City of Hamilton
PUBLIC WORKS COMMITTEE
AGENDA

Meeting #:	22-001
Date:	January 10, 2022
Time:	1:30 p.m.
Location:	Due to the COVID-19 and the Closure of City Hall (CC) All electronic meetings can be viewed at: City's Website: https://www.hamilton.ca/council-committee/council-committee-meetings/meetings-and-agendas City's YouTube Channel: https://www.youtube.com/user/InsideCityofHamilton or Cable 14

Carrie McIntosh, Legislative Coordinator (905) 546-2424 ext. 2729

Pages

1. CEREMONIAL ACTIVITIES

2. APPROVAL OF AGENDA

   (Added Items, if applicable, will be noted with *)

3. DECLARATIONS OF INTEREST

4. APPROVAL OF MINUTES OF PREVIOUS MEETING

   4.1. December 6, 2021 — 4

5. COMMUNICATIONS

6. DELEGATION REQUESTS

   6.1. Nick Becker, Victoria Park Assembly, respecting Lighting at Victoria Park's Baseball Diamonds (for a future meeting) — 19

7. CONSENT ITEMS

8. STAFF PRESENTATIONS

9. PUBLIC HEARINGS / DELEGATIONS

10. DISCUSSION ITEMS

11. MOTIONS

12. NOTICES OF MOTION

13. GENERAL INFORMATION / OTHER BUSINESS

13.1. Amendments to the Outstanding Business List

13.1.a. Items Considered Complete and Needing to be Removed:

13.1.a.a. Lymantria Dispar Dispar (LDD) Moth Control Program

Addressed as Item 10.2 on today's agenda - Report PW21069(a)

Item on OBL: ABX

13.1.b. Items Requiring a New Due Date:

14. PRIVATE AND CONFIDENTIAL

15. ADJOURNMENT

PUBLIC WORKS COMMITTEE
MINUTES 21-018
1:30 p.m.
Monday, December 6, 2021
Council Chambers
Hamilton City Hall
71 Main Street West

Present: Councillors A. VanderBeek (Chair), N. Nann (Vice-Chair), J.P. Danko, J. Farr, L. Ferguson, T. Jackson, S. Merulla, E. Pauls, M. Pearson and R. Powers

Absent with Regrets: Councillor T. Whitehead - Personal

THE FOLLOWING ITEMS WERE REFERRED TO COUNCIL FOR CONSIDERATION:

1. APPOINTMENT OF COMMITTEE CHAIR AND VICE-CHAIR FOR 2022 (Item 2)

(Danko/Pearson)
That Councillor Nann be appointed as Chair of the Public Works Committee for 2022.

Result: **Motion CARRIED by a vote of 10 to 0, as follows:**

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

(Pearson/Ferguson)
That Councillor Powers be appointed as Vice-Chair of the Public Works Committee for 2022.

Result: **Motion CARRIED by a vote of 10 to 0, as follows:**

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

2. Trillium Open Space - Erosion Protection Plan and Disaster Mitigation and Adaptation Fund Project Update (PW21072) (City Wide) (Item 8.1)

(Farr/Pearson)
That the report respecting Trillium Open Space - Erosion Protection Plan and Disaster Mitigation and Adaptation Fund Project Update (PW21072) (City Wide), be received.

Result: **Motion CARRIED by a vote of 10 to 0, as follows:**

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

3. Intersection Control List (PW21001(e)) (Ward 5) (Item 8.2)

(Powers/Danko)

That the appropriate By-law be presented to Council to provide traffic control as follows:

Intersection			Stop Control Direction		Class	Comments / Petition	Ward
	Street 1	Street 2	Existing	Requested			
Section "E" Hamilton							
(a)	Riverbank Court	Berkindale Drive	NC	NB	A	Missing stop control	5

Legend

No Control Existing (New Subdivision) - **NC**
Intersection Class: **A** - Local/Local **B** - Local/Collector **C** - Collector/Collector

Result: **Motion CARRIED by a vote of 10 to 0, as follows:**

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

4. Stormwater Gap Evaluation (PW21074) (City Wide) (Item 9.1)

(Danko/Nann)

(a) That Report PW21074, respecting Stormwater Gap Evaluation, be received***; and***

(b) That the appropriate staff report back to the Public Works Committee with a review of the benefits and challenges of various stormwater program funding options including water rates, a dedicated stormwater fee or tax levy or any other options and provide a recommendation for the preferred financing model for the City's stormwater programs, including a preliminary plan and any resource requirements necessary to conduct a detailed review of the preferred financing model.

Result: **Motion, *As Amended* CARRIED by a vote of 9 to 1, as follows:**

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson

YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
NO - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

5. Renewal of Enbridge Gas Inc. Franchise Agreement with the City of Hamilton (PW21070) (City Wide) (Item 11.1)

(Ferguson/Pearson)

(a) That Council approve the 2000 Model Franchise Agreement (MFA), attached to Report PW21070 as Appendix “A” and the Letter of Understanding (LOU) attached to Report PW21070 as Appendix “B”, dated August 25, 2021 with Enbridge Gas Inc. (Formerly Union Gas);

(b) That Council authorizes the submission of these to the Ontario Energy Board (OEB) for approval pursuant to the provisions of Section 9 of The Municipal Franchises Act;

(c) That Council pass and enact the attached by-law upon receipt of an Order from the Ontario Energy Board;

(d) That the General Manager of Public Works be authorized and directed to request the Ontario Energy Board to make an Order declaring and directing that the assent of the municipal electors to the By-law attached to Report PW21070 as Appendix “C” and franchise agreement pertaining to the City of Hamilton is not necessary pursuant to the provisions of Section 9(4) of the Municipal Franchises Act;

(e) That the Mayor and City Clerk be authorized and directed to execute the necessary documents, all documents being in a form satisfactory to the City Solicitor.

Result: Motion CARRIED by a vote of 10 to 0, as follows:

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

6. Truck Route Sub-Committee Report 21-001, November 29, 2021 (Item 11.2)

(Pearson/Nann)

(a) Truck Route Master Plan Update (PED19073(b)) (City Wide) (Item 8.1)

(a) That the Truck Route Master Plan Update (PED19073(b)) (City Wide), be received, and;

(b) That staff be directed to review the recommendations in Report PED19073(b) Truck Route Master Plan Update with prioritization given to the Terms of Reference ratified by Council, including an analysis that would permit a ring road approach for the Truck Route Master Plan Update and report back to the Truck Route Sub-Committee by March 31, 2022.

Result: Motion CARRIED by a vote of 10 to 0, as follows:

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

7. Lymantria dispar dispar (LDD) Aerial Control Program (PW21069) (City Wide) (Item 11.3)

(Pearson/Ferguson)

(a) That the amending By-law, attached as Appendix “A” to Report PW21069, being a By-law to Amend By-law 08-070, respecting Gypsy Moth Infestation, which has been prepared in a form satisfactory to the City Solicitor, be enacted and effective immediately;

(b) That, pursuant to By-law 08-070, respecting Gypsy Moth Infestation, staff be directed to implement a Lymantria dispar dispar (LDD) Aerial Control Program involving aerial application of the biological control agent bacillus thuringiensis ‘kurstaki’ (Btk);

(c) That infested areas which exceed 2,500 egg masses per hectare, as identified in By-law 08-070 as the treatment threshold, be the areas to receive aerial application of the biological control agent bacillus thuringiensis ‘kurstaki’ (Btk);

(d) That the direction provided to staff in Closed Session, as detailed in confidential Appendix “B” to Report PW21069, respecting Lymantria dispar dispar (LDD) Aerial Control Program, be approved;

(e) That Appendix “B” to Report PW21069, respecting Lymantria dispar dispar (LDD) Aerial Control Program, remain confidential until after a contract has been executed with Zimmer Air Services Inc. or negotiations have ceased with no intent of executing a contract with Zimmer Air Services Inc.; and

(f) That staff be directed to report back to Public Works Committee in Q1 of 2022 detailing the terms of the agreement with Zimmer Air Services Inc., the recommended aerial treatment areas and to seek approval to execute the contract.

Result: **Motion CARRIED by a vote of 10 to 0, as follows:**

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

8. Hamilton Cycling Committee Budget 2022 (PED21189) (City Wide) (Item 11.4)

(Farr/Pearson)

(a) That the Hamilton Cycling Committee 2022 Base Budget submission, in the amount of $10,000, as described in Appendix “A” attached to Report PED21189, be approved and referred to the 2022 Budget process for consideration;

(b) That, in addition to the base funding, a one-time budget allocation for 2022 of $4,000 to support community events and initiatives that meet the mandate of the Committee, funded by the Hamilton Cycling Committee Reserve, be approved and referred to the 2022 Budget process for consideration;

(c) That remaining funds from the 2021 Hamilton Cycling Committee Budget be allocated into the Hamilton Cycling Committee Reserve, to the upmost allowable amount.

Result: **Motion CARRIED by a vote of 10 to 0, as follows:**

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead 6

9. Playground Addition Armstrong Park Hamilton (Ward 7) (Item 12.1)

(Pauls/Jackson)
WHEREAS, the Hamilton Wentworth District School Board has provided space on their property at 460 Concession Street, Hamilton, for an existing play structure that is available for public use;

WHEREAS, the existing structure has reached its end of life and requires removal or replacement; and

WHEREAS, these community amenities are valuable recreation opportunities for children, youth and families within the Burkholme neighbourhood;

THEREFORE BE IT RESOLVED:

(a) That the design and installation of a new play structure at 460 Concession Street, Hamilton (G.L. Armstrong School), at an upset limit of $125,000, allocated from Ward 7 Special Capital Re-Investment Reserve Fund (#108057), be approved; and

(b) That a formal agreement for the operation and maintenance of the proposed structure as a public amenity on non-City owned lands be executed between the City and the Hamilton Wentworth District School Board; and

(c) That the Mayor and City Clerk be authorized and directed to execute any required agreement(s) and ancillary documents for the installation and ongoing maintenance of the play structure located at 460 Concession Street, Hamilton, with such terms and conditions in a form satisfactory to the City Solicitor.

Result: **Motion CARRIED by a vote of 9 to 0, as follows:**

YES - Ward 2 Councillor Jason Farr

YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
CONFLICT - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

10. Investment in Victoria Park (Ward 1) (Item 12.2)

(Danko/Powers)
WHEREAS, the City of Hamilton owned fieldhouse facilities in Ward 1 are maintainedby the City of Hamilton's Facilities Operations & Maintenance Section of the Energy, Fleet & Facilities Management Division, Public Works;

WHEREAS, many of the current fieldhouses in Ward 1 need lifecycle repair andaccessibility upgrades;

WHEREAS, flexible community space will enhance all season programming at Victoria Park, and will draw more users to the Park; and,

WHEREAS, the Victoria Park Field House has been identified by the community as a priority facility inneed of improved accessibility, including accessible washrooms to support the field house users;

THEREFORE, BE IT RESOLVED:

(a) That Public Works Facilities staff be authorized and directed to retain a Prime Design Consultant to undertake both a feasibility study of accessibility improvements, as well as a Cultural Heritage Study, of Victoria Park Field House to determinerecommendations for upgrades to support the community and programming uses;

(b) That the funding for the feasibility study of accessibility improvements, as well as aCultural Heritage Study, of the Victoria Park Field House, at a cost of $150,000, to be funded fromthe Ward 1 Area Rating Reserve Account (108051) be approved; and,

(c) That the Mayor and City Clerk be authorized and directed to execute any requiredagreement(s) and ancillary documents, with such terms and conditions in a formsatisfactory to the City Solicitor.

Result: Motion CARRIED by a vote of 10 to 0, as follows:

YES - Ward 2 Councillor Jason Farr

YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

11. Commemorative Plaque and Tree at Woodlands Park in Honour of Holly Ellsworth-Clark (Ward 3) (Item 12.3)

(Nann/Pearson)
WHEREAS, the tragic disappearance of Holly Ellsworth-Clark in January 2020 was of deep community concern, responded to with compassion and care by hundreds of Hamiltonians engaging in the search efforts; and,

WHEREAS, to support community healing and provide an accessible location for ongoing reflection for the Ellsworth-Clark family and community members, a commemorative tree and plaque was requested for installation in Woodlands Park;

THEREFORE, BE IT RESOLVED:

(a) That a commemorative plaque and tree in honour of Holly Ellsworth-Clark be installed in Woodlands Park; and

(b) That the installation costs of the commemorative plaque and tree in the honour of Holly Ellsworth-Clark in Woodlands Park, be funded from the Ward 3 Capital Discretionary Account 3301909300 at an upset limit, including contingency, not to exceed $1,000.

Result: Motion CARRIED by a vote of 10 to 0, as follows:

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

FOR INFORMATION:

(a) CHANGES TO THE AGENDA (Item 3)

The Committee Clerk advised of the following changes to the agenda:

8. CONSENT ITEMS

8.3 Hamilton Cycling Committee Minutes - November 3, 2021

11. DISCUSSION ITEMS

11.3 Lymantria dispar dispar (LDD) Aerial Control Program (PW21069) (City Wide)

11.4 Hamilton Cycling Committee Budget 2022 (PED21189) (City Wide)

14. GENERAL INFORMATION / OTHER BUSINESS

14.1 (b) Items Requiring a New Due Date:

14.1 (b) (a) HSR / ATS / DARTS Passenger Policies for Persons with Disabilities
Item on OBL: ABR
Current Due Date: December 6, 2021
Proposed New Due Date: November 28, 2022

15. PRIVATE AND CONFIDENTIAL

15.1 Appendix "B" to Report PW21069 respecting Lymantria dispar dispar (LDD) Aerial Control Program

Pursuant to Section 9.1, Sub-section (k) of the City's Procedural By-law 21-021, and Section 239(2), Sub-section (k) of the Ontario Municipal Act, 2001, as amended, as the subject matter pertains to a position, plan, procedure, criteria or instruction to be applied to any negotiations carried on or to be carried on by or on behalf of the municipality or local board.

(Pearson/Pauls)
That the agenda for December 6, 2021 Public Works Committee meeting be approved, as amended.

Result: **Motion CARRIED by a vote of 10 to 0, as follows:**

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls

YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

(b) DECLARATIONS OF INTEREST (Item 4)

Councillor Danko declared an interest to Item 12.1, Motion respecting the Playground Addition to Armstrong Park Hamilton (Ward 7), as his wife is Chair of the Hamilton-Wentworth District School Board.

(c) APPROVAL OF MINUTES OF PREVIOUS MEETING (Item 5)

(Pearson/Nann)
That the Minutes of the November 15, 2021 meeting of the Public Works Committee be approved, as presented.

Result: Motion CARRIED by a vote of 10 to 0, as follows:

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

(d) COMMUNICATIONS (Item 6)

(Pearson/Jackson)
That the following Communication Items be received and referred to the consideration of the Truck Route Sub-Committee Report 21-001, November 29, 2021 (Item 11.2):

6.1 Correspondence from Michelle Blanchette respecting concern regarding the Truck Route Master Plan designating Grays Road, Frances Avenue and Drakes Drive as a truck route

6.2 Correspondence from Hamilton Health Sciences regarding heavy truck traffic in the Hamilton General Hospital zone

Result: Motion CARRIED by a vote of 10 to 0, as follows:

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann

YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

For disposition of this matter, please refer to Item 6.

(e) CONSENT ITEMS (Item 8)

(i) Hamilton Cycling Committee Minutes - November 3, 2021 (Item 8.3)

(Pauls/Ferguson)
That the Hamilton Cycling Committee Minutes for November 3, 2021 be received.

Result: Motion CARRIED by a vote of 10 to 0, as follows:

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

(f) STAFF PRESENTATIONS (Item 9)

(i) Stormwater Gap Evaluation (PW21074) (City Wide) (Item 9.1)

Cassandra Kristalyn, Senior Project Manager, Public Works, addressed Committee respecting Report PW21074, Stormwater Gap Evaluation, with the aid of a presentation.

(Powers/Nann)
That the presentation respecting Report PW21074, Stormwater Gap Evaluation, be received.

Result: Motion CARRIED by a vote of 10 to 0, as follows:

YES - Ward 2 Councillor Jason Farr

YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

For further disposition of this matter, refer to Item 4.

(g) GENERAL INFORMATION / OTHER BUSINESS (Item 14)

(Farr/Pauls)
That the following amendments to the Public Works Committee's Outstanding Business List, be approved, ***as amended***:

(1) Items Considered Complete and Needing to be Removed (Item 14.1 (a)):

(i) Sidewalk Snow Clearing Trillium Open Space - Erosion Protection Plan and Disaster Mitigation and Adaptation Fund Project Update
Addressed as Item 8.1 on today's agenda - Report (PW21072) (City Wide)
Item on OBL: ABP
(Item 14.1 (a) (i))

~~***(ii) Stormwater Gap Evaluation***~~
~~***Addressed as Item 8.2 on today's agenda - Report (PW21074) (City Wide)***~~
~~***Item on OBL: ABM***~~
~~***(Item 14.1 (a) (ii))***~~ (Refer to Item 14.1 (b) (ii) for amendment)

(2) Items Requiring a New Due Date (Item 14.1 (b)):

(i) HSR / ATS / DARTS Passenger Policies for Persons with Disabilities
Item on OBL: ABR
Current Due Date: December 6, 2021
Proposed New Due Date: November 28, 2022

(ii) Stormwater Gap Evaluation
Item on OBL: ABM
Current Due Date: December 6, 2021
Proposed New Due Date: Q1 2022

Result: Motion CARRIED by a vote of 10 to 0, as follows:

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
YES - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

(h) PRIVATE AND CONFIDENTIAL (Item 15)

(i) Appendix "B" to Report PW21069 respecting Lymantria dispar dispar (LDD) Aerial Control Program (Item 15.1)

Committee determined that it was not necessary to move into Closed Session to discuss Appendix "B" to Report PW21069, respecting Lymantria dispar dispar (LDD) Aerial Control Program.

For disposition of this matter, please refer to Item 7.

(i) ADJOURNMENT (Item 16)

(Ferguson/Farr)
That there being no further business, the Public Works Committee be adjourned 4:00 p.m.

Result: Motion CARRIED by a vote of 9 to 0, as follows:

YES - Ward 2 Councillor Jason Farr
YES - Vice Chair - Ward 3 Councillor Nrinder Nann
NOT PRESENT - Ward 4 Councillor Sam Merulla
YES - Ward 5 Councillor Russ Powers
YES - Ward 6 Councillor Tom Jackson
YES - Ward 7 Councillor Esther Pauls
YES - Ward 8 Councillor John-Paul Danko
YES - Ward 10 Councillor Maria Pearson
YES - Ward 12 Councillor Lloyd Ferguson
YES - Chair - Ward 13 Councillor Arlene VanderBeek
NOT PRESENT - Ward 14 Councillor Terry Whitehead

Respectfully submitted,

Councillor A. VanderBeek Chair,
Public Works Committee

Carrie McIntosh
Legislative Coordinator
Office of the City Clerk

6.1

Request to Speak to Committee of Council

Submitted on Monday, January 3, 2022 - 7:00pm

==Committee Requested==
Committee: Public Works Committee

==Requestor Information==
Name of Individual: Nick Becker

Name of Organization: Victoria Park Assembly

Contact Number: [redacted]

Email Address: [redacted]

Mailing Address:
[redacted]

Reason(s) for delegation request: Trying Understand why the lighting at Victoria Park's baseball diamonds were removed in the middle of winter last year. And why insufficient lighting was left as a replacement. Less than 1% the Existing lighting lumens is now there. As hopefully with the colder weather is will be able to get another successful year of ice. The light that is there now after the removal of the Stadium lighting is vastly under size for what is needed for safety of the Rink.

Will you be requesting funds from the City? Yes

Will you be submitting a formal presentation? No

McIntosh, Carrie

From: [redacted]
Sent: Friday, December 3, 2021 10:47 AM
To: Pimentel, Danny
Subject: Re: Cycling Committee

Thank you Danny

On Fri, Dec 3, 2021 at 8:44 AM Pimentel, Danny <Danny.Pimentel@hamilton.ca> wrote:

> Hi Joachim,
>
> Clerks has advised that there is no timeline for when in-person meetings will take place.
>
> Based on that information and your indication that you have no interest in attending virtual meetings, we will proceed with submitting a resignation.
>
> Thanks for getting back to me and please don't hesitate to reach out if you have any questions. Have a happy holiday!
>
> Regards,
>
> **Danny Pimentel**
>
> (905) 546-2424 x4581
>
> ---
>
> **From:** Pimentel, Danny
> **Sent:** Thursday, December 2, 2021 2:30 PM
> **To:** Joachim Brouwer [redacted]
> **Subject:** RE: Cycling Committee
>
> Hi Joachim,
>
> Not a problem – I appreciate you getting back to me. I will double check with Clerks and let you know.

Regards,

Danny Pimentel

(905) 546-2424 x4581

From: Joachim Brouwer [redacted]
Sent: Thursday, December 2, 2021 2:21 PM
To: Pimentel, Danny <Danny.Pimentel@hamilton.ca>
Subject: Re: Cycling Committee

Sorry for getting back to you sooner Danny.

I have no interest in attending virtual meetings.

Is there any possibility of there being in person meetings in before the end of this election/citizens advisory committee cycle?

Joachim

On Thu, Dec 2, 2021 at 11:44 AM Pimentel, Danny <Danny.Pimentel@hamilton.ca> wrote:

> Hi Joachim,
>
> My name is Danny Pimentel and I am the staff liaison for the Hamilton Cycling Committee. The chair and vice-chair have advised that they have not heard back from you about your intent/desire to participate in this committee.
>
> Could you please let me know if you still would like to be part of the committee? If so, is there a reason as to why you have not attended (or provided notice of missing the meeting) meetings in 2021?

If you could please let me know by Friday December 10, 2021 that would be appreciated.

Regards,

Danny Pimentel

Active Transportation Technologist

Planning and Economic Development

Transportation Planning & Parking, City of Hamilton

(905) 546-2424 x4581

From: wmoates [redacted]
Sent: Wednesday, November 24, 2021 5:58 PM
To: Joachim Brouwer [redacted]
Cc: Chris Ritsma [redacted] Pimentel, Danny <Danny.Pimentel@hamilton.ca>
Subject: Cycling Committee

Hi Joachim

Just want to know how you are? I know you have not attended since we went virtual. Do you have any interest in attending?

Also I was still interested in the criterium idea. Are you at all interested?

Best

William Oates

CITY OF HAMILTON
PUBLIC WORKS DEPARTMENT
Environmental Services Division

TO:	Chair and Members Public Works Committee
COMMITTEE DATE:	January 10, 2022
SUBJECT/REPORT NO:	2022 Volunteer Committee Budget - Keep Hamilton Clean and Green Committee (PW22002) (City Wide)
WARD(S) AFFECTED:	City Wide
PREPARED BY:	Whitney Slattery (905) 546-2424 Ext. 5089 Florence Pirrera (905) 546-2424 Ext. 5523
SUBMITTED BY: **SIGNATURE:**	Cynthia Graham Acting Director, Environmental Services Public Works Department

RECOMMENDATION

(a) That the Keep Hamilton Clean and Green Committee's 2022 base budget submission attached as Appendix "A" to Report PW22002 in the amount of $18,250, representing a zero-net levy impact from the previous year budget, be approved and referred to the 2022 operating budget process for consideration.

EXECUTIVE SUMMARY

The Keep Hamilton Clean and Green (KHCG) Committee is a Council-endorsed, citizen volunteer group that has existed since 2001 and has actively addressed issues related to litter, graffiti and beautification across the City of Hamilton (City). The KHCG Committee has prepared their annual funding request for proposed activities in 2022 in the amount of $18,250 and this request for funding is being submitted to the Public Works Committee as Appendix "A" Attached to Report PW22002 for review and consideration during the 2022 operating budget process.

The funding in the 2022 budget request will pay expenses directly related to the Committee's workplan and goals.

Alternatives for Consideration – See Page 4

FINANCIAL – STAFFING – LEGAL IMPLICATIONS

Financial: The KHCG Committee is requesting a 2022 budget of $18,250 (Dept ID #300361), representing a zero net levy increase from the 2021 budget.

Staffing: N/A

Legal: N/A

HISTORICAL BACKGROUND

The Clean & Green Hamilton Strategy was endorsed by City Council in November 2012. In October 2013, the Clean City Liaison Committee changed its name to the Keep Hamilton Clean and Green Committee which better reflects its alignment to the Clean & Green Hamilton Strategy.

The KHCG Committee coordinates and promotes litter and graffiti remediation and prevention programs and supports beautification and environmental stewardship initiatives in the community.

In November 2021 the committee met to confirm that there would be no alterations to their budget requests for the following operating year.

POLICY IMPLICATIONS AND LEGISLATED REQUIREMENTS

The recommendation provided in this report aligns to the Vision and Mission of the City's 2016-2025 Strategic Plan and supports the Clean and Green priority area.

The recommendation also supports the ongoing implementation of the Clean & Green Hamilton Strategy, which includes:

- Contributing to an enhanced quality of life for our citizens through clean and green initiatives;
- Supporting community and stakeholder engagement through partnerships, collaboration and consultation, and;
- Contributing to the social, economic and environmental wellbeing of Hamilton.

RELEVANT CONSULTATION

The recommendation in this report was prepared in consultation with staff from the Corporate Services Department (Financial Planning, Administration and Policy Division) and with the members of the KHCG Committee.

ANALYSIS AND RATIONALE FOR RECOMMENDATION(S)

The proposed 2022 KHCG Committee base budget supports various activities that align with the five focus areas of the Clean & Green Hamilton Strategy including litter, illegal dumping, graffiti, beautification and environmental stewardship as well as the Committee's administrative costs. The 2022 operating budget request includes the following categories:

Team Up to Clean Up Program - $6,000
The KHCG Committee's workplan continues to support many volunteer groups through the Team Up to Clean Up Program. The 2022 budget request includes the purchase of supplies and promotional costs to support the Team Up to Clean Up Program.

Keep America Beautiful – $650
The KHCG Committee acts as members to the Board of Directors of Keep America Beautiful (KAB) affiliate. As such, the Committee is required to pay an annual affiliate fee and participate in training and development opportunities offered by KAB. The 2022 affiliate fee has been confirmed to be $460 USD (which is approximately $611 CDN).

Graffiti Management Strategy – $2,000
The City's Graffiti Management Strategy Team continues to identify new pilot programs that support a reduction of illegal tagging and graffiti across the City. To continue the ongoing action towards addressing these initiatives in 2022, the KHCG Committee will allocate funds to support a proactive graffiti prevention or deterrent initiative based on recommendations to be developed by the City's internal Graffiti Working Group.

Clean and Green Neighbourhood Grants – $6,000
The KHCG Committee continues to support community-led clean and green projects through the Clean & Green Neighbourhood grants program. The KHCG Committee will allocate funds towards these grants in 2022.

Cigarette Litter Prevention – $2,500
In 2019 and up to March 2020, the Cigarette Litter Prevention Program was funded through a grant from the Main Street Revitalization program. The funds from the grant were used to purchase promotional items such as pocket ashtrays and develop promotional materials such as labels for containers and a video that was promoted on social media. The grant has not awarded funding since March 2020. Because of this,

funds for this program were requested in the 2021 KHCG operating budget. Funds are being requested again in the 2022 KHCG operating budget for use on similar promotional activities.

Environmental Stewardship – $600
In 2022, the KHCG Committee will look for new opportunities to foster a sense of environmental stewardship in the local community. The Committee is exploring various ways to recognize and reward local volunteers in the environmental sector, which will be a component of the 2022 workplan.

Administration and Meeting Costs – $500
The KHCG Committee has a membership of up to 15 committee members. The Committee meets approximately eight times per year. A portion of the Committee's budget is allocated for administrative and meeting related expenses. This is a reduction from the amount that was requested in 2021 as all meetings remain virtual at this time.

ALTERNATIVES FOR CONSIDERATION

Council could reduce the KHCG Committee's annual base budget in 2022. The Committee's annual base budget is $18,250 and has not been increased since 2007. A reduction from this amount would reduce the Committee's capacity to invest in grassroots neighbourhood development initiatives, environmental stewardship initiatives and behaviour modification.

Furthermore, a reduction in the Committee's base budget would reduce the ability of the KHCG Committee to implement the Clean & Green Hamilton Strategy and Clean & Green strategic priorities.

Financial: A reduction in the budget would require the committee to reduce the number of items on their workplan for 2022.

Staffing: N/A

Legal: N/A

ALIGNMENT TO THE 2016 – 2025 STRATEGIC PLAN

Community Engagement and Participation
Hamilton has an open, transparent and accessible approach to City government that engages with and empowers all citizens to be involved in their community.

Healthy and Safe Communities
Hamilton is a safe and supportive City where people are active, healthy, and have a high quality of life.

Clean and Green
Hamilton is environmentally sustainable with a healthy balance of natural and urban spaces.

Built Environment and Infrastructure
Hamilton is supported by state-of-the-art infrastructure, transportation options, buildings and public spaces that create a dynamic City.

APPENDICES AND SCHEDULES ATTACHED

Appendix “A” to Report PW22002 – 2022 Advisory Committees Budget Submission for the Keep Hamilton Clean & Green Advisory Committee

CITY OF HAMILTON

2022

ADVISORY COMMITTEES

BUDGET SUBMISSION

KEEP HAMILTON CLEAN & GREEN ADVISORY COMMITTEE

PART A: General Information

ADVISORY COMMITTEE MEMBERS (Voting & Non-Voting):

Heather Donison (Chair)
Paulina Szczepanski (Vice Chair & HWCDSB Youth Representative)
Leisha Dawson
Kerry Jarvi (BIAAC Representative)
Brenda Duke
Lennox Toppin
Diana Meskaukas
Marisa DiCenso (HWCDSB Representative)
Felicia Van Dyk
Michelle Tom
Jen Baker (Environmental Representative – Non-voting)
Whitney Slattery (Staff Liaison – City Staff – Non-voting)
Florence Pirrera (Project Manager – City Staff – Non-voting)
Theresa Phair (Community Liaison – City Staff – Non-voting)
Councillor Nrinder Nann (Council Representative)

MANDATE:

Reporting through the Public Works Committee, the Keep Hamilton Clean & Green (KHCG) Committee will provide input and advice to staff and Council on engaging citizens to take greater responsibility for improving our community environments. The KHCG's focus is to encourage behaviours and attitudes conducive to a clean, healthy and safe community through leadership and action.

The KHCG Committee will provide input and guidance to City staff, Council and other stakeholders on community involvement, private sector involvement and identification of resources to sustain Clean & Green Hamilton programs and initiatives that aim to beautify our community, promote environmental stewardship and prevent litter, illegal dumping and graffiti.

PART B: Strategic Planning

STRATEGIC OBJECTIVES:

Litter

- Support the development and marketing of a coordinated cigarette litter prevention program.
- Lead the promotion and collaboration with community partners for the ongoing operation of Team Up to Clean Up.
- Administer Keep America Beautiful Community Appearance Index survey in 2022.
- Support and promote City and community litter remediation and prevention initiatives.

Illegal Dumping

- Support the development of educational and communication tools to prevent illegal dumping.

Graffiti

- Support stakeholder engagement strategies and victim assistance initiatives with prevention and remediation tools.

Beautification

- Recognize volunteer contributions to beautification initiatives and projects that support the Clean & Green Hamilton Strategy.
- Support neighbourhood beautification and greening initiatives as needed.

Environmental Stewardship

- Support and promote the engagement of citizen volunteers in programs and initiatives that encourage ecological integrity and minimize human impact on natural habitats and ecosystems on public and private properties.

