or start-up/shutdown activities and the identification of air contaminants, and the estimated emission rates. If a facility owner and/or operator is subject to continuous stack monitoring and quarterly reporting requirements, he need not submit reports for equipment maintenance or start-up/shutdown for the facility to the commissioner's representative.

(b) In the event that emissions of air contaminants in excess of any emission standard in 6 NYCRR Chapter III Subchapter A occur due to a malfunction, the facility owner and/or operator shall report such malfunction by telephone to the commissioner's representative as soon as possible during normal working hours, but in any event not later than two working days after

becoming aware that the malfunction occurred. Within 30 days thereafter, when requested in writing by the commissioner's representative, the facility owner and/or operator shall submit a written report to the commissioner's representative describing the malfunction, the corrective action taken, identification of air contaminants, and an estimate of the emission rates. These reporting requirements are superceded by conditions elsewhere in this permit which contain reporting and notification provisions for applicable requirements more stringent than those above.

(c) The Department may also require the owner and/or operator to include in reports described under (a) and (b) above an estimate of the maximum ground level concentration of each air contaminant emitted and the effect of such emissions depending on the deviation of the malfunction and the air contaminants emitted.

(d) In the event of maintenance, start-up/shutdown or malfunction conditions which result in emissions exceeding any applicable emission standard, the facility owner and/or operator shall take appropriate action to prevent emissions which will result in contravention of any applicable ambient air quality standard. Reasonably available control technology, as determined by the commissioner, shall be applied during any maintenance, start-up/shutdown or malfunction condition subject to this paragraph.

(e) In order to have a violation of a federal regulation (such as a new source performance standard or national emissions standard for hazardous air pollutants) excused, the specific federal regulation must provide for an affirmative defense during start-up, shutdowns, malfunctions or upsets.

Condition 14: Emission Unit Definition
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable State Requirement:6 NYCRR Subpart 201-5

Item 14.1:
The facility is authorized to perform regulated processes under this permit for:
Emission Unit: U-00APT
Emission Unit Description:
Emission Unit U-00APT includes the processing of concentrated ore to produce sodium tungstate solution by crushing, ball milling, alkali digestion, dilution and filtration. The sodium tungstate solution generated from the concentrated ore undergoes additional processing which includes purification, filtration, solution pH adjustment, filtration, ion exchange, vaporization/crystallization, filtration and ammonium paratungstate drying.

Building(s): APT

Condition 15: Visible Emissions Limited
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable State Requirement:6 NYCRR 211.2

Item 15.1:
Except as permitted by a specific part of this Subchapter and for open fires for which a restricted

burning permit has been issued, no person shall cause or allow any air contamination source to emit any material having an opacity equal to or greater than 20 percent (six minute average) except for one continuous six-minute period per hour of not more than 57 percent opacity.

****** Emission Unit Level ******

Condition 16: Emission Point Definition By Emission Unit
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable State Requirement:6 NYCRR Subpart 201-5

Item 16.1:
The following emission points are included in this permit for the cited Emission Unit:

Emission Unit: U-00APT

Emission Point: 00001
Height (ft.): 100 Diameter (in.): 18
NYTMN (km.): 4757.198 NYTME (km.): 198.494 Building: APT

Emission Point: 00002
Height (ft.): 80 Diameter (in.): 6
NYTMN (km.): 4757.198 NYTME (km.): 198.494

Emission Point: 00004
Height (ft.): 58 Diameter (in.): 3
NYTMN (km.): 4757.198 NYTME (km.): 198.494 Building: APT

Emission Point: 00005
Height (ft.): 58 Diameter (in.): 6
NYTMN (km.): 4757.198 NYTME (km.): 198.494 Building: APT

Emission Point: 00006
Height (ft.): 58 Diameter (in.): 6
NYTMN (km.): 4757.198 NYTME (km.): 198.494 Building: APT

Emission Point: 00007
Height (ft.): 58 Diameter (in.): 6
NYTMN (km.): 4757.198 NYTME (km.): 198.494 Building: APT

Emission Point: 00008
Height (ft.): 58 Length (in.): 18 Width (in.): 12
NYTMN (km.): 4757.198 NYTME (km.): 198.494 Building: APT

Emission Point: 00009
Height (ft.): 58 Length (in.): 18 Width (in.): 12
NYTMN (km.): 4757.198 NYTME (km.): 198.494 Building: APT

Emission Point: 0003A
Height (ft.): 58 Diameter (in.): 2

NYTMN (km.): 4757.198 NYTME (km.): 198.494 Building: APT

Emission Point: 0003B
Height (ft.): 58 Diameter (in.): 2
NYTMN (km.): 4757.198 NYTME (km.): 198.494 Building: APT

Condition 17: Process Definition By Emission Unit
Effective between the dates of 09/10/2012 and Permit Expiration Date

Applicable State Requirement:6 NYCRR Subpart 201-5

Item 17.1:
This permit authorizes the following regulated processes for the cited Emission Unit:

Emission Unit: U-00APT
Process: 002
Process Description:

Process 002 includes a purification process. Sodium tungstate filtrate solution containing soluble impurities is transferred into purification tanks where chemicals including magnesium sulfate, sodium sulfide, 10% sulfuric acid and recycle liquor from the hydrogen sulfide scrubber are added. The pH of the solution remains slightly alkaline as silicone containing compounds are precipitated and then filtered out. Filtrate is collected and transferred to the pH adjustment tanks where dilution water and more 10% sulfuric acid are added. The key purpose of pH adjustment is to precipitate virtually all of the molybdenum present as the pH is lowered to approximately 3.0. At this pH a reaction takes place which results in the release of hydrogen sulfide and some sulfur oxide. These vapors discharge to a hydrogen sulfide scrubber.

The hydrogen sulfide scrubber system is designed to eliminate 99 percent of the hydrogen sulfide from the pH adjustment reaction. Hydrogen sulfide itself is acidic and will react with a base. The incoming hydrogen sulfide gas is scrubbed in a packed tower with a solution containing 20% sodium hydroxide (caustic soda) and 12.5% sodium hypochlorite. The tower is maintained at a pH of 8.0 via a pH probe, transmitter, controller and control valve. Sodium hypochlorite is added to the mix via an Oxidation Reduction Potential (ORP) probe, transmitter, controller and control valve. The probe will maintain a minimum of 600 millivolts of potential or approximately 8 mg/l of free chlorine to react with sodium sulfide. Sodium sulfate and sodium chloride salts are produced and discharged to the Buffalo Sewer Authority.

Emission Source/Control: 00017 - Control
Control Type: GAS SCRUBBER (GENERAL, NOT CLASSIFIED)

Emission Source/Control: 521VC - Control
Control Type: VENT CONDENSER

Emission Source/Control: 522VC - Control
Control Type: VENT CONDENSER

Emission Source/Control: 00056 - Process

Emission Source/Control: 00521 - Process

Emission Source/Control: 00522 - Process

Emission Source/Control: 00571 - Process

Emission Source/Control: 00572 - Process

Emission Source/Control: 00573 - Process

Emission Source/Control: 00621 - Process

Emission Source/Control: 00671 - Process

Emission Source/Control: 00672 - Process

Emission Source/Control: 00673 - Process

Emission Source/Control: IONEX - Process

Item 17.2:
This permit authorizes the following regulated processes for the cited Emission Unit:

Emission Unit: U-00APT
Process: 003
Process Description:
Process 003 includes the crystallization process. Aqueous ammonia tungstate solution, containing excess unreacted ammonium hydroxide, is fed to a batch operated evaporator-crystallizer system. Here ammonium paratungstate (APT) is precipitated and recovered as wet cake. The APT cake is then dried. All of the units are heated and vaporize the water and ammonia present. Some ammonia is released during the crystallization as ammonium tungstate converts to crystallized APT. Solution containing crystallized APT is filtered through a vacuum filter. Dewatered ammonium paratungstate crystals are then dried at 250 to 300 degrees Celcius in a furnace. Furthermore, at times, the facility plans to make tungsten oxide (WO3) instead of APT through additional heating in a calcining furnace. The production of WO3 drives off the combined ammonia and results in the liberation of additional ammonia. Ammonia from this process is vented

to a dilute ammonia recovery process.

