

5 December 2014

Responses to:

An Open Letter to Bob Clark, Leveraged Green Energy

Dear Mr. Calverley, Sherman Hub readers and everyone that will read this,

Thank you in advance for the opportunity to address these additional 15 questions from the Sherman Hub. We believe this is an opportunity to bring 21st Century Green Technology to Hamilton with far more environmentally beneficial waste transformation into renewable energy than is currently being used in Hamilton.

This information in this note will be posted on the Port Fuels & Materials Services, Inc. (PFMSI) web site (www.PFMSI.com). I will also use the opportunity to address some questions and/or comments from other attendees at the last Open House on 13 November 2014 and include them at the end of this reply.

I will reply directly after the questions that are shown in “*Italics*” below. Some of the questions may be very technical in nature. I will respond first in summary form and then in a more detailed technical response.

Dear Mr. Clark,

I have received the following questions from a local resident. I am wondering if you would please review these with your team and advise us of the answers? I will be sure to post your answers onto our Sherman Hub facebook page where this open letter and these questions have just been posted.

*Thank you very much.
Steve Calverley*

My concerns about the Energy from Waste facility being proposed for Hamilton are as follows:

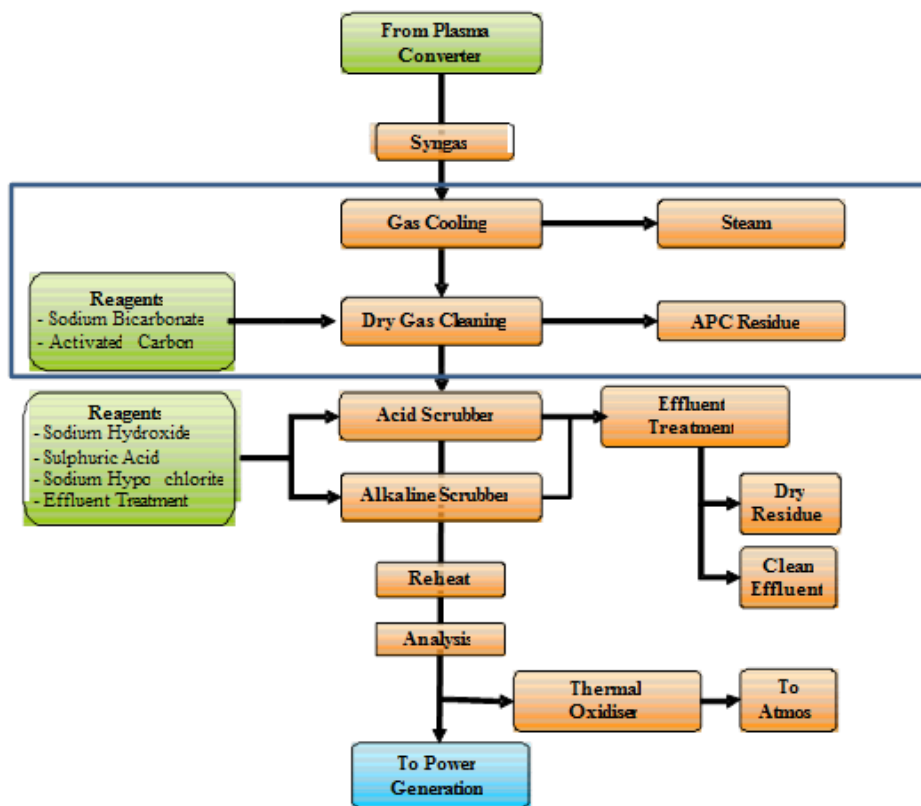
1. Municipal solid Wastes contain heavy metals such as Lead, Cadmium and Mercury. In a fluidized bed gasification system, the temperature is high enough that these heavy metals will be vapourized and carried along with the syngas. When cooled, Lead and Cadmium will solidify and could possibly be removed by some reliable methods but at this time, I have not heard that they are doing anything about these metals. Mercury will continue along with the syngas and if not removed will be combusted and released to the atmosphere. What techniques will be used to ensure that Mercury is not released?

#1 Response: As background for the audience, a “heavy metal” is usually defined as any metal or metalloid of environmental concern. The term originated with reference to the harmful effects of cadmium, mercury and lead, all of which are denser than iron (and therefore heavier). It has since been applied to any other similarly toxic metal, or metalloid, regardless of density.

