Committee of the Whole Meeting

Agenda

Monday, July 22, 2024, Immediately Following City Council (Public Meeting)

S.H. Blake Memorial Auditorium

Report 253-2024-Infrastructure, Development & Operations-Capital Facilities and Construction supporting Administration's recommendation to maintain the existing Thunder Bay Public Library facilities rather than Scenario 2 or Scenario 3 of the Thunder Bay Public Library's Master Facilities Plan due to fiscal prudence, risk of investment in a leased space, and indirect impacts on the south core with the sale of Brodie Library.

Correspondence received from Dr. Richard Togman dated June 4, 2024, requesting to provide a deputation relative to the Thunder Bay Public Library (TBPL) Master Facilities Plan.

Correspondence received from TBPL Board Chairperson Carol Grieves dated July 11, 2024, relative to the TBPL Board endorsing and approving the TBPL 2024 Master Facilities Plan.

Correspondence received from Kaisa Piech dated July 12, 2024, providing a written deputation relative to the Thunder Bay Public Library - proposed new Central Location.

WITH RESPECT to Report 253-2024 - Infrastructure, Development & Operations – Capital Facilities Construction we support Administration's recommendation to maintain the existing Thunder Bay Public Library facilities for the reasons outlined in the Report, rather than Scenario 2 or Scenario 3 of the Thunder Bay Public Library's Master Facilities Plan which require additional municipal debt, significant investment in a leased space, and indirect impacts on the south core with the sale of Brodie Library;

AND THAT a copy of this resolution be provided to the Thunder Bay Public Library Board to guide future planning;

AND THAT Administration work with Thunder Bay Public Library to plan future capital investments in existing facilities;

AND THAT item 2023-003-ADM TBPL Master Facilities Plan be removed from the Outstanding Items list;

AND THAT any necessary by-laws be presented to City Council for ratification.

7.2 Transit and Municipal Fleet Zero Emissions Transition Plan 62 - 366

At the May 13, 2024 Committee of the Whole meeting Report 144-2024-Infrastructure, Development & Operations-Engineering & Operations, recommending that the Transit and Municipal Fleet Net Zero Transition

Plans be approved was presented as a First Report to allow Committee of the Whole and the general public time to consider the implications of the report before its recommendations are considered by Committee of the Whole on July 22, 2024.

Memorandum from Manager - Capital Facilities Construction Kelvin Jankowski dated June 14, 2024 recommending that the re-presentation date for the First Report - Transit and Municipal Fleet Net Zero Transition Plans, be changed from July 15, 2024 to July 22, 2024.

Memorandum from Manager - Capital Facilities Construction Kelvin Jankowski dated July , 2024 providing a summary of questions and responses received relative to First Report - Transit and Municipal Fleet Net Zero Transition Plans.

Report 144-2024-Infrastructure, Development & Operations-Engineering & Operations, recommending that the Transit and Municipal Fleet Net Zero Transition Plans be approved, re-presented.

WITH RESPECT to Report 144-2024-Infrastructure, Development & Operations-Engineering & Operations, we recommend that the Transit and Municipal Fleet Net Zero Transition Plans be approved;

AND THAT Administration continue advancing planning, design and construction to move forward with transit and municipal fleet electrification based on the Transition Plans;

AND THAT projects be brought forward for approval through the annual budget process;

AND THAT any necessary By-laws be presented to City Council for ratification.

8. Outstanding Items 367 - 368

Memorandum from Director - Legislative Services & City Clerk Krista Power dated July 9, 2024, containing the Planning Services Outstanding List, for information.

9. Open Session (Administrative Services)

Chair: Councillor Mark Bentz

10. Reports of Committees, Boards and Outside Agencies

10.1 Police Service Board 369 - 398

Minutes of the Police Services Board Meeting(s) held on October 17, 2023, November 21, 2023 and December 19, 2023, respectively, for information.

Minutes of Meeting 01-2024 of the Official Recognition Committee held on February 29, 2024, for information.

Minutes of Meeting 03-2024 of the Clean, Green & Beautiful Committee held on April 25, 2024, for information.

Minutes of Board of Health Meeting held on May 15, 2024, for information.

11. Reports of Municipal Officers

Report 271-2024-Corporate Services-Licensing & Enforcement recommending that a Downtown Core resident rate be established for the parkades at $52.28 +HST per month, a 25% discount from the listed rate, effective August 15, 2024.

WITH RESPECT to Report 271-2024-Corporate Services-Licensing & Enforcement, we recommend that a Downtown Core resident rate be established for the parkades at $52.28 +HST per month, a 25% discount from the listed rate, effective August 15, 2024;

AND THAT a Downtown Core resident rate be established for the Crooks and Courthouse Daily Lots at $46.47 +HST per month, a 25% discount from the listed rate, effective August 15, 2024;

AND THAT current Schedule D of the User Fee By-law 28-2007 be repealed and replaced with the amended Schedule D, as appended to this report;

AND THAT By-law 245-2024 be repealed;

AND THAT By-law 075-2024 be amended to include a Temporary Construction Exemption as outlined in this report;

AND THAT the Outstanding Item 2024-003-ADM-Corportate Services Report Back – Parking Authority Financial Plan – Resident Consultation be removed from the Outstanding list;

AND THAT any necessary by-laws be presented to City Council for ratification on August 12, 2024.

12. Outstanding Items 427 - 428

Memorandum from Director - Legislative Services & City Clerk Krista Power dated July 9, 2024, containing the Administrative Services Outstanding List, for information.

13. New Business

14. Adjournment

February 29, 2024

COMMITTEE OF ADJUSTMENT

DATE February 29, 2024

MEETING NO. 02-24

TIME 2:00 p.m.

PLACE McNaughton Room * Electronic Participation using MS teams.

Matthew Pascuzzo, Acting Chair
Tyler Rizzuto, Member
Normand Roy, Member
Brian Phillips, Member

Adam Crago, Assistant Secretary-Treasurer
Fiona Buchan, Secretary-Treasurer
*Jillian Fazio, Planner II
Decio Lopes, Supervisor
*Aaron Ward, Project Engineer

ABSENT: Chair Peterson

Acting Chair Pascuzzo outlined the procedure which the Committee would follow in dealing with an application, and then called for a poll of disclosures of interest. The Secretary Treasurer polled the Committee.

DISCLOSURE OF INTEREST: Member Pascuzzo – A-01-2024, A-02-2024, A-03 2024; business dealings

The Agenda was adjusted to add an application that was omitted on the Agenda, 5a at 18 Lake Street.

APPLICATIONS

1. Application No.: **A-62-2023** Kathleen Foley
62 Machar Avenue

The Secretary-Treasurer provided an overview of the Minor Variance Application.

Minor Variance application for reduction of lot area from 450 m^2 to 410.6 m^2 , reduction of the minimum lot frontage from 15 m to 10.36 m, reduce the maximum interior side set back from 3 m to 1.27m , 3 parking spaces side by side and to allow for the shed to be closer than 0.6, reducing the set back to 0 and eaves from .03 to 0.

Applicant Kathleen Foley participated in person, and confirmed the sign was posted. The applicant did not have any further comments at the time.

Comments:

The Secretary-Treasurer read correspondence noting that Tbaytel, Thunder Bay Fire, Thunder Bay Police, Parks and Open Spaces Section had no comments or concerns.

Realty Services commented that if any access to parking is over the adjoining laneway the applicant should be required to enter into a License of Access with Realty Services.

Planning Technician Crago presented planning comments, confirming that the four tests were met with the exception of the requested variances to the location of the existing shed. With a requested condition to relocate the existing shed to comply with Table 3.2.2 of the Zoning By-law, Planning Services supports the application.

The Secretary Treasurer provided an overview of the Engineering comments.

The Applicant asked for clarification on the shed and provided photos of the shed.

Planning Technician Crago explained the request is to relocate the shed to be 0.6m from the lot line as opposed to the 0.0m requested.

Conditions were confirmed by the Secretary-Treasurer.

Questions about the parking, Applicant explained the parking arrangements.

The Acting Chair called for a vote to the approval of the application. Members Roy, Rizzuto, Phillps and Pascuzzo were in favour. The majority of members have supported the approval of the application, therefore the application was approved.

Member Pascuzzo left the room due to Conflicts with A-01-2024, A-02-2024, A-03-2024.

Member Rizzuto took over to Chair the hearing.

2. Application No. **A-01-2024** — Carolynn Almos (733515 Ontario Inc.)
Triad
154 Bruin Crescent

The Secretary-Treasurer provided an overview of the Minor Variance. Reduction of interior side setback from 3 m. to 1.5 m on both sides. Reduce the distance between the driveways from 6 m to 5.3 m to accommodate extra driveways for four-plex development.

The Secretary-Treasurer explained that the effect of the application would be to allow for the construction of a Four- unit apartment building.

Agent Carolynn Almos (Triad), participated virtually and was available to answer questions regarding the application. Acting Chair Tyler Rizzuto asked if the required signs had been posted. The applicant confirmed that the sign was posted. The applicant did not have any additional comments.

COMMENTS:

The Secretary-Treasurer read the correspondence, TbayTel, Synergy North, Realty Services, all had no comments or concerns.

Engineering **–**no comments or concerns.

Parks Open Spaces made a comment that in the future if the property is severed the proposed driveway width of 4.8 m on a 9 m wide lot would exceed the 50 % hard surface for front yards and would require a variance.

Planner Labelle presented Planning Comments, confirming that the four tests were met and that Planning supports the application as presented.

The Secretary Treasurer confirmed that no conditions are requested.

Acting Chair Rizzuto called for a vote. Acting Chair Rizzuto, Member Roy, and Member Phillips were all in favour. The majority of members have supported the approval of the application and therefore the application was approved.

3. Application No. **A-02-2024** Carolynn Almos (733515 Ontario Inc.)
Triad
154 Bruin Crescent

The Secretary-Treasurer provided an overview of the Minor Variance.

Reduce the interior side setback from 3 m to 1. 5 for both sides. Reduce the distance between the driveways from 6 m to 5.34 m

The Secretary-Treasurer explained that the effect of the application would be to allow for the construction of a 4 unit apartment building.

Agent Carolynn Almos (Triad), participated virtually and was available to answer questions regarding the application. Acting Chair Tyler Rizzuto asked if the required signs had been posted. The applicant confirmed that the sign was posted. The applicant did not have any additional comments.

COMMENTS:

The Secretary-Treasurer read the correspondence, TbayTel, Synergy North, Realty Services, all had no comments or concerns.

Engineering no conditions or comments**.**

Planner Labelle presented Planning Comments, confirming that the four tests were met and that Planning supports the application as presented.

No conditions were requested.

The Secretary Treasurer confirmed that no conditions are requested.

Acting Chair Rizzuto called for a vote. Acting Chair Rizzuto, Member Roy, and Member Phillips were all in favour. The majority of members have supported the approval of the application and therefore the application was approved.

4. Application No. **A-03-2024** Carolynn Almos (733515 Ontario Inc.:
Triad
154 Bruin Crescent

The Secretary-Treasurer provided an overview of the Minor Variance.

Reduce the interior side setback from 3 m to 1. 5 for both sides. Reduce the distance between the driveways from 6 m to 5.34 m.

The Secretary-Treasurer explained that the effect of the application would be to allow for the construction of a 4 unit apartment building.

Agent Carolynn Almos (Triad), participated virtually and was available to answer questions regarding the application. Acting Chair Tyler Rizzuto asked if the required signs had been posted. The applicant confirmed that the sign was posted. The applicant did not have any additional comments.

COMMENTS:

The Secretary-Treasurer read the correspondence, TbayTel, Synergy North, Realty Services, all had no comments or concerns.

Engineering no conditions or comments**.**

Planner Labelle presented Planning Comments, confirming that the four tests were met and that Planning supports the application as presented.

The Secretary Treasurer confirmed that no conditions are requested.

Acting Chair Rizzuto called for a vote. Acting Chair Rizzuto, Member Roy, and Member Phillips were all in favour. The majority of members have supported the approval of the application and therefore the application was approved.

5. Application No.: **A-06-2024** Stefan Huzan (Michael Parry, Lakehead Property Solutions)
380 Dufferin Street

The Secretary-Treasurer provided an overview of the Minor Variance application and requested variances as follows:

Increase the driveway width from 6 m to 9 m for two driveways. Increase the maximum spaces accessed from the driveway off Dufferin Street from 3 spaces to 4 spaces. Allow for 3 parking spaces in the required landscaped open space in the front yard. Reduce the required accessible parking spot from 1 to 0 accessible spots.

The purpose and effect of the application would be the redevelopment of the existing building to a four-unit apartment building.

Michael Parry was present in person and was able to speak to the application. The Chair asked if the required signs had been posted. The applicant confirmed that the sign was posted and did not have any comments at the time.

COMMENTS:

The Secretary-Treasurer read the correspondence, TbayTel, Building Services and Synergy North, all had no comments or concerns.

Engineering Comments – one condition that the applicant reapply for an entrance permit.

Realty services – Commented a License Agreement for the use of the proposed parking for spaces which encroach on to Dufferin Street and Banning Street.

Parks and Open Spaces – no objections but made comment recommend consider additional tree, shrubs or perineal planting on their lands fronting on both Dufferin and Banning to visually compensate for the hard surface driveway added.

Planning Services’ comments were presented by Acting Senior Planner Fazio, who confirmed that the four tests were met and supported the application as presented. Planner Fazio also noted that the variances are for parking spaces that are exceeding the minimum spaces required. Planner Fazio noted the parking spaces encroach into the City boulevard, and a license agreement is required. It was also noted that there is no sidewalk on Banning Street, and should a sidewalk be constructed, there is no guarantee the parking spaces will remain therefore they should be constructed at the applicant’s own risk. Assessable parking space is not required. The applicant has provided more then the required parking spaces. Planning Services recommends conditional approval of the variances.

One condition is recommended the agreement to use portions of the street allowance for parking to the satisfaction of the Realty Services Division.

Acting Chair Pascuzzo asked Planning how a potential future sidewalk would impact the parking spaces on Banning Street. Acting Senior Planner Fazio responded explaining if a sidewalk was constructed, the proposed driveway on Banning Street would no longer comply, and that there are no guarantees the spaces would remain if this was ever to happen.

Conditions were confirmed.

Chair Pascuzzo called for a vote. Approval was supported by, Member Roy, Member Rizzuto, and the Member Phillips. The majority of members have supported the approval of the application and therefore the application was approved.

6. Application No.: **A-04-2024** Paula Cummingham
18 Lake Street

The Secretary-Treasurer provided an overview of the Minor Variance application and requested variances as follows:

Reduce the maximum number of homes from 1 home per 135 m^2 to 1 home per 100 m^2 of lot area. Increase the maximum lot coverage from 40% to 55% of lot area. Reduce the minimum lot frontage from 4.5 m to 3.33 m per home (13.5 m to 10 m for three homes). Reduce the minimum interior side setback from 3.0m to 1.5m for both sides. Reduce the minimum rear setback from 6.0m to 1.5m. Reduce the minimum landscaped area from a 3.0 m strip to a 1.5 m strip along all lot lines abutting a street allowance. Increase the minimum 1 parking spaces per home to 2 parking spaces in tandem. Increase the minimum 1 parking space per home to 2 parking spaces (in tandem).

The purpose and effect would be the construction of an attached garage with a barrier-free bachelor apartment on the ground floor and a two-bedroom apartment on the second floor for a total of three units.

Paula Cunningham was present to speak to her application. She confirmed the required sign was posted.

<u>COMMENTS:</u>

The Secretary-Treasurer read the correspondence, Tbay tel, Building Services, Synergy North, Parks and Open Spaces all had no comments.

Realty Services stated that any access to parking that is over the adjoining laneway would require an applicant to enter into a Licence Agreement with Realty Services.

City Official Aaron Ward presented the Engineering conditions, lot grading and drainage plan and that the applicant must submit an application and deposit to the Environment Division for the installation of water and storm sewer and sanitary connections.

Planning Comments were presented by Acting Senior Planner Fazio. Confirmed that the development is minor but is consistent with buildings in the area. Explained the Downtown zone regulations. Confirmed parking and landscaping requirements as well as storm sewer condition. Planning Services recommends approval of the subject application.

Questions asked by Chair Pascuzzo asked about locations of the units.

Conditions were confirmed.

Chair Pascuzzo called for a vote. Approval was supported by, Member Roy, Member Rizzuto, Member Phillips and Chair Pascuzzo. The majority of members have supported the approval of the application and therefore the application was approved.

Application B-05-2024 has been deferred to the March 28 hearing.

7. Application No. **A-07-2024** Fred Wood (Santosh Sultoo)
604-606 Winnipeg Avenue

The Secretary-Treasurer provided an overview of the Minor Variance application and requested variances as follows:

Reduce the minimum lot frontage from 4.5 m to 3.75 m per home, increase the maximum number of homes from 1 per 135 m^2 to 102 m^2 of lot area. Reduce the minimum interior side setback from 3 m to 1.2 m for one side of the building. Increase the maximum number of driveways from 1 to 2. Reduce the minimum separation distance between driveways on the same form 6 m to 3 m.

COMMENTS:

The Secretary-Treasurer read the correspondence, Tbay Tel, Realty Services, Building Services, Synergy North all had no concerns or objections.

Parks and Open Spaces had no opposition for the Minor Variance but did have the following comments:

1) There appears to be an existing coniferous tree close to the north property and street line. This may or may not be on municipal lands. In any case the driveway as shown would have negative impacts to the tree. If the tree is located on municipal lands it will be required to be compensated at a rate of 2:1, meaning a street tree fee of 2 x $500.
2) The Parks & Open Spaces section does not support 3.0m wide parking spaces in the front yard, resulting in little residual landscape space. We recommend the parking stalls be reduced to the standard 2.4m or 2.8m widths as applicable.
3) We recommend the property be designated as under Site Plan Control if not already so.

Engineering had two conditions, presented by City Official Aaron Ward, a Lot Grading and Drainage Plan and submit an application and deposit to the Environment Division for the installation of water and storm sewer and sanitary connections.

Planning Comments from Acting Senior Planner Fazio. Planning is supportive of the proposed development and discussed parking requirements, landscaping along with the separation of driveways.

Question was asked by Chair Pascuzzo, who is responsible for the location of the tree in the Parks comment, is it the applicant or the City figures out where the tree is located and how it is dealt with. The City would review the driveway permit and this tree would be reviewed and conditioned if needed.

Conditions were confirmed by the Secretary-Treasurer.

Chair Pascuzzo called for a vote. Approval was supported by, Member Roy, Member Rizzuto, Member Phillips and Chair Pascuzzo. The majority of members have supported the approval of the application and therefore the application was approved.

OLD BUSINESS

Minutes from January 2024 had been sent out but the members felt they should wait for Member Peterson to approve.

Re-posting of COA member – Communicating with the Clerk's Office for next posting. Advertisement on City Website for new Committee of Adjustment Member from April 14 to April 28, 2024. Secretary-Treasurer stated the posting is a little hard to find. Member's contact observed the hearing thinking about applying to join the COA as a member.

NEW BUSINESS

The script for members and appeal rights needs to be updated. The Secretary-Treasurer confirmed this would be done by next hearing.

Motion to adjourn by Member Roy and seconded by Member Phillips.

ADJOURNMENT

The meeting was adjourned at 3:14 p.m.

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CHAIR

____
SECRETARY-TREASURER

CITY OF Thunder Bay Superior by Nature

Mayor's Taskforce on Building More Homes Advisory Committee Meeting Minutes

Wednesday, May 22, 2024, 12:30 p.m.
McNaughton Room - 3rd Floor, City Hall

1. Mayor's Taskforce on Building More Homes Advisory Committee Meeting 02-2024

Chair: Mayor Ken Boshcoff

2. Members

Mayor Ken Boshcoff
Justyn Desjardins -Representative - Institution Delivering Construction and Trades Training
Karen Hill - Representative - Real Estate Association
Harold Lindstrom - Representative - Construction/trades Association involved in Housing Construction
Paul Magiskan - Representative - Indigenous led Stakeholder with Affordable Housing Development Experience
Ken Ranta - Representative - Public/Non-Profit Housing Organization involved in Affordable Housing
John Stephenson - Member of Public with Working Knowledge of Research involvement in Housing and Housing Affordability and Development

3. Officials/Resource Persons

Krista Power, Director of Legislative Services & City Clerk
Kerri Marshall, General Manager - Infrastructure, Development & Operations
Joel DePeuter, Director-Development Services
Summer Stevenson, Project Manager-Housing Accelerator
Jamie Lee Kostecki, Manager-Community Development
Larry Joy, Policy Assistant to the Mayor
Decio Lopes, Supervisor-Planning Services
Aaron Ward, Project Manager-Development Services

Jillian Fazio, Senior Planner
Katie Piché, Council & Committee Clerk

4. Guests

Adam Kroeker, Tim Hogan - HTFC Planning & Design
Shannon Costigan, Amanda Iachetta - Ministry of Labour, Immigration, Training and Skills Development - Employment and Training Division

5. Disclosures of Interest

6. Agenda Approval

WITH RESPECT to the May 22, 2024 meeting of the Mayor's Taskforce on Building More Homes Advisory Committee, we recommend that the agenda as printed, including any additional information and new business, be confirmed.

MOVED BY: Harold Lindstrom
SECONDED BY: Justyn Desjardins

WITH RESPECT to the May 22, 2024 meeting of the Mayor's Task Force on Building More Homes Advisory Committee, we recommend that the agenda as printed, including any additional information and new business, be confirmed.

CARRIED

7. Confirmation of Previous Minutes

The Minutes of Meeting 01-2024 of the Mayor's Taskforce on Building More Homes Advisory Committee, held on April 17, 2024, to be confirmed.

MOVED BY: Justyn Desjardins
SECONDED BY: Paul Magiskan

THAT the Minutes of Meeting 01-2024 Mayor's Taskforce on Building More Homes Advisory Committee, held on April 17, 2024, be confirmed.

CARRIED

8. Items Arising from Previous Meeting

8.1 Workforce Development

Manager - Community Development Jamie Lee Kostecki introduced representatives from the Ministry of Labour, Immigration, Training and Skills Development Shannon Costigan and Amanda Iachetta, who provided an overview relative to the Ministry's training and grant programs, and incentives available to apprentices. The following items were discussed:

- Application processing and approval
- overview of financial supports available
- Incentives to hire skilled trade workers
- How to drive recruitment
- Hosting more tradeshows for students

A discussion was held regarding stimulating additional construction and how to advertise to tradespeople that there are programs and resources available.

