Lafarge Canada Inc. – Brookfield Cement Plant

Appendix A – Nova Scotia Registry of Joint Stock Companies Information

Lafarge Canada Inc. – Brookfield Cement Plant
87 Cement Plant Rd.
Brookfield, Nova Scotia
B0N 1C0

PROFILE - LAFARGE CANADA INC. - as of: 2017-02-07 11:41 AM

Business/Organization Name:	LAFARGE CANADA INC.
Registry ID:	3304554
Type:	Extra-Provincial Corporation
Nature of Business:	MANUFACTURE AND SALE OF CEMENT, CONSTRUCTION MATERIALS AND GYPSUM PRODUCTS
Status:	Active
Jurisdiction:	Canada
Registered Office:	6509 AIRPORT ROAD MISSISSAUGA ON Canada L4V 1S7
Mailing Address:	6509 AIRPORT ROAD MISSISSAUGA ON Canada L4V 1S7

PEOPLE

Name	Position	Civic Address	Mailing Address
BRUNO ROUX	Director	39 STRATHEDEN ROAD TORONTO ON M4N 1E5	
KENNETH CATHCART	Director	139 CARTER ROAD GUELPH ON N1H 6H8	
STEPHEN H. KER	Director	2132 TINA ROAD BURLINGTON ON L7M 3R7	
ALEJANDRO CARBALLIDO	Director	10 SPRING VALLEY PL. SW CALGARY AB T3H 4V1	
RENE THIBAULT	Director	64 DISCOVERY RIDGE CIRCLE SW CALGARY AB T3H 5T8	
NICOLA FRANKLIN	TREASURY MANAGER	370 SUNNYSIDE BLVD. LASALLE ON N9J3J3	

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RENE THIBAULT	PRESIDENT & CEO, WESTERN CANADA REG	64 DISCOVERY RIDGE CIRCLE SW CALGARY AB T3H5T8	
BRUNO ROUX	PRES & CEO, EASTERN CANADA REGION	39 STRATHEDEN ROAD TORONTO ON M4N1E5	
KENNETH CATHCART	VP, GENERAL COUNSEL & SECRETARY	139 CARTER ROAD GUELPH ON N1H6H8	
ALEJANDRO CARBALLIDO	CFO	10 SPRING VALLEY PL. SW CALGARY AB T3H4V1	
ANTHONY BOND	VICE PRESIDENT, TAX	105 BURWYCK PARK DRIVE SALINE MI 48176	
THERESE HOULAHAN	VICE PRESIDENT, TREASURER	2714 RED FOX LANE MANITOWOC WI 54220	
CATHERINE FAGNAN	SR. COUNSEL & ASSISTANT SECRETARY	6509 AIRPORT ROAD MISSISSAUGA ON L4V1S7	
MICHAEL J. WILLIS	ASSISTANT-SECRETARY	24 KENTROYAL DRIVE TORONTO ON M9P2M8	
MELANIE COWIE	SENIOR TAX MANAGER	1454 SAMUELSON CIRCLE MISSISSAUGA ON L5N3J3	
RICHARD A. HIRSCH	Recognized Agent	1959 UPPER WATER STREET, SUITE 900 HALIFAX NS B3J 3N2	1959 UPPER WATER STREET, SUITE 900 HALIFAX NS B3J 3N2

ACTIVITIES

Activity	Date
Date of Filing Amalgamation	2017-01-20
Amalgamated in other Jurisdiction	2017-01-01

RELATED REGISTRATIONS

This Company ...	
LAFARGE CANADA INC.	Amalgamated From
PERMANENT LAFARGE	Registered
YARMOUTH CONCRETE & GRAVEL	Registered
LAFARGE CONSTRUCTION MATERIALS	Registered
CEMENT CARTAGE	Registered
STANDARD AGGREGATES	Registered
STANDARD PAVING MARITIME	Registered
ALBANY CARTAGE	Registered
LAFARGEHOLCIM	Registered

Lafarge Canada Inc. – Brookfield Cement Plant

Appendix B - Approval No. 2005-049646-R02

Lafarge Canada Inc. – Brookfield Cement Plant
87 Cement Plant Rd.
Brookfield, Nova Scotia
B0N 1C0

NOVA SCOTIA
Environment
Environmental Monitoring and Compliance

36 Inglis Place
Truro, Nova Scotia
Canada B2N 4B4

902 893-5880 T
902 893-0282 F
www.gov.ns.ca

Our File Number: 92100-30-TRU-049646-R02

JUN 20 2016

Lafarge Canada Inc.
c/o Scarth MacDonnell
87 Cement Plant Rd
PO Box 5
Brookfield, NS
B0N 1C0

Dear Mr. MacDonnell:

RE: Approval to Operate - Cement Plant and Limestone Surface Mine
Approval No. 2005-049646-R02
PID # 20015319

Enclosed please find Approval # 2005-049646-R02 to operate the Cement Plant and Limestone surface mine at 87 Cement Plant Rd, Shortts Lake, Colchester County, Nova Scotia. This approval replaces previous approvals numbered 2005-049646-R01 and 90-003, which are now deemed null and void.

Strict adherence to the attached terms and conditions is imperative in order to validate this approval.

Despite the issuance of this Approval, the Approval Holder is still responsible for obtaining any other authorization which may be required to carry out the activity, including those which may be necessary under provincial, federal or municipal law.

Should you have any questions, please contact Chris O'Connell, Central Region, Truro Office at (902) 902 893 5880.

Yours truly,

Brad Skinner
District Manager

cc

Eimas #: 2005-049646-R02

NOVA SCOTIA
Environment

APPROVAL

Province of Nova Scotia
***Environment Act*, S.N.S. 1994-95, c.1**

APPROVAL HOLDER: Lafarge Canada Inc.

SITE PID: 20015319

APPROVAL NO: 2005-049646-R02

EXPIRY DATE: June 17, 2026

Pursuant to Part V of the *Environment Act*, S.N.S. 1994-95, c.1 as amended from time to time, approval is granted to the Approval Holder subject to the Terms and Conditions attached to and forming part of this Approval, for the following activity:

Operation of a Cement Plant and Limestone Surface Mine, and associated works, at or near 87 Cement Plant Rd, Shortts Lake, Colchester County in the Province of Nova Scotia.

Administrator Brad Skinner

Effective Date June 17, 2016

TERMS AND CONDITIONS OF APPROVAL

Nova Scotia Environment

Approval Holder:	**Lafarge Canada Inc.**
Project:	**Cement Plant and Limestone Surface Mine**
Site:	**87 Cement Plant Rd, Shortts Lake, Colchester County PID # 20015319**
Approval No:	**2005-049646-R02**
File No:	**92100-30-TRU-049646-R02**
Map Series:	**11E/3**
Grid Reference:	**E473700 N5009600**

Reference Documents:

- Application dated October 14, 2015 and attachments.
- Approval 2005-049646-R01
- Approval 90-003
- Letter dated September 22, 1995 from the Department to the Approval Holder regarding the use of used oil (waste oil) as a supplemental fuel.
- Letter dated March 24, 2005 to the Department requesting approval for use of chipped asphalt shingles as an alternate (supplemental) fuel.
- Letter dated June 9, 2010 from Wayne Faulkner, NSE, to Lafarge Canada Inc. Authorizing the use of Glycerin as an alternate fuel in kiln #2.
- Letter dated April 20, 2015 from Brad Skinner to Scarth MacDonnell authorizing the use of a 50-50 mixture of shredded plastic and shredded asphalt shingles as a fuel source.

1. Definitions

a) "Abandonment" means cessation of production of aggregate for a period of twelve (12) months.

b) "Act" means the *Environment Act* S.N.S. 1994-1995, c.1 and includes all regulations made pursuant to the Act.

c) "Active Area" means the area required to operate a quarry/surface mine and includes the working face and associated works.

d) "Alternate Fuel" includes any material used as a fuel source or as a supplemental fuel source, other than Primary Fuels.

e) "Alternate Raw Material" includes any feedstock to the cement manufacturing process at the plant that is not of virgin origin, but does not include materials added primarily for fuel.

f) "Associated works" means any building, structure, processing facility, pollution abatement system or stockpiles of aggregate.

g) "CKD" means cement kiln dust and is defined as particulate matter that is captured by air pollution control equipment at a cement plant.

h) "CKD landfill" means a non-hazardous landfill site used for the disposal of cement kiln dust generated by the Approval Holder at the Shortts Lake plant.

i) "Department" means the Central Region, Truro Office, of Nova Scotia Environment located at the following address:

Nova Scotia Environment
Inspection, Compliance, and Enforcement Division
Central Region, Truro Office
36 Inglis Place, 2nd Floor
Truro, Nova Scotia B2N 4B4

Phone: (902) 893-5880
Fax: (902) 893-0282

j) "Disturbed Area" means any area on a quarry/surface mine site that has been stripped of vegetation and is susceptible to erosion.

k) "Facility" means the Cement Plant and Limestone Surface Mine and associated works.

l) "Minister" means the Minister of Nova Scotia Environment.

m) "Opacity" means the degree to which visible emissions obstruct the passage of light within a stack, flue, duct or stack breaching.

n) "Primary fuel" includes light oil, propane, bunker, natural gas, petroleum coke, coal, diesel, and gasoline.

o) "Rehabilitation" means restorative work performed or to be performed in accordance with the rehabilitation plan.

p) "Structure" includes but is not limited to a private home, a cottage, an apartment building, a school, a church, a commercial building or a treatment facility associated with the treatment of municipal sewage, industrial or landfill effluent, an industrial building, infrastructure or construction, a hospital, and a nursing home, etc.

2. Scope of Approval

a) This Approval (the "Approval") relates to the Approval Holder and their application and supporting documentation, as listed in the reference documents above, to operate the Facility, situated at or near 87 Cement Plant Rd, Shortts Lake, Colchester County (the "Site").

b) The Facility shall be constructed and operated as outlined in the application for industrial approval dated October 14, 2015 and supporting documentation.

c) The Site shall not exceed the area as outlined in the application and supporting documentation.

3. General Terms and Conditions

a) The Approval Holder shall construct, operate and reclaim its Facility in accordance with provisions of the:
   i) *Environment Act* S.N.S. 1994-1995, c.1, as amended from time to time;
   ii) Regulations, as amended from time to time, pursuant to the above Act;

b) The Approval Holder is responsible for ensuring that they operate the Facility on lands which they own or have a lease or written agreement with the landowner or occupier. The Approval Holder shall be responsible for ensuring that the Department has, at all times, a copy of the most recent lease or written agreement with the landowner or occupier. Breach of this condition may result in cancellation or suspension of the Approval.

c) If there is a discrepancy between the reference documents and the terms and conditions of this Approval, the terms and conditions of this Approval shall apply.

d) The Minister or Administrator may modify, amend or add conditions to this Approval at anytime pursuant to Section 58 of the Act.

e) This Approval is not transferable without the consent of the Minister or Administrator.

f) (i) If the Minister or Administrator determines that there has been non-compliance with any or all of the terms and conditions contained in this Approval, the Minister or Administrator may cancel or suspend the Approval pursuant to subsections 58(A)(1) and 58(A)(2) of the Act, until such time as the Minister or Administrator is satisfied that all terms and conditions have been met.

(ii) Despite a cancellation or suspension of this Approval, the Approval Holder remains subject to the penalty provisions of the Act and regulations.

g) The Approval Holder shall notify the Department prior to any proposed extensions or modifications of the Facility, including the active area, process changes or waste disposal practices which are not granted under this Approval. An amendment to this Approval will be required before implementing any change. Extensions or modifications to the Facility may be subject to the Environmental Assessment Regulations.

h) Pursuant to Section 60 of the *Act*, the Approval Holder shall submit to the Administrator any new and relevant information respecting any adverse effect that actually results, or may potentially result, from any activity to which the Approval relates and that comes to the attention of the Approval Holder after the issuance of the Approval.

i) The Approval Holder shall immediately notify the Department of any incidents of non-compliance with this Approval.

j) The Approval Holder shall bear all expenses incurred in carrying out the environmental monitoring required under the terms and conditions of this Approval.

k) Unless specified otherwise in this Approval, all samples required to be collected by this Approval shall be collected, preserved and analysed, by qualified personnel, in accordance with recognized industry standards and procedures.

l) Unless written approval is received otherwise from the Administrator, all samples required by this Approval shall be analysed by a laboratory that meets the requirements of the Department's "Policy on Acceptable Certification of Laboratories" as amended from time to time.

m) The Approval Holder shall submit any monitoring results or reports required by this Approval to the Department. Unless specified otherwise in this Approval, All monitoring results shall be submitted within 30 days following the month of monitoring.

n) The Approval Holder shall ensure that this Approval, or a copy, is kept on Site at all times and that personnel directly involved in the Facility operation are made fully aware of the terms and conditions which pertain to this Approval.

o) All domestic sewage and grey water generated at the Facility shall be disposed of and treated in an approved manner in accordance with Department Regulations. Effluent shall be sampled quarterly to ensure the $CBOD_5$ and Total Suspended Solids levels are below 25mg/l.

p) Signage including emergency telephone numbers and contacts are to be posted at the entrance to the Facility.

4. Particulate Emissions (Dust)

a) Particulate emissions shall not exceed the following limits at or beyond the Site property boundaries:
Annual Geometric Mean 70 $\mu g/m^3$
Daily Average (24 hr.) 120 $\mu g/m^3$

b) The use of used oil as a dust suppressant is strictly prohibited. The generation of dust from the Site shall be suppressed as required.

c) Monitoring of particulate emissions shall be conducted at the request of the Department. The location of the monitoring station(s) for particulate will be established by a qualified person retained by the Approval Holder and submitted to the Department for approval, this may include point(s) beyond the property boundary of the Site.

d) When requested, suspended particulate matter shall be measured by the EPA standard; EPA/625/R-96/010a; Sampling of Ambient Air for Total Suspended Particulate Matter (SPM) and PM_{10}. Using High Volume (HV) Sampler.

5. Sound Levels

a) Sound levels measured at the Site property boundaries shall not exceed the following equivalent sound levels (Leq):
Leq 65 dBA 0700-1900 hours (Days)
60 dBA 1900-2300 hours (Evenings)
55 dBA 2300-0700 hours (Nights)

b) Monitoring of sound levels shall be conducted at the request of the Department. The location of the monitoring station(s) for sound will be established by a qualified person retained by the Approval Holder and submitted to the Department for approval, this may include point(s) beyond the property boundary of the Site.

6. Surface Water

a) The site shall be developed and maintained to prevent siltation of the surface water which is discharged from the property boundaries into the nearest watercourse or beyond the property boundary. Additional controls shall be implemented if site runoff exceeds the discharge limits contained herein.

b) No authority is granted by this Approval to enable the Approval Holder to discharge channelled surface water beyond the property boundary and onto adjoining lands without the authorization of the affected landowner(s). It is the responsibility of the Approval Holder to ensure that the authorization of said landowner(s) is current and valid. Failure to maintain said authorization will result in this Approval being null and void.

c) The Approval Holder shall ensure the following liquid effluent levels are met and that the effluent is monitoring at the frequency and locations indicated.

i) **Total Suspended Solids**

Clear Flows (Normal Background Conditions):

1) Maximum increase of 25 mg/l from background levels for any short term exposure (24 hour or less)
2) Maximum average increase of 5 mg/l from background levels for longer term exposure (inputs lasting between 24 hours and 30 days)

High Flow (Spring Freshets and Storm Events):

1) Maximum increase of 25 mg/l from background levels at any time when background levels are between 25 mg/l and 250 mg/l
2) Shall not increase more than 10% over background levels when background is > 250 mg/l

ii) **pH**

1) Between 5 to 9 in grab sample
2) Between 6 to 9 as a Monthly Arithmetic Mean

iii) **Monitoring Locations**

1) The Approval Holder shall sample at the following locations: SW1, SW2A, SW3A, SW4, SW4A, SW6A, and SW9.

iv) **Sampling Frequency**

1) The Approval Holder shall sample at least quarterly and as required to ensure compliance with this approval. Results shall be submitted to the Department with the annual report referenced in Section 15 of this approval, except for any exceedance which shall be reported the next business day.

d) The Approval Holder shall review historical surface water monitoring data and recommend whether changes to the monitoring locations/frequency are warranted. This recommendation shall be included in the March 1st, 2017 annual report.

7. Cooling Water Discharge

a) Lafarge Canada Inc. shall establish a compliance monitoring station for cooling water discharges to ensure they meet the following criteria prior to leaving the property or entering a watercourse;

Parameter	Maximum in a Grab Sample	Monitoring Frequency
pH (units)	>= 6.0 and <= 9.0	As required during discharge events to ensure compliance with the limits listed in this table.
Total Suspended Solids	50.0 mg/l	
Oil and Grease	1.0 mg/l	
Metals*	CCME Freshwater Aquatics Criteria	

*The Cooling Water discharged shall have a representative sample tested to determine the levels of arsenic, antimony, barium, cadmium, beryllium, chromium, lead, silver, and thallium.

b) If requested by the Department, the Approval Holder shall define the extent of the surface thermal plume from the cooling water discharged into Shortt's Lake.

c) With the exception of exceedences of approved limits, which must be immediately reported to the Department, results of Cooling Water sampling shall be submitted to the Department with the annual report referenced in Section 15 of this approval.

8. Groundwater

a) The Approval Holder shall replace at their expense any water supply which has been lost or damaged as a result of extracting aggregate.

b) The Approval Holder shall monitor MW10A-98, MW11A-98, LW12-98, and BH1A on a quarterly basis for parameters listed in Schedule 1, Column 2, attached to this approval.

c) The Approval Holder shall monitor MW10A-98, MW11A-98, LW12-98, and BH1A on an annual basis for parameters listed in Schedule 1, Column 1, attached to this approval.

d) The Approval Holder shall review historical groundwater monitoring data and recommend whether changes to the monitoring locations/frequency are warranted. This recommendation shall be included in the March 1st, 2017 annual report..

9. Operation and Stack Emissions:

a) The Approval Holder shall develop an Environmental Management Plan document, **by March 1st, 2017**, that shall include, but not be limited to; process and site description, environmental controls, groundwater and surface water monitoring requirements and a contingency plan in accordance with the Department's Contingency Planning Guidelines.

b) The opacity of emissions from the kilns shall be continuously monitored with continuous emission monitors (CEMS), and calculated as a 6 minute arithmetic average of instantaneous observations, when the kilns are being operated . The Approval Holder shall ensure that the monitors undergo calibration and cleaning, in accordance with manufacturers specifications.

c) The Approval Holder shall ensure the 6 minute average opacity of emissions from the kiln(s) are maintained at or below 20 percent (%). If the 6 minute average opacity of emissions from the kiln(s) exceeds 20% the Approval Holder shall document the incident, the duration of the exceedance, and corrective measures taken to reduce the opacity of the emissions.

d) If the 6 minute average opacity of emissions from the kilns exceeds 30% the Approval Holder shall immediately contact the Department and explain the nature of the upset conditions and the time frame for correction of the situation. The Approval Holder shall initiate shut down of the operation of the Facility if the situation cannot be rectified immediately or if requested by the Department.

e) Emissions of particulate matter from the kilns shall not exceed 90 milligrams per cubic metre of dry, undiluted exhaust gas at standard conditions. Stack testing for compliance with this limit may be required where opacity levels indicate potential operational problems.

f) The Approval Holder must ensure that air emissions from the Facility do not contribute to an exceedance of the maximum permissible ground level concentrations specified in Schedule "A" (attached) of the *"Air Quality Regulations"*.

g) Where it is the opinion of the Department that the Approval Holder is contributing to exceedances of the Schedule "A" concentrations, the Approval Holder shall implement a corrective action plan which may include ambient air monitoring.

h) Where required by the Department, the Approval Holder shall submit an air monitoring plan to the Department for review and approval. This plan shall include but not be limited to sampling locations, parameters, monitoring methods, protocols and frequency.

i) The Approval Holder shall participate in future air shed management plans as determined by the Department.

j) Spills or releases shall be reported in accordance with the *Act* and the *Environmental Emergency Regulations.*

k) Spills or releases shall be cleaned up in accordance with the *Act* and the *Contaminated Sites Regulations.*

10. Separation Distances

a) The Facility loading and unloading areas shall not be located within the following minimum separation distances:

(i) 30 metres from any surface watercourse
(ii) 30 metres from any property boundary
(iii) 90 metres from any residential structure
(iv) 90 metres from any domestic water supply

11. Blasting

a) The Approval Holder shall have a technical blast design prepared by a qualified person which ensures the ground vibration and air concussion limits in this Approval can be achieved.

b) The Approval Holder shall maintain records of pre-blast surveys including a water quality analysis of all structures within 800 metres of the Facility. The survey shall be conducted in accordance with the Department's 'Procedure For Conducting a Pre-Blast Survey" and the results of this survey sent to the Department prior to any blasting on the Site. Water quality parameters will be determined by NSE staff.

c) The Approval Holder shall call the nearest weather office, to assess the climatic conditions prior to conducting any blasting. No blasting will be permitted if a thermal inversion is anticipated at the time of the proposed blast.

d) No blasting shall occur on Sunday, on a statutory holiday prescribed by the Province, or on any day between 1800 and 0800 hours.

e) The Approval Holder shall ensure that all blasts are monitored for concussion and ground vibration to ensure that the following limits are not exceeded:

Blasting Limits			
Parameters	**Maximum**	**Monitoring Frequency**	**Monitoring Station**
Concussion (Air Blast)	128 dBL	Every Blast	Within 7 m of the nearest structure not located on the Site
Ground Vibration	0.5 in/sec (12.5 mm/s)	Every Blast	Below grade or less than 1 m above grade in any part of the nearest structure not located on the Site

f) Additional monitoring stations for blasting may be required by the Department.

g) A summary of results of monitoring shall be maintained by the Approval Holder for at least two years, with results submitted to the Department upon request. Any exceedance of the maximum limits listed above shall be reported to the Department during the next business day.