Inorganic materials (recyclables) are not expected nor desired in the Gasplasma® process since they do not have calorific value (CV) that are normally associated with organic material. The recyclable metal pieces that are collected will be removed during the fuel preparation. For the limited amount of metals that may remain in the waste stream, even if they include heavy metals, the Gasplasma® process can treat these very effectively.

In general, various metals and their compounds will behave in different ways. Metals with a higher affinity to oxygen than iron, such as aluminum (Al), magnesium (Mg) and calcium (Ca) are oxidized and dissolved in the Plasmarok®, a slag-like beneficial aggregate product that is going to be hereunder referred as Plasmarok®.

Volatile metals that were asked in this question, such as mercury (Hg) and Thallium are evaporated and leave the gasifier as a vapor and will be captured and cleaned with injection of activated carbon in the gas phase.



Any residual inorganics are melted in this process inside the plasma converter and bound as Plasmarok® will form a glass-like material along with the metals that are not

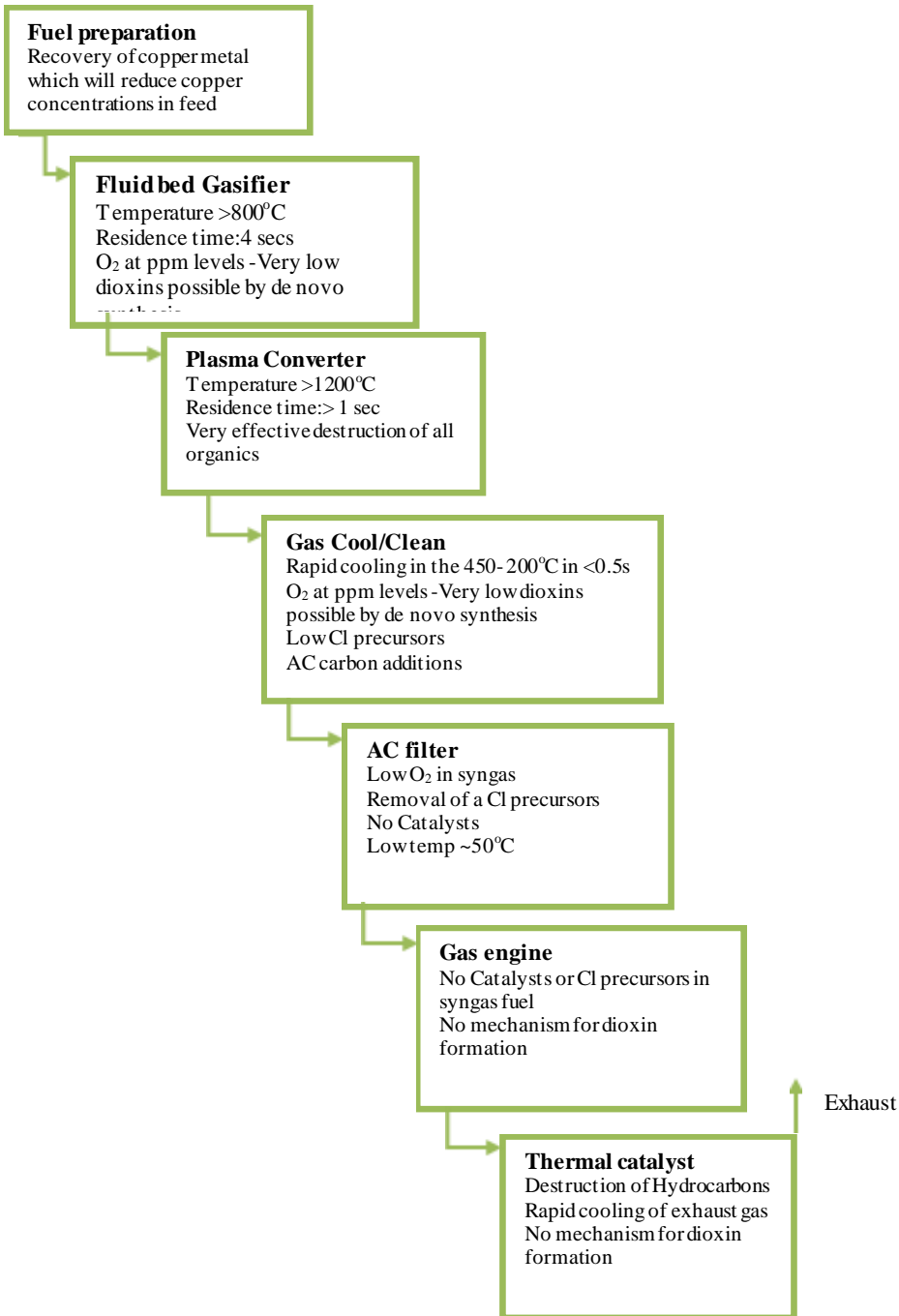
separately recovered. Contrary to the high volumes of bottom ash and fly ash associated with incineration and other technologies that requires disposal and/or additional treatment, Plasmarok® has a positive value. The residue is vitrified, inert, and non-leachable. This product is recyclable as an aggregate. It can be used for road construction, buildings or other beneficial uses.