The Committee formed a working group comprised of Justyn Desjardins, Karen Hill, Harold Lindstrom and Jamie Lee Kostecki for the purpose of determining further promotion of apprenticeship programs and incentives within the community.

It was noted that Justyn Desjardins will provide an overview of Confederation College's upcoming recruitment events and workshops at a future meeting.

MOVED BY: Justin Desjardins
SECONDED BY: Karen Hill

WITH RESPECT to the Ministry of Labour, Immigration, Training and Skills Development presentation on apprenticeship programs at the May 22, 2024 Mayor's Taskforce on Building More Homes Advisory Committee meeting, we endorse the programs available and will assist in the promotion of the information within the housing industry.

CARRIED

9. Housing Accelerator Fund (HAF) Action Plan Update

Project Manager Summer Stevenson provided an update relative to the recent reports presented to Council and advised that commencing in June, Planning Services can begin accepting applications for Housing Accelerator funding.

It was noted that Housing Accelerator Coordinator Paula Cunningham is leading the outreach for the Affordable Rental Housing Funding Program.

10. Zoning By-law Update

Director - Development Services Joel DePeuter introduced Senior Planner Jillian Fazio who provided a PowerPoint presentation relative to the above noted and responded to questions. The following items were discussed:

- Proposed amendments to encourage housing
- Purpose of amendments
- Notable changes: low density housing, medium density housing and parking for multi-unit housing
- Process and next steps

Amendments will be presented at City Council (Public Meeting) to be held on May 27, 2024.

A discussion was held relative to the specific parking amendments and Jillian Fazio noted that the Planning Division will consider future amendments based on feedback from the Committee.

11. Housing Land Needs Study Results

Director - Development Services Joel DePeuter introduced consultants Adam Kroeker and Tim Hogan from HTFC Planning & Design who provided a PowerPoint presentation relative to the above noted and responded to questions. The following items were discussed:

- Background and timelines
- Community engagement
- Population
- International students
- Need for affordable housing, housing need by type
- House prices vs. income

- Homeownership by age
- Units built per year
- Population projections
- Inventory of vacant lots, future development areas, urban growth area
- Official Plan policies and zoning regulations
- Incentivizing housing and other strategies

The report includes recommendations to improve housing affordability, reduce barriers for development, and address the gaps in existing housing supply. Many of the recommendations have become part of Thunder Bay's Housing Accelerator Fund initiatives.

A discussion was held relative to growth projection assumptions, forecasted land, current restrictions and steps being taken to address the challenges.

Further discussion was held relative to the number of homes being build outside of City limits (ie: Shuniah, Oliver Paipoonge, etc.) and how to stimulate growth within the City of Thunder Bay.

Director - Development Services Joel DePeuter, Supervisor - Planning Services Decio Lopes and Project Manager Summer Stevenson responded to questions.

12. Next Meeting

The next meeting date will be held on June 19, 2024 at 12:30 p.m. in the McNaughton Room.

13. Adjournment

The meeting adjourned at 2:09 p.m.

Corporate Report

REPORT NUMBER 253-2024-Infrastructure, Development & Operations-Capital Facilities and Construction			
DATE PREPARED	June 17, 2024	***FILE***	
MEETING DATE	July 22, 2024		
SUBJECT	Thunder Bay Public Library - Master Facilities Plan Operating and Capital Implications		

RECOMMENDATION

WITH RESPECT to Report 253-2024 - Infrastructure, Development & Operations – Capital Facilities Construction we support Administration's recommendation to maintain the existing Thunder Bay Public Library facilities for the reasons outlined in the Report, rather than Scenario 2 or Scenario 3 of the Thunder Bay Public Library's Master Facilities Plan which require additional municipal debt, significant investment in a leased space, and indirect impacts on the south core with the sale of Brodie Library;

AND THAT a copy of this resolution be provided to the Thunder Bay Public Library Board to guide future planning;

AND THAT Administration work with Thunder Bay Public Library to plan future capital investments in existing facilities;

AND THAT item 2023-003-ADM TBPL Master Facilities Plan be removed from the Outstanding Items list;

AND THAT any necessary by-laws be presented to City Council for ratification.

EXECUTIVE SUMMARY

As part of its Master Facilities Plan, the Thunder Bay Public Library (TBPL) is proposing several scenarios in which one or more of their current facilities are closed, and a new central library is established inside the Intercity Shopping Centre.

Three relevant scenarios included in the Plan are summarized as follows:

- **Status Quo:** Maintain the existing library system with necessary investments in current facilities, including significant retrofits for Waverley Library.

- **Scenario 2:** Close Brodie Street Library and establish a new central library in the Intercity Shopping Centre, while maintaining other branches.

- **Scenario 3:** Close both Brodie Street Library and the existing library space in County Fair Mall and establish a new central library in the Intercity Shopping Centre, while maintaining other branches.

Administration was directed to review Scenarios 2 and 3 and report back on potential capital and operating financial implications for these two scenarios.

Further, during 2024 Budget deliberations, Council provided direction to approve the capital budget for the TBPL presented in the City's proposed budget and that no further City of Thunder Bay funds be committed to the central library project until the results of the planning process were complete.

By legislation and supported by past practise, the TBPL is an independent body mandated to deliver high-quality library services to the City of Thunder Bay. As such, City Administration has no role in analysing or commenting on the plans established by the TBPL Board and CEO. Future initiatives, structures, products, and services are the sole responsibility of the TBPL Board. It would be wholly inappropriate for City Administration to comment (positively or negatively) on those items within the purview of this independent body.

That said, Council, and by extension City Administration, does have an important role in ensuring that it is comfortable with the financing provided to the TBPL. It also has a role in determining acceptable risk for that financing, and in examining potential liabilities to the City. Finally, Council can and should consider impacts to the community that may indirectly occur due to the decisions made by the TBPL.

Therefore, this report focuses on financial impacts, risk of investment in a non-owned facility, and impact to growth and community strategies.

A revised Library Facilities Master Plan was issued in June 2024, providing current financial and operating implications as identified by TBPL for the central library and the scenarios. This document forms the basis for Administration's review. Administration has been working in consort with TBPL on more detailed financial breakdowns and other information such as lease terms and current and future operating expenses.

Administration recommends that city capital investments be directed to incremental upgrades to modernize existing owned assets and that the central library concept not proceed at this time. Key financial and strategic considerations that influenced Administration's recommendation are listed below:

- The total cost to construct a centralized facility is estimated at $17.6 million, with a potential for an additional $3.3 million should tenders come in at the high end of the estimate range. This represents a significant investment in a privately owned leased space with no guarantee of lease renewal, risking the loss of investment in leasehold improvements.

- Focusing spending on existing infrastructure supports asset management goals.

- Debt servicing costs are not fully accounted for in TBPL's projections and are estimated at approximately $1.1 million to $1.9 million in the first year.

- A Central Library at the proposed location will likely include a request for a 100% charitable tax rebate which, if approved by Council, could result in approximately $220,000 lost tax revenues.

- Potential for increases in ongoing operating and lease costs which may result in additional budget requests to the City in order to support operations.

- The City's Official Plan's Strategic Core policies emphasize providing a full range of amenities in downtown areas. The removal of the Brodie Library contradicts the Official Plan's aim to restore downtowns as vibrant, mixed-use community nodes.

- The Brodie Street Library is a designated heritage property with significant historical value. Disposal of the property will lead to a lack of control over its maintenance and preservation.

- Removal of the Brodie Street Library is detrimental to Council's revitalization efforts for the south core downtown area.

- The City has not carried out any public engagement or consultation on the cost impacts of these scenarios to taxpayers.

DISCUSSION

At the June 26, 2023 Committee of the Whole meeting, a deputation from the Thunder Bay Public Library (TBPL) was held and a subsequent resolution was passed by City Council, endorsing, in principle, the central library concept as outlined in the TBPL Master Facilities Plan and referring Scenarios 2 and 3 of the Plan to Administration for review and to provide capital and operating financial implications.

This Report does not discuss the merits of the TBPL Master Facilities Plan. The primary focus of this report is to comment on financial impacts of Scenarios 2 and 3 presented in the TBPL Master Facilities Plan, in accordance with Council direction, and other strategic implications identified by Administration that may result from the closure of Brodie Library.

In both scenarios, Brodie Street Library will be disposed of, and a Central Library constructed. The difference between Scenario 2 and 3 in the TBPL Master Facilities Plan is the closure of the existing Library space in County Fair mall. The Central Library is proposed in a portion of the vacant former Lowe's space within the Intercity Shopping Centre with an area of approximately 55,000 square feet.

An updated TBPL Master Facilities Plan was issued in June 2024 which provided current financial and operating implications for the TBPL, and this document forms the basis for Administration's review of the two scenarios. While this document does not provide complete financial information, Administration has been working in consort with TBPL in the background on more detailed financial breakdowns and proprietary information such as lease terms and other current and future operating expenses.

Design Review

Administration was provided with a design package, which included a set of preliminary drawings and renderings, a design brief from the consultant, and a class 'C' cost estimate with an accuracy range of +/- 15 to 20%. Through an iterative review process several items were clarified and addressed on both the design and costing provided and Administration confirmed that the design substantially meets the City's Facilities Design Standard, Ontario Building Code accessibility requirements for new construction, and current costing methodologies. The costing appears consistent with the elevated market conditions in both the country and locally.

Note that the changes in the site presented to Administration will require site plan control approval, should the central library concept proceed. Concerns were voiced to the Library about lack of pedestrian access to the central library location which were mitigated by the addition of a sidewalk in conceptual drawings. The conceptual sidewalk currently indicated is not constructible without a retaining wall, costs of which are not currently captured. Other options are possible to address pedestrian access, but additional costs will likely be associated with any improvements.

Required Capital Investment in Library Buildings

In the TBPL Master Facilities Plan, the Status Quo option indicates a required investment in library buildings of $9.5 million over 5 years. Out of the total $9.5 million, TBPL has allocated $7.5 million for a full retrofit of the Waverley Library in this scenario. While the facility does require work to meet current accessibility standards, it is within building code legislation that all existing facilities can be brought to accessibility compliance over time through planned renovations, and that this work has no specific timelines attached. Furthermore, if this value is to be applied to the Status Quo, it should also be fairly applied to Scenarios 2 and 3 as Waverley will continue to exist as a TBPL asset in the other scenarios. TBPL has indicated that the new Central location, being built to current accessibility standards, would lessen the need to retrofit Waverley, as that new location would be their flagship site. The context of Waverley renewal is addressed separately in later sections.

Accessibility compliance for existing facilities is meant to be a continuous process, and there are a number of potential funding pathways available. Corporate Policy # 08-01-04 speaks to a multi-year accessibility plan for the City that continues to improve accessibility in both the built and virtual environments.

TBPL Future Capital Works

It is understood that the $7.5M retrofit of Waverley referenced above would also include some updates to modernize the library as well as make it fully accessible. In 2017, TBPL presented a feasibility study and concept design to Council for the revitalization and modernization of the Waverley Library, which amounted to a $5.7 million project at the time. Subsequently, in the 2018 Budget, Council committed up to $1.4 million of the funding towards a full retrofit which included energy and accessibility upgrades, contingent on other funding sources. The TBPL has been, to date, unsuccessful in garnering funding support from other sources for this endeavour. The $7.5 million indicated in TBPL's financials for Waverley renovations is reflective of this value, and this project is still technically active pending external funding.

The City had building condition assessments completed in 2021 of Brodie and Waverley libraries. The following summarizes capital improvements that may be considered as required within the 4-year tactical planning window of 2022-26.

Brodie Library

In 2021, the main boiler system was replaced, with a corresponding natural gas meter and piping replacement. In 2022, TBPL constructed and renovated barrier free washrooms on the lower level. Based on the condition assessment completed in 2021, the overall maintenance and upkeep of the building is fair to good. There are some cyclical capital works that would be recommended in the short-term including replacement of the fire alarm system and electrical panels, insulation for energy savings, investigation of water infiltration near basement windows and other maintenance items like caulking and painting.

Estimated costs to proceed with the cyclical capital works total approximately $425,000 in 2024 dollars. Minor capital items identified above and other items in the report would typically be captured in regular operations and maintenance budgets.

Waverley Library

Based on the condition assessment completed in 2021, the cyclical capital works recommended in the short term include window, cooling unit, fire alarm system, electrical panel, and humidity control replacements as well as remediation plans for the foundation, exterior stair, and elevator.

Estimated costs to proceed with the cyclical capital works total approximately $1,100,000 in 2024 dollars. Some of these items can be deferred into the next tactical planning window. Minor capital items identified above and other items in the report would typically be captured in regular operations and maintenance budgets.

Replacements noted would typically be included in TBPL's annual capital budget forecast for consideration. Deferral of the key items mentioned above may have detrimental affects on the use and enjoyment of the facilities. The infrastructure deficit affects all assets that the City funds, including capital funding for libraries, and the speed at which renewal can take place. From an asset management perspective, it is important to focus capital funds on maintaining existing assets before investing in new.

Risk and Value for Money

The TBPL's Central Library concept represents a substantial investment in a facility that is neither owned nor controlled by the TBPL or the City. With the exception of the actual library supplies and furnishing, fixtures and equipment provided for the space, any leasehold improvements on the space would be lost at the end of lease. The capital investment would be a sunk cost and not recoverable.

In the initial design there are a number of community partners identified as generating revenue for use of the space which acts to offset the ongoing leasing costs paid to Intercity Mall. The TBPL, being the lone signatory to the lease, is responsible for the total value of the lease regardless of occupancy by community partners which, based on preliminary floor plans occupy roughly 1/5th of the total floor area. Administration has been advised by TBPL that the impacts to the overall operating budget would be minor in the event that community partner space was vacant.

Strategic Considerations

On June 17, 2024, Council approved Report 174-2024 (Planning Services) which recommended in support of an application to add 'Library' as a permitted use under the Zoning By-law at 1000 Fort William Road, being Intercity Shopping Centre. Council was advised that this Planning Approval decision was specifically about whether a library would be a compatible use at the property and was not a recommendation on whether to proceed with the central library project at the time.

Within that report, 44 support letters from various groups and agencies were reviewed. These letters expressed support for the proposed library use at Intercity Shopping Centre and/or zoning allowance and will not be revisited in this report.

Administration does not support investment in a central library at Intercity Shopping Centre and closure of Brodie Street Library at this time. The closure of Brodie is contrary to Council's downtown renewal efforts, not consistent with Council's Official

Plan (Strategic Core policies) and the placement of a Central Library in a private facility has real estate investment risk.

The following points support Administration's strategic position:

- Council has directed that Victoriaville be demolished and established a Fort William Downtown Revitalization Advisory Committee to revitalize Downtown Fort William. It is Administration's opinion that removal of the Brodie Street Library would be detrimental to Council's revitalization efforts.

- Official Plan, Page 83, states that the 'Strategic Core areas are "…intended to provide a full range of amenities accessible to residents and visitors, including vibrant streetscapes, shopping, business, entertainment, housing, transportation connections, and educational, health, social, and cultural services. These areas are viewed as significant assets, important to the City as a whole, and shall function as identifiable, walkable, mixed-use districts of symbolic and physical interest."

- Official Plan, Page 83, also states that "The Strategic Core Areas are viewed as the preferred location for major capital investments in major cultural institutions and entertainment facilities."

- Council's Strategic Core Area Community Improvement Plan is designed to restore the downtowns "as community nodes for work, shopping and living as they were in past years. To succeed, the Downtowns must transition into mixed-use neighbourhoods where living, working, and leisure activities and uses are all intertwined in the urban fabric of the area". Removing Brodie Library would not be in keeping with these policies.

- From a real estate perspective, such magnitude of investment in a leased space for the proposed term carries risk. There is no guarantee of a lease renewal in which case there would be no retained value to the leasehold improvements at end of term.

- The Brodie Library is a designated and historically significant heritage building which has been well maintained and preserved under public ownership. Council should be aware that if the property is disposed of there will not be control over the degree of maintenance and repair.

- The Brodie Street Library is within walking distance of a greater number of residences and is better serviced by the active transportation network than is the case of Intercity Mall. Both locations are well serviced by transit.

Site Access

The location of the Central Library in Intercity Mall, is easily accessible by transit and provides access to free parking. The Central Library location is not well serviced by active transportation with only one designated active transportation facility leading to the southwest corner of the property. The arterial streets that lead to the location do not have designated facilities and the Active Transportation Plan does not identify improvements to these corridors in the 20 year plan. There are sidewalks on two sides of the property but limited pedestrian connectivity on the site.

When comparing the new Intercity Mall location with the existing Brodie Library location proposed to be closed, the density of residential properties within a 1km walking distance is significantly lower at Intercity Mall. Preliminary estimates show that the density is approximately 3 times higher at the Brodie location. Considering the remote location of Intercity Mall from residential properties, it would be expected that most visitors would have to drive or take transit which would limit the access to the central library for some target users.

Heritage of the Brodie Library

The Brodie Library is a Designated Heritage building. The full Heritage Listing is included as Attachment A, and additional information as Attachment B.

The Brodie Street Library was built with a $50,000 grant received from the Carnegie Foundation. There is no restriction in the original Carnegie Foundation grant that the building continues to operate as a library in perpetuity. Administration would recommend amending the designating bylaw to list specific noted heritage features of the Brodie Library prior to any planned dispossession of the asset.

FINANCIAL IMPLICATION

Capital

The estimated cost (construction and soft) of the Central Library proposal is $17.6 million, with a potential for an additional $3.3 million should tenders come in at the high end of the estimate range.

In the TBPL Master Facilities Plan, June 2024, TBPL has indicated a required Municipal capital investment of $8.55 million over 5 years for the Central Library proposal.

In the Plan, the $8.55 million Municipal capital investment in the Central Library proposal is compared to a status quo Municipal capital investment of $9.48 million which includes a $7.5 million investment in Waverley in year 1 as discussed above. Administration understands that additional investment may be required under the status quo option, however, to assume that $7.5 million would be invested in Waverley all in year 1 is not realistic.

Administration has identified other considerations to the Municipal capital investment:

- The regular City capital envelope contribution of $400,000, as well as the MJLB ($40,000) and Waverley ($200,000) capital expenditures are part of the City's annual tax-supported capital budget for existing facility asset management and should not be netted against the capital construction cost of a new proposed facility.

- The *Public Libraries Act* requires City Council consent for any sale, lease or other disposition of any land or building that is no longer required for the library board's purposes. A Council decision has not been made on the potential sale of Brodie; therefore, it is premature to factor sale proceeds ($750,000) into calculations.

- Fundraising revenues beyond the two-year construction period should not be factored against the capital investment.

Assuming the TBPL is successful in its grant application(s) and fundraising targets and utilizes the existing reserves as proposed, Administration has calculated the estimated Municipal capital contribution for the Central Library construction to be $10.55 million:

Construction	$16,650,000
Design and Other Soft Costs	$ 950,000
Total Project Cost	**$17,600,000**
Less Grants	($ 2,000,000)
Less TBPL Contribution from Reserves	($ 4,300,000)
Less Fundraising (first 2 years)	($ 750,000)
Estimated Municipal Capital Contribution	**$10,550,000**

The $4.3 million contribution from TBPL would require repurposing a large percentage of their existing internally restricted reserves towards the new Central Library. These amounts were previously intended to support all existing branches and initiatives. A significant reduction in reserves increases the financial risk for the Library.

TBPL has indicated that if the Central Library proposal is approved, they will request the City provide $14.5 million in 2024, with the understanding that the City would later be reimbursed with Grants, fundraising and TBPL contributed funds as received.

Given the uncertainty of potential Grants and fundraising, in order to move forward with the project and ensure project financing for the current class 'C' estimate, City Council would need to commit resources for the full $14.5 million.

To facilitate this project the City could authorize a $14.5 million loan from its Reserves and Reserve Funds during construction, replaced with a 15-year debenture post-construction. The debenture term would match the base lease term at an estimated 4% interest rate.

TBPL has also indicated that any cost overruns from the class ‘C’ estimate (the costs are at a +/- 15-20% range) would need to be covered by the City. Those potential costs could be up to an additional $3.3 million and would be added to the debenture.

Operating

The annual debt servicing cost of this debenture in year one, which would be added to the municipal levy, would range from $1.1 million to $1.9 million depending on final construction costs and TBPL’s success in securing grants and fundraising efforts. Total interest costs during the term of the debenture would range from $3.3 million to $5.5 million. Debt servicing costs were not factored into the Operating Pro Forma that TBPL presented in the Master Facilities Plan.

The Operating Pro Forma also excludes municipal property tax expense. It is understood that if the Central Library proposal is approved, the TBPL will apply for a charitable tax rebate on the proposed Central Library. There is a 100% charitable tax rebate for municipal and education taxes currently in place for the County Fair location. Initial estimates are that a 100% charitable rebate at the proposed Central Library location would represent $220,000 in lost tax revenue for the City.

TBPL reports their financials based on the full library network, not broken down by location therefore high-level operating cost impacts were provided by TBPL for each scenario. Lease costs at Intercity Shopping Centre are an additional cost identified for Scenarios 2 and 3 with some balancing reduction identified with the sale of Brodie. The ongoing operating costs for Brodie Library are not included in the comparative Scenarios 2 or 3 prior to disposition. The operating projections provided by TBPL are based on a variety of assumptions that cannot be fully validated by Administration without a fulsome understanding of the Library’s operations and financial allocation methodologies. There is a risk that potential costs will be higher than anticipated and a further risk of future inflationary impacts to these costs.

CONCLUSION

It is concluded that the existing Thunder Bay Public Library facilities be maintained for the reasons outlined in this Report, rather than supporting Scenario 2 or Scenario 3 of the Thunder Bay Public Library’s Master Facilities Plan which require additional municipal debt, significant investment in a leased facility, and have indirect impacts on the south core with the sale of Brodie Library.

It is also concluded that a copy of this resolution be provided to the TBPL Board to guide future planning and Administration work with TBPL to plan future capital investments in existing facilities.

BACKGROUND

At the June 17, 2024 Committee of the Whole meeting, a proposed Official Plan and Zoning By-law Amendment No. 14 was passed to allow for the inclusion of a Library in Official Plan and Zoning By-law 1-2022. The Planning Section recommended approval of the proposed amendments associated with application OZ-03-2024. This in principle allows a library as an acceptable use within the Intercity Shopping Centre from a zoning perspective, but does not address or endorse the Central Library concept.

At the February 1, 2024 Capital & Operating Budget Review meeting, memorandum from City Manager Norm Gale providing an overview of the budget process, report back deliverables and planning process as it relates to the Thunder Bay Public Library and the central library concept.