12. Alternate Fuels

a) Tests using alternate fuels may be approved by a Letter of Authorization on a case-by-case basis provided the following criteria are met:
   i) written notification of the intent to utilize an alternate fuel identifying the type, volume, source, and rate of consumption, and
   ii) analytical data identifying trace metals and/or contaminants in the proposed fuel is provided (depending on the type and source of the proposed alternate fuel, additional analytical data may be required), and
   iii) the proposed feed rate (including the percentage this alternate fuel will be of the total feed material to the kiln when the alternate fuel is used) and feed mechanism is identified, and
   iv) the anticipated change in emissions from the Facility when the alternate fuel is being used at the proposed feed rate are provided, and
   v) The Approval Holder has provided written confirmation that local residents have been informed through the Community Liaison Committee.

b) If a Letter of Authorization is issued by the Department for a test of an alternate fuel, the Approval Holder may be required to;
   i) Provide the Department with a schedule detailing a trial burn utilizing the proposed alternate fuel at the maximum proposed feed rate. The maximum duration of the trial burn shall be 120 hours (unless approved otherwise in writing by the Department), and
   ii) following completion of the trial burn, a report detailing the feed rate, quality and quantity of the proposed alternate fuel and other fuels used, all sources of raw materials used during the trial burn, and the overall effectiveness of the material as an alternate fuel.

c) The Approval Holder shall provide emission testing data for a trial burn, including SO_2, NO_x, particulate, HCl, and total hydrocarbon (expressed as methane), if requested by the Department.

d) If the Department is satisfied that continued use of the alternate fuel is acceptable and will meet the Terms and Conditions of this Approval (the completion of an environmental assessment may be required to make this determination), and the Approval Holder indicates their desire to have the alternate fuel included in the on-going operation, the Department may issue a "Letter of Authorization" approving the continued use of the alternate fuel.

e) The Approval Holder may use "Used Oil" as an alternate fuel in accordance with the *"Used Oil Regulations"* and as authorized in a Letter dated September 22, 1995 from the Department to the Approval Holder regarding the use of used oil (waste oil) as a supplemental fuel.

f) The Approval Holder may use blended used oil and Bunker "C" fuel as approved in a letter dated November 9, 1995.

g) The Approval Holder may use drilling fluids as an alternate fuel as approved in a letter dated March 23, 2005.

h) The Approval Holder may use asphalt shingles as an alternate fuel as outlined in the Report titled, "Lafarge Canada Inc. - Brookfield Cement Plant Emission Testing For Supplemental Fuel 2004, Final Report", as dated February 23, 2005.

i) The Approval Holder may use a 50-50 mixture of shredded plastics and shredded asphalt shingles as an alternate fuel as authorized in a letter dated April 20, 2015 from Brad Skinner to Scarth MacDonnell.

13. CKD Landfill

a) All reject Cement not reclaimed through the production process shall be disposed of at the CKD landfill. The Approval Holder shall record the volume of reject cement placed in the CKD landfill along with an explanation why the cement could not be reclaimed.

b) The CKD Landfill shall be progressively capped and a vegetative cover maintained.

14. Rehabilitation

a) The Approval Holder shall submit a rehabilitation plan to the Department for review at least 60 days before abandoning the site in accordance with the *Approval and Notification Procedures Regulations*.

15. Reporting

a) The Approval Holder shall maintain a written record of all sources and volume of primary and alternate fuels received and used at this site including all analytical data of required testing; volume of raw materials used; volume of CKD and reject cement sent to the CKD landfill; a summary of any on-site environmental emergencies; opacity levels of kiln stack emissions with 6 minute averages greater than 30%, and a summary of all complaints received and an outline of the action taken to resolve the issue. This information shall be submitted to the Department in an **Annual Report by March 1st** annually for the previous calender year of operation.

SCHEDULE "A"

MAXIMUM PERMISSIBLE GROUND LEVEL CONCENTRATIONS

CONTAMINANT	AVERAGING PERIOD	MAXIMUM PERMISSIBLE GROUND LEVEL CONCENTRATION	
		ug/m^3	pphm
Carbon Monoxide (CO)	1 hour	34 600	3000
	8 hours	12 700	1100
Hydrogen Sulphide (H_2S)	1 hour	42	3
	24 hours	8	0.6
Nitrogen Dioxide (NO_2)	1 hour	400	21
	Annual	100	5
Ozone (O_3)	1 hour	160	8.2
Sulphur Dioxide (SO_2)	1 hour	900	34
	24 hours	300	11
	Annual	60	2
Total Suspended Particulate (TSP)	24 hours	120	-
	Annual	70*	-

* - Geometric mean
ug/m^3 - micrograms per cubic metre
pphm - parts per hundred million

APPENDIX 1

TYPICAL SURFACE AND GROUNDWATER MONITORING PROGRAM

1.0 SITE ASSESSMENT AND DESIGN

1.1 Hydrogeologic Assessment

Prior to the establishment or expansion of a site, a report shall be prepared by the owner containing plans, specifications, and descriptions of the hydrogeologic conditions of the site, adjacent and nearby properties, and the regional area in which the site is located, including at a minimum, the following;

1 a general description of the regional geologic and hydrogeologic conditions occurring within 5 km of the site. This description should identify any unstable soils or bedrock, indicate the location and nature of any boundaries to groundwater movement, and characterize the significance of groundwater resources and the use made of these resources;

2 a description of local hydrogeologic conditions occurring at the site, and adjacent and other properties within 500 m of the site, and the description shall indicate how local conditions relate to regional conditions;

3 a detailed hydrogeologic investigation of the site which establishes soil, rock, and groundwater conditions;

4 an interpretation of the results of the detailed hydrogeologic investigation of the site, including plans, specifications, and descriptions:

5 an assessment of the suitability of the site for water disposal purposes considering the regional, local, and site specific hydrogeologic conditions, the design of the site, and the contingency plans for the control of leachate and landfill gas.

1.2 Surface Water Assessment

Prior to the establishment or expansion of a site, a report shall be prepared by the owner containing plans, specifications, and descriptions of the surface water conditions of the site, adjacent and nearby properties, and the regional area in which the site is located, including, at a minimum, the following:

1 a general description of the surface water features occurring within 5 km of the site that is based on the contributing/receiving drainage area, catchment,

subwatershed or watershed that is sufficiently large to assess the range and extent of potential effects. This description will include, but not be limited to, flood plains, natural watercourses, drainage paths and boundaries, streamflows, surface water quality, and sources of water supply;

2 a description of the local surface water features occurring at the site, and adjacent and other properties within 500 m of the site, and the description shall include how local feature relate to regional features;

3 a detailed surface water investigation of the site to assess water quality, quantity, and habitat conditions of the surface water features identified on site;

4 an interpretation of the results of the detailed surface water investigation of the site, including plans, specifications, and descriptions;

5 an assessment of the suitability of the site for waste disposal purposes considering the regional, local, and site specific surface water conditions, the design of the site, and the contingency plan for the control of leachate.

2.0 OPERATION AND MONITORING

2.1 Groundwater Monitoring

A program for monitoring groundwater quality and quantity shall be carried out by the owner and shall include, at a minimum, the following:

1 representative samples of groundwater within the site shall be:

a) obtained annually from groundwater monitoring facilities and be analyzed for the parameters listed in column 1 of Schedule 1; and

b) obtained quarterly from groundwater monitoring facilities and be analyzed for the parameters listed in column 2 of Schedule 1;

2 where requested by property owners or occupants, representative samples of groundwater shall be obtained from domestic wells located within 500 m of the site at a frequency of 1 sample per well per year and these groundwater samples shall be analyzed for the parameters listed in column 2 of Schedule 1;

3 the results of analysis of a water sample collected under Subsection 2.1.2 shall be provided to the Department and the owner or occupant of the property with the domestic well from which the sample was obtained, within 60 days of obtaining the sample;

4 the results of analysis of all water samples collected in the groundwater monitoring program, together with an assessment of these results shall be provided to the Department in an annual report, and where the assessment indicates a significant increase in contaminant concentrations, within 60 days of obtaining the sample and 5 days of making the assessment;

5 the parameters to be monitored may be amended where the owner prepares a report showing alternative parameters should be monitored, based on the type of waste to be deposited at the site.

2.2 Surface Water Monitoring

A program for monitoring surface water quality, quantity, and biological features shall be carried out by the owner and shall include, at a minimum, the following:

1 representative samples of surface water being discharged from the site and of any waterbody, including upstream control locations, which may be affected by leachate, stormwater runoff, or sediment from the site , shall be:

a) obtained semi-annually, and be analyzed for the parameters listed in column 3 of Schedule 1 and for other parameters of concern identified in the surface water assessment;

b) obtained quarterly and be analyzed for the parameters listed in column 4 of Schedule 1;

2 annual monitoring of biological features to assess the composition and any changes to the benthic community present in any waterbody, located downstream of storm water discharges, that may be affected by leachate, stormwater runoff, or sediment from the site;

3 the results and assessment of the results of the surface water monitoring shall be provided to the Department in an annual report, and where the assessment indicates an increase in contaminant concentrations exceeding the natural variability exhibited by baseline and operational monitoring data, within 60 days of obtaining the sample and 5 days of making the assessment;

4 the parameter to be monitored may be amended where the owner prepares a report showing alternative parameters should be monitored, based on the type of waste to be deposited at the site.

Schedule 1
Groundwater, Leachate and Surface Water Monitoring Parameters

Parameter				
Parameter Group	Column 1	Column 2	Column 3	Column 4
	Comprehensive List for Groundwater and Leachate	Indicator List for Groundwater and Leachate	Comprehensive List for Surface Water	Indicator List for Surface Water
Inorganics				
	Alkalinity	Alkalinity	Alkalinity	Alkalinity
	Ammonia		Ammonia	Ammonia
	Arsenic		Arsenic	
	Barium		Barium	
	Boron		Boron	
	Cadmium	Cadmium	Cadmium	
	Calcium	Calcium		
	Chloride	Chloride	Chloride	Chloride
	Chromium		Chromium	
	Conductivity	Conductivity	Conductivity	Conductivity
	Copper		Copper	
	Iron	Iron	Iron	
	Lead	Lead	Lead	
	Magnesium	Magnesium		
	Manganese			
	Mercury		Mercury	
	Nitrate	Nitrate	Nitrate	Nitrate

Parameter				
Parameter Group	Column 1	Column 2	Column 3	Column 4
	Comprehensive List for Groundwater and Leachate	Indicator List for Groundwater and Leachate	Comprehensive List for Surface Water	Indicator List for Surface Water
	Nitrite		Nitrite	Nitrite
	Total Kjeldahl Nitrogen		Total Kjeldahl Nitrogen	Total Kjeldahl Nitrogen
	pH	pH	pH	pH
	Total Phosphorus		Total Phosphorus	Total Phosphorus
	Potassium	Potassium		
	Sodium	Sodium		
	Suspended Solids	Suspended Solids	Suspended Solids	Suspended Solids
	Total Dissolved Solids	Total Dissolved Solids	Total Dissolved Solids	Total Dissolved Solids
	Sulphate	Sulphate	Sulphate	Sulphate
	Zinc		Zinc	
Volatile Organics				
	Benzene			
	1, 4 Dichlorobenzene			
	Dichloromethane		Dichloromethane	
	Toluene		Toluene	
	Vinyl Chloride			

Parameter				
Parameter Group	Column 1	Column 2	Column 3	Column 4
	Comprehensive List for Groundwater and Leachate	Indicator List for Groundwater and Leachate	Comprehensive List for Surface Water	Indicator List for Surface Water
Other Organics				
			Biochemical Oxygen Demand (BOD_5)	Biochemical Oxygen Demand (BOD_5)
	Chemical Oxygen Demand	Chemical Oxygen Demand	Chemical Oxygen Demand	Chemical Oxygen Demand
	Dissolved Organic Carbon	Dissolved Organic Carbon	Total Organic Carbon	
	Phenol		Phenol	Phenol
Field Parameters				
			Temperature	Temperature
	pH	pH	pH	pH
	Conductivity	Conductivity	Conductivity	Conductivity
			Dissolved Oxygen	Dissolved Oxygen
			Flow	Flow

Lafarge Canada Inc. – Brookfield Cement Plant

Appendix C – CEO Signature

Lafarge Canada Inc. – Brookfield Cement Plant
87 Cement Plant Rd.
Brookfield, Nova Scotia
B0N 1C0

Proponent Contact:

Robert Cumming, Environment Director
6509 Airport Road
Mississauga, Ontario, L4V 1S7
Phone: 613-484-7714

Chief Executive Officer:

Bruno Roux
6509 Airport Road
Mississauga, Ontario L4V 1S7
Phone: 905-738-7773

Consultant Contact:

Peter Oram, P. Geo
45 Akerly Blvd.
Darthmouth, Nova Scotia, B3B 1J7
Phone: 902-468-1248

Mar 9, 2017

Bruno Roux
CEO, Lafarge Canada Inc

Dated

1.2 Project Information

1.2.1 Name of the Undertaking

Lafarge is proposing to operate a new Lower Carbon Fuel: Tire Derived Fuel (TDF) System to use scrap tires, in place of coal and petroleum coke, as a low carbon fuel. Lafarge is committed to reducing its carbon footprint and the use of scrap tires has the potential of lowering CO_2 emissions compared to traditional fossil fuels as well as other environmental benefits. The proposed undertaking is on kiln #2 at the Brookfield Cement Plant.

1.2.2 Project Location

The Brookfield Cement Plant is located at 87 Cement Plant Road, Pleasant Valley, Colchester County, Nova Scotia, B0N 1C0 (PID 20015319). The coordinates for the approximate centre point of the project are UTM Zone 20 E4733775 N5009620 (NAD83(CSRS)) or Geographic 63° 20' 2.8"W / 45° 14' 22.6"N (NAD83(CSRS)). **Figures 1** shows map with the site in regional context and **Figures 2 and 3 (below)** show the site location, site boundary, and the proposed project location.

Lafarge Canada Inc. – Brookfield Cement Plant

Appendix D – Draft Engineering Plan for Tire Delivery

Lafarge Canada Inc. – Brookfield Cement Plant
87 Cement Plant Rd.
Brookfield, Nova Scotia
B0N 1C0

CHAIN LINK FENCE

ELECTRICAL SUB STATION

OUTLINE 20 FT. CLEARANCE

℄ TRUCK STN 1

℄ TRUCK STN 2

EXISTING ROADWAY

NEW ROADWAY

SINGULATOR AND LB BIN NOT SHOWN

JERSEY BARRIERS

15x25' DOCK

19 1/2' CONVEYOR

TRAILER TILTER

EXISTING DRAIN PIPE

PROPANE RESERVOIR

RAMP

PIPE RACK
TO WO FACILITY

℄ KILN #2

℄ PIER #2

℄ PIER #3

℄ PIER #4

℄ PIER #4

℄ TIRE INJECTION

35'-0"

39'-10"

106'-2"

82'-2"

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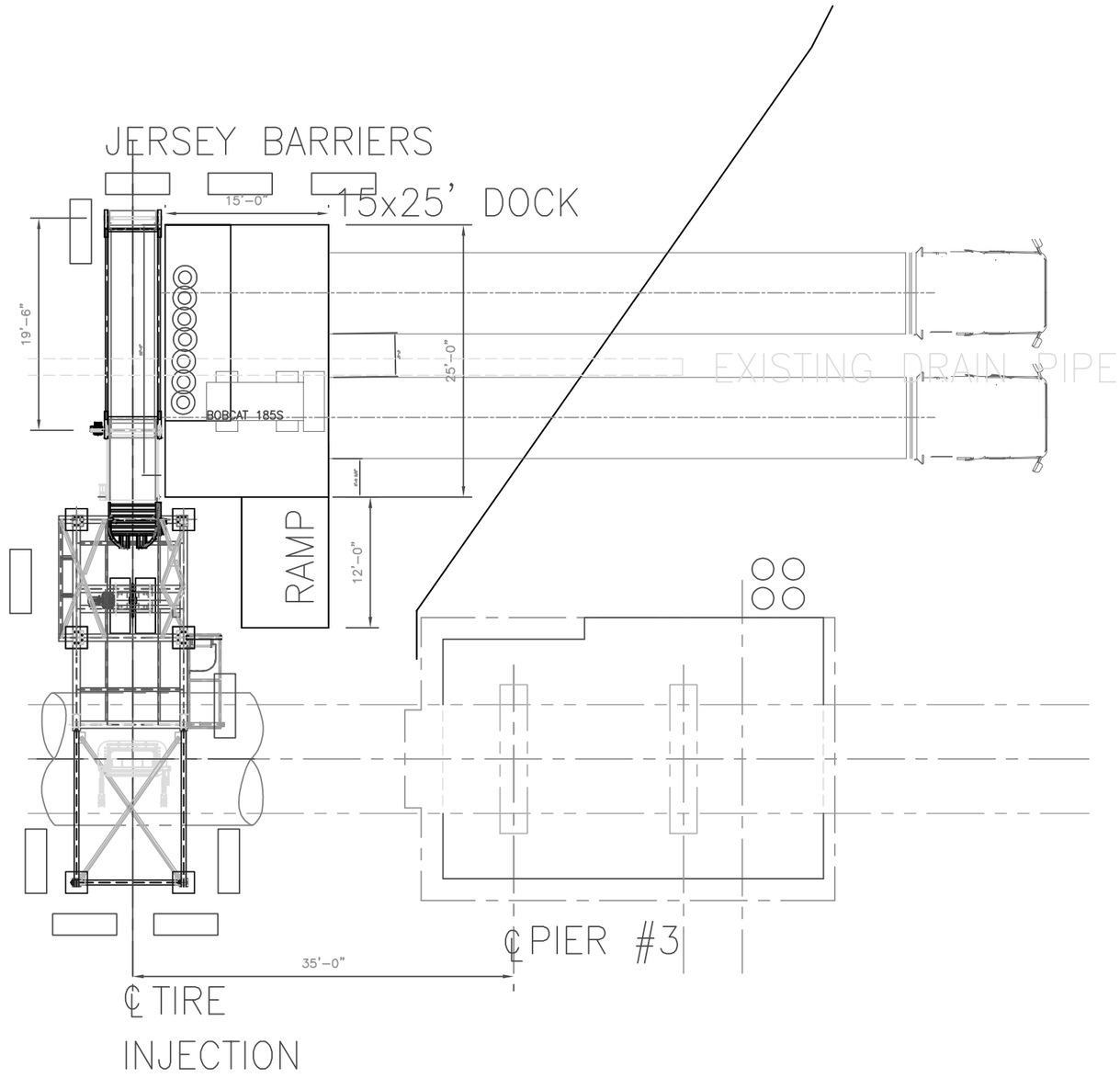
ENGINEERING & MANAGEMENT LTD
HALIFAX, NOVA SCOTIA (902) 220-8899
www.conrose.ca