ALIGNMENT WITH CORPORATE GOALS:

Please check off which Council approved Strategic Commitments your Advisory Committee supports			
1) **Community Engagement & Participation**	✓	2) **Economic Prosperity & Growth**	
3) **Healthy & Safe Communities**	✓	4) **Clean & Green**	✓
5) **Built Environment & Infrastructure**	✓	6) **Culture & Diversity**	
7) **Our People & Performance**			

PART C: Budget Request

INCIDENTAL COSTS:

Meeting Expenses	$500.00
Member Parking	$0.00
Keep America Beautiful Affiliate Fee / Training and Development	$650.00
SUB TOTAL	**$1,150.00**

SPECIAL EVENT/PROJECT COSTS:

Cigarette Litter Prevention	$2,500.00
Team Up to Clean Up	$6,000.00
Graffiti	$2,000.00
Volunteer recognition	$600.00
Clean & Green Neighbourhood Grants	$6,000.00
SUB TOTAL	**$17,100.00**

TOTAL COSTS	**$18,250.00**

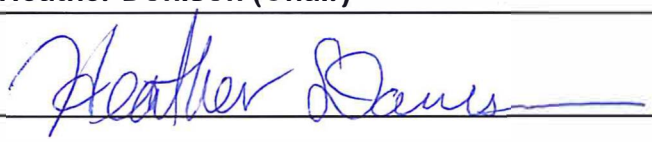
Funding from Advisory Committee Reserve (only available to Advisory Committees with reserve balances)	**$0.00**

TOTAL 2022 BUDGET REQUEST (net of reserve funding)	**$18,250.00**
PREVIOUS YEAR (2021) APPROVED BUDGET	**$18,250.00**

CERTIFICATION:

Please note that this document is a request for a Budget from the City of Hamilton Operating budget. The submission of this document does not guarantee the requested budget amount. Please have a representative sign and date the document below.

Representative's Name: **Heather Donison (Chair)**

Signature: 

Date: **November 30, 2021**

Telephone #: Staff Liaison Whitney Slattery ext. 5089

CITY OF HAMILTON
PUBLIC WORKS DEPARTMENT
Environmental Services Division

TO:	Chair and Members Public Works Committee
COMMITTEE DATE:	January 10, 2022
SUBJECT/REPORT NO:	2022 *Lymantria dispar dispar* (LDD) Moth Treatment Plan (PW21069(a)) (City Wide)
WARD(S) AFFECTED:	City Wide
PREPARED BY:	Caleb Gibbons (905) 546-2424 Ext. 2566
SUBMITTED BY: **SIGNATURE:**	Cynthia Graham Acting Director, Environmental Services Public Works Department 

RECOMMENDATIONS

(a) That the single source procurement of Zimmer Air Services Inc. for the aerial treatment of *Lymantria dispar dispar* (LDD) Aerial Control program, pursuant to Procurement Policy #11 – Non-competitive Procurement be approved; and,

(b) That the Mayor and City Clerk be authorized and directed to execute the contract and any ancillary documents between the City of Hamilton and Zimmer Air Services, for the aerial treatment of *Lymantria dispar dispar* (LDD) in a form satisfactory to the City Solicitor;

(c) That the project budget previously approved through Report PW21069 be amended from $3,500,000 to $2,000,000 for 2022 and $1,000,000 for 2023, to be funded from the Tax Stabilization Reserve (#110046);

(d) That staff be directed to return to Council with an Information Report in Q1 2023 detailing the success of the 2022 treatment program and provide an update on further treatment applications to be completed in 2023;

(e) That the Outstanding Business List Item Respecting "*Lymantria dispar dispar* (LDD) Program" be identified as completed and removed from the Public Works Outstanding Business List.

EXECUTIVE SUMMARY

By-law 08-070 *Lymantria dispar dispar* (LDD) Moth Infestation directs the General Manager of Public Works to deem any areas with LDD egg mass counts over 2,500 per hectare a public nuisance. This By-law also authorizes the General Manager of Public Works to implement an aerial spray program using biological control agent *bacillus thuringiensis 'kurstaki'* (Btk).

In 2021, LDD was observed in the City of Hamilton (City) at varying levels of infestation, which resulted in the defoliation of public and private trees; thus, negatively impacting the City's tree canopy and causing a nuisance to residents. Significant and repeated defoliation of the many tree species will likely result in mortality.

At the December 6, 2021 General Issues Committee, Report PW21069 was approved, recommending:

(a) That the amending By-law, attached as Appendix "A" to Report PW21069, being a By-law to Amend By-law 08-070, respecting Gypsy Moth Infestation, which has been prepared in a form satisfactory to the City Solicitor, be enacted and effective immediately;

(b) That, pursuant to By-law 08-070, respecting Gypsy Moth Infestation, staff be directed to implement a *Lymantria dispar dispar* (LDD) Aerial Control program involving aerial application of the biological control agent bacillus thuringiensis 'kurstaki' (Btk);

(c) That infested areas which exceed 2,500 egg masses per hectare, as identified in By-law 08-070 as the treatment threshold, be the areas to receive aerial application of the biological control agent bacillus thuringiensis 'kurstaki' (Btk);

(d) That the direction provided to staff in Closed Session, as detailed in confidential Appendix "B" to Report PW21069, respecting *Lymantria dispar dispar* (LDD) Aerial Control program, be approved;

(e) That Appendix "B" to Report PW21069, respecting *Lymantria dispar dispar* (LDD) Aerial Control program, remain confidential until after a contract has been executed with Zimmer Air Services Inc. or negotiations have ceased with no intent of executing a contract with Zimmer Air Services Inc.; and

(f) That staff be directed to report back to Public Works Committee in Q1 of 2022 detailing the terms of the agreement with Zimmer Air Services Inc., the recommended aerial treatment areas and to seek approval to execute the contract.

In the fall of 2021, Urban Forest Innovations were engaged to complete egg mass surveys using two common survey methods in order to determine the number of LDD Moth egg masses per hectare. The completed surveys had a total of 490 plots with between 5 and 19 trees per plot and found that 47% of those plots exceed 2500 egg masses per hectare. The data collected from the egg mass surveys was then added to a spatial layer in order to determine areas of public trees that would be suitable for aerial treatment. Those areas are recommended for a spray program in 2022 and are outlined in “Appendix “A” to Report PW21069(a).

Staff met with Zimmer Air Services and agreed to a price per hectare for an aerial treatment program based on a map of locations where aerial spraying is required. The agreement between Zimmer Air Services and the City of Hamilton to complete the 2022 and 2023 aerial programs will be executed following Council approval of Report PW21069(a).

Alternatives for Consideration – N/A

FINANCIAL – STAFFING – LEGAL IMPLICATIONS

Financial: The project budget that was previously approved in Report PW21069 be amended from $3,500,000 to $2,000,000 for 2022 and from $500,000 to $1,000,000 for 2023 for a total cost of $3,000,000 over the 2-year aerial spraying program, funded from the Tax Stabilization Reserve (#110046).

Staffing: N/A

Legal: N/A

HISTORICAL BACKGROUND

LDD Moth is an invasive species that is known to be a significant defoliator of primarily, but not limited to, hardwood tree species common in Southern Ontario. Report PW21069 outlines the biology and history of the pest in Ontario, as well as outlines the legislation and use of Btk as a control agent.

Btk is a soil-borne bacterium which has been used worldwide for over 30 years as a biological control agent. Health Canada's Pest Management Regulatory Agency (PMRA) permit the application of Btk as a “restricted” product, and the Canadian General Standards Boards permits the use of Btk in Organic Productions Systems for crop production (CAN/CGSB-32.311-2020).

In accordance with the Ontario Pesticide Act, Ontario Regulation 63/09, a licensed exterminator is required to post signage that details the nature of the work being

performed on site. Given the large-scale nature of the proposed aerial application of Btk, there is a mechanism within the Act whereby an applicant can perform an alternative notification of pesticide use. This mechanism was implemented for the 2018/2019 spray programs through a comprehensive communications strategy, which included: mail outs to impacted properties as well as social and print media outreach and information. Staff also maintained information about the program on the City webpage, which was updated regularly. This same approach will be used for the 2022 and 2023 spray program.

LDD egg mass surveys must be completed when deciduous trees species drop their leaves in the fall. Egg mass surveys are undertaken as part of an Integrated Pest Management (IPM) program to monitor population changes over time. Staff engaged Urban Forest Innovations who completed surveys throughout the City in the late fall of 2021. This provided staff with the data to determine recommended treatment areas for aerial application of Btk in 2022 as per Appendix “A” to Report PW21069(a) - LDD Treatment Plots 2022. Staff will continue to monitor LDD populations throughout the spring and summer of 2022 and 2023 as part of an ongoing IPM program following aerial treatment in the spring of 2022.

POLICY IMPLICATIONS AND LEGISLATED REQUIREMENTS

By-law 08-070 is in place to address LDD infestations as a nuisance, with City staff being given authority to treat with Btk when egg mass quantities exceed 2,500 per hectare.

Transport Canada has only approved twin engine helicopters for use in the application of Btk over built-up areas, as per Canadian Aviation Regulations Standard 722 – Aerial Work. This type of work also requires the air operator to apply for a Special Flight Operations Certificate for aerial work. Staff have confirmed that the vendor Zimmer Air Services Inc., identified in Recommendations (a) and (b) of Report PW21069(a), is the sole vendor in Ontario that has this certification and equipment required to complete the work.

RELEVANT CONSULTATION

The following internal groups are were consulted and are supportive of the recommendations in Report PW21069(a):

Corporate Services Department, Legal and Risk Management Division;
Corporate Services Department, Financial Planning, Administration & Policy Division, Finance & Administration Section
Corporate Services Department, Financial Services and Taxation, Procurement Section;

Additionally, the affected Ward Councillors were sent mapping and proposed spray information for their consideration in December 2021.

ANALYSIS AND RATIONALE FOR RECOMMENDATION

In November / December of 2021, staff engaged a vendor through a Request for Quotations Policy 5.2 procurement process in order to complete LDD Moth egg mass surveys in the City of Hamilton. Areas for egg mass surveys were identified by overlaying maps of previous years' egg mass surveys, aerial treatment locations in 2007 and 2018/2019, and resident concerns from 2021.

Using the egg mass survey results completed by a contractor, staff analysed the results to determine locations that would meet the threshold for aerial treatment. The criteria to be selected for aerial treatment included the egg mass survey results but also confirming the ownership of the trees to be public, and that the number of trees found warrant an aerial spray as opposed to ground spraying or tree banding.

The information from the data collection was used to create Appendix "A" to Report PW21069(a) - LDD Treatment Plots 2022 which found that high to severe levels of infestation were found in areas of Hamilton, Dundas, Ancaster, Flamborough, Waterdown and Glanbrook. Based on these findings, staff identified approximately 869 hectares of land to receive aerial treatment in May/June of 2022.

Following approval of Report PW21069 at the December 6, 2021 General Issues Committee, staff met with Zimmer Air Services Inc. to review the treatment areas and came to an agreement for the aerial application program in 2022. The agreement outlines the roles and responsibilities of Zimmer Air Services Inc. to complete the aerial application of Btk to approximately 1850 hectares (2 applications over 925 hectares) in 2022 The agreement with Zimmer Air Services Inc also confirms the pricing for aerial treatment in 2023 for approximately 925 hectares.

ALTERNATIVES FOR CONSIDERATION

N/A

ALIGNMENT TO THE 2016 – 2025 STRATEGIC PLAN

Community Engagement and Participation

Hamilton has an open, transparent and accessible approach to City government that engages with and empowers all citizens to be involved in their community

Economic Prosperity and Growth
Hamilton has a prosperous and diverse local economy where people have opportunities to grow and develop.

Healthy and Safe Communities
Hamilton is a safe and supportive City where people are active, healthy, and have a high quality of life.

Clean and Green
Hamilton is environmentally sustainable with a healthy balance of natural and urban spaces.

Built Environment and Infrastructure
Hamilton is supported by state-of-the-art infrastructure, transportation options, buildings and public spaces that create a dynamic City.

Culture and Diversity
Hamilton is a thriving, vibrant place for arts, culture, and heritage where diversity and inclusivity are embraced and celebrated.

Our People and Performance
Hamiltonians have a high level of trust and confidence in their City government.

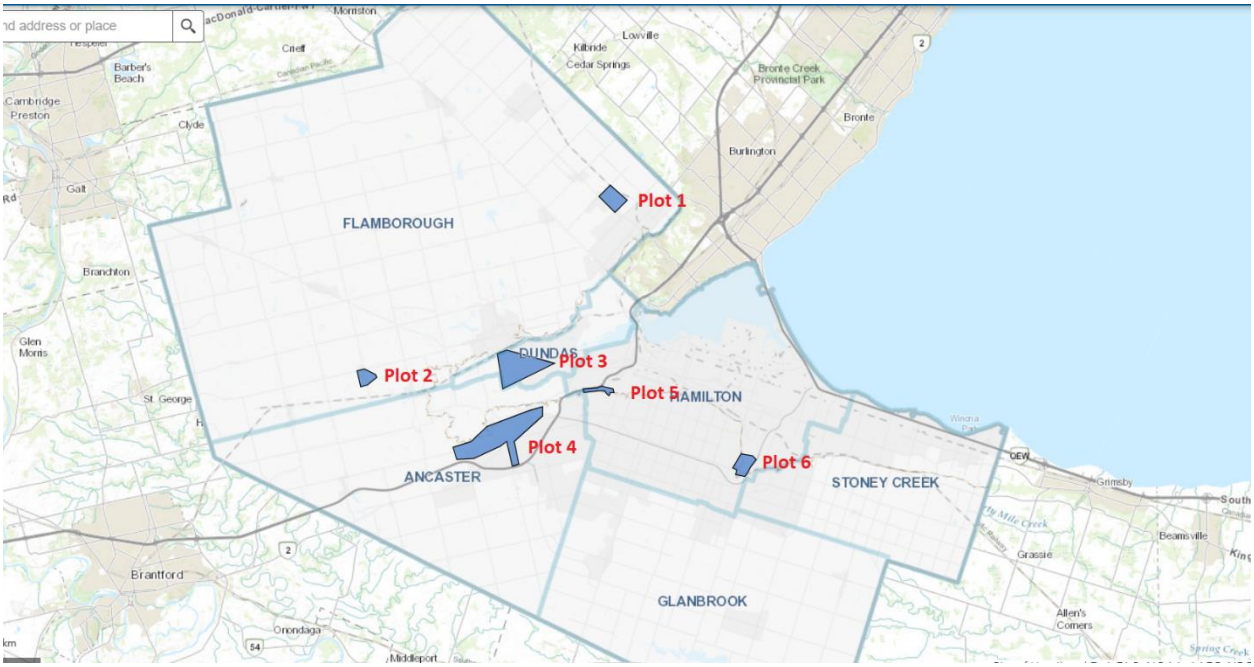
APPENDICES AND SCHEDULES ATTACHED

Appendix “A” to Report PW21069(a) – LDD Treatment Plots 2022

Appendix “B” to Report PW21069(a) – Hamilton Zimmer Aerial Moth Spraying Service Contract 2022

Appendix A

Overview



Treatment Plot Number	Estimated Total Area (Ha) 2022	Ward(s)
1	75	15
2	0	12
3	250	13
4	300	12
5	150	1
6 *	150	4 and 6
Application 1	925	
Application 2	925	
Total hectares	**1850**	

* pending review and approval by Joint Stewardship Board as this location is in the Red Hill Valley.

CITY OF HAMILTON
PUBLIC WORKS DEPARTMENT
Energy, Fleet and Facilities Management Division

TO:	Chair and Members Public Works Committee
COMMITTEE DATE:	January 10, 2022
SUBJECT/REPORT NO:	Natural Gas Waste Collection Trucks (PW22003) (City Wide)
WARD(S) AFFECTED:	City Wide
PREPARED BY:	Tom Kagianis (905) 546-2424 Ext. 5105
SUBMITTED BY: **SIGNATURE:**	Rom D'Angelo, C.E.T.; CFM Director, Energy, Fleet and Facilities Management Public Works Department 

RECOMMENDATIONS

(a) That the following appendices attached to Report PW22003 be received:

(i) City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Study Report as identified in Appendix “A” attached to Report PW22003;
(ii) City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Supplemental Study Report as identified in Appendix “B” attached to Report PW22003;
(iii) City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling 2nd Supplemental Study Report as identified in Appendix “C” attached to Report PW22003;

(b) That Council approve funding to support the cost premium of 10 CNG waste collection trucks and related facility ancillary requirements in the amount of $700,000 to the Fleet Project ID 4942151100 from:

(i) Unallocated Capital Reserve (#108020) in the amount of $200,000;
(ii) Appropriate from Capital Project 5121855137 Waste Management R&D Program in the amount of $10,000;
(iii) Internal Loan from the Energy Conservation Initiatives Reserve 112272 in the amount of $490,000 amortized over 7 years;

(c) That the estimated fuel savings of $70,000 per year from the new CNG vehicles funded in Recommendation (b) be used to repay the funds borrowed, plus applicable interest, to the Energy Conservation Initiatives Reserve (112272) as indicated in Appendix “D” attached to Report PW22003 from the Public Works Waste Division Dept ID 512560;

(d) That a new Capital Project be set up with a budget of $490,000 funded from the Energy Conservation Initiatives Reserve #112272 to fund future incremental costs from Fleet and Facilities for projects and/or purchases which qualify according to the Corporate Energy and Sustainability Policy as determined by the Manager, Energy Initiatives;

(e) That the Goods and Services be procured through a Purchase Order, a formal Contract or any other process as approved by the Director of Financial Services and Corporate Controller and that the General Manager of Public Works, or their designate, be authorized to negotiate and enter into a single source procurement and execute the completion of all associated documents with Envoy Energy Fuels Inc. for the supply, installation and management of CNG mobile refuelling equipment, commodity and operational requirements for the life of the 10 CNG vehicles to be procured, in a form satisfactory to the City Solicitor.

EXECUTIVE SUMMARY

The purpose of this report is to recommend the purchase of 10 Compressed Natural Gas (CNG) powered waste collection trucks that will align to the Motion adopted by City of Hamilton (City) Council on March 27th, 2019 (Item 3 of the Board of Health Report 19-003, March 18th, 2019) an Accelerating and Prioritizing Climate Action in Response to the Climate Emergency as well as endorsing a clear direction from the Bay Area Climate Change Summit that allows Hamilton to meet climate change targets, notably, “that all diesel vehicles be decommissioned by 2030 and all vehicles electrified by 2050.”

The City’s Waste Collections Section currently operates 37 diesel powered trucks. The 10 vehicles in this recommendation are scheduled for replacement in 2023 and represents 27% of the waste collection fleet.

In July 2019 Marathon Technical services was contracted to perform a CNG Packer Truck Fuelling Study in consideration of replacing all City owned waste collection trucks from diesel powered to CNG powered as they became due for replacement.

The recommended solution will result in a net reduction of GHG emissions of approximately 99 tonnes annually and is not expected to have any negative operational impacts.

Envoy Energy Fuels Inc. is the only known company in Canada that offers this combination of equipment for a CNG mobile refuelling solution. The recommended single source procurement for the mobile CNG fuelling station required to fuel all 10 (new) CNG vehicles is estimated to be $190,000 annually, which is based on a historical annual average fuel consumption rate, this figure can fluctuate due to operations and fuel usage. There are no budget impacts as the fuel cost to operate the waste management fleet is pre-established as part of the base budget. The expected life of a CNG waste packer truck is 7 years.

Replacement approval for the 10 CNG vehicles identified in this report is scheduled for replacement in 2023 and has been submitted in the 2022 Fleet Replacement Capital Budget for council approval. This will allow for enough time to issue the appropriate procurement documents and schedule build of vehicles and installation of refuelling infrastructure in a timely fashion for the delivery of new CNG waster packers in 2023.

Alternatives for Consideration – See Page 9

FINANCIAL – STAFFING – LEGAL IMPLICATIONS

Financial: The cost premium (estimated 20%- 25%) to purchase a natural gas-powered chassis compared to the same diesel-powered chassis is $60,000 each. Capital cost for ancillary requirements (lighting, parking and impact protection) is estimated at a one-time cost of $100,000 for a total cost of premium including the trucks of $700,000.

The estimated expenditure to purchase 10 CNG waste packers is $4.1M (plus $100,000 one-time expenses).

- $3.0M will be drawn from the Fleet Reserve (previously approved through the capital budget process);
- $0.5M Waste's Capital Project (previously approved through the capital budget process);
- $0.7M incremental cost will be funded as follows and transferred into to Fleet Project # 4942151100:
    - the Energy Conservation Initiatives Reserve (112272) in the amount of $490,000. These funds will be repaid over seven (7) years plus applicable interest. The payback schedule to the

- Energy Conservation Initiatives Reserve is outlined in Appendix "D" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Funding Repayment;
- An additional $200,000 will be transferred from the Unallocated Capital Reserve (#108020). The request is being made based on the recent Waste Management WIP closure of Capital Project 5122194029 SWMMP – Alternative Disposal Facility which was closed on the June 30th, 2021;
- The balance of $10,000 of the incremental costs will be appropriated from Capital Project 5121855137 Waste Management R&D to the Fleet Project ID 4942151100.

Based on the increased replacement cost, waste collections annual contributions to reserve will increase approximately $68,500 for all 10 new trucks. This is based on the estimated purchase cost of the trucks and will change based on the actual contract price realized after tender.

The recommended single source procurement for the mobile CNG fuelling station required to fuel the new CNG vehicles is estimated to be $190,000 annually, which is based on a historical annual average fuel consumption rate, this figure can fluctuate due to operations and fuel usage. There are no budget impacts as the fuel cost to operate the waste management fleet is pre-established as part of the base operating budget.

Staffing: The slow fill CNG station will result in less time to refuel vehicles. Typically, Waste Collection staff would use a City owned fuel station on their collection route. In some instances, staff would modify their route to get to a City fuel site. The refuelling process, including travel could take 15 minutes or more. However, by locating the fuel site at 1579 Burlington St., staff will forgo the current time to refuel and simply attach a fuel nozzle to the vehicle at the end of their shift. The refilling process will happen overnight during low peak energy consumption applicable rates.

Legal: Fleet/Energy staff will work with legal to draft an agreement in a form satisfactory to the City Solicitor.

HISTORICAL BACKGROUND

The Waste Collection Section of the Waste Management Division operates 37 diesel powered waste collection trucks in the following configurations to accommodate specific operational requirements.

Quantity of Vehicles	Body Configuration	Scheduled Replacement Year	Estimated Annual Diesel Fuel Use (Litres)
16	Rear Load	2021	232,137
10	Side Load	2023	211,450
2	Mini Rear Load	2023	12,610
9	60/40 split Rear Load	2025	140,382

Fleet Services sets the replacement schedule of waste collection trucks based on several factors which include maintenance, mileage, new vehicle lead time and operating impacts. In 2021 Fleet Service reduced the expected life of waste collection trucks from 8 years to 7 years. This was based on an analysis that showed spiking maintenance costs in years 6-8.

CNG powered waste collection trucks have been in the industry for many years and are available in many styles and configurations to meet specific operational requirements. The City currently has one CNG fuel site located at 2200 Upper James. This location is used to refuel transit buses. A previous site at 330 Wentworth Street N., was installed in the mid 1990’s with a Pro Logic Controller and compressors that were no longer supported by the manufacturer for parts supply therefore the site was decommissioned.

Over the last few years development of hybrid and fully electric powered chassis have shown a stronger presence in the market. Several cities throughout the United States are working with manufacturers to test operational requirements. The City has contacted industry representatives to stay current on availability in our market and have asked to be notified when demonstration models are available.

The Battery Electric Vehicle options currently available in the industry for the 10 Side Load vehicles are not available in configurations that would meet waste collections operating requirements in Hamilton.

Fleet Services keeps current on options for vehicle replacements by attending various waste expo's, Fleet equipment trade shows and through public and private industry contacts.

POLICY IMPLICATIONS AND LEGISLATED REQUIREMENTS

- Procurement Policy By-law: Policy 11- Non-Competitive Procurements
- Corporate Energy and Sustainability Policy

RELEVANT CONSULTATION

The following departments provided input into the development of this report:

- Corporate Services Department, Financial Planning Division;
- Corporate Services Department, Procurement Division**. (**Provided information only with respect to adherence to the Procurement Policy);
- Public Works Department, Waste Management Division;
- Public Works Department, Corporate Asset Management Division;
- Healthy & Safe Communities Public Health Services; (Air Quality & Climate Change)
- Public Works Department, Energy Fleet and Facilities Management Division.

External consultation included:

Marathon Technical Services provided Compressed Natural Gas Packer Truck Fueling Studies attached hereto as:

- Appendix "A" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fueling Study Report;
- Appendix "B" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Supplemental Study;
- Appendix "C" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Supplemental Study.

Marathon has over 35 years of full-time experience in the CNG market providing professional consulting technical and financial analysis and support services for the CNG infrastructure market. Marathon provides professional services from project conceptual analysis, through the design and construction phases to the development of maintenance and support programs and has no affiliation with any equipment supplier

but has extensive experience with a wide variety of CNG equipment suppliers, installers and other service providers.

In the initial report, Marathon evaluated a total of five scenarios. A cost analysis of replacing the City's waste collection fleet vehicles from diesel powered to CNG powered as they became due for replacement was conducted.

Subsequently the City asked Marathon to conduct a further analysis on a few additional options that recently were identified. The additional options presented flexibility to reduce the typical long-term commitment to a traditional life cycle of a CNG refuelling station and offset the substantial capital cost required. This would also allow the City to quickly pivot and take advantage of developing new technologies of electric or other power options that could become available in the near future and further assist in the reduction of GHG emissions.

ANALYSIS AND RATIONALE FOR RECOMMENDATION

The trucks are either currently not available in an electric option that will suit the operating departments requirements or are cost prohibitive. In the meantime, the short-term option of purchasing 10 CNG powered waste collection trucks will bridge the gap and continue the City on the path towards reducing Green House Gasses (GHG's).

The recommended solution in this report will result in a net reduction of GHG emissions of 99 tonnes annually and is not expected to have any negative operational impacts.

The recommended option provided by Envoy Energy Fuels Inc. is the lowest cost for a short-term solution and allows flexibility to expand if the vehicles scheduled for replacement in 2025 don't offer an electric alternative.

A complete analysis of short term CNG options are provided in the attached consultants report (Appendix "B" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Supplemental Study) and (Appendix "C" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Supplemental Study).

The analysis included evaluation of several CNG refueling option scenarios, a cost analysis, estimated reduction of GHG's and some commentary of other chassis power options that are currently available in the industry.

The result of the study provided five scenario's that ranged in a Net Present Value (NPV) cost from between $(1.2M) and $1.3M. The option that provided the highest NPV was contingent on other factors that presented significant operational risks and are not recommended. An additional concern of all options was the long-term commitment to CNG refuelling infrastructure when electric options appear to be making a strong surge in this vehicle class.

Fleet Services then requested Marathon Technical Services to review the CNG refuelling options on two smaller scale scenarios (Appendix "B" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Supplemental Study) and (Appendix "C" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Supplemental Study) that included only a portion of the fleet vehicles and for a shorter term. The additional refuelling options, until recently, have not been traditional options available in the market. These additional options allow for shorter term CNG refuelling solutions and alleviates the City from the substantial capital investment that is typically associated with a natural gas compressor station installation (Est. $4M).

The recommended option supplied by Envoy Energy Fuels Inc. consists of a trailer mounted compressor and gas storage dispensed to 10 vehicles, time fill manifold refuelling stations (Appendix "C" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Supplemental Study Table 4--Company A--Trailer Concept using Contractor Fuel):

The contractor assumes:

- All the equipment and installation capital costs;
- All the operation and maintenance costs;
- All repair costs;
- All station licensing and permitting costs;
- All trucking of gas to site;
- The commodity and utility gas cost.

All costs identified above will be charged by the vendor at a cost per m^3 of gas used and will be expensed to Waste Collections operating budget.

The Energy Conservation Initiatives Reserve (112272) is used in part to fund incremental costs according to the previously approved Corporate Energy and Sustainability Policy (PW14050(a)). Eligible capital costs are targeted towards

incremental costs that relate to the purchase of high efficiency, low emission equipment that will move the City of Hamilton towards its long-term targets that relate to the reduction of energy intensity and lowering emissions / Greenhouse Gases (GHG's). These costs are typically outlined in a lifecycle analysis that depicts a base line or standard equipment purchase compared to the high efficiency or low emission alternative. This was clearly outlined in the waste collection truck analysis that shows the lower GHG's and lower fuel costs that accompany the CNG option compared to the diesel option.

ALTERNATIVES FOR CONSIDERATION

1. Convert All Waste Collection Vehicles to CNG

   The option to convert the entire waste collection fleet to CNG was the primary focus of the initial consultation with Marathon. This analysis considered 5 different refuelling station options.

   Marathon assembled capital cost and operating cost data from its own sources and from the City. Where possible, City data and HSR data, rather than general industry data. A conservative mix of costs was used for analysis over a 21-year life cycle based on truck replacement at 7-year increments as discussed in the report. The 21-year period corresponds to the normal expected life of the CNG station. Two of the scenarios have a positive NPV and all achieve payback within the project period.

   This option would require a 21-year commitment to replace waste collection vehicles with natural gas to realize the cost savings and reductions in GHG's.

   The fleet industry is moving towards battery electric vehicles which will offer a greater reduction in GHG within the 21-year window. Therefore, Fleet does not recommend investing in an option with a 21-year commitment.

   Switching from diesel to natural gas reduces GHG's by 17%.

   Financial: A complete financial analysis of CNG options are provided in the attached consultants report (Appendix "A" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fueling Study Report).

   Staffing: N/A

   Legal: N/A

2. Short Term Agreement with Traditional CNG Equipment

   Marathon Technical Services was contracted to conduct further analysis after their initial consultation to investigate options. A complete analysis of CNG short term options are provided in the attached consultants supplemental reports (Appendix B attached to Report PW22003- City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Supplemental Study) and (Appendix "C" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Supplemental Study).
   Financial: N/A

   Staffing: N/A
   Legal: N/A

3. Upgrade of 330 Wentworth Street CNG Fuel Site

   This option was considered in the initial consultant's report and would be cost prohibitive as little if any of the current equipment could be used. This option also conflicts with future development of these lands.

   Financial: A complete financial analysis of CNG options are provided in the attached consultants report (Appendix "A" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fueling Study Report).

   Staffing: N/A

   Legal: N/A

4. Biodiesel

   Biodiesel is a renewable fuel made from vegetable oil and waste cooking oil, animal fats such as beef tallow and fish oil, and even algae oil. Biodiesel can be blended in a variety of ratios with conventional diesel fuel. B10 – A blend of 10% biodiesel and 90% fossil diesel. An annualized blend of B20 (used during summer months) and B5 (used during winter and shoulder months).

   Biodiesel can be used not only for waste collection vehicles but for all diesel-powered City vehicles. Cost of Biodiesel blends up to 20% are at parity to that of conventional diesel fuel.

   Biodiesel presents some concerns with cold weather operations and long-term storage stability. Some precautions must be taken before making the switch to

biodiesel, including using a lower blend due to viscosity issues at cold temperatures.

Additives also may be needed to improve storage conditions and allow for the use of biodiesel fuel in a wider range of ambient temperatures.

Biodiesel fuel is an excellent medium for microbial growth. Since water accelerates microbial growth and is naturally more prevalent in biodiesel fuels than in petroleum-based diesel fuels, care must be taken to remove water from fuel tanks.

Biodiesel results in reductions of GHG's but not to the extent of CNG. Possible cold weather concerns are further heightened as waste collection vehicles are parked outdoors.

Average annual blend of B12.5 biodiesel can reduce GHG's by 10-12%

Financial: N/A

Staffing: N/A

Legal: N/A

5. Electric Powered

   Fleet has contacted many potential providers including LION, Mack, Volvo and BYD however there are currently no electric powered vehicle configurations that could meet the operational requirement of the waste collections group for semi automated side loading.

   Financial: N/A

   Staffing: N/A

   Legal: N/A

6. Fuel new CNG trucks at the 2200 Upper James HSR location

   The round-trip distance from 1579 Burlington St to 2200 Upper James is 46km and 42 minutes drive time

Financial: Additional cost of approximately $430,000 annually to drive to this location. A complete financial analysis of CNG options are provided in the attached consultants report (Appendix "A" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fueling Study Report).

Staffing: This option adds 42 minutes of unproductive staff time each operating day

Legal: N/A

ALIGNMENT TO THE 2016 – 2025 STRATEGIC PLAN

Healthy and Safe Communities
Hamilton is a safe and supportive City where people are active, healthy, and have a high quality of life.

Clean and Green
Hamilton is environmentally sustainable with a healthy balance of natural and urban spaces.

Built Environment and Infrastructure
Hamilton is supported by state-of-the-art infrastructure, transportation options, buildings and public spaces that create a dynamic City.

Our People and Performance
Hamiltonians have a high level of trust and confidence in their City government.