At the June 26, 2023 Committee of the Whole meeting, the Thunder Bay Public Library presented their Master Facilities Plan and Council referred Scenario 2 and 3 to Administration for review and report back on Capital and Operating implications of the two scenarios.

On June 26, 2017, the TBPL presented a Request for Funding for Renovations to Waverly Resource Library. Council approved the City's contribution of $1.9 million which was conditional upon the Thunder Bay Public Library securing funding from other sources in the amount of $3.8 million, and that the source of financing for the $1.9 million be $1.3 million capital out of revenue and $0.6 million Renew Thunder Bay Reserve Fund. No funding associated with the capital cost of the renovations to the Waverly Resource Library was to be released until such time as funding from other sources has been confirmed. In the 2018 budget, $1.4 million was ultimately committed with the remaining $500K to be committed out of TBPL reserve funds. To date, the City has expended $61,000 on this project, and continues to hold the remaining $1.34 million of the approved $1.4 million, as well as the TBPL portion.

REFERENCE MATERIAL ATTACHED

Attachment A – Brodie Library Heritage Listing
Attachment B – Brodie Street Resource Library-Additional Information

REPORT PREPARED BY

Kelvin Jankowski, Manager Capital Facilities Construction - Engineering & Operations
Andrea Morrison, CPA CA, Deputy City Treasurer

REPORT SIGNED AND VERIFIED BY

Matthew Pearson, Acting General Manager – Infrastructure, Development & Operations

Date 07/16/2024

Brodie Resource Library
216 Brodie Street South

Year Built:1912
Architect: Hood and Scott
Style: Classic Revival
Notable Features: Stained glass windows illustrating famous authors
Built in accordance with the Carnegie Foundation's 'Notes on the Erection of Library Building'
Date of Designation: February 27th, 1982
By-Law No: 76-1981
Registration No: 234508
Current Owner: Thunder Bay Public Library Board

Description:

The Library was originally organized as the CPR Employees Library, in 1885 and was housed in the old CPR Roundhouse at West Fort William "to promote among the employees a desire for good wholesome literature."[1] The roundhouse was also home to a smoking and recreation room, bath (with hot, cold and lukewarm water) and a reading room. More than one hundred people were present for the opening of the "library and social club," and the institution continued to enjoy success for the next few years.[2] By 1891, there were 107 members and $1,019.67 in the treasury.[3]

Nearing the end of the century, the library committee concerned itself mainly with the organization of the annual picnic which helped to raise funds for maintenance.

[1] Fort William Journal, *C.P.R. Library, its present flourishing condition*. Jan 30, 1892
[2] Fort William Public Library, *The Story…* (1959)
[3] Fort William Journal, *C.P.R. Library, its present flourishing condition*. Jan 30, 1892

During the picnics, games were to be played and “steps taken for the safety of women and children.” This meant “no liquors or rowdyism.”(*sic*)[4]

Although membership was maintained at “nearly one hundred” people, by 1903 the financial state of the library was dismal. Discussion arose in the next few years as to whether the library site should be moved to a “more central part of town.” The collection of 2000 books was moved from the Roundhouse to the northeast corner of the basement of Fort William Town Hall in 1905. Membership cost $1 annually, although the board was working towards a free library for the community.[5]

Miss Mary J. L. Black was appointed head librarian in 1909, and she saw the opening of the public library at the Brodie Street location.[6] The board had been negotiating with the Carnegie Foundation, established by Scottish-American philanthropist Andrew Carnegie, and received a grant of $50,000. Carnegie had been offering grants to hundreds of small towns and cities so more communities could enjoy the benefits of a public library. Although he asserted each community was responsible for acquiring their own architect, so as to promote individuality, Carnegie did create some guidelines for the style of building he envisioned for the libraries. Classic in style and symmetrical in design, Carnegie libraries are instantly recognizable as welcoming public buildings. The interior is designed in an efficient and practical manner, which enables only one librarian to effectively supervise the entire library.[7]

Brodie Resource Library opened its doors in 1912 and, under the leadership of Mary J. L. Black was considered one of the “finest libraries in Ontario.”[8] Black proved herself to be a competent and fair librarian, collecting the first late fine from the first man to enter the building upon opening, a Times Journal representative.[9] Her service to the library was described as “long, devoted and able.”[10] In honour of her work as head librarian from 1909-1937, the Westfort branch library, which opened in 1938, was named the Mary J. L. Black Library. Interestingly, Mary J. L. Black was also the first woman to be elected president of the Ontario Library Association, in 1916-1917. She was noted for her “progressive methods and tireless devotion to service ethic library work.”[11]

Architecture

The Brodie Resource Library, which opened in 1912, followed the architectural guidelines established by its benefactor, Mr. Andrew Carnegie. The firm of Hood and Scott, Architect and Contractor were hired as architects for the project.[12] Designed in

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4 Sentinel, *mintues for the CPR employees library meeting*. July 15, 1891
5 Fort William Public Library, *The Story…* (1959)
6 ibid
7 http://www.carnegie-libraries.org/styles.html
8 Amy Donati, *Fort William Public Library*. Bookman Vol. III, #4. May 1967
9 Lakehead Living, *Brodie Resource's 70th anniversary*, Wednesday May 5th, 1982.
10 Alexander Calhoun, letter of memories to Mr. Donovan, Chief Libraian
11 Libraries Today, Mary J. L. Black < http://www.uoguelph.ca/~lbruce/photos/Blackmj.htm >
12 J. Spooner, Publicity Chairman, *Chronological Order of Events Leading up to the Establishment of Brodie Street Library*.

1910, it is a good example of the eclectic style of architecture which developed in America after 1900. The library design is very formal. Resembling Palladian Renaissance architecture, the library's symmetrical staircase entrance was embellished with a pair of Ionic columns enclosed by pilasters.[13] Carnegie generally approached library design with symbolism in mind, and the staircase entrance was supposed to have denoted a person's rise through intellectual learning. Brodie Street Resource Library's entrance however, was renovated in 1966, because in modern times, the staircase tends to represent inaccessibility more than higher learning. To accommodate the renovations, the pilasters were translated into square piers at this time.

The overall composition of the exterior is Neo-Renaissance in character. Red brick and limestone pilasters and columns rest on a heavy stone plinth. Arches and columns arranged symmetrically about the main entrance support a bracketed cornice. The cornice in turn supports a brick parapet which corresponds to the Renaissance balustrade. It has been suggested that the purpose of the library design was to provide the appearance of a pleasing building, rhythmic and inviting.

Other notable architectural features of the library, which have remained intact are the arched windows and their surrounding decorative stonework, the stained-glass windows depicting famous authors, from Dante to Ibsen, the parapet inscribed 'Public Library,' and the ornamental scrolls which adorn it.[14]

[13] Fraser and Brown Architects; Restorations Proposed for the Brodie Street Resource Library
[14] J.A. MacDOnald, *Local Architectural Conservation Advisory Committee*. October 15, 1979

Attachment B: Brodie Street Resource Library- Additional Information

Brodie Street Resource Library, located at 216 Brodie Street South, started out as the CPR Employee Library and was originally located on North Vickers Street in the CPR roundhouse. The library was formed in 1885 to "promote among the employees a desire for good wholesome literature." By 1903 the library had around 100 members but was experiencing financial troubles. It was later decided in 1906 that the library would become a town library in Fort William and the collection of around 2,000 books was transferred to a location in Fort William City Hall. Until the end of 1908 there was still a membership fee of $1.00 for CPR employees and $1.25 for citizens, but the CPR Library Committee soon started applying to the Carnegie Foundation for funds to build a new library. In November of that year, they received $50,000 from the Carnegie Foundation to create a proper public library. After that the CPR Library Board was formed into a Public Library Board under the Ontario Public Libraries Act.

Carnegie Libraries are libraries built with money donated from Andrew Carnegie. Andrew Carnegie originally owned a steel company, and he accumulated a large fortune through his time owning it, then added to that fortune when he sold the company in 1901. Mr. Carnegie had a strong belief in free public education and with his fortune he spent $2,556,600 on the construction of 2,509 free public libraries around the world, 111 of those in Ontario and 14 in other Canadian locations. He believed the best way to provide free education and foster growing communities was to establish public libraries. The Library Committee was lucky enough to receive around the 4th largest donation, and with that $50,000 donation Brodie Library was able to be opened in 1912 under the guidance of Librarian Mary J.L. Black.

For a while known as one of the "finest libraries in Ontario", Brodie Resource Library was built in compliance with the loose guide Andrew Carnegie gave each library that was going to be built using his money. Designed by architects Harry Scott and Hood, Brodie Library is Neo-Renaissance in character with red brick walls and limestone pilasters on a stone base. With many arches and columns, the front entrance has a large welcoming frame capped with a parapet inscribed "Public Library". The building was designed to give a rhythmic and inviting feel to its incoming visitors. Another notable and iconic feature of Brodie Library is the stained-glass windows depicting 9 famous authors. Wrapping from the front right corner to the side of the building that runs along the laneway behind City Hall, the authors sitting atop the windows are Thomas Moore, Charles Dickens, Robert Burns, Oliver Goldsmith, William Shakespeare, Henry Wadsworth Longfellow, Leo Tolstoy, Walter Scott, and Johann Wolfgang von Goethe. The stained glass window that sat above the entrance of the library, depicting the generous Andrew Carnegie, has now been moved to a safe viewing area in the lower level of the library. Other renovations include the south wing addition, built in 1955, and the accessibility alterations that were made to the entrance in 1966.

Resources:

- *Carnegie libraries in Ontario.* (n.d.) Ontario.ca. https://www.ontario.ca/page/carnegie-libraries-ontario
- Heritage Registry; Designated Property No. 4. (1982). In *Brodie Resource Library*. https://www.thunderbay.ca/en/city-hall/resources/Documents/HistoryHeritageand Records/Brodie-Resource-Library---ACC.pdf
- City of Thunder Bay Archives Heritage General File

Hello,

Please note the following response to Speak to City Council has been submitted at Tuesday June 4th 2024 9:52 AM with reference number 2024-06-04-007.

- **What would you like to speak to Council about:**
  major updates to the Library master facilities plan

- **Is this an item scheduled on a current agenda?:**
  No

- **Provide as much information as you can about the matter you would like to speak to:**
  new information regarding the Library's Master Facilities Plan including new designs, new costings, new operational model details and major revisions to the original document presented in 2023

- **Provide specific actions you would like Council to take:**
  likely Councillor Giertuga or Zussino will be making a motion regarding the adoption of our new plan along with consent regarding property details and funing the new model

- **Have you already been in contact with City staff in regards to the subject matter of your deputation request?**
  Yes

- **Who did you speak to in City Administration? What was the outcome?**
  Krista Power, Kayla Dixon, Keri Greaves, etc

- **Please select the date of the meeting:**
  Committee of the Whole - Monday, June 24 2024

- **Please choose**
  Dr

- **First name:**
  Richard

- **Last name:**
  Togman

- **Email:**
  rtogman@tbpl.ca

- **Phone:**
  (807) 707-7948

- **Organization you represent: (optional)**
  Thunder Bay Public Library

- **Please note the names of the presenters that will be attending with you:**
  Richard Togman, Cherri Braye

- **Please indicate how you intend to participate in the meeting.**
  In Person

Thunder Bay Public Library

Master Facilities Plan June 2024

Our Mission

The Thunder Bay Public Library facilitates knowledge sharing and helps build a connected and healthy community by providing the space, collections, services and programs that residents need to learn, grow, create and be successful.

Our Vision

Thunder Bay Public Library provides the community with inspiring and vibrant gathering spaces where anyone can achieve a lifetime of learning, build community, grow as a person, and fulfill endless possibilities.

Our Values

Access and Sharing
Diversity and Inclusion
Innovation and Opportunity
High Quality of Service
Collaboration
Intellectual Freedom

Executive Summary

On June 26, 2023 City Council unanimously passed a resolution endorsing, in principle, the creation of a new Central Library branch and the further study of Scenarios Two and Three of the Library's Master Facilities Plan.

	Central	Waverley	MJLB	County Park	Brodie
Scenario Two	✓	✓	✓	✓	✗
Scenario Three	✓	✓	✓	✗	✗

After intensive study by Library Management, working in consort with City Administration, design and architectural work completed by Brook McIlroy, engineering work completed by TBT Engineering and costings verified by a 3rd party independent cost consultant in A.W. Hooker Associates Ltd, the financial implications are:

	Status Quo	Scenario Two	Scenario Three
Square Footage in Library System	61,920	92,378	88,378
% Increase in size Library System	n/a	49%	42%
% Increase in open hours	n/a	26.5%	26.5%
Required Investment in Library Buildings (over 5 years)	$9,475,000	$8,550,000 (low estimate) to $11,000,000 (high estimate)	$8,550,000 (low estimate) to $11,000,000 (high estimate)
% increase in City budget for capital investment (based on 2024 figures)	0.07% each year for 5 years	0.06% to 0.08% each year for 5 years	0.06% to 0.08% each year for 5 years
Ongoing Annual Costs	$7,645,300	$8,135,600	$7,630,500
$ Change in annual Library budget	n/a	$490,300	$(14,800)
% change in annual Library budget	n/a	6.4%	-0.19%
Avg Residential Property Tax Change for Operating	n/a	$11.00	$0.00

The new Central Library will function as **core community infrastructure**. It will serve an audience far larger than our neighbourhood branches and act as a necessary addition to our neighbourhood branch infrastructure. Making up for a critical shortage of programming rooms, partnership space and modern infrastructure in our current branches, this new space will have it all. It will give us needed space for our book collection and traditional library offerings. It will address an organizational and community-wide shortage of indoor children's and youth space. More public library space will augment the capacities of dozens of local non-profits in terms of bookable meeting rooms and partner opportunities. It will support a significant step forward for Thunder Bay's reconciliation and anti-racism work by creating a major culturally appropriate public space for the growing Indigenous community. The Central Library will also support local business and the vitality of the Intercity business district.

The old model of stand-alone library buildings is declining across North America. There is a clear national and international trend towards mixed-use locations that combine library spaces with retail, commercial and community spaces. Libraries across Canada are partnering with malls, shopping centres, and community centres to create dynamic, multi-use destinations that cater to the whole family. Most cities in Canada have a large format central branch with neighbourhood branches. Indeed this was the history of our own community with Port Arthur and Fort William each having their own historic central branches located in business districts and smaller neighbourhood branches in suburban areas.

The shift from the status quo to a Library system that meets modern needs has extremely broad support in the community. Our 2023 public survey shows that the average Thunder Bay resident is willing to pay an extra $39.90 on top of their regular taxes to fund this new vision. Over the course of 2023-2024 the Library has held nine (9) public engagement events and has secured over fifty (50) letters of support from organizations representing groups from across the spectrum of our community which publicly call upon the City to fund the creation of a new Central Library.

The proposed model for the Thunder Bay Public Library (TBPL) is the dominant model across Canada with a proven track record of success. Moving towards mixed-use spaces to create vibrant, multi-purpose destinations that are fully accessible, transportation friendly and have elements of private-public partnership is the clear path forward for municipalities across the country.

Scenario Details

Context Overview

Thunder Bay Public Library is one of the most popular and heavily used public resources in our community.

To highlight a few of the Library's successes:

- In 2023, the Library was used more than 8,000 times per day (both online and in-person services).
- In 2023, over 39,000 residents attended Library programs.
- The Library supports over 45 local partnerships which enable our government and non-profits to do more than they could alone.
- Achieves a 94% Citizen Satisfaction Score on the City of Thunder Bay Citizen Satisfaction Survey.

Research proves that libraries are the best municipal institutions for fostering social trust, building community and improving education and labour force outcomes.

Many cities across Canada co-locate libraries within malls and a number have been very successful creating central libraries in a mall.

We have a severe shortage of space which is harming our ability to modernize and adapt to changing community needs. Library usage across the country is increasingly driven by programs, services and partnerships. However, our main buildings were never built to accommodate anything but books. For example, the entire north side of town has only one (1) space where we can run a program, host a partnership or hold an event. Thus, if there is a tech for teens program running we can't offer anything for children, seniors or book clubs in need of space. The south side of town fares little better and is stuck with small, inadequate space with which to run or host a program.

Brodie Library was built in 1912, the era of the horse and buggy. Our society has evolved tremendously since then and community needs have changed beyond recognition. However, to our detriment, core Library infrastructure remains stuck in the past. We have approximately 40% of the space a library system should have according to national standards. Our buildings are falling far behind community needs.

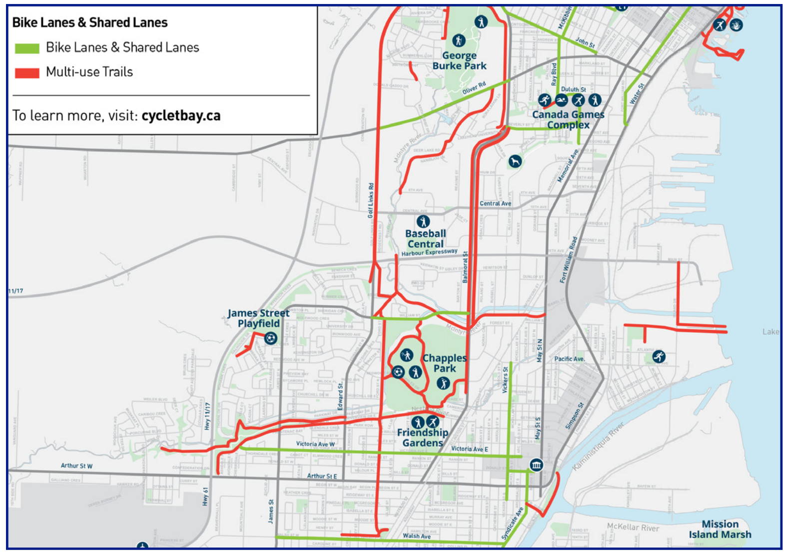
Reports over the last twenty (20) years have consistently and repeatedly come to the conclusion that the best way to operate a library system in Thunder Bay is with one (1) large, central branch and a number of smaller neighbourhood branches. Reports by different consultants, planners and Library staff in 2003, 2005, 2006, 2008, 2015 and 2022 all came to the same conclusion (as detailed in the 2023 Master Facilities Plan report to Council).

We became one city more than fifty years ago yet the Library system remains moored in the 1960's. Thunder Bay and its libraries need to move past the old divisions of Port Arthur and Fort William. We need a large main branch with extended hours that can serve the entire community in addition to strong, sustainable neighbourhood branches to meet the needs of the tens of thousands of residents who use the Library.

Ultimately, the costs of maintaining the status quo are not acceptable. As documented extensively in the 2023 Master Facilities Report, our buildings have been under-invested in for decades and the system is expensive to maintain relative to its capacity and potential for delivering modern library services to the community. We need new infrastructure if we are to meet the needs of the community, modernize our system and provide improving returns on investment for taxpayer dollars.

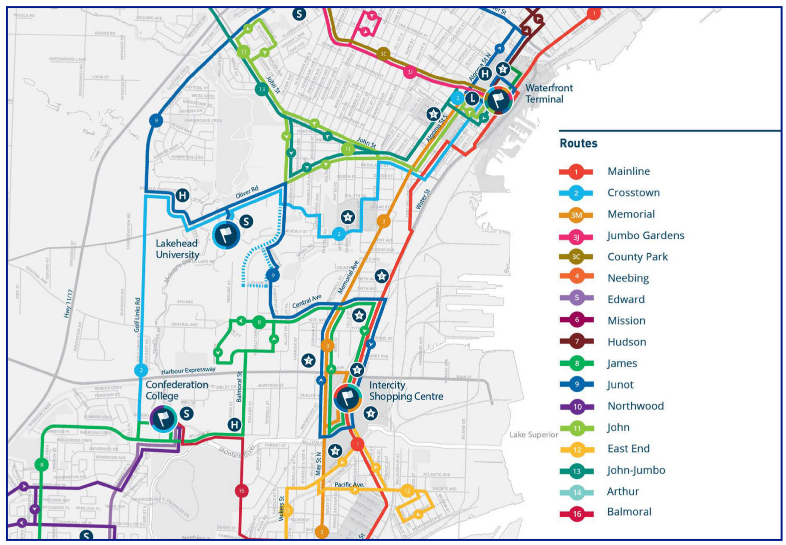
Location

The Central Library will offer programming for the whole family in roughly 55,000 square feet within the Intercity Shopping Centre, in the former Lowe's location. Filling vacant, underutilized space allows us to work within existing infrastructure and produces significant savings in cost and time. Neither the Library nor the City need to construct new buildings that add to our capital deficit or environmental footprint which must be maintained for generations. A long term lease with affordable rates gives us the security and predictability that we need as a Library to plan and operate with the best return on investment for the community.



City of Thunder Bay's Active Transportation Network

The location is ideal from a community planning perspective. The City Planning Department has set aside the Intercity area for large format operations - ideal for our Central Library. It is located on major arterial roads providing quick and easy access from all across the city. There are over 1,800 parking spaces at the mall. This overcomes a major challenge in our current system as neither Waverley nor Brodie Library have any dedicated parking spaces for Library users. The mall is a designated transit hub functioning as a "major terminal and transfer point," providing ready bus access to the community. As well, the mall is on a City active transportation corridor and multi-use trail.



City of Thunder Bay's Transit System Map

Most Canadian cities follow the model of having a large format central library to anchor the system with neighbourhood branches in support. A central location provides the full range of programming, services, collections and spaces that no neighbourhood branch could accommodate. It also houses the offerings that can only be equitably housed in one central location - such as 3D printers, podcasting booths, larger meeting rooms and event spaces - standard offerings in most Canadian libraries.

Thunder Bay united as one city over fifty years ago, yet remains stuck in the infrastructure of Port Arthur and Fort William. This investment would be the first significant piece of public infrastructure located in Intercity - the area of town that was designed to unite us, bringing us together as one in a central gathering space for the community. It will be equally accessible from all corners of our city and create true mixed-use space to increase the potential of both the Library and the businesses in a core commercial district.

As well, the current Library system struggles to meet AODA code and patrons with mobility or disability issues often experience barriers to entry. A new space at the mall allows for a Library that meets and exceeds accessibility standards. This is critical to serve all of our users with dignity and respect. It is also increasingly important as our population ages and more residents experience health and mobility challenges.