Ammonia (NH3) Recovery Process Description

Ammonia is used at Niagara Refining to pull tungsten containing molecules off a resin bed, in the production process of tungsten oxide. When the ammonia has done its job, the excess free ammonia is “boiled” off in the crysallizer and recovered. During crystallization, as the free ammonia is boiled off, a chemical reaction occurs to form Ammonium Paratungstate or APT. During this reaction, ammonia is also formed. A subsequent process, in which crystalline APT is calcined to form tungsten oxide also forms ammonia.

These two sources of ammonia together with the free ammonia boiled off from the crystallizer are captured for reuse. The system that does this process is called the Ammonia Recovery System or ARS.

The ARS consists of a purified water spray, a heat recovering heat exchanger, a condenser and a scrubber. The ammonia from the crystallizer goes through a spray bank where purified water helps absorb the ammonia during the early stages of the crystallization. From there, the ammonia/water stream enters a heat recovery heat exchanger that helps cool the ammonia/water stream and heats the plant hot water system. The stream then combines with tha calciner ammonia, and then enters a large condenser. All the water condenses and most of the ammonia is absorbed in the water. This stream (now called aqua ammonia) is later strengthened back to its original strength with fresh commercial aqua ammonia.

Any ammonia that does not absorb into the water at the condenser is sent to a scrubber (packed tower) where it is absorbed by purified water. This weak stream of aqua ammonia is also reused in the process and can be strengthened back to usable strength with commercial aqua ammonia.

Emission Source/Control: 00015 - Control
Control Type: AMMONIA SCRUBBING

Emission Source/Control: 08101 - Control
Control Type: PARTICULATE TRAP

Emission Source/Control: 08102 - Control
Control Type: PARTICULATE TRAP

Emission Source/Control: 841ME - Control
Control Type: MIST ELIMINATOR

Emission Source/Control: 842ME - Control
Control Type: MIST ELIMINATOR

Emission Source/Control: 00841 - Process

Emission Source/Control: 00842 - Process

Emission Source/Control: 00851 - Process

Emission Source/Control: 00852 - Process

Emission Source/Control: 00891 - Process

Emission Source/Control: 00892 - Process

Emission Source/Control: 00ARS - Process

Item 17.3:
This permit authorizes the following regulated processes for the cited Emission Unit:

Emission Unit: U-00APT
Process: 004
Process Description:

Process 004 includes the gaseous ammonia scrubbing system. Niagara Refining's ammonium paratungstate production operation includes a two-stage scrubbing system to remove gaseous ammonia vented from various process tanks containing aqueous solutions. Most of the ammonia emissions occur during transfers of vessel contents.

The primary vent system consists of a common manifolded vent header purged with dilution air. Vents for three of the tanks, which normally contain liquors higher in ammonia content, are separately manifolded and padded with nitrogen to eliminate flammability potential. This manifold is also tied into the primary vent system.

Sulfuric acid is used as the scrubbing media. This is ideal since it reacts very rapidly with ammonia and exhibits no vapor pressure. Product formed is soluble ammonium sulfate. Pumps, one for each system, recirculate acidic liquor over a venturi eductor where the gas and liquid intimately contact.

The scrubber system utilizes venturi eductors not only to achieve vapor-liquid contacting but also to pull the dilution air and ammonia vapors through the common vent system. Gases exiting the first scrubber system are drawn into the second scrubber where further contacting takes

place. The second scrubber will always be richer in acid content then the first. When the first scrubber is spent, valves are switched to reverse the scrubbing order. The No.1 scrubber is pumped out, re-charged with dilute sulfuric acid to become the No.2 scrubber. The previous No.2 scrubber becomes No.1.

Vent pipes from the scrubber tanks, only one open at any given time, combine into a single vent pipe and direct dilution air containing moisture and small amounts of unneutralized ammonia to the atmosphere.

Emission Source/Control: 00018 - Control
Control Type: AMMONIA SCRUBBING

Emission Source/Control: 00491 - Process

Emission Source/Control: 00492 - Process

Emission Source/Control: 00711 - Process

Emission Source/Control: 00870 - Process

Emission Source/Control: 00925 - Process

Emission Source/Control: 00926 - Process

Emission Source/Control: 00927 - Process

Emission Source/Control: 07101 - Process

Emission Source/Control: 07141 - Process

Emission Source/Control: 09212 - Process

Emission Source/Control: 09214 - Process

Item 17.4:
This permit authorizes the following regulated processes for the cited Emission Unit:

Emission Unit: U-00APT
Process: 005
Process Description:
Process 005 includes tank vents not vented to the scrubber control systems. There are several chemical solution tanks that do not vent through the scrubber control systems. These include two NaOCl, NaOH, H2SO4, MgSO4, Na2S, NH3Cl and two IT feed tanks. Some of these tanks vent directly to the roof and others vent through filter cartridges to remove particulates before being vented inside the building. Particulates are generated from the addition of dry raw material used to create the

desired tank solution. Other particulate emissions are generated from the transfer of dry material to the Blue/Yellow Tungsten screeners. Particulates from these sources are controlled by a baghouse before being vented inside the building.

Emission Source/Control: 08151 - Control
Control Type: FABRIC FILTER

Emission Source/Control: 08152 - Control
Control Type: FABRIC FILTER

Emission Source/Control: 980FC - Control
Control Type: PARTICULATE TRAP

Emission Source/Control: 990FC - Control
Control Type: PARTICULATE TRAP

Emission Source/Control: 00674 - Process

Emission Source/Control: 00675 - Process

Emission Source/Control: 00716 - Process

Emission Source/Control: 00717 - Process

Emission Source/Control: 00781 - Process

Emission Source/Control: 00782 - Process

Emission Source/Control: 00783 - Process

Emission Source/Control: 00911 - Process

Emission Source/Control: 00941 - Process

Emission Source/Control: 00942 - Process

Emission Source/Control: 00951 - Process
Design Capacity: 5,000 gallons

Emission Source/Control: 00953 - Process
Design Capacity: 5,000 gallons

Emission Source/Control: 00980 - Process

Emission Source/Control: 00990 - Process

Emission Source/Control: 08121 - Process

Emission Source/Control: 08122 - Process

Emission Source/Control: 09141 - Process

Emission Source/Control: 09142 - Process

Item 17.5:
This permit authorizes the following regulated processes for the cited Emission Unit:

Emission Unit: U-00APT
Process: 01A
Process Description:
Process 01A includes the initial processing of ore concentrate. Scheelite or Wolframite is transferred from bulk super sacs and sent to a ball mill. The ore concentrate solution is mixed with sodium hydroxide to leach a sodium tungstate solution which is later purified. Particulate emissions are generated from the transfer of dry material to the Scheelite ore hoppers. Particulates from these sources are controlled by a baghouse before being vented inside the building.