P1	17/03/02	PROJECT REPORT / CLIENT REVIEW
P1	17/02/06	QUOTATION / CLIENT REVIEW

CLIENT: LAFARGE NORTH AMERICA

TITLE: TIRE INJECTION - KILN K2
SITE PLAN

Drawn: BTL	Checked:	Scale: CAD 1:1
Date: DECEMBER 2016	Date:	Dwg. # 1614-M-01



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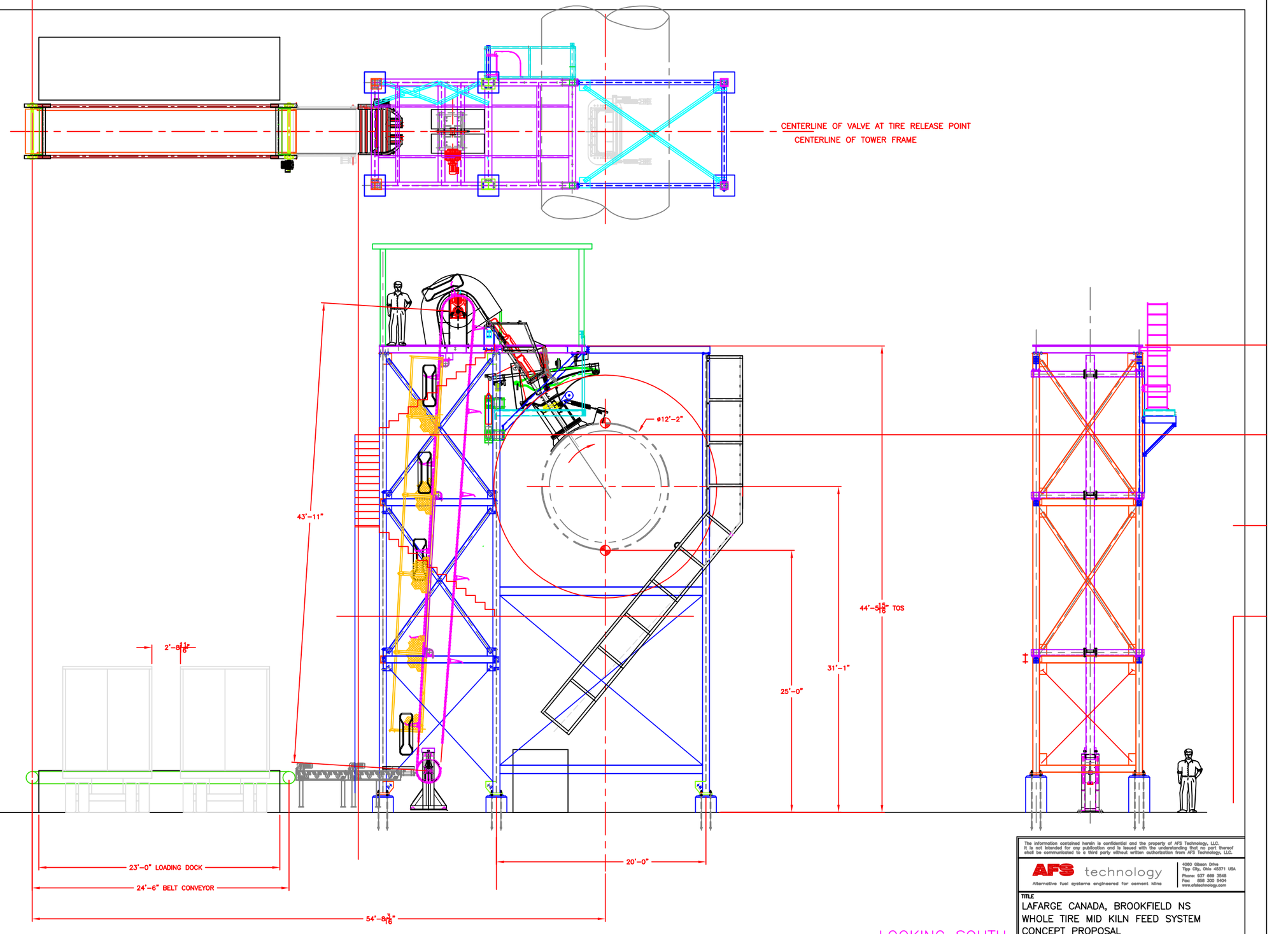
ENGINEERING & MANAGEMENT LTD
HALIFAX, NOVA SCOTIA (902) 220-8899
www.conrose.ca

P1	17/03/02	PROJECT REPORT / CLIENT REVIEW

CLIENT: LAFARGE NORTH AMERICA

TITLE: TIRE INJECTION - KILN K2
GENERAL ARRANGEMENT - PLAN

Drawn: BTL	Checked:	Scale: CAD 1:1
Date: DECEMBER 2016	Date:	Dwg. # 1614-M-02



LOOKING SOUTH

AFS technology
Alternative fuel systems engineered for cement kilns
4080 Gibson Drive
Tipp City, Ohio 45371 USA
Phone: 937 669 3548
Fax: 858 300 8404
www.afstechnology.com

TITLE
LAFARGE CANADA, BROOKFIELD NS
WHOLE TIRE MID KILN FEED SYSTEM
CONCEPT PROPOSAL

DRAWN BY	SCALE	DATE
MR	1/4"=1'-0"	2016-OCT-21
CHECKED BY	APPROVED	PROJECT#
DWG. NO.		SHEET NO.
1642PGA01A		OF

NOTES:
Unless otherwise noted, the following shall apply
1. All hardware is to be minimum grade 5 and zinc plated.
2. Paint is to be intercoat two-part epoxy with minimum 5 mil DFT.
3. Surface prep to be SSPC 2/3.
4. All welds and corners are to be spot primed.

0.0	0.03	⊥	0.03
0.00	0.015	//	0.03
0.000	0.005	▱	0.03
x/x	1/32	—	0.03
Ⓜ	0.03	∠	0.03

Lafarge Canada Inc. – Brookfield Cement Plant

Appendix E - Consultation Report

Lafarge Canada Inc. – Brookfield Cement Plant
87 Cement Plant Rd.
Brookfield, Nova Scotia
B0N 1C0

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FIGURES AND TABLES

APPENDICES

1.0 Introduction

Lafarge Canada Inc. (Lafarge) is evaluating alternatives to fossil fuels and their optimum use in the cement manufacturing process at the Brookfield Cement Plant. As part of Lafarge's commitment to low carbon economy, Lafarge is studying the substitution of traditional fuel sources with locally derived, sustainable, Low Carbon Fuel (LCF) sources to reduce imported fossil fuel use, and lower carbon and other emissions. With recent research that indicates scrap tires are a promising alternative fuel, the Brookfield cement plant is looking to amend their existing Industrial Approval to using Tire Derived Fuels (TDFs) as a fuel source.

Lafarge's goal is to be open and transparent, and encourage public and stakeholder involvement in the study and use of TDFs at the Brookfield Cement Plant. The purpose of a consultation report in the application process is to allow the proponent to identify and consider issues that are important to the public and to provide stakeholders with an opportunity to receive information about, and provide meaningful input to the application process. Described in the following sections are the consultation activities that were undertaken and the information that was discussed.

2.0 Public Consultation Activities Completed

2.1 Ecology Action Nova Scotia Meeting – August 18, 2016

On August 18, 2016, the Environment Director of Lafarge met with three representatives of Ecology Action Nova Scotia at Ecology Action office in Halifax Nova Scotia. At this meeting, Lafarge gave an introduction to the upcoming application project for TDFs to be used as an alternative fuel at the plant. Ecology Action was also given the date of the Public Meeting to post on their website.

2.2 Shortts Lake Residents Meeting #1 - September 28, 2016

On September 28, 2016, representatives of Lafarge met with residents living near Shortts Lake at the Lafarge Brookfield cement plant in Brookfield Nova Scotia. Lafarge verbally invited the Shortts Lake community to visit the site for an introductory meeting. At the meeting, Lafarge representatives announced their plans to apply for a new LCF at the plant and their collaboration with Dalhousie University on TDFs. Dr. Mark Gibson was introduced as a collaborator with his research team to support the environmental testing for the project. The Shortts Lake residents were encouraged voice their concerns or questions throughout the application and testing process.

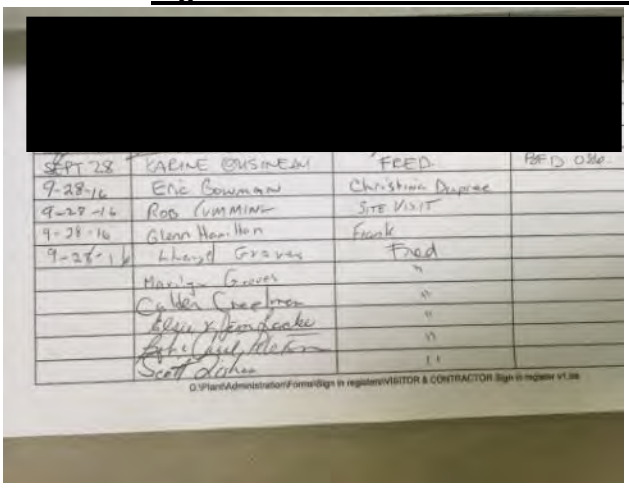
The questions that were raised during this meeting were mainly related to air emissions and environmental testing that would have to be done at the plant. The following questions were asked:

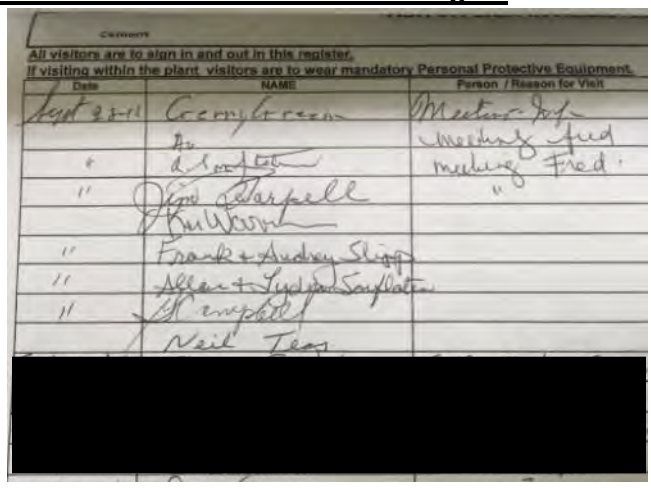
- Would you consider air monitoring near the plant?
- What are the weird smells and odors that started last year?
- Would there be more upsets?
- Would it be consistent in burning?

- How will the testing protocol look like compared to the current process to the new one?

Attendees signed in at the plant front desk as guests for the meeting. The attendance list is shown in **Figure 1a and 1b (below).**

Figure 1a and 1b. List of Attendees Shortts Lake Residents Meeting #1





In response to these concerns, Lafarge scheduled a follow up meeting for October 20, 2016 to answer questions before the Public Meeting that day.

2.3 Press Release – September 28, 2016

On September 28, 2016 Lafarge had a Press Release to announce the new LCF initiative at the Brookfield cement plant and partnership with Dr. Mark Gibson from the Dalhousie University. The press release included information on Dr. Gibson's research on TDFs and Lafarge's commitment to a low carbon economy. The Public Meeting information was posted for stakeholders and community members to attend and learn more details about the project. The Press Release is attached in **Appendix A.**

2.4 Shortts Lake Residents Meeting #2 – October 20, 2016

On October 20, 2016 representatives from Lafarge met with Shortts Lake residents at the Holiday Inn in Truro Nova Scotia. This meeting was scheduled in response to their concerns raised at the first meeting. Dr. Mark Gibson was introduced at this meeting to the community and he gave a presentation on his research, the results of his TDF study, and the environmental testing that will be done at Brookfield. Lafarge representatives confirmed that environmental test results from the plant, including air modeling, will be shared with the Shortts Lake residents.

All guests signed in and provided contact information for Lafarge to send additional information to. Lafarge's representatives and Shortts Lake residents who were present at the meeting are provided below in **Table 1**.

Table 1. Attendees at the Shortts Lake Residents Meeting #2

Attendees	Affiliation
Robert Coming	Lafarge Canada – Environment Director

Frederic Bolduc	Lafarge Canada – Plant Manager at Brookfield Plant
Amanda Kiu	Lafarge Canada – Environment Compliance Coordinator
Dr. Mark Gibson	Dalhousie University
Calder Creelman	Shortts Lake Resident
Donna Creelman	Shortts Lake Resident
Cathy Fisher	Shortts Lake Resident
Scott Fisher	Shortts Lake Resident
Marilyn Groves	Shortts Lake Resident
Audrey Slipp	Shortts Lake Resident
Bob Peterson	Shortts Lake Resident
Carol Peterson	Shortts Lake Resident
Gerry Greene	Shortts Lake Resident
Jim Harpell	Shortts Lake Resident

From this second meeting, the Shortts Lake residents had concerns and feedback that can be grouped into these broad categories:

- The levels of heavy metals released to the environment;
- The testing plan that will take place at the plant and results from an air model at the site;
- Potential contamination of Shortts Lake.

The Shortts Lakes residents detailed questions and concerns are listed in below in **Table 2**. Lafarge planned a follow up meeting **(Shortts Lake Meeting #3 – January 26, 2017)** to answer the questions present during this meeting and to collect additional information to answer their questions.

Table 2. Questions from Shortts Lake Residents Meeting #2

Category	Questions and Comments	Lafarge's Response
Environmental data from the Plant	Would like to see the weather station data on website (or have access)	Lafarge is willing to share this information, will need to study technical approach on how best to accomplish this.
	10 years ago, scientific studies showed that burning tires wasn't a good idea, what is the difference this time?	A lot has changed. Additional studies have been done in the 10 year period, there is more data to support the use of scrap tires as a lower carbon fuel, Lafarge has learned to work with independent researchers such as those from the University of Dalhousie, a Pilot Approach is being proposed where results will be shared with the community prior to permanent, extended use. The plant is also installing Continuous Emission Monitors.
	What does "testing" mean?	In this context, it refers to the validation of laboratory testing carried out at Dalhousie University. The specific emission testing particulars will be reviewed

		by Dalhousie and Nova Scotia Environment. It will be wide ranging including cement quality testing, process data assessments, continuous emission monitoring, as well as other practical observations.
	How will the pilot be tested in Brookfield (after the lab testing was done)?	A Test Plan is being prepared to describe this in detail but it will encompass process data collection, continuous emission data, product quality testing, laboratory testing, and emission testing.
	What is the frequency of testing, do you start after the flame is at full temperature, top or bottom of stack? Etc… (he wants details on the test)	A test plan is being prepared to describe this in detail and will include multiple evaluations. The source emission testing program will be conducted in accordance with NSE requirements which require operating at a maximum condition. Typically, the plant is started up on traditional fuels and when operating temperatures are reached raw materials are added and other fuels are introduced.
	How will you do the baseline testing? Will you have the same protocols? How do we know you don't burn 'cleaner fuels' during this test instead of the real tires	Dalhousie researchers will oversee both baseline emission testing and emission testing with scrap tires. Scrap tires will be supplied by third parties not under Lafarge's control. Records are kept of materials used.
	Are you burning 30% tires right now and increasing to 50%?	The Brookfield plant is currently providing up to 30% of its fuel needs from plastics, glycerine, and shingles. The use of scrap tires, which are not in current use, will increase the use of lower carbon fuels from 30% to almost 50%.
Heavy metals	Noted heavy metal analysis has not been completed	Heavy metal analysis will be included in baseline and scrap tire tests and results will be made available.
	Are there a lot more dangerous compounds in bigger tires (e.g. car tires vs heavy machinery)? Which tires will we burn?	We will be using local tires and the upper size will be limited by the kiln feed opening dimensions. While chemistry is kept as a closely held trade secret by tire manufacturers, previous studies are available to the research team. Emission testing will include heavy metals and results will be shared.
	If we don't burn the tires hot enough, 'nasty metals' will be produced.	Tires are injected at extremely high temperatures and the non-combustible fractions (such as metals) are incorporated into the cement produced. These temperatures result from the process requirements needed to make quality cement. Emission testing will include metals and

		results will be shared.
	Concerned about the heavy metals that end up in cement - do they end up in the soil/ground? (experience in China with contaminated lands with heavy metals)	Trace metals are present in all raw materials and solid fuels. When cement is used in making concrete, these metals are chemically bound within the concrete. In fact, cement is one of the solutions used in Brownfield applications due to this characteristic. Cement produced at the cement plant is continuously submitted to quality control testing to meet CSA and other standards.
	Will testing include heavy metals? How and who will be conducting the testing (including heavy metals)?	Testing will include heavy metals and results will be shared. Some testing will consist of samples sent to third party laboratories, potentially at the University of Dalhousie. Other emission testing consists of third party experts inserting probes into the stack to collect samples. This will be overseen by researchers from Dalhousie. Some testing will rely on process and continuous emission monitors, again this will be made available to the research team for evaluation.
Plant Processes	If the tire burning is profitable but not environmentally safe, will we stop the tire burning?	Lafarge must comply with all Nova Scotia Environment's emission limits and other conditions of operation. Results will be shared with the public. Based on current data and experience elsewhere there is high confidence in the safe use of scrap tires as fuel in cement plants and this will be confirmed in proposed validation tests.
	Is the tire system built already?	Lafarge must obtain a Pilot Approval from Nova Scotia Environment prior to construction. The current proposal is to commence construction of the system Summer, 2017
	What is going to be different at the plant process that makes this burning ok now vs 10 years ago?	The plant is installing continuous emission monitors. The plant team has more experience with alternative fuels. Lafarge has learned to work with partners, such as Dalhousie researchers and further research has been carried out by Dalhousie researchers (and is available) including combustion testing.
	Are you burning motor oils right now?	We are burning used oils right now
	Concerned with strong odour smells	There should be no odour smells, please report the date and time of when odours were noted to help

		determine their source
	Concerned with the temperature reaching the hottest point with the door opening in the kiln	The tire injection door will be open only for a few seconds and will not have a large effect on the temperature of the kiln. The temperature in the kiln is monitored as well.
Shortts Lake Water	Is there anything going into the lake?	The plant does not currently discharge water into Shortts Lake. Air dispersion models are being developed and will be shared.
	The lake water is important to us, if you take the boats out of the water, the water is clean enough to drink.	Lafarge understands the importance of good water quality to the enjoyment and use of the local community and shares a desire to protect and if possible enhance local water quality.
	Concerned about the safety of residents living further than Shortts Lake (dispersion model)	The air dispersion model is being developed and will be made shared.
	Discussion about human waste being discharged into the lake from local fishermen	We have looked into having a portable toilet installed at the location but there are concerns about maintaining the facility.

2.5 Public Meeting – October 20, 2016

The Public Meeting notice was sent out via postcards and newspaper advertisement. A total of 1470 postcards were sent to neighbors and residents in the local area in October. The Lafarge Brookfield website also posted a link to information about the Public Meeting. On October 18, 2016 The Truro News, New Glasgow News, and The Citizen printed the Public Meeting date, time, and information. The postcard and newsprint invitations can be seen in **Appendix B**.

On October 20, 2016, the Public Meeting was held at the Holiday Inn in Truro Nova Scotia between 3 pm to 7 pm. The Public Meeting was held in a drop-in format to allow community members to review the information at their own pace and come in when they were available. Lafarge and Dalhousie representatives were stationed around the room with information display boards set up. A list of project representatives at the meeting is provided below in **Table 3**.