Library System Size

	Central	Waver-ley	MJLB	County Park	Brodie	Total	% Increase
Status Quo	X	24,824 ft²	9,400 ft²	4,000 ft²	23,696 ft²	61,920 ft²	0%
Scenario Two	54,154 ft²	24,824 ft²	9,400 ft²	4,000 ft²	X	92,378 ft²	49%
Scenario Three	54,154 ft²	24,824 ft²	9,400 ft²	X	X	88,378 ft²	42%

The national standard for public library space is one (1) square foot per resident. The City of Thunder Bay has long argued that our city acts as a regional hub and has far more residents than are accounted for in the official census. The latest Census Canada report estimates that our population is 130,752. We currently have only 47% of the recommended amount of library space.

Adopting any of these scenarios will still leave us with a deficit of library space, but would give us, at minimum, an increase of 42% more space than the status quo. This spatial advantage will be compounded by the modern and purpose built nature of the space. Our two main buildings (Brodie, Waverley) are over eighty years old and cannot meet resident needs on their own. Having a Central Library will allow the neighbourhood branches to be more purposeful and tailored to neighbourhood needs - without having to try to service the entire city's needs in every branch.

Hours of Operation

		Status Quo	Scenario 2	Scenario 3
WAVERLEY	Monday & Tuesday	9:30 am - 8:00 pm	9:30 am - 8:00 pm	9:30 am - 8:00 pm
	Wednesday to Friday	9:30 am - 5:00 pm	9:30 am - 5:00 pm	9:30 am - 5:00 pm
	Saturday	9:30 am - 5:00 pm		9:30 am - 5:00 pm
	Total Weekly Hours	**51**	**43.5**	**51**
BRODIE	Monday	9:30 am - 5:00 pm		
	Tuesday	9:30 am - 8:00 pm		
	Wednesday	9:30 am - 8:00 pm		
	Thursday & Friday	9:30 am - 5:00 pm		
	Total Weekly Hours	**43.5**		
COUNTY PARK	Monday to Friday	9:30 am - 5:00 pm	9:30 am - 5:00 pm	
	Thursday	12:30 - 8:00 pm	12:30 - 8:00 pm	
	Total Weekly Hours	**37.5**	**37.5**	
MARY J.L. BLACK	Monday & Tuesday	9:30 am - 5:00 pm	9:30 am - 8:00 pm	9:30 am - 8:00 pm
	Wednesday & Thursday	9:30 am - 8:00 pm	9:30 am - 8:00 pm	9:30 am - 8:00 pm
	Friday	9:30 am - 5:00 pm	9:30 am - 5:00 pm	9:30 am - 5:00 pm
	Saturday	9:30 am - 5:00 pm		
	Sunday			9:30 am - 5:00 pm
	Total Weekly Hours	**51**	**49.5**	**57**
CENTRAL	Monday		9:30 am - 8:00 pm	9:30 am - 8:00 pm
	Tuesday		9:30 am - 8:00 pm	9:30 am - 8:00 pm
	Wednesday		9:30 am - 8:00 pm	9:30 am - 8:00 pm
	Thursday		9:30 am - 8:00 pm	9:30 am - 8:00 pm
	Friday		9:30 am - 5:00 pm	9:30 am - 5:00 pm
	Saturday & Sunday		9:30 am - 5:00 pm	9:30 am - 5:00 pm
	Total Weekly Hours		**64.5**	**64.5**

Community Consultation

The Library has undergone a multi-year consultation process to speak with as many local stakeholders as possible. Organizations ranging from business associations to social service agencies and student groups to seniors clubs have all weighed in to improve the design and functionality of the Central Library space.

After being consulted, over fifty (50) organizations decided to publicly endorse the project and call for City Council to fund the Central Library and the new vision for our system. Letters supporting the project have come in from:

1. **Alpha Court**
2. **Association des Francophone du Nord-Ouest du l'Ontario**
3. **Canada Learning Code**
4. **Caribbean and African Multicultural Association of Thunder Bay**
5. **Club Culturel Francophone de Thunder Bay**
6. **Thunder Bay Chamber of Commerce**
7. **Children's Centre**
8. **Centre Francophone de Thunder Bay**
9. **Communities Together for Children**
10. **Confederation College Student Union**
11. **Creighton Youth Services**
12. **Dew Drop Inn**
13. **Diversity Thunder Bay**
14. **Ecosuperior**
15. **Elevate NWO**
16. **Evergreen: A United Neighbourhood**
17. **Friends of the Thunder Bay Public Library**
18. **George Jeffrey Children's Centre**
19. **Healthy Kids Thunder Bay**
20. **Hill City Kinsmen**
21. **Impact ON**
22. **Indigenous Student Services - Confederation College**
23. **John Howard Society**
24. **Ka Na Chi Hih**
25. **Kairos Community Resource Centre**
26. **Kinna-aweya Legal Clinic**
27. **L'Accueil Francophone de Thunder Bay**
28. **Lakehead Social Planning Council**
29. **Lakehead University Student Union**
30. **Local Immigration Partnership NWO**
31. **Lutheran Community Care**
32. **Magnus Theatre**
33. **March of Dimes**
34. **Metis Nation of Ontario**
35. **MPP Lise Vaugeois**
36. **Multicultural Association of Thunder Bay**
37. **New Directions Speakers School**
38. **Noojmawing Sookatagaing Ontario Health Team**
39. **Norwest Community Health Centres**
40. **Novocentre**
41. **NWO Innovation Centre**
42. **Our Kids Count**
43. **PACE**
44. **Rainbow Collective of Thunder Bay**
45. **Roots Community Food Centre**
46. **Science North**
47. **Shelter House Thunder Bay**
48. **Thunder Bay and District Métis Council**
49. **Thunder Bay Executives**
50. **Thunder Bay Museum**
51. **Thunder Bay Pickleball Club**
52. **Thunder Bay Repair Cafe**
53. **United for Literacy**
54. **United Way**
55. **Waterfront District BIA**

In addition, over the course of 2023-2024 the Library has held nine (9) well attended public engagement events. At each of these events, the overwhelming majority of attendees enthusiastically expressed their support for the Central Library and new vision for the system.

The Library also conducted a major public survey which yielded a significant amount of interest with over 2,200 residents responding. We asked respondents to enter their demographic information and then answer the hardest question we could ask: "How much extra would you be willing to pay on your taxes to fund a new Central Library?" This method is superior to a simple yes/no question as it gauges the intensity of the respondents' feelings and their willingness to pay for the desired outcome. Those responding with a '$0' answer clearly do not wish to see the project come to life, while others may be willing to pay a great deal because of the value they feel Library services offer to the community.

The results were broken down by an independent statistician to ensure no bias and the validity of the results. The results were quite consistent. On average, residents are willing to pay $39.90 extra on their taxes to create a new Central Library. This is consistent regardless of age, income level, ward, family status or whether they primarily drive, bus or walk in the city.

How much extra would you be willing to pay on your taxes to fund a new Central Library?	
Household	Average $
Adults (no children)	39.75
Households with Children	40.54

How much extra would you be willing to pay on your taxes to fund a new Central Library?	
Income	Average $
0 - $34,999	33.97
$35,000 - $59,999	37.28
$60,000 - $99,999	41.65
$100,000 - $149,999	40.17
$150,000 +	43.37

How much extra would you be willing to pay on your taxes to fund a new Central Library?	
Age	Average $
18 - 24	52.27
25 - 34	42.42
35 - 44	42.92
45 - 64	36.04
65+	39.69

Financial Details

Thunder Bay Public Library
Facilities Capital Investment

Central Library Proposal	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
MJLB	40,000	40,000	40,000	40,000	40,000	200,000
Waverley	200,000	200,000	200,000	200,000	200,000	1,000,000
Central Soft Costs	950,000					950,000
Central Construction	8,325,000	8,325,000				16,650,000
Sale of Brodie			(750,000)			(750,000)
City Regular Contribution	(400,000)	(400,000)	(400,000)	(400,000)	(400,000)	(2,000,000)
Fundraising	(600,000)	(150,000)	(150,000)	(150,000)	(150,000)	(1,200,000)
Grants		(2,000,000)				(2,000,000)
TBPL Contribution	(2,150,000)	(2,150,000)				(4,300,000)
	6,365,000	3,865,000	(1,060,000)	(310,000)	(310,000)	8,550,000

Status Quo Capital Investment

	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
MJLB	85,000	85,000	85,000	85,000	85,000	425,000
Waverley	7,500,000	50,000	50,000	50,000	50,000	7,700,000
Brodie	270,000	270,000	270,000	270,000	270,000	1,350,000
	7,855,000	405,000	405,000	405,000	405,000	9,475,000

Thunder Bay Public Library			
Operating Pro Forma **Description**	***Status Quo*** **Wav, Brod, CP & MJLB**	***Scenario 2*** **MJLB, CP, Wav + Central**	***Scenario 3*** **MJLB, Wav + Central**
Operating & Capital Cashflow			
Public Service Staffing	3,645,300	3,841,900	3,483,400
Building & Equipment	1,361,000	1,934,900	1,808,800
Library Services	1,696,000	1,602,500	1,608,000
Administrative and general	1,243,000	1,216,000	1,190,000
Total cash outflows	7,945,300	8,595,300	8,090,200
Library Revenues	(300,000)	(459,700)	(459,700)
Net Cash Outflow	7,645,300	8,135,600	7,630,500
Current Annual Operating & Capital Budget *	7,645,300	7,645,300	7,645,300
Difference $	-	490,300	(14,800)
Difference %	0.00%	6.41%	-0.19%

Design for Central Library

The architectural design has been produced by Brook McIlroy. Brook McIlroy has a long history of designing some of Thunder Bay's most iconic infrastructure, including the new waterfront at Prince Arthur's Landing and the revitalization of the north core with the Waterfront/North Core streetscape project. They are also working on the Thunder Bay Art Gallery and are in partnership with Science North for their future facility.

Brook McIlroy has a robust history of building libraries across Canada, having built the University of Winnipeg's Centennial Library, the Elliot Lake Public Library, the Algonquin College Library in Ottawa and the Indigenous Centre for Innovation and Entrepreneurship Knowledge House in Toronto. The Thunder Bay Central Library project was led by Brook McIlroy's Indigenous Design Studio team. Lead Architect Ryan Gorrie, from Sand Point First Nation, grew up in Thunder Bay and drew heavily on Indigenous design themes and community input to develop his vision for a culturally meaningful gathering place for the entire community of Thunder Bay.

Main Entrance, Architectural Rendering (Brook/McIlroy)

Layout

The Central Library floor plan is designed to accommodate the diverse needs of the Library's various user groups. For example, the community service space is designed with the needs of lower income Library users in mind. It hosts many of our public access computers and internet stations, the book collection focusing on employment and training resources and public bookable meeting rooms for partner organizations that focus on meeting the needs of lower income community members.


Children's Area, Architectural Rendering (Brook/McIlroy)

Our official partner spaces will accommodate key organizations whose missions align so well with our own that they wish to offer full time programs and services in partnership with the Library. The synergies created by these partnerships will generate incredible impetus towards our shared goals and will contribute to the financial sustainability of the branch. For example, an organization like the Multicultural Association could offer language training and newcomer integration programs out of the Library, or the Thunder Bay Symphony Orchestra might host their education programs in our large Children's Theatre space..

The book shop space is dedicated to the 'Friends of the Library' to host their fundraising activities and used book sales. The children's area will contain space for active play where kids can run, jump, climb and socialize with others from across the community. Story room spaces are set aside for traditional literacy based programs while the Children's Theatre is intended to host larger scale children's programming delivered by Library staff and community partners such as Magnus Theatre and Science North.

The Youth Zone will offer youth a safe and free space to learn, be social and build community through books, games, and exclusive programs offered in partnership with the local school boards, the University, and College. Studio spaces will be built to house higher end creator technology in the form of 3D printers, makerspaces, podcasting booths and A/V studios meeting the new standard for library services across Canada. Public seating is mixed in throughout the building as is the book collection, which will be larger than in any of our existing branches.

The centrepiece of the Central Library will be the Indigenous Knowledge Centre (IKC). Aligned with the cardinal directions, this space will be particularly meaningful for the Indigenous community and will invite every resident of Thunder Bay to enjoy a culturally significant space. The IKC will welcome visitors in with a fire circle that acts as a gathering point. It will be embedded within the lodge structure which will host our Indigenous book collection and provide space for events ranging from Indigenous author readings to beading workshops. The sharing circle within the IKC is designed first and foremost for ceremony and to conduct smudging. The space will have its own independent HVAC system and walls that will permit it to be fully enclosed, so that smudging can be done properly and respectfully and the smoke can be vented out of the building so as not to affect anyone with sensitivities or allergies. It can thereafter function as an independent program space or be reintegrated into the larger IKC.

This space will offer something for everyone reflecting our mission to serve the whole family and the whole community while paying respect to our past and moving toward the future.

Indigenous Knowledge Centre, Architectural Rendering (Brook/McIlroy)


PROJECT NORTH
NORTH
Memorial Av.
N.I.C.
CORRIDOR
BOOK KIOSKS
MED MTG
SM MTG
SM MTG
MED MTG
MED MTG
COMMUNITY SERVICE
STOR.
CUST. SERV.
OFFICE
PARTNER 1
OFFICE
OFFICE
PARTNER 2
OFFICE
BOARDROOM
ADULT COLLECTION
MTG RM
BOOK SORTING
W/C
W/C
CUSTOMER SERVICE
LIBRARY SHOP
LIBRARY INFORMATION & EVENTS
STOR.
STOR.
EXISTING SPRINKLER ROOM
FOOD KIOSK
VESTIBULE
OUTDOOR TERRACE
FLOOR PLAN

BrookMcIlroy/

Appendix A - Costing Details

MASTER ESTIMATE SUMMARY
THUNDER BAY PUBLIC LIBRARY NEW CENTRAL LIBRARY
CLASS C ESTIMATE (Rev.1)
JUNE 05, 2024

A.W. HOOKER ®
QUANTITY SURVEYORS

	Hard Construction Costs		GFA (m2)	Unit (Cost/m2)	Sub Total	Estimated Total	% of Total
1	Building Shell		5,031	$116.60		$586,635	3.5%
	- Sub Structure			$0.00	$0		
	- Structure			$12.33	$62,050		
	- Exterior Enclosure			$104.27	$524,585		
2	Building Interiors		5,031	$747.15		$3,758,889	22.6%
	- Partitions and Doors			$337.74	$1,699,153		
	- Finishes			$203.40	$1,023,326		
	- Fittings and Equipment			$206.00	$1,036,410		
3	Mechanical		5,031	$480.99		$2,419,843	14.5%
	- Plumbing and Drainage			$49.41	$248,565		
	- Fire Protection			$15.70	$78,987		
	- Heating, Ventilation, Air Conditioning			$396.10	$1,992,791		
	- Controls			$19.78	$99,500		
4	Electrical		5,031	$279.84		$1,407,882	8.5%
	- Service and Distribution			$31.87	$160,344		
	- Lighting, Devices, and Heating			$120.67	$607,072		
	- Systems and Ancillaries			$127.30	$640,466		
5	Site Work		5,031	$117.85		$592,925	3.6%
	- Site Development (prep, surfaces, landscaping)			$108.11	$543,883		
	- Mechanical Site Services			$2.39	$12,000		
	- Electrical Site Services			$7.36	$37,042		
6	Ancillary Work		5,031	$13.19		$66,350	0.4%
	- Demolition			$13.19	$66,350		
	- Alterations			$0.00	$0		
7	Contractor's General Requirements		5,031	$683.26		$3,437,500	20.6%
8	Contractor's Fees (OH&P)	5.0%	5,031	$122.04		$614,000	3.7%
9	Design & Pricing Contingency	10.0%	5,031	$256.11		$1,288,500	7.7%
	Sub Total (current dollars)		5,031	$2,817.04		$14,172,520	
10	Escalation Contingency	6.8%	5,031	$191.55		$963,700	5.8%
	Sub Total (including escalation to Q2 2025)		5,031	$3,008.59		$15,136,220	
11	Construction Contingency (Post Contract Changes)	10.0%	5,031	$300.85		$1,513,600	9.1%
	Total Estimated Hard Construction Cost		5,031	$3,309.48		$16,650,000	
	Imperial Conversion		54,154	$307.46		Per SF	

	Estimated Construction Costs (Breakdown by Major Component)	GFA m2	Unit Cost/m2	Estimated Total	% of Total
1	Building	5,031	$3,062.41	$15,407,000	92.5%
2	Alterations and Demolition	5,031	$24.85	$125,000	0.8%
3	Site Work (including M&E site services)	5,031	$222.22	$1,118,000	6.7%
4	Soft Costs	5,031	$0.00	Excluded	0.0%
	Total Estimated Hard and Soft Construction Costs	5,031	$3,309.48	$16,650,000	
	Imperial Conversion	54,154	$307.46	Per SF	

Appendix B - Why Invest in the Library?

Academic Literature on Library Value

There is robust academic literature demonstrating the value of well funded public libraries to the community. Investing in libraries is a direct investment in community building, public safety and the future of our workforce.

Public Safety

There is strong evidence to suggest that public libraries have an impact on crime - both directly and indirectly. Studies done by leading researchers such as Porter (2014), Borges, Nowicki and Shakya (2021) and Floyd (2016) show a statistically significant correlation between proximity to a public Library and reductions in certain types of crime such as burglary, robbery, assault and vandalism. The effect on reductions in crime is compounded during hours that the Library is open. The presence of a major non-profit public institution reduces crime through its function in serving as a public gathering place. The volume and character of members of the public circulating in and around the building makes for a criminal deterrent and keeps potential victims of crime in a safe place.

The Library indirectly contributes to a reduction in crime through its role in building the social capital of a community. Social capital refers to the richness of networks and social ties members of the community have to each other. It is directly related to social cohesion, community building and the capacity of a community to act collectively. There is very strong evidence showing tight correlations between social cohesion/social capital and neighbourhood level crime. Neighbourhoods with low levels of social capital experience higher rates of crime and the Library has been identified by social scientists as an institution that is critical to facilitating the development of social capital. Libraries serve as an essential element of community building practices that actively contribute to the fight against crime.

Community Building

A wide range of studies by a diverse set of authors (Chow and Tian 2021, Dalmer 2022, Johnson 2009, Oliphant 2014) all conclude that the Library is one of the premier community building institutions in municipalities. The capacity of the Library to build social capital in a community is unmatched due to the diversity of free services it offers to the public. Often, social capital builds within more closed circles - amongst those who share certain markers such as similar income levels, socio-economic status or ethnic background. Organizations such as churches, sports teams and volunteer associations all contribute to building the social capital of a community but tend to do so within these narrower parameters.

The Library is a leading cultivator of community building and social capital development because of its barrier free nature (no fees or costs associated with membership) and the wide diversity of residents participating in its programs and services. It is relatively unique in this regard and a powerful tool in building community across social, economic and ethnic lines.

Social capital has been identified as a major pillar in understanding the nature of wealth, along with physical capital (machinery, factories, physical equipment) and human capital (trade skills, formal training, formal education). Our community runs on social capital as the web of interconnections that underpin our lives are critical to a functioning economy and a prosperous society. Social capital is the means by which civic engagement occurs, community partnerships are developed, local dialogue is facilitated and local data distributed. In a city like Thunder Bay, it is also critical to gaining employment, finding housing and participating in meaningful community life. When who you know matters as much as what you know, building social capital is building wealth.

The authors mentioned above detail how Library use is highly correlated with social capital development. Library users are more likely to be part of a club, vote in elections, contribute to charity and generally report higher levels of trust than non-Library users. Libraries are documented to foster feelings of belonging and the social infrastructure that underpins community life. This is economically critical for Thunder Bay, where retaining skilled labour is vital to our future. Without strong social bonds to our city many workers and students leave our community after an initial employment or study period.

Investing in our People

Investments in public libraries have surprisingly strong and long lasting effects on people's lives. This is most impactful for children and youth. For example, Bhatt (2010) has documented that there is a direct relationship between the distance to the closest public Library and the time a child spends reading versus watching TV. Gilpin, Karger and Nencka (2021) have outlined how there is a statistically strong correlation between greater investment in public libraries and increasing reading scores in neighbouring school districts.

Physical proximity to a Library is the single biggest predictor of Library use for children according to Oliphant (2014) while Chow and Tian (2021) find that greater Library funding is correlated with a higher percentage of high school graduation rates, college graduation rates and median household income, while negatively correlated to persons living below the poverty line. These are statistically significant and predictive relationships developed from a big data study. Investing in public libraries is a direct investment in the future success of our children. This is confirmed by Karger's 2021 longitudinal study linking access to a public Library to childhood educational attainment and labour market outcomes.

Survey Data

General survey data across Canada and the US show extremely strong public support for high levels of Library funding. Oliphant's (2014) survey shows that 86% of respondents believe that a Public Library is essential to a strong community. This is not mere rhetoric, as 89% of respondents described that they would be willing to pay, on average, an additional $30 per year, on top of regular municipal and provincial taxes, to fund their local Library. Interestingly, this was regardless of whether the respondent actually used the Library or not and was not dependent on income. Respondents from across the income spectrum all reported similar levels of support and willingness to pay.

Pew Research Centre's comprehensive survey (2013) articulated that:

- 90% of residents said that closing their local Public Library would have a significant impact on the community, with 67% saying it would directly affect them and their families;
- 95% of respondents indicated that Library materials and resources play an important role in giving everyone a chance to succeed;
- 81% saying that public libraries provide a service that they would have a hard time finding elsewhere;
- 47% of job seekers reported that help they received at the Library in finding or applying for a job was "very important" to them and their families;
- 40% of those living with a disability say that getting help applying for government assistance/services at the Library is "very important"; and
- Overall, 94% of people say that having a public Library in their neighbourhood improves their quality of life.

According to the Canadian Book Consumer Study 2022, some other important statistics to consider include:

- 20% of all Canadians regularly borrow books from the Library. Canadian book borrowers borrow an average of 4.8 books per month from the Public Library;
- At an average cost of $15.86 per paperback book, Library collections are saving residents over $913 per year, just in book costs - not including the value of any other Library programs or services (which range from storytime for children to public access computers for those on low income); and
- In 2022, many Canadian book borrowers visited their local Library either online (77%) or in person (70%) in a given month, showing the need for both high quality digital experiences and modern, dynamic Library buildings.

Decolonization and Anti-Racism

The Thunder Bay Public Library is one of Thunder Bay's premier institutions in the fight against racism and discrimination. Recognized in national coverage for our work in building relationships with Indigenous people and honoured by the Lieutenant-Governor for our fight against racism, TBPL is one of the most forward thinking institutions in our city.