A schematic of our process is presented on the previous page and is discussed in more detail as follows:

- Activated carbon and sodium bicarbonate sorbents are added up-stream of the filter to remove volatile heavy metals (i.e. Hg, Cd and Thallium) and HCl/SO₂ acid gases respectively. It has been confirmed that the HCl concentrations are reduced by 90%-96% and SO₂ reductions of 90%. The heavy metal removal efficiencies will be in the range of 80 to 99%. These emissions control technologies are state-of-the-art and designed to meet and favorably exceed the air limits requirements in Ontario.
- Mercury will be captured in the ceramic filter after the plasma converter. The mercury vapors will be adsorbed in the very active surface of the injected activated carbon, removed from the filter and disposed of properly. Activated carbon injection will be monitored and adjusted to ensure compliance with Ontario air standards.
- The syngas temperature and the addition type and rate of activated carbon will be adjusted to ensure the required efficiency of removal to achieve the final emissions limits.

2. PVC plastics will be present in the waste. These plastics gasify into Vinyl Chloride unless a catalyst is used to break the Vinyl chloride down into syngas and HCl. If the Vinyl Chloride is combusted (either in an engine or a flame), there is a probability that some dioxins will be formed and released to the atmosphere. What technology is being used to ensure that this is not occurring?

- PVC plastics will be removed from the feedstock and recycled in the fuel processing and preparation area.
- Wet scrubbing system (Acid and Alkaline scrub): The wet scrubber circuit will achieve removal efficiencies of: ~96% for H₂S, 90-96% for residual SO₂/HCl following dry scrubbing, and 99%+ removal of ammonia.
- A schematic of the gas plasma process flow sheet shows the dioxin mitigation measures that are present at each stage of the process. (see next page)



The process schematic shows key stages in the Gasplasma® process and the operating conditions at each stage which either destroys or prevents the formation of dioxins

It is seen that there will be very high destruction efficiency at the thermal treatment stage of the process. In the plasma converter, the high temperature combined with the intense ultra violet light from the plasma arc, with a gas phase residence time of >1 second,

provides an ideal environment for the very effective destruction of dioxins and other complex organic species.

Subsequently, formation of dioxins in the cooling and cleaning train is minimised by rapid cooling of the syngas through the temperature range of approximately 450°C down to 250°C, to avoid prolonged exposure in the temperature range known to favor dioxin and furan formation.

Downstream of the gas cleaning there is no mechanism under which dioxin formation may occur.

3. Rubber tires are being proposed as part of the feed stock. Rubber in tires is vulcanized for durability and gasification will produce Hydrogen Sulfide which in low concentrations is obnoxious smelling but in higher concentrations is toxic, flammable and explosive. Since it is heavier than air, it can concentrate aground level and travel into lower levels to reach deadly and explosive concentrations. Some electrical generating systems, such as the Jenbacher are easily damaged by such compounds and also will not combust it and hence will release Hydrogen Sulfide to the environment because of its burn rate compared to Hydrogen. What techniques will be used to remove this, knowing that Plasco has failed in their attempt to mediate this problem?

Rubber tires are listed as a possible fuel source and only a small percentage of the overall waste fuel supply would ever come from tires (max 15%). See previous responses above for various cleaning processes that reduce the levels of H₂S. The expected level of H₂S in the clean syngas is less than 10 parts per million (ppm) and is proven to be suitable for use as a fuel. In addition, all major companies who sell electrical engines or turbines have provided guarantees for clean combustion of the clean syngas in their engines and turbines.

