To: Director From: Peter Lawrie		Date: June 22, 2016 File: PA-8808 (Job 341684)
Application: Permit Amendment		Pre-Application Date;
BCENIC 221110 Secondary 562930	Production Capacity: 67 Megawatt electricity	Application Date:
Applicant: Atlantic Power Preferred Equity Ltd.		
Location of Facility: Williams Lake		

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1. Amendment Request

The Permittee has requested the following amendments to permit PA-8808.

Section	Proposed Amendment
1.3	Delete Ash Silo Vent
2.7	Add on-site storage of fuels
2.7.1	Increase treated wood component from 5% of the total biomass fuel supply calculated on an annual basis to 50% of the total biomass fuel supply on an annual basis.
2.7.1	Delete clause "permittee may request authorization to increase the proportion of treated wood residue incinerated by submitting a request to the Director."
2.7.2	Authorize the acceptance and incineration of up to 872 L of hydrocarbon contaminated materials originating from accidental spills. The waste oil must meet provisions of the Hazardous Waste Regulation.
2.7.3	Expand the scope of materials that may be burned to include non-hazardous biomass wastes originating within the Cariboo Regional District and may contain clean construction and demolition waste.
2.7.3	Allow for the inclusion of clean biomass from logging and landscaping works without limiting the sources to those within the CRD.
3.2	Clarify the definition of the 90 day operational parameter period prior to an emission test to 90 operating days.
3.3	Delete requirement to maintain and audit CEMs in accordance with Canada EPS 1/PG/7 protocols.

2. Background

2.1. Project Description

The Atlantic Power Williams Lake facility (APWL) seeks to retain a stable long term fibre-fuel supply for continued operation. Recent decreases in allowable annual cut and increased competition from pellet plants and pulp mills have diminished the amount of cost effective traditional fuels available. Increasing the amount of rail tie material is one of the alternatives that APWL has been considering in addition to other sources such as logging debris.

2.2. Permit History

Permit issued. February 20, 1991 Last amended November 20, 2012.

Facility began commercial operations in 1993.

On June 19, 1995 BC Rail and the proponent at the time, North West Energy were advised by letter that “no amendment, or other authorization is needed for NW Energy

(Williams Lake) Corp. to utilise hog fuel derived from scrap railway ties. This appears to have been in error.

Permit version April 18, 1991 was amended January 17, 2003 to include conditions for using treated wood as feedstock.

The original 2003 amendment allowed for the incineration of rail ties through the following clause:

> Subsection 2.7 Conditions for Incinerating Treated Wood
>
> The Permittee shall only accept and incinerate untreated wood residue or wood residue treated with pentachlorophenol (PCP) or creosote preservatives. The treated wood waste shall be well mixed with untreated wood waste prior to incineration. The Permittee shall ensure the wood residue treated with heavy metal derived preservatives are not delivered to the site nor incinerated.

The company's predecessor (NW Energy) conducted test runs of 100% rail tie fuel in 2001 to determine feasibility of tie incineration. The trial emission testing was performed by A. Lafranco and associated and the results are contained in the Emission Survey Report, Regular Wood Waste and Rail Tie Wood Waste: April 2001(the Lafranco Report). The testing at the time noted no increases in particulate, trace metals, dioxin and furans (PCDD/PCDF) and polycyclic aromatic hydrocarbons (PAH). Increased levels of Chlorophenols (0.01 to 0.09 $\mu g/m^3$) were an order of magnitude below the emission standards of the time of 1 $\mu g/m^3$. Sulphur Oxides (as SO_2) and Hydrogen Chloride (HCL) emissions increased significantly. SCREEN 3 modelling was applied using the stack test data for SO_2 (16.54 g/sec) and HCl (5.75 g/sec) for both simple, flat and complex terrain. Under the complex terrain model, localized levels in excess of the ambient air objectives could be expected within 280 meters of the facility. The memorandum identified that SCREEN 3 modelling is conservative and will tend to predict "worst case" levels. It also noted that the burn was done using 100% rail ties and it was anticipated that the annual percentage of total fuel makeup would be approximately 3%.

The discharge limits from the boiler were not changed as a result of the inclusion of PCP and Creosote treated rail ties nor was a cap imposed on the additional contaminants associated with rail ties.

A subsequent letter to a successor company (EPCOR Utilities Inc.) clarified that the facility was authorized to incinerate materials containing creosote and PCP but not mixtures containing metal derived preservatives.[i]

The permit was amended October 21, 2010 to put restrictions on the authorized fuel and amount of treated material incinerated.

Included in the amendment was a limit on the amount of treated wood to 5%.

> 2.7 Authorized Fuel

The authorized fuel is untreated wood residue unless authorized below or the approval of the Director is obtained and confirmed in writing.

2.7.1 The incineration of wood residue treated with creosote and/or creosote-pentachlorophenol blended preservative (treated wood) is authorized subject to the following conditions:

- The treated wood component shall not exceed 5% of the total biomass fuel supply calculated on an annual basis.
- The treated wood waste shall be well mixed with untreated wood prior to incineration;
- The incineration of wood residue treated with metal derived preservatives is prohibited;
- The Permittee shall measure and record the weight of treated wood residue received. The source of the wood shall be recorded. The Permittee may request authorization to increase the proportion of treated wood residue incinerated by submitting a request in writing to the Director.

2.7.2 The incineration of hydrocarbon contaminated wood residues originating from accidental spills is authorized provided that written approval in accordance with section 52 of the hazardous Waste Regulation has been received by the responsible party for disposal of the waste by incineration. The Permittee shall maintain a record of the quantity, date received, and identify the responsible party of hydrocarbon contaminated residues originating from accidental spills.

2.73. Vegetative residues (i.e. foliage, invasive weeds, diseased plants, etc.) seedling boxes, and paper records are authorized as fuel provided such materials constitute less than 1% of the daily feed into the boiler. Non-biomass contaminants (e.g. plastic, glass metal) shall not exceed 1% of the daily feed into the boiler.

The annual cap under 2.7.1 was a result of an increased amount of complaints relating to:

1. Rail tie chipping and storage in downtown Williams Lake;
2. Spontaneous combustion of fibre piles on site;
3. Disposal of ash from incineration of treated wood; and
4. Emissions of treated wood compounds from the power plant.[ii]

The same amendment included provisions for requiring storm water and fugitive dust management plans and increased the allowable flow from the boiler from 100 m^3/second to 110 m^3/second to address minor flow exceedances. This increase in flow without a proportional decrease in concentration had the potential to increase the net particulate discharge by 7.8% (19.8kg/hr) and NOx by 10% (11.5 kg/hr).

Further administrative amendments (ownership and name) were made February 20, 2012 and November 21, 2012.

3. Consultation

Consultation Report Acceptable: Yes [x] No [ ] N/A [ ]

Environmental Quality Section Consulted: Yes [x] No [ ] N/A [ ]

APWL received consultation instructions from the Ministry August 6th and 7th 2015 and submitted a draft consultation plan September 29, 2015. After minor revisions to the plan, Environmental Protection Notice and cover letter the official consultation process began October 9, 2015.

Required Consultation

	Concerned Party	Contacted	Concerns Raised?
1	Nearest neighbours	Oct 13, 2015	No
2	Sign at entranceway of facility	Oct 6, 2015	N/A
3	EPN in Local Paper	Oct 14, 2015	Yes
4	City of Williams Lake	October 13, 2015	No
5	Cariboo Regional District	October 13, 2015	No
6	Interior Health	October 13, 2015	Yes
7	Cariboo Chilcotin Conservation Society	October 13, 2015	Yes
8	Neskonlith Indian Band	October 13, 2015	No
9	Tsilqot'in National Government	October 13, 2015	No
11	Tsilhqot'in Nation-Toosey Indian Band	November 2, 2015	No
12	Williams Lake Indian Band	October 13, 2015	Yes
13	BC Gazette	October 15, 2015	N/A

Parties received a consultation package consisting of a stake holder cover letter dated October 8, 2015, a copy of the original application cover letter dated July 10, 2015, a two page application synopsis, the Environmental Protection Notice and a project description entitled "Fact Sheet: APWL Williams Lake Renewal Project." The October 8, 2015 cover letter directed stake holders to the Williams Lake Library where copies of the RWDI Dispersion Modelling Report, APWL Williams Lake Renewal Project Fact Sheet, a copy of the current permit (November 20, 2012), amendment application for Permit 8808 and Environmental Protection Notice were provided to the Library October 13, 2015.

APWL also gave a presentation to the Williams Lake Air Quality Round Table November 19, 2015.

3.1. Pre-consultation

Prior to the official consultation period the proponent conducted a number of outreach activities to inform stakeholders of the proposed project. Included in the pre-consultation were:

Date	Organization	Name	Position	Activity
03-Jun-15	BC Government	Donna Barnett	MLA	Meeting
21-Jul-15	BC Government	MLA's Env, JTST, Local		Presentation
05-May-15	Cariboo Region District	Al Richmond	Chair	Meeting
05-May-15	Cariboo Region District	Janice Bell	CAO	Meeting
12-Jun-15	Cariboo Region District	CRD Board	Directors	Meeting
04-May-15	City of Williams Lake	Walt Cobb	Mayor	Meeting
15-Sep-15	City of Williams Lake	City Council	Council	Presentation
17-Jun-15	Public Meeting (Ad in Williams Lk Tribune)	70 members of public	General	Presentation
07-Jul-15	Rotary Club-Daybreak	16 members		Presentation
08-Jul-15	Rotary Club-Daytime	25 members		Presentation
24-Sep-15	Williams Lake Chamber of Commerce	Commerce Members		Presentation
18-Aug-15	Williams Lk Field Naturalists Club	Cathy Koot		Invitation to meet

3.2. First Nations Consultation

The proponent undertook a number of First Nations consultative activities before, during and after the public notification period mandated by the Public Notification Regulation. Included were the following activities:

Date	Organization	Name	Position	Activity
01-Oct-15	Alkali Lake Band	Community Reps		Update presentation
07-Jul-15	Canim Lake Indian Band	Don Dixon		Informal Meeting
07-Jul-15	Canoe Creek Indian Band	2 Staff		Informal Meeting
20-Aug-15	Neskonlith FN			Invitation to meet
30-Sep-15	Neskonlith FN			Invitation to meet
14-Oct-15	Neskonlith FN			Invitation to meet
16-Oct-15	Neskonlith FN	Chris Ortner	Interim Natural Resources Coordinator	Invitation to meet
16-Oct-15	Neskonlith FN	Chris Ortner	Interim Natural Resources Coordinator	Phone call
05-May-15	Soda Creek Indian Band	Julia Banks	Natural Resources Officer	Meeting
31-Aug-15	Toosey Indian Band			Invitation to meet
30-Sep-15	Toosey Indian Band			Invitation to meet
22-Oct-15	Toosey Indian Band	Violet Tipple		Meeting with council delayed.
08-Jul-15	Tsilhqot'in National Government	Luke Doxtator	TNG Stewardship Coordinator	Informal Meeting
05-May-15	Williams Lake Indian Band		Band Staff	Meeting
30-Sep-15	Williams Lake Indian Band	Band Staff		Meeting
22-Oct-15	Williams Lake Indian Band	Band Staff		Meeting
7-Jan-16	Williams Lake Indian Band	Band Government		Signed Community Benefits Agreement.
22-Feb-16	Williams Lake Indian Band	Band Government	Chief Ann C. Louie	Conditional Letter of Support

3.2.1. Williams Lake Indian Band

There was active consultation between the proponent and the Williams Lake Indian Band. The Band retained Teranis Consulting Ltd. (Teranis) to review the Lafranco report and the RWDI Air Inc. modelling report and provided questions and commentary to the proponent. RWDI on behalf of the proponent responded in kind. The Band and APWL signed a community benefits agreement January 7, 2016. A letter of support from Chief Ann C. Louie was provided on February 22, 2016 stating the band supported the proposal provided the proponent can satisfy all environmental standards and any other reasonable requests imposed by the province of British Columbia. A draft consultation and Technical Report was provided to the band March 14, 2016.

3.2.2. Toosey Indian Band and Tsilhqot'in National Government

The proponent provided a copies of the consultation package to the Toosey Indian Band and the parent organization, the Tsilhqot'in National Government. There were multiple attempts to arrange a meeting with the Chief and Council of the Toosey Indian Band without success. No feedback was provided by the band or by the Tsilhqot'in National Government.

The power facility is located within Zone A of the Tsilhqot'in Stewardship Agreement (2014-2017). If a project is within Zone A, engagement is not required if there are no significant:

- Fish and wildlife impacts;
- Water and land impacts;
- Land alteration;
- Major policy changes;
- Access structures;
- Aboriginal activities or rights displaced; or
- Impacts on previous aboriginal rights or title claims.

None of the above criteria are associated with this application therefore engagement with Tsilhqot'in is not required.

3.2.3. Neskonlith Indian Band and Shuswap Nation Tribal Council

The Neskonlith Indian Band received copies of the consultation package and multiple attempts were made to meet with band representatives without success. No feedback was received. Currently there is not a strategic engagement agreement between the province and the Shuswap Nation Tribal Council.

3.2.4. Other First Nations Groups

In addition to the First Nations bodies identified for required consultation the following groups received consultation packages:

- Xatsull First Nation-Soda Creek Indian Band;
- Stswecem'c Xgat'tem-Canoe Creek Indian Band;
- Stswecem'c Xgat'tem-Canim Lake Indian Band; and
- Stswecem'c Xgat'tem-Esk'temc.

No responses were received.

3.3. Agency Consultation

3.3.1. Interior Health

Greg Baytalan, Air Quality Specialist with Interior Health responded to the proponent on October 28, 2015 with specific questions with regards to:

1. Justification for removal of EC protocol EPS 1/PG/7.
2. Operational conditions suitable to destroy chemicals (e.g. PCDD/F).
3. Impact of diesel fuel combustion on sulphur emissions.
4. Procedures to ensure that demolition waste is clean and free of non-biomass.
5. Provisions for particulate reduction.

This is a place holder
Interior Health was an active participant in the process and received both the proponent's technical assessment reports along with the Ministry's Assessment and draft permit. The final outcome was…….

3.3.2. Worksafe BC

Consultation with Worksafe BC was not required as part of this amendment application. The proponent has committed to conducting industrial hygiene monitoring once rail tie processing has commenced.

3.4. Local Governments

3.4.1. City of Williams Lake

A presentation was given to the City of Williams Lake Council on September 15, 2015. According to the pre-consultation notes the Council unanimously supported the proposal and a motion was made to provide a letter of support. A letter was provided from Mayor Walt Cobb on September 22, 2015 stating they were confident that the proposed measures taken by Atlantic Power would address environmental a, health and safety concerns and that Atlantic Power was a significant employer and contributor to the local economy. A second letter of support was received May 2, 2016.

3.4.2. Cariboo Central Regional District (CCRD)

The Cariboo Regional District has provided a letter of support for the project (November 4, 2015).

3.5. Public Consultation

Applications to burn rail ties tend to be contentious and this amendment application is no exception. The proposal appeared both in local print media and on radio with twelve articles in the Williams Lake Tribune, two features on CBC Radio, one article in the Green Gazette plus numerous letters to the editor. As the proposal was quite technical in nature and the discharge of rail tie contaminants did not have a cap, the environmental protection notice focused on process changes so that the public at large could better understand the implications. The ministry received over 120 letters as well as a petition summary, mostly expressing opposition to the project. The following is a synopsis of issues identified by the public, phrased as questions:

Contaminants in the Raw Material

1. Rail tie material contain contaminants (e.g. diesel, coal tar, dioxins, furans, polycyclic aromatic hydrocarbons (PAH), creosote, pentachlorophenol (PCP), pentachlorobiphenyls (PCB);
2. What percentage of the rail ties will contain PCP?
3. Is it safe to burn plywood which contains glue?
4. Is it safe to burn waste oil from spills which may be contaminated?
5. How will rail ties treated with other chemicals be addressed (e.g. metal or borate formulations)?

Material Transportation, Storage and Processing

6. Where are the rail ties coming from?
7. How much rail tie material will be burnt daily/annually?
8. How much rail tie material will be store on site?
9. How will fugitive odour, PAH and dust be controlled?
10. How will the fire hazard and spontaneous combustion be controlled?
11. How will leaching and runoff of contaminants from storage and processing be prevented?
12. Will the carbon footprint of transport be taken into consideration?
13. How will transportation of insects transported with tie material be prevented?
14. What are the risks of release of contaminants to air and water as a result of a catastrophic event (e.g. forest fire)?
15. How will the 50% rail ties be determined (volume, wet or dry weight, other)?
16. What receiving procedures will be in place to screen out prohibited materials?

17. What is being done to ensure that construction waste is clean and not contaminated with deleterious material (e.g. asbestos, plastic, lead paint)?
18. What sort of testing will be conducted on the rail ties?
19. How will emissions from the rail transfer station be addressed?

Williams Lake Airshed

20. Will Williams Lake's frequent air inversions be taken into account with this assessment?
21. Is the 2006 Williams Lake Airshed Management Plan being taken into consideration?
22. Is the 2005 CALPUFF Modelling for the Williams Lake Airshed report being considered?
23. The airshed is already at maximum capacity. Can it take any additional pollution?
24. What operational practices will be in place in the event of an air quality advisory (stop rail tie feed?)
25. Need commitment and direction from Air Quality Round Table?
26. Is the air quality management plan up to date enough to enable a good assessment?

Ambient Monitoring and Modelling

27. Can the resolution of mapping be increased so members of the public can see if they are in the impacted zone?
28. Will bioindicators be used to assess impacts?
29. Is the the 2001 LaFranco tests used for modelling outdated and is being taken into account?
30. Are the 2001 LaFranco report results representative of actual conditions (underestimates)?
31. Is the Columneetza monitoring station representative of conditions closer to the plant?
32. Is the assessment going to take into account secondary particulate formation from SO_2 or NOx?
33. What sort of monitoring will be conducted in the receiving environment?
34. Will the receiving environment be monitored for dioxins, furans and other chlorinated hydrocarbons?
35. Is monitoring to done at the proponents expense?
36. Is monitoring being done by an independent third party?
37. Does the modelling take into account air inversions?
38. How accurate is the modelling?
39. Are the appropriate air standards being applied?
40. Shouldn't the modelling be done by the MoE?
41. Shouldn't the assessment be done by an independent third party?
42. Will the assessment review the validity of the RWDI report double counting of NOx argument?

43. Isn't better background data for SO_2, HCl and PAH needed to assess the application properly?
44. Will using the flow from the 2001 LaFranco tests as opposed to the permit maximum value change the modelling results?
45. Aren't there insufficient numbers of samples in original trial for statistical validity?