APPENDICES AND SCHEDULES ATTACHED

Appendix "A" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Study Report

Appendix "B" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Supplemental Study

Appendix "C" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fuelling Supplemental Study

Appendix "D" attached to Report PW22003 - City of Hamilton Compressed Natural Gas (CNG) Packer Truck Funding Repayment

City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fueling Study Report

Submitted To:

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Energy, Fleet & Facilities
Public Works
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FINAL REPORT

2020 03 03

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Executive Summary:

The City of Hamilton, Energy, Fleet & Facilities Public Works department (the City) contracted with Marathon Technical Services (Marathon or MTS), to study the technical and financial viability of transitioning the current diesel fleet of 37 packer (refuse collection) trucks to CNG. This analysis was focused on infrastructure and operation costs.

A total of five scenarios were evaluated, the first two involving fast fill fueling at a rebuilt Wentworth CNG station, the third involving fast fill fueling at Wentworth using gas compressed in the proposed HSR CNG station on the adjacent property and the last two evaluating time fill at the Burlington Street location where the packer trucks are domiciled. All five scenarios are technically feasible.

Marathon assembled capital cost and operating cost data from its own sources and from the City. Where possible, City data and HSR data, rather than general industry data, have been used to ensure that data is accurate and applicable to this situation.

A conservative mix of costs was used for analysis over a 21-year life cycle based on truck replacement at 7-year increments as discussed in the report. The 21-year period corresponds to three full life cycles of the Classification 78 packer trucks and the normal expected life of the CNG station. Net Present Value (NPV) and payback were used as quantitative evaluation metrics. Two of the scenarios have a positive NPV and all achieve payback within the project period.

Although fast fill at Wentworth (Scenario 3) achieved the highest NPV and payback ($1.25M and the fastest payback--10 Years), it is heavily dependent on the HSR project timing and operations. Given the long-term nature of this CNG packer truck transition, Marathon recommends constructing a time fill fueling station with two 636 scfm compressors and 37 time fill stalls at the Burlington Street packer truck operations location (Scenario 5). This location and approach de-couples the packer truck project from the current HSR project, gives a convenient fueling location that will save labour and truck mileage and still has the second highest NPV ($102K and the second fastest payback--13 Years).

Marathon also performed a sensitivity analysis to investigate the impact of fleet growth. It was found that the addition of trucks to the fleet increases the economic and environmental benefits of the project. Furthermore, the earlier in the period that vehicles are added, the greater the benefits.

Marathon recommends that the City of Hamilton proceed with the project to transition its diesel packer fleet to CNG. There are two scenarios that show a positive economic impact and all scenarios provide carbon reduction and the ability to implement RNG in the future resulting in carbon elimination.

It is estimated that this project will create a savings of 5,537 tonnes CO_2e over the lifecycle of the project --projecting a “green” image for the City. This represents a

17.3 percent reduction from the diesel fleet and based on US EPA data, this is the equivalent of taking about 57 passenger vehicles off the road.

Hamilton has its own RNG supply. Transportation is an excellent application for RNG and can make a CNG vehicle even more environmentally responsible than an electric vehicle—avoiding the pollution of battery production. Unlike Battery Electric Trucks (BET) which have a very limited selection of vehicle types and are early in the development and commercialization phase, CNG packer trucks are widely available, industry tested and have the daily range to exceed the distance of the longest current City of Hamilton diesel truck routes.

Table of Contents:

Introduction:

The City of Hamilton (the City, or Hamilton) is evaluating the possible transition of its diesel-powered packer truck refuse collection fleet to Compressed Natural Gas (CNG). The City has over three decades of successful CNG heavy fleet experience at the Hamilton Street Railway (HSR).

CNG is a fuel that is capital intensive but low cost to operate and provides toxic gas and greenhouse gas (GHG) emissions reduction when compared with diesel. It is also the most proven alternative fuel in heavy vehicle applications.

To evaluate the qualitative and quantitative issues with the transition of the 37 packer trucks from diesel to CNG, the City has contracted with Marathon Technical Services (Marathon) to assemble required data and provide a rigorous study of the costs and technical viability of this transition.

Marathon has been contracted to perform the following scope:

1. Review truck procurement, truck operations, truck fuel data for the existing fleet and any internal project analysis/reports and project a sizing of the station required based on time fuel and separately based on fast fill.

2. Review drawings of sites (as available) to determine which sites are viable for time fill or fast fill.

3. Review of 3 to 5 fueling location alternatives from the following list:
    a. Removal of the existing Wentworth CNG station equipment (except the dryer) and reuse of the existing fueling infrastructure for the installation of new CNG station sized to fast fill only the packer fleet using the islands previously used for HSR bus fueling (with new dispensers).
    b. As per option a above but also with a time fill barricade on the adjacent property.
    c. Construction of a time fill fueling station at the 1579 Burlington St. truck parking facility.

4. For the options above, Marathon will:
    a. Determine gas pressure and availability with Enbridge.
    b. Provide an ROM cost estimate for the capital cost.
    c. Provide an estimate of the time required for design, equipment delivery and installation.
    d. Provide a narrative discussion of the relative Pros and Cons of each fueling option.

5. Marathon will investigate the current Operating Engineer requirements and determine what workarounds are possible, if required.

6. Marathon will investigate interim/fast deployment fueling options including portable fueling. (deadheading to Mount Hope was evaluated as a temporary measure as was the use of a tube trailer to bring gas to Wentworth) (The options investigated were applied only as a temporary measure for one of the scenarios.)

7. Marathon will identify potential incentives/grants that might decrease the truck purchase or station construction costs.

8. Marathon will provide a written report including findings, analysis and recommendations based on the above bullets.

9. Packer truck types are classified as follows:
    a. Classification 78—full sized rear loader
    b. Classification 157—full sized side loader
    c. Classification 157A—mini-packer
    d. Classification 170A—60/40 split rear loader

10. Life cycle cost analysis for the initial and subsequent purchase and integration of CNG packer trucks into the collection fleet. The initial purchase will be for approximately 16 rear loader trucks to go into service in 2021, an additional 10 side loader and 2 mini-packer trucks added to the service in 2022 and another 9 trucks in 2024. This analysis will identify the net present value (NPV) of the CNG program and will also identify the expected environmental and other benefits. Marathon will make recommendations related to the implementation of this program.

11. It is understood that City trucks are maintained off site by service providers and thus no garage upgrades related to CNG are required or anticipated at this time and no consulting associated with upgrades is included in this scope.

Analysis Assumptions and Data Sources:

The life cycle cost analysis uses data from a variety of sources and covers a wide range of data to address all readily quantifiable cost elements to provide a comprehensive and conservative analysis. The list below summarizes the cost elements and data sources that were determined or assumed in this study:

1. **T**he lifecycle analysis is based on a 21-year life cycle with year 0 being 2021 and running to 2041. This 21-year life cycle was selected as it corresponds to three full 7-year truck life cycles for the initial truck procurement and corresponds to a typical CNG station life.

2. Discount rate--5% (Marathon standard, confirmed with the City of Hamilton). See Glossary in Appendix A for definition of discount rate.

3. Inflation--2.5 percent to 3.0 percent (dependent on item) (Marathon standard, confirmed with the City of Hamilton). See Appendix C for individual rates used.

4. HST was applied at a net rate of 1.76 percent on the full capital cost of the CNG station and the upcharge/differential cost for the CNG trucks over the diesel truck cost. As discussed with the City, it is understood that diesel fuel, electricity, natural gas, CNG station maintenance costs and truck operating and maintenance costs already include HST embedded in the costs provided by the City.

5. Fleet replacement schedule used was as communicated by the City. See Appendix E. Truck life was assumed to be 7 years, the same as diesel with no differential salvage value assigned (as provided by the City).

6. Truck capital cost differential compared to clean diesel was $45,000 plus HST (ie the CNG trucks are more expensive than the diesel trucks) for all full sized CNG packer trucks (as provided by the City). The two mini-packer trucks (classification 157A) are much lower capital cost than the other ten full-sized Classification 157 packer trucks in this group, but it is the differential cost compared to diesel that is relevant to this study. Given that these mini-packer trucks have smaller engines and less CNG tankage, a estimate of $30,000 plus HST was used for the mini-packers.

7. Truck maintenance cost differential—no differential truck maintenance cost compared with clean diesel was assumed. Although CNG and diesel trucks have both been widely used in this application for a number of years, there is still a variety of opinions as to which fuel has lower truck maintenance costs including the prevailing opinion that there is no difference. HSR indicated that their current experience is there is no difference in maintenance costs between these fuels for their fleet of heavy buses—this is the assumption used in this report.

8. Future CNG vehicle fuel consumption is equal to diesel since it was assumed that there is no increase or decrease in routes or total distance except as studied in the sensitivity analysis. This is a conservative assumption since if additional trucks are required to meet a growing population (significant population growth is very likely over a 21-year period). Based on the conservatively sized CNG station used in the 37-truck baseline scenario, additional CNG trucks will have only a very small station capital cost impact (as noted in the two sensitivity analyses performed), but will provide a substantial additional fuel cost savings compared to diesel trucks.

9. Current diesel prices were supplied by the City and based on 2018/2019 average diesel fuel cost per litre then inflated at 3.0 percent per annum.

10. Engine efficiency—CNG engines are assumed to be 88 percent of diesel engine efficiency (Cummins). CNG engines are spark ignition with lower compression ratio than diesel and thus diesel engines have a higher thermal efficiency than CNG, although this advantage is narrowing making this a conservative assumption.

11. Station capital costs for all five scenarios are broken out in Appendix D. At the bottom of each station cost breakdown are several factored costs, these include:

    a. Installation cost factor—The capital costs estimated in this report are not based on a detailed design since the project has not yet advanced to that stage. Marathon has used an experience-based cost factor (a multiplier on top of the equipment cost) to reflect the cost to install this equipment on site. The value used for this multiplier reflects Marathon's opinion of the likely cost based on site conditions (for example cost factors are higher at Burlington Street since more site development and services work is required) and local construction costs. Marathon has presented a conservative cost for the stations.
    b. Contingency—It is common to add contingency to a project to account for unknowns and factors outside of the Owner's control—for example exchange rates on equipment purchases, or unknown site conditions. 10 percent has been used as this is a common contingency rate.
    c. Contractor Markup for Overhead and Profit, Bonds, General (Specification) conditions—A general contractor will add a percentage to account for their overhead and profit and for contract terms. This has been shown as separate from the equipment and installation costs, although this is sometimes included in those other cost categories.

d. Design and Construction Management (CM) Fee—The City will contract the design of these facilities and may contract out the construction management of the project. 15 percent has been carried as a combined percentage for these services. This is a common rate used for municipal CNG projects.

12. Gas utility commodity and gas distribution charges were based on 2018/2019 HSR CNG station charges as provided by the City. These were inflated at 2.5 percent per annum. Enbridge has confirmed that ample natural gas supply is available at both sites at a delivery pressure of 80 psig—this supply pressure will be discussed in the recommendations section.

13. Electricity charges were based on 2018/2019 HSR CNG station charges as provided by the City. Electricity costs were initially calculated based on the total load that the City attributes to the HSR CNG station. As a check of this calculation, Marathon also calculated the expected load of a new CNG station and multiplied it by the total cost per kWh that HSR paid in 2019. The second calculation netted a higher cost per unit of gas compressed and thus it was used as the conservative assumption. Electricity was inflated at 3.0 percent per annum. See calculations at the bottom of the table in Appendix G.

14. CNG station maintenance cost was based on the greater of the pro-rated 2018/2019 HSR CNG station maintenance charges as provided by the City and an inflation adjusted fixed monthly charge of $5000 per month (2019 value). The HSR data was calculated on a pro-rated $/m^3 of gas throughput then multiplied by the annual throughput at the new packer fleet station—note that the packer fleet station is considerably smaller than HSR's CNG station. Annual costs were inflated at 3.0 percent per annum—the higher than inflation rate was used to address cost increases expected as the station ages. The fixed monthly charge was consistently higher than the HSR data, so the fixed monthly charge governed—this is a conservative assumption.

15. GHG calculations are based on motor fuel data for the Canadian National Inventory Report (NIR) Table A6-12.

16. Trucks will continue to be serviced off site by third party maintenance shops, therefore no Hamilton shop upgrades for CNG are required or included.

17. No government grants or other incentives or subsidies are currently available or included in the cost estimates.

18. For scenario 3, the cost of both the driver time and the truck cost per km were included for a one-year period from Wentworth to Mount Hope. This

was included as a 23.2 km round trip (at $1.88 inflation adjusted per km) consuming one hour of total labour per truck trip.

19. For scenario 3, as an alternative to deadheading the trucks to Mount Hope HSR for fueling for 12 months, the City requested that Marathon evaluate the technical viability and economics of fueling a CNG trailer at HSR Mount Hope and trucking the gas to Burlington Street to fuel the fleet at that location for the 12 month period. Temporary fueling at Burlington Street will require either a temporary time fill or temporary fast fill which will incur considerable sunk cost. It should also be noted that the trailer must have its own compressor, or an external compressor must be installed to pump down the trailer.

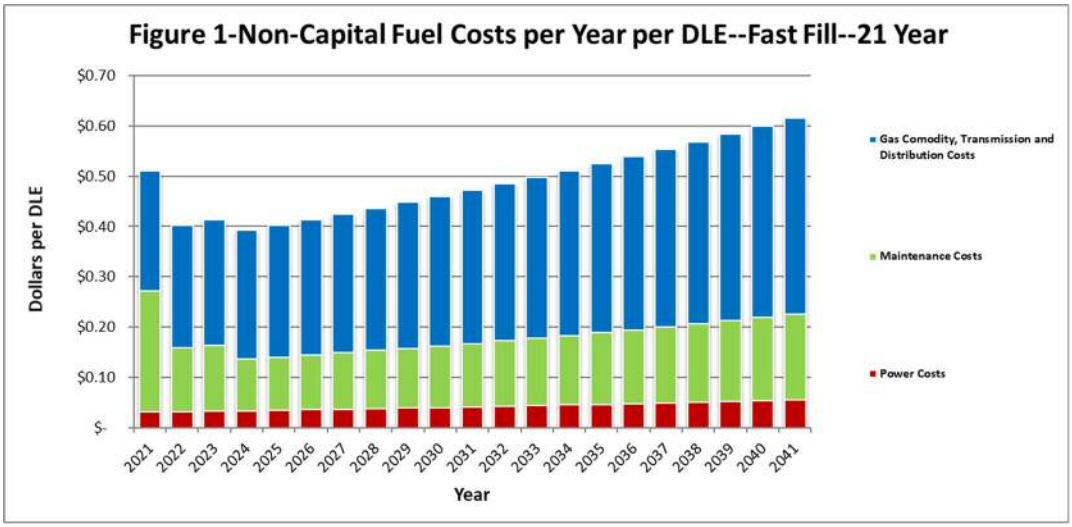
    Marathon has considered the trailer use approach and has developed a lower cost option. To investigate this approach, Marathon proposes to install the new permanent packer truck CNG fast fueling equipment (CNG storage and two new high flow dispensers as well as controls and ancillary equipment) at Wentworth and bring the trailer to that site for fueling during the 12-month period. The trailer gas will be used to continuously and automatically recharge the permanent gas storage and the new dispensers will provide a fueling experience for staff that duplicates the permanent station operation. After the 12-month period, the Wentworth packer truck CNG fueling station will be connected to the new HSR fueling station adjacent to the Wentworth site. The new HSR station will take over for the gas trailer. This approach eliminates the sunk cost issue with temporary fueling at Burlington Street.

    Marathon has identified a supplier in Ontario that can furnish a trailer with sufficient gas storage for several days (up to one week) of initial-year (2021) fueling volumes. The trailer includes its own 75 Hp electric drive compressor which could be powered at Wentworth using the electrical service for the existing CNG station and the trailer can be fueled at HSR Mount Hope. Marathon received pricing on this trailer option based on a per mile transportation charge and separately on a trailer rental for one year. Marathon is not currently confident in the pricing provided by this vendor so for the purposes of this study, it has been assumed that the trucks will deadhead to Mount Hope for the 12 month period—this is the conservative (ie highest cost) assumption and the one that the City has the most control over.

    If the City proceeds with Scenario 3, the use of the trailer option should be revisited.

20. In scenarios 4 and 5, fueling the fleet at Burlington Street provides operational savings (Scenario 5) and simplicity (Scenarios 4 and 5). An attempt to partially capture this benefit was made by including the truck per km operating cost savings (at $1.88 inflation adjusted per km). The $1.88

was adjusted downward to reflect the lower cost of CNG compared to diesel—the recalculated CNG cost per km for 2020 is $1.34. See Figure 1 below that illustrates the low non-capital cost of CNG—note for comparison that diesel in 2020 is projected to be $1.06 for City trucks.



Driver labour savings has not been included due to the challenge in realizing this cost savings (ie, routes would need to be reworked and extended to make use of the time savings). The cost included for deadheading from Burlington to Wentworth assumes half the fleet must make the 9.1 km round trip daily. (the other half of the fleet are assumed to incorporate a fueling stop into their collection route).

21. A sensitivity analysis was performed to illustrate the effect of fleet growth over time. To quantify this impact, an additional analysis was made with an increase of one truck for each Classification 78, 157 and 170A (3 trucks in total) at the time of the second procurement of each. This adds to the truck capital cost but also increases the diesel consumption displaced with CNG. This is a relatively modest fleet growth of less than 10 percent over the 21-year period. A second analysis with 2 of each of the full-sized trucks (6 trucks in total) is also provided—the additional trucks are added at the third procurement—we believe that this second sensitivity analysis will most accurately project the actual conditions. It should be noted that the fueling station costed in this report will easily accommodate this fleet growth and much more.

Approach/Methodology:

A 21-year life cycle cost analysis was built by Marathon Technical Services using inputs from a variety of sources (as previously outlined). 21 years was selected as it represents three truck life cycles for the initial group of 16 classification 78 packer trucks—other packer truck types also include 3 truck procurement cycles although truck classification types 157/157A and 170A will have two years and four years of truck life (respectively) left at the end of the 21-year period. It is assumed that if the City intends to continue with CNG after the 21-year period, that a capital update/upgrade to the CNG station will be made and the trucks will continue to serve out their full 7-year life. If the City decides to transition away from CNG at the end of the 21 years, the CNG station (which at that time will be fully depreciated) will continue to be used until the last packer trucks reach the end of their life and then the station will be retired.

The focus of this analysis was to identify and quantify those items that are differential costs for CNG compared to clean diesel—it should be stressed that there may be additional costs that are not identified in the analysis because they apply to both CNG and Diesel. These additional costs might include the base cost of a diesel truck (only the differential is used herein), end of life truck salvage value, packer truck maintenance costs (as previously noted), truck licensing costs, and truck driver costs as examples.

A total of 5 CNG station scenarios were conceived. Each scenario was then evaluated in the customized spreadsheet to determine the NPV over the 21 years, the payback year and a cashflow for each scenario (cash flow tables not included in this report for brevity but available separately if desired).

A scenario that was considered but not further evaluated was the construction of a time fill facility at the Wentworth station. This scenario was of interest only because it was a time fill option that could leverage the Wentworth infrastructure. A preliminary evaluation raised serious concerns about the lack of space required for this time fill area (considerable onsite parking would be lost) and more importantly about the logistical challenges and on-going costs associated with having the packer fleet domiciled remote from the Burlington Street operations.

See Appendix B for concept level station layouts drawings for Scenarios 1, 2 and 3 (Wentworth--Drawing G-01) and Scenarios 4 and 5 (Burlington--Drawing G-02). More detail related to the equipment associated with each scenario is listed and costed in Appendix D.

A brief description of the scenarios that were evaluated follows:

Scenario 1--Rebuild Wentworth Fast Fill

The existing fast fill CNG station at Wentworth is well beyond its normal life. This station equipment could be swapped out with new equipment using the existing electrical and gas supply, pipe racks, control building, dryer and building and potentially the existing pads. A generator has been added for redundancy. Under this scenario, all CNG packer trucks would fast fill at Wentworth. The equipment required is listed below:

- Existing CNG Dryer
- Two new 250 Hp (w/ VFD) 636 scfm compressors
- 70 MCF storage
- New Fast Fill Priority/ESD Panel
- Two Combo Dispensers
- Fuel Management Terminal
- No Time Fill System
- Recapture Defueling System
- New Compressed Air System
- New Electrical Control panels in Existing Building
- New Diesel Generator

Scenario 2--Rebuild Wentworth Fast Fill and Tie-in to Future Adjacent HSR

The existing fast fill CNG station at Wentworth is well beyond its normal life. This station equipment could be swapped out with new equipment using the existing electrical and gas supply, pipe racks, control building, dryer and building and potentially the existing pads. No generator has been added and smaller storage was included due to the capacity and redundancy provided by a piped connection to the new (adjacent) HSR station. Under this scenario, all CNG packer trucks would fast fill at Wentworth. The equipment required is listed below:

- Existing CNG Dryer
- Two new 250 Hp (w/ VFD) 636 scfm compressors
- 35 MCF storage
- New Fast Fill Priority/ESD Panel
- Two Combo Dispensers
- Fuel Management Terminal
- No Time Fill System
- Recapture Defueling System
- New Compressed Air System
- New Electrical Control panels in Existing Building
- No Diesel Generator

Scenario 3--Accelerate HSR Initial Station

The new HSR fueling station construction would be accelerated, at least for the portion of the equipment required to fuel packer trucks. The accelerated HSR station would be constructed to be available one year after the initial packer truck arrivals-- this scenario assumes that one year of deadheading of the first 16 trucks to HSR Mount Hope will be required (the mileage and labour cost of this deadheading is included in the analysis). Note that costs associated with the new equipment installed on the HSR site have been removed from this analysis (ie HSR is paying for the dryer, compressors and generator) and only packer truck incremental costs are shown for fast fill of packer trucks on Wentworth site. A pipe feeding storage on the current Wentworth site would be installed and fastfiill dispensers on the Wentworth site would be used to fuel trucks—packer trucks would not be fueled on the HSR site. The equipment required is listed below:

- HSR CNG Dryer
- HSR-Two new 250 Hp (w/ VFD) 636 scfm compressors (minimum)
- 70 MCF storage
- New Fast Fill Priority/ESD Panel
- Two Combo Dispensers
- Fuel Management Terminal
- No Time Fill System
- HSR--Recapture Defueling System
- HSR--New Compressed Air System
- New Electrical Control panels in Existing Building
- HSR--Diesel Generator

Scenario 4--New Burlington Street Fast Fill and Time Fill

Construct a new standalone fueling station at the Burlington Street site complete with a diesel generator for redundancy. The station would primarily fuel using a time fill fueling manifold, however, a small storage and a single fast fill dispenser would be installed to allow fast fill as well—in the event a truck returns from service and must fuel quickly to allow it to go into service. The equipment required is listed below:

- Relocate Existing CNG Dryer
- Two new 250 Hp (w/ VFD) 636 scfm compressors
- 35 MCF storage
- New Fast Fill Priority/ESD Panel
- One Combo Dispenser
- Fuel Management Terminal
- 37 Time Fill Posts with Barricade
- Recapture Defueling System
- New Compressed Air System
- New Electrical Control panels in Existing Building

- New Diesel Generator

Scenario 5--New Burlington Street with Time Fill Only

Construct a new standalone fueling station at the Burlington Street site complete with a diesel generator for redundancy. The station would only fuel using a time fill fueling manifold. It would be possible to allow space for a future small storage and a single fast fill dispenser to allow the future installation of fast fill as well. The equipment required is listed below:

- Relocate Existing CNG Dryer
- Two new 250 Hp (w/ VFD) 636 scfm compressors
- 37 Time Fill Posts with Barricade
- Recapture Defueling System
- New Compressed Air System
- New Electrical Control panels in Existing Building
- New Diesel Generator

Findings-Quantitative

The primary means of quantitative evaluation of the project is the Net Present Value (NPV) of the Costs and Savings compared to Clean Diesel trucks and operation (savings are calculated as the cost of diesel that is displaced).

A payback analysis was also performed (note that the time value of money and discount rate is not used in a payback analysis). See Glossary in Appendix A for additional definition of payback analysis. Although payback analysis does not include any discounting to current dollars (as used in NPV), it uses cash flow over the life of the project in dollar costs as incurred in each of the 21 years—these costs are escalated using the inflation rates indicated in Appendix C so they represent the cash outlay in a given year. Capital costs such as the CNG station and the upcharge on the packer trucks as well as operating costs such as the electricity and maintenance to operate the CNG station are offset against the cost that would have been spent purchasing diesel fuel. Thus, the payback year is the year when the savings on CNG offsets the cost of CNG capital and operating costs. The summary table on the next page provides a breakdown of the cost categories in 2019 dollars (ie the NPV). Negative numbers are costs and positive numbers are savings versus diesel or current practice.

Net Present Value of All Costs-21 Year--Baseline Scenario with 37 Trucks

	Scenario	1	2	3	4	5
		Rebuild Wentworth Fast Fill	Rebuild Wentworth Fast Fill and Tie-in to Future Adjacent HSR	Accelerate HSR Initial Station Configuration to be Available One Year After Initial Packer Truck Arrivals--Note that HSR Station Dryer, Compressor and Generator Costs have been Removed and Only Packer Truck Fast Fill Storage, Dispensing and Controls System Costs are Shown for Wentworth Site	New Burlington Street Fast Fill and Time Fill	New Burlington Street Time Fill Only
	Description	NPV				
1	Diesel Fuel and DEF	$ 11,154,085	$ 11,154,085	$ 11,154,085	$ 11,154,085	$ 11,154,085
2	CNG Fast Fill Only Station	$ (4,131,583)	$ (3,224,902)	$ (1,246,687)		
3	CNG Time Fill Station					$ (4,050,875)
4	CNG Fast Fill and Time Fill Station				$ (4,832,201)	
5	Gas Utility Commodity and Transportation Costs	$ (2,520,301)	$ (2,520,301)	$ (2,520,301)	$ (2,520,301)	$ (2,520,301)
6	Gas Compression Electrical Costs--note that fast fueling at Wentworth will take place from 2pm to 5pm which is high-peak in the summer and mid-peak in the winter. Rates change frequently but mid-peak is approximately 50% higher than off-peak and high-peak is approximately 100% higher than off-peak. Baseline data for HSR is primarily off-peak usage. To be conservative, the high-peak rates are assumed so HSR power costs are doubled.	$ (340,128)	$ (340,128)	$ (340,128)	$ (340,128)	$ (340,128)
7	Compression System O&M--Note that Scenario 3 is not discounted to reflect the use of HSR equipment as it is assumed that the Packer Fleet will reimburse HSR for fuel at a rate that will compensate HSR for these costs.	$ (1,110,363)	$ (1,110,363)	$ (1,110,363)	$ (1,110,363)	$ (1,110,363)
8	Incremental Cost of Vehicles	$ (4,255,284)	$ (4,255,284)	$ (4,255,284)	$ (4,255,284)	$ (4,255,284)
9	Deadheading--Burlington to Wentworth--Truck O&M Savings, not including Labour				$ 1,224,615	$ 1,224,615
10	Fast Fill Deadheading--Wentworth St. to Mount Hope (Year 1) round trip--Labour			$ (297,201)		
11	Fast Fill Deadheading--Wentworth St. to Mount Hope (Year 1) round trip--Mileage			$ (135,375)		
12	**Total NPV for Life Cycle (see Glossary in Appendix A for explanation of NPV)**	**$ (1,203,575)**	**$ (296,894)**	**$ 1,248,744**	**$ (679,578)**	**$ 101,748**
	Description	Payback Year				
13	**Payback Achieved in Year: (see Glossary in Appendix A for explanation of Payback)**	**16**	**16**	**10**	**16**	**13**

Quantitative Findings-Summary Points:

It should be understood that the best alternative(s) will provide a blend of qualitative and quantitative benefits. The table on the preceding page is only quantitative.

1. See Appendix D for station capital cost estimates and Appendix F for fuel consumption and GHG emission calculations.

2. Scenarios 3 and 5 are currently returning a positive NPV and all Scenarios are achieving payback between 10 and 16 years of the 21-year period.

3. The table on the previous page shows the Net Present Value (NPV) to be highest for scenario 3—Wentworth fast fill scenario using HSR compression and other infrastructure (NPV=$1.25M). This high NPV is due to significant leveraging of the investment in the new HSR facility, thus this scenario is very dependent on the HSR facility being constructed in a schedule not exceeding one year after the initial 16 packer trucks are put into service—the deadheading cost from Wentworth to Mount Hope for fueling accounts for about $433K per year and this assumes that fueling is done on regular time (not overtime).

4. Scenario 5 also has a positive NPV ($102K) and provides a number of operational advantages, however it should be noted that scenario 4 and 5 are both very dependent on the assumed truck mileage savings of a 50 percent reduction in trips to Wentworth street for fueling.

5. The lowest NPV scenario was number 1—the rebuild of the Wentworth fast fill. This scenario showed an NPV of -$1.20M.

6. It should be noted that all of the scenarios result in Classification 157, 157A and 170A trucks that are early or mid-way through their life cycle at the end of the 21 years. If the City decided to transition away from CNG in 21 years, the CNG station could continue to operate for another 5 years to recoup the cost of the trucks. This would add to the economic value of all scenarios.

7. Fleet expansion is likely in the future to meet a growing City; however, no fleet growth is included in these baseline calculations (a conservative assumption) (see the sensitivity analysis findings for additional information). Marathon calculated a compression capacity requirement of 522 scfm for fast fill and 196 scfm for time fill of the 37 trucks. The best “fit” compressor provides 636 scfm of compression (two compressors are included for redundancy for a total of 1272 scfm if both are operable) and thus the conservatively sized station used in this analysis can comfortably handle an expanded Hamilton packer truck fleet.

Findings-Qualitative and Quantitative Benefits of Time fill at the Burlington Street Location:

Scenarios 4 and 5 are both based on the use of a predominantly or completely time fill approach to fueling at the Burlington Street location. Time fill in this location has several benefits:

1. Time fill of trucks takes place over a period of many hours. This additional fill time allows the heat generated during fueling to partially dissipate while fueling progresses and thus results in cooler, denser gas in truck tanks after fueling—this translates into a more complete fill and improved range.

2. Given that packer trucks are typically parked for 12 to 16 hours, time fill is well adapted to packer truck operations. The picture below is of a large refuse time fill designed by Marathon and installed in Tucson Arizona.

3. Time fill can significantly reduce the number of compressor starts and stops which leads to reduced wear and tear on station equipment. Time fill equipment is also simpler than fast fill dispensing equipment and thus is less prone to breakdown.

4. With much more time available for time filling, a (much) smaller compressor can be used. This analysis assumes the same two 636 scfm compressors as the fast fill scenarios to allow for the future use of the station as a relatively high capacity fast fill station and because these larger compressors are more robust and durable than smaller compressors.

5. The elimination of the need to drive trucks to another location for the sole purpose of fueling reduces unnecessary truck operating costs. This analysis has assumed that half of the truck fleet would be required to make an unnecessary trip to Wentworth for fast fueling if fueling did not take place at Burlington street. Based on this assumption, (not including labour costs) the added cost over the **life cycle has an NPV of $1,224,615**. This has been included in the analysis and plays a pivotal role in the overall NPV.

6. It is anticipated that there will be a reduction of personnel time required related to the use of time fill rather than fast fill fueling (Burlington Street options). Based on an estimated 10 minutes of time reduction per vehicle per night (conservative), this results in an **NPV lifecycle labor reduction equivalent to $2,330,426.** This has not been included in the cost summary since a rework and extension of existing routes would be required to realize this time/labour reduction.

7. Fueling at Burlington Street consolidates the trucks to the location of dispatch, simplifying operations.

Findings-Qualitative and Quantitative Benefit Summary by Scenario

Pros and Cons of each Scenario:

Scenario 1--Rebuild Wentworth Fast Fill

Pros:

1. It uses the existing developed location and services, making it the fastest to deploy (same for scenario 2).

2. This scenario is schedule independent of the HSR project.

Cons:

3. Requires trucks to fuel at Wentworth—lacks the operational simplicity and convenience of consolidating fueling to truck domicile location at Burlington Street.