TBPL began working to decolonize the Library by looking within. We knew that if we wish to serve our community that our staff must reflect our residents. TBPL created one of the very first Indigenous Relations Librarian positions, which was followed soon after with a technician position focusing on First Nations, Métis and Inuit patrons. An Indigenous Action Council was founded to help shape Library policy and procedure and a pioneering Indigenous Knowledge Centre was established. These foundational reforms laid the ground for systemic change and focused projects such as the Stories of Anishinabek Resistance (SOAR) project and an innovative partnership with Sheridan College to design custom furniture for our Indigenous Knowledge Centres.

The work to defeat racism and build inclusive communities is a daily one and TBPL helps lead the way with programming and partnerships that bring Indigenous and non-Indigenous people together. Programs like children's story times bring kids from diverse backgrounds together to share space, learn and play together. Teen programs gather youth from all walks of life in the Library to share their passions. Hosting Indigenous authors and culture creators at the Library makes learning from Indigenous knowledge holders accessible to everyone and bridges a cultural divide that many may not otherwise pass.

There are few institutions in this city where income, ethnicity, education and status are truly not barriers to inclusion. Public libraries are unique spaces of equality and accessibility and TBPL has a proven record of successfully combating racism and building inclusive communities. Investments in the Public Library are direct investments in building the social spaces where reconciliation happens.

Appendix C - History of Consultation Efforts

LGA led consultations in 2021

City Council:

Bill Mauro, Mayor

Councillor Peng You, at large

Councillor Mark Bentz, at large

Councillor Shelby Ch'ng, at large

Councillor Trevor Giertuga, at large

Councillor Rebecca Johnson, at large

Councillor Aldo Ruberto, at large

Councillor Albert Aiello, McIntyre Ward

Councillor Andrew Foulds, Current River Ward

Councillor Cody Fraser, Neebing Ward

Councillor Brian Hamilton, McKellar Ward

Councillor Brian McKinnon, Red River Ward

Councillor Kristen Oliver, Westfort Ward

City Senior Staff:

GM Community Services - Kelly Robertson

GM - Infrastructure and Operations - Kerri Marshall

GM Development and Emergency Services- Karen Lewis

GM - Corporate Services and Long-Term Care - Linda Evans

CEDC - Erik Zakrewski - CEO

Manager - Cultural Development and Events - Leah Prentice

Corporate Records Manager and City Archivist -Matt Szybalski

Project Manager– Youth Inclusion Program, Recreation & Culture Division - Kaitlin Prezio

Manager – Parks & Open Space Planning - Cory Halverson

Manager of Tourism - Paul Pepe

City Manager - Norm Gale

Cynthia Olsen Manager, Community Strategies – Cynthia.Olsen@thunderbay.ca

Lee-Ann Chevrette- CSWB Specialist, Community Safety & Well-Being Thunder Bay

Community Groups:

Anishinabek Employment and Training Services (AETS)

Thunder Bay Museum

Science North

Underground Gym

Regional Multicultural Youth Council

People Advocating for Change through Empowerment (PACE)

Dew Drop Inn

Alpha Court

Thunder Bay District Health Unit - Street Nurses

Magnus Theatre

Northwestern Ontario Sports Hall of Fame

Ontario Genealogical Society - Thunder Bay Branch

Shelter House Thunder Bay

Friends of the Library

Thunder Bay Public Library Board

Library Staff Led Consultations 2023

United for Literacy

Thunder Bay Chamber of Commerce

Podium Events

Elleiance

Breakwater Events

Rainbow Collective

Tourism Northern Ontario

Thunder Bay Literacy Group

Magnus Theatre

Mastercard Foundation

Kinna-aweya Legal Clinic

Elizabeth Fry Society

Blue Prints Audio

Ka Na Chi Hih

Lutheran Community Care

Poverty Free Thunder Bay

Thunder Bay Art Gallery

Options Northwest

United Way

Anishinabek Employment and Training Services

Confederation College Library

George Jeffrey Children's Centre

EcoSuperior

Norwest Community Health Centre

Thunder Bay Community Foundation

William Creighton Youth Services

Our Kids Count

Science North

Thunder Bay Multicultural Association

March of Dimes

Evergreen: A United Neighbourhood

John Howard Society

Salvation Army

Communities Together for Children

Elevate NWO

Hospice Northwest

Thunder Bay District Health Unit

Lakehead University Northern Studies Resource Centre

Thunder Bay Catholic District School Board

Thunder Bay Indigenous Friendship Centre

Northwestern Ontario Writers Workshop

New Directions Speakers' School

Beendigen

Thunder Bay Weavers and Spinners Guild

Library Staff Led Consultations 2024

Public Engagement Sessions

- May 11 at Intercity Shopping Centre
- May 14 at Mary J.L. Black Library
- May 16 at Waverley Library
- June 12 at 55 Plus Centre
- June 15 at Brodie Library for an Indigenous Sharing Circle

Alpha Court

Association des Francophones du Nord-Ouest de l'Ontario - AFNOO

Caribbean and African Multicultural Association of Thunder Bay

Children's Centre of Thunder Bay

Canada Learning Code

Communities Together for Children (EarlyON)

Confederation College Student Union

Club Culturel Francophone de Thunder Bay

Indigenous Student Services - Confederation College

Dew Drop Inn

Diversity Thunder Bay

Ecosuperior

Elevate NWO

Evergreen

Fort William First Nation - Chief Solomon

Friends of the Thunder Bay Public Library

George Jeffrey Children's Centre

Healthy Kids - Thunder Bay District Health Unit

Hill City Kinsmen

John Howard Society

Ka Na Chi Hih

Kairos Community Resource Centre

Kinna Aweya Legal Clinic

La Cooperative Centre Francophone de Thunder Bay

L'Accueil Francophone de Thunder Bay

Lakehead Public Schools

Lakehead Social Planning Council

Lakehead University Student Union

Local Immigration Partnership

Lutheran Community Care

Magnus Theatre

March of Dimes

Métis Nation of Ontario

MP Marcus Powlowski

MP Patty Hajdu

MPP Kevin Holland

MPP Lise Vaugeois

New Directions Speakers School

Northern Ontario Innovation Centre

Norwest Community Health Centre

Nookmawing Sookatagaing Ontario Health Team

Novocentre

Our Kids Count

PACE

Rainbow Collective of Thunder Bay

Roots Community Food Centre

Salvation Army Thunder Bay

Science North

Soccer Northwest

Thunder Bay 55 Plus Centre

Thunder Bay and District Injured Workers Support Group

Thunder Bay Chamber of Commerce

Thunder Bay Community Foundation

Thunder Bay Executives

Thunder Bay Repair Cafe

Thunder Bay and District Métis Council

Thunder Bay Literacy Group

Thunder Bay Multicultural Association

Thunder Bay Museum

Thunder Bay Pickleball Club

Thunder Bay Symphony Orchestra

United for Literacy

United Way of Thunder Bay

Waterfront BIA

William Creighton Youth Services

2023-24 Central Library Steering Committee

Chief Michele Solomon

Rebecca Johnson

Andrei Rosario

Jase Watford

Charmaine McCraw

Jason Thompson

Councillor Trevor Giertuga

Councillor Brian Hamilton

Thunder Bay Public Library
285 Red River Road
Thunder Bay, ON P7B 1A9

Hello,

Please note the following response to Speak to City Council has been submitted at Friday July 12th 2024 12:32 AM with reference number 2024-07-12-001.

- **What would you like to speak to Council about:**
  In support of the New Central Library

- **Is this an item scheduled on a current agenda?:**
  Yes

- **Provide as much information as you can about the matter you would like to speak to:**
  I do not necessarily need to speak if someone could read this for me. As a person and a home owner living and working in Thunder Bay, which we now is a growing and developing city, having a grand central library that is fully assessable to all the residents of Thunder Bay would be the just way to go. Thunder Bay has four library locations none of which have large enough accessible bathrooms for people with disabilities. This central library will be fully accessible with the adequate size accessible bathrooms. Not only the bathrooms would be accessible the location would have adequate parking and full bus/ lift system in place. The central library would have community programming and meeting rooms as well as an extensive children's program. This new location and the development of a central library system makes sense for a growing city and to have a fully accessible building will be welcoming for all.

- **Provide specific actions you would like Council to take:**
  I would like council to listen and hopefully approve the central library project .

- **Have you already been in contact with City staff in regards to the subject matter of your deputation request?**
  No

- **Please select the date of the meeting:**
  Committee of the Whole - Monday, July 22 2024

- **Please choose**
  Ms

- **First name:**
  Kasia

- **Last name:**
  Piech

- **Email:**
  kasia.piech@cltb.ca

- **Phone:**
  (807) 252-6644

- **Please note the names of the presenters that will be attending with you:**
  Nikki Heath, Keira Pepe

- **Please indicate how you intend to participate in the meeting.**
  Written comments only.

Corporate Report

REPORT NUMBER	144-2024-Infrastructure, Development & Operations-Engineering & Operations		
DATE PREPARED	March 18, 2024	***FILE***	
MEETING DATE	May 13, 2024		
SUBJECT	Transit and Municipal Fleet Zero Emissions Transition Plan		

RECOMMENDATION

WITH RESPECT to Report 144-2024-Infrastructure, Development & Operations-Engineering & Operations, we recommend that the Transit and Municipal Fleet Net Zero Transition Plans be approved;

AND THAT Administration continue advancing planning, design and construction to move forward with transit and municipal fleet electrification based on the Transition Plans;

AND THAT projects be brought forward for approval through the annual budget process;

AND THAT any necessary By-laws be presented to City Council for ratification.

LINK TO STRATEGIC PLAN

The Transit and Municipal Fleet Zero Emissions Transition Plan aligns with Maamawe, Growing Together 2023-2027 Strategic Goal to take decisive action to respond to the climate emergency by accelerating initiatives to reduce Corporate greenhouse gas (GHG) emissions.

EXECUTIVE SUMMARY

In response to City Council declaring a Climate Emergency and endorsing the Net-Zero Strategy, two implementation plans have been developed to transition the City's fleet to electric vehicles. The City of Thunder Bay's (City) Transit and Municipal Fleet Zero Emissions Transition Plans (Transition Plans) outline a phased approach to implementing battery electric vehicles (BEV) into the City's fleet as it is operationally and financially viable to do so. The phased approach will allow operations that are directly and indirectly impacted to gain valuable experience with the technology as industry best practices and technology continues to develop prior to full implementation. The Transition Plans evaluate the feasibility of electric vehicles and provide transition plans with preferred pathways, associated costs and service impacts.

The transition to Battery Electric Buses (BEBs) over the lifecycle of the project from 2023 to 2050 is anticipated to be an increase to capital and operating of approximately $61.4 million dollars, compared to continuing to operate at baseline scenario utilizing internal combustion engines (ICE) buses. It will result in transit fleet emissions being reduced by more than 90% or approximately 60,000 tonnes of GHG emissions, compared to baseline scenarios. This is the equivalent of the annual GHG emissions from 13,000 gas powered vehicles.

The Transition Plans outline the significant funding that is available currently to municipalities to help fund the transition to zero emissions fleet. The City has been successful in receiving funding from Infrastructure Canada's Zero Emissions Transit Fund (ZETF) totalling $128,400 for the development of the Transition Plans. Additional funding from the capital stream of the ZETF program is available with the prerequisite of the development of the Transition Plans.

In March 2024, it was announced that the City was successful in securing $10.4 million from the Investing in Canada Infrastructure Program (ICIP) for capital infrastructure including charging infrastructure and facility/shop modifications for the implementation of the Transition Plan at the Fort William Transit Garage. ICIP funding plus $4 million from the City's capital budget, will contribute a total of $14.4 million towards the infrastructure initial phase of the Plan. ICIP has also provided $12.2 million for the procurement of BEBs.

DISCUSSION

As part of the City's commitment to achieving net-zero GHG by 2050, assessments were completed to transition the municipal fleet and equipment to net-zero emission vehicles where technologically and operationally viable, and where resources and funding are available. The assessments determined that fleet electrification is largely viable, and the implementation plan proposed will see the City reduce transit fleet related GHG emissions by more than 90% or approximately 60,000 tonnes. This is the equivalent of the annual GHG emissions from 13,000 gas powered vehicles.

The scope of work for the project comprised of four tasks: Route modeling and scheduling optimization; Facility Assessment; Full Transit Fleet Electrification Plan; and

Municipal Fleet Transition Plan. The Final Draft Transition Plans are included as Appendix A and D.

The Transition Plans evaluate the feasibility of electric vehicles and develop transition plans with preferred pathways, associated costs and service impacts. They provide a point in time analysis of the requirements to transition the transit fleet to battery electric buses (BEB) as well as an overview for the conversion of the municipal fleet to BEVs. The transition to battery electric vehicles (BEV) is a significant undertaking that requires robust planning and will impact all aspects of the city's operations. Within three (3) to five (5) years, it is recommended to review and update the Transition Plans based on operating data, new technology, and growth.

Transit Fleet Electrification

The Transit Fleet Zero Emissions Transition Plan has been developed to address the following elements: 1. System level planning; 2. Deployment Strategy; 3. Operational Planning; 4. Capacity to implement the technology; 5. Financial Planning; and 6. Environmental Benefits.

System Level Planning

As transit agencies review options to implement zero emissions technologies, there are two main options; BEB's and hydrogen fuel cells, with BEB's being the predominant model due to the readily available source of fuel and ease of connection to receive power. Hydrogen fuel cell analysis was not included within the scope of work, however, should local hydrogen production opportunities become viable, hydrogen fuel options will be reviewed.

In developing a transition pathway for BEB's in Thunder Bay, extensive energy consumption modeling was undertaken to understand how different battery electric vehicles could be deployed. Energy modeling considers factors including topography, ambient temperatures, heating/cooling requirements and others.

Multiple scenarios were modelled to determine the optimal transition pathway including depot charging only, enroute charging, and auxiliary heaters.

Based on the energy modeling conducted, a phased implementation to BEB is recommended using auxiliary diesel heaters and a combination of depot and enroute charging. Utilizing existing diesel buses while transitioning to BEBs and supporting infrastructure are recommended through the transition to full implementation in approximately 2044. This will provide Transit operations the opportunity to operate the BEBs within the City's environment for real time data to validate the modeling. Starting with depot charging at the Fort William Transit Garage allows the City to investigate the addition of enroute charging at the Waterfront Transit Hub with potential expansion to other locations.

It is recommended that, prior to a full transition to BEB, a follow up evaluation in three (3) to five (5) years be undertaken to confirm operating performance based on actual field operations and review technology improvements. This reassessment would confirm how the BEBs perform in Thunder Bay, charging infrastructure required, and feasibility of enroute charging.

Energy consumption analysis was also completed for the Lift+ Specialized transit fleet based on the average and maximum daily mileage compared to the range capability of other similar style EVs. It is recommended to operate a limited number of battery electric specialized buses on shorter duty routes to evaluate performance and allow time for the market to develop.

Operational Planning and Deployment Strategy

The four phases of the Transit BEB transition plan (Figure 1) incorporate both the fleet and purchasing strategy as well as the facility and infrastructure requirements to operate an electric fleet.

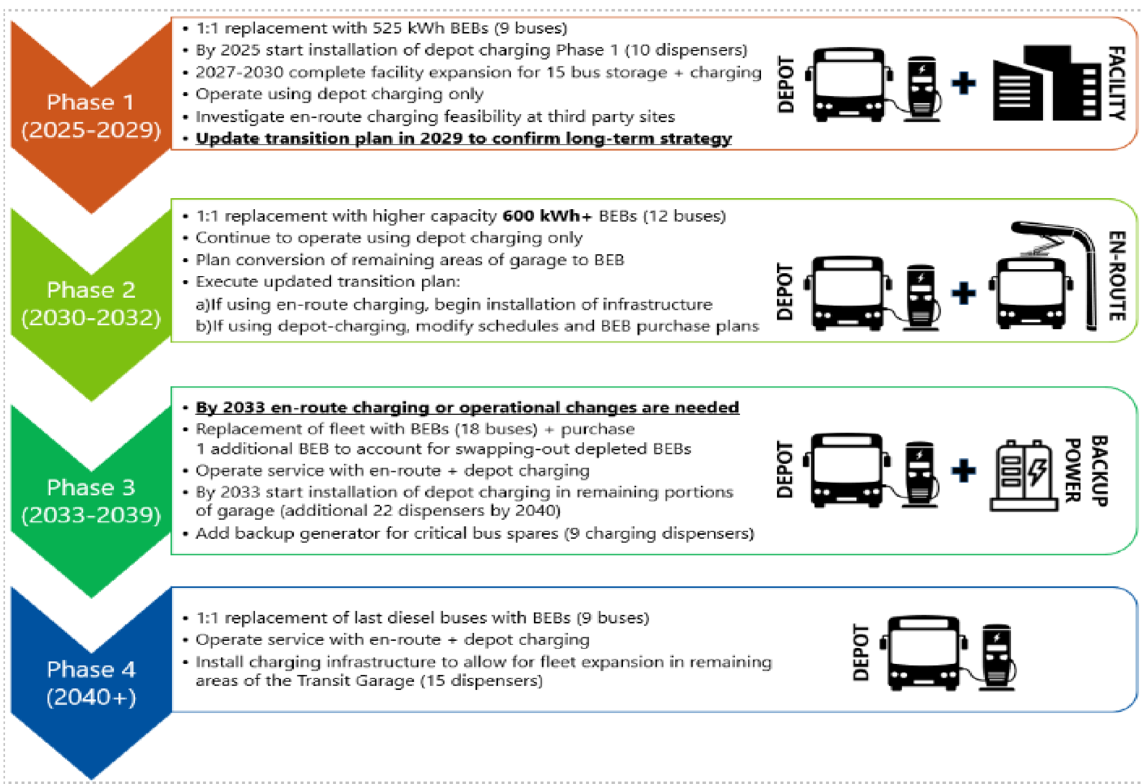


Figure 1: Phased implementation for the Transit Zero Emissions Transition Plan

Transit Bus Procurement:

A phased approach will be taken to replace the current fleet of Internal Combustion Engine (ICE) buses with BEB's. If all ICE buses procured after 2027 are replaced with a BEB, the full build out of the transition plan will be complete by 2044 (Figure 2). If the transition plan concept develops with the implementation of enroute chargers, in 2037 one additional BEB will be required to allow for bus swapping on routes that do not have access to an enroute charger.

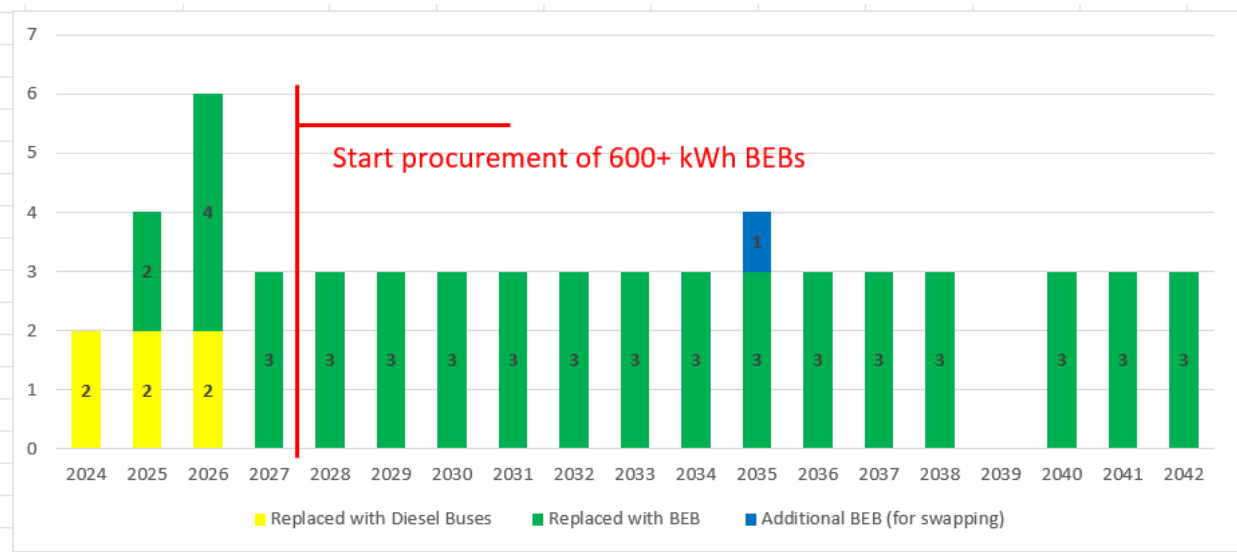


Figure 2. Procurement strategy for 12m conventional BEB buses.

It should be noted that it can take up to two years from order date to receive the BEBs. BEBs ordered in 2025 will not be operational until 2027.

Lift+ Procurement:

As with the 12m conventional buses, the capital replacement schedule for BEB Lift+ specialized buses will remain at three (3) buses per year after the initial procurement in 2024 of two electric Lift+ buses.

Facility and Infrastructure Plans:

The City's Transit operations and maintenance facility is currently nearing 100% capacity. The conceptual plan for the Fort William Transit Garage includes considerations for charging of the BEBs, both conventional and specialized paratransit, as well as light duty support vehicles. Phase 1 of the transition plan will focus on the installation of wall mounted plug-in chargers in a portion of the existing facility. Phase 2 will begin the facility expansion with increases to vehicle charging infrastructure in Phases 3-4. This will allow operations some flexibility as expansion and revision of maintenance bays is also required concurrently.

All phases will involve bringing in additional power capacity as more units come online. Throughout the development of the transition plan, Synergy North has actively participated in discussions involving electrical feed sizes, grid capacities, locations of installations and associated upgrade costs which are incorporated into the plan. Synergy North has indicated there is currently capacity in their distribution network for the work to be completed within the Plan and has requested to continue to be engaged as the transition plan is implemented.

Capacity to Implement the Transition

For the successful transition to BEB's, it will be essential to involve all stakeholders in the process. Stakeholders include operations and maintenance staff, management, customers, unions and other key groups directly and indirectly impacted. Engaging stakeholders will help to build support and mitigate challenges as they arise to ensure a successful implementation.

Another key component for the successful implementation of the BEB fleet is training and resource development. It is critical to provide adequate training and support to operations and maintenance staff who will be involved in any part of this transition. The training should cover technical aspects of operating electric vehicles, safety protocols, maintenance procedures and other relevant topics. Software systems are included within the recommended transition process to assist operations staff to effectively monitor and operate the BEB fleet.