Air Emissions

46. Will the modelling results that indicate that NOx exceeds provincial air quality standards be taken into consideration?
47. How will the potential to emit carcinogens including dioxins, furans, PAH from burning be addressed?

Emission Monitoring

48. Will compliance testing results be made publically available?
49. Is the stack monitoring robust enough?
50. What is the justification for removal of the EC EPS 1/PG/7 continuous emission monitoring protocols?
51. Will SO_2 levels be monitored and controlled?
52. Will there be continuous monitoring of CO, O_2 and CO_3?
53. Will there be web cameras to monitor haze?
54. Can NOx monitoring be used as an indicator for HCl, HFl and SO_2?

Process

55. Is the process is capable of destroying contaminants;
56. Is dioxin and furan formation during combustion going to be prevented?
57. Are NOx levels going to increase as a result of this application?
58. How is SO_2 from sulphur in the diesel and coal tars of the ties going to be controlled?
59. Can the discharge be elevated out of the airshed?
60. Is there sufficient time, temperature and turbulence to destroy the dioxins and furans?
61. Will best available technology be used?
62. Is the burner system best available technology?
63. What process controls will be in place?
64. What maintenance systems will be in place?
65. Can today's facility still meet the 2001 levels of emissions used for modelling?
66. What happens during process upsets?
67. What is the duration of the burns?
68. How will ultrafine particles be removed?

69. Have there been any changes to the boiler or process that would change the results of the 2001 test?
70. What were the process conditions for original 2001 trial?
71. The 2001 trial showed artificially low TPM during the rail trial, how will this affect the modelling?

Health and Environmental Effects

72. What are the long term and cumulative effects?
73. Will there be bioaccumulation?
74. Will there be an impact on drinking water?
75. What will the impact on the adjacent hockey rink be?
76. What will the impact on sensitive individuals be?
77. Will Interior Health be provided with full information?
78. Is there sufficient data to determine short and long term effects?
79. Intrinsik report needs stronger rational for dismissing the human health risk quotients " >1".
80. Since the Intrinsik report is ultimately based on the 2001 LaFranco which understates some contaminants could the human risk quotients also be toolow?
81. Is the Intrinsik report assumption that synergistic effects of chemicals only occurs at medium to high levels valid?
82. Does the Intrinsik report take into account BC Air Quality Guidelines?

Communication

83. Can the consultation period be extended?
84. Is more time available to review the proponent's Technical Assessment Report?
85. How can people get answers from the Ministry of Environment?
86. Doesn't the public protection notice require more information about the type and amount of pollutants?

Ash/Landfill

87. Is the potential for dioxin, furan, metals, PAH, pH leaching from ash to fluvial soil being considered and mitigated?
88. How will fugitive dust from landfill be controlled?
89. Considering the landfill's proximity to river is there not a risk of contaminating it?
90. The landfill is on unstable ground, what happens when rail tie ash is added and there is a slump?
91. Have the human health effects of the landfill dust been taken into consideration?

Science

92. Can the science behind this application be made easier to understand?

93. Is the application being reviewed on a scientific basis?
94. Will the technical information be reviewed by an impartial third party.

Miscellaneous

95. What will the impact be on property values?
96. How will this affect the community image?
97. How will this affect residences in close proximity?
98. Didn't the US EPA (40 CFR part 63 MACT standard) prohibit the use of rail ties?
99. Wasn't a similar proposal in Kamloops rejected by the MoE?
100. Doesn't the Kamloops facility permit prohibit burning of rail ties containing PCP (MoE permit # 103943);
101. Why aren't alternate locations being considered?
102. Aren't alternate methods of disposal preferable?
103. Shouldn't alternate sources of fibre be considered first?
104. Some areas of the province have a surplus of hog fuel and are allowed to export, therefore why are rail ties allowed to be burned?
105. Will other aspects of the permit be improved as part of this amendment (i.e. continuous improvement)?
106. Why is burning of biomass considered when it's more polluting than natural gas?
107. Why 872 liters/day of spill waste oil disposal?
108. Has a deposit tax on rail ties been considered?
109. Why is industry allowed to self-regulate?
110. Aren't there more job opportunities from other sources of fibre?
111. The consultation report is repetitive and doesn't use the MoE recommended format.
112. Has the Ministry considered the WL Airshed management plan?

3.6. Post Consultation

Dialogue with the public continued after the mandatory 30 day consultation period.

Copies of the most current versions of the technical assessment and consultation reports were provided on the proponent's website, the Williams Lake Public library and on a Ministry of Environment website www2.gov.bc.ca/gov/content/environment/air-land-water/site-permitting-compliance/atlantic-power. The Ministry Website also included a copy of the current permit prior to amendment.

Individuals who contacted the Ministry with concerns and left contact information were sent letters by the Regional Authorizations Director notifying them where the information could be found on the Ministry's website and Place Holder notice of the additional open house. information could be found

This is a place holder. The following section is to be completed once the activities are complete.

To address concerns from the public that the original environmental protection notice contained insufficient detail regarding the quantity and quality of the discharge changes as well as provide an opportunity for stakeholder's to review the final draft assessments and draft permits the Proponent and Ministry undertook the following activities:
Williams Lake Tribune Advertisement Date
Open House Date
Revised notice on site Date
A 30 day review period then occurred where additional information was accepted and included in the Ministry Assessment and final drafting of the permit.

Petition

A petition was publically circulated with the following header:

"We the undersigned reject Atlantic Power Plants permit application to use creosoted rail road ties as a fibre source in the Williams Lake Power Plant."

The Public Notification Regulation states:

> **4. Notice by concerned persons**
>
> **7** (1) A person who may be adversely affected by the granting of a permit, approval or operational certificate, or by the granting of an amendment to a permit, approval or operational certificate, may, within 30 days after the last date of posting, publishing, service or display required by this regulation, notify a director in writing stating how that person is affected.
>
> (2) The director may take into consideration any information received after the 30 day period prescribed by subsection (1) if the director has not made a decision on the permit, approval or operational certificate.

According to the organizers, as of June 2, 2016 the 466 people signed the petition which were gathered by community individuals or located at four local businesses. An additional 435 persons responded to an on-line petition at www.change.org. While the number of responses does indicate that there is resistance to the proposal, the petition does not state how persons are affected or provide additional information for consideration.

4.1. Monitoring and Stewardship Section

Air Quality Meteorologist Assessment

The discharge from the main stack was assessed using CALPUFF 6.2 in CALMET over a 25 km by 25 km by the Proponent's consultant RWDI Air Inc.. This air dispersion modelling is pivotal to their application to increase the discharge from rail tie burning at the WLPP. The final modelling concluded that there would be no exceedances of either

the provincial air quality objectives (AAQO) or in the absence of a BC objective, the Ontario objective.

MOE Air Meteorologist, Ralph Adams provided initial direction to the Proponent and reviewed their modelling reports (see Appendix A for Meteorologist's full report).

Based on his review, the meteorologist concluded that:

1. No errors were found that would significantly affect the output from the models.
2. The contaminants that are expected to change significantly if the firing rate of railway ties is increased are sulphur dioxide (SO2), hydrogen chloride (HCl) and polycyclic aromatic hydrocarbons (PAH). These increases will result in maximum concentrations for SO2, HCl and PAH that are 47%, 30% and 12% of the respective AQQO levels.
3. The predicted increases in all other contaminants expected to change due to the amendment all result in changes to maximum concentrations that are less than 0.5% and most change by less than 0.01%
4. Should the amendment be granted and the firing of railway ties increased to 50%, none of these increases would are predicted to exceed current air quality objectives.
5. It is unlikely the proposed changes would result in significant detrimental changes in the ambient air quality in Williams Lake airshed.

The MOE Air Meteorologist made the following recommendations:

1. Stack testing be conducted in a timely fashion at the maximum firing rate (50% rail ties) to confirm 2001 Transcanada Power Emission Survey Report.
2. The first stack tests include size fractionation of TPM to determine PM_{10} and $PM_{2.5}$ content.
3. Emission limits be established in the permit to ensure that the discharge reflects the conditions of the assessment. In particular, SO2 and HCl.
4. The existing NOx emission limit be maintained.
5. An ambient monitoring programme, acceptable to the Director, be developed by the proponent to confirm that the ambient levels of SO2, PAH and HCL in the airshed meet AAQO.
6. The proponent be required to participate in an ambient monitoring programme with other stakeholders in the airshed to investigate the spatial variability of $PM_{2.5}$ and NO_2.

It should be noted that the Modelling Report indicated that NOx and SOx could exceed provincial AAQO. In consultation with the MOE Air Meteorologist, corrections were made to initial errors in the stack base elevation, standard flow rate, NOx conversion and source of total particulate matter flow and concentration. Once these errors were corrected the modelling indicated that the AAQO would not be exceeded even when feed stock was composed of 100% rail ties.

No biologist assessment required at this time.

5. Technical Assessment

Technical Report

Applicant Technical Report Acceptable:	Yes	x	No		N/A	
Prepared by Qualified Professional:	Yes		No		N/A	x
Monitoring Proposal Acceptable:	Yes		No		N/A	x
Ministry Technical Report Attached:	Yes	x	No		N/A	

The inclusion of rail tie material in the boiler feedstock has the potential to change the quantity and quality of gaseous, solid and liquid waste released into the environment. The following is a comprehensive technical analysis of the potential harm the emissions may cause to human health and the environment and recommended measures by which the emissions may be controlled or mitigated It focuses on the waste type and then the contaminants of greatest concern.

5.1. System Description

The boiler is a 680MMBTU/hr Babcock and Wilcox Canada, Stirling type boiler designed for biomass incineration with a controlled combustion zone and equipped with a Detroit stoker hydro-grate. The exhaust gas is treated with multiclones and a five field Environmental Elements Corporation electrostatic precipitator (ESP) with an overall design efficiency of 99.95%.[iii] The boiler efficiency is approximately 68% to 75%.

Combustion zone temperatures range from approximately 1370°C above the grate to 1081°C at the Superheater inlet with a retention time of approximately 1-3 seconds within the combustion zone.

5.2. End-of- Life Rail Tie Disposal

The proponent estimates that the plant would consume between 800,000 to 1.2 million rail ties per year (approximately 84-126 thousand cubic meters based on a standard tie of 7” x 9” x 8.5’) from Western Canada.

The Waste Discharge Regulation Schedule 1 includes rail ties under the 1 list of prohibited materials that may be incinerated therefore requiring authorization in order to discharge. Rail ties are exempt from the requirements of the BC Hazardous Waste Regulation (HWR) they can contain a number of compounds designated as priority substances under the *Canadian Environmental Protection Act* requiring management.

A steering group of Environment Canada and wood preservation industry members developed the Industrial Treated Wood Users Guidance Document (ITWUD)[iv] to establish best management practices for treated wood use, storage and disposal. ITWUD identified that where reusing rail ties in applications such as landscaping is not feasible, recycling rail ties including for energy is a preferable alternative to hazardous waste disposal or landfilling.

A 1991 report commissioned buy the Ministry of Environment reviewed the practice of open burning of rail ties and concluded that from a human health risk point of view creosote treated ties was acceptable while the open burning of PCP treated ties was not.[v]

The Canadian Council of Ministers of the Environment Provisional Code of Practice for the Management of Post-Use Treated Wood (CCMEPC)[vi] identified the potential for recycling retired ties in the landscaping market but states that "Railways are also concerned about any liabilities that may arise from the misuse of ties or from the improper disposal of cull ties by contractors." The CCMEPC supported controlled burning of rail ties for electrical power generation stating "the destruction of wood treated with organic preservatives can be accomplished by incineration, using combustion conditions that prevent the release of toxic gases and other emissions."

During the permit amendment consultation process it was identified that in March 2011, the U.S. EPA reclassified rail ties and woody construction debris from being traditional fuels to a non-hazardous secondary materials (NHSM) [vii]. As a result of this ruling, burning of rail ties and construction debris were to be evaluated on a case by case basis[viii]. It is not, as some members of the public asserted, a ban on the burning of rail ties and construction debris. On February 8, 2016, the EPA modified the ruling to delist construction debris that had been processed according to best management practice and up to 40% creosote ties per annum that are processed in units that are designed to burn both biomass and natural gas as part of normal operations.[ix] Other types of rail tie treatments were not delisted although creosote borate, copper naphthenate and copper naphthenate-borate are listed as candidates for categorical non-waste listings in the future.

It can be concluded that there is a substantial quantity of waste that must be managed and the conversion to energy through burning is a viable method of disposal for end-of-life rail ties. The next question is whether or not the APWL facility has the conditions and equipment capable of processing the material with minimal impact on the receiving environment and the public.

Open Burned Rail Ties, Prince George 2016-05-11 PDL

5.3. Rail Tie Treatment

The conditions for effective contaminant destruction are dependent on the chemicals in the rail ties and the process by which they are eliminated. During the consultative process, many of the letters to the director identified concerns about the "toxic contents" of the rail ties themselves and the contaminants emitted when the ties are burned.

Rail ties can be treated with a number of different chemicals and methods to prolong their useful life. The CCMEPC identified that in 1992 treated wood consumption, 88% had been treated with a creosote/oil mixture, 12% with a pentachlorophenol (PCP) and oil mixture and less than 1% with pure creosote. A more recent survey of railroad tie purchases in the United States[x] found that in 2013, 51.4% were creosote treated, 38% were treated with creosote/borate, and 1.7% with copper napthenate and the remainder from inert materials. PCP treated rail ties were not identified. The survey also noted that in 2013, 81.3% were disposed of using "recycle combustion"

5.3.1. Creosote Rail Ties

According to the CCME, creosote does not release any more harmful components than the burning of coal, from which it is derived[xi] and the petroleum carrier[xii]. The major pollutants of concern are particulate matter, sulphur oxides (SOx) and nitrogen oxides (NOx), carbon monoxide (CO), organic compounds including unburned hydrocarbons, PCDD/Fs, poly aromatic hydrocarbons(PAHs), trace metals, and acid gases (HCl and HF). [xiii] Included in the organic component are polycyclic aromatic hydrocarbons (PAHs) and PCDD/F which according to the U.S. EPA "can release into the air" under

uncontrolled conditions [xiv] Incineration of creosote waste water treatment sludges identified that test ash contained low levels of arsenic, lead, chromium copper and zinc.[xv]

Dual treatment of rail ties, first with borate compounds as an insecticide and then with creosote, is becoming increasingly popular.[xvi] Sodium borate solutions can be an irritant and are slightly hazardous in the case of skin contact, ingestion or inhalation.[xvii] Borate treatment is relatively new to Canada and used in applications that are protected from excessive rain and not in direct contact with soil."[xviii] According to Bolon and Smith, boron treatment by itself is colourless and the identification of wood that has been treated can be difficult. "Emissions of carbon monoxide and NOx were of similar or lower levels for boron containing wood fuel than for untreated wood fuel. Boron is not listed in the Clean Air Act as a hazardous air pollutant and can be used as an energy recovery fuel in a properly designed and permitted combustion facility."[xix] Boron containing chemicals are also not managed under the *Canadian Environmental Protection Act* list of toxic substances to be managed. Given the infrequent historical use in Canada it is expected that the proportion of dual treated rail ties would be minimal, the potential emissions of low risk and therefore, there is no need to prohibit borate or dual treated ties.

5.3.2. PCP Rail Ties

With the British Columbia pulp industry, it has been long recognized that the burning of hog fuel from logs stored in salt water had the potential for PCDD/F formation. The large hog fuel boilers at pulp mills are a similar technology to that employed at the WLPP.

Similarly, PCP is produced by reacting phenol with chlorine. The resulting compound usually contains about 86% PCP and about 10% other chlorophenols such as tetrachlorophenol and trichlorophenol. PCP also contains trace amounts of polychlorinated dibenzodioxins, polychlorinated dibenzofurans (PCDD/F), and hexachlorobenzene impurities. Petroleum oils are used to carry the PCP into the wood structure.[xx] PCP therefore contains elemental chlorine and the carrier petroleum oil contain contaminants including chlorine and sulphur which when the woody matrix is broken down through combustion can be released to the furnace.

The original application assumed 2% of the furnish would be PCP treated rail ties. The 2001 Lafranco Report does not specify how much of the rail tie material of the test burn contained PCP treated material nor is it apparent from a review of the file or Ministry assessment of the time. While the TAR states that CN Rail has never used PCP ties except for experimental purposes, mergers and acquisitions of other rail companies e.g. BC Rail, could introduce such ties. The other consideration is that PCP ties would not be mixed homogenously with creosote treated ties at the source but rather depend on the original purchases and maintenance installation. The identification and separation of end of life PCP containing rail ties can be difficult due to the significant deterioration of the ties.

An alternative to limiting the amount of infeed is to monitor the contaminants of the discharge. HCl emissions are a surrogate measure for the amount of chlorine and therefore the amount of PCP containing rail tie material entering the furnace. By

controlling the HCl levels, congeners would also be controlled. The proponent has volunteered to install CEM technology for HCl monitoring.

5.3.3. Metal Based and Other Preservatives

Water borne metal based preservatives are not being considered in the application. The draft permit includes a prohibition on incineration of materials treated with these chemicals. A requirement for a excluding non-conforming material procedure (modelled after U.S.EPA 40 CFR 258.20) has been included in the draft permit.

Copper naphthenate is another type of oil borne preservative that may be hard to distinguish from creosote and PCP treated wood as it can have a light brown oily colour. Copper napthenate is not as widely used as creosote or PCP, but used primarily for the treatment of utility poles and highway construction.[xxi] Copper naphthenate is commonly used over sensitive aquatic habitat and has a low toxicity.[xxii] Copper naphthenate treated material incineration is prohibited under the draft permit both through the metal based preservative clause and the exclusion of telephone poles. If tramp material such as bridge decking makes it into the fuel mix it is expected to be such a minor percentage as to have no discernable environmental impact.

5.4. Logging and Landscaping Debris

In a May 19, 2016 e-mail the proponent stated that "Atlantic Power had received inputs from a number of stakeholders requesting that the APWL consider logging debris as an alternate fuel. To this point, logging debris has not proven an economically viable fuel but variables, including provincial policy, may change that situation."

As a result, the proponent asked that the amendment request also include an allowance for the inclusion of clean biomass from logging and landscaping works.

Clean logging and horticultural debris has the same properties when incinerated as the hog fuel currently utilized by the facility. No change is anticipated in the discharge nor would there be any special handling and storage requirements required to prevent pollution.

5.5. Guidelines

The proponent's technical assessment report (TAR) and modelling uses the data from the Lanfranco Report. Given the limited sample size there is insufficient margin of error to establish discharge limits on that information alone and risks being too restrictive. Therefore, this Ministry Technical Assessment also makes use of information from the permit file, Ministry of Environment guidelines, other jurisdictions and scientific and technical literature.