Emission Source/Control: 00027 - Control
Control Type: FABRIC FILTER

Emission Source/Control: 422VC - Control
Control Type: VENT CONDENSER

Emission Source/Control: 00211 - Process

Emission Source/Control: 00212 - Process

Emission Source/Control: 00221 - Process

Emission Source/Control: 00222 - Process

Emission Source/Control: 00241 - Process

Emission Source/Control: 00242 - Process

Emission Source/Control: 00413 - Process

Emission Source/Control: 00414 - Process

Emission Source/Control: 00422 - Process

Emission Source/Control: 00442 - Process

ATTACHMENT A2

EMISSIONS CALCULATIONS

ATTACHMENT A2
TABLE 1.0

NIAGARA REFINING LLC
TOTAL AMMONIUM PARATUNGSTATE PROCESS EMISSIONS
JANUARY 2012

Parameter	*Emission Rate Potential (ERP)* [1]		*Controlled Emissions* [2]	
	(lbs/hr)	*(tons/yr)*	*(lbs/hr)*	*(tons/yr)*
Hydrogen sulfide (H_2S)	25.1	41.2	0.25	0.4
Sulfur dioxide[3] (SO_2)	192.8	316.5	11.6	19.0
Ammonia[3] (NH_3)	35.9	157.0	2.2	9.4
Sulfuric Acid (H_2SO_4)	0.04	0.2	Not Controlled	Not Controlled
Sodium Hypochlorite (NaOCl)	0.02	0.10	Not Controlled	Not Controlled
Particulate (PM)	0.2	0.7	0.002	0.01

Notes:

[1]Refer to Tables 1.1-1.5.

[2]Controlled Emissions (m-tons/yr) = ERP * (1-Removal Efficiency)

H_2S controlled by scrubbing with removal efficiency of: 99%

SO_2 controlled by scrubbing with removal efficiency of: 94%

NH_3 controlled by scrubbing with removal efficiency of: 94%

[3]See attachment titled Fugitive Emissions for additional H_2S, SO_2 and NH_3 emissions which are considered minimal as they would not impact the total emissions.

ATTACHMENT A2
TABLE 1.1

NIAGARA REFINING LLC (AMMONIUM PARATUNGSTATE PROCESS)
PROCESS HYDROGEN SULFIDE (H_2S) EMISSIONS DETERMINATION
JANUARY 2012

Maximum H_2S Emissions [1,2]		*H_2S Annual ERP*	
(lbs/hr)	*(lbs/day)*	*(lbs/yr)*	*(tons/yr)*
25.1	225.5	82,322	41.2

Notes:

[1]Refer to attachment A6 H_2S Scrubber for chemistry used in determining lbs/hr.

[2]Total H_2S emitted per batch * Maximum of nine batches per day.

ATTACHMENT A2
TABLE 1.2

NIAGARA REFINING LLC (AMMONIUM PARATUNGSTATE PROCESS)
PROCESS SULFUR DIOXIDE (SO_2) EMISSIONS DETERMINATION
JANUARY 2012

	Maximum SO_2 Emissions[1]			*SO_2 Annual ERP*	
	(lbs/batch)	*(lbs/hr)*	*(lbs/day)*	*(lbs/yr)*	*(tons/yr)*
Total from SO_2 Scrubber[2]:	573.5	191.2	1720.6	628,015	314.0
Total from H_2S Scrubber[3]:	1.54	1.54	13.86	5,059	2.5
Total SO_2:		*192.8*			*316.5*

Notes:

[1]Refer to attachment A6 H_2S and SO_2 scrubbers for chemistry used in determining lbs/hr.

[2]Total SO_2 emitted per batch * Maximum of three batches per day.

[3]Total SO_2 emitted per batch * Maximum of nine batches per day.

ATTACHMENT A2
TABLE 1.3

NIAGARA REFINING LLC (AMMONIUM PARATUNGSTATE PROCESS)
AMMONIA (NH_3) EMISSIONS DETERMINATION
JANUARY 2012

	Maximum NH_3 Emissions[1]		*NH_3 Annual ERP*	
	(lbs/hr)	*(lbs/day)*	*(lbs/yr)*	*(tons/yr)*
Total from NH_3 Recovery System Scrubber:	25.7	616.0	224,825	112.4
Total from NH_3 Header System:	10.19	244.6	89,264	44.6
Total NH_3:	*35.9*			*157.0*

Notes:
[1]Refer to attachment A6 NH3 Scrubber and Ammonia Header Design & Ammonia Scrubber for chemistry used in determining lbs/hr.

ATTACHMENT A2
TABLE 1.4

NIAGARA REFINING LLC (AMMONIUM PARATUNGSTATE PROCESS)
EMISSION SUMMAARY FOR STORAGE VESSELS GREATER THAN 10,000 GALLONS
JANUARY 2012

Tank Parameters	ph Adjustment Sol.	ph Adjustment Sol.	NaOH Sol.	H_2SO_4 Sol.[1]	NaOCl Storage Tank
Identification Number:	6.7.4	6.7.5	9.4.1	9.1.1	9.5.1
Storage Capacity (gal):	10,150	10,150	10,500	10,500	9,200
Diameter (ft):	12'	12'	11' 10"	11' 10"	
Height (ft):	12'	12'	14' 0.75"	14' 0.75"	
Annual Throughput (gal):	10,213,440	10,213,440	875,510	514,560	753,330
Chemical Makeup:	89.8% Water 3.0% Na6H2W12O40 6.1% Na2SO4 1.1% other non-volatiles	89.8% Water 3.0% Na6H2W12O40 6.1% Na2SO4 1.1% other non-volatiles	50% NaOH 50% H20	93.19% H2SO4 6.81% H20	86.5% H2O 0.5% NaOH 3% NaOH 10% NaOCl
Vapor Pressure (psi):	No Vapor Pressure	No Vapor Pressure	No Vapor Pressure	0.33	
Total (lbs/hr):	*NA*	*NA*	*NA*	***0.04***	***0.02***
Total (lbs/yr):	*NA*	*NA*	*NA*	***331.3***	***193.22***
Total (tons/yr):	*NA*	*NA*	*NA*	***0.17***	***0.10***

Notes:

[1] H_2SO_4 & NaOCl emissions were determined using EPA Tanks Software 4.0.9d (Refer to attachment A8).

*All other storage vessels are considered trivial or exempt per NYSDEC Subpart 201-3:
Exempt: (25) Storage tanks, with capacities under 10,000 gallons, except those subject to either Part 229 or Part 233 of this Title.
Trivial: (44) Storage vessels, tanks and containers with a capacity of less than 750 gallons.

ATTACHMENT A2
TABLE 1.5

NIAGARA REFINING LLC (AMMONIUM PARATUNGSTATE PROCESS)
PARTICULATE EMISSIONS DETERMINATION
JANUARY 2012

Dry Materials	*Scheelite Ore*	*Sodium Sulfate*	*Magnesium Sulfate*	*Sodium Sulfide*	*Ammonium Chloride*	*Blue/Yellow Tungsten Oxide*
Total Usage :						
lbs/year:	5,793,715	1,971,000	536,254	112,623	402,234	5,108,722
tons/year:	2,897	986	268	56	201	2,554
Em. Factors (lbs/ton)[1]:	0.12	0.12	0.12	0.12	0.12	0.12
No. of Transfer Locations[2]:	1	1	2	2	2	3
Particulate Em. Rates[3]:						
Uncontrolled lbs/yr:	*347.6*	*118.3*	*64.4*	*13.5*	*48.3*	*919.6*
Uncontrolled tons/yr:	*0.16*	*0.05*	*0.03*	*0.01*	*0.02*	*0.42*
Controlled lbs/yr:	*3.48*	*5.91*	*0.64*	*0.14*	*0.48*	*9.20*
Controlled tons/yr:	*0.0017*	*0.0030*	*0.0003*	*0.0001*	*0.0002*	*0.0046*
Other Parameters:						
Control Devices[2]:	Baghouse	Scrubber	Filter Cartridges	Filter Cartridges	Filter Cartridges	Baghouse
Removal Efficiency:	99	95	99	99	99	99
Container:	Super Sac	Super Sac	Super Sac	20 Kg bags	20 Kg bags	250 Kg Drums
Mode of Transfer:	Dumped into hopper	Dumped into smelter	Screw Conveyer to Dissolver	Screw Conveyer to Dissolver	Screw Conveyer to Dissolver	Screw Conveyer to Screener to Drum
Exhaust Location:	Inside Building	Atmosphere	Inside Building	Inside Building	Inside Building	Inside Building

Notes:

[1]Particulate emission factor was obtained from AP-42 Table 11.24.2 for material handling and transfer of low moisture ore.