4. One of the highest capital cost scenarios ($4.1M).

Scenario 2--Rebuild Wentworth Fast Fill and Tie-in to Future Adjacent HSR

Pros:

1. It uses the existing developed location and services, making it the fastest to deploy (same for scenario 1).

2. Second lowest capital cost ($3.2M).

Cons:

3. Requires trucks to fuel at Wentworth—lacks the operational simplicity and convenience of consolidating fueling to truck domicile location at Burlington Street.

4. This scenario is somewhat schedule dependent of the HSR project—for station redundancy.

Scenario 3--Accelerate HSR Initial Station

Pros:

1. Highest NPV ($1.25M). Fastest payback (10 Years).

2. Lowest capital cost ($1.25M)—less than half of the next lowest cost alternative.

3. Leverages the HSR station making more use of those assets. Packer truck and HSR bus schedules have little to no overlap.

Cons:

4. Requires trucks to fuel at Wentworth—lacks the operational simplicity and convenience of consolidating fueling to truck domicile location at Burlington Street.

5. This scenario is very schedule dependent of the HSR project—for gas drying, compression and redundancy.

6. This scenario requires one year of deadheading of packer trucks to Mount Hope for fuel at an included cost of about $433K. If the HSR station were delayed, this annual cost would continue to accrue. Any non-revenue time on the street increases vehicle wear and tear and introduces additional operating risk. The alternative of trailering gas to the Wentworth site also creates risk due to equipment failure without redundancy, third party equipment operating on City property and the risk of trucking the gas through the City.

7. Although this scenario is appealing from a cost perspective, the heavy reliance on the HSR project, coupled with the need for ongoing fueling of the fleet at Wentworth reduces the desirability of this option significantly.

Scenario 4--New Burlington Street Fast Fill and Time Fill

Pros:

1. This scenario is schedule independent of the HSR project.

2. Convenience and operational simplicity of consolidating fueling to the Burlington Street truck domicile location.

3. Benefits of time fill, with the option to perform some fast fill when necessary.

Cons:

4. Second lowest NPV (-$680K).

5. Highest capital cost ($4.8M) of all scenarios as the new site will require development.

Scenario 5--New Burlington Street with Time Fill only

Pros:

1. Second highest NPV ($102K) and second fastest payback (13 Years).

2. This scenario is schedule independent of the HSR project.

3. Convenience and operational simplicity of consolidating fueling to the Burlington Street truck domicile location.

4. Benefits of time fill.

Cons:

5. Third highest capital cost ($4.1M) of all scenarios as the new site will require development.

6. No fast fill facility is provided, although, space could be left for a future fast fill storage and island if desired. It should also be noted that with the planned compressors, one compressor will time fill one truck directly in 10 to 15 minutes, thus the need for fast fill is very low.

Findings-Sensitivity Analysis to Test the Impact of Fleet Growth:

Sensitivity Analysis 1--One Additional Heavy Truck of Classification 78, 157 and 170A added at Second Procurement Cycle (total 40 trucks):

Net Present Value of All Costs-21 Year Sensitivity Analysis with 37 Trucks in First Truck Procurement and 40 Trucks after Second Truck Procurement						
	Scenario	1 Rebuild Wentworth Fast Fill	2 Rebuild Wentworth Fast Fill and Tie-in to Future Adjacent HSR	3 Accelerate HSR Initial Station Configuration to be Available One Year After Initial Packer Truck Arrivals--Note that HSR Station Dryer, Compressor and Generator Costs have been Removed and Only Packer Truck Fast Fill Storage, Dispensing and Controls System Costs are Shown for Wentworth Site	4 New Burlington Street Fast Fill and Time Fill	5 New Burlington Street Time Fill Only
	Description	NPV				
1	Diesel Fuel and DEF	$ 11,734,773	$ 11,734,773	$ 11,734,773	$ 11,734,773	$ 11,734,773
2	CNG Fast Fill Only Station	$ (4,131,583)	$ (3,224,902)	$ (1,246,687)		
3	CNG Time Fill Station					$ (4,086,936)
4	CNG Fast Fill and Time Fill Station				$ (4,868,262)	
5	Gas Utility Commodity and Transportation Costs	$ (2,645,908)	$ (2,645,908)	$ (2,645,908)	$ (2,645,908)	$ (2,645,908)
6	Gas Compression Electrical Costs--note that fast fueling at Wentworth will take place from 2pm to 5pm which is high-peak in the summer and mid-peak in the winter. Rates change frequently but mid-peak is approximately 50% higher than off-peak and high-peak is approximately 100% higher than off-peak. Baseline data for HSR is primarily off-peak usage. To be conservative, the high-peak rates are assumed so HSR power costs are doubled.	$ (357,415)	$ (357,415)	$ (357,415)	$ (357,415)	$ (357,415)
7	Compression System O&M--Note that Scenario 3 is not discounted to reflect the use of HSR equipment as it is assumed that the Packer Fleet will reimburse HSR for fuel at a rate that will compensate HSR for these costs.	$ (1,110,363)	$ (1,110,363)	$ (1,110,363)	$ (1,110,363)	$ (1,110,363)
8	Incremental Cost of Vehicles	$ (4,467,884)	$ (4,467,884)	$ (4,467,884)	$ (4,467,884)	$ (4,467,884)
9	Deadheading--Burlington to Wentworth--Truck O&M Savings, not including Labour				$ 1,287,671	$ 1,287,671
10	Fast Fill Deadheading--Wentworth St. to Mount Hope (Year 1) round trip--Labour			$ (297,201)		
11	Fast Fill Deadheading--Wentworth St. to Mount Hope (Year 1) round trip--Mileage			$ (135,375)		
12	**Total NPV for Life Cycle (see Glossary in Appendix A for explanation of NPV)**	**$ (978,380)**	**$ (71,698)**	**$ 1,473,940**	**$ (427,387)**	**$ 353,939**
	Description	Payback Year				
13	**Payback Achieved in Year: (see Glossary in Appendix A for explanation of Payback)**	**16**	**16**	**11**	**16**	**13**

It is clear from the above sensitivity analysis 1 that the NPVs are all improving although the payback is not improving due to the additional truck purchases in later years. The ranking of scenarios does not change since the capital station costs do not change (other than additional time fill posts in Scenarios 4 and 5). Operating costs are variable and increase according to fuel usage.

Note that if additional trucks were introduced even sooner, the benefits would be more pronounced.

Sensitivity Analysis 2--One Additional Heavy Truck of Classification 78, 157 and 170A added at Second (total 40 trucks) and One More at Third Procurement Cycle (total 43 trucks):

Net Present Value of All Costs-21 Year Sensitivity Analysis with 37 Trucks in First Truck Procurement, 40 Trucks after Second Truck Procurement and 43 Trucks after Third Truck Procurement						
	Scenario	1 Rebuild Wentworth Fast Fill	2 Rebuild Wentworth Fast Fill and Tie-in to Future Adjacent HSR	3 Accelerate HSR Initial Station Configuration to be Available One Year After Initial Packer Truck Arrivals--Note that HSR Station Dryer, Compressor and Generator Costs have been Removed and Only Packer Truck Fast Fill Storage, Dispensing and Controls System Costs are Shown for Wentworth Site	4 New Burlington Street Fast Fill and Time Fill	5 New Burlington Street Time Fill Only
	Description	NPV				
1	Diesel Fuel and DEF	$ 11,977,661	$ 11,977,661	$ 11,977,661	$ 11,977,661	$ 11,977,661
2	CNG Fast Fill Only Station	$ (4,131,583)	$ (3,224,902)	$ (1,246,687)		
3	CNG Time Fill Station					$ (4,122,997)
4	CNG Fast Fill and Time Fill Station				$ (4,904,323)	
5	Gas Utility Commodity and Transportation Costs	$ (2,697,517)	$ (2,697,517)	$ (2,697,517)	$ (2,697,517)	$ (2,697,517)
6	Gas Compression Electrical Costs--note that fast fueling at Wentworth will take place from 2pm to 5pm which is high-peak in the summer and mid-peak in the winter. Rates change frequently but mid-peak is approximately 50% higher than off-peak and high-peak is approximately 100% higher than off-peak. Baseline data for HSR is primarily off-peak usage. To be conservative, the high-peak rates are assumed so HSR power costs are doubled.	$ (364,645)	$ (364,645)	$ (364,645)	$ (364,645)	$ (364,645)
7	Compression System O&M--Note that Scenario 3 is not discounted to reflect the use of HSR equipment as it is assumed that the Packer Fleet will reimburse HSR for fuel at a rate that will compensate HSR for these costs.	$ (1,110,363)	$ (1,110,363)	$ (1,110,363)	$ (1,110,363)	$ (1,110,363)
8	Incremental Cost of Vehicles	$ (4,565,239)	$ (4,565,239)	$ (4,565,239)	$ (4,565,239)	$ (4,565,239)
9	Deadheading--Burlington to Wentworth--Truck O&M Savings, not including Labour				$ 1,315,881	$ 1,315,881
10	Fast Fill Deadheading--Wentworth St. to Mount Hope (Year 1) round trip--Labour			$ (297,201)		
11	Fast Fill Deadheading--Wentworth St. to Mount Hope (Year 1) round trip--Mileage			$ (135,375)		
12	Total NPV for Life Cycle (see Glossary in Appendix A for explanation of NPV)	$ (891,687)	$ 14,995	$ 1,560,633	$ (348,546)	$ 432,780
	Description	Payback Year				
13	Payback Achieved in Year: (see Glossary in Appendix A for explanation of Payback)	16	16	11	16	13

Sensitivity analysis 2 shows additional NPV improvement, even though the costs of the additional CNG trucks in procurement 3 for truck classifications 157 and 170 are not fully utilized by the end of the 21-year period.

Note that if additional trucks were introduced even sooner, the benefits would be more pronounced. Given the expected growth of the City, Marathon believes that Sensitivity Analysis 2 is the most likely reflection of actual project economics.

Findings-Environmental:

The growing concern over climate change and the recent advancements in controlling toxic tailpipe emissions has caused a shift in focus toward greenhouse gases and most notably toward CO_2 reduction. Unlike other pollutants that can be reduced by exhaust treatment, CO_2 is simply a product of combustion—thus, if a hydrocarbon (HC) fuel is consumed, CO_2 is produced. In fact, there are basically three ways to reduce CO_2 emissions of a vehicle:

1. Reduce fuel consumption through greater engine or drive train efficiency (reduce weight, use a hybrid drive system, etc.).

2. Use a low carbon fuel such as CNG or Renewable Natural Gas (RNG).

3. Use an energy source that has no tailpipe emissions (Battery Electric or hydrogen) however, these technologies are not yet field proven or durable to the extent that diesel and CNG are, and these energy sources can emit as much GHG as CNG depending on how the hydrogen or electricity is produced.

The first point above is relatively straightforward, since CO_2 production is linked to fuel consumption, any improvement in fuel consumption will provide a similar reduction in CO_2 emissions.

The second point is not as obvious. The products of complete combustion of any hydrocarbon fuel are CO_2 and H_2O, thus if one uses a fuel that is inherently lower in carbon content per unit of energy output, there will be lower CO_2 emissions. This study has included an analysis of the annual and lifecycle GHG reduction associated with the transition from diesel to CNG trucks and a further analysis to illustrate the reduction if RNG were used instead of CNG. Southern California Gas Company has claimed that more than half of the natural gas dispensed to vehicles in California is RNG (https://www.socalgas.com/smart-energy/renewable-gas/what-is-renewable-natural-gas).

The GHG analysis indicated above is provided in Appendix F. Based on this data, the replacement of the diesel fleet with a CNG fleet will provide a reduction of 5,537 tonnes CO_2e over the lifecycle of the project, an amount equal to about 57 passenger vehicles (using US EPA equivalents) and about a 17.3 percent reduction from the diesel trucks.

Note that RNG is functionally identical to CNG—there is no difference in the CNG station or vehicle and in most cases, the molecules consumed in the vehicle are not the RNG molecules produced at the source—an accounting exercise is used to track the RNG through the pipeline system—analogous to deposits and withdrawals from a bank.

An RNG scenario was not analyzed since the costs are identical, (with the possible exception of the fuel cost) to the costs in the 5 scenarios that were investigated. Thus, the decision on whether to transition to CNG and which fueling plan and location to adopt is independent of the decision to utilize RNG.

RNG can be used to displace any portion of gas consumed. Many of the large fleets in California use 100 percent RNG. The use of 100 percent RNG results in near zero GHG emissions as no new carbon is introduced and methane that would have naturally been released to the environment is captured and used. The GHG reduction for RNG is calculated to be 31,965 tonnes CO_2e over the lifecycle of the project— an amount equal to about 331 passenger vehicles (using US EPA equivalents) and representing an almost complete elimination of GHGs. Therefore, RNG can provide a scenario that emits essentially no CO_2 making it comparable to, or lower in GHGs than electric trucks powered from Ontario's grid.

It is understood that the City has a limited supply of RNG and there will be internal competition for its use. Vehicle applications provide a very publicly visible way of promoting the use of this green fuel—one that has been widely used by the company Waste Management in promoting their fleet. The use of RNG allows the City to use mature and proven CNG truck technology whereas, BET truck technology is still very developmental and there are very limited packer truck types currently available and vehicle range is considerably less than with CNG.

Findings-CNG Truck Range:

The City's maximum route at this time is 180 km. Current major CNG packer truck suppliers advertise trucks with total capacity of 60 to 105 Diesel Gallon Equivalent (DGE) or 228 to 399 Diesel Litre Equivalent (DLE). The difference in tank volume is related to different positioning of tanks on the trucks (see following page). Tank location options on the truck is limited by truck type—for example, a rear loader will not have a tailgate tank option. Using the City's current average fuel economy and factoring in for the portion of the tank capacity that is not useable due to incomplete filling and due to residual pressure when the tank is functionally empty, these trucks have a range of 180 to 300 km. Thus, it will be important for the City to be vigilant in optimizing the range on these trucks since a truck with a 225 to 250 km range would be needed for a 180 km route. It should also be noted that time fill improves the vehicle range by an estimated 10 percent due to the lower tank temperatures during time filling, compared to fast filling.

Back of Cab/Front Body (Rear Loader shown) CNG Tanks-Picture Credit Agility Fuel Solutions

Roof Mounted CNG Tanks (Side Loader shown)-Picture Credit Agility Fuel Solutions

Tailgate CNG Tanks (Front Loader shown)-Picture Credit Agility Fuel Solutions

Findings-Operating Engineers:

Marathon spoke with the Technical Standards and Safety Authority (TSSA) (Brian Gee) by email and by phone. The major takeaways from the correspondence were:

1. The 150 Hp threshold above which an operating engineer or compressor operator is required, is still in place, however, TSSA is having internal discussions related to relaxing or removing this requirement. Mr. Gee indicated that he believed this will happen, but not before next June at the earliest and likely later—perhaps much later.

2. TSSA will allow up 150 Hp for the compressor itself and does not include ancillary loads such as fans.

3. TSSA will allow more than one 150 Hp compressor to be installed provided there is an interlock to limit operation to one compressor to avoid exceeding the 150 Hp threshold.

4. TSSA will allow larger compressors (perhaps 200 to 250 Hp) if they are horsepower limited to 150 Hp. This could be accomplished using a VFD to avoid exceeding the 150 Hp threshold. TSSA would also require a device such as current monitoring to verify that the 150 Hp limit is not exceeded. This approach gives the City the opportunity to increase flow in the future if you either; add an operating engineer, or if the requirement is removed in the future.

Conclusions and Recommendations:

1. It is recommended that the City of Hamilton proceed with the CNG project.

2. All of the identified scenarios are technically feasible. Marathon has considered the balance between qualitive and quantitative factors and based on a balanced approach between these two general criteria, Marathon has rank ordered the scenarios by overall desirability are as following:
    1) Scenario 5--New Burlington Street with Time Fill only
    2) Scenario 3--Accelerate HSR Initial Station and provide packer truck fueling on the 330 Wentworth site using gas compressed at the new HSR site.
    3) Scenario 2--Rebuild Wentworth Fast Fill and Tie-in to Future Adjacent HSR
    4) Scenario 1--Rebuild Wentworth Fast Fill

    Scenario 4 was eliminated since it would primarily provide the same benefits as Scenario 5 but at higher cost. Scenario 5 can provide a “fast” (10 to 15 minutes) time fill of a single vehicle making it almost as fast as the fast fill portion of Scenario 4. It is also a possibility that fast fill capability for packer trucks could be included with the new HSR station at lower cost than Scenario 4.

    Scenario 3 is lower initial cost and thus, higher NPV, however, the NPV is spread across 21 years. This equates to an actual average benefit of $55K per year in current dollars. This is a relatively low price for the operational convenience and efficiency of having the fueling operation at Burlington Street.

    Given the long term nature of this project, Marathon recommends constructing the fueling facility at Burlington Street as this decouples the project from the current HSR project, gives a convenient fueling location that will save labour and truck mileage and still has a high NPV and the second best payback.

3. The sensitivity analysis demonstrates that more trucks will add to the financial viability of the transition to CNG. This is not a surprising conclusion since CNG is an inexpensive fuel but with high infrastructure costs. More throughput does not (in this case) add to the capital cost significantly but it does increase the amount of diesel that is displaced which in turn improves the NPV of all of the Scenarios. It should also be noted that adding trucks earlier improves the NPV more than later fleet growth.

4. Enbridge has indicated that both locations have ample gas supply and are they are currently proposing an 80 psig delivery pressure—note that the Wentworth site has historically had a 200 psig delivery pressure. Marathon

recommends negotiating for higher inlet pressure as this will reduce the electricity and maintenance costs on the compressors (although they are still likely to be 4 stage compressors unless much higher pressure is available). Unregulated utility pressure is often the best overall approach from an Owner and Utility perspective.

5. It is estimated that this project will create a savings of 5,537 tonnes CO_2e over the lifecycle of the project --projecting a “green” image for the City. If there is fleet growth beyond 37 trucks, the environmental benefit will be increased.

6. Hamilton has its own RNG supply. Transportation is an excellent application for RNG and can make a CNG vehicle even more environmentally responsible than an electric vehicle—avoiding the pollution of battery production. The CNG vehicle has the power and range to match the current diesel routes whereas a fleet size increase is often necessary with electric vehicles.

7. Given the unknowns related to future TSSA regulations, if the City proceeds with time fill, there are two approaches:

    a. Install two 150 Hp/380 scfm compressors with interlocks so they cannot operate simultaneously. This will provide ample flow to serve the time fill station for 37 trucks and beyond.

    b. Install two 250 Hp/ 636 scfm compressors with VFDs and interlocks to prevent the compressors from operating simultaneously and at a power consumption level exceeding 150 Hp.

    Marathon recommends the second alternative (b) above since it provides the ability to significantly upgrade the station flow rate in the future. The analysis in this report was based on the second alternative (b). Note that the first alternative will slightly reduce the capital cost.

Appendix A

Glossary of Terms

ACH	Air Changes per Hour
AHJ	Authority having Jurisdiction (the regulatory body with the authority to mandate design)
BET	Battery Electric Truck
CH_4	Methane—natural gas is about 90 to 95 percent methane.
CNG	Compressed Natural Gas
CO_2e	Carbon Dioxide Equivalent—a means of comparing other GHGs to CO_2 and also to combine the effects of multiple GHGs to a common unit for simplification of quantification.
DGE	Diesel Gallon Equivalent (the amount of CNG required to provide an amount of energy equal to one USG of diesel fuel).
Discount Rate	This is a percentage used to discount a future value back to a present value to be used in the calculation of the Net Present Value (NPV). The discount rate used is often the borrowing rate, however, it could also be the minimum acceptable rate of return also called the “hurdle rate”. This should not be confused with the Internal Rate of Return (IRR) which is the rate at which the project has a net present value of zero—ie the rate at which the project is “breakeven”.
ESD	Emergency Shut Down
F	Fahrenheit
GGE	Gasoline Gallon Equivalent (the amount of CNG required to provide an amount of energy equal to one USG of gasoline=5.66 pounds of CNG).
GHG	Greenhouse Gas—CO_2 (Carbon Dioxide), CH_4(methane) and N_2O (Nitrous Oxide) are the most common greenhouse gases.
HP or Hp	Horsepower
HSR	Hamilton Street Railway
HST	Harmonized Sales Tax—the sales tax in place in Ontario. At the time of this report, the City pays a net tax rate of 1.76 percent.
HVAC	Heating Ventilation and Air Conditioning

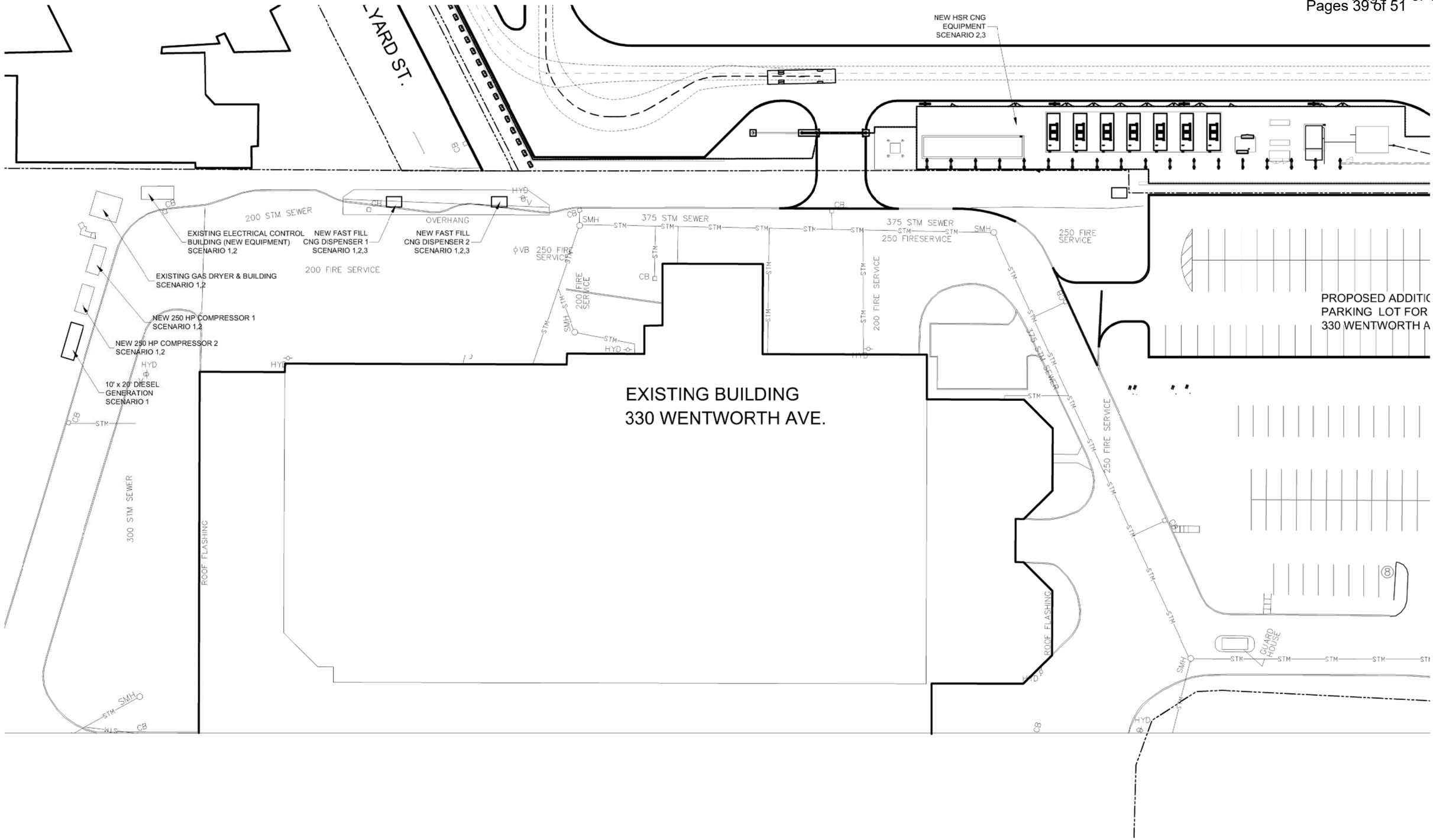
IR	Infrared
LCA	Life Cycle Analysis
LEL	Lower Explosive Limit (this is 5 percent gas in air by volume—thus 20 percent LEL is 1 percent gas in air by volume)
LNG	Liquefied Natural Gas
m^3	Cubic meter of natural gas
NG	Natural Gas
NGV	Natural Gas for Vehicles or Natural Gas Vehicle (depending on context)
NPV	Net Present Value is the value of the project expressed in current dollars. It is calculated by “discounting” the future cost and savings back to current dollars using the “discount rate.”
Payback or Simple Payback	is based on a cash flow analysis and is the time (expressed in years in this report) required for the income (or in this case the savings compared to a diesel fleet) to exceed the capital and operating expenditures. Future costs and savings are increased using inflation factors to their value in future years but there is no cost of money or “discount rate” applied) as this is not a Net Present Value. As with all analysis herein, the analysis is based on differential costs and savings only compared to the diesel baseline.
PSI	Pounds per Square Inch
PSIG	Pounds per Square Inch Gauge (Atmospheric pressure is 0 psig)
RNG	Renewable Natural Gas—natural gas sourced from landfills or digesters.
SCF	Standard Cubic Feet (the volume of gas within one cubic foot at atmospheric pressure and 60 F)
USG	US Gallon
VFD	Variable Frequency Drive—allows AC motors to operate at part speed.

Appendix B

Site Layout Drawings:

G-01 Hamilton Packer Truck CNG Concept Layout-330 Wentworth St., Hamilton ON

G-02 Hamilton Packer Truck CNG Concept Layout-1579 Burlington St., Hamilton ON



MarathonTechnical Services
6 Venus Crescent,
Haleseberg, Ontario,
N0B 2M1

PROJECT ENGR./ARCH:	
DESIGNER:	Robert R. Adams
DRAWN BY:	KH
SCALE:	NTS
DATE:	12/10/2019
CHECKED BY:	
CHECKED/APPROVED BY:	

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

PROJECT: HAMILTON PACKER TRUCK CNG STATION CONCEPT LAYOUT

SHEET TITLE: 330 WENTWORTH ST. HAMILTON, ONT

WORK PROJECT NO.

G-01

OFFICE AREA: 640 m2
NG SPACES: 50
ICAP SPACES: 1
LE RACKS: 1
V ASPHALT PAVING: 24,200 m2
AREA: 1,000 m2

PIT
PIT
PIT 1
PIT 2
PIT 3

Metal Clad
Brick and Concrete Block Building
No. 1579

FILL IN PIT 1
SEE DWG. SC02

FILL IN PIT 2
SEE DWG. SC03

TIME FILL PARKING
MINIMUM 37 STALLS
SCENARIO 4,5

TIME FILL PARKING
MINIMUM 37 STALLS
SCENARIO 4,5

TRUCK BARRIERS

PROP. CB
RIM=(78.67)
INV=(77.78)

27.5m–200mm STORM at 1.2%
CLASS 3 CONCRETE (CSA A257.1–M92)
(FROST PROTECTION REQUIRED)

TRENCH

FILL IN PIT 3
SEE DWG. SC04

PIT=77.38

PROP. CB
RIM=(78.67)
INV=(77.78)

27.5m–200mm STORM at 0.54%
CLASS 3 CONCRETE (CSA A257.1–M92)
(FROST PROTECTION REQUIRED)

PIT=74.644

CLASS 3 CONCRETE (CSA A257.1–M92)
(FROST PROTECTION REQUIRED)
35.0m – 300mm STORM at 0.5%
CLASS 3 CONCRETE (CSA A257.1–M92)

NEW MAN
DOOR

NEW CONCRETE WALL

NEW
TRUCK
DOOR

TRUCK BARRIERS

38.0m–200mm STORM at 0.53%
CLASS 3 CONCRETE (CSA A257.1–M92)
(FROST PROTECTION REQUIRED)

PROP. CB
RIM=(78.73)
INV=(78.02)

NEW WALL

PROP. CB
RIM=(78.71)
INV=(77.96)

250ø BOLLARDS (TYP.)

REMOVE EXISTING WALKWAY

GUARD RAIL
RETAINING WALLS
EX. CB
TOP=77.28
SMH
BOLLARDS
MWELL
RAMP
(SOUTH SIDE OF BLDG NOT LOCATED)
BLDG
CONC PAD
HYD
BROKEN WP
PROTECT EX. EL. SUBSTATION W/ 5–200mm DIA PIPE BOLLARDS @ 2.0M C/C. SEE ALSO TYPICAL BOLLARD DETAIL ON THIS DWG.

5' X 20'
FAST FILL
FUEL ISLAND
SCENARIO 4

DIESEL GENERATOR
SCENARIO 4,5

NEW CNG FUELING
STATION EQUIPMENT

NATURAL GAS DRYER
FROM WENTWORTH
SCENARIO 4,5

DUPLEX 250HP COMPRESSOR
SCENARIO 4,5

EXISTING BUILDING ROOF TO BE DEMOLISHED

STORAGE
SCENARIO 4

W. INV=(77.58)
S. INV=(77.63)
E. INV=(77.63)

PROP. CB
RIM=(78.72)
INV=(77.78)

OVERHEAD DUCTS/CATWALK

GENERAL NOTES

1. ALL WORK INVOLVED IN THE CONSTRU
RELOCATION, REPAIR OF MUNICIPAL SERVICE
PROJECT SHALL BE TO THE SATISFACTION
OF DEVELOPMENT AND REAL ESTATE DIVISIO
AND ECONOMIC DEVELOPMENT DEPARTMENT.
2. FIRE ROUTE SIGNS AND 3–WAY FIRE
BE ESTABLISHED TO THE SATISFACTION OF
DEPARTMENT AND AT THE EXPENSE OF THE
3. MAIN DRIVEWAY DIMENSIONS AT THE P
BOUNDARIES ARE PLUS OR MINUS 7.5 M U
OTHERWISE STATED.
4. ALL DRIVEWAYS FROM PROPERTY LINE
FIRST 7.5 M SHALL BE WITHIN 5% MAXIMU
THEREAFTER, ALL DRIVEWAYS SHALL BE WIT
MAXIMUM GRADES.
5. THE APPROVAL OF THIS PLAN DOES N
OWNER'S BONDED CONTRACTOR FROM THE
TO OBTAIN THE VARIOUS PERMITS/APPROVA
REQUIRED TO COMPLETE A CONSTRUCTION
AS, BUT NOT LIMITED TO THE FOLLOWING:
–BUILDING PERMIT – SEWE
WATER PERMITS
–ROAD CUT PERMITS –
SERVICES
–APPROACH APPROVAL PERMITS
ENCROACHMENT AGREEMENTS (IF REQUIRE
–COMMITTEE OF ADJUSTMENT

2 DRAINAGE CONTRACTOR UTILIZE AS MUCH AS POSSIBLE THE EXISTING PITS TO BE FILLED, AS OPPOSED TO CUTTING THROUGH AND REMOVING EXISTING CONCRETE SLAB.

W. INV=(77.77)
S. INV=(77.82)

AS BUILT

MAIN GAS VALVE TO SHUT OFF ABANDONNED BUILDING SUPPLY

SUPPORT POSTS FOR WALKWAY

OVERHEAD CATWALK

STEPS

CONC PAD

ELEVATED WALKWAY

KEY PLAN

KEY PLAN NOT TO SCALE

=78.68

XST. ELEVATED BAY

NEW GAS METER – ATTACH TO EX. GAS FEED PER GAS COMPANY STANDARDS

200ø BOLLARDS AROUND NEW GAS METER

EAST SECTION

XST. ELEVATED BAY

EXISTING CONCRETE
FIN. FLOOR=78.68

46.33 RAMP

REMOVE EXISTING RWC

REMOVE EXISTING RWC

NEW MAN DOOR

NEW MAN DOOR

RAMP (SEE DWG. SC01)

CONCRETE STEPS

29.01

15.27 RAMP WIDTH

ALKWAY

GM

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Heidelberg, Ontario,
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PROJECT ENGR./ARCH:	
DESIGNER:	Robert R. Adams
DRAWN BY:	KH
SCALE:	NTS
DATE:	12/10/2019
CHECKED BY:	
CHECKED/APPROVED BY:	

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

PROJECT: HAMILTON PACKER TRUCK
CNG STATION
CONCEPT LAYOUT

SHEET TITLE: 1579 BURLINGTON ST.
HAMILTON, ONT.