Table 3. Project Representatives at the Public Meeting

Name	Affiliation	Title
Jonathan Moser	Lafarge Canada	Head, Environment & Public Affairs
Alex Wojciechowski	Lafarge Canada	Cement Industrial Director
Robert Cumming	Lafarge Canada	Environment & Public Affairs Director
Frederic Bolduc	Lafarge Canada	Plant Manager
Karine Cousineau	Lafarge Canada	Senior Manager Communications
Robert Fiander	Lafarge Canada	Maintenance Supervisor
Amanda Kiu	Lafarge Canada	Environment Compliance Coordinator
Dr. Mark Gibson	Dalhousie University	Associate Professor
Thomas Codey Barnett	Dalhousie University	Manager and Senior Research Scientist
Gabriella Makarious	Dalhousie University	Chemical Engineering co-op student
Sarah Donovan	Dalhousie University	Chemical Engineering co-op student

Colleen Gosse	Dalhousie University	MASc Environmental Engineering student
Yunchen Li	Dalhousie University	MASc Environmental Engineering student
Ellen Patrick	Dalhousie University	MASc Environmental Engineering student
Loay Jabre	Dalhousie University	MASc Environmental Engineering student
Dr. Ebenezer Asamany	Dalhousie University	Chemical Engineering

The display boards provided a plain language summary on plant processes, TDFs, the application process, and Dr. Gibson's research and results shown in **Figure 2 (below)**.A copy of all the display boards is provided in **Appendix C**. The display boards available at the Public Meeting included the following topics:

- Welcome
- The Project
- Where will scrap tires be used?
- What is the predicted outcome?
- Application of precautionary principle:
- What happens next?
- Sustainability in action
- Where are scrap tires used today?
- How will the testing be done?
- Research team members
- Dr. Gibson's research paper on combustion emissions with cement kilns
- Comments and Questions

Figure 2. Display Boards at the Public Meeting

The Comments and Questions display board allowed for participants to provide feedback directly onto the board. This interactive display board allowed participants to openly indicate their concerns and questions they wanted Lafarge to address. The Comments and Questions display board had a mirror paper handout copy at the table for participants to write on as well.

Information about Lafarge's Low Carbon Fuel Program was posted on the boards including information about the predicted reduction in carbon emissions and socio-economic benefits by using TDFs at the plant. Dalhousie University prepared display boards with information on Dr. Gibson and his team. They included their support to conduct extensive baseline tests prior to using scrap tires at the plant. They also prepared display boards summarizing their research paper investigating changes in emissions from cement kilns in North America using alternative fuels including TDFs.

2.5.1 Documentation of Public Meeting Feedback

All attendees were asked to sign in and provide their contact information. The sign in list is included in **Appendix D**. Including Lafarge and Dalhousie project team members, a total of 82 people signed in at the Public Meeting with 66 public attendees who provided their name for the sign in sheet. All attendees were encouraged to fill out the comment form or sign on the Comments and Question display board. To document questions from the local community, a questions and comments board was created for community members to write for Lafarge to address. The display board had sticky notes with comments written on them for everyone to view. There were a total of 18 questions written from both the comment board and comment forms provided at the meeting.

2.5.2 Record of Public Meeting Comments

Table 4 includes a comprehensive list of all comments and questions written during the Public Meeting. Below is a summary of questions and concerns that were asked often grouped by relevant environmental criteria.

Environmental Testing at the Plant

Environmental testing at the plant was one of the topics that had the most feedback on the display board. There were 4 comments out of 18 that were related to the testing and results that would be done at the plant. Attendees were also interested in seeing baseline and air modeling result when TDFs are used as an alternative fuel.

Contaminants and Chemicals

There was a general concern during the Public Meeting on a broad range of toxic or harmful chemicals that could be found in scrap tires and the environmental effects of their combustion. There were two questions raised about the incineration and the chemicals that are used to make tires and their toxicity.

Odor

There were questions asking about the odor that will be produced from changing the fuel used at the plant and concerns on how that would affect the local area.

Water Quality

There was significant feedback related to water especially related to Shortts Lake. Many attendees were concerned about emissions affecting the quality of the lake including changes in pH. Attendees wanted to see testing results and if there would be any changes in water quality from using TDFs.

Plant Processes

There was also interest in the new tire injection process that the plant would have to adopt to use TDFs in the kiln. Many participants inquired on how the new system that would be installed, its operation, and any environmental impacts.

Table 4. Comments and Questions from the Public Meeting

Category	Comment	Lafarge Response
Comment	I'm not convinced	Data will be independently assessed and transparently shared and ultimately must meet Nova Scotia air emission requirements
Environment Testing	Will testing be done on different types of tires?	Testing will be done on the tires provided from various local sources as available during the various testing programs. Some minor variation is known to exist between tires (tread, hardness, wear, silica, etc.) but these differences are expected to be minor in use as fuel. Size / weights are monitored by the fuel delivery system to deliver a consistent fuel rate.
	Will there be a retest to see the result of burning tires and fracking fluid; will there be any bad results?	Regular emission testing will continue throughout the demonstration / research phase and continuous emission monitors are being installed, in addition to existing process monitoring. Results will be assessed (and shared) and if negative results occur corrective action will be taken.
	Would like to have copies of baseline studies before approval	We can provide copies to interested members and these will be available on the website.
	Is the reduction emissions in this process worth taking NS tires out of current recycling that has no emissions? (from Ged Stonehouse)	One of the research aspects will be a life cycle assessment to compare the environmental footprint of using scrap tires, in place of coal, to other alternative re-use options such as tire derived aggregate, the current use in Nova Scotia. Results will be shared.

Government Related Questions	Dr. Gibson: your original study led you to believe that the best use of used tires was in asphalt. Are you aware of any consideration by government to mandate a percentage of rubber in asphalt? (from Orland Kennedy)	Divert Nova Scotia recent released a RFP for scrap tire management. This process may produce a bidder prepared to review crumb rubber for use in asphalt.
	Why don't we have more concrete highways in Nova Scotia?	Too expensive… The cement and concrete associations continue to provide evidence for the long term benefits of using concrete vs asphalt in road construction.
	Data published chemicals …. Minister of Environment ...who views on this issue (illegible)	
Contaminants and Chemicals	Dr. Gibson: No chemical process is completely benign. Could you list the negative results in order of concern to the best of your knowledge? (from Orland Kennedy)	While compared to coal and petcoke, the emissions from scrap tires are considered to be either similar or lower, there are still emissions. The plant's largest emission is that of NO_x – a smog precursor – and using scrap tires will reduce NO_x but not eliminate it. During laboratory combustion tests, carbon monoxide and [fill in] were also detected. However, these would be expected from the combustion of coal and petcoke.
	I am very concerned about toxic chemicals used to make this. I worked at Michelin Tire and wore a mask to work every day. I need you to explain this to me (from Ron MacQuarrie)	Extensive studies on the emissions from the tires will be carried out and shared in order to ensure the safety of human and environmental health
Odor	Will there be any odor produced from the burning of tires? (from Brian Matthews Truro)	There are no expected odours to arise from the use of scrap tires as fuel due to high combustion temperatures present in the cement kiln. This will be confirmed during the demonstration testing period and results will be shared.
Plant Process	How long will the plant be viable in its present state (years)?	The plant's competitive environment is ever changing. Lafarge continues to invest in the plant to maintain its competitiveness and the local team is known to be one of the most agile and committed teams. Using scrap tires as fuel will make the plant more competitive and will prepare it to meet upcoming carbon regulations.
	How much coal will be replaced by using tires?	The plant does not use coal currently but rather petcoke (but can return to coal). However, they are similar solid fossil derived fuels on an energy per weight basis, up to 15% of the plant's fuel needs can be provided through mid-kiln injection of scrap tires.

	Explain the upgrade made to the process in Brookfield that will show a different opinion than the one in 2009?	The context has changed in a number of ways. The plant is installing continuous emission monitors. The plant team has more experience with non-traditional fuels. Lafarge has learned to work with partners, such as Dalhousie researchers, to apply a cautious approach – and one based on transparency and dialogue. Further research has been carried out by Dalhousie researchers (and is available) including combustion testing.
	Is this the first step in cement plant becoming a waste facility only? How competitive will Brookfield be when new plant in Gaspe comes online? (from Roger Ryan 902 899 1949)	Lafarge continues to invest in retaining the Brookfield cement plant's competitiveness. While the high temperatures, well above that of an waste incinerator, are such that the plant can indeed combust waste materials with high efficiency the main focus is on making cement for the foreseeable future. The use of scrap tires in addition to the other lower carbon fuels (shingles, plastics) will enable the plant to reach 50% replacement of fossil fuels, readying the plant to meet upcoming carbon regulations.
Water Quality	Why do want to destroy the lake?	The purpose of this project is to confirm the research that indicates that the use of scrap tires will reduce emissions and contribute to global efforts to reduce carbon emissions. Lafarge also has an active program to conserve water and enhance community benefits from water. The recent Brook diversion project was a positive benefit for the local environment.
	What happens if the cement containing the ash is used in well casing; will water pH affect leaching; can it get into the water?	All of the cement produced must meet CSA standards including a wide array of quality control testing.
	Are you going to do any measurements on the lake before burning tires and after to see if the emissions make changes in the water quality	While the focus of the research demonstration project is on the measurement of emissions from the cement plant itself, Lafarge is prepared to have a dialogue about Shortts Lake water quality concerns.

2.5.3 Follow up after Public Meeting

Posters and presentations were sent to guests who wanted more information. Lafarge also extended a site tour invitation to the Sipekne'katik First Nations who were interested in the TDF project from the Public Meeting. **Appendix F** includes follow up emails that were sent to the attendees.

2.6 Shortts Lake Residents Meeting #3 – January 26, 2017

The third Shortts Lake Residents Meeting was held on January 26, 2017 at the Brookfield Cement Plant at 1 pm. There were four main topics that Lafarge representatives and research partners wanted to share and discuss with the community:

1. An update on the TDF research pilot
2. Discuss the results of a recent SMU report published on Shortts Lake
3. Air dispersion modeling
4. Follow up on action items and questions from previous meetings.

Research Pilot Status

The plant has started some preliminary engineering required for the construction of the new injection system at kiln #2 subject to Nova Scotia Environment (NSE) Approval. The pilot permit application is almost complete including a detailed consultation report and early modeling results. The application will be submitted around the end of Q2 to the NSE for review and comments and approval. Once the permit has been approved, construction could begin as early as Q3.

Lafarge has also submitted a RFP response to Divert Nova Scotia with a conditional offer for tire use. Passenger and light truck tires are the focus of the proposal.

St. Mary's University Study

After reviewing the recent St. Mary's University study, which included sampling from Shortts Lake, Lafarge contacted GHD Limited, who is a third party consultant familiar with the site's water context, to review the mercury and arsenic results that were found in fish from Shortts Lake. GHD compiled regional maps with soil and sediment data from Nova Scotia Department of Natural Resources showing mercury and arsenic levels around Shortts Lake. The data shows that concentrations at Shortts Lake were comparable to regional lakes.

GHD also had an ecologist and eco-risk assessor review the levels of metals in the fish tissue in the lake. These levels are also comparable to those found broadly in the region; arsenic levels are higher than recommended intake amounts but that is thought to be due to the naturally elevated levels in the soil and groundwater in Nova Scotia. GHD noted that the Gaspereau, which was included in the study, is an anadromous fish species and the importance of where fish migrate to and from. University or public studies may exist which determine the background concentrations in the fish from other lakes to determine if the elevated levels are specifically related to Shortts Lake circumstances, specific species, or if it is due to the natural environment.

Lafarge has signed the Minamata Convention which commits all of our plants to test inputs at the plant and to find ways to reduce mercury inputs to the kiln operation. This includes evaluating alternatives to coal such as using scrap tires which have lower mercury concentrations. In terms of comparison to standards, the mercury levels at the Brookfield Cement Plant are in compliance with the Canada Wide Standard and are among the lowest results in Lafarge's plants.

Air Dispersion Modeling

Dr. Mark Gibson from Dalhousie University gave a presentation to explain in more detail the science and calculations behind air dispersion modeling. The presentation discussed the sources, the mapping, and what the results could look like once the modeling is complete for the Brookfield Cement Plant. Dr. Gibson will also review and comment on the air dispersion modeling that will be completed for scrap tires at the plant.

Frequently Asked Questions

After holding community meetings for the past months, Lafarge wanted to provide some answers to the most common questions and comments the community was interested in.

What is different from 10 years ago?

Lafarge has learned to work with independent partners, such as Dalhousie University, to apply a precautionary approach. A pilot approach is being proposed and the results will be shared the community prior to permanent approval which is based on favourable results. The cement plant is better positioned today with additional studies and data to support the use of scrap tires and will install continuous emission monitors in 2017 to further support the research.

What testing will be done and How will it be done?

A test plan is being jointly prepared with Dalhousie University to describe the details of the testing plan. This includes process data collecting, product quality testing, laboratory testing, emission testing, stack testing, and the frequency of testing throughout the research phase and the need for corrective actions. Dalhousie researchers will conduct the baseline and emission testing with scrap tires.

Will Heavy Metals be tested?

Heavy metals will be included in the baseline and scrap tire testing and the results will be made available. It is expected that metals from scrap tires will be incorporated into the cement – this applies to all heavy metals present in raw materials and other fuels as well. In general, trace amounts of metals are found in all raw materials and fuels used to make cement, and the plant conducts periodic emission testing to confirm compliance with emission limits. The plant also monitors the performance of the Electrostatic Precipitator with continuous emission monitors to ensure it is functioning normally.

All guests signed in and provided contact information for Lafarge to send additional information to. Lafarge's representatives and Shortts Lake residents who were present at the meeting are provided below in **Table 5**. A list of questions that were asked is listed in **Table 6**.

Table 5. List of Attendees Shortts Lake Residents Meeting #3

Attendees	Affiliation
Robert Coming	Lafarge Canada – Environment Director
Frederic Bolduc	Lafarge Canada – Plant Manager at Brookfield Plant

Amanda Kiu	Lafarge Canada – Environment Compliance Coordinator
Dr. Mark Gibson	Dalhousie University
Peter Oram	GHD Ltd – Environmental Consultant
Gerry Greene	Shortts Lake Resident
Don Cameron	Shortts Lake Resident
Ken Smith	Shortts Lake Resident
Gary Carter	Shortts Lake Resident

Table 6. Questions from Shortts Lake Residents Meeting #3

Questions and Comments	Lafarge's Response
How will tires be delivered to the plant? Are they from Nova Scotia?	The tires will be delivered from Nova Scotia and will arrive by trailer trucks. It is predicted that with the TDF fuel replacement, there will be an insignificant effect with a one truck per day increase for on-site and off-site traffic.
Where does the glycerin come from?	The glycerin is fish based source that has been approved in the plant's industrial approval for use as an alternative fuel.
Would like to see results of mercury modeling for ambient air conditions	The results of the air dispersion model will be released and includes information on the mercury levels at ambient conditions.
Would like to have a better avenue for communication post-meeting	The Lafarge liaison committee will be looking to add other methods to communicate updates, news, and new results from the plant. The community is currently encouraged to give the plant a call at any time if they have questions about our processes or the TDF system application
What is the amount of coal that tires will replace in the fuel	The plant does not use coal currently but rather petcoke (but can return to coal). However, they are similar solid fossil derived fuels. On an energy basis, up to 15% of the plant's fuel needs can be provided through mid-kiln injection of scrap tires.
How much mercury is emitted from each fuel source?	Once the air dispersion model is complete for TDF emissions at the plant, a comparison list will be release which shows how the emissions from the stack will change
Are you able to burn tires currently without additional monitoring technologies added to the stack?	The plant does not have the technology to burn tires as they need to have an injection point installed first in addition to the new monitoring technology that will be installed at the stack to monitor NO_x and SO_x levels.
How will dioxins and furans change with TDFs?	Dioxins and Furans are not expected to change from the current plant emission levels.
Please send a list a contaminants that will be tested for	A list of contaminants will be made available for the community to access
What contaminants will be increased from using TDFs	While compared to coal and petcoke, the emissions from scrap tires are considered to be either similar or lower, there are still emissions. The plant's largest emission is that of NO_x – a smog precursor – and using scrap tires will reduce NO_x but not eliminate it. During laboratory combustion tests, carbon monoxide and [fill in] were also detected. However, these would be expected from the combustion of coal and petcoke.
Does our Health and Safety Department think emissions are dangerous from TDFs?	The Health and Safety department has not expressed any concerns with the emissions from TDFs as they are more involved in the ergonomic and logistic side during this process

Are there plants that are operating that shouldn't be if they are out of compliance?	There may be plants that are allowed to operate in certain regions that are not in compliance with their regulatory agents. Lafarge does not operate without the appropriate approvals or permits and works closely with regulatory agencies to make sure we are in compliance.

2.7 Sipekne'katik First Nation Informal Tour – February 7, 2017

Jennifer Copage, representing the Sipekne'katik First Nation, was sent an invitation for an informal tour at the Brookfield Cement Plant on February 7, 2017. Lafarge representatives and Dr. Gibson met with her and gave a site tour about the current manufacturing cement process. Lafarge representatives also gave information on the progress of the TDF system and the Environment Assessment application. The emission testing and monitoring that is planned at the site was also explained to her and Lafarge representatives offered to provide results, reports, and a copy of the EA for her to review as part of the process.

Lafarge offered additional tours or meetings if they have any questions in the future related to the cement plant.

2.8 Colchester Council Meeting – February 7, 2017

Lafarge requested to make a presentation to the Municipality of the County of Colchester Council on the topic of the TDF Injection System at the plant. The goal of the presentation was to provide more information to the Council, explain the plant process, new technologies and science that will be used, and the collaboration with Dalhousie University.

Lafarge representatives and Dr. Gibson presented to the Council on February 7, 2017 at the Council Chambers. The presentation included information on the plant processes, the TDF project details, and Dr. Gibson gave an overview on the air emissions and testing that will be conducted. The Council also reviewed past public consultations and was notified of any concerns or questions that the community frequently asked.

Concerns that the Council mentioned during this meeting include the following:

- Suggested to organize a Liaison committee
- Questions about the testing at the plant
- Which cement plants in Canada use TDF and for how long
- What other fuels are being used
- How many trucks will be used
- What size of tires can the system use
- How many new jobs will be created
- What is the current amount of cement kiln dust (CKD) landfilled

These questions were answered during the meeting by Lafarge representatives and Dr. Gibson. Lafarge has noted that some questions were asked by other community members and will be sure to communicate a response to the community by scheduling additional consultation meetings.

3.0 Planned Consultation Activities

Lafarge has planned for additional consultation and engagement activities with stakeholders in the upcoming months. The dates for these meetings are to be confirmed.

3.1Shortts Lake Residents Meeting #4

Shortts Lake residents will have a follow up meeting potentially in April or May where the results of the environmental testing and air modeling will be presented and discussed. They will be further consulted for their feedback and given information on the upcoming Public Meeting.

3.2 Second Public Meeting

A second Public Meeting is planned to potentially happen in May to address questions and comments received from the first Public Meeting. Based on the questions from the first meeting, there will be a new display board which will include answers and information to address the local community concerns. There will also be additional information on the application process and allow for more discussion from the local stakeholders.

Appendix A – Lafarge Low Carbon Fuel Press Release

LAFARGE
Building better cities

PRESS RELEASE

Taking Low Carbon Fuel Research from the Lab to the Industrial World

Lafarge Partners with Dalhousie University Researcher

September 28, 2016 (Halifax, NS) - Lafarge is proud to announce a partnership with Dalhousie University researcher Dr. Mark Gibson that will allow low carbon fuel research to be tested on an industrial scale. Working under a Natural Sciences and Engineering Research Council of Canada (NSERC) Discovery Grant, this initiative will research the adoption of low carbon fuels in the cement industry. This continuing partnership between Lafarge Canada Inc. and Dalhousie's Faculty of Engineering will support the testing of tire derived fuel as a low carbon fuel alternative in the cement industry at the Lafarge Brookfield cement plant.

Recent laboratory studies conducted by Dr. Mark Gibson, Associate Professor in Dalhousie University's Department of Civil and Resource Engineering and his colleagues in Process Engineering and Applied Science, Dr. Michael Pegg and PhD student, Ebenezer Asamany, show that tire derived fuel has the potential to lower CO_2 emissions compared with coal derived fuel when co-fired in cement kilns.