[2]Only dry material transfers are used in determining particulate emissions. Throughout the process most transfers move wet material only.

[3]Uncontrolled Emissions = Total Usage (tons/yr) * Em. Factor (lbs/ton) * No. of Transfer Points

ATTACHMENT A6

SCRUBBER ESTIMATES

Scrubber Flowrates Estimate for NYSDEC Permit

SO2 Scrubber

Gas out of Smelter to Scrubber:
(per batch, pounds)

(Major Assumption: O2 needed = combustion O2 + 3 X reaction O2)

N2	11,759.47	72.2%
O2	1,176.22	7.2%
H2O	1,130.67	6.9%
CO2	1,647.11	10.1%
SO2	573.53	3.5%
	16,286.99	100.0%

Assumption #2: The batch is 4 hours in length, and double the SO2 emissions come off between ½ hours and 2½ hours as the other hours

Time Period	N2	O2	H2O	CO2	SO2	
0-0.5 hours	1,469.93	170.93	141.33	189.375	47.78	2,019.34
0.5-1 hour	1,469.93	123.13	141.33	222.402	95.61	2,052.41
1-1.5 hours	1,469.93	123.13	141.33	222.402	95.61	2,052.41
1.5-2 hours	1,469.93	123.13	141.33	222.402	95.61	2,052.41
2-2.5 hours	1,469.93	123.13	141.33	222.402	95.61	2,052.41
2.5-3 hours	1,469.93	170.93	141.33	189.375	47.78	2,019.34
3-3.5 hours	1,469.93	170.93	141.33	189.375	47.78	2,019.34
3.5-4 hours	1,469.93	170.93	141.33	189.375	47.78	2,019.34
	11,759.47	1,176.22	1,130.67	1,647.11	573.53	

Assumption #3, Scrubber is designed to be 94% efficient with SO2, and 20% efficient with CO2
Will use largest hourly rate:

SO2 Scrubber Chemistry

This is a MAXIMUM calculation

Vapor into Scrubber:

	lb/hr
N2	2,939.87
O2	246.26
CO2	444.80
SO2	191.21
H2O	282.67
Total	4,104.81

Vapor from Scrubber — Assumption: SO2 Scrubber runs at 50°C

	lb/hr	
N2	2,939.87	
O2	246.26	
CO2	355.84	Assumption: 20% of the CO2 reacts with NaOH in scrubbing liquor
SO2	11.47	Assumption: SO2 scrubber is 94% efficient
H2O	289.45	Assumption: Not all water from reaction goes out with vapor; some condenses.
Total	3,842.89	is the maxium hourly rate per batch, with 3 batches run per day

Reaction #1:

	SO2	+ 2 NaOH	---->	Na2SO3	+ H2O
Mass	179.742	224.474		353.671	50.545
Mole Wt	64.066	40.005		126.060	18.016
Moles	2.806	5.611		2.806	2.806

Delta = 0.000

Reaction #2:

	CO2	+ NaOH	---->	NaHCO3
Mass	71.169	64.692		135.861
Mole Wt	44.010	40.005		84.015
Moles	1.617	1.617		1.617

Delta = 0.000

Reaction #3:

	CO2	+ 2 NaOH	---->	Na2CO3	+ H2O
Mass	17.792	32.346		42.855	7.283
Mole Wt	44.010	40.005		106.004	18.016
Moles	0.404	0.809		0.404	0.404

Delta = 0.000

Reaction #1 a:

	SO2	+ NaOH	---->	NaHSO3
Mass	179.742	112.237		291.954
Mole Wt	64.066	40.005		104.062
Moles	2.806	2.806		2.806

Delta = 0.025

Reaction #1 b:

	NaHSO3	+ NaOH	---->	Na2SO3	+ H2O
Mass	291.954	112.237		353.671	50.545
Mole Wt	104.062	40.005		126.060	18.016
Moles	2.806	2.806		2.806	2.806

Delta = -0.025

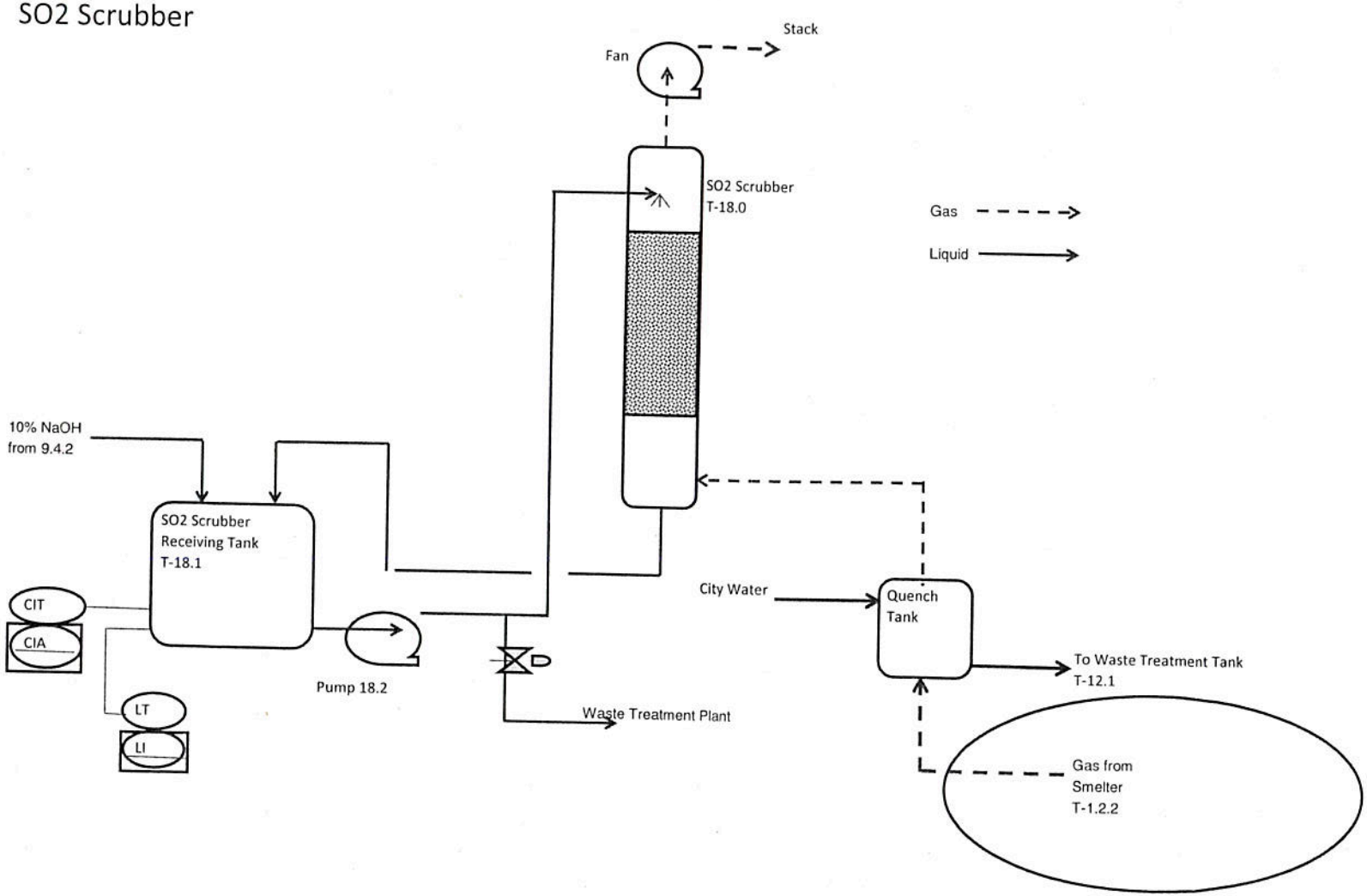
Vapor from Scrubber — Assumption: SO2 Scrubber runs at 50°C

This is an AVERAGE calulation for the entire day

	lb/day	
N2	35,278.40	
O2	3,528.67	
CO2	3,953.06	Assumption: 20% of the CO2 reacts with NaOH in scrubbing liquor
SO2	103.24	Assumption: SO2 scrubber is 94% efficient
H2O	3,473.38	Assumption: Not all water from reaction goes out with vapor; some condenses.
Total	46,336.76	

Physical Concept

SO2 Scrubber



Scrubber Flowrates Estimate for NYSDEC Permit

H2S Scrubber

Total Mass into pH 3 Reactors = 35,455.38 lbs.