WORK PROJECT NO.

G-02

Appendix C

General Cost Inputs

City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fueling Study Report

Maximum Finance Term (Years):	
Term for Accounting Depreciation (Years):	21
Discount Rates:	
Standard	5.00%
Inflation Rates:	
General:	2.50%
Natural Gas:	2.50%
Power:	3.00%
Maintenance: (New Equipment)	3.00%
Diesel Fuel	3.00%
Working Days per Year:	260

Trucks:		
Classification 78		
Number of Trucks		16
2019 Replacement Cost	$	242,000
Percentage Premium for CNG		
Dollar Premium for CNG--includes 1.76% HST	$	45,792
Initial Replacement Year		2021
Lifespan (years)		7
Annual litres of Diesel Consumed per truck:		14,509
Classification 157		
Number of Trucks		10
2019 Replacement Cost	$	300,000
Percentage Premium for CNG		
Dollar Premium for CNG--includes 1.76% HST	$	45,792
Initial Replacement Year		2022
Lifespan (years)		7
Annual litres of Diesel Consumed per truck:		21,145
Classification 157A		
Number of Trucks		2
2019 Replacement Cost	$	166,000
Percentage Premium for CNG		
Dollar Premium for CNG--includes 1.76% HST	$	30,528
Initial Replacement Year		2022
Lifespan (years)		7
Annual litres of Diesel Consumed per truck:		6,305
Classification 170A		
Number of Trucks		9
2020 Replacement Cost	$	330,000
Percentage Premium for CNG		
Dollar Premium for CNG--includes 1.76%	$	45,792
Initial Replacement Year		2024
Lifespan (years)		7
Annual litres of Diesel Consumed per truck:		15,598

Gas Charges: All energy charges below are charged on a per M3 basis.		
Using HSR Data		
Total paid for natural gas 2018-2019 (all of Calendar 2018 plus first 8 months of 2019)	$	2,246,896
Total Gas Throughput (m3) 2018-2019 (all of		8,893,093
Natural Gas Commodity, Transmission and Distribution Cost $/m3	$	0.2200

CNG Station Power:		
Prime Mover (HP)		250 x 2
Ancillary Loads-Pumps, Fans, Controls (%)		10%
Flow Provided		636*2
Utility Pressure (PSIG)		80
Total kWh (all of Calendar 2018 plus first 8 months of 2019 multiplied by 19.8% as directed by Hamilton)		1,023,088
Calculated power cost/kWh--based on Hamilton provided estimated station consumption percentage at HSR	$	0.1444
Using HSR Data		
Total paid by HSR for CNG Station Electricity for 2018-2019 (all of Calendar 2018 plus first 8 months of 2019--using 19.8% of cost as directed by Hamilton)	$	147,706
Total Gas Throughput 2018-2019 (all of Calendar 2018 plus first 8 months of 2019) (m3)		8,893,093
Electricity Cost $/m3--current HSR based data for throughput and fraction of power attributable to HSR ($/m3)	$	0.0166
Electricity cost per kWh including all costs--based on HSR 2019 Data ($/kWh)	$	0.1490
Separate electricity calculation using HSR per kWh electricity cost and calculated load at new site ($/m3)	$	0.02804

CNG Station Maintenance:		
Cost Per Therm:		
Cost per m3:		
Minimum Monthly Cost:	$	5,000
Using HSR Data		
Total paid to maintain station 2018-2019 (all of Calendar 2018 plus first 8 months of 2019)	$	583,554
Total Gas Throughput 2018-2019 (all of Calendar 2018 plus first 8 months of 2019)(m3)		8,893,093
Maintenance Cost $/m3	$	0.0656

Appendix D

Station Capital Cost-all Scenarios

Station Cost Estimate--Scenario 1 Rebuild Wentworth Fast Fill				Station Cost Estimate--Scenario 2 Rebuild Wentworth Fast Fill and Tie-in to Future Adjacent HSR				Station Cost Estimate--Scenario 3 Accelerate HSR Initial Station Configuration to be Available One Year After Initial Packer Truck Arrivals--Note that HSR Station Cost have been Removed and Only Packer Truck Incremental Costs are Shown for Fastfill of Packer Trucks on Wentworth Site			
Qty	Equipment Description	Unit Cost	Extended Cost	Qty	Equipment Description	Unit Cost	Extended Cost	Qty	Equipment Description	Unit Cost	Extended Cost
1	CNG Dryer-use existing Wentworth Dryer		$ -	1	CNG Dryer-use existing Wentworth Dryer		$ -	0	CNG Dryer-New HSR Dryer		$ -
2	CNG Compressor(s) with enclosures-250 Hp/636 scfm	$ 400,000	$ 800,000	2	CNG Compressor(s) with enclosures-250 Hp/636 scfm	$ 400,000	$ 800,000	0	New HSR Compressors	$ 400,000	$ -
2	CNG Storage--35MCF	$ 140,000	$ 280,000	1	CNG Storage--35MCF	$ 140,000	$ 140,000	2	CNG Storage--35MCF	$ 140,000	$ 280,000
1	Storage Priority/ESD Panel	$ 75,000	$ 75,000	1	Storage Priority/ESD Panel	$ 75,000	$ 75,000	1	Storage Priority/ESD Panel	$ 75,000	$ 75,000
2	CNG High Flow/Standard Flow "Combo" Dispensers	$ 80,000	$ 160,000	2	CNG High Flow/Standard Flow "Combo" Dispensers	$ 80,000	$ 160,000	2	CNG High Flow/Standard Flow "Combo" Dispensers	$ 80,000	$ 160,000
0	Time Fill Panel	$ 40,000	$ -	0	Time Fill Panel	$ 40,000	$ -	0	Time Fill Panel	$ 40,000	$ -
0	Time Fill Posts	$ 5,000	$ -	0	Time Fill Posts	$ 5,000	$ -	0	Time Fill Posts	$ 5,000	$ -
1	Defueling System (with Recapture)	$ 100,000	$ 100,000	1	Defueling System (with Recapture)	$ 100,000	$ 100,000	0	Defueling System (with Recapture)--use HSR	$ 100,000	$ -
1	Air Compressor and Dryer	$ 30,000	$ 30,000	1	Air Compressor and Dryer	$ 30,000	$ 30,000	0	Air Compressor and Dryer--use Compressed Ai	$ 30,000	$ -
1	Miscellaneous Valves and Equipment	$ 20,000	$ 20,000	1	Miscellaneous Valves and Equipment	$ 20,000	$ 20,000	1	Miscellaneous Valves and Equipment	$ 20,000	$ 20,000
1	MCC/MSP	$ 80,000	$ 80,000	1	MCC/MSP	$ 80,000	$ 80,000	0	MCC/MSP--Located at HSR	$ 80,000	$ -
1	Master PLC Panel (MCP)	$ 60,000	$ 60,000	1	Master PLC Panel (MCP)	$ 60,000	$ 60,000	1	Master PLC Panel (MCP)--Remote Dispenser Panel Only	$ 30,000	$ 30,000
1	SCADA System	$ 40,000	$ 40,000	1	SCADA System	$ 40,000	$ 40,000	0	SCADA System--Use HSR	$ 40,000	$ -
1	Fuel Management System	$ 30,000	$ 30,000	1	Fuel Management System	$ 30,000	$ 30,000	1	Fuel Management System	$ 30,000	$ 30,000
1	600V/600kW Diesel Generator and ATS	$ 300,000	$ 300,000	0	Diesel Generator and ATS--redundancy provided by proximity and Piping Tie in to HSR	$ 300,000	$ -	0	New HSR Generator	$ 300,000	$ -
1	Equipment Freight	$ 30,000	$ 30,000	1	Equipment Freight	$ 30,000	$ 30,000	1	Equipment Freight	$ 10,000	$ 10,000
			$ -				$ -				$ -
	Equipment Subtotal		$ 2,005,000		Equipment Subtotal		$ 1,565,000		Equipment Subtotal		$ 605,000
	Installation Cost Factor	50%	$ 1,002,500		Installation Cost Factor	50%	$ 782,500		Installation Cost Factor	50%	$ 302,500
	Subtotal CNG Station Equipment Infrastructure Installation Cost:		$ 3,007,500		Subtotal CNG Station Equipment Infrastructure Installation Cost:		$ 2,347,500		Subtotal CNG Station Equipment Infrastructure Installation Cost:		$ 907,500
	Contingency	10.00%	$ 300,750		Contingency	10.00%	$ 234,750		Contingency	10.00%	$ 90,750
	Escalation (included in LCA)	0.00%	$ -		Escalation (included in LCA)	0.00%	$ -		Escalation (included in LCA)	0.00%	$ -
	Contractor Markup-Overhead and Profit, Bonds, General Conditions	10.00%	$ 300,750		Contractor Markup-Overhead and Profit, Bonds, General Conditions	10.00%	$ 234,750		Contractor Markup-Overhead and Profit, Bonds, General Conditions	10.00%	$ 90,750
	Design/CM Fee	15.00%	$ 451,125		Design/CM Fee	15.00%	$ 352,125		Design/CM Fee	15.00%	$ 136,125
	Subtotal Before Tax		$ 4,060,125		Subtotal Before Tax		$ 3,169,125		Subtotal Before Tax		$ 1,225,125
	HST	1.76%	$ 71,458		HST	1.76%	$ 55,777		HST	1.76%	$ 21,562
	Total Station Cost Estimate		$ 4,131,583		Total Station Cost Estimate		$ 3,224,902		Total Station Cost Estimate		$ 1,246,687

Station Cost Estimate--Scenario 4
New Burlington Street Fast Fill and Time Fill

Qty	Equipment Description	Unit Cost	Extended Cost
1	CNG Dryer-relocate existing Wentworth Dryer	$ -	$ -
2	CNG Compressor(s) with enclosures-250 Hp/636 scfm	$ 400,000	$ 800,000
1	CNG Storage--35MCF	$ 140,000	$ 140,000
1	Storage Priority/ESD Panel	$ 75,000	$ 75,000
1	CNG High Flow/Standard Flow "Combo" Dispensers	$ 80,000	$ 80,000
1	Time Fill Panel	$ 40,000	$ 40,000
37	Time Fill Posts	$ 5,000	$ 185,000
1	Defueling System (with Recapture)	$ 100,000	$ 100,000
1	Air Compressor and Dryer	$ 30,000	$ 30,000
1	Miscellaneous Valves and Equipment	$ 20,000	$ 20,000
1	MCC/MSP	$ 80,000	$ 80,000
1	Master PLC Panel (MCP)	$ 60,000	$ 60,000
1	SCADA System	$ 40,000	$ 40,000
1	Fuel Management System	$ 30,000	$ 30,000
1	Diesel Generator and ATS	$ 300,000	$ 300,000
1	Equipment Freight	$ 30,000	$ 30,000
			$ -
	Equipment Subtotal		$ 2,010,000
	Installation Cost Factor	75%	$ 1,507,500
	Subtotal CNG Station Equipment Infrastructure Installation Cost:		$ 3,517,500
	Contingency	10.00%	$ 351,750
	Escalation (included in LCA)	0.00%	$ -
	Contractor Markup-Overhead and Profit, Bonds, General Conditions	10.00%	$ 351,750
	Design/CM Fee	15.00%	$ 527,625
	Subtotal Before Tax		$ 4,748,625
	HST	1.76%	$ 83,576
	Total Station Cost Estimate		**$ 4,832,201**

Station Cost Estimate--Scenario 5
New Burlington Street Time Fill Only

Qty	Equipment Description	Unit Cost	Extended Cost
1	CNG Dryer-relocate existing Wentworth Dryer	$ -	$ -
2	CNG Compressor(s) with enclosures-250 Hp/636 scfm	$ 400,000	$ 800,000
0	CNG Storage--35MCF	$ 140,000	$ -
0	Storage Priority/ESD Panel	$ 75,000	$ -
0	CNG High Flow/Standard Flow "Combo" Dispensers	$ 80,000	$ -
1	Time Fill Panel	$ 40,000	$ 40,000
37	Time Fill Posts	$ 5,000	$ 185,000
1	Defueling System (with Recapture)	$ 100,000	$ 100,000
1	Air Compressor and Dryer	$ 30,000	$ 30,000
1	Miscellaneous Valves and Equipment	$ 20,000	$ 20,000
1	MCC/MSP	$ 80,000	$ 80,000
1	Master PLC Panel (MCP)	$ 60,000	$ 60,000
1	SCADA System	$ 40,000	$ 40,000
0	Fuel Management System	$ 30,000	$ -
1	Diesel Generator and ATS	$ 300,000	$ 300,000
1	Equipment Freight	$ 30,000	$ 30,000
			$ -
	Equipment Subtotal		$ 1,685,000
	Installation Cost Factor	75%	$ 1,263,750
	Subtotal CNG Station Equipment Infrastructure Installation Cost:		$ 2,948,750
	Contingency	10.00%	$ 294,875
	Escalation (included in LCA)	0.00%	$ -
	Contractor Markup-Overhead and Profit, Bonds, General Conditions	10.00%	$ 294,875
	Design/CM Fee	15.00%	$ 442,313
	Subtotal Before Tax		$ 3,980,813
	HST	1.76%	$ 70,062
	Total Station Cost Estimate		**$ 4,050,875**

Appendix E

Truck Replacement Schedule and Differential Cost

Calculation of Vehicle Differential Cost

	Vehicle Purchase and Retirement Schedule	NPV of Vehicle Premium	Vehicle CNG Differential Cost	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
	Packer Fleet																							
	Classification 78--Vehicles Purchased			16	0	0	0	0	0	0	16	0	0	0	0	0	0	16	0	0	0	0	0	0
	Classification 78--Vehicles Retired			0	0	0	0	0	0	0	16	0	0	0	0	0	0	16	0	0	0	0	0	0
A	Differential Cost per Vehicle includes 1.76% HST		$ 45,792	$ 46,937	$ 48,110	$ 49,313	$ 50,546	$ 51,809	$ 53,105	$ 54,432	$ 55,793	$ 57,188	$ 58,618	$ 60,083	$ 61,585	$ 63,125	$ 64,703	$ 66,320	$ 67,978	$ 69,678	$ 71,420	$ 73,205	$ 75,036	$ 76,911
	Total Differential Cost			$ 750,989	$ -	$ -	$ -	$ -	$ -	$ -	$ 892,690	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,061,128	$ -	$ -	$ -	$ -	$ -	$ -
	Cost Differential Recapture on Retirement--assumed $0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NPV of Total Vehicle Differential Cost	$ 1,921,348		$ 750,989	$ -	$ -	$ -	$ -	$ -	$ -	$ 634,418	$ -	$ -	$ -	$ -	$ -	$ -	$ 535,942	$ -	$ -	$ -	$ -	$ -	$ -
	Classification 157--Vehicles Purchased			0	10	0	0	0	0	0	0	10	0	0	0	0	0	0	10	0	0	0	0	0
	Classification 157--Vehicles Retired			0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	10	0	0	0	0	0
B	Differential Cost per Vehicle includes 1.76% HST		$ 45,792	$ 46,937	$ 48,110	$ 49,313	$ 50,546	$ 51,809	$ 53,105	$ 54,432	$ 55,793	$ 57,188	$ 58,618	$ 60,083	$ 61,585	$ 63,125	$ 64,703	$ 66,320	$ 67,978	$ 69,678	$ 71,420	$ 73,205	$ 75,036	$ 76,911
	Total Differential Cost			$ -	$ 481,102	$ -	$ -	$ -	$ -	$ -	$ -	$ 571,879	$ -	$ -	$ -	$ -	$ -	$ -	$ 679,785	$ -	$ -	$ -	$ -	$ -	$ -
	Cost Differential Recapture on Retirement--assumed $0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NPV of Total Vehicle Differential Cost	$ 1,172,251		$ -	$ 458,193	$ -	$ -	$ -	$ -	$ -	$ -	$ 387,070	$ -	$ -	$ -	$ -	$ -	$ -	$ 326,988	$ -	$ -	$ -	$ -	$ -	$ -
	Classification 157A--Vehicles Purchased			0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0
	Classification 157A--Vehicles Retired			0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0
C	Differential Cost per Vehicle includes 1.76% HST		$ 30,528	$ 31,291	$ 32,073	$ 32,875	$ 33,697	$ 34,540	$ 35,403	$ 36,288	$ 37,195	$ 38,125	$ 39,078	$ 40,055	$ 41,057	$ 42,083	$ 43,135	$ 44,214	$ 45,319	$ 46,452	$ 47,613	$ 48,804	$ 50,024	$ 51,274
	Total Differential Cost			$ -	$ 64,147	$ -	$ -	$ -	$ -	$ -	$ -	$ 76,251	$ -	$ -	$ -	$ -	$ -	$ -	$ 90,638	$ -	$ -	$ -	$ -	$ -	$ -
	Cost Differential Recapture on Retirement--assumed $0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NPV of Total Vehicle Differential Cost	$ 156,300		$ -	$ 61,092	$ -	$ -	$ -	$ -	$ -	$ -	$ 51,609	$ -	$ -	$ -	$ -	$ -	$ -	$ 43,598	$ -	$ -	$ -	$ -	$ -	$ -
	Classification 170A--Vehicles Purchased			0	0	0	9	0	0	0	0	0	0	9	0	0	0	0	0	0	0	9	0	0
	Classification 170A--Vehicles Retired			0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	9	0	0	0
D	Differential Cost per Vehicle includes 1.76% HST		$ 45,792	$ 46,937	$ 48,110	$ 49,313	$ 50,546	$ 51,809	$ 53,105	$ 54,432	$ 55,793	$ 57,188	$ 58,618	$ 60,083	$ 61,585	$ 63,125	$ 64,703	$ 66,320	$ 67,978	$ 69,678	$ 71,420	$ 73,205	$ 75,036	$ 76,911
	Total Differential Cost			$ -	$ -	$ -	$ 454,912	$ -	$ -	$ -	$ -	$ -	$ -	$ 540,748	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 642,779	$ -	$ -	$ -
	Cost Differential Recapture on Retirement--assumed $0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NPV of Total Vehicle Differential Cost	$ 1,005,385		$ -	$ -	$ -	$ 392,970	$ -	$ -	$ -	$ -	$ -	$ -	$ 331,972	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 280,442	$ -	$ -	$ -
	Packer Fleet Total Vehicle Differential Cost			$ 750,989	$ 545,249	$ -	$ 454,912	$ -	$ -	$ -	$ 892,690	$ 648,130	$ -	$ 540,748	$ -	$ -	$ -	$ 1,061,128	$ 770,423	$ -	$ 642,779	$ -	$ -	$ -
	NPV Packer Fleet Total Vehicle Differential Cost			$ 750,989	$ 519,285	$ -	$ 392,970	$ -	$ -	$ -	$ 634,418	$ 438,680	$ -	$ 331,972	$ -	$ -	$ -	$ 535,942	$ 370,587	$ -	$ 280,442	$ -	$ -	$ -

NPV of Vehicle Cost Differential:	$ 4,255,284

Appendix F

Diesel, CNG and RNG Consumption and GHG Emissions

Calculation of Total Fuel Used Per Year-Diesel and CNG and Associated CO_2e Reduction

	Diesel/ CNG Efficiency	Fuel Consumption per Day per Truck (Litres of Diesel)	Fuel Consumption per Year per Truck (Litres of Diesel)		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
					2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Packer Fleet--CNG Trucks in Fleet																									
Classification 78--Vehicles in Fleet					16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Classification 157--Vehicles in Fleet					0	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Classification 157A--Vehicles in Fleet					0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Classification 170A--Vehicles in Fleet					0	0	0	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Total CNG Trucks					**16**	**28**	**28**	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**
Packer Fleet--Diesel Displaced by CNG (litres)																									
Classification 78		**55.80**	**14,509**		232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137
Classification 157		**81.33**	**21,145**		-	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450
Classification 157A		**24.25**	**6,305**		-	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610
Classification 170A		**59.99**	**15,598**		-	-	-	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382
Total Diesel Displaced by CNG Trucks (litres):					**232,137**	**456,197**	**456,197**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**	**596,579**
Packer Fleet--CNG Consumed (m^3)																									
Classification 78--300 Series					271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725
Classification 157					-	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511
Classification 157A					-	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761
Classification 170A					-	-	-	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323
Total CNG Consumed (m^3):	**0.88**				**271,725**	**533,997**	**533,997**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**	**698,319**
Packer Fleet--GHG---CO_2e Carbon Accounting	**Emission Factors**	**Total GHG Emission Savings**																							
Diesel																									
Emission Factor--CO_2 Emissions per Unit (gCO_2e/l) (Table A6-11 NIR Chapter 2)	**2690**																								
CO_2e for Diesel Displaced--tonnes CO_2e					624.4	1,227.2	1,227.2	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8
CNG																									
Emission Factor--CO2 Emissions per Unit ($gCO2e/l$) (Table A6-11 NIR Chapter 2)	**1.9**																								
Emission Factor--CO2 Emissions per Unit ($gCO2e/m3$)--converted	**1900**																								
CO_2e for CNG Consumed--Tonnes CO2e					516.3	1,014.6	1,014.6	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8	1,326.8
Net CO_2e Reduction for CNG					108.2	212.6	212.6	278.0	278.0	278.0	278.0	278.0	278.0	278.0	278.0	278.0	278.0	278.0	278.0	278.0	278.0	278.0	278.0	278.0	278.0
Lifecycle Total for CNG (tonnes CO_2e):		**5,537.1**																							
Percent Reduction From Diesel		**17.3%**																							
RNG																									
Emission Factor--CO_2 Emissions per Unit ($kgCO_2e/m^3$) (BC Government)	**0.011**																								
CO_2e for CNG Consumed--tonnes CO2e					0.002989	0.005874	0.005874	0.007682	0.007682	0.007682	0.007682	0.007682	0.007682	0.007682	0.007682	0.007682	0.007682	0.007682	0.007682	0.007682	0.007682	0.007682	0.007682	0.007682	0.007682
Net CO_2e Reduction for RNG					624.4	1,227.2	1,227.2	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8	1,604.8
Lifecycle Total for RNG (tonnes CO_2e):		**31,965.0**																							
Percent Reduction From Diesel		**100.0%**																							

Appendix G

Diesel and CNG Consumption and Electricity Calculations

Calculation of Total Fuel Used Per Year

	Vehicle Purchase and Retirement Schedule	Diesel/ CNG Efficiency	Fuel Consumption per Day per Truck (Litres of Diesel)	Fuel Consumption per Year per Truck (Litres of Diesel)	Spare Ratio	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	
						2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	
	Packer Fleet																										
	Classification 78--Vehicles Purchased					16							16							16							
	Classification 78--Vehicles Retired												16							16							
	Fleet Size--Number of Vehicles of this Type					16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	
	Spare Ratio not applied as Annual Totals are Used					16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	
A	Number of Diesel Litres Consumed Each Year for Vehicle Type			14,509		232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	232,137	
	Number of Diesel Litres Consumed Each Day for Vehicle Type (assumes 260 equal consumption days per year)		55.80			893	893	893	893	893	893	893	893	893	893	893	893	893	893	893	893	893	893	893	893	893	
	Total m3 of CNG per Year for Vehicle Type	0.88				271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	271,725	
	Classification 157--Vehicles Purchased						10							10							10						
	Classification 157-Vehicles Retired													10							10						
	Fleet Size--Number of Vehicles of this Type					0	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
	Spare Ratio not applied as Annual Totals are Used					**0**	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
B	Number of Diesel Litres Consumed Each Year for Vehicle Type			21,145		-	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	211,450	
	Number of Diesel Litres Consumed Each Day for Vehicle Type (assumes 260 equal consumption days per year)		81.33			-	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	
	Total m3 of CNG per Year for Vehicle Type	0.88				-	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	247,511	
	Classification 157A--Vehicles Purchased						2							2							2						
	Classification 157A--Vehicles Retired													2							2						
	Fleet Size--Number of Vehicles of this Type					0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
	Spare Ratio not applied as Annual Totals are Used					**0**	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
B	Number of Diesel Litres Consumed Each Year for Vehicle Type			6,305		-	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	12,610	
	Number of Diesel Litres Consumed Each Day for Vehicle Type (assumes 260 equal consumption days per year)		24.25			-	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	
	Total m3 of CNG per Year for Vehicle Type	0.88				-	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	14,761	
	Classification 170A--Vehicles Purchased								9							9							9				
	Classification 170A--Vehicles Retired															9							9				
	Fleet Size--Number of Vehicles of this Type					0	0	0	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	
	Spare Ratio not applied as Annual Totals are Used					**0**	0	0	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	
C	Number of Diesel Litres Consumed Each Year for Vehicle Type			15,598		-	-	-	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	140,382	
	Number of Diesel Litres Consumed Each Day for Vehicle Type (assumes 260 equal consumption days per year)		59.99			-	-	-	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	
	Total m3 of CNG per Year for Vehicle Type	0.88				-	-	-	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	164,323	
																											Life Cycle
	Packer Fleet Total Annual Fuel Consumption (m3)					271,725	533,997	533,997	698,319	698,319	698,319	698,319	698,319	698,319	698,319	698,319	698,319	698,319	698,319	698,319	698,319	698,319	698,319	698,319	698,319	698,319	13,637,742
																											-
	Minimum Firm Compression Required in SCFM based on a daily compression time of : 8 Hours					76	150	150	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	
	Minimum Firm Compression Required in SCFM based on a daily compression time of : 3 Hours					203	399	399	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	522	
	Electicity/Power Calculation																										
	Flow per 250 hp Compressor (scfm) (m3/Hr)	636	1090																								
	Calculation of Hours of Compressor Operation per year					249	490	490	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	640	
	Total Hp per Compressor (250 Hp Compressor) plus 10 percent for fans and control loads times .8 for average operating load	250	275	220																							
	Calculation of kWh per hour			205																							
	Calculation of kWh per year					51,128	100,478	100,478	131,397	131,397	131,397	131,397	131,397	131,397	131,397	131,397	131,397	131,397	131,397	131,397	131,397	131,397	131,397	131,397	131,397	131,397	
	Rate per kwh (from HSR total power cost data)		$0.1490			7,618																					
	Energy cost per m3 for Year 0 ($/m3)					**0.02804**																					

City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fueling
Supplemental Study

Submitted To:

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Superintendent Capital Planning
& Contract Management
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Email: Tom.Kagianis@hamilton.ca

Energy, Fleet & Facilities
Public Works
330 Wentworth Street, L8L 5W2

FINAL REPORT

2021 03 19

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Executive Summary:

The City of Hamilton, Energy, Fleet & Facilities Public Works department (the City) contracted with Marathon Technical Services (Marathon or MTS), to study the technical and financial viability of fueling 16 of the fleet of 37 packer (refuse collection) trucks with CNG over a 7-year project life.

This analysis focused on a non-conventional infrastructure procurement approach—"Fuel as a Service". This "Fuel as a Service" contracting method is well suited to this project and allows the City to complete a small scale, shorter term project that was studied in Marathon's 2020 report.

This approach reduces or eliminates capital expenditure by the City and allows a shorter term, lower risk project that is geared to the 7-year life of the initial truck order. Ownership of the equipment is retained by the contractor and equipment is removed at their expense at the conclusion of the contract. This approach allows the City to quickly and inexpensively adopt lower carbon CNG truck technology that is available today, while preserving the option of electric trucks in the future when these become more technically and cost competitive.

A total of three companies and four approaches were evaluated. In every case, fueling will be performed as "time fill" with no "fast fill" provided. All fueling will take place at the Burlington Street truck facility. The solutions proposed by the companies consulted, have additional capacity that would allow the City to extend and expand the project at nominal cost. All four options are technically feasible.

Net Present Value (NPV) was used as quantitative evaluation metric. None of the four options returned a positive net present value although these solutions have excess capacity and equipment life (other than Company C) that would allow the City to purchase additional CNG trucks and extend the contract resulting in a much better project economic return. NPV as studied, ranged from -$293,440 to -$2,693,534 indicating that the CNG project costs are not fully offset by diesel cost savings.

The average lead time from award of contract to a fully permitted and operational station was 12-months with no solution approach providing any notable lead time advantage.

It is estimated that this project will create a savings of 757 tonnes CO_2e over the lifecycle of the project --projecting a "green" image for the City. This represents a 17.3 percent reduction from the diesel fleet and based on US EPA data. This total project savings is lower than the 2020 study due to the shorter project length and reduction in truck count.

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Introduction:

The City of Hamilton (the City, or Hamilton) is evaluating the possible transition of a portion of its diesel-powered packer truck refuse collection fleet to Compressed Natural Gas (CNG). The City has over three decades of successful CNG heavy fleet experience at the Hamilton Street Railway (HSR).

CNG is a fuel that is capital intensive but low cost to operate and provides toxic gas and greenhouse gas (GHG) emissions reduction when compared with diesel. It is also the most proven alternative fuel in heavy vehicle applications. This supplemental study follows a study in 2020 that evaluated the possibility of changing the entire City fleet of garbage trucks to CNG. The scaled down approach in this supplemental study is shortened to a 7-year project term, matching a single purchase of 16 trucks. This smaller, shorter term project allows the City to implement CNG trucks into its fleet now and retain the option to transition to electric trucks when those become more economically and technically viable.

Marathon has been contracted to perform the following scope:

1. Assume a single purchase of 16 trucks that require fueling over a 7-year period.

2. Assume that fueling will take place at the existing City truck facility on Burlington Street. A concept level plan that was prepared for the 2020 study has been included in this supplemental study for reference in Appendix B. Note that the scale of equipment is likely to change from this drawing to match this de-scoped study.

3. Review of four fueling alternatives provided by three well experienced industry contractors using a “Fuel as a Service” contracting approach. This approach is based on the contractor assuming:
    a. All of the equipment and installation capital costs.
    b. All of the operation and maintenance costs.
    c. All repair costs.
    d. All station licensing and permitting costs.
    e. All trucking of gas to site for the trailer option.
    f. In one case the commodity and utility gas cost.
    g. See Appendix C for a description of the request for information forwarded to the station vendors.

4. For the options above, Marathon used assumptions consistent with the 2020 analysis to allow some level of comparison between reports.

5. Marathon has updated the Operating Engineer requirements and the impact of changes.

6. Project life cycle cost analysis for the initial and subsequent purchase and integration of CNG packer trucks into the collection fleet. The initial and sole purchase will be for approximately 16 rear loader trucks to go into service in 2021. This analysis will identify the net present value (NPV) of the CNG program and will also identify the expected environmental and other benefits. Marathon will make recommendations related to the implementation of this program.

7. It is understood that City trucks are maintained off site by service providers and thus no garage upgrades related to CNG are required or anticipated at this time and no consulting associated with upgrades is included in this scope.

Analysis Assumptions and Data Sources:

The life cycle cost analysis uses data from a variety of sources and covers a wide range of data to address all readily quantifiable cost elements to provide a comprehensive and conservative analysis. The list below summarizes the cost elements and data sources that were determined or assumed in this study:

1. The lifecycle analysis is based on a 7-year life cycle with year 0 being 2021. This 7-year life cycle was selected as it corresponds to one full 7-year truck life cycle for the truck procurement.

2. Discount rate: 5% (Marathon standard, confirmed with the City of Hamilton). See Glossary in Appendix A for definition of discount rate.

3. Inflation: 2.5 percent to 3.0 percent (dependent on item) (Marathon standard, confirmed with the City of Hamilton). See Tables 3 to 6 for individual rates used.

4. HST was applied at a net rate of 1.76 percent on the cost of CNG contractor services and on the upcharge/differential cost for the CNG trucks over the diesel truck cost. As discussed with the City, it is understood that diesel fuel, electricity, natural gas, CNG station maintenance costs and truck operating and maintenance costs already include HST embedded in the costs provided by the City.

5. The station concepts proposed do not include a standby power (generator), thus in the event of a protracted power outage, it will be necessary to deadhead trucks to another site-most likely to HSR.

6. Two of the three companies responded with a concept that includes an on-site redundant compressor. The other respondent proposes a trailer mounted compressor which can be changed out in the event of a compressor failure. If a spare compressor is not available in a timely manner, it will be necessary to deadhead trucks to another site-most likely to HSR. Note that performance penalties can be built into the service contract to fund such an occurrence.