A key component of the transition plan is to maintain the current workforce and provide a pathway to empower the existing staff with the required training and skills to support the successful transitions to BEBs. As part of the scope of the transition plan, a review of current staffing and responsibilities was undertaken to identify gaps in the current complement and skill sets. This review will recommend a path forward to adapt and train the current workforce to become familiar with the new technology and operations. As transition to electric vehicles will have significant impacts on many aspects of the corporation, including but not limited to both infrastructure and operations, it is recommended that a dedicated energy project manager and a new position for fleet maintenance be added.

An integral part of the transition plan is the development and implementation of detailed safety protocols and procedures as staff will be required to work with and around high voltage electrical hazards. Additionally, lithium battery fires are very difficult to extinguish. It is recommended that safety protocols be developed with first responders and other stakeholders prior to the delivery of the first BEV.

Environmental Benefits

The implementation of the zero-emissions transition plan for Transit Services supports the City's climate change goals to reach net zero emissions by 2050. By implementing the transition plan as recommended, transit fleet emissions will be reduced by more than 90% or approximately 60,000 tonnes of GHG emissions from 2025 to 2050, compared to baseline scenarios. This is the equivalent of the annual GHG emissions from 13,000 gas powered vehicles.

The GHG emissions are calculated based on a well to wheel basis that compares the GHG emissions of combustion of diesel fuel to the electricity required to operate a BEB. Table 1 illustrates the results of the GHG emissions analysis from 2025 - 2050.

	2025	2030	2050	TOTAL
Baseline	**3,884**	**3,884**	**3,884**	**108,763**
Diesel	3,884	3,884	3,884	108,763
BEB	-	-	-	-
BEB Scenario	**3,884**	**2,834**	**652**	**48,891**
Diesel	3,884	2,794	519	46,469
BEB	-	40	133	2,422

Table 1: GHG analysis from 2025 to 2050 for the transition to BEBs.

A small amount of diesel will continue to be used for auxiliary heaters required in the winter.

Municipal Fleet Zero Emissions Plan

The Municipal Fleet Zero Emissions Transition Plan reviewed BEVs ready to electrify (Priority One) as well as review of future potential vehicle replacements that are expected to become available (Priority Two) at the following locations: Mountdale and Front Street Public Works Yards, Mapleward Solid Waste and Recycling Facility, Parks North, Traffic Control and Streetlighting and Fort William Transit Garage. The transition plan allows the flexibility to implement BEVs as the technology improves and it becomes operationally viable to incorporate BEVs into daily operations.

The Plan proposes charging infrastructure to be in place by 2025 to align with the current fleet replacement strategy of Priority One ICE vehicles with BEVs starting in 2026. Two Ford F-150 Lighting XL are currently successfully operating as Transit Control support vehicles. Operational data will continue to inform the transition plan update in three to five years.

To accommodate the transition to BEVs, conceptual utility infrastructure plans were developed for the five locations and sized to support Priority One BEVs at full implementation and Priority Two BEVs as they become operationally viable. The conceptual designs of the sites were completed in coordination with Synergy North to confirm power grid capacity.

The transition to electrifying for Priority 1 vehicles would reduce GHG emissions by approximately 18,000 tonnes across the study period.

As discussed within the Transit BEB Transition Plan, proper training, and development of safety procedures for all staff directly and indirectly involved with operating the BEVs is essential.

Next Steps

Administration will move forward with the implementation of the first phase of charging infrastructure and expansions at the transit garage and BEB procurement. In 2029 it is recommended to review and update the transition plans based on actual operating data, new technology, and growth in both population and ridership.

LINK TO EARTHCARE SUSTAINABILITY PLAN

In response to the climate change emergency declared by City Council in January 2020, the City endorsed the Net Zero Strategy as outlined in the Climate-Forward City: Thunder Bay Net-Zero Strategy (NZS). The NZS identified a near term tactic for the development of a decarbonization strategy for the municipal fleet including transit with a goal of municipal transit fleet conversion to 100% electric by 2035 and the conversion of the municipal fleet to 100% electric by 2040.

FINANCIAL IMPLICATION

There are no immediate costs associated with approving the Transition Plans at this time. The implementation of the Transition Plans will require future capital infrastructure costs and increased operating and maintenance costs which will be presented through the regular budget process.

The transition to BEBs over the lifecycle of the project from 2023 to 2050 is anticipated to be an increase to existing capital and operating of approximately $61.4 million dollars, compared to continuing to operate at baseline scenario utilizing internal combustion engines (ICE) buses. This estimate includes a significant capital investment in buses and supporting infrastructure, and a minor increase in operating and maintenance costs due to the need to maintain charging components but will generate almost 40% decrease in fuel/electricity costs. Energy savings will continue to increase after 2050 as the transit fleet will be fully electric at that time.

As with the Transit Zero Emissions Transition Plan, the capital cost associated with the charging infrastructure is significant as well as the current pricing of some Priority One BEVs. Operating and maintenance costs are included, however many of the O&M costs are still unknown until operation begins and will be presented during regular budget deliberations. It is anticipated that to transition to BEVs will cost $12.5 million more than maintaining a baseline municipal fleet of ICE vehicles.

The Transit and Municipal Zero Emissions Transition Plans will require the City to maintain dedicated full-time resources for their successful implementation. Future financial implications would be forecasted through the administrative review process and brought forward to Council for approval as required through the annual budget process.

In March 2024, it was announced that the City of Thunder Bay was successful in securing funding from ICIP Public Transit Stream for capital infrastructure, which included charging infrastructure, facility, and shop modifications at the Fort William Transit Garage to facilitate the operation of BEBs. Provincial and Federal funding totalling $10,335,685, plus $4,000,000 matching funds from the City of Thunder Bay will fund the initial phases of the infrastructure capital transition plan for BEBs. This project was included in the 2024 Capital Budget.

Funding through ICIP is also in place for purchases of six (6) BEBs and eight (8) electric specialized transit vehicles. Administration will continue to pursue additional external funding opportunities as they become available.

CONCLUSION

It is concluded that Council should endorse the Zero Emission Fleet Transition Plans.

It is also concluded that Administration should continue advancing planning, design, and construction work to move forward with transit and municipal fleet electrification plans. It is also concluded that projects be brought forward for Council approval through the annual budget process or as appropriate.

It is also concluded that Report 144-2024 be introduced as a First Report on May 13, 2024, and Council consider the recommendations in detail at the July 15, 2024, Committee of the Whole meeting.

BACKGROUND

In May 2021, Metrolinx Transit Procurement Initiative (TPI) held an information session to understand the needs of member transit agencies related to the joint procurement for battery electric buses (BEB). Based on the feedback, TPI created a BEB Joint Procurement Roadmap that provides a pathway to fleet electrification, beginning with the procurement of consulting services to plan for fleet electrification, followed by future vehicle and infrastructure procurement. The scope of work was to provide participating municipalities with a complete and comprehensive plan to electrify their transit fleet. As some of the participating municipalities also expressed interest in municipal fleet, an additional scope of work was added to the initiative for non-revenue municipal fleet. The City of Thunder Bay participated in both initiatives.

REFERENCE MATERIAL ATTACHED

Appendix A-Transit Fleet Zero Emission Transition Plan

Appendix B- Transit Fleet Zero Emission Transition Plan- Fort William Transit Garage (Transition Plan Appendix B1A)

Appendix C- Transit Fleet Zero Emission Transition Plan- Waterfront Transit Terminal (Transition Plan Appendix B1B)

Appendix D- Municipal Fleet Zero Emission Transition Plan

REPORT PREPARED BY

Vanessa DeGiacomo-Zwaresh, Energy Analyst-Infrastructure, Development & Operations

REPORT SIGNED AND VERIFIED BY

Kerri Marshall, General Manager – Infrastructure, Development & Operations

Date (05/08/2024)

CITY OF Thunder Bay
Superior by Nature

TRANSIT FLEET ZERO EMISSION TRANSITION PLAN

TASK 3 DRAFT REPORT

5/7/2024

DISCLAIMER

In preparing this report, HDR relied, in whole or in part, on data and information provided by the Client and third parties that was current at the time of such usage, which information has not been independently verified by HDR and which HDR has assumed to be accurate, complete, reliable, and current. Therefore, while HDR has utilized its best efforts in preparing this report, HDR does not warrant or guarantee the conclusions set forth in this report which are dependent or based upon data, information or statements supplied by third parties or the client, or that the data and information have not changed since being provided in the report.

This report is intended for planning purposes for the Client, and for Client's sole and exclusive use and is not for the benefit of any third party and may not be distributed to, disclosed in any form to, used by, or relied upon by, any third party without prior written consent of HDR, which consent may be withheld in its sole discretion. Use of this preliminary feasibility report or any information contained herein, if by any party other than Client, shall be at the sole risk of such party and shall constitute a release and agreement by such party to defend and indemnify HDR and its affiliates, officers, employees and subcontractors from and against any liability for direct, indirect, incidental, consequential or special loss or damage or other liability of any nature arising from its use of the Report or reliance upon any of its content. To the maximum extent permitted by law, such release from and indemnification against liability shall apply in contract, tort (including negligence), strict liability, or any other theory of liability.

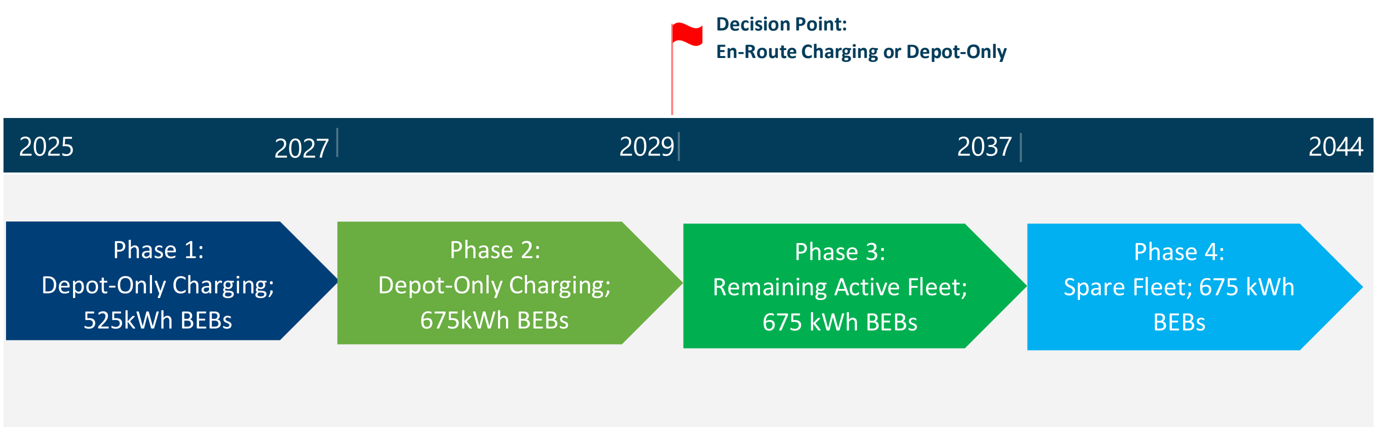
CONTENTS

EXECUTIVE SUMMARY

Transitioning to a zero-emission fleet involves more than simply buying vehicles and a fueling system; the transition introduces new technology and processes into day-to-day operations. Successful fleet transition plans take a holistic approach to consider operational requirements, market conditions, available power, infrastructure demands, and costs. This Zero Emission Fleet Transition Plan encompasses all these elements and is intended to be a roadmap for Thunder Bay Transit to convert their transit bus fleet to zero emission by 2044.

This study utilized energy modelling of battery electric buses (BEBs) using current route data to confirm operational feasibility and develop fleet charging strategies and recommendations for vehicle and charging infrastructure types. The in-depth analysis summarized below provides Thunder Bay Transit with data to guide important decisions involving capital programs and operations necessary to build key partnerships and support transition actions and phases.

This Transition Plan outlines a phased implementation approach that will allow the agency to integrate BEBs into the fleet gradually. Thunder Bay Transit will be able to gain valuable experience with the technology while the market continues to develop and mature. BEBs are impacted by limited range and the time to recharge may not be consistent with current fleet operations, depending on the operating profile of the fleet. As technology advances, it's anticipated that batteries will become bigger and lighter, increasing vehicle range and overall capability to do longer service runs like the service the current diesel fleet is capable of. Just as battery and vehicle performance are expected to improve, charging technology and performance are also expected to improve as the technology matures.



Thunder Bay Transit can electrify a significant portion of the fleet using depot-only charging, but in future years, based on today's battery technology, an expanded fleet or en-route charging would be required to support a full BEB transition. The transition should begin with the installation of required plug-in depot charging infrastructure and required supporting utility infrastructure at Fort William Road Transit Garage. Utility infrastructure should be sized for full buildout to avoid rework and multiple construction phases, but chargers will be installed in phases as buses are delivered and enter revenue service. In future years, the City will re-evaluate fleet and operating needs to determine whether or not en-route charging should be implemented at up to five locations. Depending on this decision, along with vehicle battery range capabilities at the time, the fleet size may need to increase to facilitate bus swaps and maintain the same level of service.

The fleet may further grow as part of a future service expansion; if so, the City would need to re-evaluate the feasibility of procuring BEBs to operate future expanded service and determine the needs of the fleet.

1 INTRODUCTION

In response to the climate emergency declared by the City of Thunder Bay's council in January 2020, the City developed and adopted a Net Zero Strategy (NZS) outlined in the *Climate Forward City: Thunder Bay Net Zero Strategy*.[1] The report identifies near-term tactics to kick-start the implementation of the NZS with a goal to reach net-zero greenhouse gas (GHG) emissions by 2050.

To support the NZS and the elimination of GHG emissions, the City investigated the feasibility of electrifying their revenue transit fleet. The City applied to Infrastructure Canada's Zero Emissions Transit Fund (ZETF) program to provide partial funding for planning efforts to de-carbonize the transit fleet.

In connection with Metrolinx's Joint Transit Procurement Initiative, the City of Thunder Bay engaged HDR to evaluate the feasibility of electric vehicles and to develop a transition plan for the revenue transit fleet that would lay out a roadmap for Thunder Bay Transit to convert gas and diesel-powered vehicles to zero emission vehicles. The Transit Fleet Zero Emission Transition Plan (Transition Plan) identifies the feasible transition pathway(s), associated capital and operating costs, service impacts, and the preferred transition pathway. The transition plan will allow for the City of Thunder Bay to meet its net-zero goal by 2050.

[1] https://www.thunderbay.ca/en/community-energy-and-emissions-plan.aspx#:~:text=The%20Net-Zero%20Strategy%20%28NZS%29%20is%20a%20community-wide%20energy,emergency%20declared%20by%20City%20Council%20in%20January%202020.

2 TRANSIT ZERO EMISSION FLEET TRANSITION PLAN

The transition from conventional gasoline and diesel buses to battery electric buses (BEBs) is a significant undertaking that requires robust planning and will impact many aspects of the organization. Infrastructure Canada has created the ZETF to support organizations in transitioning their fleets.[2] In addition to funding planning projects, ZETF has a capital stream that provides opportunities for transit agencies to receive funding for capital projects. To apply for capital funding, there are six planning elements that applicants must satisfy. This Transition Plan has been developed to address those elements:

1. **System Level Planning:** Description of system-level planning undertaken for the project, such as analysis of zero emission bus (ZEB) technologies, energy consumption analysis, and identification of charging/refueling and facility requirements.
2. **Deployment Strategy:** Includes the fleet and infrastructure implementation plan.
3. **Operational Planning:** Identifies operational considerations to support innovative and effective BEB deployment and future operations. Operational considerations include aspects such as scheduling, dispatching, in-service monitoring, charging and storage strategies.
4. **Capacity to Implement the Technology:** Provides details on the organization's resources, skills and training required for the deployment and operation of a new ZEB fleet. It also provides an assessment of risks and mitigations that will need to be monitored during implementation.
5. **Financial Planning:** Provides cost estimates of different scenarios as well as estimated lifecycle cost savings.
6. **Environmental Benefits:** Includes a lifecycle assessment of environmental benefits associated with the transition, including estimates of greenhouse gas (GHG) emissions reduction, noise reduction, and non-GHG pollutant reduction.

This Transit Fleet Zero Emissions Transition Plan addresses each of these topics in the following report and accompanying appendices.

[2] https://www.infrastructure.gc.ca/zero-emissions-trans-zero-emissions/zetf-applicant-guide-demandeur-ftcze-eng.html#a

3 SYSTEM LEVEL PLANNING

The foundation of this Transit Fleet Zero Emissions Transition Plan begins with the approach to system-level planning. An analysis of ZEB technologies was performed to further understand both BEB and fueling options within the market for the City of Thunder Bay to consider. A comprehensive energy consumption analysis was performed for Thunder Bay Transit to develop an accurate and unique energy profile, which further works to identify charging, refueling and facility requirements specific to the agency's needs.

3.1 BATTERY ELECTRIC BUSES & FUELING OPTIONS

As transit agencies look for a zero-emission technology to replace gas and diesel buses, there are two (2) primary options, BEBs and hydrogen fuel cell electric buses (FCEBs). Currently, BEBs are the most popular replacement choice because they use the electrical grid as their fuel source, which is universally available and relatively simple to connect to and receive power. However, electric vehicles have a limited range compared to diesel, which means they are often not capable of directly replacing buses with long duty cycles or blocks. In some cases, it's not possible to adjust routes and service to account for BEB capabilities, so an alternative zero emission vehicle type or enhancement is needed.

En-route charging is an enhancement that can greatly improve the feasibility of BEBs in many situations. They can extend the range of a BEB and facilitate one-to-one replacement of diesel vehicles when the routes are conducive to this charging strategy. This is particularly helpful with circular routes where the same en-route charger can be used by a vehicle multiple times throughout the day. En-route charging infrastructure is ideally located at places such as transit centers where buses operating on multiple routes have scheduled layover time.

3.2 FIXED ROUTE ENERGY CONSUMPTION ANALYSIS

Understanding energy consumption is a key component of fleet transition planning, as it informs the choice of vehicle technology, infrastructure requirements, finances, and fleet replacement strategies. The following sections outline the methodology and key findings.

3.2.1 METHODOLOGY

HDR's propriety energy consumption model, Zero+, provides a comprehensive understanding of the potential impacts BEB technology may have on Thunder Bay Transit's existing service. **Figure 1** shows the Zero+ Model inputs, outputs, and process.

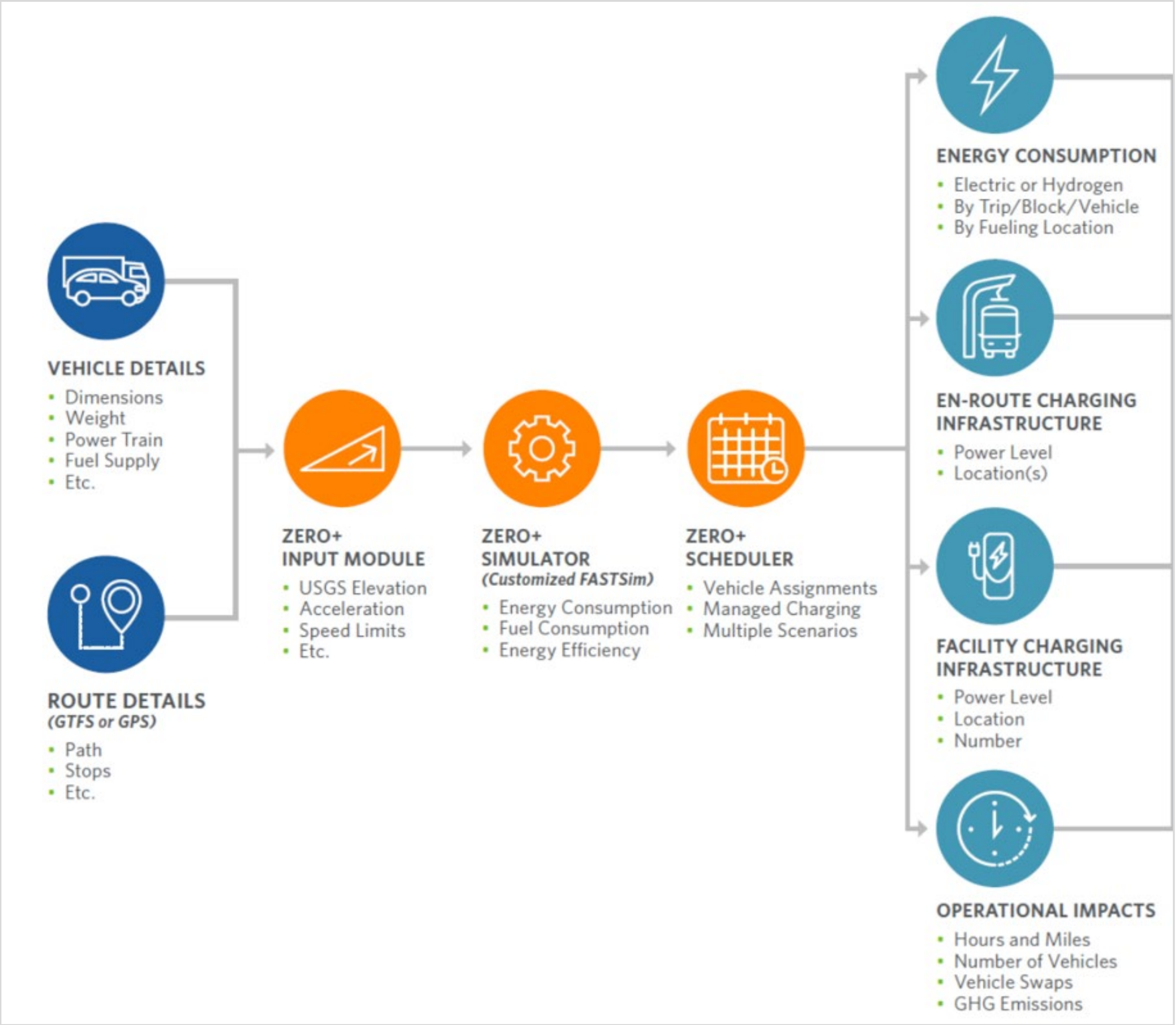


Figure 1. HDR's Zero+ Model Inputs, Outputs and Process

Energy consumption is impacted by several factors including slope and grade of the bus routes, number of vehicle stops, anticipated roadway traffic, and ambient temperature. The Zero+ model also analyzes variables known to impact lifetime vehicle performance, like energy density, battery degradation, operating environment, HVAC and auxiliary power loads, as well as the lifecycle of bus batteries and hydrogen fuel cells. The model is fed by GTFS data, GIS data, and vehicle profile assumptions to create an accurate energy consumption profile unique to Thunder Bay Transit's existing service. In sum, Zero+ results include many data variables, yielding the most accurate results possible to influence strong, effective decision making.