Wt.% $Na_2S_2O_3$ =	0.011%	3.79 lbs.
Wt.% Na_2MoS_4 =	0.014%	4.81 lbs.
Wt.% Na_2S =	0.158%	56.02 lbs.

Reaction #1: (SO_2 Gas to Scrubber)

	$Na_2S_2O_3$ +	H_2SO_4	----->	Na_2SO_4 +	H_2O +	SO_2 +	S
Mass	3.79	2.35		3.41	0.43	1.54	0.77
MW	158.13	98.08		142.06	18.02	64.07	32.07
Moles	0.02	0.02		0.02	0.02	0.02	0.02

Delta = 0.00

Reaction #2: (Formation of Na_2S)

	Na_2MoS_4	----->	MoS_3 +	Na_2S
Mass	4.81		3.42	1.39
MW	270.21		192.15	78.06
Moles	0.02		0.02	0.02

Delta = 0.00

Reaction #3: (H_2S Gas to the Scrubber)

	Na_2S +	H_2SO_4	----->	H_2S +	Na_2SO_4
Mass	57.41	72.13		25.06	104.48
MW	78.06	98.08		34.08	142.06
Moles	0.74	0.74		0.74	0.74

Delta = 0.00

Assumption: #1: 1,000:1 dilution of the H_2S mass, for an air mix of 25,064.95 lbs. air per batch or
19,224.82 lbs. N_2 per batch and 5,840.13 lbs. O_2 per batch.

Gas out of pH3 Reactors to Scrubber:
(per batch, pounds)

N2	19,224.82
O2	5,840.13
H2S	25.06
SO2	1.54
H2O	30.17 Assumption: a ratio of 1.204 H2O:H2S goes out as vapor
	25,121.72

Assumption: It takes 30 minutes to add acid charge and make H2S
Assumption: The reaction is doubled in a 15 minute interval

Time Period	N2	O2	H2S	SO2	H2O
0-5 minutes	3,204.14	973.36	2.78	0.171	3.35
5-10 minutes	3,204.13	973.36	5.57	0.342	6.70
10-15 minutes	3,204.13	973.36	5.57	0.342	6.70
15-20 minutes	3,204.13	973.36	5.57	0.342	6.70
20-25 minutes	3,204.13	973.36	2.78	0.171	3.35
25-30 minutes	3,204.13	973.36	2.78	0.171	3.35
	19,224.81	5,840.13	25.06	1.54	30.17

H2S Scrubber Chemistry

This is a MAXIMUM calculation

Assumption: Scrubber runs at 20°C

Vapor into Scrubber:	lb/hr	Vapor from Scrubber:	lb/hr	
N2	19,224.81	N2	19,224.81	
O2	5,840.13	O2	5,840.13	
H2S	25.06	H2S	0.25	Assumption: Scrubber is 99% efficient
SO2	1.54	SO2	0.02	Assumption: Scrubber is 99% efficient
H2O	30.17	H2O	3.02	Assumption: Water comes out of scrubber at 10% of vapor inlet mass (most is condensed)
	25,121.71		25,068.22	is the maxium hourly rate per batch, and this is being emitted over a 15 minute period. There are 9 batches run per day

Note: the pounds per hour here are for a time period of 15 minutes for peak rate

Reaction #1:

	H2S +	2 NaOH	---->	Na2S +	2 H2O
Mass	24.809	58.242		56.822	26.229
Mole Wt	34.082	40.005		78.060	18.016
Moles	0.728	1.456		0.728	1.456

Delta = 0.000

Reaction #2:

	SO2 +	2 NaOH	---->	Na2SO3	+ H2O
Mass	1.525	1.904		3.000	0.429
Mole Wt	64.066	40.005		126.060	18.016
Moles	0.024	0.048		0.024	0.024

Delta = 0.000

Reaction #2 a:

	SO2 +	NaOH	---->	NaHSO3
Mass	1.525	0.952		2.476
Mole Wt	64.066	40.005		104.062
Moles	0.024	0.024		0.024

Delta = 0.000

Reaction #2 b:

	NaHSO3	+ NaOH	---->	Na2SO3	+ H2O
Mass	2.476	0.952		3.000	0.429
Mole Wt	104.062	40.005		126.060	18.016
Moles	0.024	0.024		0.024	0.024

Delta = -0.000214

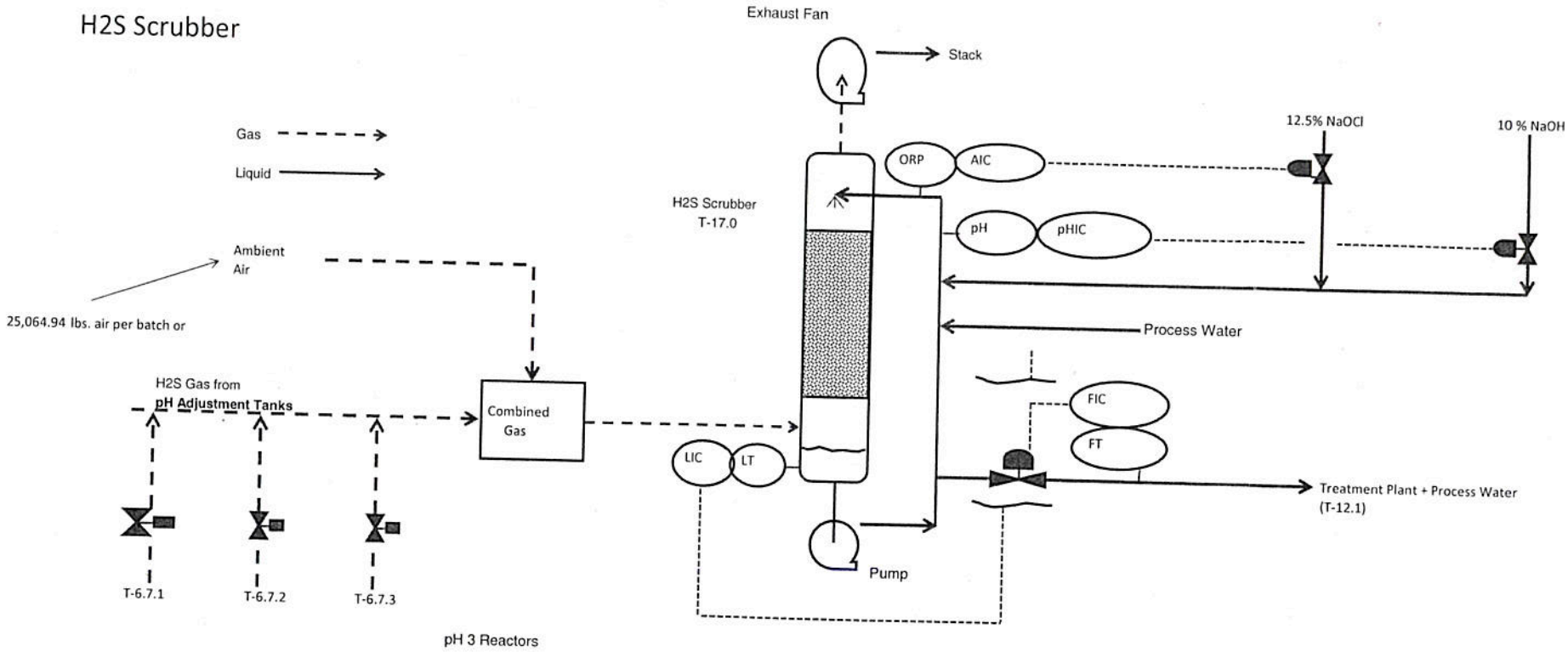
Vapor from Scrubber: Assumption: Scrubber runs at 20°C