7. Truck capital cost differential compared to clean diesel was $45,000 plus HST (ie the CNG trucks are more expensive than the diesel trucks) for all full sized CNG packer trucks (as provided by the City).

8. Truck maintenance cost differential—no differential truck maintenance cost compared with clean diesel was assumed. Although CNG and diesel trucks have both been widely used in this application for a number of years, there is still a variety of opinions as to which fuel has lower truck maintenance costs including the prevailing opinion that there is no difference. HSR indicated that their current experience is there is no difference in

maintenance costs between these fuels for their fleet of heavy buses—this is the assumption used in this report.

9. Future CNG vehicle fuel consumption is equal to diesel since it was assumed that there is no increase or decrease in routes or total distance except as studied in the sensitivity analysis. This is a conservative assumption since if additional trucks are required to meet a growing population (significant population growth is likely over a 7-year period).

10. Current diesel prices were supplied by the City and based on 2018/2019 average diesel fuel cost per litre then inflated at 3.0 percent per annum.

11. Engine efficiency—CNG engines are assumed to be 88 percent of diesel engine efficiency (Cummins). CNG engines are spark ignition with lower compression ratio than diesel and thus diesel engines have a higher thermal efficiency than CNG, although this advantage is narrowing making this a conservative assumption.

12. Gas utility commodity and gas distribution charges were based on 2018/2019 HSR CNG station charges as provided by the City. These were inflated at 2.5 percent per annum. Enbridge has confirmed that ample natural gas supply is available at the Burlington Street site at a delivery pressure of 80 psig.

13. No gas utility service cost has been included as it has been assumed that the station load will pay the utility for this new gas service.

14. Electricity charges were based on 2018/2019 HSR CNG station charges as provided by the City. Electricity costs were initially calculated based on the total load that the City attributes to the HSR CNG station.

15. GHG calculations are based on motor fuel data for the Canadian National Inventory Report (NIR) Table A6-12.

16. Trucks will continue to be serviced off site by third party maintenance shops, therefore no Hamilton shop upgrades for CNG are required or included.

17. No government grants or other incentives or subsidies are currently available or included in the cost estimates.

Approach/Methodology:

A 7-year life cycle cost analysis was built by Marathon Technical Services using inputs from a variety of sources (as previously outlined). Seven years was selected as it represents one truck life cycle for the sole group of 16 packer trucks. It is assumed that if the City intends to continue with CNG after the seven-year period which may include having more than 16 trucks, it will renegotiate the contract with the contractor—this should lower the unit cost of fuel. If the City decides to transition away from CNG at the end of the seven years, the CNG station will be decommissioned and removed by the contractor.

The focus of this analysis was to identify and quantify those items that are differential costs for CNG compared to clean diesel—it should be stressed that there may be additional costs that are not identified in the analysis because they apply to both CNG and Diesel. These additional costs might include the base cost of a diesel truck (only the differential is used herein), end of life truck salvage value, packer truck maintenance costs (as previously noted), truck licensing costs, and truck driver costs as examples.

A total of three CNG station scenarios were conceived. Each scenario was then evaluated in the customized spreadsheet to determine the NPV over the seven years. Unlike the 2020 analysis, a payback year was not calculated since the payments are spread over the seven-year period with little to no upfront costs to pay back. Cash flow information is provided in the spreadsheets by cost category.

See Appendix B for concept level station layout drawing from the 2020 analysis. The layout for the concepts in this report will be similar to this layout but with fewer time fill locations and less compression equipment.

The Fuel as a Service contracting approach has the following features:

1. Little to no upfront cost.
2. No cost at end of contract.
3. No asset ownership.
4. Most costs including cost of capital are embedded in annual and/or throughput related charges. While this is beneficial to the City, the contractor will need to cover these costs so the City will be required to enter into a take-or-pay contract.

A brief description of the Fuel as a Service concept equipment and cost structure follows on Table 1 and 2 respectively.

Figure 1 provides photographs of equipment similar to Company A concept. Figure 2 provides photographs of equipment similar to Companies B and C concepts.

Table 1-List of Equipment for Fuel as a Service

		Company A	Company B	Company C
Fuel Station Concept:		Trailer mounted compressor and storage (gas from HSR) gas dispensed to time fill manifold. No Fast Fill.	Conventional compressor station (gas from utility line) gas dispensed to time fill manifold. No Fast Fill.	Conventional compressor station (gas from utility line) gas dispensed to time fill manifold. No Fast Fill.
Dryer:		None required as gas is already dry from HSR station.	Single Tower--PSB 10-3 DDP	Single Tower
Compressor(s):		One--trailer mounted hydraulic compressor. 1x75Hp	One duplex (two compressors in total) stationary compressor package. 2x100Hp	Three simplex (three compressors in total) stationary compressor package. 3x50Hp
	Redundancy:	Exchanging compressor trailers if compressor fault cannot be rectified. Willing to accept a penalty for not fueling.	Second compressor to automatically start upon compressor fault.	Third compressor to automatically start upon compressor fault.
	Equipment Age:	<5 years	New--conservative case	~30 years old
Storage:		Trailer Mounted	One 23' 5500psig tube with 345m^3 capacity	Not required for time fill with compression from utility line.
Time Fill Posts Included:		16	16	16
Electric Generator:		None--fueling will not occur with power outage.	None--fueling will not occur with power outage.	None--fueling will not occur with power outage.

Table 2-List of Cost Structure for Fuel as a Service Contractors

		Company A	Company B	Company C
Assumed station annual throughput (m^3)		271,429	271,429	271,429
All In Fixed Cost:	Annual Cost: (based on a throughput charge of $\$0.729/m^3$)	None required as gas is already dry from HSR station.		$ 198,000
All In per m^3 Cost:	Year 1 to 3	$ 0.40		
	Year 4 to 5	$ 0.42		
	Year 6 to 7	$ 0.45		
Fixed plus Throughput Cost:	Annual Cost:		$ 444,000	
	Per m^3 Cost:		$ 0.270	
Annual Cost Escalation (percent):		As noted in throughput cost schedule.	Canadian CPI	0%
Length of contract (years):		7	7	7
Initial Capital costs to City:		$ -	$ -	$ -
End of Term Costs to City:		$ -	$ -	$ -
Year 1 costs for Contractor Services:		$ 108,572	$ 517,286	$ 197,872
Costs Included:				
All equipment costs for equipment in Equipment list.		Yes	Yes	Yes
All installation costs for station equipment and time fill except as excluded below.		Yes	Yes	Yes
All Equipment O&M		Yes	Yes	Yes
All Equipment Repairs		Yes	Yes	Yes
All costs to load fuel at HSR and truck to Burlington Street		Yes	N/A	N/A
Cost Exclusions:		Gas service not required	Cost of Gas Service	Cost of Gas Service
		Natural Gas Cost	Natural Gas Cost	Natural Gas Cost
		Cost of Electricity--this is added to Marathon Total Fuel Cost Estimate	Cost of Electricity--this is added to Marathon Total Fuel Cost Estimate	Cost of Electricity--this is added to Marathon Total Fuel Cost Estimate
		Site lighting, bollards and curbstones--other minor installation costs. A $100,000 contingency has been added to address this.	Site lighting, bollards and curbstones--other minor installation costs. A $100,000 contingency has been added to address this.	Site lighting, bollards and curbstones--other minor installation costs. A $100,000 contingency has been added to address this.
				Electrical Upgrade (this has been added by Marathon)

Figure 1—Trailer mounted CNG Station (left) and time fill barricade (below).

Figure 2—Conventional CNG Station with CNG dryer (blue), two compressors for redundancy (silver enclosures), one storage tube (white tube with panel) (left).

Findings- Benefits of Time fill at the Burlington Street Location (abbreviated from the 2020 report):

Time fill in this location has several benefits:

1. Time fill of trucks takes place over a period of many hours. This additional fill time allows the heat generated during fueling to partially dissipate while fueling progresses and thus results in cooler, denser gas in truck tanks after fueling—this translates into a more complete fill and improved range.

2. Given that packer trucks are typically parked for 12 to 16 hours, time fill is well adapted to packer truck operations.

3. Time fill can significantly reduce the number of compressor starts and stops which leads to reduced wear and tear on station equipment. Time fill equipment is also simpler than fast fill dispensing equipment and thus is less prone to breakdown.

4. With much more time available for time filling, a (much) smaller compressor can be used than is used for fast fill.

5. The elimination of the need to drive trucks to another location for the sole purpose of fueling reduces unnecessary truck operating costs.

6. It is anticipated that there will be a reduction of personnel time required related to the use of time fill rather than fast fill fueling. This has not been included in the cost summary since a rework and extension of existing routes would be required to realize this time/labour reduction.

7. Fueling at Burlington Street consolidates the trucks to the location of dispatch, simplifying operations.

Findings-Quantitative

The primary means of quantitative evaluation for the project is the Net Present Value (NPV) of the costs and savings compared to Diesel trucks and operation (savings are calculated based on the cost of diesel that is displaced).

Costs are broken down as contractor costs, non-contractor City costs (such as power and gas), and the upcharge on the trucks have been used to offset the diesel expenditure that is displaced through the use of CNG.

Tables 3 through 6 on the next four pages provide the cost breakdown and totals as well as GHG emission savings.

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Table 3--Company A--Trailer Concept using HSR Fuel				Year						
	NPV Calculations			0	1	2	3	4	5	6
Company A-using HSR Fuel	Contractor Costs	Assumed station annual throughput (m^3)		271,429	271,429	271,429	271,429	271,429	271,429	271,429
		All In per m^3 Contractor Cost:		$ 0.400	$ 0.400	$ 0.400	$ 0.420	$ 0.420	$ 0.450	$ 0.450
		Contingency for Lighting, Bollards, other minor site work.		$ 100,000						
		Total Annual Contractor Cost:		$ 208,572	$ 108,572	$ 108,572	$ 114,000	$ 114,000	$ 122,143	$ 122,143
		Discount Rate:	5.00%	$ 208,572	$ 103,402	$ 98,478	$ 98,478	$ 93,788	$ 95,702	$ 91,145
		NPV--Contractor Cost with net HST at 1.76% added:	**$ 803,460**							
	City Fuel Costs not Including Contractor Costs	Gas Commodity & Utility Cost based on HSR Data: (per m3)	2.50%	$ 0.231	$ 0.237	$ 0.243	$ 0.249	$ 0.255	$ 0.262	$ 0.268
		HSR Compression Electricity and Station Maintenance Costs:	3.00%	$ 0.099	$ 0.102	$ 0.105	$ 0.109	$ 0.112	$ 0.115	$ 0.119
		On-site Electrical Compression Costs based on HSR (per m3)	3.00%	$ 0.030	$ 0.031	$ 0.032	$ 0.033	$ 0.033	$ 0.034	$ 0.036
		Total City Costs Related to Fuel and not Covered in Contractor Costs:		$ 97,779	$ 100,399	$ 103,090	$ 105,853	$ 108,690	$ 111,605	$ 114,598
		Total City Costs Related to Fuel and not Covered in Contractor Costs discounted for Time:	5.00%	$ 97,779	$ 95,618	$ 93,505	$ 91,440	$ 89,420	$ 87,445	$ 85,515
		NPV--City Cost:	**$ 640,723**							
	Contractor Plus City Fuel Costs	Total Annual Fuel Cost including Contractor and City Costs:		$ 306,351	$ 208,971	$ 211,661	$ 219,853	$ 222,691	$ 233,748	$ 236,741
		Total Annual Fuel Cost including Contractor and City Costs Discounted for Time:	5.00%	$ 306,351	$ 199,020	$ 191,983	$ 189,917	$ 183,208	$ 183,148	$ 176,660
		NPV--Contractor+City Cost:	**$ 1,430,287**							
		Cost per Diesel Litre Equivalent (DLE):		$ 1.16	$ 0.79	$ 0.80	$ 0.83	$ 0.85	$ 0.89	$ 0.90
	Displaced Diesel Costs	Diesel+DEF Annual Cost (Total $)		$ 271,492	$ 279,637	$ 288,026	$ 296,667	$ 305,567	$ 314,734	$ 324,176
		Diesel+DEF Annual Cost (Total $) Discounted for Time	5.00%	$ 271,492	$ 266,321	$ 261,248	$ 256,272	$ 251,391	$ 246,602	$ 241,905
		NPV--Diesel+DEF Annual Cost (Total $)	**$ 1,795,233**							
	Truck Capital Cost Premium	**Differential Cost Premium for CNG vs Diesel Trucks**	**$ 750,989**							
	Net Project NPV	**Net Project NPV (-ve favours Diesel, +ve favours CNG)**	**$ (386,043)**							
	Carbon Reduction-Tonnes CO2	**757.2**		108.2	108.2	108.2	108.2	108.2	108.2	108.2

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Table 4--Company A--Trailer Concept using Contractor Fuel				Year						
	NPV Calculations			0	1	2	3	4	5	6
Company A-using ComTech Fuel	Contractor Costs	Assumed station annual throughput (m^3)		271,429	271,429	271,429	271,429	271,429	271,429	271,429
		All In per m^3 Contractor Cost including Gas:		$ 0.700	$ 0.700	$ 0.700	$ 0.720	$ 0.720	$ 0.750	$ 0.750
		Contingency for Lighting, Bollards, other minor site work.		$ 100,000						
		Total Annual Contractor Cost:		$ 290,000	$ 190,000	$ 190,000	$ 195,429	$ 195,429	$ 203,572	$ 203,572
		Discount Rate:	5.00%	$ 290,000	$ 180,953	$ 172,336	$ 168,819	$ 160,780	$ 159,504	$ 151,908
		NPV--Contractor Cost with net HST at 1.76% added:	**$ 1,306,903**							
	City Fuel Costs not Including Contractor Costs	Gas Commodity & Utility Cost based on HSR Data: (per m3)	N/A							
		HSR Compression Electricity and Station Maintenance Costs:	N/A							
		On-site Electrical Compression Costs based on HSR (per m3)	3.00%	$ 0.030	$ 0.031	$ 0.032	$ 0.033	$ 0.033	$ 0.034	$ 0.036
		Total City Costs Related to Fuel and not Covered in Contractor Costs:		$ 8,073	$ 8,315	$ 8,565	$ 8,822	$ 9,087	$ 9,359	$ 9,640
		Total City Costs Related to Fuel and not Covered in Contractor Costs discounted for Time:	5.00%	$ 8,073	$ 7,919	$ 7,769	$ 7,621	$ 7,475	$ 7,333	$ 7,193
		NPV--City Cost:	**$ 53,384**							
	Contractor Plus City Fuel Costs	Total Annual Fuel Cost including Contractor and City Costs:		$ 298,074	$ 198,316	$ 198,565	$ 204,251	$ 204,515	$ 212,931	$ 213,212
		Total Annual Fuel Cost including Contractor and City Costs Discounted for Time:	5.00%	$ 298,074	$ 188,872	$ 180,104	$ 176,439	$ 168,255	$ 166,837	$ 159,102
		NPV--Contractor+City Cost:	**$ 1,337,684**							
		Cost per Diesel Litre Equivalent (DLE):		$ 1.13	$ 0.75	$ 0.75	$ 0.78	$ 0.78	$ 0.81	$ 0.81
	Displaced Diesel Costs	Diesel+DEF Annual Cost (Total $)		$ 271,492	$ 279,637	$ 288,026	$ 296,667	$ 305,567	$ 314,734	$ 324,176
		Diesel+DEF Annual Cost (Total $) Discounted for Time	5.00%	$ 271,492	$ 266,321	$ 261,248	$ 256,272	$ 251,391	$ 246,602	$ 241,905
		NPV--Diesel+DEF Annual Cost (Total $)	**$ 1,795,233**							
	Truck Capital Cost Premium	**Differential Cost Premium for CNG vs Diesel Trucks**	**$ 750,989**							
	Net Project NPV	**Net Project NPV (-ve favours Diesel, +ve favours CNG)**	**$ (293,440)**							
	Carbon Reduction-Tonnes CO2	**757.2**		108.2	108.2	108.2	108.2	108.2	108.2	108.2

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Table 5--Company B--Conventional CNG Station Concept				Year						
	NPV Calculations			0	1	2	3	4	5	6
Company B	Contractor Costs	Assumed station annual throughput (m^3)		271,429	271,429	271,429	271,429	271,429	271,429	271,429
		Annual Contractor Cost (Capital Recovery):		$ 444,000	$ 444,000	$ 444,000	$ 444,000	$ 444,000	$ 444,000	$ 444,000
		Per m^3 Contractor O&M Cost:		$ 0.270						
		Annual Cost Escalation (percent):	2.50%	$ 0.27	$ 0.28	$ 0.28	$ 0.29	$ 0.30	$ 0.31	$ 0.31
		Contingency for Lighting, Bollards, other minor site work.		$ 100,000						
		Total Annual Contractor Cost:		$ 617,286	$ 519,118	$ 520,996	$ 522,921	$ 524,894	$ 526,916	$ 528,989
		Discount Rate:	5.00%	$ 617,286	$ 494,398	$ 472,559	$ 451,719	$ 431,831	$ 412,853	$ 394,740
		NPV--Contractor Cost with net HST at 1.76% added:	**$ 3,333,032**							
	City Fuel Costs not Including Contractor Costs	Gas Commodity & Utility Cost based on HSR Data: (per m3)	2.50%	$ 0.231	$ 0.237	$ 0.243	$ 0.249	$ 0.255	$ 0.262	$ 0.268
		On-site Electrical Compression Costs based on HSR (per m3)	3.00%	$ 0.030	$ 0.031	$ 0.032	$ 0.033	$ 0.033	$ 0.034	$ 0.036
		Total City Costs Related to Fuel and not Covered in Contractor Costs:		$ 70,811	$ 72,621	$ 74,478	$ 76,383	$ 78,337	$ 80,341	$ 82,396
		Total City Costs Related to Fuel and not Covered in Contractor Costs discounted for Time:	5.00%	$ 70,811	$ 69,163	$ 67,554	$ 65,983	$ 64,448	$ 62,949	$ 61,485
		NPV--City Cost:	**$ 462,393**							
	Contractor Plus City Fuel Costs	Total Annual Fuel Cost including Contractor and City Costs:		$ 688,096	$ 591,739	$ 595,474	$ 599,304	$ 603,231	$ 607,257	$ 611,385
		Total Annual Fuel Cost including Contractor and City Costs Discounted for Time:	5.00%	$ 688,096	$ 563,561	$ 540,113	$ 517,701	$ 496,279	$ 475,802	$ 456,225
		NPV--Contractor+City Cost:	**$ 3,737,778**							
		Cost per Diesel Litre Equivalent (DLE):		$ 2.61	$ 2.25	$ 2.26	$ 2.27	$ 2.29	$ 2.30	$ 2.32
	Displaced Diesel Costs	Diesel+DEF Annual Cost (Total $)		$ 271,492	$ 279,637	$ 288,026	$ 296,667	$ 305,567	$ 314,734	$ 324,176
		Diesel+DEF Annual Cost (Total $) Discounted for Time	5.00%	$ 271,492	$ 266,321	$ 261,248	$ 256,272	$ 251,391	$ 246,602	$ 241,905
		NPV--Diesel+DEF Annual Cost (Total $)	**$ 1,795,233**							
	Truck Capital Cost Premium	**Differential Cost Premium for CNG vs Diesel Trucks**	**$ 750,989**							
	Net Project NPV	**Net Project NPV (-ve favours Diesel, +ve favours CNG)**	**$ (2,693,534)**							
	Carbon Reduction-Tonnes CO2	**757.2**		108.2	108.2	108.2	108.2	108.2	108.2	108.2

Table 6--Company C--Conventional CNG Station Concept				Year						
	NPV Calculations			0	1	2	3	4	5	6
Company C	Contractor Costs	Assumed station annual throughput (m^3)		271,429	271,429	271,429	271,429	271,429	271,429	271,429
		All In Contractor Fixed Cost (Capital Recovery + O&M):		$ 198,000	$ 198,000	$ 198,000	$ 198,000	$ 198,000	$ 198,000	$ 198,000
		Annual Cost Escalation (percent):	0	$ 198,000	$ 198,000	$ 198,000	$ 198,000	$ 198,000	$ 198,000	$ 198,000
		Contingency for Lighting, Bollards, other minor site work.		$ 100,000						
		Electrical Upgrade:		$ 150,000						
		Total Annual Contractor Cost:		$ 448,000	$ 198,000	$ 198,000	$ 198,000	$ 198,000	$ 198,000	$ 198,000
		Discount Rate:	5.00%	$ 448,000	$ 188,571	$ 179,592	$ 171,040	$ 162,895	$ 155,138	$ 147,751
		NPV--Contractor Cost with net HST at 1.76% added:	**$ 1,478,560**							
	City Fuel Costs not Including Contractor Costs	Gas Commodity & Utility Cost based on HSR Data: (per m3)	2.50%	$ 0.231	$ 0.237	$ 0.243	$ 0.249	$ 0.255	$ 0.262	$ 0.268
		On-site Electrical Compression Costs based on HSR (per m3)	3.00%	$ 0.030	$ 0.031	$ 0.032	$ 0.033	$ 0.033	$ 0.034	$ 0.036
		Total City Costs Related to Fuel and not Covered in Contractor Costs:		$ 70,811	$ 72,621	$ 74,478	$ 76,383	$ 78,337	$ 80,341	$ 82,396
		Total City Costs Related to Fuel and not Covered in Contractor Costs discounted for Time:	5.00%	$ 70,811	$ 69,163	$ 67,554	$ 65,983	$ 64,448	$ 62,949	$ 61,485
		NPV--City Cost:	**$ 462,393**							
	Contractor Plus City Fuel Costs	Total Annual Fuel Cost including Contractor and City Costs:		$ 518,811	$ 270,621	$ 272,478	$ 274,383	$ 276,337	$ 278,341	$ 280,396
		Total Annual Fuel Cost including Contractor and City Costs Discounted for Time:	5.00%	$ 518,811	$ 257,735	$ 247,146	$ 237,023	$ 227,343	$ 218,087	$ 209,236
		NPV--Contractor+City Cost:	**$ 1,915,380**							
		Cost per Diesel Litre Equivalent (DLE):		$ 1.97	$ 1.03	$ 1.03	$ 1.04	$ 1.05	$ 1.06	$ 1.06
	Displaced Diesel Costs	Diesel+DEF Annual Cost (Total $)		$ 271,492	$ 279,637	$ 288,026	$ 296,667	$ 305,567	$ 314,734	$ 324,176
		Diesel+DEF Annual Cost (Total $) Discounted for Time	5.00%	$ 271,492	$ 266,321	$ 261,248	$ 256,272	$ 251,391	$ 246,602	$ 241,905
		NPV--Diesel+DEF Annual Cost (Total $)	**$ 1,795,233**							
	Truck Capital Cost Premium	**Differential Cost Premium for CNG vs Diesel Trucks**	**$ 750,989**							
	Net Project NPV	**Net Project NPV (-ve favours Diesel, +ve favours CNG)**	**$ (871,136)**							
	Carbon Reduction-Tonnes CO2	**757.2**		108.2	108.2	108.2	108.2	108.2	108.2	108.2

Quantitative Findings-Summary Points:

A summary of the findings and additional considerations follows:

General:

1. None of the proposed approaches include standby power. This was eliminated to reduce cost. The City will need to deadhead the trucks to HSR for fuel in the event of a protracted power outage.

2. All of these alternatives are somewhat under-utilized with a fleet of 16 trucks. This provides an opportunity for the City to expand the number of trucks and/or extend the contract with a likely reduction in the overall per unit fuel cost. It is recommended that a procurement contract build in options to address these possibilities for future growth.

3. All of the alternatives studied appear to require a net investment by the City (ie the CNG total cost exceeds the diesel cost savings), however, this analysis does not include the very substantial impact of the upcoming rise in carbon fuel costs related to the federal government carbon tax escalations over the period of this project. This was not included in the analysis for four reasons:

    a) There could be a relaxation of these requirements due to public push-back or the installation of a new government.

    b) There will be some increase in both diesel and natural gas prices although it is expected that diesel price increases will be more pronounced.

    c) One purpose of a carbon tax is to reduce consumption so it is expected that market forces will reduce the non-tax portion of the fuel cost, making it difficult to predict final market prices.

    d) This report follows a 2020 report and to the extent possible, assumed prices and inflation rates used in the 2020 report have been carried forward on this report for consistency and to allow some comparison if desired.

Company A—HSR Fuel

1. Company A provided two concepts, the first being a trailer mounted CNG station (a compressor trailer plus a storage trailer) using gas compressed at the HSR station and delivered to the Burlington Street truck facility where trucks are time filled overnight. The HSR station is high capacity and the trailer filling will take place during the daytime when buses are not fueling. The use of the HSR station will increase the utilization of that existing asset.

2. Trucking CNG from a remote location introduces some risk to the project due to inclement weather, truck breakdowns, etc.

3. This scenario is the second lowest cost and is almost breakeven with the cost of diesel with a net cost of about $386,043 spread across seven years.

4. This approach was expected to be the fastest to deploy (along with Company A's alternative option), however, it was found that project time is equal to the conventional station proposals. This contractor has projected a 12-month time from contract award to fully permitted, operational station. This company is experiencing high demand for their mobile system and is gearing up to address this but is currently equipment limited. They anticipate improvement in this lead time in the future.

5. This approach (along with Company A's alternate option) requires less site work/improvements so the station will also be easy to decommission at contract completion.

6. Company A concepts include only one compressor on site. This means that in the event of a planned or unplanned protracted compressor outage, Company A will bring a "spare" compressor trailer to site and swap out with the existing compressor trailer.

7. This approach has been successfully used on similar fleets in Ontario and elsewhere.

Company A—Contractor Fuel

1. The second Company A approach is identical to the first except that the Contractor would supply the fuel rather than using fuel from HSR.

2. This scenario is the lowest cost and is almost breakeven with the cost of diesel with a net cost of about $293,440 spread across seven years.

3. See comments in previous bullet 8.

Company B—Utility Gas

1. Company B provided one concept with a conventional stationary CNG station with two 100 Hp compressors. The equipment as proposed is new equipment and is the most underutilized of all of the concepts, which means it has the greatest growth potential.

2. This scenario is the highest cost compared with the cost of diesel with a net cost of about $2,693,534 spread across seven years. This cost is much higher than the other concepts because the equipment is new, and the

installation is more extensive than Company A's installation due to the semi-permanent nature of this installation. This station is effectively a 20-year asset that is being depreciated over 7 years.

3. Gas is provided from a new utility service to the site.

4. Company B's concept includes two compressors on site. The second compressor will automatically start in the event of a fault on the other compressor.

5. This approach is the typical station design across North America and is consistent with the general approach of the 2020 study although somewhat scaled down to serve the smaller fleet and without some of the additional features (generator and fast fill) included in the 2020 study.

6. This contractor has projected a 6- to 18-month time from contract award to fully permitted, operational station.

Company C—Utility Gas

1. Company C provided one concept with a conventional stationary CNG station with three 50 Hp compressors.

2. This scenario is slightly more expensive than the two Company A approaches as compared with the cost of diesel with a net cost of about $871,136 spread across seven years. The major equipment as proposed is approximately 30 years old and has been fully depreciated on previous sites, allowing a lower project cost here.

3. Gas is provided from a new utility service to the site.

4. Company C's concept includes three compressors on site. The third compressor will automatically start in the event of a fault on one of the other compressors.

5. This approach is the typical station design across North America but uses older equipment that may not be suitable for operation beyond the 7-year project life.

6. This contractor has projected a 9- to 12-month time from contract award to fully permitted, operational station.

Findings-Environmental:

The growing concern over climate change and the recent advancements in controlling toxic tailpipe emissions has caused a shift in focus toward greenhouse gases and most notably toward CO_2 reduction. Unlike other pollutants that can be reduced by exhaust treatment, CO_2 is simply a product of combustion—thus, if a hydrocarbon (HC) fuel is consumed, CO_2 is produced. In fact, there are basically three ways to reduce CO_2 emissions of a vehicle:

1. Reduce fuel consumption through greater engine or drive train efficiency (reduce weight, use a hybrid drive system, etc.).

2. Use a low carbon fuel such as CNG or Renewable Natural Gas (RNG).

3. Use an energy source that has no tailpipe emissions (Battery Electric or hydrogen) however, these technologies are not yet field proven or durable to the extent that diesel and CNG are, and these energy sources can emit as much GHG as CNG depending on how the hydrogen or electricity is produced.

The first point above is relatively straightforward, since CO_2 production is linked to fuel consumption, any improvement in fuel consumption will provide a similar reduction in CO_2 emissions.

The second point is not as obvious. The products of complete combustion of any hydrocarbon fuel are CO_2 and H_2O, thus if one uses a fuel that is inherently lower in carbon content per unit of energy output, there will be lower CO_2 emissions. This study has included an analysis of the annual and lifecycle GHG reduction associated with the transition from diesel to CNG trucks. In each of the alternatives studied, the 7-year project saving is projected to be 757.2 tonnes CO_2.

Findings-Operating Engineers:

As noted in the 2020 report, there has been some adjustment to the Technical Standards and Safety Authority (TSSA) operating engineer requirements. It is now possible to apply for and receive a waiver from the requirement to staff a site with more than 150 Horsepower of reciprocating compressor(s) in simultaneous operation. This waiver is subject to a review of a safety plan, and further de-regulation is forthcoming.

While these developments are positive and may help with large stations like HSR, with the scaling down of the packer truck project, we are now down to a station size that is under the 150 Horsepower threshold, so this de-regulation does not impact this project. Note that Company B is proposing two 100 horsepower compressors, but these could be interlocked to prevent more than 100 Horsepower from operating at any time.

Conclusions and Recommendations:

1. It is recommended that the City of Hamilton proceed with the CNG project using a Fuel as a Service contracting approach.

2. All of the identified scenarios are technically feasible. Marathon has considered the balance between qualitive and quantitative factors and based on a balanced approach between these two general criteria, Marathon has rank ordered the scenarios by overall desirability are as following:
    1) Company A—Contractor Fuel
    2) Company A—HSR Fuel
    3) Company C—Utility Gas
    4) Company B—Utility Gas

    The two Company A proposals feature easier deployment and lowest cost. In the case where Company A is contracting for fuel, the cost was lower and can be locked in for the duration of the contract, giving the City more price certainty. This trailer mounted station approach does involve higher operational risk than the other alternatives since the CNG must be trucked to site and there is no redundant compressor on site. Marathon believes that this risk can be mitigated contractually using performance penalties for failure to fuel trucks, combined with an emergency plan to fuel at HSR, if required.

    The Company C proposal is somewhat appealing since it provides more on-site redundancy that Company A alternatives at a relatively low cost-premium. Marathon is concerned that the age of the equipment (~30 years) may lead to less operational stability and will not be as suited to a time extension to the contract as the other alternatives—this contract could end up being the most expensive if the City expands or extends its CNG fleet project.

    The Company B approach is in many ways the “best” and lowest risk approach since it includes new, modern, high-capacity equipment that can tolerate both more trucks and a longer project life. This station also includes full on-site compressor redundancy. The issue with this approach is its much higher cost.

3. Note that the lead time estimates ranged from 6- to 18-months with a typical/average lead time for the three vendors at 12-months. This was expected for the two conventional station solutions (Companies B and C) but much longer than expected for the trailer solution (Company A). The reason for the longer lead time with the trailers relates to equipment availability.

4. Enbridge has indicated (during the 2020 study) that the Burlington Street location has ample gas supply, and they are currently proposing an 80-psig delivery pressure.

5. It is estimated that this project will create a savings of 757.2 tonnes CO_2 over the lifecycle of the project --projecting a “green” image for the City.

6. Hamilton’s interest in this “Fuel as a Service” approach is to minimize its infrastructure commitment given the evolving Battery Electric Truck (BET) propulsion technology is still very new and essentially unproven in this application; however, it is expected that BETs will evolve to meet the operational challenges of a refuse collection fleet. It is unknown when this technology will be sufficiently proven to meet the City’s needs, so Marathon strongly recommends that any “Fuel as a Service” RFP and contract be written to provide the City with flexibility in throughput and contract duration both from a capacity and cost perspective. This will allow the City to make additional CNG truck purchases if required.

7. To ensure competitive bidding, the Fuel as a Service RFP will need to be performance/outcome oriented and allow a range of solutions that meet the City’s performance needs.