4. Gasification produces not only Syngas but also Carbon Dioxide, Methane and higher molecular weight hydrocarbons such as benzene and dioxins. It is common knowledge that turbine engines such as Jenbachers will not combust benzene when syngas is used as a fuel. Hence the benzene and related hydrocarbons would be released to the atmosphere. How are these compounds to be mitigated?

See the previous notes above about dioxins and furans. Long hydrocarbons exist only in very minor parts per millions as a result of the cracking reactions that take place inside the high temperature atmosphere of the plasma converter. The low levels of tars (benzene and other hydrocarbons) and the high levels of hydrogen result in the production of syngas that behaves like natural gas and combusts in electrical engines with high efficiency, reliability and low emissions. The results of the demonstration plant and other due diligence has added evidence and provided data to support this position.

5. *A fluidized bed requires a consistent shape and density for waste to be fed into the system. How are the various wastes, i.e., Municipal Solid Wastes, Biosolids, rubber tires, commercial and Industrial wastes et cetera being pretreated to ensure that they will effectively be gasified?*

Consistent shape and density are important factors for the process. Standard commercially proven pre-treatment equipment will be used to shred the waste, homogenize, remove and recycle inorganics, plastics and metals and prepare homogeneous feed in the gasifier.

6. *Partial oxidation is used in a fluidized bed to generate the temperature for gasification. Since the elements for forming dioxins and furans are present in the fluidized bed reactor, what is the predicted concentration of such compounds and how will they be monitored and assessed? Taking the experience of Swan Hills and their state of the art facility for destroying PCBs which turned out to have contaminated the biosphere with dioxins and furans (Health Surveillance, Alberta Health Edmonton, Alberta, 1997) what mitigating steps are being taken to ensure that this problem does not happen in Hamilton, especially since this is a densely populated region with wildlife?*

See previous notes above about the process cleaning steps for dioxins and furans. Also note that the formation of dioxins and furans requires high levels of oxygen to be present. The gasification process occurs with only a limited amount of oxygen and steam which prohibits the formation of dioxins and furans. In the gasifier, only gasification takes place because this supply of oxygen is restricted.

7. *Biosolids are to be processed at this facility. Such solids are very smelly. How are these wastes being stored to ensure that they do not cause odour problems? Are they being pelletized for the fluidized bed? If so, how much of that process is being done on site?*

Only dry biosolids will be used. Wet (fresh) biosolids will NOT be received or processed. The plant is designed with proper systems to ensure low levels of odors and compliance with Ontario standards.

8. *It has been stated that Acelor Mittal, Dofasco will be purchasing the electricity generated by this facility. What is the electrical rate that is being paid?*

PFMSI has not stated this. After PFMSI obtains necessary approvals from the MOECC, then our ongoing discussions with potential FSA's (feed supply agreement) companies and PPA's (power purchase agreements) with end users of electricity and heat will become public information.

9. *What is the ROI and IRR of the plant?*

PFMSI is a privately owned company. The expected investment return is estimated to be at a level that investors and lenders find adequate to invest.

10. *What is the expected lifetime of the plant?*

The expectation is a minimum of 25 years.

11. *Will there be royalties provided to the public and City of Hamilton per tonne of waste processed?*

The City of Hamilton has not expressed an interest to become an equity partner in PFMSI.

12. *What insurance will the company carry for this operation?*

The insurance will be in accordance with appropriate standards.

13. *Jenbacher states that “Gas treatment might be necessary (depending on the actual gas quality). Applicable gas types: Natural Gas and high BTU gas. Other specialty gases upon request (Wood Gas, Syngas, Coke Gas, Pyrolysis Gas). (GE Energy, 2008) What gas cleaning is required for the syngas to meet their specifications?*

See previous responses above about syngas cleaning.

14. *The gas engine requires gas to be provided at a specific pressure; hence some buffer tank will be required. Since roughly 30 to 50% of the syngas consists of Hydrogen, storing the syngas at elevated pressure will cause hydrogen embrittlement of the metal. What are the dimensions, shape, volume, operating pressure and the blast radii for your storage tank?*

There is no significant storage for syngas foreseen in the design.