The Zero+ model results, combined with discussions with agency staff, provide the basis upon which the preferred vehicle technology and refueling strategy will be determined. This modelling evaluated whether the optimal charging strategy is depot charging only or a mix of depot and on-route charging, which nameplate battery capacity and auxiliary heater type is optimal and identifies potential strategies that best complement Thunder Bay Transit's service and fleet plans. Simulations were performed at the granular level, so that the strategy can inform individual vehicles, routes, and blocks as well as the full Thunder Bay Transit fleet. Examining each vehicle individually drives decisions for the right technology at the system, depot, route, and block levels. This analysis balanced impacts to operations, overall fleet size, and infrastructure requirements and ultimately provided Thunder Bay Transit with the information to make a data-driven determination of the preferred BEB transitional technologies and deployment pace.

Scenarios modelled included:

- Baseline (diesel buses);
- 525 kWh BEB with depot-only charging;
- 525 kWh BEB with depot and en-route charging; and
- 675 kWh BEB with depot-only charging.

Various iterations of these scenarios were also conducted to inform the key findings summarized below.

3.2.2 FIXED ROUTE KEY FINDINGS

The analysis revealed that with depot-only charging, only 25% of the current fleet (8 of 32) could be replaced with 525 kWh BEBs without any modifications to the current fleet or service profile. When increasing the battery capacity to a longer-range 675kWh BEB, this increases to 50% (16 of 32). The phases of the deployment plan were developed in a manner that allows Thunder Bay Transit to transition the entire fleet to zero emissions with the least number of additional vehicles or infrastructure as possible. By procuring higher capacity BEBs, the City can delay the purchase of additional vehicles or installing en-route charging infrastructure until 2029; during the initial phases of the transition, Thunder Bay Transit can wait for the technology and market to mature before making investments that may no longer be needed in the future with advanced technology.

The detailed results of the initial route modelling analysis can be found in **Appendix A**.

3.3 LIFT+ ENERGY CONSUMPTION ANALYSIS

Thunder Bay Transit's Lift+ Specialized services were modelled separately from fixed route services due to the available data types. This modelling effort was based on operating data provided by the agency as well as the battery and charging specifications of equivalent BEBs. Existing paratransit and specialized fleet vehicles' average and maximum daily kilometres and hours in service, derived from Thunder Bay Transit's monthly vehicle data, were considered in the modelling. The total energy consumption of the BEB fleet is computed using the worst-case vehicles to forecast overall site energy and fleet size impacts.

If the daily amount of energy required exceeds the available energy for a vehicle, then the cases for an increase in fleet size is considered. This additional case facilitates protecting the vehicles' health while avoiding interruptions to normal operations. Two scenarios were considered: a base scenario and a scenario reflecting an expanded BEB fleet.

3.3.1 LIFT+ KEY FINDINGS

Analysis based on similar currently available fleet vehicles (using a cutaway truck chassis) indicated that 69% of the work blocks could be replaced with the vehicles that are currently available. The remaining 31% of work blocks would require a swap midday for a fully charged replacement, which would require an increase of 12 fleet vehicles (or 44% of the current fleet) to allow for a fully charged vehicle to be available at the garage when a swap is needed.

4 OPERATIONAL PLANNING & DEPLOYMENT STRATEGY

The following sections highlight critical fleet and infrastructure implementation needs, including actions that will be taken to effectively deploy BEBs and ensure efficient future operations. The fleet deployment plan highlights each phase of the plan, offering a purchase schedule and insight into the phased deployment effort. The facility and infrastructure plan for the depot facility is also provided, covering existing conditions and facility infrastructure implementation. The feasibility of en-route charging is also considered, with potential locations that may be beneficial for Thunder Bay Transit to assess in the future.

4.1 TRANSIT FLEET DEPLOYMENT PLAN

The recommended charging strategy is to proceed with beginning the transition to BEBs with the procurement of eight (8) 525 kWh BEBs; these buses are readily available on the market and would allow the agency to transition the fleet at a one-to-one ratio for the first 3 years. Following this initial phase, the agency will procure additional BEBs equipped with a greater battery capacity, allowing the agency to transition an additional eight (8) vehicles before a decision to implement en-route charging becomes necessary.

In 2029, the City will re-evaluate the feasibility of implementing en-route charging at Waterfront Transit Hub and four (4) additional sites not currently owned by the Town. This decision will be dependent on both the ability to reach land use agreements with current landowners and the state of the BEB market.

When the City re-evaluates the feasibility of en-route charging at some or all of the five (5) identified locations, the fleet transition plan will be revised to include the selected path forward and reflect future fleet needs. At full buildout, the City will operate a fleet of at most 36 *active* BEBs, dependent on future infrastructure decisions. The transit fleet will be transitioned to a uniform fleet of 675 kWh BEBs, with the 525 kWh BEBs procured in the first three years of the transition subsequently being replaced with 675 kWh BEBs. Though no OEMs currently offer a 675 kWh BEB, many are in development and are expected to be available in the next 3-5 years with near certainty.

Thunder Bay Transit doesn't currently operate any BEBs but plans to begin purchasing BEBs in 2025; the City will cease purchasing diesel buses in 2027 and all future procurements are assumed to be BEB. The fleet will be electrified in phases based upon utility infrastructure needs at the depot facility, available vehicle battery capacity, and potential en-route charging. The vehicle battery capacity varies from phase to phase, but all plug-in depot chargers for fixed-route transit buses are assumed to be 150kW with three dispensers each. All plug-in chargers for Lift+ Specialized buses are assumed to be single-port 22.5 kW DCFCs.

All phases are defined by the procurement year for vehicles as shown in **Figure 2** and infrastructure, with a two-year lead time assumed from procurement to delivery. These phases are further defined below.

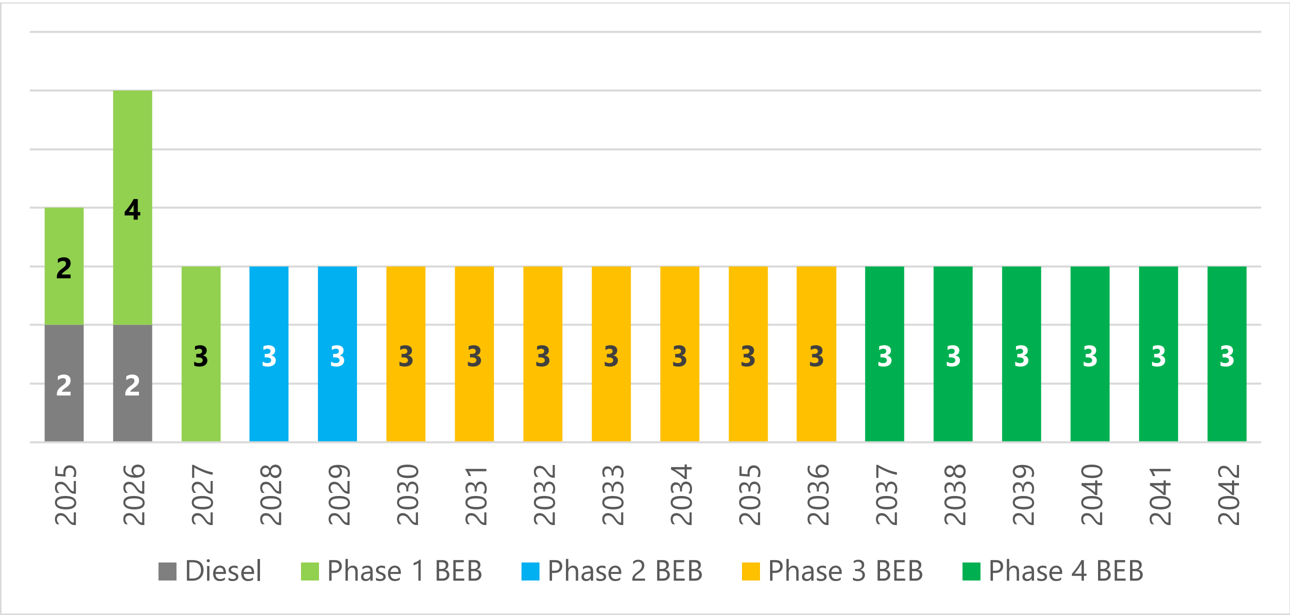


Figure 2. Fixed Route Transit Fleet Procurement Schedule by Purchase Year

Phase 1 (2025-2027): BEBs purchased in Phase 1 will be one-to-one replacements with 525 kWh+ buses; vehicle charging will be supported by pantograph or plug-in chargers at the depot that are powered by a new unit-substation and electrical service. During Phase 1 Thunder Bay Transit will also need to assess if installation of en-route charging at third party sites is a viable option for future phases.

This phase includes starting the construction of a building expansion to the Fort William Transit Garage that will allow the storage and charging of 15 vehicles by 2030. The facility expansion will allow Thunder Bay Transit space to relocate vehicles during upgrades to other portions of the facility construction as well as supporting longer term fleet growth.

During this phase, the agency will also procure four (6) Lift+ Specialized BEBs that will be supported by (6) single-port 22.5 kW chargers, one for each vehicle.

Phase 2 (2028-2029): BEBs purchased in Phase 2 will be one-to-one replacements with 675 kWh BEBs utilizing depot-only charging; vehicle charging will be supported by additional plug-in and pantograph chargers in the newly completed building expansion. At the end of this phase, in 2029, the City will need to decide if en-route charging will be implemented or if the transition will continue utilizing depot-only charging.

The first sixteen (16) BEBs can be operated using depot-only charging. If elected, construction and installation of en-route chargers would need to begin in 2030 to ensure chargers are ready for use in revenue service by 2032 with the delivery of the 17th BEB.

During this phase, the agency will also procure twenty-one (6) additional Lift+ Specialized BEBs that will be supported by (6) single-port 22.5 kW chargers, one for each vehicle.

Phase 3 (2030-2036): BEBs purchased in Phase 3 will be 675kW BEBs replaced at a greater than one-to-one replacement ratio. If en-route charging is implemented, only one additional bus will be required; if not, four additional buses will be required for peak active service. Regardless of charging strategy, this phase will include the electrification of the *active* fleet. During this phase, depot charging will be supported by a combination of plug-in and pantograph depot chargers.

An additional (15) Lift+ Specialized BEBs supported by (13) single-port 22.5 kW chargers; there is currently only space available to support (25) 22.5 kW chargers so vehicles will rotate amongst chargers as necessary. If additional parking space is made available for the remaining two Lift+ vehicles, an additional (2) 22.5 kW chargers could be installed to ensure each vehicle has a dedicated charger.

This phase will also include the installation of a new unit substation to support future charging infrastructure.

Phase 4 (2037-2042): BEBs purchased in Phase 4 will be 675 kWh, electrifying the remainder of Thunder Bay Transit's existing total fleet inclusive of spares. The quantity of spare buses in the fleet will remain constant at seventeen (17); the final spare bus will be procured in 2042 to enter revenue service in 2044.

A 650 kW diesel back-up generator will also be installed in Phase 4 to support charging of critical operations vehicles in the event of a wide-spread, sustained power outage. Until this generator is installed, Thunder Bay transit will utilize the remaining diesel fleet to facilitate critical operations in the event of a power outage.

Table 1 lists the key infrastructure installed in each of the four phases along with an estimated lump sum cost. Infrastructure and associated costs for a future fleet expansion are not included in this table but are further discussed below the table.

Table 1. Key Infrastructure by Phase

	Purchase Years	Estimated Cost	Key Infrastructure
Phase 1	2025 – 2027	$	(1) new unit substation (3) 150 kW chargers (fixed route) - (9) plug-in dispensers (6) 22.5 kW chargers (Lift+)
Phase 2	2028 – 2029	$	(2) 150 kW chargers (fixed route) - (6) plug-in dispensers (6) 22.5 kW chargers (Lift+)
Phase 3	2030 – 2036	$	(1) new unit substation (7) 150 kW chargers (fixed route) - (5) plug-in dispensers - (16) pantographs (8) 450 kW pantograph chargers (en-route) (15) 22.5 kW chargers (Lift+)
Phase 4	2037 – 2042	$	(1) 650 kW backup generator (6) 150 kW chargers (fixed route) - (18) pantographs
Total		$	

Future Fleet Expansion: While the plan focuses on the current fleet being transitioned to BEBs, the construction of the expanded parking area used during the transition will prepare Thunder Bay Transit for anticipated fleet growth that is expected to occur between now and 2050. Planned future fleet expansion would introduce up to fifteen (15) additional fixed-route transit buses that would be supported by depot charging overnight.

If Thunder Bay Transit proceeds with fleet expansion in the future, charging infrastructure could be fed from the existing electrical service, meaning no additional supporting utility infrastructure installations or upgrades would be necessary. Additional planning efforts would need to be completed prior to expanding the fleet to ensure other operations and maintenance areas have corresponding capacity to operate and maintain the additional fleet.

4.2 LIFT+ PARATRANSIT DEPLOYMENT PLAN

Thunder Bay Transit currently has 27 paratransit buses and operates the Lift+ paratransit service using a mix of modified vans and shuttles that are typically built on a cutaway truck chassis. The market for battery electric shuttles is underdeveloped with limited availability; however, many manufacturers are in prototype development phases and the market will likely mature significantly over the next five years.

Modelling of the Lift+ Specialized services indicated much of existing service (31% of service blocks) cannot feasibly transition to BEB without modification to fleet and/or service profile. To support current operations, the fleet size would need to increase by 12 vehicles (44%) to facilitate mid-day bus swaps when in-service vehicles' batteries are depleted.

The required increase in fleet size would significantly increase both capital and operating costs; the need for a larger fleet introduces additional non-revenue time and distance to facilitate bus swaps, along with increased per-kilometre maintenance costs. To allow time for the market to mature, Thunder Bay Transit will begin by operating a limited number of battery electric paratransit vehicles on the shorter duty cycles until the operational range of market-ready vehicles increases.

Up to eighteen (18) Lift+ vehicles can be transitioned to battery electric before an increase in fleet size becomes necessary. In 2029, with the procurement of the 18th battery electric shuttle, if battery technology has advanced enough to meet or exceed operational needs, the City will continue to transition the fleet at a one-to-one replacement ratio. Alternatively, if the market has not matured enough by 2029, the City will need to re-evaluate the needs of the fleet and decide whether to continue supplementing service with existing gasoline shuttles or procure additional electric vehicles to facilitate mid-day bus swaps.

The City of Thunder Bay plans to start procurement of a battery electric paratransit shuttle in 2024 as shown in **Figure 3**; after 2024, all retiring shuttles will be replaced with battery electric vehicles provided the initial vehicles perform as expected. Initially, battery electric Lift+ vehicles would operate on shorter duty cycles while gasoline shuttles continue to operate longer duty cycles. Throughout the first several years of the transition, the City will continue to monitor the vehicle market and re-evaluate the transition strategy when vehicles fitting the City's operational needs become available.

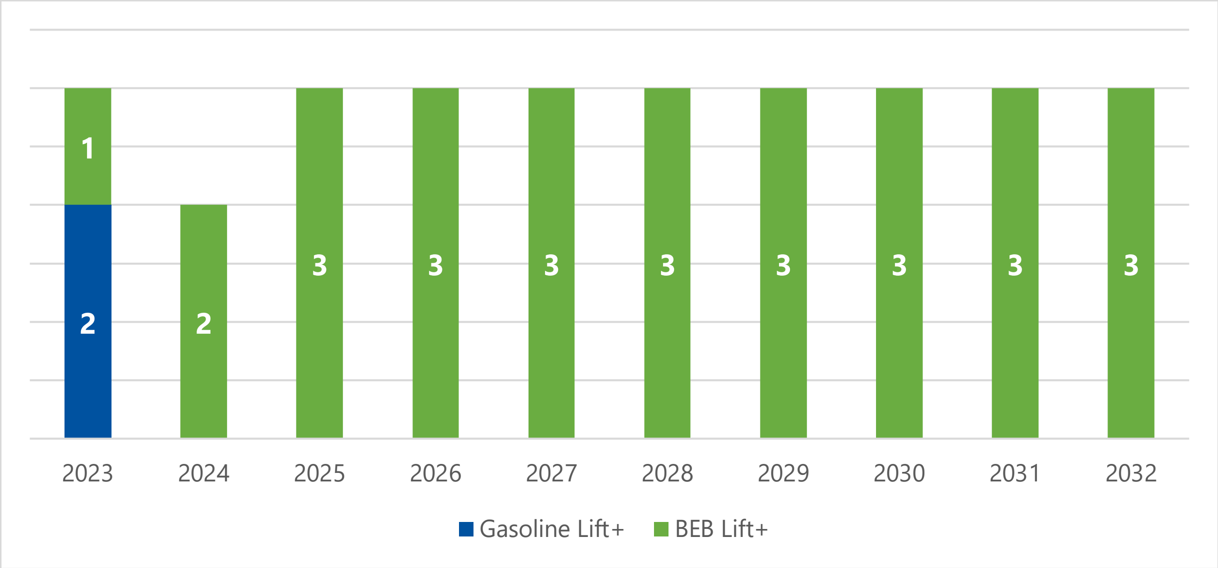


Figure 3. Lift+ Paratransit Fleet Purchases by Purchase Year

A two-year lead time from purchase to delivery of electric vehicles for Lift+ paratransit vehicles is assumed to account for ongoing supply chain issues across the industry. **Figure 4** below shows the composition of the fleet by the year vehicles are anticipated to enter revenue service.

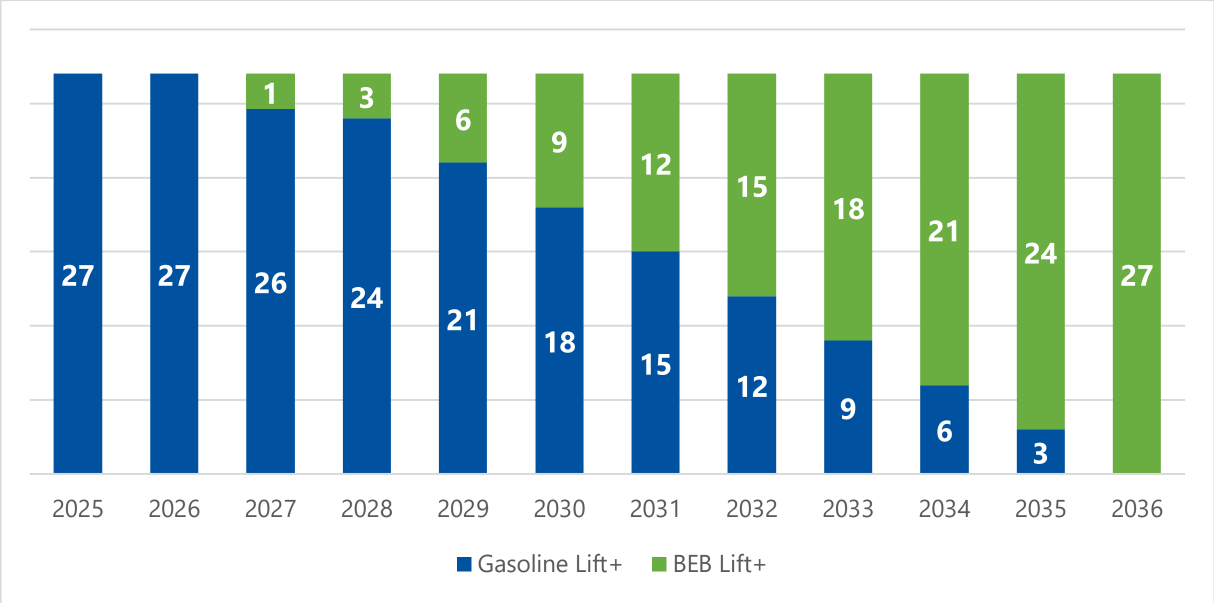


Figure 4: Lift+ Paratransit Fleet Composition by In-Service Year

4.3 FACILITY & INFRASTRUCTURE PLAN

The following sections will address the facility and infrastructure planning required at Fort William Road Transit Garage and the five potential en-route charging locations identified through this Study. Further details about the analyses performed can be found in **Appendix B: Facilities Assessment Report**; results should be interpreted with caution as some revisions have been made to the Plan since completion of these analyses.

4.3.1 FORT WILLIAM ROAD TRANSIT GARAGE

4.3.1.1 Existing Conditions

Thunder Bay Transit's operations and maintenance facility, referred to as the Fort William Road Transit Garage, is located at 570 Fort William Road in Thunder Bay, Ontario. **Figure 5** is an aerial photo of the site highlighting the key functional areas of the facility including an administration building, a vehicle maintenance and servicing section, and a vehicle storage section. The Fort William Road Transit Garage is near 100% capacity and currently holds 75 transit vehicles, including (48) 12-metre conventional buses and 27 specialized paratransit vehicles.

Figure 5. Fort William Road Transit Garage Aerial View

4.3.1.2 Future Vehicle Charging Infrastructure

The concept plan in **Figure 6** for the Transit Garage includes considerations for charging the fixed route transit fleet, paratransit fleet and light duty support vehicles that could be located at the facility. Phase 1 will focus on the easiest to install charging which will be wall mounted plug-in charging in a portion of the existing facility. Phase 2 includes a building expansion with vehicle charging that will allow Thunder Bay Transit to move its fleet into while the existing portions of the garage are upgraded with charging infrastructure during Phases 3-5. The building expansion will also allow additional parking capacity for the transit fleet once the transition is complete.

Through this Study, input from Synergy North was taken into consideration when developing the concept plans to discuss the electrical feed sizes and have incorporated comments from the local utility company into the concept plans. Synergy North indicated that there is currently capacity for the electrical feed capacities displayed in Figure 5 and requested to be engaged in the electrification transition as it develops. City of Thunder Bay continues to work with Synergy North on a strategy to provide electrical infrastructure for the transit garage. Recent discussions with Synergy North have led to the utility suggesting that multiple smaller transformers be utilized instead of the larger unit-substation due to the expected shorter lead times for equipment, and consistency with equipment they typically provide to other customers. Those changes are not reflected in the current plans and should be incorporated into the detailed design.

While the current plan considers vehicle charging demands, any additional electrical demands for future net-zero conversion of existing building systems are not included. Once loads are known for those systems, they should be included in the calculation of future electrical demand at the facility.