The BC Ministry of Environment does not have emission standards specific to the burning of end of life rail ties. Based on the composition of the rail ties, the potentials contaminants and the process used there are a number of regulations and guidelines which can be used to inform for the development of appropriate emission limits for an amended permit. These include:

BC *Environmental Management Act*: Hazardous Waste Regulation, B.C. Reg. 63/88

BC Ministry of Environment, British Columbia Ambient Air Quality Objectives, Environmental Standards Branch, January 18, 2016

BC Ministry of Environment, Operational Policy Manual Environmental Protection Division: Determining Best Achievable Technology Standards, Interim Policy 1.01.04, May 5, 2008 (BATP)

BC Ministry of Environment, Operational Policy Manual Environmental Protection Division: Coal-fired Power Boiler Emission Guidelines, Subsection 2.09.05, April 16, 2009 (CPBP)

BC Ministry of Environment, Operational Policy Manual Environmental Protection Division: Guideline for Emissions from Biomass-Fired Electrical Generation, Subsection 2.02.25, August 4, 2009 (BFEP)

BC Ministry of Environment, Operational Policy Manual Environmental Protection Division: Authorizing Wood-Fired Energy Systems and Wood Residue Incinerators and the cross referenced ministry report entitled "Emissions from Wood-Fired Combustion Equipment" report[xxiii], Subsection 2.02.26, December 15, 2009 (WFEP)

BC Ministry of Environment, Operational Policy Manual Environmental Protection Division: Reviewing Regional Solid Waste Management Plans or proposals/application that include Municipal Solid Waste as a feedstock for Waste to Energy facilities, Subsection 2.02.27, March 26, 2010 (MSWP)

BC Ministry of Environment, Operational Policy Manual Environmental Protection Division: Guideline for Emissions from Municipal Solid Waste Combustion, Subsection 2.09.08, March 29, 2011 (SWCG) and its accompanying report "Waste to Energy: A Technical Review of Municipal Solid Waste Thermal treatment Practices" [xxiv]

Canadian Council of Ministers of the Environment Provisional Code of Practice for the Management of Post-Use Treated Wood (CCMEPC) September 1996

Environment Canada, Industrial Treated Wood Users Guidance Document, Version 1-September 2004

6. Waste Description

The inclusion of rail tie material in the boiler feedstock has the potential to change the quantity and quality of gaseous, solid and liquid waste released into the environment. Based on the proponents TAR and the literature, the following section assesses the contaminants and mitigation measures needed.

6.1. Gaseous Waste

6.1.1. Sulphur Oxides

SOx is produced from the reaction of sulphur from the fuels and oxygen. Standards use SO_2 as the indicator for the broader mix of gaseous SOx in the ambient air.[xxv] High concentrations of SOx can adversely affect the respiratory systems of humans and animals, and can damage vegetation. SOx can also react with other compounds to form secondary particulate. The contribution of SOx toward PM2.5 formation is not fully understood and is highly variable depending on atmospheric contributions including moisture, temperature and other miscellaneous factors.[xxvi] Stoichiometrically, the amount of SO_2 is dependent on the amount of sulphur in the feed stock and therefore will vary with the rail tie source, original treatment and level of deterioration.

The year 2000 inventory of common air contaminants in the Williams Lake Airshed[xxvii] identified that the annual loading from all sources of SOx (as SO_2)to the airshed was approximately 80 tonnes per year with the electrical power facility (based on AP-42 factors) contributing 29.9 tonnes/year. Consequently, SO_2 was not identified as a priority air pollutant in the Williams Lake airshed management plan which instead focused on PM_{10} and $PM_{2.5}$.

The CALPUFF modelling for this application used the 2001 trial results averaging SO_2 concentration over three tests at 100% rail tie feed for an equivalent to 224.1 mg/m^3 at 8% O_2 and a flow of 94.6 m^3/second (669 tonnes/year). The revised modelling at 100% rail tie feed predicted levels below the AAQOs by approximately 6%. At these levels it would not be necessary for additional scrubbing technology to be installed for SOx control while still meeting the AAQO. To provide allowance for contingencies such as temporary process upsets where acute effects are more of a concern than the chronic impact on the airshed, the draft permit incorporates this as the half hour limit.

The revised RWDI modelling also extrapolated what ambient levels of SO_2 would look like given a maximum of 50% rail ties assuming direct relationship of tie volume to SO_2 creation. The predicted results were less than half the AAQO. As actual sulphur content of the ties will vary with the treatment, a cautionary approach would be to set a maximum SO_2 discharge limit rather than specify a percentage of rail ties that may be incinerated on a daily basis. The inputs used for the 50% rail tie modelling would be approximately equivalent to 96.3 mg/m^3 SO_2 at 8% O_2 and 110 SDm^3/sec. Based on the last 5 years of testing the average flow was 98.5 SDm^3/sec. At this flow rate the 50% discharge level would be 107.6 mg/m^3(rounded off to the nearest 1, 110 mg/m^3). This would be a maximum of 382 tonnes SO_2/year permitted value. As the 100% rail tie modelling indicated that the levels at 100% rail ties composition still met the AAQO.

The preceding proposed levels are conservative. By way of comparison, the *2007 Kraft Pulp Mill Emission Guidelines and Standards Pre-scoping Final Report*[xxviii]recommended a limit of 314 mg/m^3 at 8% O_2 limit for Kraft Recovery Boilers. Environmental Protection Division Coal- fired Power Boiler Emission Guidelines (CFPBEG) [xxix] recommended limit of 444 mg SO_2/m^3 (based on 222.2 ng/J thermal output for the WL 1000MMBTU/hr boiler with an efficiency of 75%). The SWCG

guideline for SO_2 (adjusted to 8% O_2) is 65 mg/m^3 daily average and 248 mg/m^3 ½ hour average.

Based on the modelling and the operational processes, SOx is the parameter limiting how much rail tie material may be safely incinerated and can act as a surrogate for other pollutants (except particulate). Continuous emission monitoring technology (CEMs) for SOx is proven and readily available and can be used both as an operating control and for compliance verification. While the proponent has requested authorization to burn up to 50% rail ties, adopting a maximum limit of 110 mg/m^3 daily average and 248 mg/m^3 half hour using CEMs data is a more accurate and reliable method of control than an estimation of the amount and proportion of fuel burned.

6.1.2. Hydrogen Chloride

Under combustion conditions, chlorine reacts with hydrogen to produce hydrogen chloride (HCl). It is predominately found in flue gas from wastes containing chlorinated organic compounds or chlorides.[xxx] In gas form it is corrosive and can contribute to acid rain. Chloride may come from either the breakdown of the chloro-organics or as a contaminant (e.g. NaCl) in the creosote base.

The results of the 2001 testing found HCl levels in excess of the SWCG and the HWR Schedule 2 parameters (see Table 2).

Table 2: SWCG and 2001 Test Results Comparison: HCl

		mg/m^3 at 8% O_2 20°C
2001 Observed Max. 100% Rail Tie	1 hour test	99
2001 Average 3 tests (3 hrs) 100% Rail Tie	average 3 tests	66.9
SWCG Max	1/2 hour average	78
SWCG Max	Daily average	13
HWR	8 hour rolling average	65

BC does not have an ambient air quality guideline for HCl. Looking to other jurisdictions, Alberta has adopted the Texas 1999 1-hour average of 75 µg/m^3[xxxi] and Ontario uses a 24 hour average of 20 µg/m^3.[xxxii] The RWDI revised modelling predicted a maximum 24 hour average of 11.8 µg/m^3 or 59% of the Ontario criteria when burning 100% rail ties.[xxxiii] As the modelling indicates that the levels of HCl discharge would not negatively impact the airshed even at 100% railtie feed stock.

The amount of HCl emitted will be dependent stoichiometrically on the amount of chlorine entering the furnace with the PCP containing rail ties. The proponent has volunteered to install CEM technology for the monitoring of HCl emissions as a method for controlling the PCP rail tie infeed. The draft permit adopts the SWCG guideline of 78 mg/m^3 guideline of the SWCG. The averaging period has been expanded to one hour to enable operational control.

6.1.3. Organic Compounds

Burning ties can lead to the release or production of polycyclic aromatic hydrocarbons (PAHs), chlorophenols including pentachlorophenol (PCP), PCDD and PCDF.[xxxiv]

6.1.3.1. PAH from Boiler Operation

According to the Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, PAHs are organic compounds composed of two or more benzene rings in their structure. They are present in the environment as a result of incomplete combustion. [xxxv] According to Pakpahan et al (2009) [xxxvi] PAHs have mutagenic properties and the mechanism of formation and degradation of different ringed isomers is dependent on temperature and excess oxygen to promote complete combustion. PAHs at the Williams Lake facility can originate from either the incomplete combustion of hydrocarbons, biofuel or rail ties. Control of PAH emissions is through promotion of complete combustion conditions of time, temperature and turbulence. CO levels are a good indicator of combustion conditions and the draft permit includes provisions for continuous emission monitoring of CO and a CO limit of 50 mg/m^3(65 mg/m^3 when corrected to 8% O_2)based on the SWCG.

6.1.3.2. Chlorophenols from Boiler Operation

PCP treated rail ties contain chlorine. In the presence of chorine, chlorinated combustion by-products are formed including PCDD and PCDF formation, especially under incomplete combustion conditions.

The emission of organic compounds from combustion systems is dependent upon either molecules passing through the furnace unchanged or via de novo synthesis and precursor formation. According to Salthammer, Klipp and Peek (1995) the concentration of PCDD and PCDF in the exhaust gas can be kept low under good combustion conditions. [xxxvii] The rate at which organic compounds are emitted depends on the combustion residence time, temperature and turbulence. [xxxviii] There is no correlation between the levels of dioxin formation and the fuel chlorine content.[xxxix] According to the 2009 Canada-wide Standards for Dioxins and Furans progress report, de novo synthesis of PCDDs and PCDFs probably occurs when gas phase metal and chlorine react with carbon structures on flyash. [xl] This reaction is followed by metal-catalyzed oxidation /gasification of the flyash surface which releases various chlorinated organic compounds including PCDD/PCDF, chlorophenols, chlorobenzenes and aliphatics, usually in the post furnace

region including the electrostatic precipitators (ESPs). Precursor formation occurs when two precursor molecules condense on the surface of fly ash in the presence of metal catalysts to form a dioxin or furan structure. The optimal temperature for PCDD/PCDF formation is between 250 and 450 °C with a retention time of at least 1 second. The levels of PCDDs and PCDFs at temperatures above 600°C are low but increase as the temperature decreases[xli].

The SWCG is the most current provincial guideline with PCDD/PCDF standard to protect human health and the environment and recommends a toxicity equivalent (TEQ) dioxin concentration limit of 0.08 ng/m^3. There are a number of performance trials that support the argument that the APWL boiler can process chlorinated contaminated wood waste and meet this standard.

According to the Lafranco report, the levels of total dioxins from the WLPP trial were well below the 0.08 ng/m^3 of the provincial standard (See Table 2). While the original trial did not account for the proportion of PCP in the feedstock, the levels in the stack emissions and ash were greater than that for clean hogfuel.

Combustion PCDD/PCDF has been an issue at coastal mills where logs can be transported and stored in salt water. When processed in the mill boilers of a similar size to the WLPP boiler, PCDD and PCDF are within acceptable parameters. For instance a 2008 PCDD/F emission survey was conducted of a hog fuel boiler with hog samples containing up to 0.415% NaCl. The PCDD/F concentration averaged 0.0594 ng/dscm @11% O_2.[xlii]

In 1987 Environment Canada and the BC Ministry of Environment conducted a test burn of hogfuel mixtures containing up to 400µg/g chlorophenol at the Prince George-Northwood pulp mill. The results of the test were that greater than 99.9993% of PCDD/PCDF and 99.9971% of chlorophenols were destroyed at temperatures above 920 °C and a combustion gas residency time of 3.2 seconds. Dioxins, furans and the most toxic aromatic hydrocarbon, benzo(a)pyrene were below detection limits in the accompanying ambient air testing.[xliii]

According to the Stantec report, the specification of temperature and retention time in the combustion zone varies with the jurisdiction. North American jurisdictions generally opt for 1000 °C with a retention time of 1 second and the EU favours a minimum of 850 °C with a retention time of 2 seconds[xliv].

The proponent estimates a minimum retention time of approximately 1 second and a minimum furnace temperature of 1127 degrees C. Based on the Boiler Operating Characteristics Summary prepared by Jansen Combustion and Boiler Technologies temperatures drop below the 600 degrees C threshold at the outlet of the economizer and would be in the zone of formation through the tertiary air heater and subsequent pollution control works. A minimum temperature of 1000 degrees C as measured at a point acceptable to the Director has been included in the draft permit.

According to the proponent, in the event of a power outage or significant equipment malfunction, interlock controls would ensure no more tie material would be added to the

boiler. Tie material already in the furnace would stay in place and burn out very quickly in the matter of minutes.[xlv]

Table 2 provides a comparison of the SWCG limits and the maximum observed values in the 2001 trial at 100% rail tie feed.

Table 2: SWCG and 2001 Test Results Comparison: Organics

Parameter	SWCG Max @11% O_2 20°C	SWCG Max @8% O_2 20°C	2001 Observed Max @8% O_2 20°C @ 100% Rail Tie		Units
Chlorophenols	1	1	0.19	daily average	µg/m^3
Polycyclic Aromatic Hydrocarbons (PAH)	5	7	0.098	daily average	µg/m^3
Total Dioxins and Furans (as PCDD/F TEQ)	0.08	0.10	0.004	daily average	ng/m^3

The revised RWDI modelling indicates that the ambient PCDD/F TEQ/m^3 was less than 0.01% of the Ontario AAQC for 100% rail ties.

Adopting the SWCG limits for CO, Chlorophenols, PAH and total dioxins and furans is considered protective of the environment and would be attainable by the proponent without modifications to the existing equipment. The SWCG are therefore incorporated into the draft permit.

6.1.4. Nitrogen Oxides

Nitrogen oxides (collective known as NOx) is a group of seven compounds that in sufficient concentration can be toxic to humans as well as contribute to ozone formation, acid rain and secondary particulate..

NOx can be produced three ways during the combustion process [xlvi]and control methods differ according to source. The three NOx formation pathways are:

1) Through the reaction of nitrogen, oxygen and hydrocarbon radicals (Prompt NOx)
   $CH_4 + O_2 + N_2 \rightarrow NO, NO_2, CO_2, H_2O$, trace species
   Prompt NOx is generally a concern at lower-temperature combustion processes and not at the higher temperatures found in many industrial combustion processes.

2) Through the direct oxidation of organic nitrogen compounds contained in the fuel (fuel NOx)
   $RxN + O_2 \rightarrow NO, NO_2, CO_2, H_2O$, trace species

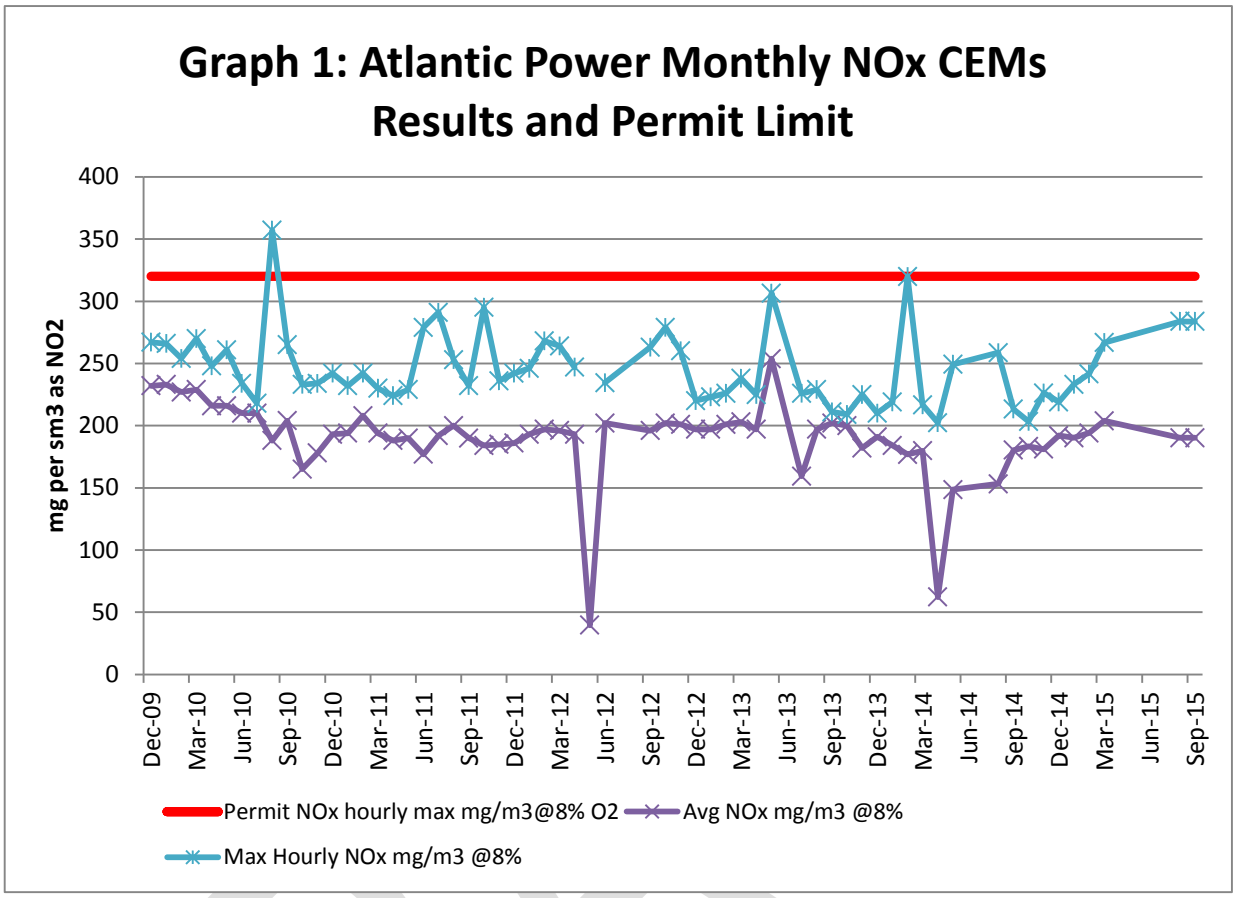
Fuel NOx is dependent on the amount of organonitrogen compounds contained in the fuel and may be important when oil, coal, or waste fuels are used which may contain significant amounts of organically bound nitrogen.