In 2015, Dr. Gibson and his team published a report entitled *Use of scrap tires as an alternative fuel source at the Lafarge cement kiln, Brookfield, Nova Scotia.* "My students and I are very pleased to see this work enter the real world. Based on our research, we expect to see significant reductions in greenhouse gas emissions from the Brookfield cement plant and thereby help Nova Scotia move one step closer to a low carbon economy," said Dr. Gibson. "We also expect that the use of tire-derived fuel will reduce NOx emissions as well as make excellent use of scrap tires," he added.

Lafarge Canada is committed to a low carbon economy and reducing its carbon footprint. "It is important that we work with partners in tackling the challenging problem of climate change. Dr. Gibson's team's research in recent years has been essential to our understanding of how to replace fossil fuels, like coal, with lower carbon alternatives," said Rob Cumming, Environment Director for Lafarge.

While there are a number of levers available to reduce the carbon emissions in the cement industry, the one of most relevance is the growing usage of lower carbon fuels. Thanks to different initiatives including previous work with Dalhousie's Faculty of Engineering, the Brookfield plant has reached world class status in the percentage of its fossil fuels replaced with

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www.lafarge-na.com

A member of LafargeHolcim

lower carbon fuels, in the form of front end burner injection, and is expected to reach substitution rates as high as 30% on an energy basis by the end of this year.

The project proposal will be explained in further detail at a Public Meeting planned for October 20, in Brookfield. If the demonstration shows that, as expected from the research, tires can be used safely to replace coal, Lafarge expects that about 15% of its fuel needs can be met from using approximately 450,000 scrap tires per year which is just under half of the amount of tires generated in Nova Scotia.

-30-

For more information:

Karine Cousineau
Senior Manager, Communications
Lafarge Canada Inc.
Phone: (416) 459-5816
Email: karine.cousineau@lafargeholcim.com

Dr. Mark Gibson
Associate Professor
Department of Civil and Resource Engineering
Dalhousie University
Tel: (902) 494-3278
Email: mark.gibson@dal.ca

LAFARGE
Building better cities

ABOUT LAFARGE CANADA INC.

Lafarge Canada Inc., a member of LafargeHolcim, is Canada's largest provider of solutions to the construction and development industry. With more than 6,000 employees across Canada, our mission is to provide construction solutions that build better cities and communities. The cities where we live, work, and raise our families along with the infrastructure that supports our communities such as roads, bridges, transportation links, water, and waste management benefit from the solutions provided by Lafarge.

Lafarge is committed to providing solutions using sustainable manufacturing practices and improving the environment in and around our operations. At locations across Canada, we have worked to reduce carbon dioxide emissions, restore wetlands for native plants and animals, and identify waste materials that can be recycled and used at our operations.

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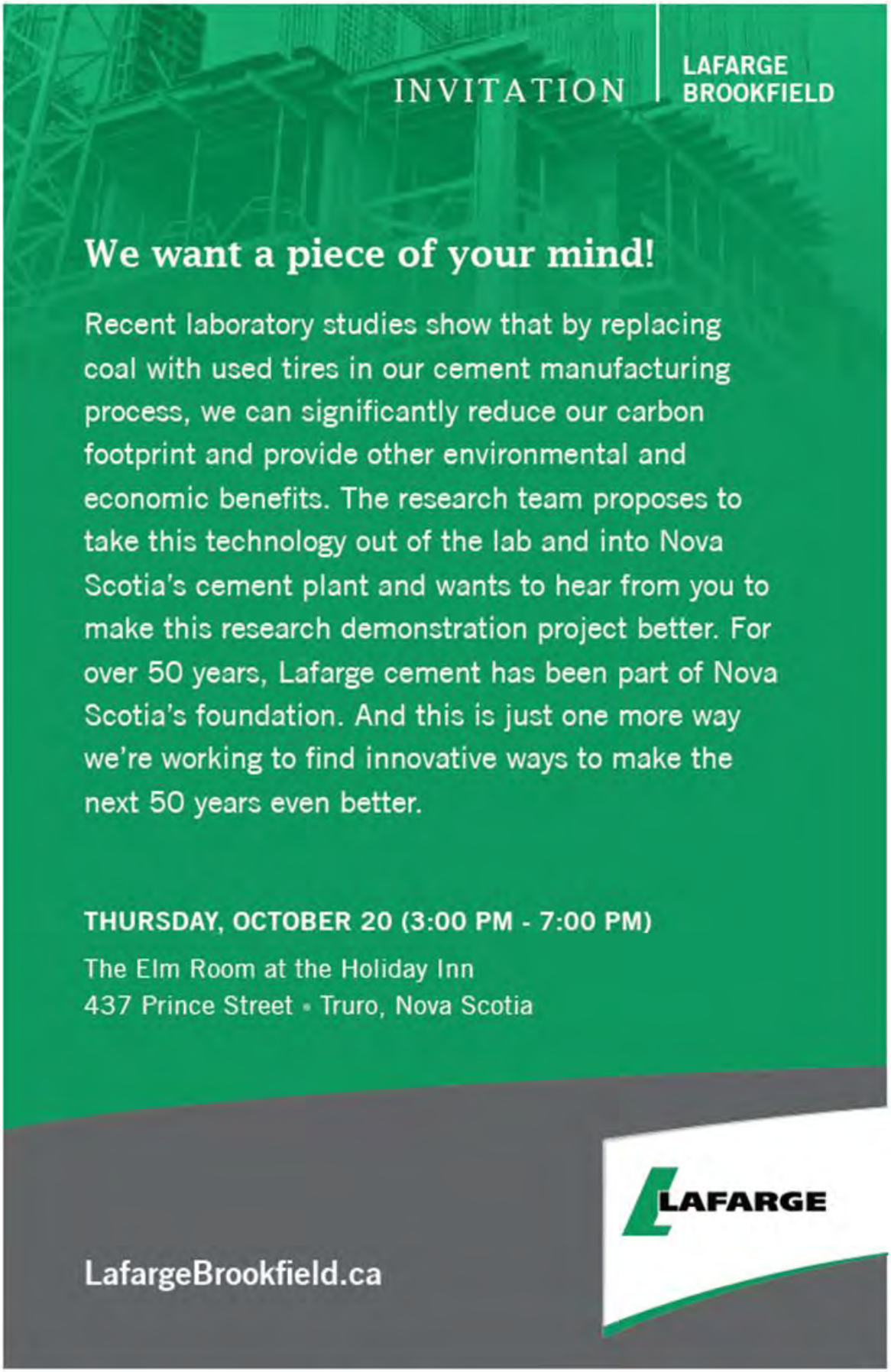
Appendix B – Public Meeting Notices


INVITATION
LAFARGE
BROOKFIELD
Let's talk
about a
SUSTAINABLE
FUTURE
LAFARGE


INVITATION
LAFARGE
BROOKFIELD
We want a piece of your mind!
Recent laboratory studies show that by replacing coal with used tires in our cement manufacturing process, we can significantly reduce our carbon footprint and provide other environmental and economic benefits. The research team proposes to take this technology out of the lab and into Nova Scotia's cement plant and wants to hear from you to make this research demonstration project better. For over 50 years, Lafarge cement has been part of Nova Scotia's foundation. And this is just one more way we're working to find innovative ways to make the next 50 years even better.
THURSDAY, OCTOBER 20 (3:00 PM - 7:00 PM)
The Elm Room at the Holiday Inn
437 Prince Street • Truro, Nova Scotia
LAFARGE
LafargeBrookfield.ca

Mission Sunday

SUBMITTED

Pastor John Dunnett chats with guest speaker Pastor Randy Stanton, regional representative for Canadian Baptist Ministries (CBM), at First Baptist Church on Mission Sunday. CBM embraces a broken world through word and deed. Stanton stated there will always be a tension involved with ministries: give locally, give globally; provide the word (evangelize), provide food (feed the hungry); help now, help later, etc. Just as Jesus was sent by His father to minister to others, we are commissioned to serve the Lord at home and around the world.

ORGANIZATIONS

Sir Frederick Banting IODE meets

The Sir Frederick Banting chapter IODE met on Oct. 5 at the Westside Sobeys community room. President Josie McInnis called the meeting to order and prayers were offered.

Eight members were in attendance and 56 work hours reported. Minutes were read by Marlene MacLellan.

The bag sale held on Sept. 29 and 30 was fairly successful. Our treasurer was unavailable for a report.

During the meeting plans were made regarding our upcoming meal preparation for the Good Shepherd lunch room.

We were contacted by our fellow chapter regarding a Christmas get-together on Dec. 6 at 6 p.m. at the Westside Bistro.

Past president reps got together and decided not to proceed with an area conference any longer. A private auction was held and funds were raised for our chapter.

Josie declared the meeting officially closed and a light luncheon was enjoyed.

Submitted by Brenda Dunn

MEETING

Women's Institute has special police K-9 demonstration

SUBMITTED

RCMP officer Mark Murnahan and German shepherd Bo.

McPhersons Mills Women's Institute had a very successful Lunch and Learn in the community hall last Thursday. This event was offered free of charge to the seniors in our community.

Our guest speaker was K-9 unit RCMP officer Mark Murnahan and his four-year-old German shepherd "Bo." Items were hidden ahead of time and the dog was given commands to search them out. The presentation was well received with lots of questions from those present. Mark was thanked and given a gift.

This was our largest attendance yet with a total of 40 people present. Members from our twin branch Port Bickerton were also present and we gave them bottles of grape jelly to take back home to all their members.

We served a choice of soups and deserts along with rolls and biscuits, tea and coffee. We had many positive comments on both the presentation and the homemade meal.

Many of the seniors stayed after and socialized.

HEALTH

East Cumberland Lodge honours long-term employees

250 years of collective service to residents

TC MEDIA

PIGNASH

As part of its annual Continuing Care Month celebrations, East Cumberland Lodge recently honoured 10 employees for their more than 250 years of service collectively to residents at the facility.

"We are proud of all our employees not only for their dedication of years of commitment to our residents and families," said Joe Gauthier, facility administrator, "but also for the caring, kindness and sense of warmth they bring in their provision of service to others. We are very proud of having them on staff with us."

The following individuals were recognized for their years of service by board chair Debbie Cameron and municipal councillors Al Gillis and Lynne Welton, who are also members of the East Cumberland Lodge Board of Directors: Cheryl Newcombe, Executive Secretary – 20 years; Lisa Benjamin, Food Services – 25 years; Yvonne Moore, Food Services – retiree; Angela Ferguson, Licensed Practical Nurse – 25 years; Jennifer Jamieson, Registered Nurse Supervisor – 25 years; Gail Scott, Personal Care Worker – 30 years; Halena Steven, Personal Care Worker – 30 years; and Anne Thompson, Registered Nurse Supervisor – 30 years.

The service was part of the celebrations held across the province to recognize the continuing care sector and the contributions of its employees and what that means for the Nova Scotians who require their support.

Continuing care services promote health, well-being and independence and support families in caring for their loved ones.

Continuing Care Month was in September. For the past 13 years, Health Association Nova Scotia has sponsored a public awareness campaign during this monthlong recognition. The theme, Continuing Care: Your Home, Our Passion, reflects the aim of continuing care services to help people to live well in the place they can call home. It also reinforces the commitment and compassion of the many people who have chosen this caring field of employment.

The goal of this year's campaign is to profile the advances being made in Nova Scotia's continuing care sector to improve quality of life and quality of care for the Nova Scotians who rely on these important services.

The campaign is also about promoting recruitment to this important sector. It's a major growth industry.

SUBMITTED

East Cumberland Lodge presented service awards to long-term employees during a recent ceremony. (From left) Debbie Cameron, ECL board chair presents a 30-year and retiree award to Gail Scott, PSW while municipal councillors and ECL board members Lynne Welton and Al Gillis look on.

SUBMITTED

East Cumberland Lodge presented service awards to long-term employees during a recent ceremony. (From left) Debbie Cameron, ECL board chair presents a 30-year award to Halena Stevens, PSW while municipal councillors and ECL board members, Lynne Welton and Al Gillis look on.

TAX SALE 2016-1

The Town of Oxford in the matter of Municipal Government Act Being Chapter 18 of the Revised Statutes of Nova Scotia and Amendments 1998.

TAKE NOTICE

That the land and premises situated in the Town of Oxford hereinafter described may be sold at Public Auction at the Town Hall at 105 Lower Main Street, Oxford, **NOVEMBER 22, 2016** at **10 O'CLOCK AM** in the forenoon, for arrears of rates and taxes still owed to the Town of Oxford.

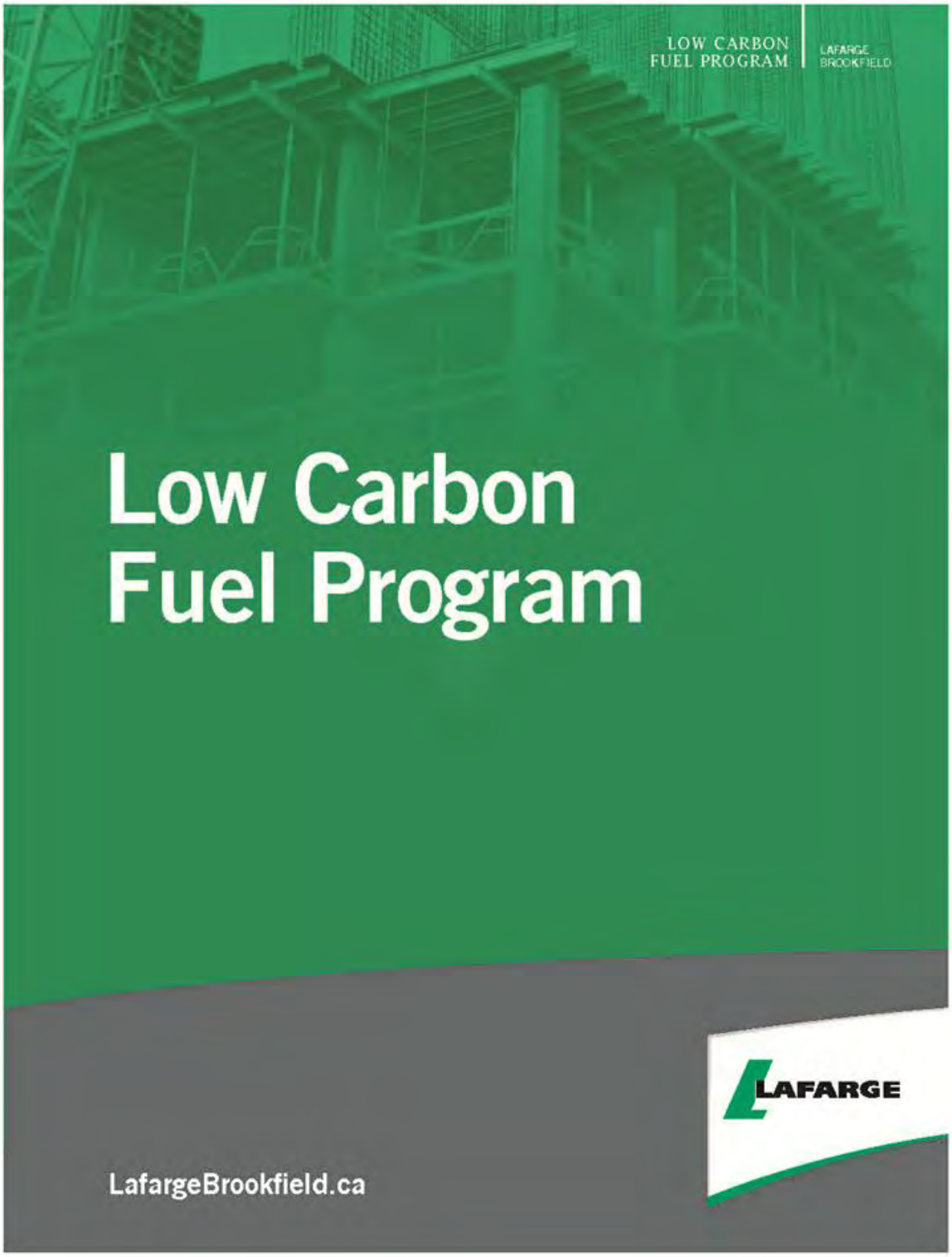
Account # 02515938 **PID# 25371535**
Assessed to: Logan MacEachern
Land situate in the Town of Oxford, 55 Thompson Road
Taxes, Interest and Expenses: **$ 4,500.61**

Account # 09694188 **PID# 25467176**
Assessed to: Estate of Rufus Wood
Land situate in the Town of Oxford,
Taxes, Interest and Expenses: **$ 815.90**

Signed Darrell White
Town Clerk and Treasurer

For a more detailed description contact the Town Office at 105 Lower Main Street, Oxford, Nova Scotia. Payment method at the Tax Sale is by cash, certified cheque, money order, bank draft or lawyer's trust cheque only.

Appendix C – Poster Display Boards


LOW CARBON
FUEL PROGRAM
LAFARGE
BROOKFIELD
Low Carbon
Fuel Program
LAFARGE
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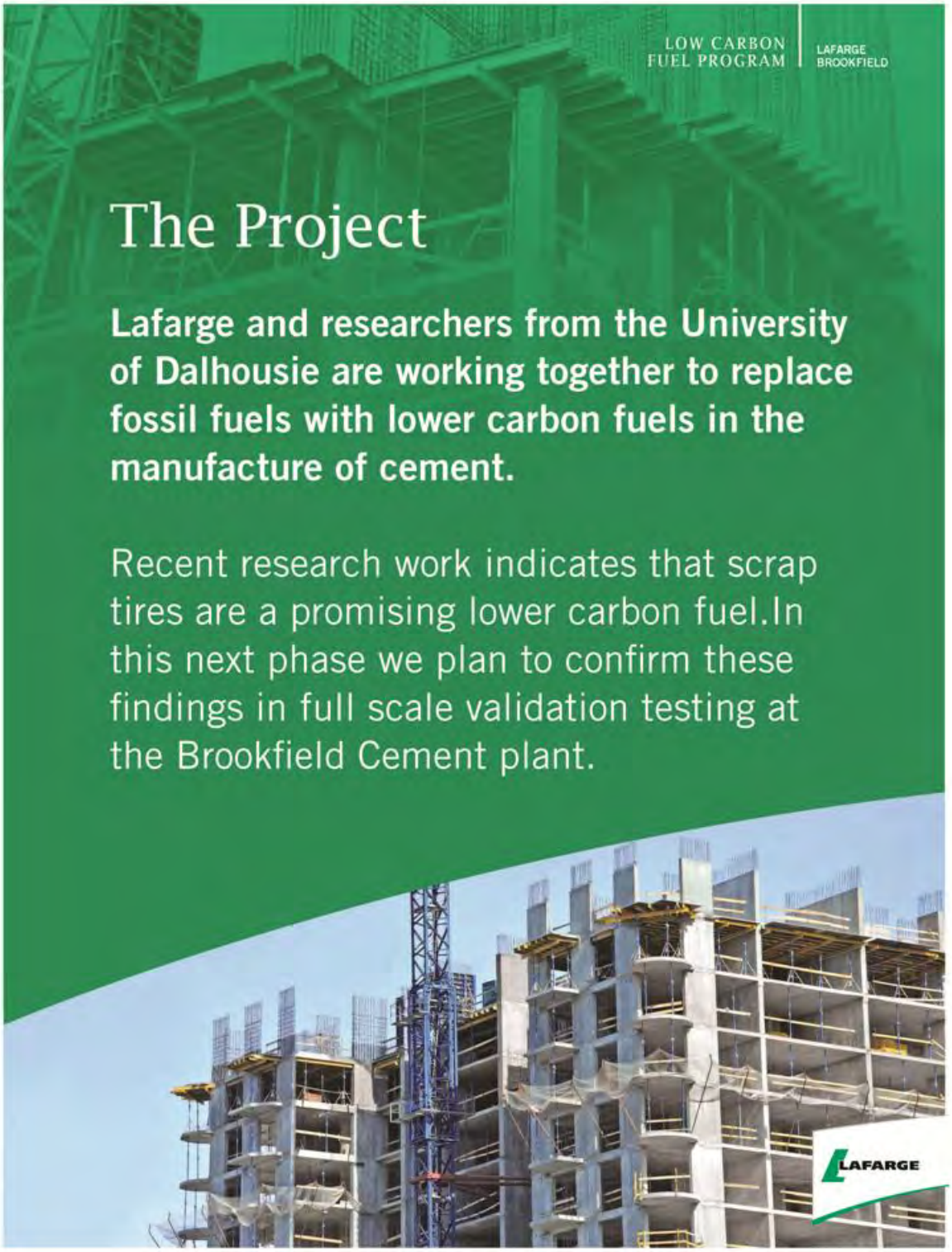
LOW CARBON FUEL PROGRAM
LAFARGE BROOKFIELD
The Project
Lafarge and researchers from the University of Dalhousie are working together to replace fossil fuels with lower carbon fuels in the manufacture of cement.
Recent research work indicates that scrap tires are a promising lower carbon fuel.In this next phase we plan to confirm these findings in full scale validation testing at the Brookfield Cement plant.
LAFARGE