This is an AVERAGE calculation for the entire day

	lb/day	
N2	173,023.27	
O2	52,561.18	
H2S	2.26	Assumption: Scrubber is 99% efficient
SO2	0.14	Assumption: Scrubber is 99% efficient
H2O	27.15	Assumption: Water comes out of scrubber at 10% of vapor inlet mass (most is condensed)
	225,613.99	

Physical Concept

H2S Scrubber



Scrubber Flowrates Estimate for NYSDEC Permit

NH3 Scrubber

NH3 & H2O Vapor Out of Crystallizers (per batch)

Batch Input to Crystallizer

Material

H2O	41,519.06
NH3	1,600.68
NH4Cl	488.70
(NH4)2WO4	8,212.21
(NH4)3VO4	64.31
Total	51,884.95

Assumption: 2.95 lbs. of ammonia remain in the crystals

NH3 Vapor:

1. "Free Ammonia" boiled off = 1,597.73 lbs

2 "Chemical Ammonia" = 574.585 lbs. 2,172.32 Total lbs. per batch
(Below)

Reaction:

	12 (NH4)2WO4	----->	(NH4)10W12O41.5H2O	+	14 NH3	+ 2 H2O
Mass	8,212.206		7,550.796		574.585	86.826
MW	284.000		3,133.520		17.032	18.016
Moles	28.916		2.410		33.736	4.819

Delta = 0.000

H2O Vapor:

H2O in charge :	41,519.06
H2O made in reaction:	86.83
H2O remaining in batch:	9,255.01
	32,350.87 Total lbs per batch

There will be 2.4 batches per day, so:

Vapor to Ammonia Recovery System (ARS):

	lb/day
NH3	5,213.56
H2O	77,642.10
	82,855.66

NH3 & H2O Vapor Out of Calciners

Ammonia/Water Vapor		X 24 hrs
N2	22.27 PPH	534.40 lbs.
NH3	39.42 PPH	946.04 lbs.
H2O	75.98 PPH	1,823.44 lbs.
	137.66 PPH	3,303.89 lbs.
	Steady Flow	

Total from both systems to the ARS:

	lbs./day
N2	534.40
NH3	6,159.60
H2O	79,465.54
	86,159.54

Ammonia to Scrubber:

	lbs./day	
NH3	615.96	Assumption: (90% of the NH3 dissolves in the condensate)

Off-Gas from Scrubber

This is an AVERAGE calculation for the entire day

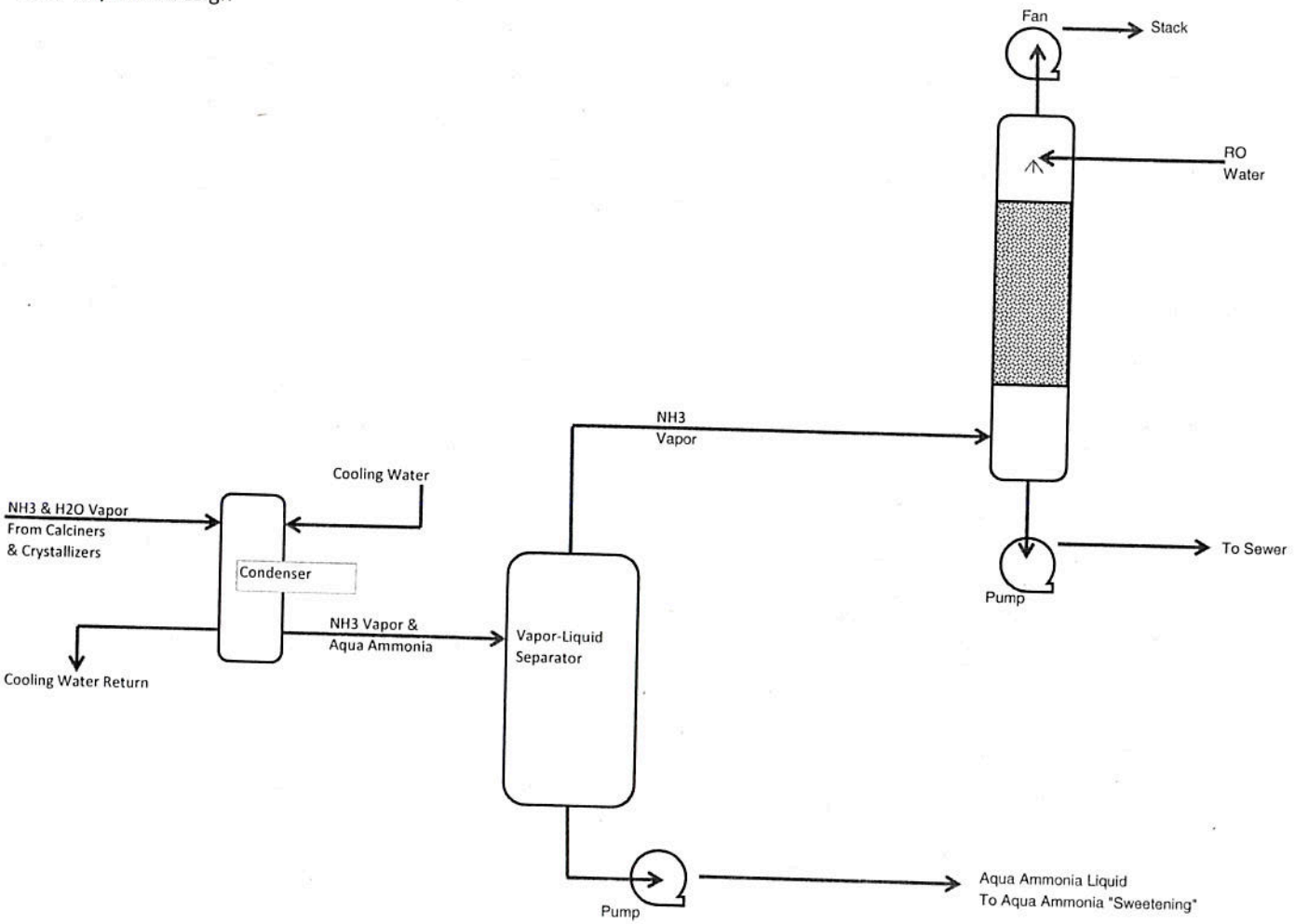
	lbs./day	
N2	534.40	
NH3	36.96	Assumption: the ARS is 94% efficient
H2O	38.19	Assumption: most of the H2O is condensed in the scrubber
	942.16	

NOTE: I do not have a maximum flow calculated, as this system is not designed yet.