3) High temperature reaction of nitrogen with oxygen (Thermal NOx)
   $O_2 + N_2 \rightarrow NO, NO_2$
   At temperatures above 1,100°C thermal NOx is generally the predominant mechanism. Thermal NOx emissions are an exponential function of flame temperature.[xlvii]

NOx from organonitrogen compounds will be indistinguishable from thermal or prompt NOx. The permit is not being amended for increased NOx and the continued use of the CEM will ensure that NOx levels are maintained even if the rail ties containing organically bound nitrogen are used as feedstock.

The facility was established in 1991 to eliminate the need for beehive burners. Since the facility was built the one hour ambient NOx level was reduced from 400 $\mu g/m^3$ acceptable limit and 1000 $\mu g/m^3$ tolerable limit to 188 $\mu g/m^3$. The proponent has not applied for an increase in NOx emissions and there have not been any major equipment or process changes at the facility.

Review of facility emission monitoring data indicates that the current permit limit of 320 mg/m^3 (1110 tonnes/year) is almost fully utilized (see graph 1).



The current NOx limit of 320 mg/m^3 is not excessive when compared to the current standards and guidelines. The burning of rail ties is not anticipated to change NOx emissions.[xlviii] According to the 2008 Emissions from Wood-Fired Combustion Equipment report[xlix] NOx emissions range from 303 mg/m^3(95g/GJ) for wet wood to 674 mg/m3 (211 g/GJ) for dry wood with BACT values in the order of 320 mg/m^3. The HWR NOx standard for thermal treatment facilities is 380 mg/m^3 at 11% O_2 (495 mg/m^3 @8% O_2), the MSWCF limit is 190 mg/m^3 @ 11% O_2 (248 mg/m^3 @ 8% O_2) for new facilities and the CFPBEG recommended limit of 192 ng/J or 383 mg NOx/m^3(based on 192 ng/J thermal output for the WL 1000MMBTU/hr boiler with a 75% efficiency).

To meet a lower NOx permit limit would require the Permittee to make substantive changes to the boiler and the operations. According to a U.S. EPA Technical Bulletin[l] there are seven methods of NOx reduction, each with its associated advantages and disadvantages. They are:

1. Reduce peak temperature;
2. Reduce residence time at peak temperature;
3. Chemical reduction;
4. Oxidation;
5. Removal of nitrogen;
6. Sorbent use; and
7. Combination of the above.

Each method has its pros and cons including cost and impact on other pollutants. For example, selective catalytic reduction can have ammonia slippage which in turn can result in secondary particulate particularly in winter months.[li] The proponent reviewed the BAT options[lii] and concluded that given ambient NOx AAQO would not be exceeded and that since the added incremental cost of treatment would be prohibitive, control limits were the preferred option.

The initial 2015 CALPUFF dispersion modelling report[liii] identified that the provincial AAQO one hour nitrogen dioxide NOx levels would be exceeded. The modelling reviewed two scenarios. The first reviewed ambient NOx levels as if APWL was to be a greenfield facility. The second assumed that facility was already a substantial contributor and discounted current emissions from background. In the first instance the NOx levels were predicted to be 135% of the AAQC and the second at 101%. The exceedance would occur on non-residential steep hillside area approximately 500 m northwest of the facility. Subsequently the modelling was corrected for standard conditions, stack base height and NOx to NO_2 hour by hour ozone concentration.[liv] The updated modelling results found that hourly ambient NOx levels would not be exceeded.

Dispersion modelling tends to be over conservative and does not establish with any certainty that the AAQO is being exceeded or that the environment or human health is negatively impacted. Without verification of the modelling results there are inadequate grounds to require lower limits and costly upgrades therefore the establishment of NOx ambient monitoring has been included in the draft amendment.

It is therefore recommended that the NOx limits in the permit remain unchanged.

6.1.5. Metals Discharged to Air

Metals may enter the combustion zone as either contaminants in the wood, the creosote or PCP treatment chemicals, or may also be accidentally included via materials treated with metal based preservatives or contaminated construction debris.

The maximum stack discharge results from the 2001 rail tie trial were consistently below the BCMSWCG limits (see Table 3).

Table 3: SWCG and 2001 Test Results Comparison: Metals

	BC Guideline	2001 Results max	
Metals (Pb, As, Cr)	83	15	$\mu g/m^3$ at 8% O_2 20°C
Cadmium (Cd)	9	0.65	$\mu g/m^3$ at 8% O_2 20°C
Mercury (Hg)	26	0.88	$\mu g/m^3$ at 8% O_2 20°C

Metals vaporize during the combustion process followed by condensation on cooler surface away from the heating zone resulting in higher metal concentrations in fly ash.[lv]

While the comparison against the BCMSWCG indicates that there is minimal risk from the facility including rail ties in the feed stock, the draft permit adopts the HWR Schedule 2 limits as it provides a broader spectrum of metals.

Table 4: HWR Schedule 2 and 2001 Test Results Comparison: Metals

	2001 Observed Max. Baseline	2001 Observed Max. 100% Rail Tie	2001 Average 3 tests (3 hrs) 100% Rail Tie	HWR Schedule 2 Standard
	mg/m^3 at 8% O_2 20°C	mg/m^3 at 8% O_2 20°C	mg/m^3 at 8% O_2 20°C	mg/m^3 at 8% O_2 20°C
Class I (Pb, Sb, Cu, Mg, V, Zn)	0.091	0.109	0.053	4.7
Class II (As, Cr, Co, Ni, Se, Te)	0.006	0.005	0.003	0.9
Class III (Tl, Cd, Hg)	0.005	0.003	0.001	0.20

It is noteworthy that the concentrations of metals in the 2001 tests for the biomass baseline did not differ significantly from the 2001 test at 100% rail tie feed and all were well below the HWR thresholds.

Metals can be controlled by controlling metals in the feedstock. The draft permit therefore prohibits metal based wood preservatives.

The draft permit includes the requirement adapted from U.S. EPA 40 CFR 258.2[lvi] for a receiving procedure to prevent inclusion of wood treated with metal based preservatives or construction debris contaminated with such things as lead paint to keep metals from being volatized in the combustion zone.

6.1.6. Particulate

When the 2001 test results were reviewed in 2015 it was noticed that there is a substantial decrease in particulate for Rail Tie Test 2 and Test 3 indicating a possible process change.

There was a similar drop in metals in Tie Tests 2 and 3 which is to be expected as the vaporized metals condense on the carbon particles.

During the consultation period, stakeholders frequently identified poor air quality during meteorological inversion conditions and the Williams Lake Airshed Plan identified particulate as the priority contaminant. The application to burn construction debris and end-of-use rail ties will not directly affect primary particulate levels which are largely

captured in the ESP. There was however a concern about secondary particulate formation.

Secondary particulate is formed in the atmosphere from gases and is in the sub $PM_{2.5}$ classification. Secondary particulate includes sulphates (PSO_4^{2-}) formed from SOx, and nitrates (PNO_3^-) formed from NOx. Reactive organic gases can also form secondary particulate; however, due to the complete combustion conditions associated with the APWL facility; reactive organic gases are less of a concern. The conversion of NOx and SOx to secondary particulate is highly dependent on atmospheric conditions and sunlight. Khoder (2002) concluded that the highest level of PSO_4^{2-} and PNO_3^- occurred during the daytime hours of summer.

RWDI on behalf of Atlantic Power reviewed secondary particulate formation.[lvii] The review concluded that secondary particulate formation was not likely significant as it would be from an isolated source and the precursors would disperse before they had a chance to "form appreciable amounts of secondary PM". RWDI also concluded that the isolated source and meteorological conditions favoured dispersion before NOx and SOx reactions could proceed and where low wind speeds did occur, they tended to occur in winter months where there was low solar influence to facilitate the reactions.

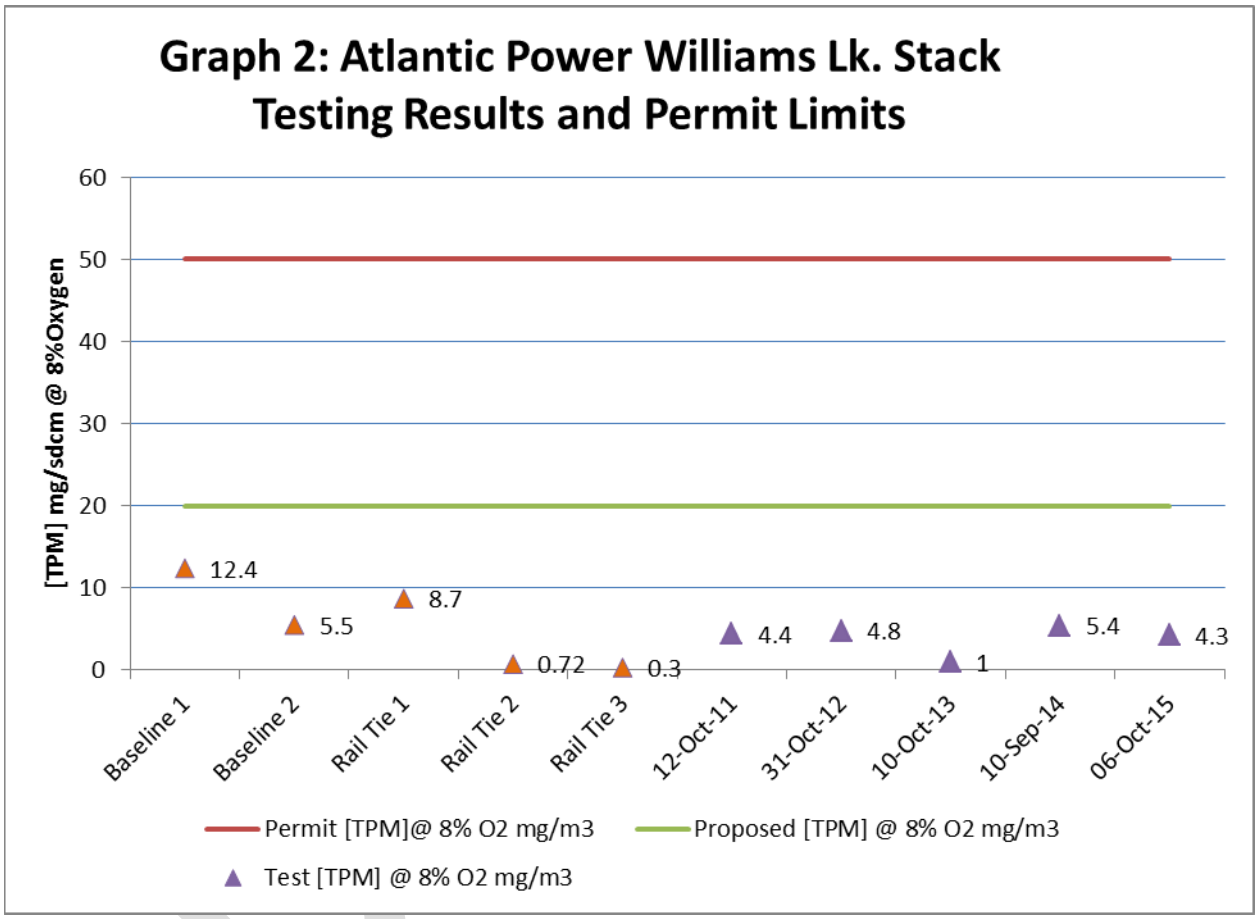
RWDI's assessment is supported by the scientific literature. Khoder observed that the maximum SO_2:PSO_4^{2-} was 28% and NO_2:PNO_3^- was 16.5%.[lviii]. A study by the Desert Research Institute on air pollution found that the median values for conversion of the fraction of NOx to PNO_3^- ranged from 4% to 8 %.[lix] The areas studied by Khoder and the Desert Research Institute were highly polluted with multiple sources of NOx and SOx creating chemically saturated conditions favouring the formation of secondary particulate.

The proponent, in their TAR, uses the argument that the facility's low particulate emission concentration of 2.3 mg/m^3 (3.3 mg/m3 when corrected to 20 degrees C and 8% O_2) during the 100% rail tie test was significantly below the BC guideline of 20 mg/m^3. Review of the 2001 test runs of rail ties identified that there was a dramatic drop in particulate levels between the baseline tests, rail tie test 1 and the final rail tie tests 2 and 3. The results of rail tie tests 2 and 3 were also substantially lower than the subsequent compliance testing (See Graph 2). Given the temperature, oxygen, moisture flow rates remain relatively stable throughout it is likely that the ESP was run for maximum removal efficiency rather than economy as would be the status quo under normal operation. Anecdotally, the five field ESP system is oversized and fully capable of meeting the BAT standard.[lx]

The operational policy *Setting Standards, Policies and Guidelines* (*SSPG*)[lxi] recommends that when setting standards, policies and guidelines, the ministry must/should be positioned for the future "by practicing and promoting continual improvement in response to technological advances, changes in economic and social factors and advances in scientific knowledge and understanding." PM2.5 has been designated as a priority in the Williams Lake Airshed.

The draft permit includes a reduction in total particulate limit to 20 mg/m^3 at 8% oxygen.

Reducing the permit limit to the 20mg/m^3 standard of the BFEP would reduce the primary particulate discharge allowance by approximately 104 tonnes per year. Not only would the lower limit ensure that $PM_{2.5}$ is reduced to best achievable standards, it would improve the recapture efficiency of metals and PCDD/F as more volatile elements tend to concentrate in the fly ash.[lxii] The large surface area to mass ratio of smaller particles results in an enrichment of flyash particles with metals.[lxiii] A similar mechanism has been observed for PCDD/F.[lxiv] The reduction in primary particulate would also serve to offset any uncertainty associated with secondary particulate.



6.1.7. Air Contaminants from Raw Material Handling and Storage

Much of the feedback from the public has focussed on odour issues that resulted from processing ties in the downtown Williams Lake area. Coal tar and crude oil contain naphthalene and other PAHs that are odorous and if in sufficient concentration and duration can impact human health or the environment. The hogging of the end-of-use ties using a high speed grinder would have released these aromatic compounds to the atmosphere, especially under hot summer conditions.

Administratively, the challenge with the processing in the downtown area was that it was conducted by a railway contractor on railway property which was under Federal rather than provincial jurisdiction. Railways can be recalcitrant when it comes to airshed management, but the shredding of ties on the WLPP site and the Director's ability to

impose additional monitoring requirement and impose tighter controls would mitigate most if not all the previous issues.

A study was conducted by United Research Services (URS) on behalf of the Association of American Railroads on the levels of polynuclear organic material (POM) including polynuclear aromatic hydrocarbons (PnAH) in used creosote treated rail ties.[lxv] The study concluded the levels of PnAH and POM to be within the range of PnAH concentrations found in fuel oils. It also observed that the PnAH concentration in coal tar is much higher than used rail ties. Therefore, it could be inferred that the odours emanating from the processing of ties will be less than at a treatment plant such as Stella Jones in Prince George which uses the pure liquid creosote and PCP to treat rail ties. It would also infer that by applying best practices PAH can be controlled.

It was also noted in both the file review and in the consultation process that the storage pile at the facility has a history of spot fires from spontaneous combustion. During a Ministry site visit on December 2, 2015 evidence of a spot fire was observed. A storage pile fire would likely have the incomplete combustion conditions necessary for PCDD/PCDFs formation and lacks sufficient temperature and turbulence for destruction. It is therefore imperative that PCP containing fuel be segregated from the hogfuel pile and be prevented from uncontrolled combustion.

Under the proposed handling methodology, end-of-use ties would be received on site and a maximum of three days' worth of shredded ties would be on site at any one time. This equates to approximately 2300 tonnes based on 80 tonnes/hour feedstock x 40% of total feedstock as rail ties x 24hours/day x 3 days.

According to the proponent, when the shredder manufacturer's facility was toured it was in operation and there was minimal odour observed. With the shredding on site the proponent would need to ensure worker exposure to key PAHs met WorkSafe BC occupational health limits which by proxy would safeguard the public.

Increasing the amount of tie material that may be incinerated makes the investment in improved handling and storage infrastructure viable. If the permit is not amended to allow for increased rail tie incineration then it is recommended that an internal amendment requiring changes to how shredded material is currently handled and stored be initiated.

According to the proponents TAR, the preliminary design of the rail-tie handling system includes:

- Receipt of whole ties and unloading with a grapple arm;
- Covered conveyors for shredded materials;
- Skirtboards below the shredders discharge chute;
- Enclosed chutes;
- Enclosed storage of shredded ties; and
- Low speed shredder.

Requiring that a QP certify a plan that meets BC Fire Code standards will ensure that the materials are managed in accordance with best practices and will also provide a tool to Compliance Officers in the event of spontaneous combustion.

6.1.8. Waste Oil From Spills

The 2012 version of the permit requires that hydrocarbon contaminated wood residues to be incinerated in accordance with section 52 of the HWR. Under Section 52, the Director must be satisfied that the waste will not pose a threat to human health or the environment and is in the public interest.

The disposal of materials from minor spills is done on a Good Samaritan basis by the proponent for the community and is not viewed as a source of fuel. It is to the public's benefit to have carefully controlled disposal as opposed to illegal dumping.

The proposed amendment includes authorization for the acceptance and incineration of up to 872 L/day (four standard drums) of hydrocarbon contaminated materials originating from accidental spills. Authorization would be contingent upon the waste oil meeting the HWR Section 41(5) Waste Oil Specifications for use as fuel. This measure would screen out non-approved materials such as PCBs while ensuring spill material can be safely disposed at the same time as reducing administrative burden.

6.1.9. Air Contaminants from Glue

It was noted in the consultation that there was concern about the incineration of glue containing material as currently authorized in the permit. An analysis by the National Council for Air and Stream Improvement Inc. (NCASI) of polyurethane and phenol-formaldehyde glues identified that the resins emitted the same types and levels of gaseous compounds as when clean wood is burned at a high temperature (735°C+).[lxvi] Methylene diphenyl diisocyante (MDI) would also have a similar fate at the temperatures at the WLPP boiler.[lxvii] There would be no additional pollutants released as a result.

6.1.10. Air Contaminants from Construction Debris

The proponent has applied to include clean construction waste as an authorized fuel with non-biomass components not to exceed 1% of the daily feed in the boiler. Construction debris is on the prohibited list of the Open Burning Smoke Control Regulation (OBSCR) and as a result is generally landfilled with no added benefit. The inclusion in the permit is a formality as the shredding of clean wood waste at a number of the Cariboo Regional District transfer stations and shipping to the power facility has been conducted for over a decade with the MoE's full knowledge.

In its January categorical delist of clean construction debris the EPA specified best management practices including sorting by trained operators and exclusion of non-wood materials including polyvinyl chloride and other plastics, drywall, concrete, aggregates, dirt and asbestos and treated wood or wood treated with lead base paints.[lxviii]

If the construction waste is truly clean then the emissions from the incineration would be little different from that of clean biomass. The presence of paint, plastic and other contaminants has the potential to emit other contaminants of concern. The furnace has sufficient time, temperature and turbulence to mitigate most contaminants and the

adoption of applicable elements of the SWCG into the permit would provide protection of human health and the environment.