LOW CARBON
FUEL PROGRAM
LAFARGE
BROOKFIELD
The fuels you will hear about today are expected to lower emissions and reduce the environmental footprint of the cement industry.
We are seeking government approvals to validate these findings. Your participation today will ensure a robust research program.
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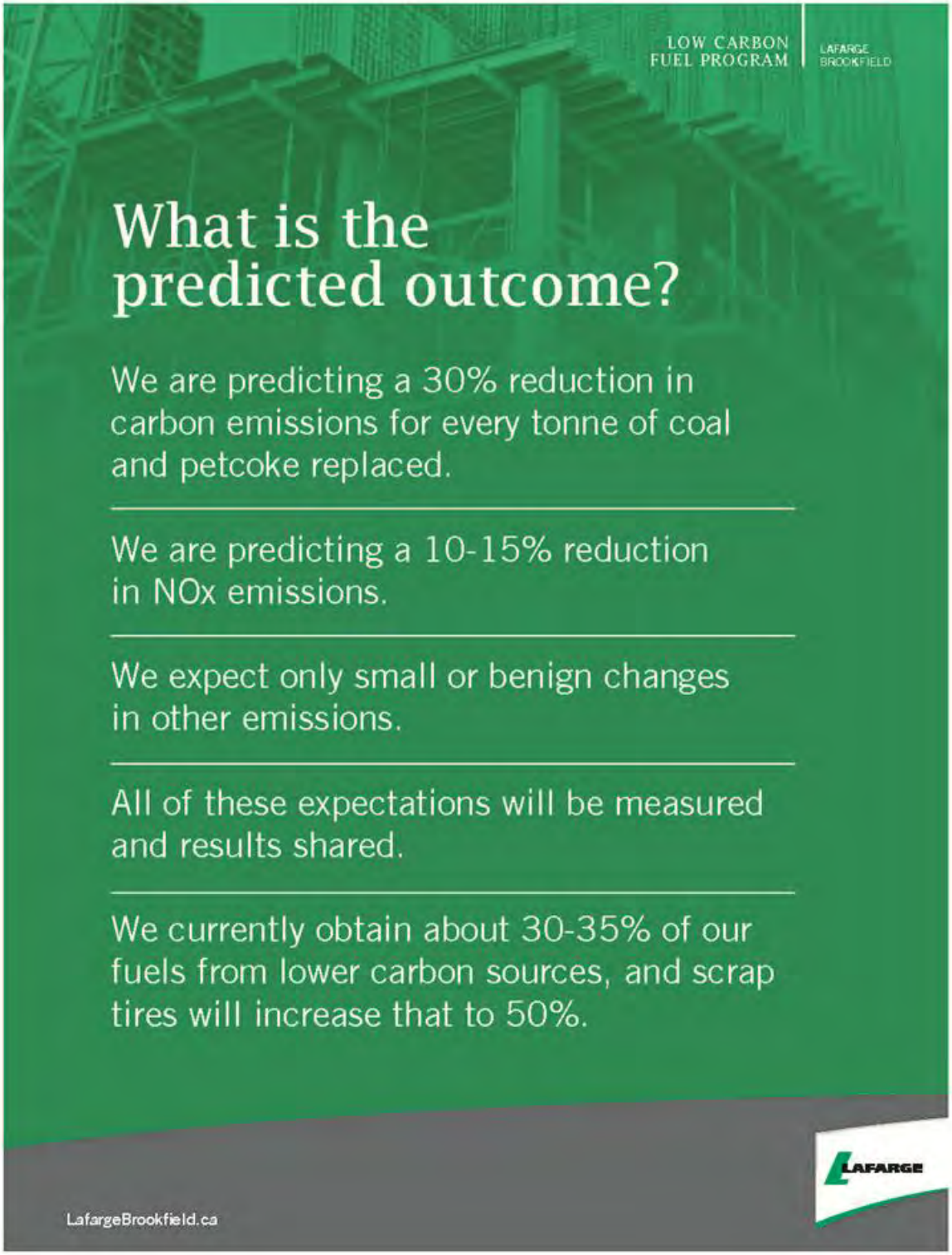
LOW CARBON FUEL PROGRAM | LAFARGE BROOKFIELD

Where will scrap tires be used?

They will be used in what is called mid-kiln injection. They are slid into the top side of the rotary kiln on each rotation. Here the temperatures are so high that they immediately ignite and disappear from sight as per our observations at other plants. The non-combustible components (eg. steel belts) drop to the floor of the kiln where they melt into the molten rock – replacing virgin raw materials in so doing.


LOW CARBON FUEL PROGRAM
LAFARGE BROOKFIELD
What is the predicted outcome?
We are predicting a 30% reduction in carbon emissions for every tonne of coal and petcoke replaced.
We are predicting a 10-15% reduction in NOx emissions.
We expect only small or benign changes in other emissions.
All of these expectations will be measured and results shared.
We currently obtain about 30-35% of our fuels from lower carbon sources, and scrap tires will increase that to 50%.
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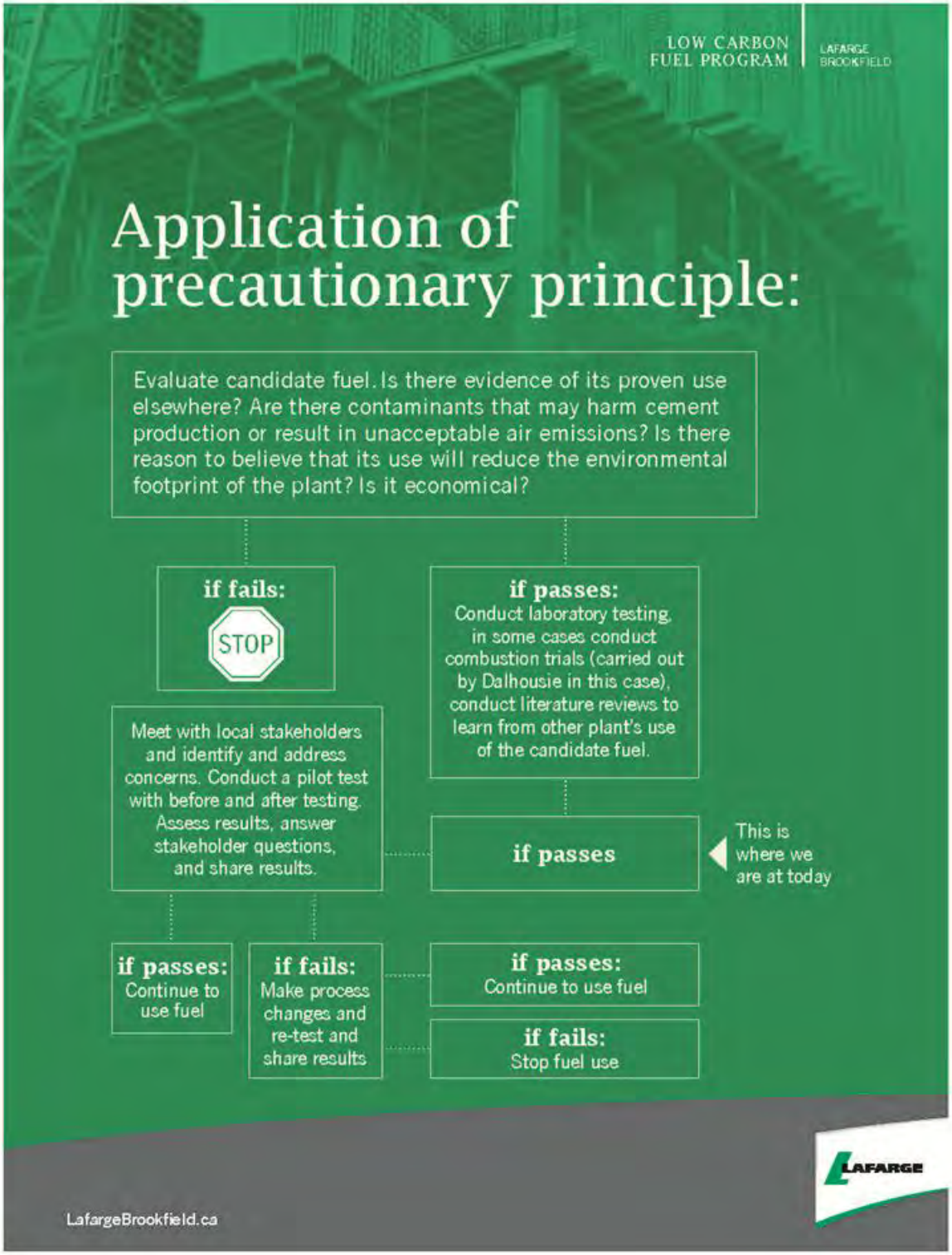
LOW CARBON FUEL PROGRAM
LAFARGE BROOKFIELD
Application of precautionary principle:
Evaluate candidate fuel. Is there evidence of its proven use elsewhere? Are there contaminants that may harm cement production or result in unacceptable air emissions? Is there reason to believe that its use will reduce the environmental footprint of the plant? Is it economical?
if fails:
STOP
if passes:
Conduct laboratory testing, in some cases conduct combustion trials (carried out by Dalhousie in this case), conduct literature reviews to learn from other plant's use of the candidate fuel.
Meet with local stakeholders and identify and address concerns. Conduct a pilot test with before and after testing. Assess results, answer stakeholder questions, and share results.
if passes
This is where we are at today
if passes:
Continue to use fuel
if fails:
Make process changes and re-test and share results
if passes:
Continue to use fuel
if fails:
Stop fuel use
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LOW CARBON FUEL PROGRAM
LAFARGE BROOKFIELD
What happens next?
Each and every comment, question, concern, or suggestion will be documented and made available to the public and Nova Scotia Environment.
Lafarge, supported by the Dalhousie research team, will seek the necessary regulatory Approvals to allow the testing to proceed [Fall/Winter 2016]
Lafarge will install and commission the equipment [2017]
Various tests carried out by the research team and results formalized
Public meeting to share & disseminate results
Based on positive results, scrap tires will become a regularly used lower carbon fuel
Results will be used to spur further research and implementation at other Canadian cement plants
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LOW CARBON FUEL PROGRAM
LAFARGE BROOKFIELD
Sustainability in action
ENVIRONMENTAL
Carbon footprint, life cycle assessments, emissions, greening the supply chain, and beneficial re-use
SOCIAL
Transportation, transparency and community participation, research and education opportunities, and knowledge building
ECONOMIC
maximizing local benefits, affordable fuels, local jobs and economic development
Sustainability means "[meeting] the needs of the present without compromising the ability of future generations to meet their own needs" — Brundtland Commission, 1989
LAFARGE
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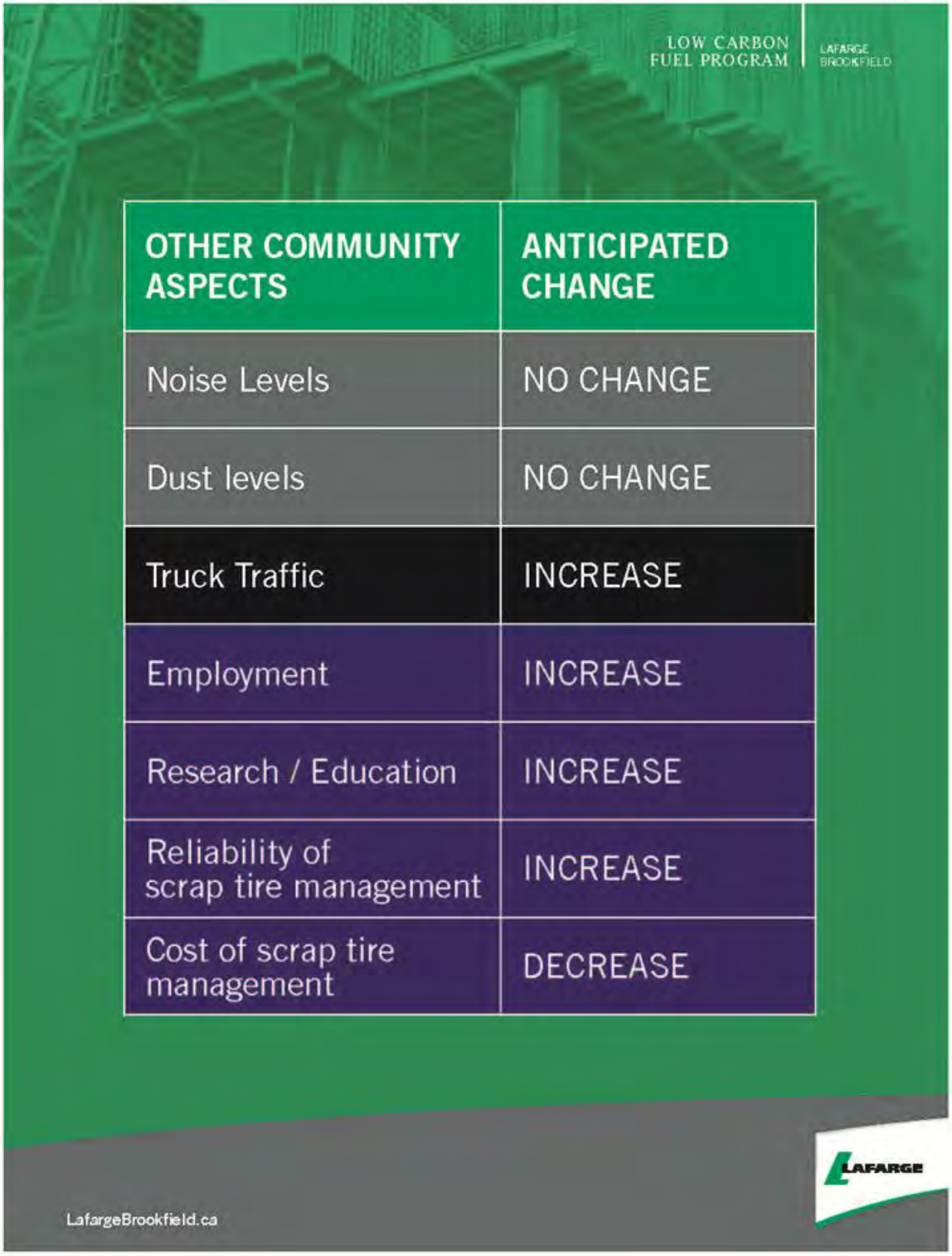
LOW CARBON FUEL PROGRAM
LAFARGE BROOKFIELD
Where are scrap tires used today?
There are 19 cement plants in Europe using scrap tires and 4 in Canada.
In the US in 2008, there were 48 cement plants in 21 states using scrap tires. This has since grown and in 2014 there were 40 cement plants using scrap tires in the US.
In those plants, about 12% of our fuel came from local scrap tires. The Rubber Manufacturer Association reports that 210,000,000 tires are used as fuel in the US.
By comparison, Nova Scotia generates about 800,000 - 1,000,000 tires per year and the Brookfield plant can only use about 400,000 of those.
LAFARGE
LafargeBrookfield.ca



OTHER COMMUNITY ASPECTS	ANTICIPATED CHANGE
Noise Levels	NO CHANGE
Dust levels	NO CHANGE
Truck Traffic	INCREASE
Employment	INCREASE
Research / Education	INCREASE
Reliability of scrap tire management	INCREASE
Cost of scrap tire management	DECREASE


How will the testing be done?
A team of students, specialists, and Lafarge staff, under the supervision of Dr Gibson will conduct extensive baseline tests to measure kiln performance and emissions prior to the use of scrap tires and will then repeat these tests when using scrap tires and analyze and compare results. These results will be shared with the public. The emission tests themselves consist of independent analyzers drawing gases from the stack in addition to a team of specialists who climb the stack in order to draw out stack gases through a series of filters and solutions to capture all of the compounds. The samples are sent to specialized environmental laboratories and all of the data is put together to report on the concentrations of the compounds measured. The testing methodologies follow government approved methods.
DALHOUSIE UNIVERSITY
Inspiring Minds


Ebenezer Asamany
(PhD candidate in Chemical Engineering)
Codey Barnett B.Eng MASc
(Dr. Gibson's Research Group Manager)
Ellen Patrick B.Eng
(MASc candidate in Environmental Engineering)
Dr. Mark Gibson
Associate Professor
Department of Civil and Resource Engineering
DALHOUSIE UNIVERSITY
Inspiring Minds

Utilizing TEMPO surface estimates to determine changes in emissions, community exposure and environmental impacts from cement kilns across North America using alternative fuels

Mark D. Gibson[1*], Ebenezer A. Asamany[1], Michael J. Pegg[1]
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*Corresponding author: mark.gibson@dal.ca

AGU Fall Meeting, San Francisco. Poster: A11G-0135. 14 December 2015
Session Number and Title: A11G: Emergence of a Global Observing System for Air Quality: Integrated Approaches Using Observations and Models of Tropospheric Composition and Pollution to Inform Air Quality Analyses and Applications

ABSTRACT

Managing solid waste from residential and non-residential sources is a major challenge faced by all North American (NA) governments. One way to mitigate the need to expand landfill sites across NA is waste diversion for use as alternative fuel in industries such as cement manufacturing plants. Currently, waste plastic, tires, waste shingles and other high carbon content waste destined for landfill are being explored, or currently used, as alternative supplemental fuels for use in cement kilns across NA. While this is an attractive, environmentally sustainable solution, significant knowledge gaps remain in our fundamental understanding of whether these alternative fuels may lead to increased air pollution emissions from cement kilns across NA.

The long-term objective of using the NASA Tropospheric Emissions Monitoring of Pollution (TEMPO) remote sensing package is to advance fundamental understanding of uncharacterized air pollution emissions and to assess the actual or potential environmental and health impacts of these emissions from cement kilns across NA. TEMPO measurements will be made in concert with in-situ observations augmented by air dispersion, land-use regression and receptor modelling.

BACKGROUND

This application of TEMPO follows current research on a series of bench scale and pilot studies for a local cement plant which investigated the change in combustion emissions from various mixtures of coal (C), petroleum coke (PC) and non-recyclable alternative fuels. From our work we demonstrated that using an alternative fuel mixture containing mixed plastics in a cement kiln has potential to reduce emissions of CO2 by 34%; reduce NOx by 80%, and reduce fuel SO2 emissions by 98%.

OBJECTIVE

To advance the fundamental understanding of combustion emissions associated with cement kilns utilizing alternative fuels from bench scale and pilot studies; and to assess actual environmental and health impacts associated with fuel change across NA through the application of satellite based remote sensing.

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FIGURE 1: Potential sources of plastic waste derived alternative fuels before and after size reduction. Such plastic films and crushed containers contain large quantities of energy which could displace a reasonable fraction of coal/coke.