Physical Concept

NH3 Recovery System

Ammonia Recovery System
Croll-Reynolds Design



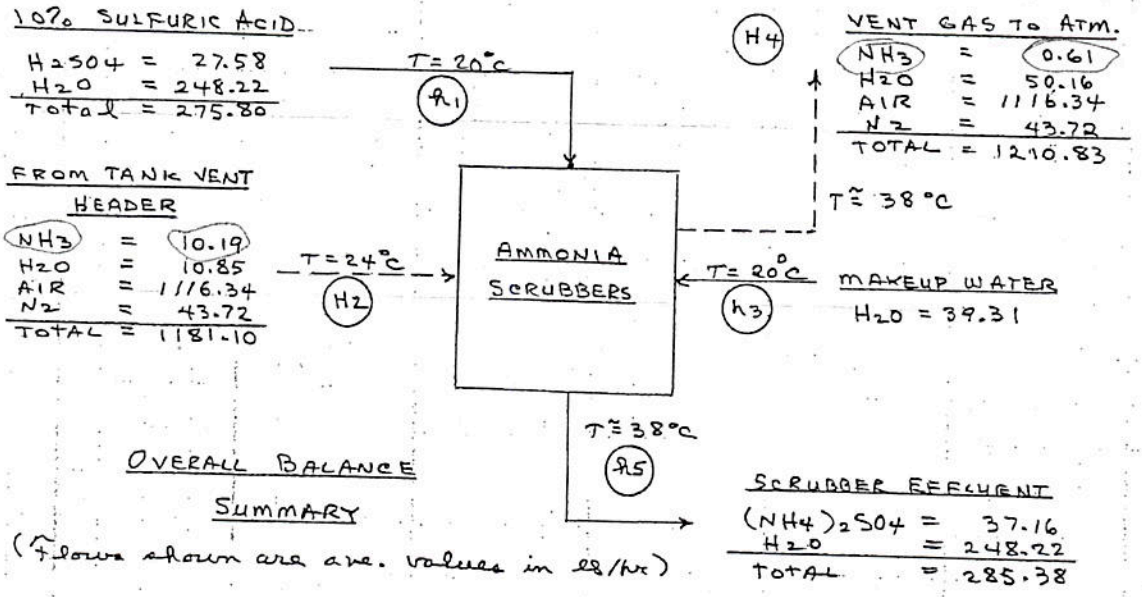
CONESTOGA-ROVERS & ASSOCIATES

PROJECT No.: 630770 60
PROJECT NAME: NIAGARA REFINING NH3 SCRUBBERS
DESIGNED BY: R.W. FOSTER

DATE: 1/12/12
CHECKED BY: RPM
PAGE 1 OF 3

NIAGARA REFINING NH3 VENT SCRUBBERS

MATERIAL & ENERGY BALANCES



OVERALL BALANCE SUMMARY

(Flows shown are ave. values in lb/hr)

This balance is based on the peak NH_3 flow venting during the simultaneous filling of three tanks containing aqua NH_3 in Niagara Refining's planned ammonium paratungstate (APT) production operations. See also separate Excel spreadsheet.

NH_3 Conversion = 94%

$$\underset{17.032}{2\,NH_3\,(g)} + \underset{98.082}{H_2SO_4\,(aq.)} \longrightarrow \underset{132.146}{(NH_4)_2SO_4\,(aq.)}$$

(9.58 lb NH_3; 27.58 lb H_2SO_4; 37.16 lb $(NH_4)_2SO_4$)

ΔH_{s0}: $2(-11.04)$ $\quad -216.90 \quad -283.34$

$$\Delta H_R = -283.34 + 2(11.04) + 216.9$$

$$\Delta H_R = -44.36 \text{ cal/gm mol } (NH_4)_2SO_4 \text{ or}$$

$$\Delta H_R = \frac{-44.36 \times 1800}{132.146} = -604.24 \text{ Btu / lb } (NH_4)_2SO_4$$

Total Reaction Heat = $604.24 \times 37.16 = 22\,454$ Btu/hr

Pump Heat Input

Two pumps will circulate scrubber liquor over the venturi scrubbers. Size for 60 gpm @ 200 ft each. Power Required ≅ 8 HP each.

Heat Equivalent = (2)(8)(42.44)(60) = 40742 Btu/hr

Conductive Heat Losses

Take as 10% of combined reaction + pump heat input.
This is 0.10 (22454 + 40742) = 6320 Btu/hr

Calculate Equilibrium Temperature & Water in Vent Gas

Use enthalpies & take h = 0 @ 20°C.
Therefore, h_1 & h_3 = 0.

(H2)

H_{NH3}	= (10.19)(0.52)(24-20)(1.8)	=	38
H_{H2O}	= (10.85)(1055.5) + 10.85(0.45)(24-20)(1.8)	=	11487
H_{air}	= (1116.34)(0.25)(24-20)(1.8)	=	2009
H_{N2}	= (43.72)(0.25)(24-20)(1.8)	=	79
Total	=	=	13613 Btu/hr

Determine Equilibrium Temperature by Trial & Error

Try T = 37.7 °C (final trial)
P'_{H2O} = 48.7 mm Hg (vapor pressure)
P_t = 1 atm = 750 mm Hg (WNY)

$$\frac{n_{H2O}}{n_{noncond}} = \frac{P'_{H2O}}{\bar{P}_{noncond}}$$

$$\frac{n_{H2O}}{\frac{1116.34}{29} + \frac{43.72}{28.02} + \frac{0.61}{17.032}} = \frac{48.7}{750 - 48.7}$$

n_{H2O} = 2.784 lb mol/hr

This equates to 50.16 lb/hr H_2O in vent gas.

Calculate H4 & h5 Using this Temperature & Water Flow

(H4)

H_{NH3}	=	$(0.61)(0.52)(37.7-20)(1.8)$	= 10
H_{H2O}	=	$(50.16)(1055.5) + (50.16)(0.45)(37.7-20)(1.8)$	= 53663
H_{air}	=	$(1116.34)(0.25)(37.7-20)(1.8)$	= 8892
H_{N2}	=	$(43.72)(0.25)(37.7-20)(1.8)$	= 348
Total	=		= 62913 Btu/hr

(h5)

$h_5 = (285.38)(0.86)(37.7-20)(1.8) = 7819$ Btu/hr

Heat Balance Check

$h_1 + H_2 + h_3 + \Delta HR + Q_{pump} = H_4 + h_5 + Q_L$

$0 + 13613 + 0 + 22454 + 40742 = 62913 + 7819 + 6320$

$76809 \neq 77052$ (?)

Very Close

Complete overall balance schematic on P-1.