6.1.11. Contaminants from Narcotics and Drug Paraphernalia

Historically, law enforcement authorities have disposed of confiscated narcotics and drug paraphernalia by incinerating at the Williams Lake and other similar BC facilities. The practice is safe, produces no discernable additional emissions and is in the public interest.

The inclusion in the draft permit of up to 4 m^3 per month clause is from the LP Fort Saint John permit (17751).

6.2. Solid Waste

6.2.1. Ash

Ash from the combustion process would be the primary solid component associated with this amendment. The CCMEPC states that for waste wood treated with inorganic preservatives, the bulk of the waste can be drastically reduced by incineration. However the ashes would require subsequent disposal, encapsulations or recovery for reuse.[lxix]

Ash from the boiler is collected from two separate places and the characteristics vary according to the location. The ash from the grate or "bottom ash" is the non-airborne residue which falls to the bottom of the boiler and is removed via the hydrograte. The "flyash" is the suspended particulates that are recaptured from the gas stream, primarily through the pollution control works. According to the literature, bottom and flyash have distinctly different properties.

According to Pöykiö et al, "combustion acts like a thermodynamic separation process for the different inorganic materials in the fuel. Elements with a low volatility will concentrate in the bottom ash while more volatile elements will concentrate in the fly ash. The consequence of the separation effect in combustion plants is that the different ash fractions have different chemical compositions.[lxx] The Stantec Waste to Energy Report noted that ash collected from the hearth of a municipal waste incinerator consists mainly of non-combustible residues, and potentially residuals of incomplete combustion which are typically disposed of in a landfill.

Vaporization of metals in the combustion process is followed by condensation on cooler surface away from the heating zone resulting in high heavy metal concentration in fly ash.[lxxi] The literature confirms that fly ash from wood energy systems can contain high levels of cadmium, copper, chromium, lead and arsenic.[lxxii] The ash resulting from chemically treated wood may require stabilization depending on the preservative used.[lxxiii] Ash produced during the combustion of sea salt laden wood, can result high levels of PCDD/Fs and dioxin in the fly ash but not the bottom ash .[lxxiv] A similar outcome would be expected from the inclusion of PCP treated ties. Residues collected from pollution control works (flyash) of municipal waste incinerators contain high levels of soluble salts, particularly chlorides, and trace levels of organic pollutants such as dioxins and furans. [lxxv] PCDD/Fs are immobilized in wood ash and are unlikely to leach out of wood ash due to its absorbent nature.[lxxvi]

According to the 2009 Capital Power facility description ash and solid waste exit the boiler in two ways. Bottom ash falls off the hydrograte into a submerged ash conveyer where it is conveyed into a holding bunker. Flyash from the combustion zone of the boiler is separated from the gas stream by multiclones and ESP and handled separately from the bottom ash. It is therefore possible to segregate, monitor and dispose of the two types of ash separately if needed. The 2001 report does provide details as to the source of the ash tested for PCDD/PCDF and PAH but metals are identified as having come from fly ash.

The SWCG recommends that for waste to energy facilities there must be clearly identifiable solutions for disposal or use of bottom ash and fly ash and if the ash is hazardous it must be managed in accordance with the HWR. A regular monitoring regime for key contaminants in the flyash is therefore included in the draft amendment.

The public consultation process identified the high pH and alkalinity associated with wood ash as a concern. The 2001 test pH range of the ash was 5.15 to 9.73; however. The pH alone is not necessarily an environmental concern if disposed of in a properly designed and monitored landfill. Application of wood ash is also an accepted practice as a liming material for soil amendments.[lxxvii] The pH is not anticipated to change significantly with an increase of rail ties in the fuel; however, the ash would require further analysis to determine suitability for use as a soil amendment.

The PAH content of ash from 2001 trial was similar in concentration and type as untreated wood and were within acceptable limits. The ash PCDD/PCDF content was significantly higher than untreated wood at 788 pg/g (0.788 ppb). The HWR schedule states that waste containing a dioxin TEQ in excess of 100 ppb or a PAH TEQ in excess of 100 ppm by weight is to be treated as a hazardous waste. The ash analysis was well below that threshold. Chlorophenols, Chlorobenzenes and Polychlorinated Biphenyls are expected to mirror the PCDD/PCDF and PAH results because of the similar destruction and formation properties.

The ash was analyzed for metals using procedures adapted from EPA “Test Methods for Evaluating Solid Waste” SW-846 Method 3050B or Method 3051. This is a strong acid method which analyzes the total metal content. The proponent then concluded that extractable metals met the leachate quality criteria under the B.C. Special Waste Regulation but did not provide an explanation on the method used or what the results meant . The HWR and its predecessor use EPA 1311toxicity characteristic leaching procedure (TCLP) as “it is not the total metal concentrations in waste, sludge and other residues which are of prime importance, but rather how easily the metals can be mobilized.[lxxviii] According to section 1.2 of the TCLP procedure, “If a total analysis of the waste demonstrates that individual analytes are not present in the waste, or that they are present but at such low concentrations that the appropriate regulatory levels could not possibly be exceeded, the TCLP need not be run.” There is also the “20:1 rule” (for 100% solids samples as per the TCLP definition), the logic being that if the total metals (strong acid digestion) divided by 20 are less than the TCLP guideline, then the TCLP passes.[lxxix]

By using the strong acid digestion method for metals, the ash analysis would effectively exaggerate the metal concentration. Metal levels within the ash were significantly lower than the HWR limits and therefore there is a good degree of confidence that the ash is

relatively benign. There is a drawback in the sample size used for the strong acid digestion (1g sample for strong acid vs 100 g for TCLP). It is therefore recommended that further sampling be conducted in a prompt manner until sufficient confidence is established that the ash is benign in terms of metal content.

According to section 2.5 of the November 20, 2012 version of the permit, "the residue of combustion shall be removed from the boiler regularly and shall be disposed of on a site and in a manner approved by the Director."

The consultative process for the air permit raised a number of issues pertaining to ash disposal and the existing landfill. Currently the ash is disposed at the proponent's landfill authorized under waste discharge permit 8809 (issued February 22, 1991). The landfill has a comprehensive development and closure plan approved by the director (September 2011) and is operated under the direction of engineering firm (AMEC Foster Wheeler).

The amendment of permit 8808 will in some aspects render permit 8809 ambiguous. According to permit 8809:

> 1.1.2 The characteristics of the discharge shall be typical of fly ash and bottom ash from a biomass fuelled boiler.

Rail ties contain anthropogenic substances and do not meet the strict criteria of biomass. Rail tie ash has previously been disposed of at the site and is a pre-existing authorized use; however, ash may also contain levels of some contaminants that are in excess of Table 1 of Schedule 4 criteria of the HWR and the existing landfill is not registered to receive hazardous waste. Materials with concentrations of the HWR using the TCLP method would need to be excluded.[lxxx] If permit 8808 is amended to increase rail tie component of the feedstock, it is recommended that for the sake of clarity permit 8809 be amended eliminating the term "biomass" from the 1.1.2 and adding provisions to exclude ash that does not meet HWR leachable standards.

The landfill is projected to reach capacity in 2018 and there have been preliminary discussions with the proponent about a possible amendment of permit8809. An amendment of this type would require a separate review and public consultation. Public concerns about siting and management of the landfill would be addressed at that time.

6.3. Effluent

The inclusion of rail ties in the authorized fuel has the potential to affect effluent quality via storm water runoff and ash conveying.

Treated wood can be a source of contaminants [lxxxi] but the effects generally decrease with the age of the material. [lxxxii] The contaminants of main concern are polycyclic aromatic hydrocarbons which are hydrophobic and bond with organic molecules in the environment. They are expected to remain either attached to the wood matrix or in the oils. This reduces their bioavailability and potential toxicity.[lxxxiii] The oily sheen of oil-type preservatives can be contained and collected.[lxxxiv] The solubility of PCP in water is slight; however other Chlorophenols and their sodium salts are soluble in water.

The life expectancy of a railway tie depends on use, location and environmental factors with expected service life of a creosote tie ranging from 30 to 50 years.[lxxxv] APWL will be receiving end-of-life ties that are well aged and present minimal risk when stored intact. Processing old ties by grinding or shredding risks exposes fresh surfaces and with a greater surface area to volume ratio and a therefore more contact to the elements. It is therefore important to minimize the amount of processed material stored on-site and prevent exposure to the elements.

The Proponent proposes to keep unprocessed ties in a covered area thereby preventing exposure to rain and snow thereby preventing leachate formation and contaminated runoff. The draft permit therefore includes requirements that whole ties be protected from exposure to the elements and the storm water management plan is to be updated and approved Qualified Professional.

The proponent proposes to shred whole ties and store up to 72 hours' worth (3000 tonnes) of material in an enclosed bin protected from the elements. This reduces the risk of release of contaminants from the shredded material.

During the consultation period a number of stakeholders expressed concern about contamination and cited cases in Calgary and Washington which were the sites of historical wood treatment facilities. The Williams Lake facility will not be preserving wood nor handling the raw treatment chemicals which were the cause of the aforementioned contaminated sites.

Effluent is also created when ash is collected from the hydrogrates and screened from the liquid. The ash is discharged to a bunker for disposal in the permit 8809 landfill. The effluent from ash conveying and storm water runoff is discharged to the municipal storm water system or the municipal waste treatment facility covered under MWR registration number 255.

6.4. Canada's EPS 1/PG/7 Protocols

The Permittee has applied to have the following requirement dropped from section 3.3 of the permit.

> The continuous emission monitors shall be maintained and audited in accordance with Environment Canada's EPS 1/PG/7 Protocols and Performance Specifications for Continuous Monitoring of Gaseous Emissions from Thermal Power Generation.

According to the proponent, the protocols are intended for fossil fuel burning systems and the continuous emission monitors are subject to Ministry of Environment audits and are also verified by regulatory stack testing. The Permittee has inferred that the requirement isn't included at any of the other bioenergy facilities in the province.

The EPS 1/PG7 protocol[lxxxvi] includes specifications for design, installation and operation of continuous emission monitoring (CEM) systems used to measure releases of SO_2 and NOx from Thermal power generating facilities. The introduction to the protocol states that *"some or all of the concepts and procedures described herein could be used, as appropriate for the measurement and monitoring of SO2 and NOx in other streams or for the measurement of other species, regardless of their origin."* With the burning of rail ties treated with coal tar extracts, similar types of emissions could be expected as from coal fired sources; therefore, the protocol is appropriate to this application.

Furthermore, the permit requires that sampling procedures follow the British Columbia Field Sampling Manual for Continuous Monitoring plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples (BCFSM).[lxxxvii] The BCFSM is as follows:

> ### *1.3 Continuous Emission Monitoring*
>
> *For in-stack continuous emission monitors (CEMs), the Regulatory Agency requires the use of Environment Canada or United States Environmental Protection Agency(U.S. EPA) protocols and performance specifications (as listed in Appendix 7.1),unless otherwise superseded by other Provincial or GVRD requirements.*

And,

> **Appendix 7.1 Parameters and Approved Methods**
>
Parameter	Method	Notes
Continuous Emission Monitoring (certification/QA/QC)	EC d, EPA PS-1 to PS-7	

While other permits may not include the CEM certification/QA/QC as explicit language, it is implicit in the requirement of the standard permit clauses of:

> "Sampling is to be carried out in accordance with the procedures described in the most recent edition of the "British Columbia Field Sampling Manual for Continuous Monitoring Plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples", or by suitable alternative procedures as authorized by the Director;" and
>
> "Analyses are to be carried out in accordance with procedures described in the most recent edition of the "British Columbia Laboratory Methods Manual for the Analysis of Water, Wastewater, Sediment, Biological Materials and Discrete Ambient Air Samples", or by suitable alternative procedures as authorized by the Director."

The BCFSM allows for an alternate procedure e.g., U.S.EPA Performance Specification 2 (PS2) for SO2 and NOx.[lxxxviii] Provincial audits only verify the precision of the instrument doing the actual analysis and do not authenticate the validity of the collection

of the sample. Personal experience is that a sample probe can be plugged or leak and yet the instrument will pass an audit.

The BC Ministry of Environment, Operational Policy Manual Environmental Protection Division: Director of Waste Management Approval of Laboratory Methods, Policy 2.01.10, August 16, 2013 states that the Knowledge Management Branch, Environmental Sustainability and Strategic Policy Division are responsible for the BCFSM and the BCFSM is utilized by the Environmental Protection Division (EPD) in authorizing and verifying compliance. Adherence to the protocol is appropriate in the instance.

The EPS 1/PG7 requirement has been removed from the permit as the requirement is covered by the BCFSM with which the proponent is required to comply.

6.5. Human Health Risk

The proponent commissioned Intrinsik Environmental Sciences Inc. to complete a screening-level human health risk assessment (HHRA) to assess the potential health risks posed to residents of criteria air contaminants, metals, PAH and chlorinated compounds.[lxxxix] Each of these contaminants of potential concern (COPC) were assessed as if sensitive individuals would be found on both a short-term and long term basis at the location of the air modelling maximum point of impingement (a sparsely populated bluff to the North West of the plant). Potential risk was determined by predicting the maximum ground-level air concentrations at the point of impingement and comparing them with both short-term and long-term exposure limits established by regulatory and scientific authorities for the protection of human health.

Cancer risk estimates were determined to be negligible and individual non-carcinogenic exposures did not predict adverse health effects. Respiratory irritant chemical mixtures (primarily NO_2 and SO_2) were the only aspect with any potential to exceed the short-term and long-term exposure limits. [xc]

According to Intrinsik, the mechanism by which combined NO_2 and SO_2 affect sensitive individuals is concentration dependent with effects only being observed when certain threshold levels reached for the individual COPC. SO_2 levels must be sufficiently high enough to overwhelm the protective mucous membranes and enable penetration of the lungs and alveolar spaces before the co-exposure to NO_2 and SO_2 on the respiratory tract becomes additive. The conditions under which this would occur were predicted to be less than 0.05% of the time in the forested area to the northwest of the facility. Intrinsik therefore predicted that exceedances in excess of the threshold level were unlikely to occur and the "assumption of additivity in the assessment of the respiratory irritants mixture, particularly the effects of NO_2 and SO_2 is likely conservative."

COPC were also predicted in soil and compared with the BC's Contaminated Sites Regulation (CSR) numerical soil standards. This assessment found the concentration of each COPC was well below the applicable CSR standard.

Intrinsik concluded that the results of the human health risk assessment showed a "low potential for adverse health effects as a result of the proposed change in fuel mix at the plant."

6.6. Airshed Inversions

The propensity of the Williams Lake air-shed to thermal inversions was frequently identified during the consultative process. The potential air quality impacts due to inversions was taken into consideration with the RWDI air modeling and therefore, the human health risk assessment.

The requirement of an ambient monitoring program in the draft permit will help determine if further mitigative measures are required.

6.7. Risk and Cumulative Effects

In addition to the information from the HHRA, in a recent decision[xci] the Environmental Appeal Board found that the *Environmental Management Act* (EMA) does not contemplate that permits may only be approved if there is zero risk to the environment. Harm or damage that may be caused by emissions should be controlled, ameliorated and where possible eliminated; however, not all harm or damage will be eliminated. The board also found that EMA does not require the consideration of cumulative effects of emissions from other facilities.

7. Monitoring and Reporting

The draft permit moves routine monitoring reporting from a 30 and 60 day reporting cycle to an annual one for purposes of administrative efficiency.

The initial verification testing and non-compliance reporting would be done on a shorter cycle to verify compliance and protect the environment.

8. General Assessment

It should also be noted that the 5% limit was on an annual basis and did not restrict the daily quantity of treated rail tries that could be incinerated. Nor were there any limits imposed for contaminants within the discharge or segregation requirements for tie materials from other biomass creating a further hazard from PCDD/PCDFs in the biomass pile.

The following is a synopsis of potential environment issues identified in the draft amendment and steps to be undertaken to reduce risk in the event the amount of rails allowed to be burned is authorized.

Aspect	Location	Mitigation or Control	Verification
Metals	Stack	Exclude metal based treated ties and contaminated construction debris from incineration. Exclude telephone and power poles. Establish discharge limits for metals based on HWR. Reduce particulate discharge limit.	Receiving procedure and analysis of discharge. Verify through stack testing and compliance inspection.
SOx levels in excess of AAQO	Stack	Impose discharge limit equivalent to 50% rail ties based on modelling.	CEM of discharge for SOx. Ambient monitoring.
NOx levels in excess of AAQO	Stack	Not impacted by rail tie incineration. Continue with existing discharge limit. Require ambient monitoring at a location yet to be determined to verify if NOx is an issue.	Continue CEMs. Require ambient modelling.
Organic Compounds (PCDD/PCDF, PAHs)	Stack	Establish a minimum combustion zone temperature requirement of 1000°C. Adopt SWCG limits for PCDD/PCDF, PAHs, and Chlorophenols. Accept only clean construction debris. Continuous monitoring of HCl to detect elevated levels of chlorine in feed stock.	Stack testing. CPM monitoring of CO and Temp.
Anhydrous hydrochloric acid.	Stack	Establish a limit for HCl based on SWCG.	CEM monitoring. Compliance Inspection. Ambient monitoring.
Particulate. Organic Compounds (PCDD/PCDF, PAHs)	Fuel Pile Fires	Require separate storage for whole and shredded rail ties and biomass. Updated plan to prevent fires.	Compliance Inspection Include BC Fire Code to allow enforcement

Aspect	Location	Mitigation or Control	Verification
Particulate	Stack	Decrease particulate limit to reflect actual operational capability, BAT.	Stack sampling. Continuous opacity measurement.
Odour and PAH control	Processing of ties	Shred ties on site only. Include suspension of incineration clause if, in the opinion of the director, it becomes a problem. Maximum three days of shredded material on site at any one time.	Compliance Inspection
Metals	ESP and cyclone ash	Testing of ash and comparison with HWR to ensure proper disposal. Amend permit 8809 to exclude hazardous waste. Exclude ties treated with metal based preservatives and contaminated construction debris.	Ash analyses. Compliance inspection.
Organic Compounds (PCDD/PCDF, PAHs)	ESP and cyclone ash	Testing of ash and comparison with HWR to ensure proper disposal. Exclude contaminated construction debris. Possible amendment of 8809 to exclude hazardous waste.	Ash analyses. Compliance inspection.
pH	Fly and bottom ash	Will not change with inclusion of rail ties. Permit 8809 is authorized to receive this material already.	Groundwater monitoring at 8809 landfill.
Organic Compounds (PCDD/PCDF, PAHs, hydrocarbons)	Effluent	QP prepared updated storm water management plan. Rail tie material to be protected from the elements.	Testing of discharge.
Discontinue CEMs protocol	Monitoring	Delete from permit but do not exempt from BCFSM table 7.	Compliance inspection
Spill Material	Stack	Require to adhere to HWR section 41(5) waste oil specifications and limit to six barrels per day.	Compliance inspection

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9. Compliance

The proponent generally has a good record of permit compliance. With the exception of fugitive dust issue in 2015 (which resulted in a fugitive dust management plan) no other non-compliances were noted since 2013.