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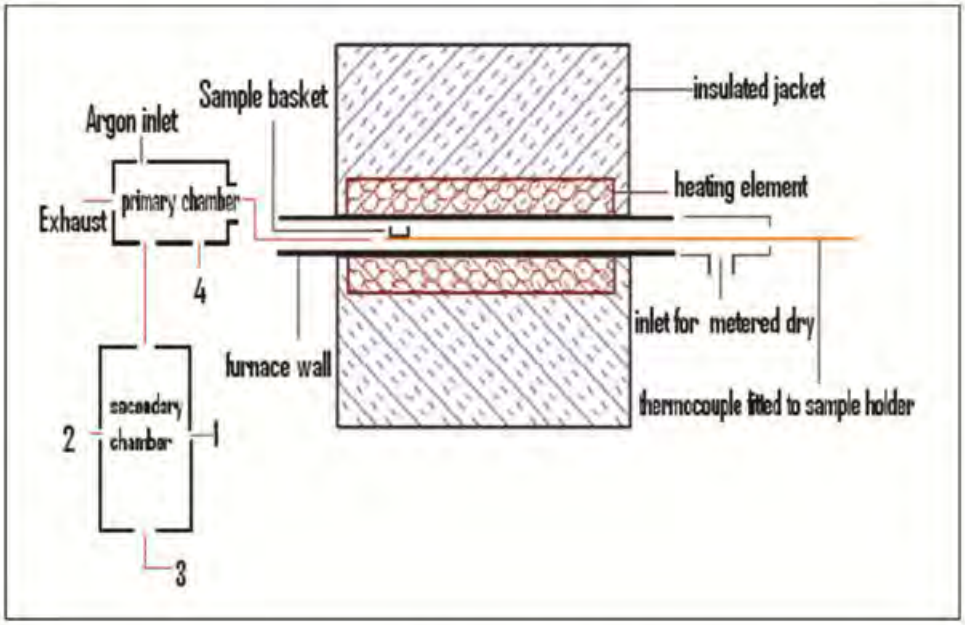

FIGURE 2: A cross-section of a modified tube furnace attached to gaseous and particulate emission detection devices. The set up was used for combustion studies on selected plastic-based waste materials to be used in a local cement kiln. Predictions of expected changes using only this approach, shown in Figure 4, are limited in scale and may require field observations to validate bench scale predictions.

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EXPERIMENTAL TECHNIQUES

Translating bench scale predictions to globally monitored observations

- Bench scale furnaces with attached emissions detection devices (Figure 2)
- The application of air dispersion, source apportionment, land use regression;
- The new NASA TEMPO satellite offering remote sensing to track dispersion plumes from cement kilns. The scope of the study is shown in Figure 3

FIGURE 3: Showing a distribution of cement plants across the three major cement producing countries in North America Canada, Mexico and USA. In all, more than 100 cement plants across North America with potential to use some form of alternative fuel could be monitored for changes in emissions to a fine detail.

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EXPECTED RESULTS BASED ON PRELIMINARY STUDIES

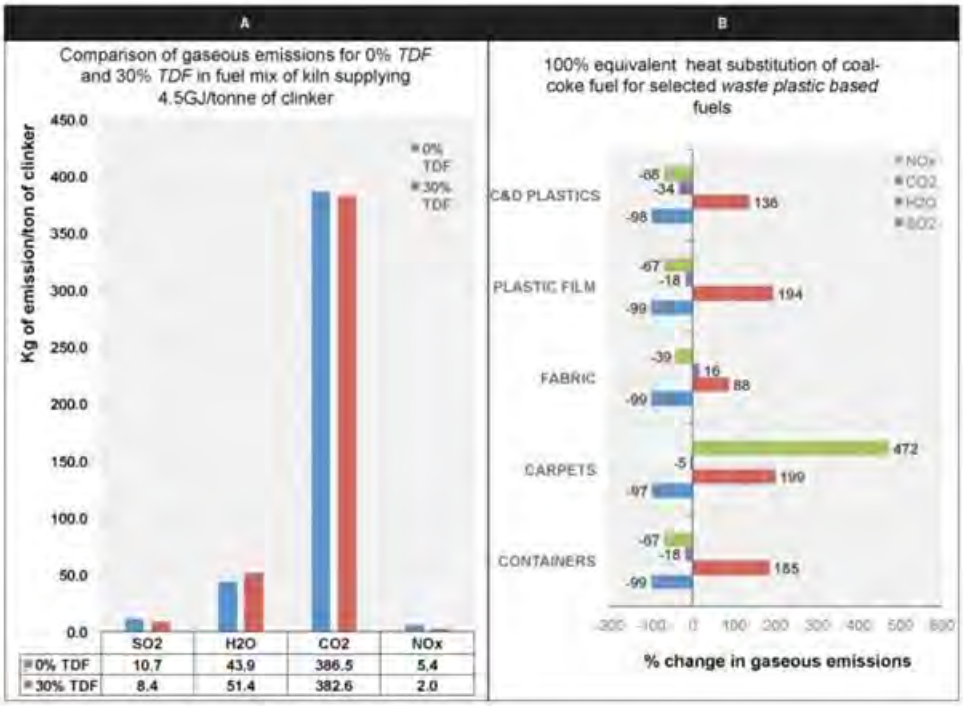

FIGURE 4: Estimations of expected changes based on ultimate analysis and stoichiometric combustion of selected waste based alternative fuels are shown for (A) Tire derived fuels (TDF) and (B) plastic based waste. These calculations are used, in conjunction with a tube furnace set up (Figure 2), to predict expected stack emission changes in particulates and gaseous compounds. Satellite monitoring will confirm if these predictive methods are within reasonable range.

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TEMPO

TEMPO will measure atmospheric pollution covering most of North America, from Mexico City to the Canadian tar/oil sands, and from the Atlantic to the Pacific hourly and at high spatial resolution. TEMPO is part of the Earth System Science Pathfinder satellite constellation (Figure 5).

FIGURE 5: Earth System Science Pathfinder

TEMPO's field of regard is shown in Figure 6 below (courtesy of NASA/Harvard Smithsonian).

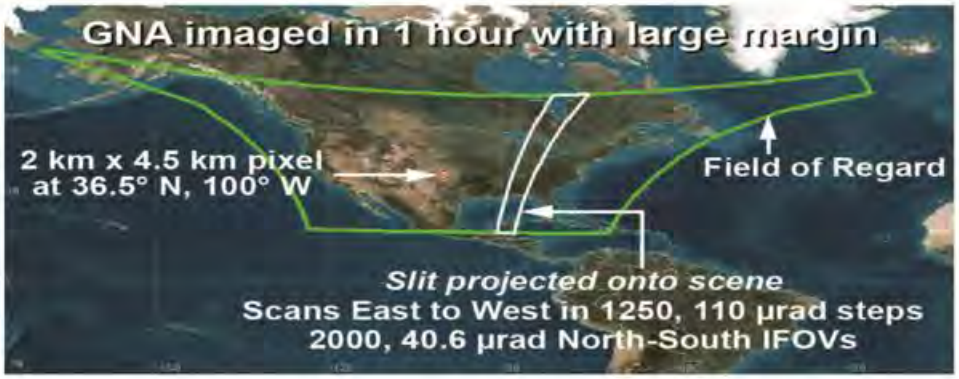

FIGURE 6: TEMPO field of regard (courtesy of NASA/Harvard Smithsonian)

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CONCLUSION

On an equivalent heat basis, the use of a selection of plastic based waste could potentially reduce CO2, NOx and SO2 by ~ 5-35%, 40-70% and 98% respectively as seen in bench scale tests [2]. Calculations on emission changes for a practical substitution rate of 30% Tire Derived Fuel (TDF) for coal-coke fuel predicts reduction in fuel SO2, CO2, and fuel NOx by 21%, 1%, and 23% respectively [3]. Given the waste management incentive and the downward trend in pollutant emissions associated with the use of otherwise waste materials as alternative fuels in cement kilns; the practice has been recommended as environmentally sustainable. Tracking actual emissions changes of kilns by TEMPO will fill significant gaps in the effects of alternative fuels on cement kiln emissions on a larger scale.

FUTURE WORK

We aim to work with Lafarge cement Inc., other cement companies and NASA to facilitate the application of TEMPO to investigate changes in emissions from cement kilns in NA using alternative fuels.

ACKNOWLEDGEMENTS

- Thermo Fisher Scientific for providing a travel bursary.
- Lafarge Cement Canada Inc. for funding the bench and plant scale alternative cement kiln fuels emissions research.
- NSERC (Discovery Grant) and MITACS for additional research funding.

REFERENCES

1. http://science.nasa.gov/missions/tempo/
2. Gibson MG, Asamany EB, Pegg MJ (2015) Characterization of coal and waste plastic combustion products in a local cement kiln, Brookfield, Nova Scotia_AFRG040815_pp1-69
3. Asamany E.A, Gibson M.G, Wilson C, Patrick E, Pegg M.J (2015) Report to Lafarge Cement Inc. Used tires as an alternative fuel in cement kilns_AFRG_210715_pp1-31
4. http://cement.ca/en/Economic-Contribution.html
5. http://globalcement.com/magazine/articles/698-cement-in-the-usa

Appendix D – Public Meeting Sign in Sheet

Table D. 1 List of Attendees who Signed In at the Public Meeting

Count	Name
1	Orland Kennedy
2	Ron Carlanad
3	Lydia Sorflaten
4	Philip MacBeth
5	Paul Greense
6	[Illegible]
7	Doug Neil
8	Wayne
9	Kevin Smith
10	Harry Sullivan
11	Andrew Lake
12	Sherry Mortell
13	Dorothy
14	Beverly Bradley
15	Stephen Warren
16	Emily Kirerstead
17	Don Murray
18	Jennifer Copage
19	Geoff Stewart
20	Rick Camm
21	Christina Dupere
22	Tom Taggam
23	Shelley Fisher
24	Brad Sutherfall
25	Rod Neilson
26	Maurice Rees
27	Janet Meech
28	Shawn Cotte
29	Charles F Cot
30	June Cot
31	Ron MacQuarrie
32	Sherri MacQuarrie
33	Ged Stonehouse
34	Grant Langlord
35	Cindy Weatherbie
36	Calden Creelman
37	Paul Pleppam
38	Scott Armstrong
39	Ken [no last name given]
40	Adrian Howie
41	Ellen Dukee
42	Bill Ring
43	Brian Matthews
44	Garry[no last name given]
45	Rhett Thompson
46	Terry Canning
47	Bill Masten
48	[Illegible]
49	Ken Warren
50	Alan Fredeen
51	Linda Fredeen
52	Mike Deuville
53	Wendy Deuville
54	Jeff Callaghan
55	Brian Layton
56	David Drummond
57	John Holster
58	Christine Blair
59	Barbara Ryan
60	Roger Ryan
61	Larry Harrison
62	Charles Burnet
63	Wilfrido Zarate
64	Richard Bowness
65	Maralyn Bowness
66	Mike Henderson

Appendix E – Public Meeting Post Correspondences

---------- Forwarded message ----------
From: **Rod NIELSEN** <rod.nielsen@lafargeholcim.com>
Date: Friday, October 21, 2016
Subject: Thanks from Ellen Durkee
To: Frederic BOLDUC <frederic.bolduc@lafargeholcim.com>

Hi Rod, I'd like to thank the Plant for the info meeting yesterday. I dont think I thanked them all. would you please pass this on to them. I've made a FB post, its a bit down on my page, giving my opinion on the plans. I'm sure they have no idea what a relief it was to be able to ask real questions and to get answers that made sense. Your people looked me in the eyes, were respectful and interested and it was easy to see they were excited about the possibilities this would bring. It was unlike any corporate led information session I've attended in that there was real information rather than the usual "just trust us because we know more than you" Again, thank you! and please keep me informed if you're able to. I'm very hopeful that this will work.

--
Rod Nielsen

Shipping & Yard Supervisor
Lafarge Brookfield
87 Cement Plant Road
Brookfield NS B0N 1C0

902.673.3710 Office
902.673.3471 Fax
902.890.0714 Cell
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http://www.lafarge-na.com/

A member of LafargeHolcim

---------- Forwarded message ----------
From: **Jennifer Copage** <jcopage@sipeknekatik.ca>
Date: Monday, November 21, 2016
Subject: Lafarge Follow Up from Brookfield Public Meeting
To: Robert CUMMING <robert.cumming@lafargeholcim.com>
Cc: Frederic Bolduc <frederic.bolduc@lafargeholcim.com>

Hi Robert,

Thank you for your email. Thank you for your offer of a site tour. I would like to take you up on this offer and maybe schedule something for December/January.

I am pleased to learn that your company is conducting studies prior to your project receiving approval.

Yes, I am interested in all studies as well as the air dispersion modelling. These studies will help in our project review and identifying if there may be potential impacts to Sipekne'katik lands or interests.

Regards,

Jennifer

Jennifer Copage

Consultation Coordinator

Lafarge Canada Inc. – Brookfield Cement Plant

Appendix F - GHD Air Dispersion Modeling Report

Lafarge Canada Inc. – Brookfield Cement Plant
87 Cement Plant Rd.
Brookfield, Nova Scotia
B0N 1C0

March 9, 2017 Reference No. 11139570-01

Mr. Robert Cumming
Lafarge-Holcim Canada
Brookfield, Nova Scotia

Dear Mr. Cumming:

Re: Air Emissions Assessment
Use of Tire Derived Fuel (TDF) at Brookfield Cement Plant
Lafarge-Holcim Facility, Brookfield, Nova Scotia

1. Introduction

GHD Limited (GHD) has prepared this Air Emissions Assessment (Assessment) in support of an Environmental Assessment (EA) for the use of tire derived fuel (TDF) at the Lafarge-Holcim (Lafarge) – Brookfield Cement Plant (Plant).

This Assessment summarizes the methodology that was used to estimate the air emissions from the kiln stack and the air dispersion modelling that was used to assess the ambient air quality when the Plant is using TDF as a fuel source.

Lafarge intends to use TDF in the Brookfield Cement Plant's kiln #2 which will use scrap tires by mid-kiln injection. In a mid-kiln system, tires are fed whole; they are not shredded, chipped, or otherwise processed prior to co-processing in the cement manufacturing process.

It is anticipated that roughly 20 tonnes per day or up to 6000 tonnes of used tires per year will be used in place of fossil fuels at Brookfield. The used tires will be delivered to the plant by truck and unloaded on site for use in Kiln 2. The system consists of conveyors and controls to feed 2-3 tires per kiln rotation to an injection point mid-way down the kiln where they instantly ignite and non-combustible fractions drop to the kiln floor for incorporation into the final product.

Used tires will replace a portion of the coal and petcoke in use today, the traditional fuel used in the manufacture of Portland cement. The active ingredient of concrete, Portland cement is a closely controlled chemical combination of calcium, silicon, aluminum, iron and small amounts of other ingredients to which gypsum is added in the final grinding process to regulate the setting time of the concrete.

It is important to understand that the use of TDF in the cement kiln only affects the potential air emissions from the main kiln stack. Using TDF as a fraction of the fuel feed will not affect the quality of the clinker produced by the kiln. All existing air emissions downstream of the kiln, associated with clinker processing and cement manufacturing will not be affected by the use of TDF as a fuel. Further, the use of TDF will not create any new or additional particulate emissions compared to existing Plant emissions. Therefore, the focus of this Assessment is the emissions from the main kiln stack.

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45 Akerley Boulevard Dartmouth Nova Scotia B3B 1J7 Canada
T 902 468 6413 **F** 902 468 2207 **W** www.ghd.com

2. Air Emission Estimates

To develop air emission estimates for the use of TDF as a fuel source, GHD referenced the previous source testing completed at the Plant, as well as the University of Dalhousie reports on the use of scrap tires as an alternative fuel source. The emissions estimates are summarized in Table 1.

Lafarge has previously completed emission testing on the main stack at the facility. The previous testing was completed in 2014 (May and September), 2010, and 2004. The September 2014 source testing report was not completed under normal steady-state (baseline) conditions. During this test program Lafarge was trialing an alternative fuel and the alternative fuel was tested prior to testing the baseline conditions. After testing of the alternative fuel the kiln was not allowed to return to baseline conditions leading to the results being unrepresentative of baseline conditions.

The other source test reports were used to estimate emissions. GHD used the most recent reports for available compounds. The majority of emission estimates were taken from the 2010 source test report as it was the most comprehensive testing at Lafarge. All of the test reports were representative of current kiln operating conditions and processing rates.

The University of Dalhousie report titled "Use of Scrap Tires as an Alternative Fuel Source at the Lafarge Cement Kiln, Brookfield, Nova Scotia, Canada" (July 21, 2015) (Dalhousie Report) was used to determine the change from existing condition emission rates when using TDF as a fuel.

The Dalhousie Report concluded that during the use of TDF, at a feed of approximately 100% of the fuel:

- There is a 71% reduction in Sulphur Dioxide and a 77% reduction in nitrogen oxides. GHD did not take into account a reduction in Sulphur dioxide or nitrogen oxides.
- With the use of TDF there is less potential for formation of PCDD/Fs due to the increased competition for oxygen. GHD used the existing PCDD/F emissions estimates as a conservative estimate.
- The ash content of TDF is approximately 6.7 times less than a coal-coke mixture. The lower ash levels from TDF reduce its potential to contribute to particulate matter emissions. GHD used the existing particulate emissions estimates as a conservative estimate.
- Carbon dioxide emissions decreased 3% through the use of TDF and it is expected that a similar reduction would be applicable to carbon monoxide. GHD used the existing carbon monoxide emission rate as a conservative estimate.
- With the use of TDF there is the potential that hydrogen chloride emissions could increase. Based on the chlorine ash content, the use of TDF resulted in 4.1 times higher chlorine concentrations. GHD incorporated the higher chlorine concentration into the emission estimates.

3. Air Dispersion Modelling

Dispersion modelling was performed using the United States Environmental Protection Agency (USEPA) multi-source dispersion model AERMOD, following the methodologies prescribed by Ontario Regulation 419/05 (O. Reg. 419/05). There is currently no guidance on the use of models in Nova Scotia, and therefore the O. Reg. 419/05 requirements were used as a basis. AERMOD is an advanced steady state plume model that has the ability to incorporate building cavity downwash, actual source parameters, emission rates, terrain and historical meteorological information to predict ground level concentrations (GLCs) at specified locations.

3.1 Modelling Methodology

3.1.1 Model Executables

The following approved dispersion models and pre-processor models were used in the assessment:

- AERMOD digital terrain pre-processor (AERMAP), version 11103
- AERMIC air dispersion model (AERMOD), version 16216r
- Building Profile Input Program (BPIP), version 04274
- AERMET meteorological preprocess (AERMET), version 16216

3.2 Meteorological Data

Meteorological data for the Facility was obtained from Environment Canada. The surface data is from the Upper Stewiacke Research Climate Station (WMO ID 71753; 98% complete) with missing data either interpolated for short periods (6 hours or less) or filled in using data from another nearby meteorological station (Debert Airport; WMO ID 71317). Halifax Stanfield International Airport (WMO ID 71395) was also used for estimating regional cloud cover as Upper Stewiacke and Derbert did not record this data. The meteorological data covers the dates from January 1, 2011 to December 31, 2015.

Upper air data was retrieved from the NOAA radiosonde database. The upper air data is from Yarmouth, NS (WMO ID 71603) for the years 2011 to 2015.

Land use surrounding the Facility was visually assessed using Google Earth imagery to determine surface roughness, albedo and Bowen ratio. Based on the assessment, the surrounding land use was classified as "coniferous forest". Land use was then processed by months of the year.

The surface and upper air data was processed using AERMET with the above information. AERMET subsequently produced surface and profile meteorological files ready for use with the AERMOD dispersion model. The processed hourly data included many factors which affect the dispersion of air contaminants including wind speed, wind direction, temperature, ceiling height, and atmospheric stability.

3.3 Averaging Periods and Time Based Concentration Conversion

Air contaminants were modelled with appropriate averaging periods.

3.4 Digital Elevation Model Data

Digital elevation model (DEM) data was obtained from Natural Resources Canada through their geospatial data extraction tool (http://geogratis.gc.ca/site/eng/extraction). The DEM data was used to include the effects of terrain in the modelling.

DEM data was preprocessed with AERMAP for use with AERMOD.

3.5 Source Input Parameters

The kiln stack source at the Lafarge facility was modelled as a point source based on information provided by Facility personnel. The kiln stack point source parameters (temperature, flow, diameter, height) and location were based on information in the source test reports and site drawings.