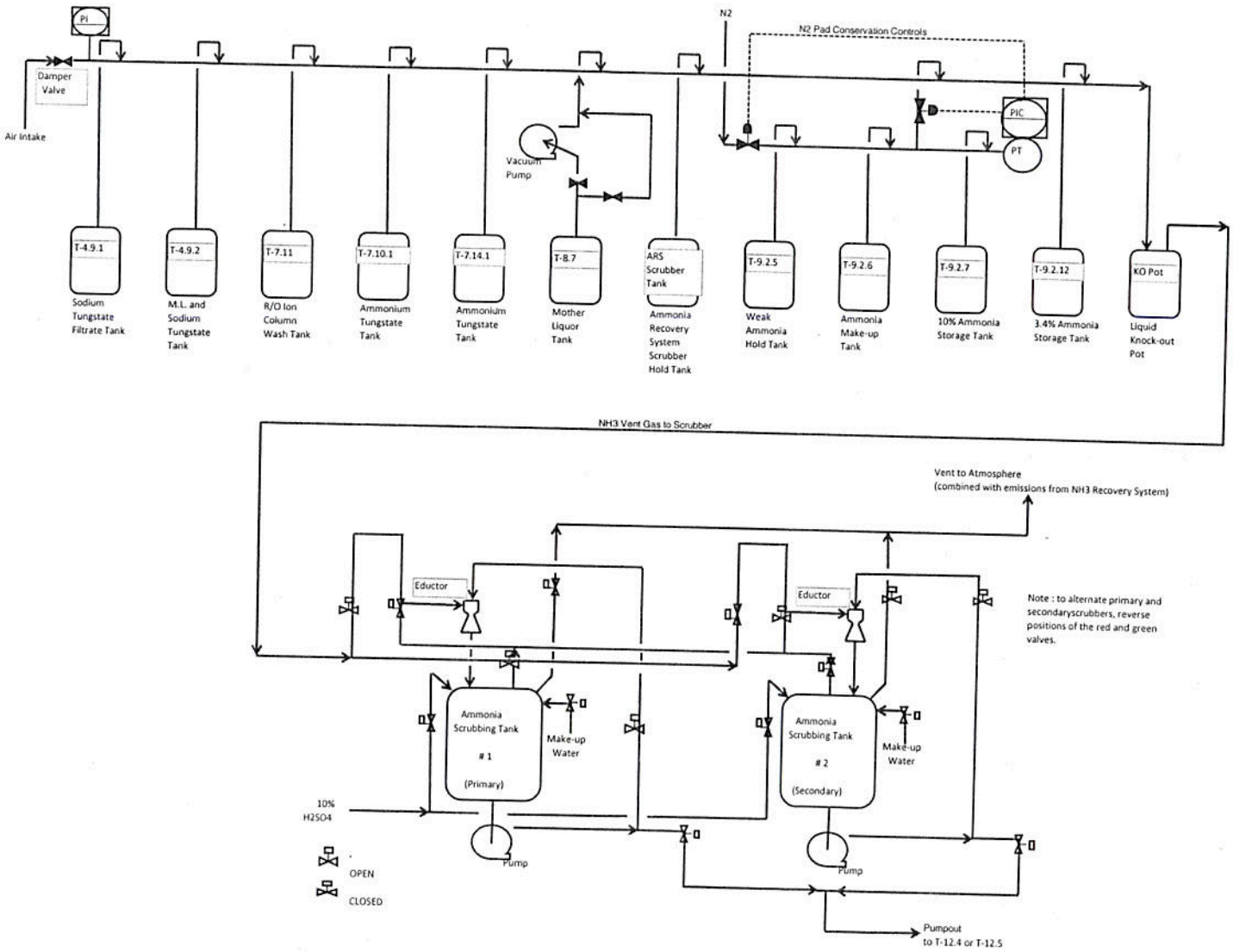
Volumetric Flow: Vent Gas to Atmosphere

$$\text{Mol/Hr} = \frac{0.61}{17.032} + \frac{50.16}{18.016} + \frac{1116.34}{29} + \frac{43.72}{28.02} = 42.875$$

$$\text{ACFM} = \frac{(42.875)(10.73)(37.7+273.2)(1.8)}{\left(\frac{750}{760}\right)(14.7)(60)} = 295.8$$

$$\text{Average M.W.} = \frac{1210.83}{42.875} = 28.241$$

Ammonia Header Schematic & Ammonia Scrubbers



ATTACHMENT A7

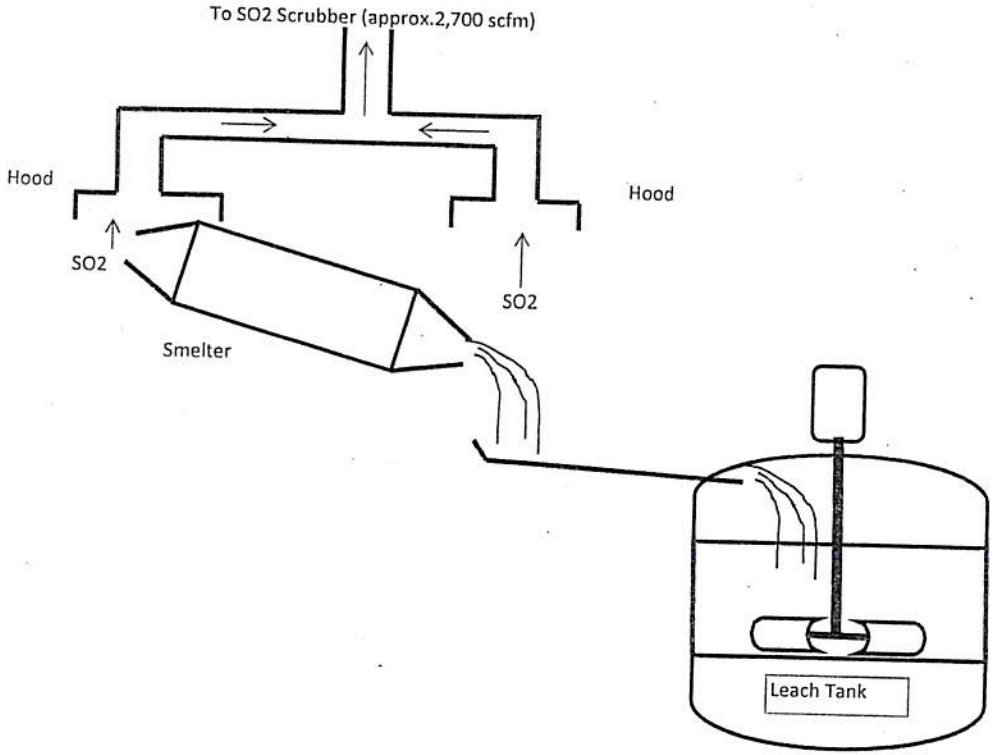
FUGITIVE EMISSIONS

Fugitive Emissions

H2S

None, there is no opening in the system

SO2



Assumption: SO2 generation from the reaction stops when the burner to the smelter is turned off
Assumption: There is approximately 10 ppm/sec. SO2 emitting from the molten Sodium Tungstate, which is SO2 "stuck" in the mas:
Assumption: The hood is 80% efficient, so it captures 80% of the SO2 (8 ppm)
Assumption: 2 ppm/sec. is lost to the atmosphere as "fugitive emissions.'

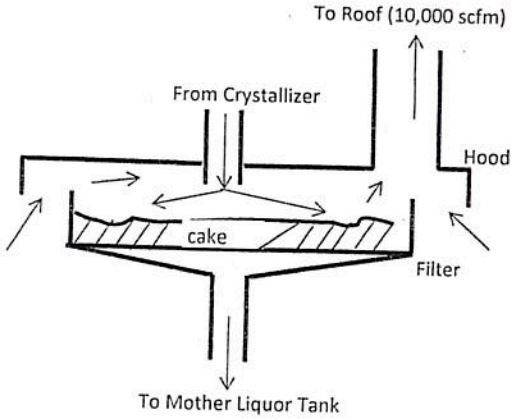
Assumption: This lasts for 15 minutes during a "dump" and 1 hour while charging scrap/Na2SO4
With three batches per day, the amount of SO2 that is lost is the following

2 ppm = 0.000002 lbs

Time = 1.25 hrs X 60 min/hr X 60 sec/min X 3 batches per day
= 13,500 seconds/day

Fugitive Mass Emitted = 0.027 lbs per day
= 8.91 lbs per year (based on a 330 day year, or 90% operating factor)

NH3



Assumption: There is approximately 20 ppm/sec. NH3 emitting from the filter cake
Assumption: The hood is 80% efficient, so it captures 80% of the NH3 (16 ppm
Assumption: 4 ppm/sec. is lost to the atmosphere as "fugitive emissions."

Assumption: This lasts approximately 1 hour for the filtration, and the washing
Assumption: After the washing, the NH3 is washed into the mother liquor; there is no more NH3 emission

24 ppm = 0.000024 lbs.
6 ppm = 0.000006 lbs.

Time = 1.0 hrs X 60 min/hr X 60 sec/min X 2.4 batches per day
= 8,640 seconds/day

Fugitive Mass Emitted = 0.207 lbs per day to the roof
= 68.429 lbs per year (based on a 330 day year, or 90% operating factor

Fugitive Mass Emitted = 0.052 lbs per day to the plant atmosphere
= 17.107 lbs per year (based on a 330 day year, or 90% operating factor

Fugitive Mass Emitted = 0.259 lbs per day total
= 85.536 lbs per year (based on a 330 day year, or 90% operating factor

Airflow = 10,000 cfm
= 26.385 lb moles/min
= 764.380 lbs./min

Concentration of NH3 in air up the stack = Non Detectable