Compliance and enforcement would continue to follow the BC Ministry of Environment's Operational Policy Manual, Environmental Protection Division Section 7.0, subsection 7.01.01 and the Compliance Policy and Procedure Manual.

10. Best Achievable Technology

APWL retained RWDI to complete a best achievable technology (BAT) study for acid gas emissions from the plant.[xcii] The study reviewed both wet and dry scrubbing. Wet scrubbing was eliminated from the review as the water demand of the system was not appropriate for the local supply capacity. Duct sorbent injection (DSI), furnace sorbent injection (FSI), selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) were also reviewed and would have resulted in a prohibitive increase in costs to the facility. The modelling indicated that the burning of rail tie material would not result in an exceedances of the BC AAQO or the Ontario Ambient Air Quality Criteria for HCL. As a result,RWDI recommended that using emission control limits was a more preferred option; in particular adding an SO2 stack emission limit to a revised permit.

11. Permittee Review

Place Holder
The permittee was provided an opportunity to review the draft Ministry Assessment and Permit on the DATE

The following items were contentious……

12. Recommendations

Place Holder
Based on this assessment it is recommended that …….

13. Calculations

Test

Permit Standard Conditions

Temperature Correction= flow x (273+20)/(273+25) e.g. 5920 m^3/min x 293/298=5821 m^3/min

Oxygen Correction = [Concentration] mg/m^3 x (20.9-8)/(20.9-11) e.g. 6.1 mg/m^3x12.9/9.9=7.94 mg/m^3

[Permit Flow]= test flow m^3/sec x [concentration] / 110 m^3/sec e.g. 224.1 mg/m3 x94.6 m^3/sec / 110 m^3/sec =192.6 mg/m^3

Test Date	04-Apr-01	05-Apr-01	06-Apr-01	Average @100% Railtie	Adjusted for 110 m^3/sec (Permit Flow)	Estimated 50% rail tie and permit flow	Draft Permit Limit	**SWCG Daily average at 8% O2**	**SWCG1/2 hour average at 8% O2**
Flow: m^3/min @ 25C, 101.3 kPa, 0% H_20	5920	5790	5600	5770					
Flow: m^3/min @ 20C, 101.3 kPa, 0% H_20	5821	5693	5506	5673	6600	6600	6600		
Flow: m^3/sec @ 20C, 101.3 kPa, 0% H_20	97	95	92	94.6	110	110	110		
[TPM] mg/m^3 @25C 11% O_2	6.1	0.5	0.2	2.3					
[TPM] mg/m^3 @20C 8% O_2	7.9	0.7	0.3	3.0	2.5	2.5	20.0	**12**	**36**
[HCl] mg/m^3 @25C 11% O_2	51.1	75.8	52.4	59.8					
[HCl] mg/m^3 @20C 8% O_2	66.6	98.8	68.3	77.9	66.9	33.5	78	**13**	**78**
[SO_2] mg/m^3 @25C 11% O_2	157	203	156	172					
[SO_2] mg/m^3 @20C 8% O_2	204.6	264.5	203.3	224.1	192.6	96.3	110	**65**	**248**

Test	1	2	3	Average @100% Railtie	Adjusted for 110 m^3/sec (Permit Flow)	Estimated 50% rail tie and permit flow	Draft Permit Limit	**SWCG Daily average at 8% O2**	**SWCG1/2 hour average at 8% O2**
Sample Volume @ 25C, 101 kPa, 0% H_20	3.829	3.879	2.847	3.5					
Sample Volume @ 20C, 101 kPa, 0% H_20	3.765	3.814	2.799	3.459					
[Chlorophenols] µg/m^3 @25C 11% O_2	0.071	0.148	0.053	0.091					
[Chlorophenols] µg/m3 @20C 8% O2	0.093	0.193	0.069	0.118	0.102		1.0	**1.3**	
[PAH] µg/m^3 @25C 11% O_2	0.071	0.029	0.075	0.058					
[PAH] µg/m3 @20C 8% O2	0.093	0.038	0.098	0.076	0.065		6.5	**6.5**	
Sample Volume @ 25C, 101 kPa, 0% H_20	3.829	3.879	2.847	3.518					
Sample Volume @ 20C, 101 kPa, 0% H_20	3.765	3.814	2.799	3.459					
[PCDD/PCDF] ng/m^3 @25C 11% O_2	0.003	0.0061	0.0012	0.003					
[PCDD/PCDF] ng/m3 @20C 8% O2	0.004	0.008	0.002	0.004	0.004		0.1	**0.1**	

14. Summary of Changes to Discharge

		Permit 2012-11-12	Draft, June 2016	Permit 2012-11-12	Draft, June 2016		
Rate of Discharge	m^3/second	110	110	**Loading (tonnes/year)**	**Loading (tonnes/year)**	**Change**	**Limit Source**
Total Particulate	mg/m^3 at 8% O_2	50	20	174	69	-104	WFCE
SOx as SO_2*	mg/m^3 at 8% O_2	9.5	110	33	382	349	RWDI Modelling
NOx	mg/m^3 at 8% O_2	320	320	1111	1111	0	WFCE
HCl	mg/m^3 at 8% O_2	0	78	0	271	271	SWCG
Class 1 metals	mg/m^3 at 8% O_2	0	4.7	0	16	16	HWR Sched 2
Class 2 metals	mg/m^3 at 8% O_2	0	0.9	0	3	3	HWR Sched 2
Class III metals	mg/m^3 at 8% O_2	0	0.2	0	1	1	HWR Sched 2
PCDD/F TEQ	ng/m^3 at 8% O_2	0	0.1	0.0	0.00000035	0.00000035	SWCG
Chlorophenol	$\mu g/m^3$ at 8% O_2	0	1.3	0.0	0.0045	0.0045	SWCG
Chlorobenzene	$\mu g/m^3$ at 8% O_2	0	1.3	0.0	0.0045	0.0045	SWCG
PAH	$\mu g/m^3$ at 8% O_2	0	6.5	0.0	0.0226	0.0226	SWCG
Opacity	%	10%	10%				WFCE

Note: Permit November 12, 2012, and previous iterations allowed use of railtie material as feedstock without restricting loading of SO2, HCl, Metals,PCDD/F, CP, CB or PAH. Values are from the Permit Fees schedule.

15. Appendix A Air Quality Meteorologist Assessment

Peter Lawrie
Senior Environmental Protection Officer
Northern Region
Prince George
Via email

File:PA-8808

Date: 25th May, 2016

Peter:

Summary and recommendations

Atlantic Power Corporation has applied for a permit amendment to increase the proportion of railway ties used as fuel at their power station in Williams Lake from 5% to 50%. Should the amendment be approved it is anticipated that there would be an increase in the discharge of sulphur dioxide (SO2), hydrogen chloride (HCl), polycyclic aromatic hydrocarbons (PAH) and other contaminants from the facility as a result. The following report is the Ministry of Environments Meteorologist's assessment of the modelling portion of the proponents technical assessment report (TAR),

I have reviewed the description of the dispersion modelling and I have found no errors or omissions that would significantly affect the output from the models.

The modelling indicates that the contaminant that would have the highest increase in ambient concentration is SO2. Based on conservative estimates of background concentrations, it is unlikely that BC interim AAQO for SO2 would be exceeded.

The two other contaminants that are predicted to increase significantly are HCl and PAH. Given the absence of other sources of these compounds in the Williams Lake airshed, existing ambient levels are anticipated to be low enough that the discharges at the Atlantic Power facility would not cause any exceedances of the applicable protective guidelines.

Other contaminants of concern in the airshed, respirable particulate matter (PM) and nitrogen dioxide (NO2) are not expected to change due to the change in firing rate of railway ties.

Due to uncertainties contained within the modelling and the original 2001 source testing report, I recommend the following:

- Discharge limits be included in the permit as a method of control.
- That as soon as feasible, stack testing is completed at the maximum firing rate allowed in the amended permit The initial stack tests would be used to confirm that the emission rates used in the modelling and this assessment are appropriate.
- That an ambient monitoring programme be developed by the proponent, which will be approved by the director, to confirm that that ambient levels of SO2, PAH and HCl in the airshed are below levels of concern.
- That the proponent be required to participate in an ambient monitoring programme with other stakeholders in the airshed to investigate the spatial variability of PM2.5 and NO2.

Background

Atlantic Power Corporation has applied for a permit amendment to increase the proportion of creosote and pentachlorophenol (PCP) railway ties used as fuel at their power station in Williams Lake. The current permit has a limit of 5% railway ties and the amendment application requests an increase to 50%. RWDI was retained by Atlantic Power to perform dispersion modelling to estimate the effect of changes in the amount of railway ties used as fuel on ambient air quality in the Williams lake Airshed. The CALMET-CALPUFF modelling system was used. The key inputs to the CALPUFF dispersion model were the emission rates of various pollutants measured during tests conducted in 2001 when railway ties comprised 100% of the fuel used. Based on the results of these stack tests it was determined that only a subset of the pollutants of concern that were tested for changed when the facility switched from woodwaste to railway ties as fuel: sulphur dioxide (SO2), Hydrogen Chloride (HCL), polycyclic aromatic hydrocarbons (PAH), dioxins and furans, chlorophenol and heavy metals. Particulate matter and oxides of nitrogen did not change when the fuel was switched from woodwaste to railway ties.

In order to estimate the emission rates when 50% of the fuel is comprised of railway ties from the stack tests conducted at 0 and 100%, RWDI assumed that there was a linear relationship between firing rate of ties and increases in the pollutants listed above that changed when ties were used as fuel. This is a reasonable assumption but should be confirmed through source monitoring.

During the review process additional information was requested by the ministry from RWDI, these resulted in a number of revisions to the modelling which resulted in changes to the original model estimates. The final estimates used in this assessment were received on April 22nd; due to a change in stack height, all values changed from the original dispersion modelling report dated 8th September, 2015, and the April 22nd, 2016 addendum.

Documents referred to in this review

I have referred to the following documents in this review:

Atlantic power Corporation Williams Lake Power Plant, Final Report, Air Dispersion Modelling Study. RWDI # 1500355 dated 8th September, 2015. This report presents the results of the CALMET-CALPUFF modelling. This document is referred to in my review as the modelling report.

Supplementary Modelling Results and MOE Information Request Atlantic Power, Williams Lake Power Plant. RWDI #1500355 dated April 22nd 2016. Memorandum from Jeff Lundgren at RWDI to Ralph Adams at MoE supplying additional information requested by Ministry. This document is referred to in my review as the modelling addendum.

Letter dated May 19th, 2016 from Jeff Lundgren at RWDI to Ralph Adams MOE. This letter describes the hourly ozone data used in the modelling report addendum for the estimation of NO2 concentrations.

Transcanada Power Emission Survey Report, Regular Wood Waste and Railtie Waste. Prepared by Lanfranco and Associates Inc. for Transcanada Power, dated November 2001. This document is also supplied as an appendix to the modelling report. The document describes the stack sampling and results undertaken in 2001 using wood waste and 100% railway ties as fuel for the facility. This document is referred to in my review as the 2001 stack test.

CALPUFF Modelling for the Williams Lake Airshed. Prepared for the Ministry of Environment by Levelton Consultants Ltd., and dated June 21st, 2005. This report describes the results of the CALPUFF modelling of the Williams lake Airshed including all known sources. This document is referred to in my review as the Levelton report.

Scope of this review

This review is only concerned with the emissions from the stack which carries the exhaust of the electrostatic precipitators treating the boiler emissions. Fugitive dust and other emissions from other facility operations are not considered.

I have not reviewed the emission factors used in the dispersion modelling, nor the 2001 stack testing, as this is outside of my area of expertise. I am informed by my colleagues in the Ministry that the values have been checked and are appropriate (Peter Lawrie, pers. comm.). I have checked that the exit velocity estimates used as input to the CALPUFF model have been correctly calculated, based on the 2001 stack test flow measurements.

Finally, this review is restricted to those contaminants that are expected to change if the facility uses railway ties for fuel. The key inputs to the CALPUFF

dispersion model were the emission rates of various contaminants measured during tests conducted in 2001 when the railway ties comprised 100% of the fuel used. Based on the results of these stack tests it was determined that only a subset of the contaminants of concern that were tested changed when the facility switched from woodwaste to 100% railways ties as fuel: sulphur dioxide (SO2), Hydrogen Chloride (HCL), polycyclic aromatic hydrocarbons (PAH), dioxins and furans, chlorophenol, and heavy metals. Particulate matter and oxides of nitrogen did not change when the fuel was switched from woodwaste to railway ties. This review also assumes that the maximum firing rate of railway ties is 50% . I have included a brief review of existing PM and NO2 levels in the Williams lake Airshed as Appendix 1.

Amendments to modelling results

Over the period that this application has been under review a number of changes were made in the modelling which resulted in significant changes in maximum ground level concentrations.

On March 1st, 2016 I wrote a memorandum to Peter Lawrie requesting that RWDI supply additional information on the distribution of NO2 and SO2 levels, and estimates of PM2.5 concentrations based on the maximum permitted stack limits rather than the values from the 2001 stack test that were used in the modelling report. This information was supplied on April 22nd, as the April modelling addendum.

However, while preparing the information I had requested, RWDI noticed that an error had been made in the stack base height used in the model . When the CALPUFF model was rerun using the correct stack base height it was found that the maximum predicted concentrations of all parameters had decreased by 10 to 20% depending on the time averaging of the statistic. The decreases are expected as maximum ground level concentrations are sensitive to effective stack height. The higher a release relative to the ground, the longer it will take for the plume to be carried to the ground and therefore the higher the dispersion will be, resulting in lower concentrations at ground level. New tables were prepared to replace tables 6, 7 and 8 in the September modelling report. In the remainder of this document I have referred only to the revised values included in the April modelling addendum.

In addition to the change in stack base height, the method of calculating NO2 levels was changed. In the CALPUFF modelling the ozone limiting method (OLM) was used to estimate the conversion of NO to NO2. The maximum ozone concentration measured at the Columneetza air station was used as the value for the OLM. When the CALPUFF model was rerun to include the higher stack base height a more refined method for providing ozone concentrations to the CALPUFF model was used. The hourly values measured at the Columneetza station were used rather than the maximum hourly value. This change resulted in significantly lower modelled estimates of maximum ground level concentrations in the April modelling addendum compared to the September modelling report.

The use of hourly zone data from a representative station in the OLM is acceptable to the ministry. However, when it is used, the proponent is asked to include a summary of the hourly data used in the modelling and a brief discussion of how representative the hourly data used is to represent the concentrations encountered by the plume. On May 4th, 2016 I sent a letter to Jeff Lundgren at RWDI requesting the additional information on the hourly ozone data. The requested data was received on May 22nd, 2016. After reviewing the information supplied I concluded that the revised NO2 levels included in the April modelling addendum were acceptable.

In summary, all references to ground level concentrations in this review, and the appendix, refer to those reported in the April modelling addendum.

Discussion

Dispersion modelling and modelling results.

I have reviewed the description of the dispersion modelling and I have found no errors or omissions that would significantly affect the output from the models. The CALMET model was run using WRF modelled mesoscale meteorological data and the MoE and Environment Canada surface stations as inputs. This is considered the most desirable and refined method of running the CALMET model. When checking CALMET model output, predicted windroses, the distribution of stability classes, and representative plots of modelled windfields and mixing heights under unstable, stable and neutral atmospheric conditions are often used. These are shown as Figures 1, 2, 3, 4 and 5 in the September modelling report . None of these diagnostic plots indicated any other concerns with the CALMET model. In addition, the isopleth maps showing the distribution of pollutant maxima are realistically aligned with prevailing winds. The model output also clearly shows the influence of topography. The maximum ground level concentrations tend to occur 1 to 2 km to the North West of the stack on the sparsely inhabited hillside. This behaviour is expected when dealing with a hot buoyant plume from a high stack close to elevated terrain. When the plume is carried toward the terrain, there is little time for dispersion to dilute the plume. When the plume is carried toward lower terrain, the plume is well diluted by the time it reaches the ground resulting in much lower maximum ground level concentrations.

Figure 1. Extract of British Columbia 1:20,000 map-sheet 093B020. North is at top of map, grid squares are 1 km in size and contour interval is 20m. Location of power plant is indicated by red arrow. The steep terrain to the NW of the plant is where the dispersion model predicts maximum ground level concentrations to occur.

Of the contaminants that are expected to change if the firing rate of railway ties is increased, only sulphur dioxide (SO2), hydrogen chloride (HCl) and polycyclic aromatic hydrocarbons (PAH) result in ambient concentrations of more than a

fraction of a percent of the appropriate AAQO. ThereforeSO2, HCl and PAH are the contaminants of concern in this review. The increases in ground level concentrations for these pollutants are shown below in table 1. The averaging periods, statistics used, and a discussion of the AAQOs used may be found in the September modelling report and the April modelling addendum. Where there is no appropriate BC AAQO, the AAQO used in Ontario were used: this is acceptable practice.

The values presented in table 1 are the maximum values of the statistics that are predicted anywhere in the modelling domain. The maxima for all the statistics are predicted to occur on the hillside to the NW of the stack, as described above. The modelling indicates that values decay rapidly away from the point of the maximum predicted concentrations. For instance, in the case of the 99th percentile of the daily maximum hourly SO2 concentration, the maximum is predicted to be 94 $\mu g/m^3$. At the Columneetza air station approximately 2.6 km away to the SE of the predicted maximum, the value has dropped to 17 , less than 10% of the AAQO. Similar patterns would exist for all modelled parameters. This suggests that the maximum predicted concentrations are a conservative estimate of the concentrations that would be expect in the residential areas of Williams Lake.

Contaminant	50% railway ties ($\mu g/m^3$)	AAQO ($\mu g/m^3$)	% of AAQO at 50% railway ties
Sulphur Dioxide	93.7	200	47
Hydrogen Chloride	5.9	20	30
PAH (hourly)	0.000005	0.00005	10
PAH (annual)	0.000001	0.00001	10

Table 1: Maximum ground level concentrations without background levels added. These values are copied from tables 6 and 8 of the April modelling addendum and include effects of increased stack base height. Note that the values for HCl and PAH were not provided for 50% railway ties in the April modelling addendum, they were calculated by dividing the values for 100% in half.