8. Further to the above recommendation, it is strongly recommended that the City include performance penalties on a per truck, per day basis for any trucks not fueled by a rollout deadline (perhaps 5:00 am).

Appendix A

Glossary of Terms

ACH	Air Changes per Hour
AHJ	Authority having Jurisdiction (the regulatory body with the authority to mandate design)
BET	Battery Electric Truck
CH_4	Methane—natural gas is about 90 to 95 percent methane.
CNG	Compressed Natural Gas
CO_2e	Carbon Dioxide Equivalent—a means of comparing other GHGs to CO_2 and also to combine the effects of multiple GHGs to a common unit for simplification of quantification.
DGE	Diesel Gallon Equivalent (the amount of CNG required to provide an amount of energy equal to one USG of diesel fuel).
Discount Rate	This is a percentage used to discount a future value back to a present value to be used in the calculation of the Net Present Value (NPV). The discount rate used is often the borrowing rate, however, it could also be the minimum acceptable rate of return also called the “hurdle rate”. This should not be confused with the Internal Rate of Return (IRR) which is the rate at which the project has a net present value of zero—ie the rate at which the project is “breakeven”.
ESD	Emergency Shut Down
F	Fahrenheit
GGE	Gasoline Gallon Equivalent (the amount of CNG required to provide an amount of energy equal to one USG of gasoline=5.66 pounds of CNG).
GHG	Greenhouse Gas—CO_2 (Carbon Dioxide), CH_4(methane) and N_2O (Nitrous Oxide) are the most common greenhouse gases.
HP or Hp	Horsepower
HSR	Hamilton Street Railway
HST	Harmonized Sales Tax—the sales tax in place in Ontario. At the time of this report, the City pays a net tax rate of 1.76 percent.
HVAC	Heating Ventilation and Air Conditioning

IR Infrared

LCA Life Cycle Analysis

LEL Lower Explosive Limit (this is 5 percent gas in air by volume—thus 20 percent LEL is 1 percent gas in air by volume)

LNG Liquefied Natural Gas

m^3 Cubic meter of natural gas

NG Natural Gas

NGV Natural Gas for Vehicles or Natural Gas Vehicle (depending on context)

NPV Net Present Value is the value of the project expressed in current dollars. It is calculated by “discounting” the future cost and savings back to current dollars using the “discount rate.”

Payback or Simple Payback is based on a cash flow analysis and is the time (expressed in years in this report) required for the income (or in this case the savings compared to a diesel fleet) to exceed the capital and operating expenditures. Future costs and savings are increased using inflation factors to their value in future years but there is no cost of money or “discount rate” applied) as this is not a Net Present Value. As with all analysis herein, the analysis is based on differential costs and savings only compared to the diesel baseline.

PSI Pounds per Square Inch

PSIG Pounds per Square Inch Gauge (Atmospheric pressure is 0 psig)

RNG Renewable Natural Gas—natural gas sourced from landfills or digesters.

SCF Standard Cubic Feet (the volume of gas within one cubic foot at atmospheric pressure and 60 F)

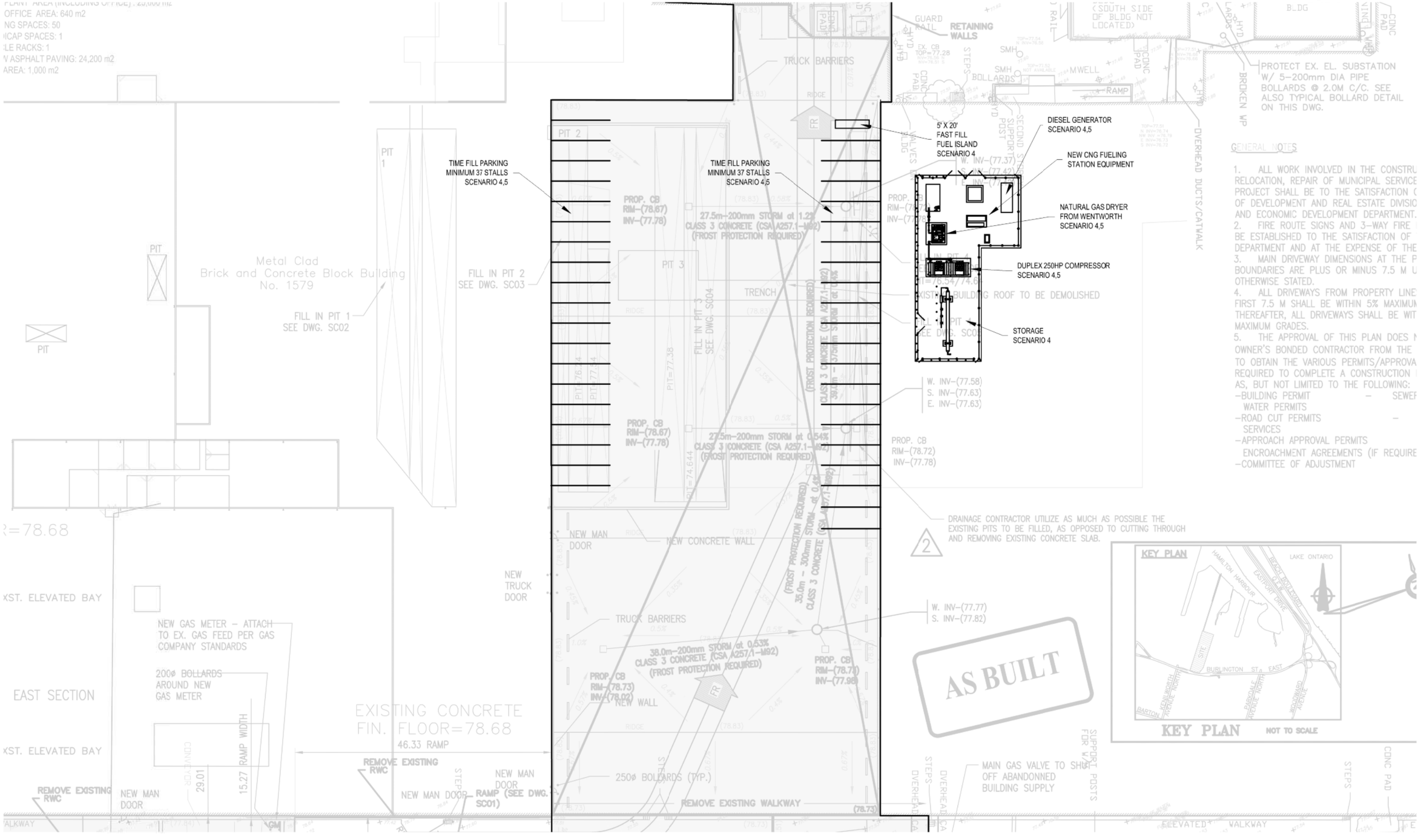
USG US Gallon

VFD Variable Frequency Drive—allows AC motors to operate at part speed.

Appendix B

Site Layout Drawings:

G-02 Hamilton Packer Truck CNG Concept Layout-1579 Burlington St., Hamilton ON



MarathonTechnical Services 9 Venus Crescent, Heidelberg, Ontario, N0B 2N1	PROJECT ENGR./ARCH:			REVISIONS							
	DESIGNER: Robert R. Adams	NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
	DRAWN BY: KH										
	SCALE: NTS										
	DATE: 12/10/2019										
	CHECKED BY:										
	CHECKED/APPROVED BY:										

PROJECT: HAMILTON PACKER TRUCK
CNG STATION
CONCEPT LAYOUT

SHEET TITLE: 1579 BURLINGTON ST.
HAMILTON, ONT.

WORK PROJECT NO.

G-02

Appendix C

Request for Information Provided to Contractors

RFI Excerpt for CNG Station "Fuel as a Service" Concepts:

We have been commissioned to study fueling options for the City of Hamilton. They are interested in exploring fueling strategies that minimize their capital commitment and are therefore looking at options that include compression as a service by a third party.

We are projecting the following project parameters:

1. 271,725 m3 annual throughput for a 7-year period—this is based on a 5-day work week and use 8 hours per day.
2. 80 psig utility pressure.
3. The Contractor would supply, install, permit, operate, maintain and own the station equipment.
4. The facility will/may be removed in 7 years—any costs associated with the removal of the equipment should be included below.
5. The City would prefer that all installation costs be included in the costs of the fuel, however, if there are costs that the City must bear, these should be identified.
6. Assume that sufficient power is available in a building approximately 250 feet from the required location.
7. Do not include any fast fill capability at this time.
8. The attached site drawing was based on a larger project scope—it is provided for general site information only. The site is located at 1579 Burlington Street, Hamilton, ON.

I would like to receive estimated costs by January 22, 2021. Please note that this is an estimate for analysis and budget purposes only. This is not a proposal, quotation or bid. Marathon will provide any information supplied to the City of Hamilton. Please provide the following information:

9. We are anticipating the City installing a 16 truck time fill barricade—is this something you can provide or do we need to supply this?
10. Please identify any capital cost items that the City will incur.
11. What are the infrastructure requirements and space/area required for your system? – please clarify any that are City furnished.
12. Please provide basic equipment specifications including horsepower, amps, scfm, make and model of compressors, dryer and other major equipment, scf of any storage.
13. Is equipment new or used at start of contract?
14. Compressor redundancy is required.
15. Please provide the cost per m3 for:
    a. New gas service from utility.
    b. Capital recovery.
    c. Operation and maintenance.
    d. Any licenses, permits or any other fees.
    e. The price should not include the natural gas commodity or transportation/distribution costs.
    f. The price should not include power costs, but please indicate the size of the motors.
16. What is the annual cost escalation over the seven-year period?

City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fueling

2nd Supplemental Study

Submitted To:

Tom Kagianis

Superintendent Capital Planning
& Contract Management
Tel: (905) 546-2424 ext. 5105
Email: Tom.Kagianis@hamilton.ca

Energy, Fleet & Facilities
Public Works
330 Wentworth Street, L8L 5W2

FINAL REPORT

2021 04 21

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Executive Summary:

The City of Hamilton, Energy, Fleet & Facilities Public Works department (the City) contracted with Marathon Technical Services (Marathon or MTS), to study the technical and financial viability of fueling 10 of the fleet of 37 packer (refuse collection) trucks with CNG over a 7-year project life based on a 2023 truck procurement.

This analysis focused on a non-conventional infrastructure procurement approach—"Fuel as a Service" and is an extension of the supplemental report submitted in March 2021. This "Fuel as a Service" contracting method is well suited to this project and allows the City to complete a small scale, shorter term project than was studied in Marathon's 2020 report.

This approach reduces or eliminates capital expenditure by the City and allows a shorter term, lower risk project that is geared to the 7-year life of the truck order. Ownership of the equipment is retained by the contractor and equipment is removed at their expense at the conclusion of the contract. This approach allows the City to quickly and inexpensively adopt lower carbon CNG truck technology that is available today, while preserving the option of electric trucks in the future when these become more technically and cost competitive.

A total of two companies and three approaches were evaluated (one company consulted in the March 2021 report did not respond with data for this report). In every case, fueling will be performed as "time fill" with no "fast fill" provided. All fueling will take place at the Burlington Street truck facility. All three options are technically feasible.

Net Present Value (NPV) was used as quantitative evaluation metric. None of the three options returned a positive net present value NPV as studied, ranging from $(137,225) to $(2,068,186), the negative values indicating that the CNG project costs are not fully offset by diesel cost savings. It should be noted that these values are similar than those calculated in the March 2021 Supplemental Study in spite of the reduced number of trucks because the per truck fuel consumption is higher with the 10 side loader trucks than with the rear loader evaluated in the previous supplemental study.

The average lead time from award of contract to a fully permitted and operational station was 12-months with no solution approach providing any notable lead time advantage.

It is estimated that this project will create a savings of 690 tonnes CO_2e over the lifecycle of the project --projecting a "green" image for the City. This represents a 17.3 percent reduction from the diesel fleet and based on US EPA data. This total project savings is lower than the 2020 study due to the shorter project length and reduction in truck count.

Table of Contents:

Introduction:

The City of Hamilton (the City, or Hamilton) is evaluating the possible transition of a portion of its diesel-powered packer truck refuse collection fleet to Compressed Natural Gas (CNG). The City has over three decades of successful CNG heavy fleet experience at the Hamilton Street Railway (HSR).

CNG is a fuel that is capital intensive but low cost to operate and provides toxic gas and greenhouse gas (GHG) emissions reduction when compared with diesel. It is also the most proven alternative fuel in heavy vehicle applications. This second supplemental study follows a study in 2020 that evaluated the possibility of changing the entire City fleet of garbage trucks to CNG and a first supplemental study (March 2021) that evaluated a single seven-year period with the procurement of 16 rear loader packer trucks. The scaled down approach in this supplemental study is based on a 7-year project term, matching a single purchase of 10 side loader packer trucks. This smaller, shorter term project allows the City to implement CNG trucks into its fleet in 2023 and retain the option to transition to electric trucks when those become more economically and technically viable.

Marathon has been contracted to perform the following scope:

1. Assume a single purchase of 10 trucks that require fueling over a 7-year period.

2. Assume that fueling will take place at the existing City truck facility on Burlington Street. A concept level plan that was prepared for the 2020 study has been included in this supplemental study for reference in Appendix B. Note that the scale of equipment is likely to change from this drawing to match this de-scoped study.

3. Review of three fueling alternatives provided by two well experienced industry contractors using a “Fuel as a Service” contracting approach. This approach is based on the contractor assuming:
    a. All of the equipment and installation capital costs.
    b. All of the operation and maintenance costs.
    c. All repair costs.
    d. All station licensing and permitting costs.
    e. All trucking of gas to site for the trailer option.
    f. In one case the commodity and utility gas cost.
    g. See Appendix C for a description of the request for information forwarded to the station vendors—this was as sent to the vendors.

4. For the options above, Marathon used assumptions consistent with the 2020 analysis and the March 2021 supplemental study to allow some level of comparison between reports.

5. Marathon has updated the Operating Engineer requirements and the impact of changes.

6. Project life cycle cost analysis for the initial and subsequent purchase and integration of CNG packer trucks into the collection fleet. The initial and sole purchase will be for approximately 10 side loader trucks to go into service in 2023. This analysis will identify the net present value (NPV) of the CNG program and will also identify the expected environmental and other benefits. Marathon will make recommendations related to the implementation of this program.

7. It is understood that City trucks are maintained off site by service providers and thus no garage upgrades related to CNG are required or anticipated at this time and no consulting associated with upgrades is included in this scope.

Analysis Assumptions and Data Sources:

The life cycle cost analysis uses data from a variety of sources and covers a wide range of data to address all readily quantifiable cost elements to provide a comprehensive and conservative analysis. The list below summarizes the cost elements and data sources that were determined or assumed in this study:

1. **T**he lifecycle analysis is based on a 7-year life cycle with year 0 being 2023. This 7-year life cycle was selected as it corresponds to one full 7-year truck life cycle for the truck procurement.

2. Discount rate: 5% (Marathon standard, confirmed with the City of Hamilton). See Glossary in Appendix A for definition of discount rate.

8. Inflation: 2.5 percent to 3.0 percent (dependent on item) (Marathon standard, confirmed with the City of Hamilton). See Tables 3 to 6 for individual rates used. Costs have been inflated 4 years to reflect a 2023 project start (data used was 2019 data) then discounted 2 years to produce a 2021 NPV.

3. HST was applied at a net rate of 1.76 percent on the cost of CNG contractor services and on the upcharge/differential cost for the CNG trucks over the diesel truck cost. As discussed with the City, it is understood that diesel fuel, electricity, natural gas, CNG station maintenance costs and truck operating and maintenance costs already include HST embedded in the costs provided by the City.

4. The station concepts proposed do not include a standby power (generator), thus in the event of a protracted power outage, it will be necessary to deadhead trucks to another site-most likely to HSR.

5. One of the two companies responded with a concept that includes an on-site redundant compressor. The other respondent proposes a trailer mounted compressor which can be changed out in the event of a compressor failure. If a spare compressor is not available in a timely manner, it will be necessary to deadhead trucks to another site-most likely to HSR. Note that performance penalties can be built into the service contract to fund such an occurrence.

6. Truck capital cost differential compared to clean diesel was $45,000 plus HST (in 2019 dollars) (ie the CNG trucks are more expensive than the diesel trucks) for all full sized CNG packer trucks (as provided by the City).

7. Truck maintenance cost differential—no differential truck maintenance cost compared with clean diesel was assumed. Although CNG and diesel trucks have both been widely used in this application for a number of years, there is still a variety of opinions as to which fuel has lower truck maintenance

costs including the prevailing opinion that there is no difference. HSR indicated that their current experience is there is no difference in maintenance costs between these fuels for their fleet of heavy buses—this is the assumption used in this report.

8. Future CNG vehicle fuel consumption is equal to diesel since it was assumed that there is no increase or decrease in routes or total distance except as studied in the sensitivity analysis. This is a conservative assumption since if additional trucks are required to meet a growing population (significant population growth is likely over a 7-year period).

9. Current diesel prices were supplied by the City and based on 2018/2019 average diesel fuel cost per litre then inflated at 3.0 percent per annum.

10. Engine efficiency—CNG engines are assumed to be 88 percent of diesel engine efficiency (Cummins). CNG engines are spark ignition with lower compression ratio than diesel and thus diesel engines have a higher thermal efficiency than CNG, although this advantage is narrowing making this a conservative assumption.

11. Gas utility commodity and gas distribution charges were based on 2018/2019 HSR CNG station charges as provided by the City. These were inflated at 2.5 percent per annum. Enbridge has confirmed that ample natural gas supply is available at the Burlington Street site at a delivery pressure of 80 psig.

12. No gas utility service cost has been included as it has been assumed that the station load will pay the utility for this new gas service.

13. Electricity charges were based on 2018/2019 HSR CNG station charges as provided by the City. Electricity costs were initially calculated based on the total load that the City attributes to the HSR CNG station.

14. GHG calculations are based on motor fuel data for the Canadian National Inventory Report (NIR) Table A6-12.

15. Trucks will continue to be serviced off site by third party maintenance shops, therefore no Hamilton shop upgrades for CNG are required or included.

16. No government grants or other incentives or subsidies are currently available or included in the cost estimates.

Approach/Methodology:

A 7-year life cycle cost analysis was built by Marathon Technical Services using inputs from a variety of sources (as previously outlined). Seven years was selected as it represents one truck life cycle for the sole group of 10 side loader packer trucks. It is assumed that if the City intends to continue with CNG after the seven-year period which may include having more than 10 trucks, it will renegotiate the contract with the contractor—this should lower the unit cost of fuel. If the City decides to transition away from CNG at the end of the seven years, the CNG station will be decommissioned and removed by the contractor.

The focus of this analysis was to identify and quantify those items that are differential costs for CNG compared to clean diesel—it should be stressed that there may be additional costs that are not identified in the analysis because they apply to both CNG and Diesel. These additional costs might include the base cost of a diesel truck (only the differential is used herein), end of life truck salvage value, packer truck maintenance costs (as previously noted), truck licensing costs, and truck driver costs as examples.

Two CNG station scenarios were conceived. Each scenario was then evaluated in the customized spreadsheet to determine the NPV over the seven years. Unlike the 2020 analysis, a payback year was not calculated since the payments are spread over the seven-year period with little to no upfront costs to pay back. Cash flow information is provided in the spreadsheets by cost category.

See Appendix B for concept level station layout drawing from the 2020 analysis. The layout for the concepts in this report will be similar to this layout but with fewer time fill locations and less compression equipment.

The Fuel as a Service contracting approach has the following benefits:

1. Little to no upfront cost.
2. No cost at end of contract.
3. No asset ownership.
4. Most costs including cost of capital are embedded in annual and/or throughput related charges. While this is beneficial to the City, the contractor will need to cover these costs so the City will be required to enter into a take-or-pay contract.

A brief description of the Fuel as a Service concept equipment and cost structure follows on Table 1 and 2 respectively.

Figure 1 provides photographs of equipment similar to Company A concept. Figure 2 provides photographs of equipment similar to Companies B concept.

Table 1-List of Equipment for Fuel as a Service

		Company A	Company B
Fuel Station Concept:		Trailer mounted compressor and storage (gas from HSR) gas dispensed to time fill manifold. No Fast Fill.	Conventional compressor station (gas from utility line) gas dispensed to time fill manifold. No Fast Fill.
Dryer:		None required as gas is already dry from HSR station.	Single Tower--PSB 10-2 DDP
Compressor(s):		One--trailer mounted hydraulic compressor. 1x75Hp	One duplex (two compressors in total) stationary compressor package. 2x30Hp
	Redundancy:	Exchanging compressor trailers if compressor fault cannot be rectified. Willing to accept a penalty for not fueling.	Second compressor to automatically start upon compressor fault.
	Equipment Age:	<5 years	New--conservative case
Storage:		Trailer Mounted	One 23' 5500psig tube with 345m^3 capacity
Time Fill Posts Included:		10	10
Electric Generator:		None--fueling will not occur with power outage.	None--fueling will not occur with power outage.

Table 2-List of Cost Structure for Fuel as a Service Contractors

		Company A	Company B
Assumed station annual throughput (m^3)		247,510	247,510
All In Fixed Cost:	Annual Cost: (based on a throughput charge of $0.729/m^3$)	None required as gas is already dry from HSR station.	
All In per m^3 Cost:	Year 1 to 3	$ 0.45	
	Year 4 to 5	$ 0.47	
	Year 6 to 7	$ 0.50	
Fixed plus Throughput Cost:	Annual Cost:		$ 395,739
	Per m^3 Cost:		$ 0.270
Annual Cost Escalation (percent):		As noted in throughput cost schedule.	Canadian CPI
Length of contract (years):		7	7
Initial Capital costs to City:		$ -	$ -
End of Term Costs to City:		$ -	$ -
Costs Included:			
All equipment costs for equipment in Equipment list.		Yes	Yes
All installation costs for station equipment and time fill except as excluded below.		Yes	Yes
All Equipment O&M		Yes	Yes
All Equipment Repairs		Yes	Yes
All costs to load fuel at HSR and truck to Burlington Street		Yes	N/A
Cost Exclusions:		Gas service not required	Cost of Gas Service
		Natural Gas Cost	Natural Gas Cost
		Cost of Electricity--this is added to Marathon Total Fuel Cost Estimate	Cost of Electricity--this is added to Marathon Total Fuel Cost Estimate
		Site lighting, bollards and curbstones--other minor installation costs. A $100,000 contingency has been added to address this.	Site lighting, bollards and curbstones--other minor installation costs. A $100,000 contingency has been added to address this.

Figure 1—Trailer mounted CNG Station (left) and time fill barricade (below).

Figure 2—Conventional CNG Station with CNG dryer (blue), two compressors for redundancy (silver enclosures), one storage tube (white tube with panel) (left).

Findings- Benefits of Time fill at the Burlington Street Location (abbreviated from the 2020 report):

Time fill in this location has several benefits:

1. Time fill of trucks takes place over a period of many hours. This additional fill time allows the heat generated during fueling to partially dissipate while fueling progresses and thus results in cooler, denser gas in truck tanks after fueling—this translates into a more complete fill and improved range.

2. Given that packer trucks are typically parked for 12 to 16 hours, time fill is well adapted to packer truck operations.

3. Time fill can significantly reduce the number of compressor starts and stops which leads to reduced wear and tear on station equipment. Time fill equipment is also simpler than fast fill dispensing equipment and thus is less prone to breakdown.

4. With much more time available for time filling, a (much) smaller compressor can be used than is used for fast fill.

5. The elimination of the need to drive trucks to another location for the sole purpose of fueling reduces unnecessary truck operating costs.

6. It is anticipated that there will be a reduction of personnel time required related to the use of time fill rather than fast fill fueling. This has not been included in the cost summary since a rework and extension of existing routes would be required to realize this time/labour reduction.

7. Fueling at Burlington Street consolidates the trucks to the location of dispatch, simplifying operations.

Findings-Quantitative

The primary means of quantitative evaluation for the project is the Net Present Value (NPV) of the costs and savings compared to Diesel trucks and operation (savings are calculated based on the cost of diesel that is displaced).

Costs are broken down as contractor costs, non-contractor City costs (such as power and gas), and the upcharge on the trucks have been used to offset the diesel expenditure that is displaced through the use of CNG.

Tables 3 through 6 on the next four pages provide the cost breakdown and totals as well as GHG emission savings.

City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fueling Study Report

Table 3--Company A--Trailer Concept using HSR Fuel				Year						
	NPV Calculations			0	1	2	3	4	5	6
Company A-using HSR Fuel	Contractor Costs	Assumed station annual throughput (m^3)		247,510	247,510	247,510	247,510	247,510	247,510	247,510
		All In per m^3 Contractor Cost:		$ 0.450	$ 0.450	$ 0.450	$ 0.470	$ 0.470	$ 0.500	$ 0.500
		Contingency for Lighting, Bollards, other minor site work.		$ 100,000						
		Total Annual Contractor Cost:		$ 211,380	$ 111,380	$ 111,380	$ 116,330	$ 116,330	$ 123,755	$ 123,755
		Discount Rate:	5.00%	$ 191,727	$ 96,214	$ 91,632	$ 91,147	$ 86,807	$ 87,950	$ 83,762
		NPV--Contractor Cost with net HST at 1.76% added:	**$ 742,075**							
	City Fuel Costs not Including Contractor Costs	Gas Commodity & Utility Cost based on HSR Data: (per m3)	2.50%	$ 0.243	$ 0.249	$ 0.255	$ 0.262	$ 0.268	$ 0.275	$ 0.282
		HSR Compression Electricity and Station Maintenance Costs:	3.00%	$ 0.104	$ 0.107	$ 0.110	$ 0.113	$ 0.117	$ 0.120	$ 0.124
		On-site Electrical Compression Costs based on HSR (per m3)	3.00%	$ 0.032	$ 0.033	$ 0.033	$ 0.034	$ 0.036	$ 0.037	$ 0.038
		Total City Costs Related to Fuel and not Covered in Contractor Costs:		$ 93,557	$ 96,063	$ 98,637	$ 101,280	$ 103,995	$ 106,783	$ 109,646
		Total City Costs Related to Fuel and not Covered in Contractor Costs discounted for Time:	5.00%	$ 84,859	$ 82,983	$ 81,149	$ 79,356	$ 77,603	$ 75,889	$ 74,213
		NPV--City Cost:	**$ 556,050**							
	Contractor Plus City Fuel Costs	Total Annual Fuel Cost including Contractor and City Costs:		$ 304,936	$ 207,442	$ 210,016	$ 217,610	$ 220,325	$ 230,538	$ 233,401
		Total Annual Fuel Cost including Contractor and City Costs Discounted for Time:	5.00%	$ 276,586	$ 179,197	$ 172,781	$ 170,503	$ 164,410	$ 163,839	$ 157,975
		NPV--Contractor+City Cost:	**$ 1,285,291**							
		Cost per Diesel Litre Equivalent (DLE):		$ 1.27	$ 0.86	$ 0.87	$ 0.91	$ 0.92	$ 0.96	$ 0.97
	Displaced Diesel Costs	Diesel+DEF Annual Cost (Total $)		$ 262,359	$ 270,230	$ 278,337	$ 286,687	$ 295,287	$ 304,146	$ 313,270
		Diesel+DEF Annual Cost (Total $) Discounted for Time	5.00%	$ 237,967	$ 233,435	$ 228,988	$ 224,626	$ 220,348	$ 216,151	$ 212,034
		NPV--Diesel+DEF Annual Cost (Total $)	**$ 1,573,549**							
	Truck Capital Cost Premium	**Differential Cost Premium for CNG vs Diesel Trucks (HST at 1.76% included in differential cost)**	**$ 505,458**							
	Net Project NPV	**Net Project NPV (-ve favours Diesel, +ve favours CNG)**	**$ (230,034)**							
	Carbon Reduction-Tonnes CO2	**689.7**		98.5	98.5	98.5	98.5	98.5	98.5	98.5

Table 4--Company A--Trailer Concept using Contractor Fuel				Year						
	NPV Calculations			0	1	2	3	4	5	6
Company A-using Company Supplied CNG	Contractor Costs	Assumed station annual throughput (m^3)		247,510	247,510	247,510	247,510	247,510	247,510	247,510
		All In per m^3 Contractor Cost including Gas:		$ 0.750	$ 0.750	$ 0.750	$ 0.770	$ 0.770	$ 0.800	$ 0.800
		Contingency for Lighting, Bollards, other minor site work.		$ 100,000						
		Total Annual Contractor Cost:		$ 285,633	$ 185,633	$ 185,633	$ 190,583	$ 190,583	$ 198,008	$ 198,008
		Discount Rate:	5.00%	$ 259,077	$ 160,356	$ 152,720	$ 149,327	$ 142,216	$ 140,721	$ 134,020
		NPV--Contractor Cost with net HST at 1.76% added:	**$ 1,158,473**							
	City Fuel Costs not Including Contractor Costs	Gas Commodity & Utility Cost based on HSR Data: (per m3)	N/A							
		HSR Compression Electricity and Station Maintenance Costs:	N/A							
		On-site Electrical Compression Costs based on HSR (per m3)	3.00%	$ 0.032	$ 0.033	$ 0.033	$ 0.034	$ 0.036	$ 0.037	$ 0.038
		Total City Costs Related to Fuel and not Covered in Contractor Costs:		$ 7,810	$ 8,044	$ 8,286	$ 8,534	$ 8,790	$ 9,054	$ 9,326
		Total City Costs Related to Fuel and not Covered in Contractor Costs discounted for Time:	5.00%	$ 7,084	$ 6,949	$ 6,817	$ 6,687	$ 6,560	$ 6,435	$ 6,312
		NPV--City Cost:	**$ 46,843**							
	Contractor Plus City Fuel Costs	Total Annual Fuel Cost including Contractor and City Costs:		$ 293,443	$ 193,677	$ 193,918	$ 199,117	$ 199,373	$ 207,062	$ 207,334
		Total Annual Fuel Cost including Contractor and City Costs Discounted for Time:	5.00%	$ 266,161	$ 167,305	$ 159,537	$ 156,013	$ 148,775	$ 147,155	$ 140,332
		NPV--Contractor+City Cost:	**$ 1,185,279**							
		Cost per Diesel Litre Equivalent (DLE):		$ 1.22	$ 0.81	$ 0.81	$ 0.83	$ 0.83	$ 0.86	$ 0.86
	Displaced Diesel Costs	Diesel+DEF Annual Cost (Total $)		$ 262,359	$ 270,230	$ 278,337	$ 286,687	$ 295,287	$ 304,146	$ 313,270
		Diesel+DEF Annual Cost (Total $) Discounted for Time	5.00%	$ 237,967	$ 233,435	$ 228,988	$ 224,626	$ 220,348	$ 216,151	$ 212,034
		NPV--Diesel+DEF Annual Cost (Total $)	**$ 1,573,549**							
	Truck Capital Cost Premium	**Differential Cost Premium for CNG vs Diesel Trucks (HST at 1.76% included in differential cost)**	**$ 505,458**							
	Net Project NPV	**Net Project NPV (-ve favours Diesel, +ve favours CNG)**	**$ (137,225)**							
	Carbon Reduction-Tonnes CO2	**689.7**		98.5	98.5	98.5	98.5	98.5	98.5	98.5

City of Hamilton Compressed Natural Gas (CNG) Packer Truck Fueling Study Report

Table 5--Company B--Conventional CNG Station Concept				Year						
	NPV Calculations			0	1	2	3	4	5	6
Company B	Contractor Costs	Assumed station annual throughput (m^3)		247,510	247,510	247,510	247,510	247,510	247,510	247,510
		Annual Contractor Cost (Capital Recovery):		$ 395,739	$ 395,739	$ 395,739	$ 395,739	$ 395,739	$ 395,739	$ 395,739
		Per m^3 Contractor O&M Cost:		$ 0.270						
		Annual Cost Escalation (percent):	2.50%	$ 0.28	$ 0.29	$ 0.30	$ 0.31	$ 0.31	$ 0.32	$ 0.33
		Contingency for Lighting, Bollards, other minor site work.		$ 100,000						
		Total Annual Contractor Cost:		$ 565,950	$ 467,705	$ 469,504	$ 471,349	$ 473,239	$ 475,176	$ 477,162
		Discount Rate:	5.00%	$ 513,333	$ 404,021	$ 386,262	$ 369,314	$ 353,138	$ 337,699	$ 322,962
		NPV--Contractor Cost with net HST at 1.76% added:	**$ 2,734,017**							
	City Fuel Costs not Including Contractor Costs	Gas Commodity & Utility Cost based on HSR Data: (per m3)	2.50%	$ 0.243	$ 0.249	$ 0.255	$ 0.262	$ 0.268	$ 0.275	$ 0.282
		On-site Electrical Compression Costs based on HSR (per m3)	3.00%	$ 0.032	$ 0.033	$ 0.033	$ 0.034	$ 0.036	$ 0.037	$ 0.038
		Total City Costs Related to Fuel and not Covered in Contractor Costs:		$ 67,915	$ 69,652	$ 71,434	$ 73,261	$ 75,135	$ 77,057	$ 79,029
		Total City Costs Related to Fuel and not Covered in Contractor Costs discounted for Time:	5.00%	$ 61,601	$ 60,168	$ 58,769	$ 57,402	$ 56,067	$ 54,763	$ 53,490
		NPV--City Cost:	**$ 402,260**							
	Contractor Plus City Fuel Costs	Total Annual Fuel Cost including Contractor and City Costs:		$ 633,865	$ 537,357	$ 540,938	$ 544,609	$ 548,374	$ 552,234	$ 556,191
		Total Annual Fuel Cost including Contractor and City Costs Discounted for Time:	5.00%	$ 574,934	$ 464,190	$ 445,031	$ 426,716	$ 409,205	$ 392,462	$ 376,452
		NPV--Contractor+City Cost:	**$ 3,088,990**							
		Cost per Diesel Litre Equivalent (DLE):		$ 2.64	$ 2.24	$ 2.25	$ 2.27	$ 2.28	$ 2.30	$ 2.31
	Displaced Diesel Costs	Diesel+DEF Annual Cost (Total $)		$ 262,359	$ 270,230	$ 278,337	$ 286,687	$ 295,287	$ 304,146	$ 313,270
		Diesel+DEF Annual Cost (Total $) Discounted for Time	5.00%	$ 237,967	$ 233,435	$ 228,988	$ 224,626	$ 220,348	$ 216,151	$ 212,034
		NPV--Diesel+DEF Annual Cost (Total $)	**$ 1,573,549**							
	Truck Capital Cost Premium	**Differential Cost Premium for CNG vs Diesel Trucks (HST at 1.76% included in differential cost)**	**$ 505,458**							
	Net Project NPV	**Net Project NPV (-ve favours Diesel, +ve favours CNG)**	**$ (2,068,186)**							
	Carbon Reduction-Tonnes CO2	**689.7**		98.5	98.5	98.5	98.5	98.5	98.5	98.5

Quantitative Findings-Summary Points:

A summary of the findings and additional considerations follows:

General:

1. None of the proposed approaches include standby power. This was eliminated to reduce cost. The City will need to deadhead the trucks to HSR for fuel in the event of a protracted power outage.