15. *In order for this project to be successful, the community and City must be committed to its success. How much of the company will be owned by the City?*

Yes, we are looking forward to the support of the community and the City. To date, the City of Hamilton has not expressed an interest to become an equity partner in PFMSI so this will remain a private company. This innovative technology offers Hamilton the opportunity to transition from antiquated disposal and landfill methods that now create greenhouse gases such as methane (21 times worse than CO2 in its greenhouse gas effect), bring Green Technology to an industrial location and we believe it will meet the objectives of the Hamilton Waste Plan.

Bibliography

GE Energy. 2008. Jenbacher Type 3 Technical Specification Sheet. St. Augustine, Florida : GE Jenbacher GmbH & Co., 2008. Health Surveillance, Alberta Health Edmonton, Alberta. 1997. Swan Hills Special Waste Treatment Center Human Health Impact Assessment Volume 1: Final Report. Edmonton : Health Surveillance, Alberta Health Edmonton, Alberta, 1997. ISBN (0-7785-0031-4.

Additional Questions and comments from sources other than the Sherman Hub Open Letter:

16. We have heard that PFMSI will be processing nuclear and hazardous toxic waste.

No, this site will not be processing nuclear and hazardous toxic waste. The permit application specifically is written and prepared for non-hazardous.

17. Some of us are just learning about this now. We have heard about some of it from the newspaper, TV, neighbors and others. How can we find out more information?

Port Fuels & Materials Services, Inc. has a web site www.pfmsi.com that has copies of documents and presentations:

- **Notice of Commencement dated 3 April 2014**
- **Poster Boards from Open House #1 dated 17 April 2014 that formally announced the Environmental Application approval process with the Studies that were to be performed**
- **Green Technology for Hamilton – A technical and summary presentation given in various forms to the City Council, MOECC, various environmental and business entities, various Community Hubs and special interest groups, several individuals, etc.**
- **Poster Boards from Open House #2 dated 13 November 2014 that gave a summary of the numerous Studies and site-specific Human Health Risk Assessment (HHRA).**
- **Frequently Asked Questions (FAQ) – This is a 2 page Handout that was distributed at Open House #2.**

It is suggested that you look at this web site. It will be updated with current events and additional data. Additionally, there is a Community Liaison Committee (CLC) with community, environmental and local representation. We encourage CLC members to dialogue with the organizations they represent to facilitate two-way dialogue with PMFSI. Please don't hesitate to contact PFMSI or your CLC representatives directly with any questions you may have.

There are 11 additional questions addressed in the FAQ. It is included on the next two-pages for those of you that did not attend the Open House #2.

Thanks you for your interest and in reading this response!



Robert M. (Bob) Clark

FAQ – Frequently Asked Questions

PFMSI Energy-From-Waste Hamilton Facility

What kind of emissions will the facility produce and are they harmful to human health?

- Air emissions from the Facility will not adversely impact the local air shed and will result in a net reduction in greenhouse gas (GHG) emissions and a reduced carbon footprint.
- The Gasplasma® process itself does not produce any emissions to atmosphere. It produces a very clean fuel gas that is composed primarily of hydrogen and carbon monoxide. After intensive cleaning and conditioning including the plasma process, this fuel will be used in the power generation units.
- The primary air emissions from the basic process will be the emissions from the power generation engines and will be comparable to emissions from combustion of natural gas.
- The process and emission control systems will all work together to keep levels well below applicable Ontario air quality guidelines.
- The Human Health Risk Assessment (HHRA) is an additional voluntary Study being conducted that also assessed emissions and shows no health concern from this facility.

Will this environmental permit application be for non-hazardous material and is it a good alternative to current practices?

- This permit process is only for non-hazardous material.
- It is targeting locally generated waste material that would normally go to a landfill where such materials would decompose and create methane (methane is a greenhouse gas 21 times more damaging to the environment than the carbon dioxide).

Where will the waste come from?

- Fuel (waste) for the facility is expected to come from businesses and operations within the Hamilton Port Authority (HPA) and locally from the nearby industrial area, including the construction and demolition debris
- These wastes are currently loaded into trucks and hauled many kilometres to landfills in Ontario or

Open House display boards and presentations will be posted on the PFMSI website (www.pfmsi.com) in addition to minutes from the CLC (Community Liaison Committee) meetings. Once completed, the Screening EA Report and supporting studies will be posted on the website.

across the border to the United States

- This local waste issue already exists within Hamilton. This fits as a part of the potential solution per the City of Hamilton's 2012 Solid Waste Management Master Plan where new technology (including gasification) will be explored to manage current/future waste issues.