3.6 Tiered Receptors

A tiered receptor grid, located at ground level, was used to identify the maximum point of impingement (POI) outside the Lafarge property boundary. The receptor grid will use the following spacing:

- 20 m spacing within 200 m of the edge of the bounding box
- 50 m spacing from 200 to 500 m
- 100 m spacing from 500 to 1,000 m
- 200 m spacing from 1,000 to 2,000 m
- 500 m spacing from 2,000 to 5,000 m
- 1000 m spacing from 5000 to 10000 m

A property line ground level receptor grid with 10 m spacing was used to evaluate the maximum property boundary concentration. No receptors were placed inside the Facility's property line.

3.7 On Site Building Data

All on site Facility buildings were modelled in AERMOD to account for building cavity downwash. Cavity downwash can result in air contaminants being forced to ground level prematurely under certain meteorological conditions, which can result in higher than expected near air compound concentrations.

The USEPA BPIP was used to calculate the downwash effects for use with the AERMOD dispersion model.

3.8 Air Contaminant Modelling Results

All air contaminants identified in Table 1 were modelled and their maximum predicted concentrations were compared against their listed limits. All the compounds modelled are emitted from the Kiln #2 main stack. Instead of modelling the compounds individually, a unitary emission rate source was created for the stack to have AERMOD predict a unitary dispersion factor (i.e., a dispersion factor based on a 1 g/s emission rate) for all the averaging periods under consideration. These dispersion factors were then used to calculate the maximum predicted concentrations for each compound and averaging period using the following formula:

$$\text{(Concentration) } (\mu g/m^3) = \text{(Dispersion Factor) } (\mu g/m^3 \text{ per 1 g/s}) \times \text{(Emission Rate) (g/s)}$$

Per the Ontario dispersion modelling guidance, high concentrations resulting from very rare meteorological conditions were removed from consideration. The maximum predicted concentrations for each contaminant in Table 1 were then assessed against their limits. All contaminants are below their respective limit.

3.9 Dispersion Modelling Options

The options used in the dispersion model are summarized below.

Modelling Parameter	Description	Used in the Assessment?
DFAULT	Specifies that regulatory default options was used	Yes
CONC	Specifies that concentration values was calculated	Yes
DDPLETE	Specifies that dry deposition was calculated	No
WDPLETE	Specifies that wet deposition was calculated	No
FLAT	Specifies that the non-default option of assuming flat terrain was used	No, the model will use elevated terrain as detailed in the AERMAP output
NOSTD	Specifies that the non-default option of no stack-tip downwash was used	No
AVERTIME	Time averaging periods calculated	1-hour, 24-hour, month, annual
URBANOPT	Allows model to incorporate the effects of increased surface heating from an urban area on pollutant dispersion under stable atmospheric conditions	No
URBANROUGHNESS	Specifies the urban roughness length (m)	Not Applicable
FLAGPOLE	Specifies that receptor heights above local ground level are allowed on the receptors	No

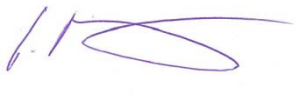
4. Conclusion

An assessment of the potential air emissions was conducted for the Lafarge Brookfield Cement Plant while using TDF in kiln #2. Historical stack testing reports and research by the University of Dalhousie were used to estimate the emissions of all potential air contaminants. The USEPA AERMOD dispersion model was used to estimate the maximum off-site concentrations of the air contaminants. Nova Scotia does not have published air quality standards for most of the potential air contaminants, therefore, the health, risk-based standards published by Ontario were used. The modelled, maximum off-site concentrations of contaminants are all well below applicable health based air standards, as summarized in Table 1.

Should you have any questions on the above, please do not hesitate to contact us.

Yours truly,

GHD



Gordon Reusing

MG/cb/1

Encl.

cc: Amanda Kiu, Lafarge
Matthew Griffin, GHD
Peter Oram, GHD

Table 1

Summary of Emission Estimates and Dispersion Modelling Results
Lararge-Holcim Brookfield Cement Plant
Brookfield, Nova Scotia

Compound	CAS	Emission Rate (g/s)	Averaging Period (hrs)	Modelled Concentration (µg/m^3)	Ontario Limit (µg/m^3)	Percent Limit (%)
Criteria Compounds						
NOx	10102-44-0	5.39E+01	1	1.61E+02	400	40.3%
NOx	10102-44-0	5.39E+01	24	6.93E+01	200	34.7%
CO	630-08-0	1.22E+01	0.5	4.39E+01	6,000	0.7%
PM	NA	2.00E+00	24	2.57E+00	120	2.1%
Sulfur Dioxide	7446-09-5	3.17E+01	1	9.47E+01	690	13.7%
Sulfur Dioxide	7446-09-5	3.17E+01	24	4.07E+01	275	14.8%
SVOCs/PAHs						
Dioxins & Furans	-	5.00E-10	24	6.43E-10	0.00000001	6.4%
Phenols (as phenol, 108-95-2)		3.61E-03	24	4.65E-03	100	0.0%
PCB (1336-36-3)	-	5.00E-04	24	6.43E-04	0.15	0.4%
PAH (as benzo(a)pyrene; surrogate)	-	1.19E-05	annual	1.85E-06	0.000010	18.5%
Volatile Organic Compounds						
2,2,4-Trimethylpentane	540-84-1	4.00E-04	24	5.15E-04	2,600	0.0%
Carbon Disulfide	75-15-0	2.77E-02	24	3.56E-02	330	0.0%
Propene	115-07-1	7.74E-02	24	9.96E-02	4,000	0.0%
Vinyl Acetate	108-05-4	3.00E-04	24	3.86E-04	140	0.0%
Vinyl Bromide	593-60-2	4.00E-04	24	5.15E-04	7	0.0%
Dichlorodifluoromethane (FREON 12)	75-71-8	5.00E-04	24	6.43E-04	500,000	0.0%
1,2-Dichlorotetrafluoroethane	76-14-2	5.00E-04	24	6.43E-04	700,000	0.0%
Chloromethane	74-87-3	3.40E-03	24	4.37E-03	320	0.0%
Vinyl Chloride	75-01-4	1.10E-03	24	1.42E-03	1	0.1%
Chloroethane	75-00-3	7.00E-04	24	9.01E-04	5,600	0.0%
1,3-Butadiene	106-99-0	5.00E-04	annual	7.76E-05	2	0.0%
Trichlorofluoromethane (FREON 11)	75-69-4	5.00E-04	24	6.43E-04	6,000	0.0%
Trichlorotrifluoroethane	76-13-1	5.00E-04	24	6.43E-04	800,000	0.0%
Ethanol	64-17-5	5.00E-03	1	1.50E-02	19,000	0.0%
2-propanol	67-63-0	3.00E-03	24	3.86E-03	7,300	0.0%
2-Propanone	67-64-1	4.29E-02	24	5.52E-02	11,880	0.0%
Methyl Ethyl Ketone (2-Butanone)	78-93-3	4.80E-03	24	6.18E-03	1,000	0.0%
Methyl Isobutyl Ketone	108-10-1	5.40E-03	24	6.95E-03	1,200	0.0%
Methyl Butyl Ketone (2-Hexanone)	591-78-6	3.40E-03	24	4.37E-03	16	0.0%
Methyl t-butyl ether (MTBE)	1634-04-4	3.00E-04	24	3.86E-04	7,000	0.0%
Ethyl Acetate	141-78-6	3.30E-03	1	9.87E-03	19,000	0.0%
1,1-Dichloroethylene	75-35-4	4.00E-04	24	5.15E-04	10	0.0%
cis-1,2-Dichloroethylene	156-59-2	3.00E-04	24	3.86E-04	105	0.0%
trans-1,2-Dichloroethylene	156-60-5	3.00E-04	24	3.86E-04	105	0.0%
Methylene Chloride(Dichloromethane)	75-09-2	1.00E-03	24	1.29E-03	220	0.0%
Chloroform	67-66-3	4.00E-04	24	5.15E-04	1	0.1%
Carbon Tetrachloride	56-23-5	8.00E-04	24	1.03E-03	2	0.0%
1,1-Dichloroethane	75-34-3	3.00E-04	24	3.86E-04	165	0.0%
1,2-Dichloroethane	107-06-2	3.00E-04	24	3.86E-04	2	0.0%
Ethylene Dibromide	106-93-4	5.00E-04	24	6.43E-04	3	0.0%
1,1,1-Trichloroethane	71-55-6	7.00E-04	24	9.01E-04	115,000	0.0%

Table 1

Summary of Emission Estimates and Dispersion Modelling Results
Lararge-Holcim Brookfield Cement Plant
Brookfield, Nova Scotia

Compound	CAS	Emission Rate (g/s)	Averaging Period (hrs)	Modelled Concentration ($\mu g/m^3$)	Ontario Limit ($\mu g/m^3$)	Percent Limit (%)
Criteria Compounds						
1,1,2-Trichloroethane	79-00-5	3.00E-04	24	3.86E-04	0.310	0.1%
1,1,2,2-Tetrachloroethane	79-34-5	6.00E-04	24	7.72E-04	NA	NA
cis-1,3-Dichloropropene	10061-01-5	3.00E-04	24	3.86E-04	1	0.0%
trans-1,3-Dichloropropene	10061-02-6	3.00E-04	24	3.86E-04	1	0.0%
1,2-Dichloropropane	78-87-5	8.00E-04	24	1.03E-03	2,400	0.0%
Bromomethane	74-83-9	5.00E-04	24	6.43E-04	1,350	0.0%
Bromoform	75-25-2	8.00E-04	24	1.03E-03	55	0.0%
Bromodichloromethane	75-27-4	5.00E-04	24	6.43E-04	NA	NA
Dibromochloromethane	124-48-1	7.00E-04	24	9.01E-04	0.20	0.5%
Heptane	142-82-5	2.70E-03	24	3.47E-03	11,000	0.0%
Trichloroethylene	79-01-6	7.00E-04	24	9.01E-04	12	0.0%
Tetrachloroethylene	127-18-4	7.10E-03	24	9.14E-03	360	0.0%
Benzene	71-43-2	5.88E-02	annual	9.12E-03	0.45	2.0%
Toluene	108-88-3	2.85E-02	24	3.67E-02	2,000	0.0%
Ethylbenzene	100-41-4	3.40E-03	10-min	1.68E-02	1,900	0.0%
p+m-Xylene	-	6.20E-03	24	7.98E-03	100	0.0%
o-Xylene	95-47-6	3.80E-03	24	4.89E-03	100	0.0%
Styrene	100-42-5	3.00E-04	24	3.86E-04	400	0.0%
1,3,5-Trimethylbenzene	108-67-8	1.00E-03	24	1.29E-03	220	0.0%
1,2,4-Trimethylbenzene	95-63-6	1.60E-03	24	2.06E-03	220	0.0%
4-ethyltoluene	622-96-8	4.40E-03	24	5.66E-03	500	0.0%
Chlorobenzene	108-90-7	1.30E-03	1	3.89E-03	3,500	0.0%
Chlorobenzene	108-90-7	1.30E-03	10-min	6.42E-03	4,500	0.0%
Benzyl chloride	100-44-7	2.10E-03	24	2.70E-03	0.10	2.6%
1,3-Dichlorobenzene	541-73-1	1.00E-03	24	1.29E-03	360	0.0%
1,4-Dichlorobenzene	106-46-7	1.00E-03	24	1.29E-03	95	0.0%
1,2-Dichlorobenzene	95-50-1	1.00E-03	1	2.99E-03	30,500	0.0%
1,2,4-Trichlorobenzene	120-82-1	6.10E-03	24	7.85E-03	400	0.0%
Hexachlorobutadiene	87-68-3	1.31E-02	24	1.69E-02	0.23	7.4%
Hexane	110-54-3	2.60E-03	24	3.35E-03	7,500	0.0%
Cyclohexane	110-82-7	6.00E-04	24	7.72E-04	6,100	0.0%
Tetrahydrofuran	109-99-9	5.00E-04	24	6.43E-04	93,000	0.0%
1,4-Dioxane	123-91-1	5.80E-03	24	7.46E-03	3,500	0.0%
Xylene (Total)	1330-20-7	1.01E-02	24	1.30E-02	730	0.0%
			10-min	4.99E-02	3,000	0.0%
Metals						
Antimony	7440-36-0	4.17E-05	24	5.36E-05	25	0.0%
Copper	7440-50-8	1.19E-04	24	1.54E-04	50	0.0%
Lead	7439-92-1	1.03E-03	24	1.32E-03	1	0.3%
Lead	7439-92-1	1.03E-03	30-day	4.23E-04	0.20	0.2%
Manganese	7439-96-5	5.75E-04	24	7.40E-04	0.40	0.2%
Vanadium	7440-62-2	5.19E-04	24	6.68E-04	2	0.0%
Zinc	7440-66-6	9.00E-04	24	1.16E-03	120	0.0%
Arsenic	7440-38-2	1.06E-04	24	1.36E-04	0.30	0.0%
Chromium	7440-47-3	1.67E-04	annual	2.59E-05	0.00014	18.5%

Table 1

Summary of Emission Estimates and Dispersion Modelling Results
Lararge-Holcim Brookfield Cement Plant
Brookfield, Nova Scotia

Compound	CAS	Emission Rate (g/s)	Averaging Period (hrs)	Modelled Concentration ($\mu g/m^3$)	Ontario Limit ($\mu g/m^3$)	Percent Limit (%)
Criteria Compounds						
Cobalt	7440-48-4	1.94E-05	24	2.50E-05	0.10	0.0%
Nickel	7440-02-0	2.22E-04	annual	3.45E-05	0.04	0.1%
Magnesium	7439-95-4	5.40E-03	24	6.95E-03	0.20	3.5%
Selenium	7782-49-2	6.11E-05	24	7.86E-05	10	0.0%
Tellurium	13494-80-9	5.28E-05	24	6.79E-05	10	0.0%
Cadmium	7440-43-9	4.44E-05	24	5.72E-05	0.025	0.2%
Mercury	7439-97-6	2.69E-04	24	3.47E-04	2	0.0%
Thallium	7440-28-0	2.14E-03	24	2.76E-03	0.240	1.1%
Barium	7440-39-3	4.33E-04	24	5.58E-04	10	0.0%
Berylium	7440-41-7	5.56E-06	24	7.15E-06	0.010	0.1%
Bismuth	7440-69-9	1.39E-05	24	1.79E-05	NA	NA
Boron	7440-42-8	4.83E-04	24	6.22E-04	120	0.0%
Iron (as metallic iron)	7439-89-6	1.28E-02	24	1.65E-02	4	0.4%
Lithium	7439-93-2	4.75E-04	24	6.11E-04	20	0.0%
Molybdenum	7439-98-7	6.11E-05	24	7.86E-05	120	0.0%
Phosporus	-	1.05E-03	24	1.35E-03	NA	NA
Silver	7440-22-4	7.22E-05	24	9.29E-05	1	0.0%
Strontium	7440-24-6	5.33E-04	24	6.86E-04	120	0.0%
Sulfur	7704-34-9	7.61E+00	24	9.80E+00	20	49.0%
Tin	7440-31-5	3.69E-04	24	4.75E-04	10	0.0%
Titanium	7440-32-6	5.89E-04	24	7.58E-04	120	0.0%
Hydrochloric acid	7647-01-0	1.20E+00	24	1.55E+00	20	7.7%
Aluminum	7429-90-5	1.50E-02	24	1.93E-02	5	0.4%

Lafarge Canada Inc. – Brookfield Cement Plant

Appendix G – Technical Memorandum for Air Dispersion Model

Lafarge Canada Inc. – Brookfield Cement Plant
87 Cement Plant Rd.
Brookfield, Nova Scotia
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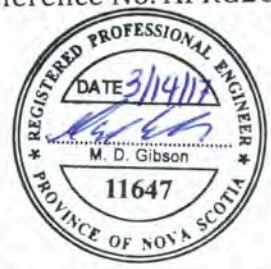
DALHOUSIE UNIVERSITY

March 14, 2017

Reference No. AFRG2017001



Mr. Robert Cumming
Lafarge-Holcim Canada
Brookfield, Nova Scotia

c.c. Ms. Amanda Kiu

Re: Review of the Air Emissions Assessment conducted by GHD Limited (GHD)
Use of Tire Derived Fuel (TDF) at Brookfield Cement Plant
Lafarge-Holcim Facility, Brookfield, Nova Scotia

Dear Mr. Cumming,

Below is my review of the air emissions modelling conducted by GHD.

During my review I referred to GHD's draft air emissions assessment (Reference No. 11139570-01) that was shared with Lafarge-Holcim and myself.

To review the modelling work conducted by GHD I used AERMOD View 9.0.0 version 15181 and AERMET View 9.0.0 version 15181.

The necessary AERMOD and AERMET input files were downloaded from GHD ftp server on February 17, 2017. They were ran the same day.

As noted in their air assessment report, GHD followed the Ontario guidelines for conducting air dispersion from elevated point sources (O. Reg. 419/05) and compared the 1hr, 24hr, monthly and annual max concentrations and 24-hr for mercury. The results were compared with the appropriate regulation for the air pollutant concerned. Rather than model every single component emitted from the stack, GHD used a unitary emission rate of 1g/s and then simply multiplied this value by the amount emitted for each component. This is valid.

The model ran upon the first attempt and the surface maps of estimated concentration were generated as described in the GHD memo to Lafarge (February 13, 2017, Reference No. 11139570-01).

The first check I performed was to determine the location where the meteorological data was collected, as shown in Figure 1 below. The locations of the meteorological stations were as stated in the GHD report.

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Figure 1. Location of the surface and upper air weather stations

The AERMOD modelling options contained in Table 3.9 of GHD's report are correct and appropriate for this assessment. I then ran AERMOD. Figure 2 below shows the Lafarge, Brookfield Cement plant boundary. The tiered receptors that were described by GHD in their report can clearly be seen by way of the Cartesian grid that was generated within the model domain. The plant buildings (blue) can also be seen. These were required so as to simulate building downwash effects on the stack plume dispersion. The location of Shortt's Lake can also be clearly seen within the model domain. By 'toggling off' the air pollutant surface contour concentration layer Shortt's lake could be clearly seen.

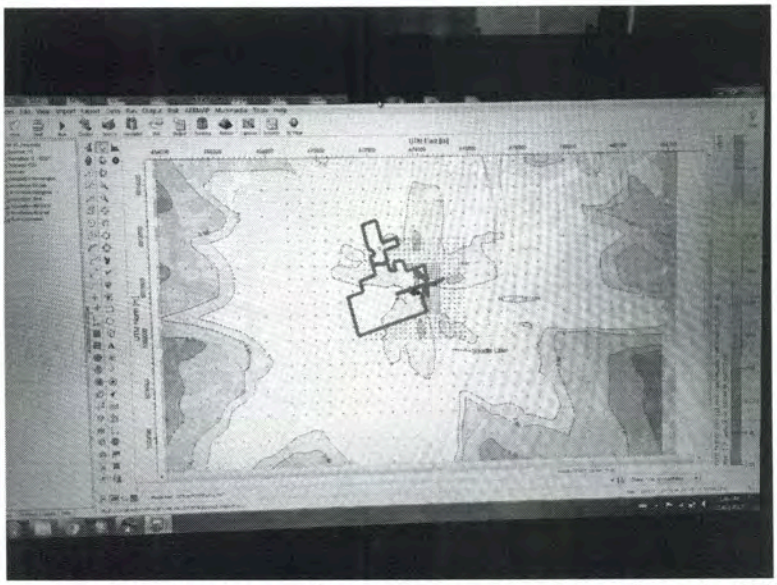

Figure 2. Cartesian grid receptors, plant boundary, buildings and surface contour plot of emissions.

As a final check I exported the surface concentration contour map to Google earth (Figure 3) to provide a more informative visualization of the air dispersion from stack #2 at the Brookfield cement plant.

Figure 3. Google Earth export of the surface concentration contour plot of the stack #2 air emission (1g/s).

Conclusion

The air dispersion modelling conducted GHD was done correctly. I concur with their conclusion that the modeled, maximum off-site concentrations of contaminants are well below applicable health based air standards as per Table 1 in their report.

Please do not hesitate to contact me if you have any questions.

Yours sincerely

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