2. These alternatives are somewhat under-utilized with a fleet of 10 trucks. This provides an opportunity for the City to expand the number of trucks and/or extend the contract with a likely reduction in the overall per unit fuel cost. It is recommended that a procurement contract build in options to address these possibilities for future growth.

3. All of the alternatives studied appear to require a net investment by the City (ie the CNG total cost exceeds the diesel cost savings), however, this analysis does not include the very substantial impact of the upcoming rise in carbon fuel costs related to the federal government carbon tax escalations over the period of this project. This was not included in the analysis for four reasons:

    a) There could be a relaxation of these requirements due to public push-back or the installation of a new government.

    b) There will be some increase in both diesel and natural gas prices although it is expected that diesel price increases will be more pronounced.

    c) One purpose of a carbon tax is to reduce consumption so it is expected that market forces will reduce the non-tax portion of the fuel cost, making it difficult to predict final market prices.

    d) This report follows a 2020 report and to the extent possible, assumed prices and inflation rates used in the 2020 report have been carried forward on this report for consistency and to allow some comparison if desired.

Company A—HSR Fuel

1. Company A provided two concepts, the first being a trailer mounted CNG station (a compressor trailer plus a storage trailer) using gas compressed at the HSR station and delivered to the Burlington Street truck facility where trucks are time filled overnight. The HSR station is high capacity and the trailer filling will take place during the daytime when buses are not fueling. The use of the HSR station will increase the utilization of that existing asset.

2. Trucking CNG from a remote location introduces some risk to the project due to inclement weather, truck breakdowns, etc.

3. This scenario is the second lowest cost and is almost breakeven with the cost of diesel with a net cost of about $230,034 spread across seven years.

4. This approach was expected to be the fastest to deploy (along with Company A's alternative option), however, it was found that project time is equal to the conventional station proposal. This contractor has projected a 12-month time from contract award to fully permitted, operational station. This company is experiencing high demand for their mobile system and is gearing up to address this but is currently equipment limited. They anticipate improvement in this lead time in the future. This situation may have been resolved by 2023, improving the implementation time frame.

5. This approach (along with Company A's alternate option) requires less site work/improvements so the station will also be easy to decommission at contract completion.

6. Company A concepts include only one compressor on site. This means that in the event of a planned or unplanned protracted compressor outage, Company A will bring a "spare" compressor trailer to site and swap out with the existing compressor trailer.

7. This approach has been successfully used on similar fleets in Ontario and elsewhere.

Company A—Contractor Fuel

1. The second Company A approach is identical to the first except that the Contractor would supply the fuel rather than using fuel from HSR.

2. This scenario is the lowest cost and is almost breakeven with the cost of diesel with a net cost of about $137,225 spread across seven years.

3. See comments in previous bullets 4 to 7.

Company B—Utility Gas

1. Company B provided one concept with a conventional stationary CNG station with two 30 Hp compressors. The equipment as proposed is new equipment and the company indicated that they feel their estimated capital costs are very conservative, however, the capital cost recovery of a conventional station in only 7 years puts a heavy cost premium on this approach..

2. This scenario is the highest cost compared with the cost of diesel with a net cost of about $2,068,186. spread across seven years. This cost is much higher than the other concepts because the equipment is new, and the installation is more extensive than Company A's installation due to the semi-permanent nature of this installation. This station is effectively a 20-year asset that is being depreciated over 7 years.

3. Gas is provided from a new utility service to the site.

4. Company B's concept includes two compressors on site. The second compressor will automatically start in the event of a fault on the other compressor.

5. This approach is the typical station design across North America and is consistent with the general approach of the 2020 study although significantly scaled down to serve the smaller fleet and without some of the additional features (generator and fast fill) included in the 2020 study.

6. This contractor has projected a 6- to 18-month time from contract award to fully permitted, operational station.

Findings-Environmental:

The growing concern over climate change and the recent advancements in controlling toxic tailpipe emissions has caused a shift in focus toward greenhouse gases and most notably toward CO_2 reduction. Unlike other pollutants that can be reduced by exhaust treatment, CO_2 is simply a product of combustion—thus, if a hydrocarbon (HC) fuel is consumed, CO_2 is produced. In fact, there are basically three ways to reduce CO_2 emissions of a vehicle:

1. Reduce fuel consumption through greater engine or drive train efficiency (reduce weight, use a hybrid drive system, etc.).

2. Use a low carbon fuel such as CNG or Renewable Natural Gas (RNG).

3. Use an energy source that has no tailpipe emissions (Battery Electric or hydrogen) however, these technologies are not yet field proven or durable to the extent that diesel and CNG are, and these energy sources can emit as much GHG as CNG depending on how the hydrogen or electricity is produced.

The first point above is relatively straightforward, since CO_2 production is linked to fuel consumption, any improvement in fuel consumption will provide a similar reduction in CO_2 emissions.

The second point is not as obvious. The products of complete combustion of any hydrocarbon fuel are CO_2 and H_2O, thus if one uses a fuel that is inherently lower in carbon content per unit of energy output, there will be lower CO_2 emissions. This study has included an analysis of the annual and lifecycle GHG reduction associated with the transition from diesel to CNG trucks. In each of the alternatives studied, the 7-year project saving is projected to be 689.7 tonnes CO_2.

Findings-Operating Engineers:

As noted in the 2020 report, there has been some adjustment to the Technical Standards and Safety Authority (TSSA) operating engineer requirements. It is now possible to apply for and receive a waiver from the requirement to staff a site with more than 150 Horsepower of reciprocating compressor(s) in simultaneous operation. This waiver is subject to a review of a safety plan, and further de-regulation is forthcoming.

While these developments are positive and may help with large stations like HSR, with the scaling down of the packer truck project, we are now down to a station size that is under the 150 Horsepower threshold, so this de-regulation does not impact this project--note that Company A is proposing a single 75 horsepower compressor and Company B is proposing two 30 horsepower compressors, so these legacy requirements would not apply in any event.

Conclusions and Recommendations:

1. It is recommended that the City of Hamilton proceed with the CNG project using a Fuel as a Service contracting approach.

2. All of the identified scenarios are technically feasible. Marathon has considered the balance between qualitive and quantitative factors and based on a balanced approach between these two general criteria, Marathon has rank ordered the scenarios by overall desirability are as following:
    1) Company A—Contractor Fuel
    2) Company A—HSR Fuel
    3) Company B—Utility Gas

    The two Company A proposals feature easier deployment and lowest cost. In the case where Company A is contracting for fuel, the cost was lower and can be locked in for the duration of the contract, giving the City more price certainty. This trailer mounted station approach does involve higher operational risk than the other alternatives since the CNG must be trucked to site and there is no redundant compressor on site. Marathon believes that this risk can be mitigated contractually using performance penalties for failure to fuel trucks, combined with an emergency plan to fuel at HSR, if required.

    The Company B approach is in some ways the “best” and lowest risk approach since it includes new, modern, high-capacity equipment that can accommodate both some additional trucks and a longer project life. This station also includes full on-site compressor redundancy. The issue with this approach is its much higher cost.

3. Note that the lead time estimates ranged from 6- to 18-months with a typical/average lead time for the three vendors at 12-months. This was expected for the conventional station solution (Company B) but much longer than expected for the trailer solution (Company A). The reason for the longer lead time with the trailers relates to equipment availability.

4. Enbridge has indicated (during the 2020 study) that the Burlington Street location has ample gas supply, and they are currently proposing an 80-psig delivery pressure.

5. It is estimated that this project will create a savings of 689.7 tonnes CO_2 over the lifecycle of the project --projecting a “green” image for the City.

6. Hamilton’s interest in this “Fuel as a Service” approach is to minimize its infrastructure commitment given the evolving Battery Electric Truck (BET) propulsion technology is still very new and essentially unproven in this application; however, it is expected that BETs will evolve to meet the

operational challenges of a refuse collection fleet. It is unknown when this technology will be sufficiently proven to meet the City's needs, so Marathon strongly recommends that any "Fuel as a Service" RFP and contract be written to provide the City with flexibility in throughput and contract duration both from a capacity and cost perspective. This will allow the City to make additional CNG truck purchases if required.

7. To ensure competitive bidding, the Fuel as a Service RFP will need to be performance/outcome oriented and allow a range of solutions that meet the City's performance needs.

8. Further to the above recommendation, it is strongly recommended that the City include performance penalties on a per truck, per day basis for any trucks not fueled by a rollout deadline (perhaps 5:00 am).

Appendix A

Glossary of Terms

ACH	Air Changes per Hour
AHJ	Authority having Jurisdiction (the regulatory body with the authority to mandate design)
BET	Battery Electric Truck
CH_4	Methane—natural gas is about 90 to 95 percent methane.
CNG	Compressed Natural Gas
CO_2e	Carbon Dioxide Equivalent—a means of comparing other GHGs to CO_2 and also to combine the effects of multiple GHGs to a common unit for simplification of quantification.
DGE	Diesel Gallon Equivalent (the amount of CNG required to provide an amount of energy equal to one USG of diesel fuel).
Discount Rate	This is a percentage used to discount a future value back to a present value to be used in the calculation of the Net Present Value (NPV). The discount rate used is often the borrowing rate, however, it could also be the minimum acceptable rate of return also called the “hurdle rate”. This should not be confused with the Internal Rate of Return (IRR) which is the rate at which the project has a net present value of zero—ie the rate at which the project is “breakeven”.
ESD	Emergency Shut Down
F	Fahrenheit
GGE	Gasoline Gallon Equivalent (the amount of CNG required to provide an amount of energy equal to one USG of gasoline=5.66 pounds of CNG).
GHG	Greenhouse Gas—CO_2 (Carbon Dioxide), CH_4(methane) and N_2O (Nitrous Oxide) are the most common greenhouse gases.
HP or Hp	Horsepower
HSR	Hamilton Street Railway
HST	Harmonized Sales Tax—the sales tax in place in Ontario. At the time of this report, the City pays a net tax rate of 1.76 percent.
HVAC	Heating Ventilation and Air Conditioning

IR Infrared

LCA Life Cycle Analysis

LEL Lower Explosive Limit (this is 5 percent gas in air by volume—thus 20 percent LEL is 1 percent gas in air by volume)

LNG Liquefied Natural Gas

m^3 Cubic meter of natural gas

NG Natural Gas

NGV Natural Gas for Vehicles or Natural Gas Vehicle (depending on context)

NPV Net Present Value is the value of the project expressed in current dollars. It is calculated by “discounting” the future cost and savings back to current dollars using the “discount rate.”

Payback or Simple Payback is based on a cash flow analysis and is the time (expressed in years in this report) required for the income (or in this case the savings compared to a diesel fleet) to exceed the capital and operating expenditures. Future costs and savings are increased using inflation factors to their value in future years but there is no cost of money or “discount rate” applied) as this is not a Net Present Value. As with all analysis herein, the analysis is based on differential costs and savings only compared to the diesel baseline.

PSI Pounds per Square Inch

PSIG Pounds per Square Inch Gauge (Atmospheric pressure is 0 psig)

RNG Renewable Natural Gas—natural gas sourced from landfills or digesters.

SCF Standard Cubic Feet (the volume of gas within one cubic foot at atmospheric pressure and 60 F)

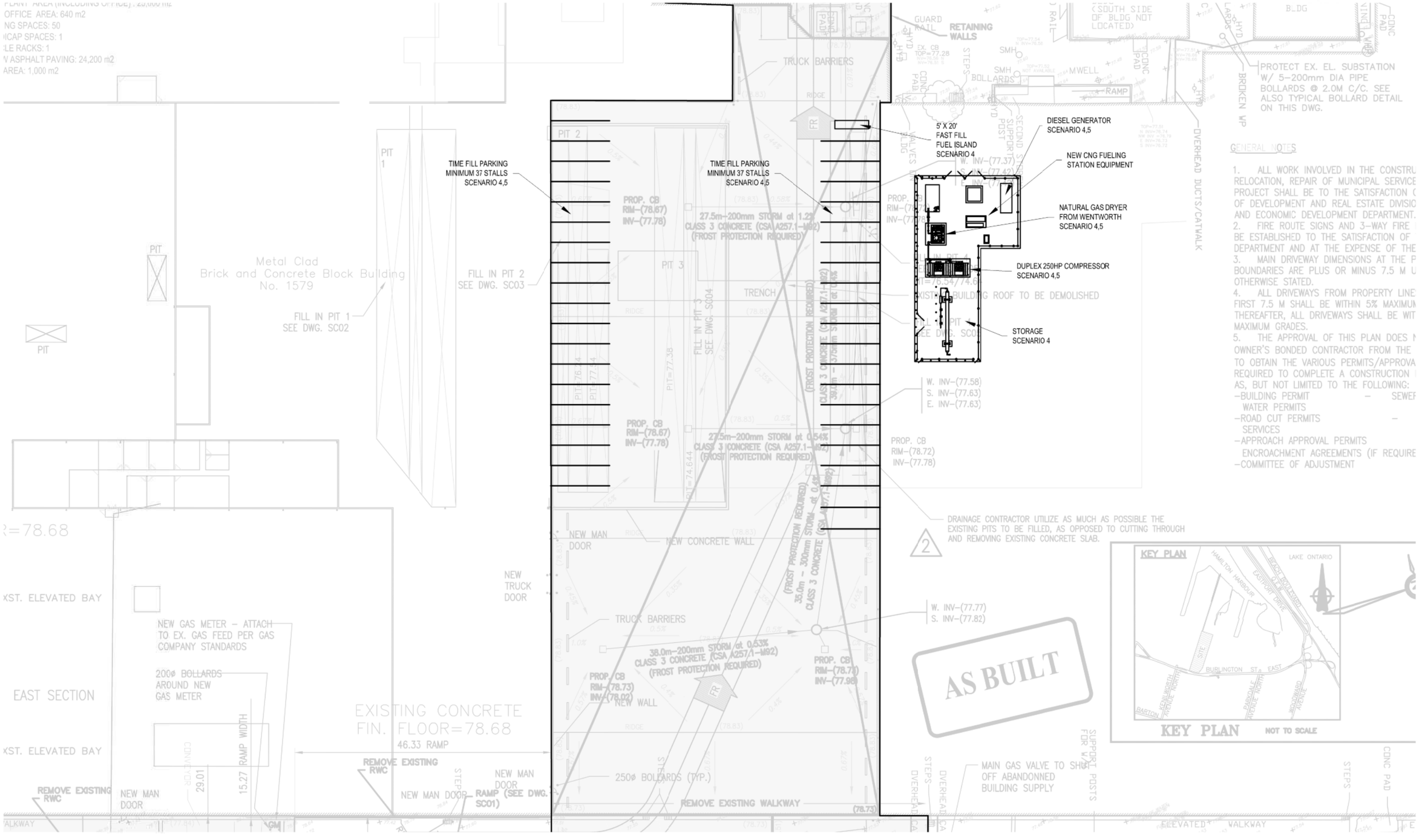
USG US Gallon

VFD Variable Frequency Drive—allows AC motors to operate at part speed.

Appendix B

Site Layout Drawings:

G-02 Hamilton Packer Truck CNG Concept Layout-1579 Burlington St., Hamilton ON



MarathonTechnical Services
9 Venus Crescent,
Heidelberg, Ontario,
N0B 2N1

PROJECT ENGR./ARCH:	
DESIGNER:	Robert R. Adams
DRAWN BY:	KH
SCALE:	NTS
DATE:	12/10/2019
CHECKED BY:	
CHECKED/APPROVED BY:	

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

PROJECT: HAMILTON PACKER TRUCK
CNG STATION
CONCEPT LAYOUT

SHEET TITLE: 1579 BURLINGTON ST.
HAMILTON, ONT.

WORK PROJECT NO.

G-02

Appendix C

Request for Information Provided to Contractors

RFI Excerpt for CNG Station "Fuel as a Service" Concepts:

We have been commissioned to study fueling options for the City of Hamilton. They are interested in exploring fueling strategies that minimize their capital commitment and are therefore looking at options that include compression as a service by a third party.

We are projecting the following project parameters:

1. 271,725 m3 annual throughput for a 7-year period—this is based on a 5-day work week and use 8 hours per day.
2. 80 psig utility pressure.
3. The Contractor would supply, install, permit, operate, maintain and own the station equipment.
4. The facility will/may be removed in 7 years—any costs associated with the removal of the equipment should be included below.
5. The City would prefer that all installation costs be included in the costs of the fuel, however, if there are costs that the City must bear, these should be identified.
6. Assume that sufficient power is available in a building approximately 250 feet from the required location.
7. Do not include any fast fill capability at this time.
8. The attached site drawing was based on a larger project scope—it is provided for general site information only. The site is located at 1579 Burlington Street, Hamilton, ON.

I would like to receive estimated costs by January 22, 2021. Please note that this is an estimate for analysis and budget purposes only. This is not a proposal, quotation or bid. Marathon will provide any information supplied to the City of Hamilton. Please provide the following information:

9. We are anticipating the City installing a 16 truck time fill barricade—is this something you can provide or do we need to supply this?
10. Please identify any capital cost items that the City will incur.
11. What are the infrastructure requirements and space/area required for your system? – please clarify any that are City furnished.
12. Please provide basic equipment specifications including horsepower, amps, scfm, make and model of compressors, dryer and other major equipment, scf of any storage.
13. Is equipment new or used at start of contract?
14. Compressor redundancy is required.
15. Please provide the cost per m3 for:
    a. New gas service from utility.
    b. Capital recovery.
    c. Operation and maintenance.
    d. Any licenses, permits or any other fees.
    e. The price should not include the natural gas commodity or transportation/distribution costs.
    f. The price should not include power costs, but please indicate the size of the motors.
16. What is the annual cost escalation over the seven-year period?

City of Hamilton Compressed Natural Gas (CNG) Packer Truck Funding Repayment

Lender	City of Hamilton
Borrower	City of Hamilton - Public Works (Energy Fleet & Facilities Management)
Purpose	To fund pruchase of CNG Waste Collection Trucks
Funding source	Energy Conservation Initatives (112272)
Report	

Principal Amount	$ 490,000.00
Annual Interest Rate	2.78 %
Loan Term (Year)	7
Debenture Date (mm/dd/yyyy)	12/01/2021
Maturity Date (mm/dd/yyyy)	12/01/2028
Payment Frequency	Annual
Loan Type	Serial

Payment Date	Total Payment	Principal Amount	Interest Amount	Principal Balance
12/01/2022	$ 83,622.00	$ 70,000.00	$ 13,622.00	$ 420,000.00
12/01/2023	$ 81,676.00	$ 70,000.00	$ 11,676.00	$ 350,000.00
12/01/2024	$ 79,730.00	$ 70,000.00	$ 9,730.00	$ 280,000.00
12/01/2025	$ 77,784.00	$ 70,000.00	$ 7,784.00	$ 210,000.00
12/01/2026	$ 75,838.00	$ 70,000.00	$ 5,838.00	$ 140,000.00
12/01/2027	$ 73,892.00	$ 70,000.00	$ 3,892.00	$ 70,000.00
12/01/2028	$ 71,946.00	$ 70,000.00	$ 1,946.00	$ 00.00
	$ 544,488.00	**$ 490,000.00**	**$ 54,488.00**	

CITY OF HAMILTON
PUBLIC WORKS DEPARTMENT
Corporate Asset Management Division

TO:	Chair and Members Public Works Committee
COMMITTEE DATE:	January 10, 2022
SUBJECT/REPORT NO:	Green Venture (PW22004) (City Wide)
WARD(S) AFFECTED:	City Wide
PREPARED BY:	Jasmine MacDonald (905) 546-2424 Ext. 2461
SUBMITTED BY: **SIGNATURE:**	Andrea Vargas Acting Director, Corporate Asset Management Public Works Department 

RECOMMENDATION

(a) That annual funding of approximately $65,000 to Green Venture for the purpose of funding community programs delivered through the Public Works Department be extended to Green Venture until the Lease expiry of January 14, 2025 at 22 Veevers Drive to align the service end date with the current lease expiry date.

EXECUTIVE SUMMARY

The City of Hamilton's (City) Public Works Department provides approximately $65,000 in annual funding to Green Venture for the purpose of funding community programs that educate citizens and students about environmental related services delivered through the Public Works Department.

The City's Procurement Policy #11 has reached its maximum allowable amount of $250,000.00 for these services with Green Venture and therefore requires staff to seek Council's authority to continue to enter into these long-standing agreements.

Alternatives for Consideration – See Page 3

FINANCIAL – STAFFING – LEGAL IMPLICATIONS

Financial: A budget base amount of $65,000 has been provided to Green Venture since 2017 and has not increased since that time. This recommendation is required due to the current Policy #11 limit of $250,000.00 being reached in 2020.

Staffing: N/A

Legal: N/A

HISTORICAL BACKGROUND

Green Venture is a registered non-profit organization which was established in 1994 as a creation of the former Region of Hamilton-Wentworth. Since that time, Green Venture has been a leading environmental agency within the Hamilton area to promote sustainable living ideas. Green Venture helps to encourage the use of Blue Boxes, Green Carts, rain barrels, sustainable transportation methods, and energy conservation in the Hamilton area.

On January 14, 2015 Council approved Report PED15005, a Lease Agreement for Veevers Estate with Green Venture. The intent of the Lease Agreement was to retain the current tenant and continue the adaptive re-use arrangement for the Veevers Estate. As in the previous Lease Agreement, Green Venture is responsible for all day-to-day costs for the facility. The City, as owner of the estate, will include longer term capital upgrades and preservation initiatives, as necessary, in its ten-year capital plan.

The current term of the Lease Agreement is for a period of 12 years (January 15, 2013 – January 14, 2025) with a nominal fee of two dollars / year, plus HST.

In addition to the funding provided by the Public Works Department, Green Venture also obtains additional funding from other agencies and levels of government and donations to help deliver their programs.

POLICY IMPLICATIONS AND LEGISLATED REQUIREMENTS

N/A

RELEVANT CONSULTATION

The recommendations in this report were prepared in consultation with staff from the Planning and Economic Development Department (Heritage Resource Management Section) and Public Works Department (Environmental Services Division, Hamilton Water Division, Transit Division).

ANALYSIS AND RATIONALE FOR RECOMMENDATION

This recommendation is required due to the current Policy #11 limit of $250,000.00 being reached in 2020. Green Ventures conducts community based social marketing education and outreach to residents of Hamilton and the surrounding region on behalf of the Public Works Department. This work has been ongoing since 1998.

The messaging from Green Venture helps disseminate Public Works key public messaging to a wide Hamilton audience. This includes messages on water conservation and water quality, waste reduction and diversion, ease and value of public transit, and integrating sustainable transportation options (e.g. cycling).

Approximately 25,000 people are directly or indirectly engaged through this work annually.

Some of the services provided by Green Venture include:

- On-site tours of the EcoHouse to area school classes;
- Delivering off-site environmental education presentations to community groups;
- Sharing Public Works program information at community events;
- Coordinate volunteer management at EcoHouse;
- Operating the Public Works related displays at EcoHouse including strategies to promote waste reduction and water conservation;
- Host a community “Zero Waste Fair”, to promote waste diversion and water quality awareness;
- Continue to house, promote and book the “Waste Education Kits”;
- Disseminate Public Works messaging in the community by sending staff to community festivals and events;
- Increase native plant biodiversity at EcoHouse; and,
- Work with Public Works staff to continue to update messaging as requested.

ALTERNATIVES FOR CONSIDERATION

If Council does not wish to approve the recommendation identified in Report PW22004, Green Venture services provided to Public Works will not continue into 2022.

ALIGNMENT TO THE 2016 – 2025 STRATEGIC PLAN

Clean and Green

Hamilton is environmentally sustainable with a healthy balance of natural and urban spaces.

Built Environment and Infrastructure
Hamilton is supported by state-of-the-art infrastructure, transportation options, buildings and public spaces that create a dynamic City.

APPENDICES AND SCHEDULES ATTACHED

N/A

Hamilton

CITIZEN COMMITTEE REPORT

To:	Public Works Committee
From:	Hamilton Cycling Advisory Committee Chris Ritsma, Chair
Date:	October 6, 2021
Re:	Barton & Fifty Road Environmental Assessment Cycling Infrastructure

Recommendation

(a) That Barton Street East cycling lanes be separated and protected according to best practices and make connections to local schools in the area; and,

(b) That Barton Street East cycling lanes be in the direction of expected automobile traffic, unless a suitable space with limited driveways can be made for a bi-directional bicycle track; and

(c) That Fifty Road cycling lanes cross the Queen Elizabeth Way bridge and connect to existing Winona cycling infrastructure; and

(d) That Fifty Road cycling lanes be extended to the South Service Road to connect to existing cycling infrastructure east of the Hamilton border, into Niagara region.

Background

The Hamilton Cycling Committee has reviewed the Barton & Fifty Road Environmental Assessment as it relates to cycling infrastructure. Members of the Committee also attended the PIC on Thursday June, 17, 2021 in order to collect additional information about the project.

The Committee reviewed a number of best practices literature including, OTM Book 18 - Cycling Facilities, NACTO - Urban Bikeway Design Guide and various other cycling manuals outside of North America. In addition, the Committee reviewed previous findings relating to multi-use pathways as well as local connections such as commercial and schools. In this review, the committee found that there are many essentials within cycling distance (i.e. less than 5km).

Analysis/Rationale

The Hamilton Cycling Advisory Committee found that Barton Street (east of Fruitland Road) and Fifty Road are on the cycling masterplan. The committee's recommendations on cycling infrastructure makes sense based on the expected growth of the area and the connection to multiple schools. In addition, Fifty Road could provide connections to both Grimsby and Niagara. Multi-use paths work best in places where usage is low, and constant. Large groups of students cycling or walking along a multi-use path would mean that during the peak period, the multi-use path would not be optimal and could be dangerous. Bi-directional bicycle lanes should only be utilized in places with few driveways, otherwise they are less safe than single direction bicycle lanes.

11.1

CITY OF HAMILTON

M O T I O N

Public Works Committee: January 10, 2022

MOVED BY COUNCILLOR T. JACKSON…….

SECONDED BY COUNCILLOR……..

Installation of Speed Cushions as a Traffic Calming Measure on Presidio Drive (Ward 6)

WHEREAS, residents on Presidio Drive in Ward 6 have advocated for the installation of speed cushions to address roadway safety concerns as a result of speeding; and

WHEREAS, signatures were collected from 26 residents resulting in support by 22 of 28 homes on Presidio Drive for the installation of speed cushions as a traffic calming measure;

THEREFORE, BE IT RESOLVED:

(a) That Transportation and Operations Maintenance staff be authorized and directed to install 3 speed cushions as a traffic calming measure on Presidio Drive as part of the 2022 Traffic Calming Program's spring application, as follows;

  (i) between the westerly curve of Presidio Drive and Enola Avenue;

  (ii) between Elona Avenue and Osgoode Court; and

  (iii) between Osgoode Court and Eaglewood Drive.

(b) That all costs associated with the installation of 3 speed cushions as a traffic calming measure on Presidio Drive be funded from Project ID 4031911606, to be completed under contract # C15-12-22.

(c) That the Mayor and City Clerk be authorized and directed to execute any required agreement(s) and ancillary documents, with such terms and conditions in a form satisfactory to the City Solicitor.

* TOTAL = 26 signees (22/28 homes on street approved.)

CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

P. Desmarais
Name (Please Print)

P. Desmarais
Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

Please note that all personal information collected will only be shared with the Office of Ward 6 Councillor Tom Jackson and Traffic Department staff. It will not be disclosed to the public in anyway.

CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Name (Please Print)

Name (Please Sign)

[redacted]
Address

Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Deborah Ward
Name (Please Print)

Deborah Ward
Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

TERRY WARD
Name (Please Print)

Terry Ward
Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

JOSH WARD
Name (Please Print)

Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Josie Alfieri
Name (Please Print)

Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Nick Alfieri
Name (Please Print)

Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Zhikong Yun
Name (Please Print)

Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Kaitlin Rooney
Name (Please Print)

Kaitlin Rooney
Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Tanya Mitchell
Name (Please Print)

Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Stephanie Skrodzki
Name (Please Print)

Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

TOM GRIMSHAW
Name (Please Print)

DONNA GRIMSHAW
Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

David & Connie McCullagh
Name (Please Print)

C. McCullagh
Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Janet Nekut
Name (Please Print)

Janet Nekut
Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Don Coffelows
Name (Please Print)

Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

KAREN BROWN
Name (Please Print)

Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

NORM BROWN
Name (Please Print)

Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Jaime Frank
Name (Please Print)

J. Frank
Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Leanne Pollack
Name (Please Print)

Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Jawad Saddik
Name (Please Print)

J. Saddik
Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Maria Talarico
Name (Please Print)

TALOSI MARIA
Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

JULIE CLARK — Judith Clark
Name (Please Print)

CHRIS CLARK
Name (Please Sign)

ANDREW CLARK
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Raven van Bommel
Name (Please Print)

Alex Voukoutiotis
Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

Mona

Name (Please Print)

Name (Please Sign)

[redacted]

Address

[redacted]

Phone Number

[redacted]

E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

MIRELA BOZZO
Name (Please Print)

Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

[redacted]
E-mail Address

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CITY OF HAMILTON
PETITION

I, THE UNDERSIGNED, SUPPORT THE INSTALLATION OF SPEED CUSHIONS ON PRESIDIO DRIVE.

JOWKHADA MUKHAIL
Name (Please Print)

Name (Please Sign)

[redacted]
Address

[redacted]
Phone Number

E-mail Address

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