Will the proposed facility produce odour? Will odour from the trucks transporting and dumping waste at the facility be contained?

- During operation, the plant will always operate under negative pressure and emission controls will be used as necessary to minimize/eliminate odour release to the environment to comply with Ministry of the Environment and Climate Change (MOECC) regulations.

How visible will the facility be?

- The facility will be housed within several buildings with low elevation stacks. It will not be a dominant visual feature in the existing context of the HPA lands and the surrounding industrial and marine structures.

How loud will the facility be?

- All plant operations will take place indoors. Relative to the site surroundings, noise levels from the proposed Facility will be minimal and will meet MOECC regulatory requirements.
- A Noise Study will be completed as part of the Environmental Screening Process. There will be no noise impacts above provincial criteria at any sensitive receptors.

Will the proposed facility impact traffic?

- Traffic could slightly increase as a result of this proposed undertaking and a Traffic Study, completed as part of the Environmental Screening Process, shows that it is acceptable relative to local traffic volumes.
- The facility will be in close proximity to waste sources within the Hamilton Port Authority and other industrial facilities limiting some traffic to internal roads.

What are the chances of a catastrophic event and what are the proposed emergency procedures? What are the possible impacts associated with a major system failure?

- There is very low risk of a catastrophic event with this facility. There is no storage of syngas on site and the process operates at normal atmospheric pressure. The process is easily halted when the waste feed is stopped and during off-nominal conditions.
- The management of the facility will provide for appropriate levels of safety and shut-down procedures in an emergency situation. We will liaise with the fire department to ensure the design and operation is appropriate in the event of a fire (i.e., availability of sufficient water supply for fire-fighting purposes). A Contingency and Emergency Response Plan (CERP) is being developed for the facility.

Has the technology been tested elsewhere?

- Yes – the Gasplasma® Pilot Plant located in Swindon, UK was first built in 2005 It has been operating successfully with various organic/inorganic waste fuels for over 3,000 operating hours with a gas engine.
- The two main components, the Gasifier and the Plasma Converter, have been operated for over 50 years nearly 100 different operations worldwide.

How much energy will the facility generate?

- The facility will generate 15,000,000 kilowatt-hours annually - the equivalent energy required to operate approximately 17,000 homes.

What is the taxpayer cost and benefit/liability?

- No taxpayer funds have been sought and no tax concessions have been requested in the development or operation of the facility.
- With respect to taxes, typically, a Federal body (such as HPA) pays what are called *Payments in Lieu of Taxes* to the City of Hamilton, as a Federal body is exempt from municipal taxation. However, given that the property is being leased by a private proponent, municipal property taxes will be paid to the City by PMFSI. The facility is estimated to add \$500,000 yearly to the Hamilton tax base.
- The Bayfront Industrial District is an established industrial zone that is primed for rejuvenation as an advanced manufacturing zone. This rejuvenation and/or economic development is enhanced by facilitating a cluster of development approaches. The PFMSI facility will contribute to the Bayfront Industrial District by offering resource recovery (waste processing), electrical energy and heat to existing and incoming advanced manufacturing facilities.

The Environmental Compliance Approval (ECA) applications will be posted for public comment via the Ontario Environmental Bill of Rights (EBR) website.

Studies	Findings
Design & Operations Report	Provides detailed description of the proposed facility and technology
Surface Water Assessment	Mitigates and controls surface water on-site and in site vicinity
Geology & Hydrogeology Assessment	Improvement to engineered and surface water controls will prevent impacts to groundwater
Land Use & Socio-Economic Assessment	Meets all Land Use requirements
Acoustic (Noise) Assessment	Meets MOECC Guidelines for daytime and nighttime noise limits
Air Quality Assessment and Human Health Risk Assessment	Complies with all Ontario emissions standards and ambient air quality standards. Cumulative effects assessed, no unacceptable human health risks.
Natural Environment Assessment	Will not have an effect on surrounding Natural Environment
Cultural Heritage Assessment	Meets Ontario Heritage guidelines
Traffic Assessment	Overall capacity of intersection to remain at or below 35% of its maximum traffic capacity