Background air quality levels.

There are no background measurements in the Williams Lake airshed for the contaminants listed in table 1. I have not been able to locate any measured values of PAH or HCl in any BC airsheds. However, I am informed that there have been no previous concerns with these contaminants in even heavily industrialised airshed in BC .

SO2 levels are usually a concern near large industrial point sources such as smelters, pulp-mills and cement plants. However, there are also many other sources of SO2 that are common in our airsheds, mostly associated with combustion . Industrial sources include asphalt plants, biomass fueled boilers and kilns, and non-industrial sources such as space heating with both natural gas and wood. Therefore all airsheds can be expected to have some levels of SO2 in the ambient air.

Although SO2 measurements have never been undertaken in Williams Lake, there are two sources of information that can be used to estimate the values in the Williams lake Airshed. In 2005 Leveton Engineering, under contract to the ministry, ran the CALMET-CALPUFF model suite with a large number of sources around the airshed included. The objective was to estimate air quality levels for a number of contaminants and also investigate the spatial distribution of the contaminants. The report included SO2.

SO2 is measured in many airsheds in BC where there are large sources of SO2 such as pulp-mills, smelters, and cement plants. It is very unusual for SO2 to be measured in an airshed which does not contain large industrial point sources; however, SO2 was measured in Vernon for a number of years as part of an investigation into the potential effect of railway locomotive idling on ambient air quality. Vernon has no large industrial point sources and can be used as an estimate of values expected in an interior airshed without such sources. Kamloops has both a pulp mill and a cement plant and Quesnel has a pulp mill, these airsheds can be used as examples of an airshed in similar topographic and weather conditions to Williams Lake airshed. The Interim BC AAQO for SO2 (99th percentile of daily maximum hours) are shown in Table 2 for the period when measurements were made in Vernon.

Year	Vernon ($\mu g/m^3$)		Kamloops ($\mu g/m^3$)	Quesnel ($\mu g/m^3$)
2004	2	15		
2005	2	16		
2006	2	17	17	
2007	1.8	22.3	21	
2008	2.1	21.2	17	
2009	3.5	16.4	24	
2010	3.1	14.2	30	
Mean for period		2.3	17.4	23

Table 2. Values of the Interim BC SO2 AAQO for the years 2004 to 2010 for several interior airsheds. Kamloops and Quesnel have large industrial sources of SO2; Vernon has no large industrial sources. The values were calculated using data down-loaded from the Ministry Envidas database. The change in number of significant figures reported for the Vernon and Kamloops stations is due to changes in instrument technology at those sites. All values are in $\mu g/m^3$

The current levels in the Williams lake airshed are expected to lie between those measured in Vernon and Kamloops. Vernon has no industrial sources of SO2, but Williams Lake has some including the asphalt plant and various biomass fuelled boilers, including the existing Atlantic power emissions due to combustion of woodwaste . However, as Williams Lake does not have the large industrial point sources (pulp-mills and cement plant) that Kamloops and Quesnel have, it is expected that Williams Lake would be more similar to Vernon than to Kamloops and Quesnel.

Assuming a worst case estimate that Williams lake had an existing background SO2 level similar to Kamloops and Quesnel (both towns having sulfate kraft mills which are significant sources of SO2 averaged 20 µg/m3), adding this to the maximum value shown in table 1 (97 µg/m3) would result in a predicted maximum value including background of 117 µg/m3. This is still well below the AAQO for SO2.

In 2005, when Levelton modelled the Williams lake Airshed, the Provincial AAQO for SO2 was based on the maximum hourly SO2 concentration; the interim AAQO adopted in 2015 uses a different statistic, the 99th percentile of the daily maximum hourly values. Therefore the 2005 Levelton report does not include the new interim objective. An isopleth map of the maximum 1-hour concentration is shown as Figure B-3 on page 55 of the Levelton report. It is included below as figure 2.

Figure 2. Isopleth map of predicted 1 hour maximum SO2 concentrations extracted from the Levelton report.

The figure shows that the maxima are all located to the NW of the community in the industrial area at the foot of the elevated terrain. The shape of the isopleth contours indicate a single local source is the main contributor to the hourly maxima in the 50 to 1000 µg/m3 range. The most likely source is the asphalt plant included in the Levelton CALPUFF modelling . The hourly maximum concentration is expected to be significantly higher than the statistic used for the SO2 interim AAQO (the 99th percentile of the daily maximum 1 hour concentration). Examination of the statistics calculated for the Kamloops Federal station for the period 2011 to 2015 suggest that the 99th percentile of the daily maximum hourly values vary from 50 to 60 percent of the hourly maximum for the year.

As discussed above, the area where the highest levels of SO2 would occur if the change to firing railways ties occurs is the elevated terrain to the NW of the Atlantic Power facility. Based on the isopleths shown in figure 2, there is the potential for the plumes form the asphalt plant to be superimposed on the plume from the Atlantic power facility. The maximum 1 hour values in figure 2 occur in similar locations to where the maximums for the Atlantic Power facility are located. Although unlikely , it is possible that superposition of the plumes could occur. The values shown in figure 2 for the asphalt plant are those less than 100 µg/m3. Assuming that this corresponds to a range of up to 60 µg/m3 for the 99th percentile of the daily hourly maximum, and adding this to the maximum value due to the proposed Atlantic power facility of 94 µg/m3 results in a maximum predicted value including the conservative background estimate of 154 □gm-3. This value is well below the interim ambient objective of 200 µg/m3

The April report prepared by RWDI did not include SO2 background levels as there are no ambient measurements available for Williams Lake. However, using conservative estimates of background SO2 concentrations based on measurements in other BC communities and the results of the Levelton

CALPUFF modelling in 2005. The sum of the predicted values and the background values are well below the BC Interim Objective, even at the point of maximum predicted concentrations.

Monitoring requirements.

As discussed above, the 2001 stack tests conducted when the facility was firing 100% railway ties are key to the modelling and modelled estimates of ambient air quality impacts. In addition, the assumption that the emission rates of certain contaminants is linearly related firing rate is also important for the modelled estimates of ambient air quality impacts. Another source of uncertainty is the lack of spatially resolved background measurements for many of the contaminants of concern. The plant is currently operating and no significant changes are required to change the firing rate of railway ties; this supplies an opportunity to test the effect of the proposed changes.

In my opinion, the most reliable method of confirming if the proposed changes in firing rate are likely to have an effect on ambient air quality is through a rigorous regimen of stack and ambient testing. Such testing would confirm both that the values used in the modelling were correct, and that the ambient levels were similar or less than the modelled estimates.

Stack testing would confirm that stack concentrations from the 2001 stack tests used in the modelling were correct. As the maximum rate of firing requested is 50%, stack testing at that rate would also confirm the assumption that the emission rate of certain parameters was linearly proportional to the firing rate. These test should be conducted at the maximum firing rate authorised, and a soon as is feasible after the change in firing rate is implemented.

The contaminants for which concentrations are expected to increase significantly (that is, result in concentrations greater than fractions of a percent of the appropriate AQQO) in the ambient environment are SO2, HCl and PAH . The proponent should develop an ambient monitoring plan to confirm that the values predicted by the modelling are not exceeded. This plan must be approved by the director.

The Atlantic Power facility is also a significant point source of PM2.5 and NO2. These contaminants are not expected to change if the firing rate of railway ties increases and have therefore not been considered in this review. However, they are of concern in the airshed and it is the intent of the ministry to make changes to the monitoring network in the Williams lake airshed to examine spatial variability of these contaminants. The proponent should be required to participate in an ambient monitoring partnership that includes the ministry, the municipality, and other industrial permittees. This partnership would replace the existing partnership that Atlantic Power is currently participating in.

Conclusions and Recommendations
My review leads me to conclude that, should the amendment be granted and the firing of railway ties increased to 50%, there would be an increase in

concentrations of some contaminants (SO2, HCL and PAH) in the airshed, but that none of these increases would exceed current air quality objectives. The predicted increases in all other contaminants expected to change due to the amendment all result in ambient concentrations that are less than 0.5% and most less than 0.01% of the appropriate AAQO; therefore, I have not included them in my review. Two other contaminants of concern in the airshed are PM2.5 and NO2, in both cases these are not expected to change due to the proposed increase in railway tie firing rate and I have not included them in this review.

The contaminant that results in the highest increase is SO2, where the firing of 50% railway ties, without background, is estimated to result in maximum ambient concentrations that are 47% of the interim BC objective of 200 $\mu g/m^3$. There are no background measurements of SO2 available for the Williams lake airshed; however, using conservative estimates of background SO2 concentrations based on measurements in other BC communities and the results of the Levelton report, it is unlikely that BC interim AAQO for SO2 would be exceeded even at the point of maximum impingement on the elevated terrain to the NW of the Atlantic facility.

The other contaminants that are predicted to increase due to the proposed amendment are HCl and PAH. The predicted maximum increase for these contaminants, without background concentrations added, would result in maximum predicted levels that are 30 and 10% of the applicable AAQO for HCl and PAH respectively. There are no ambient measurements of these contaminants in the Williams lake airshed. I have not been able to locate any measurements of ambient HCl and PAH for any airsheds in the province. Therefore it is not possible to estimate background levels of these contaminants. However, given the absence of sources of these compounds in the Williams lake airshed, it is very unlikely that there would be existing levels high enough to result in exceedances even if the increases due to changes at the Atlantic Power facility occur.

While my review indicates that it is unlikely that the proposed changes at the Atlantic facility would result in any significant changes in ambient air quality in the Williams lake Airshed, there is uncertainty both due to the assumptions used in the dispersion models, the emission rates used in the modelling, and the lack of background measurements of HCl and PAH. The emission rates used in the modelling are based on the 2001 stack testing conducted at 100% railway tie firing rates. There are therefore two assumptions implicit in the modelling; that the 2001 stack testing is still valid for current conditions, and the assumption that there is a linear relationship between contaminants other than TPM and NO2 and the firing rate of railway ties.

In my opinion the most reliable way of addressing these uncertainties is through a regimen of stack and ambient monitoring. If the amendment is granted I recommend the following:

- Discharge limits be included in the permit as a method of control.

- That as soon as feasible, stack testing is completed at the maximum firing rate allowed in the amended permit The initial stack tests would be used to confirm that the emission rates used in the modelling and this assessment are appropriate.
- That an ambient monitoring programme be developed by the proponent, which will be approved by the director, to confirm that that ambient levels of SO2, PAH and HCl in the airshed are below levels of concern.
- That the proponent be required to participate in an ambient monitoring programme with other stakeholders in the airshed to investigate the spatial variability of PM2.5 and NO2.

Sincerely,

Ralph Adams.
Monitoring, Assessment, and Stewardship
Environmental Protection

APPENDIX 1

PM and NO2 in the Williams lake Airshed.

Much of the material in this appendix is taken from a review of PM and NO2 in the Williams lake airshed currently being completed by the ministry. The objective of this review is to develop reccomendations for changes to the monitoring network in Williams Lake which currently consits of a full AQHI capable air station at the Columneetza School, a meteorology tower on the roof of the Candian Tire store, and a number of Partisol non-continous PM intruments . In this appendix I have only considered those parts of the review that are related to the effect of the Atlantic Power facility on ambient air quality.

As discussed in my review the proposed changes in firing rate of railway ties at the Atlantic Power facility are not expected to have effect on emissions of PM or NO2. Therefore the contribution of emissions from the facility to ambient air quality will not change. Information on PM2.5 and NO2 was requested from the proponent to assist in the general review of the airshed now underway.

Particulate matter

Like most interior communities, PM10 and PM2.5 levels are of concern. The statistic used to evaluate PM10 is the 98th percentile of the daily averages. The BC Objective is 50 $\mu g/m^3$ and the Williams lake Airshed Plan has set a target of 40 $\mu g/m^3$. The values measured at the Columneetza station over the past years are shown in Figure 3.

The effect of wildfires has been removed. There is little indication of a trend, and values are near the airshed plan target of 40 $\mu g/m^3$. The Levelton airshed modelling study in 2005 showed a significant increase in PM10 associated with the industrial sources spread along the south to west margin of the community. Partisol PM10 monitors were run for several years at the Golf course and at the site of the Glendale School. The relationship of daily values between the Partisol sites and the Columneetza air station were very poor showing that local sources predominate at all stations. In general the magnitude of the values at the Golfcourse were similar to those at Columneetza, but those at the Glendale School were higher than Columneetza .

Figure 3: Annual PM10 statistics measured at the Columneetza air station. The effect of wildfires has been removed.

The Atlantic Power facility does not have a significant effect on PM10 levels in Williams Lake. The September modelling report shows that over 86% of the PM10 emitted by the facility is in the PM2.5 fraction. The predicted maximum 24 hour concentration due to the facility is 0.37 $\mu g/m^3$. This is an extremely small component of the background level of 40 $\mu g/m^3$ shown in figure 3.

Results for PM2.5 are similar. However, the trend in PM2.5 is confounded by the change in monitoring technology that has occurred over the last three years. The TEOM sensors have been replaced by Sharp sensors using beta attenuation. The new monitors are better able to capture the volatile fraction of PM2.5, especially in the winter. This has resulted in an apparent increase in PM2.5 levels in most airsheds in the interior of BC. The BC annual objective for PM2.5 is 8 $\mu g/m^3$. The measurements since 1998 are shown in Figure 4. The effect of wildfires has been removed. There is an indication of a downward trend from 2002 to 2010; levels have remained nearly constant since then. The apparent increase due to the new Sharp sensors is clearly seen in 2014 and 2015. However, even with the new sensors, the values are close to the provincial objective and lower than those for other communities in the interior of BC such as Quesnel, Kamloops and Vernon.

Figure 4: Annual average PM2.5 levels measured at the Columneetza air station. The old TEOM sensors are indicated by blue, the new Sharp monitors by yellow. The effect of wild-fires has been removed.

The effect of wildfires has been removed. There is little indication of a trend, and values are near the provincial of 40 $\mu g/m^3$. Partisol PM2.5 monitors were run for several years at the Firehall. The relationship of daily values between the Firehall and the Columneetza air station were very poor showing that local sources predominate. In general the magnitude of the values at the Firehall were greater than those at Columneetza (the average values for 2013 to 2015 were 8.6 and 7.7 $\mu g/m^3$ for the Firehall and Columneetza respectively). This is expected as

the Firehall is affected by numerous local industrial sources. For comparison, the average values at the Firehall as slightly lower than those measured at the Federal Station in downtown Kamloops.

The Atlantic Power facility does not have a significant effect on PM2.5 levels in Williams Lake. Based on the April addendum, report the predicted maximum annual concentration due to the facility is 0.05 μg/m³. This is an extremely small component of the background level of 8 μg/m³ shown in figure 4.

The Levelton report attempted to model the spatial distribution and magnitude of PM2.5 in the Williams lake airshed. An isopleth map of the predicted annual PM2.5 concentrations are shown in Figure B-20 of the Levelton report. The values predicted at the Columneetza station are greater than 15 but less than 30 μg/m³. As figure 4 shows the measured value is approximately 8 μg/m³ or half the lowest predicted value. The Levelton report also indicates that annual average PM2.5 due to secondary particulate levels in the Williams Lake airshed are less than 1 μg/m³ except around the location of the Asphalt plant. This indicates that in the modelling, SO2 is driving secondary particulate formation. As noted by RWDI in the April modelling addendum, there is no relationship between predicted secondary particulate levels and NO2 levels, which would be expected if NO2 was a significant component of the secondary particulate formation.

Nitrogen Dioxide

Nitrogen dioxide emissions are not expected to change if the firing rate of railways ties is increased. Therefore, no change in ambient NO2 levels are expected in the airshed. NO2 is not currently an issue of conern in the Wiliams lake airshed. The 98th percentile of the daily hourly maximums in 2015 was 61 μg/m³. This is well below the annual objective of 188 μg/m³. The April modelling addendum indicates the maximum value due to the operation of the Atlantic Power facility is 85.2 μg/m³. The background value is usually added to the predicted maximum. However, in this case the facility was operating during the period that the background was measured at the Columneetza air station. In the April modelling report this is referred to by RWDI as double counting; however they do not attempt to estimate the magnitude of the effect. In the April addendum report the predicted maximum for the closest grid receptor to the Columneetza station is given as 16.7 μg/m³. This indicates that approximately a quarter to a third of the background measured at Columneetza may be due to “double counting” of existing Atlantic Power emissions.

The discussion of the spatial variability of Atlantic Power impacts above also apply here. It is likely that the maximum values of NO2 in the community are significantly less than those predicted on the elevated terrain to the NW of the facility. As with SO2, there is little indication of exceedances of the BC Interim NO2 objective.

However, I am recommending that monitoring be conducted to confirm that NO2 levels are not a concern in the residential areas near the Atlantic Power facility.

16. End Notes and References

[i] Hamilton, R., Letter to Eric Flanagan, EPCOR Utilities Inc Re: Permit PA-)8808 issued in the name of NW Energy (Williams Lake) Corp., November 8, 2005
[ii] Hamilton, R. Ministry Assessment Internal Amendment, March 11, 2010
[iii] Capital Power Corporation Williams Lake Power Plant Description, 26, 10, 2009
[iv] Environment Canada, Industrial Treated Wood Users Guidance Document
[v] Keyston Environmental Resources Ltd. The Impact of Open Burning Railway Ties in British Columbia, Prepared for BC Ministry of Environment, March 1991
[vi] Stephens, R.W., Brudermann, G.E., Chalmers, J.D., Canadian Council of Ministers of the Environment Provisional Code of Practice for the Management of Post-Use Treated Wood, September 1996 pg. 10 and pg 60-61
[vii]U.S. EPA, 40 CFR Part 241 6560-50-P Notice Additions to List of Section 241.5 Categorical Non-Waste Fuels. March 24, 2014 Pg 13
http://www3.epa.gov/epawaste/nonhaz/define/pdfs/nhsm-proposed-amendments-prepub.pdf
[viii] Haroz, H. and Haroz A., Waste-To-Energy : MACT's Effect on Spent Railway Ties and Other Treated Wood. *Waste Advantage Magazine*, August 10, 2015 (accessed November 12, 2015. http://wasteadvantagemag.com/waste-to-energy-boiler-macts-effect-on-spent-railway-ties-and-other-treated-wood/
[ix] U.S. EPA,Frequent Question about the Final Rule: Additions to List of Categorical Non-Waste Fuels, website https://www.epa.gov/rcra/frequent-questions-about-final-rule-additions-list-categorical-non-waste-fuels, accessed March 14, 2016
[x] Smith, Stephen T,., 2014 Railroad Ties Survey Report, April 6, 2015
[xi] Stephens, R.W., Brudermann, G.E., Chalmers, J.D., Canadian Council of Ministers of the Environment Provisional Code of Practice for the Management of Post-Use Treated Wood, September 1996
[xii] Environment Canada, Industrial Treated Wood Users Guidance Document, September 2004 , pg. 5
[xiii] U.S.EPA, AP42, Fifth Edition, Volume 1 Chapeter 1: External Combustion Sources, Bituminous and Subbitumious Coal Combustion Section , Technology Transfer Network, http://www3.epa.gov/ttnchie1/ap42/ch01/ accessed January 11, 2016 Chap 1.1-1
[xiv] U.S. EPA CLU-IN, Dense Nonaqueous Phase Liquids Multi-Component Waste-Creosote https://clu-in.org/contaminantfocus/default.focus/sec/dense_nonaqueous_phase_liquids_(dnapls)/cat/environmental_occurrence/p/6/n/2, pg 1
[xv] U.S.EPA, Project Summary,-Incineraton of Creosite and Pentachlorophenol Wood Preserving Wastewater Treatment Sludges. Pg. 2
[xvi] KMG, KMG Supports AWPA Guidelines for Creosote Retention in Wood Railroad Cross ties, http://kmgchemicals.com/category/wood-treating-chemicals/ accessed March 22, 2016
[xvii] Science Lab, Sodium Borate MSDS. http://www.sciencelab.com/msds.php?msdsId=9924968
[xviii] Environment and Climate Change Canada, Chapter I – Inorganic Boron (Borate) Wood Preservation Facilities, https://www.ec.gc.ca/pollution/default.asp?lang=En&n=E74D2327-1&offset=5 and www.ec.gc.ca/pollution/default.asp?lang=En&n=84EE00A8-1&offset=1 Accessed March 29, 2016
[xix] Bolin, C.A., Smith, S.T., End-of-life Management of Preserved Wood: The Case for Reuse for Energy, AquAeTer, November 2010 wwpinstitute.org/documents/Final_EndofLifeManagementofPreservedWood3_2010.11.15.pdf
[xx] Environment Canada, Industrial Treated Wood Users Guidance Document, September 2004 , pg. 5

[xxi] Lebow, S., Tippie, MM., Guide for Minimizing the Effect of Preservative-Treated Wood on Sensitive Environments. Gen Tech Rep FPL GTR-122. Madison, WI; U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, 2001
[xxii] Lombard, B., Kubiczki, J., New Hampshire Department of Transportation, Research-Synthesis of Wood Treatment Alternatives for Timber railroad Structures Final Report: New Hampshire DOT Research Record, December 2011
[xxiii] Beauchemin, P., Tampier, M, Emissions from Wood-Fired Combustion Equipment prepared for BC Ministry of Environment, Envirochem Services Ltd. June 30, 2008
[xxiv] [xxiv] BC Ministry of Environment , Combustion of Municipal Solid Waste Fact Sheet-Air Emissions, August 2011.
[xxv] U.S. EPA Integrated Plan for Review of the Primary National Ambient Air Quality Standards for Sulfur Oxides. October 2006, Pg. 1
[xxvi] MACTEC, Evaluating the contribution of PM2.5 Precursor Gases and Re-entrained Road Emissions to Mobile Source PM2.5 Particulate Matter Emissions, accessed January 13, 2016 http://www3.epa.gov/ttnchie1/conference/ei13/mobile/hodan.pdf
[xxvii] Plain, E., BC Ministry of Environment, Inventory of Common Air Contaminants Emitted in the Williams Lake Airshed for the Year 2000, May 2002
[xxviii] Crozier Consulting and Services, Kraft Pulp Mill Emission Guidelines and Standards Pre-scoping Final Report: A Jurisdictional Review, Prepared for the Ministry of Environment, March 2007
[xxix] BC Environmental Protection Division, Operation Policy Manual: Coal-fired Power Boiler Emission Guidelines 2.09.05, April 16, 2009
[xxx] Stantec, Waste to Energy: A Technical Review of Municipal Solid Waste Thermal treatment Practices, Prepared for Environmental Quality Branch Environmental Protection Division March 2011 Pg. 3-2.
[xxxi] Alberta Government, Alberta Ambient Air Quality Objectives and Guidelines Summary, August 2013. http://environment.gov.ab.ca/info/library/5726.pdf
[xxxii] Standards Development Branch Ontario Ministry of the Environment, Ontario's Ambient Air Quality Criteria, April 2012
http://www.airqualityontario.com/downloads/AmbientAirQualityCriteria.pdf
[xxxiii] Lundgren, Jeff, Supplementary Modelling Results and MOE Information Request Atlantic, Williams Lake Power Plant Williams Lake, British Columbia-Revisionsto Original Assessment-Attachment 1, RWDIAIR Inc., April 22, 2016
[xxxiv] Keystone Environmental Resources Ltd., The Impact of Open Burning Railway Ties in British Columbia, Prepared fo: British Columbia Ministry of Environment, March 1991. Pg. 2-4 and 3-1
[xxxv] Canadian Council of Ministers of Environment, Canadian Water Quality Guidelines for the Protection of Aquatic Life: Polycyclic aromatic hydrocarbons (PAHs). In : Canadian Environmental Quality Guidelines, 1999
[xxxvi] Pakpahan, E.N Isa, M.H., Kutty, A.M., Effect of Temperature on the Formation and Degradation of Polycyclic Aromatic Hydrocarbons, International Conference on Emerging Technologies in Environmental Science and Engineering, October 26-28, 2009 Allgarh India
[xxxvii] Salthammer, T., Klipp, H. and Peek, R.D., Formation of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) during the combustion of impregnated wood. The International Research Group on Wood Preservation IRG/WP 95-50019, 1995
[xxxviii] U.S.EPA, AP42, Fifth Edition, Volume 1 Chapeter 1: External Combustion Sources, Bituminous and Subbitumious Coal Combustion Section , Technology Transfer Network, http://www3.epa.gov/ttnchie1/ap42/ch01/ accessed January 11, 2016 Chap 1.1-1
[xxxix] Duo, W. and Leclerc, D., Thermodynamic and Kinetic Studies of Dioxin Formation and Emissions from Power Boilers Burning Salt-Laden Wood Waste, Pulp and Paper Research of Canada, Chemosphere April 30, 2007.
[xl] Canadian Councils of Ministry of EnvironmentCanada-wide Standards for Dioxins and Furnans-Pulp and Paper Boilers Burning Salt Laden Wood, Waste Incineration, Iron Sintering Plants, Steel Manufacturing Electric Ar Furnaces and Conical Municipal Wast Combustion Progress Report, 2009
[xli] Jansson, Stina, Thermal Formatin and Chlorination of Dioxins and Dioxin-Like Compounds, Umea University Department of Chemistry, 2008, pg 11.
[xlii] ECO2, Compliance Testing Report Coastland Wood Industries: PCDD/PCDF Emission Survey Hog Fuel Boiler, March 27 & 28, 2008

[xliii] Environment Canada, Summary Report for a Test Burn of Chlorophenol Contaminated Wood Wastes at Northwood Pulp Mill, Prince George, B.C., July 1989
[xliv] Stantec, Waste to Energy: A Technical Review of Municipal Solid Waste Thermal treatment Practices, Prepared for Environmental Quality Branch Environmental Protection Division March 2011 Pg. V.
[xlv] Waddell, G., Technical Assessment Atlantice Power Preferred Equity Ltd. Williams Lake, BC Permit Amendment, February 24, 2016
[xlvi] Baukal, C., Everything You Need to Know About NOx, Materials Today Nov. 10, 2006 www.materialstoday.com/metal-finishing/features/everything-you-need-to-know-about-nitric-oxides/
[xlvii] Enovity, Boiler NOx Emissions and Energy Efficiency Presentation prepared for Boiler Operators and Facility Managers. 2010 http://www.boilerenergyefficiency.com/forms/Boiler_NOx_and_Energy_Efficiency_2010.pdf
[xlviii] Salthammer, T., Klipp, H., Peek, R.D. and Marutzky, R. Emissions from the Combustion of Wood Treated with Organic and Inorganic Preservatives, Internation Research Group on Wood Preservation: Section 5 Environmental Aspects IRG/WP 94-50019, 25 Annual Meeting May 29-June 3, 1994
[xlix] Beauchemin, P., Tampier, M, Emissions from Wood-Fired Combustion Equipment prepared for BC Ministry of Environment, Envirochem Services Ltd. June 30, 2008 pg. 11
[l] U.S. EPA Clean Air Technology Center, Technical Bulletin: Nitrogen Oxides (NOx) What and How They Are Controlled,Triangle Park, NC, November 1999.
[li] Sharma, M., Shya, K., Tripathi, S.N. and Behera, S.N., Role of Atmospheric Ammonia in the Formation of Inorganic Secondary Particulate Matter: A Study in Kanpur, India, J. Atmos Chem (2007) 58:1-17
[lii] Bergeron, B., Sulley, B., Wong, M., Atlantic Power Corporation Williams Lake Power Plant- Best Achievable Technology Study, RWDI AIR Inc., May 17, 2016
[liii] Bergeron, B. Lundgren, J., et al, Atlantic Power Corporation Williams Lake Power Plant Final Report: Air Dispersion Modelling Study, RWDI Project 1500355, September 8, 2015
[liv] Lundgren, Jeff-RWDIAIR Inc., Supplementary Modelling Results and MOE Information Request Atlantic, Williams Lake Power Plant Williams Lake, British Columbia-Attachment :Secondary Formation Discussion, April 22, 2016
[lv] Pitman, R., Wood Ash Use In Forestry-A Review of the Environmental Imapcts, Forestry, Vol 79, No. 5 2006 pgs. 563-588.
[lvi] U.S. EPA 40 CFR 258.20-Procedures for Excluding the Receipt of Hazardous Waste, https://www.law.cornell.edu/cfr/text/40/258.20, Accessed February 4, 2014
[lvii] Lundgren, Jeff, Supplementary Modelling Results and MOE Information Request Atlantic, Williams Lake Power Plant Williams Lake, British Columbia-Attachment :Secondary Formation Discussion, RWDIAIR Inc., April 22, 2016
[lviii] Khoder, M.I., Atmospheric Conversion of Sulfur Dioxide to Particulate Sulfate and Nitrogen Dioxide to Particulate Nitrate and Gaseous Nitric Acid in an Urban Area, Chemosphere 49 (2002) 675-684
[lix] Watson, J.G. et al, Northern Front Range Air Quality Study Final Report; Prepared for the Office of the Vice President for Research and Information Technology-Colorado State University, Desert Research Institute, Reno Nevada, June 30, 1998.
[lx] BC Ministry of Environment, Operational Policy Manual Environmental Protection Division, Biomass-Fired Electrical Power Generation Fact Sheet-Air Emissions.
[lxi] BC MOE, Setting Standards, Policies and Guidelines: Operational Poly Manual Environmental Protection Division Section 1.01.03, February 8, 2010
[lxii] Poykio et al, Extractability of Heavy Metals in Cyclone Ash, Proceedings of the Estonian Academy of Sciences 2008, 57, 2, 100-106
[lxiii] Smith, R.D., Campbell, J.A. and Nielson, K.K., Mechanisms for Trace Elemnt Enrichment in Fly Ash During Coal Combustion , Physical Sciences Deprtment Battelle, Pacific Northwest Laboratories
[lxiv] Pitman, R., Wood Ash Use In Forestry-A Review of the Environmental Imapcts, Forestry, Vol 79, No. 5 2006 pgs. 563-588.
[lxv] URS, Evaluation of Used Railroad Ties Treated with Creosote fo Polynuclear Organic Material (POM) Which Includes Polynuclear Aromatic Hydrocarbons (PAH): Prepared to Association of American Railroads, January 28, 2013

[lxvi] Lama, Illich, National Council of Air and Stream Improvement, Memos to Kevin Warkentin, Subject Combustion of Cured MDI and Combustion of Cured PF, May 11, 2014 and May 12, 2014,
[lxvii] Lama, Illich, National Council of Air and Stream Improvement, Memos to Kevin Warkentin, Subject Combustion of Cured MDI and Combustion of Cured PF, May 11, 2014 and May 12, 2014,
[lxviii] U.S. EPA,Frequent Question about the Final Rule: Additions to List of Categorical Non-Waste Fuels, website https://www.epa.gov/rcra/frequent-questions-about-final-rule-additions-list-categorical-non-waste-fuels, accessed March 14, 2016
[lxix] Stephens, R.W., Brudermann, G.E., Chalmers, J.D., Canadian Council of Ministers of the Environment Provisional Code of Practice for the Management of Post-Use Treated Wood, September 1996 pg. 60
[lxx] Pöykiö, R., Rönkkömà, H., Nurmesniemi, H., Tenno, T., Paama, L., Extractability of Heavy Metals in Cyclone Ash. Proceedings of the Estonian Academy of Sciences, 2008, 57, 2, 100-106
[lxxi] Hakila, P., Utilisation of Residual Forest Biomass.. Springer Series in Wood Science, Springer Verlag, Berlin, 568 pp. as cited in Pitman, R.M., Wood Ash Use in Forestry-A Review of the Environmental Impacts, Forestry, Vol 79, No. 5, 2006. Doi:1010.1093 November 1, 2006
[lxxii] Pitman, R.M., Wood Ash Use in Forestry-A Review of the Environmental Impacts, Forestry, Vol 79, No. 5, 2006. Doi:1010.1093 November 1, 2006.
[lxxiii] Alberta Government, Chemically Treated Wood Waste, Acceptable Industry Practices, February 2012
[lxxiv] Luthe, C. and Prahacs, S.Dioxins from Pulp Mill Combustion Processes: Implications and Control. Pulp and Paper Canada. 94 227-236 as cited in Pitman, R.M., Wood Ash Use in Forestry-A Review of the Environmental Impacts, Forestry, Vol 79, No. 5, 2006. Doi:1010.1093 November 1, 2006
[lxxv] Stantec, Waste to Energy: A Technical Review of Municipal Solid Waste Thermal treatment Practices, Prepared for Environmental Quality Branch Environmental Protection Division March 2011 Pg 10-3
[lxxvi] Pitman, R., Wood Ash Use In Forestry-A Review of the Environmental Imapcts, Forestry, Vol 79, No. 5 2006 pgs. 563-588.
[lxxvii] Chirenje, T. and Ma, L.Q., Impact of high-Volume Wood-Fired Boiler Ash Amendment on Soil Properties and Nutrients, Commun.Soil Sci Plant Anal., 33(1&2), 2002 pg 1-17.
[lxxviii] Poykio, R. et al, Leachability of Metals in Fly Ash from a Pulp and Paper Mill Complex and Environmental Risk Characterization for Eco-efficient Utilization ff the Fly Ash as a Fertilizer. Chemical Speciation and Bioavailability (2005), 17(1)
[lxxix] Austin, J., Personal Communication, request: Metals in ash and the HWR limits, 2016-03-24
[lxxx] Stantec, Waste to Energy: A Technical Review of Municipal Solid Waste Thermal treatment Practices, Prepared for Environmental Quality Branch Environmental Protection Division March 2011 Pg 10-18
[lxxxi] Lebow, S., Tippie, MM., Guide for Minimizing the Effect of Preservative-Treated Wood on Sensitive Environments. Gen Tech Rep FPL GTR-122. Madison, WI; U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, 2001
[lxxxii] Brooks, K.M., Polycyclic Aromatic Hydrocarbon Migration from Creosote-Treated Railway Ties into Ballast and Adjacent Wetlands. Re. Pap. FPL-RP-617. Madison, WI: U.S. Department of Agriculture, Forst Service, Forest Products Laboratory. 2004 http://www.woodcenter.org/docs/fpl_rp617.pdf
[lxxxiii] Brooks, K.M., Polycyclic Aromatic Hydrocarbon Migration from Creosote-Treated Railway Ties into Ballast and Adjacent Wetlands. Re. Pap. FPL-RP-617. Madison, WI: U.S. Department of Agriculture, Forst Service, Forest Products Laboratory. 2004 http://www.woodcenter.org/docs/fpl_rp617.pdf
[lxxxiv] Lebow, S., Tippie, MM., Guide for Minimizing the Effect of Preservative-Treated Wood on Sensitive Environments. Gen Tech Rep FPL GTR-122. Madison, WI; U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, 2001
[lxxxv] Zarembski, A.M. Wood Tie Life: Pt. I-Averaqge Tie Life. Railway Track and Structures. 86: 17-18, 1990 as quoted in Brooks, K.M., Polycyclic Aromatic Hydrocarbon Migration from Creosote-Treated Railway Ties into Ballast and Adjacent Wetlands. Re. Pap. FPL-RP-617. Madison, WI: U.S. Department of Agriculture, Forst Service, Forest Products Laboratory. 2004 http://www.woodcenter.org/docs/fpl_rp617.pdf

[lxxxvi] Environment Canada, Environmental Protection Service, Environmental Technology Centre, Emissions Research and Measurement Division: Protocols and Performance Specifications for Continuous Monitoring of Gaseous Emissions from Thermal Power Generation, December 2005
[lxxxvii] Clark, M.J.R. (Editor), British Columbia Field Sampling Manual for Continuous Monitoring Plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, Ministry of Water, Land and Air Protection, Victoria, B.C.2003 edition http://www.env.gov.bc.ca/wsd/data_searches/field_sampling_manual/field_man_pdfs/fld_man_03.pdf
[lxxxviii] U.S. EPA Technology Transfer Network Emission Measurement Center, Performance Specification 2 and Procedure 1 for SO2 and NOx www3.epa.gov/ttn/emc/prompspec2.html
[lxxxix] Phillipps, K., Assessment of the Human Health Risks Associated with the Proposed Changes in the Emissions from the Williams Lake Power Plant, From the Williams Lake Power Plant, Intrinsik Environmental Sciences Inc., January 12, 2016
[xc] Koppe, B. and McFarland, C., Commentary on the Supplementary Air Dispersion Modelling Results for the Proposed Changes to the Fuel Mix at the Williams Lake Power Plant from a Public Health Perspective, Intrinsik Environmental Sciences Inc., May 26, 2016
[xci] BC Environmental Appeal Board, 2013-EMA-007(g) and 2013-EMA-010(g) Emily Toews and Elisabeth Stannus v. Dirctor, Environmental Management Act (Rio Tinto Alcan Inc., Third Party) Decision Date December 23, 2015
[xcii] Bergeron, B., Sulley, B., Wong, M., Atlantic Power Corporation Williams Lake Power Plant-Best Achievable Technology Study, RWDI AIR Inc., May 17, 2016