While the electrical feed to the site should be sized for the full implementation and future net-zero conversion, the charging infrastructure can be installed as vehicles are incorporated into the fleet. The concept plan is broken into phases that will allow the charging capacity of the facility to grow as the size of the battery electric fleet increases. The fixed route transit fleet and the Lift+ paratransit fleet have separate phasing since the timelines of these fleet types are different.

Transit Phase 1 will be crucial to enabling operation of BEBs from the facility, as it includes a new utility connection and the installation of the first unit substation at the garage that will provide power to the fixed route transit fleet and paratransit fleet.

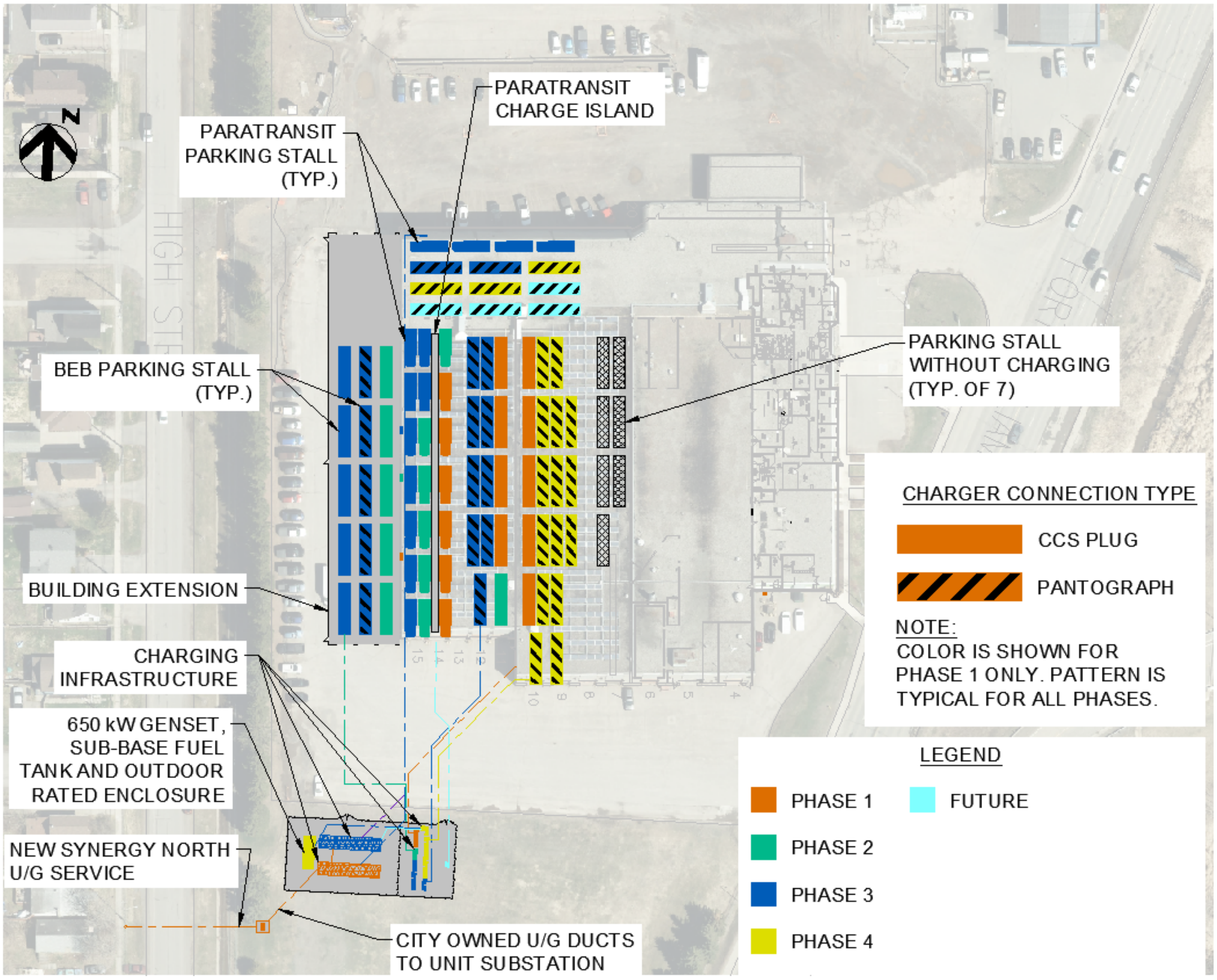


Figure 6. Fort William Road Transit Garage Conceptual Site Layout

Fort William Road Transit Garage to identify site-specific and general constraints and opportunities that may arise with the introduction of fleet electrification. While some aspects of the facility require further investigation during detailed design (such as floor and roof structural capacity), there were no significant constraints that would prohibit City of Thunder Bay from moving forward with electrification.

4.3.2 WATERFRONT TRANSIT HUB

4.3.2.1 Existing Conditions

The Waterfront Transit Hub is located off N Water Street between Van Norman Street and Camelot Street. The Waterfront Transit Hub was identified as a candidate for en-route charging because most routes (1, 2, 3M, 3J, 3C, 7, 9, 11 and 13) start and/or end service at the terminal, and it is owned by the City of Thunder Bay.

Figure 7. Street View of Waterfront Transit Hub

4.3.2.2 Future Vehicle Charging Infrastructure

If en-route charging infrastructure is installed at Waterfront Transit Hub, four (4) 450 kW overhead pantograph chargers would be all be purchased in the same year with construction beginning in 2030 for use in revenue service by 2032. All chargers would be supported by a new unit substation installed at the beginning of Phase 3. A conceptual layout for charging infrastructure at this location is shown below in **Figure 7.**

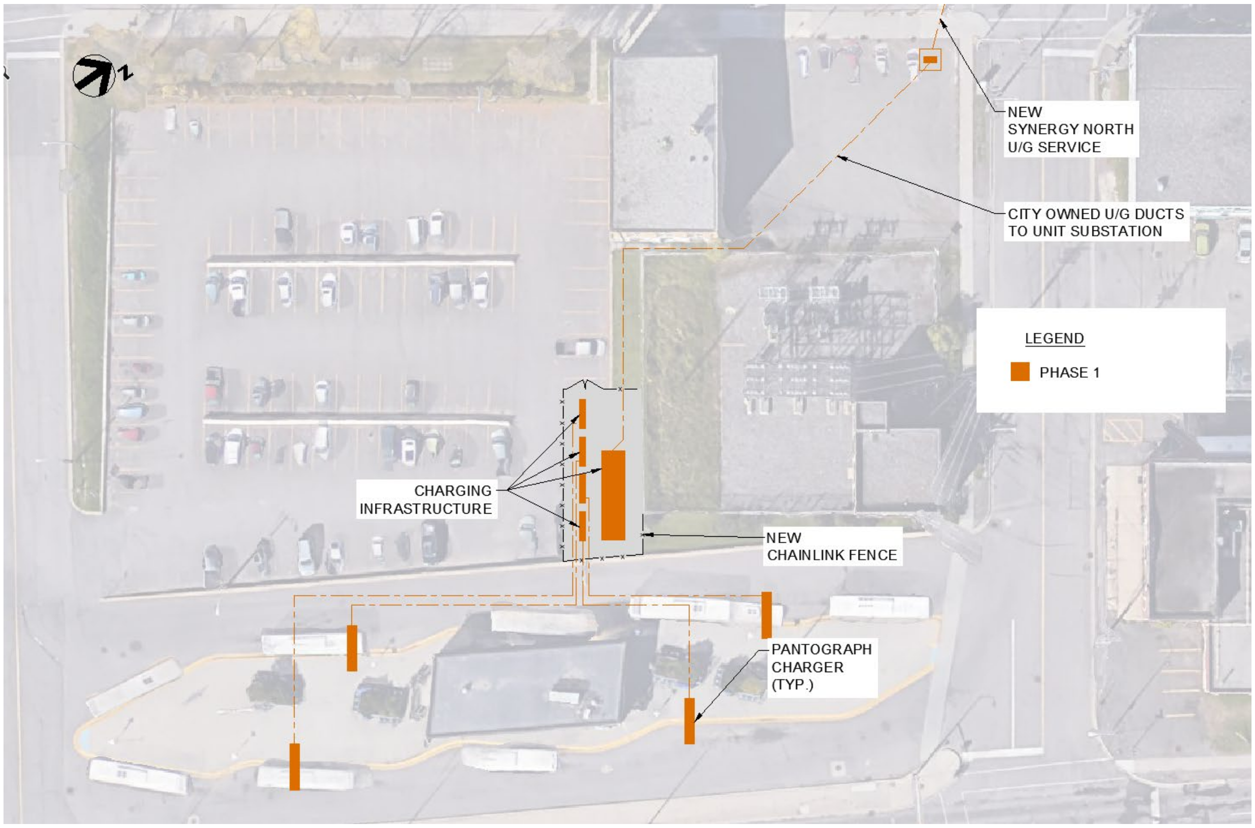


Figure 8. Conceptual Site Layout - Waterfront Transit Hub

4.4 OTHER EN-ROUTE CHARGING LOCATIONS

The energy modelling indicated that multiple en-route charging locations spread across the city would be required to minimize the need for bus swapping. While the City owns the property at Waterfront Transit Hub, several of the other potential en-route charging locations in Thunder Bay are not owned by the City. Using a combination of Zero+ modelling results and discussion with the City of Thunder Bay, areas of the city that have potential for en-route charging were identified. As the City does not currently own property at the terminal locations, discussions with property owners will be required before determining if those locations will be suitable for chargers and if en-route charging will be possible.

Figure 8 shows the location of Waterfront Transit Hub and other potential areas where en-route charging is needed. If agreements cannot be reached with owners at the current terminal locations, alternative sites could also be evaluated through a similar modelling approach or finding nearby pieces of property that is owned by the City.

Figure 9. Approximate Locations Identified for Future En-Route Charging

5 CAPACITY TO IMPLEMENT THE TECHNOLOGY

This section assesses City of Thunder Bay's current resources, skills and training required for the deployment and operation of a new BEB fleet, as well as practicing change management. Another key consideration for the transition plan is to preserve the current workforce and to provide a pathway to empower existing staff with the necessary training and skills to support the successful deployment of BEBs.

5.1 CHANGE MANAGEMENT

It is essential to involve all relevant stakeholders throughout the change management process. This includes public education for riders, employees, management, maintenance staff, scheduling teams, and other key individuals who will be directly or indirectly impacted by the transition. Engaging stakeholders from the beginning will help build support and ensure a more successful implementation. The Transition Plan can be used as a tool that outlines the specific steps and timelines for the conversion process and communicate clear objectives, milestones, and responsibilities for each stage of the transition.

Effective communication is another key to managing change successfully. Keep all stakeholders informed about the progress of the conversion process, address any concerns or questions they may have, and provide regular updates on milestones achieved. This will help build trust and ensure everyone is aligned with the goals of the transition.

As part of the change management process, it is crucial to provide adequate training and support to employees and other stakeholders who will be involved in operating and maintaining the battery electric buses. This training should cover technical aspects of operating electric vehicles, safety protocols, maintenance procedures, and any other relevant topics. The section below highlights some of the systems that will be required to support transit operations and maintenance while section **5.2 Staffing and Training Plan** discusses training and safety protocols.

5.1.1 SOFTWARE SYSTEMS

Introducing BEBs can introduce additional variables that Thunder Bay Transit may want to monitor such as dynamic vehicle scheduling, vehicle battery health, charger health and energy management. There are several software packages available for transit agencies to monitor vehicles and chargers live and retroactively; some may be available from OEMs and others are third party software packages that would be acquired separate from vehicle or charger procurements.

- **Vehicle and charging equipment monitoring software (required)** – With electric vehicles, constant monitoring and logging of system information is needed to identify errors and assist with troubleshooting. While operations may use this data to know things like real time state of charge of a vehicle, maintenance staff may also require this information for troubleshooting issues with digital systems. BEB and charger OEMs often offer software for this but are often proprietary or unable to work with other vendors and often are not integrated into an easily utilized dashboard. There are also third-party options that work with most vehicle and charging vendors. It is recommended that a third-party agnostic option is employed as they can report on all vehicles/chargers from different vendors on a single dashboard. Vehicle monitoring software should include telematic information that can provide information on energy consumption, charging activities and allow the agency to monitor vehicle performance and utilize data to plan for future BEB deployments. Thunder Bay Transit currently utilizes ConSat for their CAD/AVL system and offer a BEB telematics solution that may be a good fit for the agency. Exact costs for ConSat to provide functionality are not known but comparable systems are approximately $1,000-$1,500 per bus per year and $300-$500 per charger per year.

- **Charging and energy management system (optional) –** To schedule and manage the charging sessions between the different vehicles and control the power delivery of the charging equipment (also known as "smart charging"). Depending on the manufacturer, this software can also provide additional value in controlling demand to optimize costs where utility rates are priced in a time-of-use utility rate structure. Some providers offer options with additional functionality, such as management of other energy resources like battery energy storage and solar generation. More information on the software for infrastructure is provided in **Appendix B: Facilities Assessment Report**. Approximate costs for a charge management system for the charging infrastructure proposed at the Transit garage are $25,000 for hardware and commissioning + $70,000 annual subscription costs.
- **Scheduling software (optional) –** Thunder Bay Transit currently utilizes Giro's HASTUS for bus scheduling. Thunder Bay Transit will need to account for vehicle range and en-route charging into its service and schedule planning. Schedulers will need to become familiar with the range capabilities of vehicles and schedules buses for blocks that appropriately match the range. Thunder Bay Transit will need to include factors, such as vehicle range and en-route charging into the planning of its service. Staff will need to become familiar with the range capabilities of vehicles and plan bus blocks that are appropriate for the type of vehicle. GIRO indicates that it has capability to incorporate battery electric considerations into its software.[3] Thunder Bay Transit should work with its existing vendor to understand the extent and limitations of the software to determine if it is an appropriate fit. Cost information was not available for scheduling software functionality upgrades and will be dependent on what level of subscription Thunder Bay Transit already has.
- **Computer Aided Dispatch (CAD)/Automated Vehicle Location (AVL) systems (optional) –** Used by operations staff for vehicle location, assignment, and operations control. Thunder Bay Transit currently manually dispatches (no CAD system) buses but uses ConSat for AVL. Implementing a Computer Aided Dispatch system with BEB

[3] https://www.giro.ca/en-ca/our-solutions/segments/electric-buses/

functionality could take some of the guess work out of assigning buses to available blocks the vehicle can complete but would not be a requirement. It will allow for vehicles to be assigned to suitable bus blocks based on when the vehicle will be ready for service, and it's expected range. Automated Vehicle Location system should be upgraded to monitor BEBs and optimize assignments in real-time based on vehicle range to assist with bus swapping as necessary. Providers like ConSat are beginning to offer BEB monitoring systems as add-ons to their existing services including functionality to monitor remaining vehicle range and provide status of charging equipment.[4] Cost information was not available for CAD software functionality upgrades and will be dependent on what level of subscription Thunder Bay Transit current purchases.

- **Depot/yard management system (optional) –** Depot and yard management software can assist the agency with determining which vehicles are ready for service. Some of the tools include smart parking solutions based on state of charge (SOC) of the vehicle that instruct drivers where to park and inform Operators about which vehicles are ready for service. While not a requirement for the initial deployment, the costs and benefits should be evaluated over the coming years to understand if the benefits and efficiency improvements of a yard management system would be worthwhile. Order of magnitude costs for yard management are $200,000-$800,000 for hardware and installation + $20,000-$100,000 annual software licensing and support.

Several of the software providers that Thunder Bay Transit currently employs have developed or are developing capacity to manage BEBs and associated infrastructure, it is recommended that the City of Thunder Bay work with existing providers and upgrade their functionality. In addition to procuring the systems, Thunder Bay Transit will also need determine who will be responsible for monitoring the systems and acting when necessary to resolve issues. Some responsibilities like scheduling could remain with existing staff with new tools to do the work while other functions like charger maintenance may require additional staff to support the operations. Considerations for the staffing are discussed in later sections of the report.

Thunder Bay Transit should ensure that any software upgrades will be compatible with the BEBs and infrastructure they will procure. Coordinating discussion between stakeholders such as vehicle OEMs, charger OEMs and software service providers is recommended early in the process. City of Thunder Bay should also ensure that new hardware, such as chargers and vehicles, adhere to industry standards and protocols (e.g., OCPP, ISO 15118) that will be compatible with most software systems in the event it changes providers in the future.

[4] https://www.consat.com/telematics/consat-telematics-solution-en/

With the introduction of BEBs, operations and maintenance procedures will need to be adapted to accommodate new requirements associated with operating BEBs. This section discusses the aspects of operations and maintenance that should be considered to support future operations.

5.2 STAFFING AND TRAINING PLAN

The **Appendix C: Staffing & Training Plan** provides additional information on the skills, training and engagement that will be needed to support the transition to a fleet of BEBs. It identifies gaps in current skill sets and recommends ways to adapt and train the current workforce to work with the new equipment types confidently and safely.

The Staffing and Training Plan recommended the following actions for Thunder Bay Transit to support the transition and adapt its current workforce to meet skill gaps:

- Create a new Energy Project Manager staff position that focuses on managing the zero emission fleet transition. They would be responsible for project management during procurement, construction, change management and assessing system requirements. Once in operation the role would shift to monitoring the fleet of BEBs, charging equipment, and become the subject matter expert of the fleet transition for Thunder Bay Transit.
- Create a new BEB Maintenance Supervisor role that would support the existing maintenance supervisor monitoring BEBs, developing a training program, coordinating with bus OEMs when there are issues, monitoring chargers and the charging process in the garage and generally managing the change for maintenance staff who will require a significant amount of training and support throughout the transition.
- Require vehicle OEMs to provide maintenance and operations training to staff to address skill gaps identified in **Appendix C: Staffing & Training Plan**.
- Develop a high-voltage electrical safety program for employees working on or around battery electric vehicles.
- Develop a coordinated safety training plan with first responders.
- Explore opportunities to visit/learn from transit agencies with existing BEBs.
- Development of a qualification recordkeeping system.

Other than the two additional roles mentioned above, the number of staff required to operate and maintain the vehicles is not expected to change based on the proposed transition plan. The update to the transition plan in 2029 will be an opportunity to re-evaluate this assumption once Thunder Bay Transit has gained experience working on BEBs.

5.2.1 SAFE WORKPLACE POLICY AND STANDARDS

Below is a non-exhaustive list of relevant policies and standards related to the operation and maintenance of BEBs. As electric vehicles become a larger portion of fleets in North America, the policies and standards will change, and it will be important for City of Thunder Bay to stay current on those updated policies and standards.

In Ontario, employers have a legal obligation, through the Occupational Health and Safety Act, R.S.O. 1990 (OHSA) to develop and implement a workplace safety program that ensures the health and safety of their workers. This includes a written policy, hazard identification and control, worker training, worker involvement in program development, procedures for accidents and illness, and regular review and updates. Failure to comply with the OHSA can result in harm to workers and penalties for the employer.

The Canadian Standards Association (CSA) developed CSA Z462:21, an electrical safety standard for Canadian workplaces to prevent electrical injuries and fatalities. It provides guidelines and requirements for identifying and assessing electrical hazards (such as arc-flash risk when working on high voltage equipment like BEBs), selecting, and using personal protective equipment (PPE), establishing safe work procedures, and training workers. CSA Z462:21 is updated periodically to reflect changes in technology, regulations, and best practices. The standard is widely adopted in Canada by a variety of industries where electrical hazards exist, including manufacturing, construction, and utilities.

CSA Z462:21 is largely based on its American counterpart, developed by the National Fire Protection Association (NFPA), called NFPA 70E. Both standards are focused on fixed electrical infrastructure (such as charging infrastructure) and do not directly address “mobile” high-voltage systems such as the battery drivetrains in battery electric vehicles. Transit agencies are identifying principles from these standards to apply to battery electric workplaces, and it is possible that updated versions of the standards will include consideration of battery electric vehicles.

5.2.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal Protective Equipment (PPE) is designed to protect users from health and safety hazards. PPE must be implemented when elimination, substitution, engineering, and administrative controls are insufficient at removing or reducing hazards.[5]

Under Canadian and Ontarian law, PPE is required to be provided by the employer and worn by the employees to maintain safe working conditions. The following policies and standards related to PPE are applicable:

Canada Labour Code (R.S.C., 1995, c. L-2)

- Section 122.2 states that “Preventive measures should consist first of the elimination of hazards, then the reduction of hazards and finally, the provision of personal protective

[5] https://www.ccohs.ca/oshanswers/hsprograms/hazard/hierarchy_controls.pdf

equipment, clothing, devices, or materials, all with the goal of ensuring the health and safety of the employees."

- Section 125 (l) requires the employer to provide the prescribed safety materials, equipment, devices, and clothing and Section 126 (1) requires employees to use safety materials, equipment, devices, and clothing intended for their protection.

Occupational Health and Safety Act, R. S. O. 1990

- Section 25 of the Act outlines the duties of the employer requiring them to provide equipment, materials and protective devices in good condition ensuring safety measures and procedures are enforced in the workplace.
- Section 27 of the Act outlines the duties of the supervisor to ensure that protective devices, measures, and procedures are conducted and that they wear equipment, protective devices or clothing required by the employer.

Section 28 outlines the duties of the worker to work within the provisions of the Act and use or wear equipment, protective devices or clothing required by the employer.

This section requires review and update as policies and standards change.

5.3 LABOUR CATEGORIZATION, SKILLS ASSESSMENT AND GAP IDENTIFICATION

This section outlines the workplace responsibilities of technical staff based on skills, qualifications and assigned duties. It is acknowledged that existing staff do not currently engage with battery electric vehicles and are unfamiliar with their operation in a revenue service setting. The current qualifications for labour do not include pre-existing training with battery electric vehicles and while some new staff may have some in-class or on-the-job battery electric vehicle training, the agency will need to provide a comprehensive training program to operate as a zero emissions operation successfully and safely. **Section 5.5 Training Curriculum** identifies a prospective training curriculum for Thunder Bay Transit's staff.

5.3.1 OPERATIONS

Operations staff can further broken into two main groups who will require different levels of training based on their roles: Operations Support and Operators.

Operations Support: Staff in this category include those who are critical to bus operations but do not directly interact with the buses. As it relates to BEBs, minimal training is required as staff only need to have a high-level understanding of the technology and its capabilities. Operations Support may require training related to BEB's operational range as it relates to dispatching, scheduling, and assigning vehicles to appropriate routes.

Operators: Staff in this category include those who directly interact with the buses but do not perform any vehicle maintenance. Bus Operators require more training than Operations Support staff given their direct interaction with the vehicles. For example, Bus Operators must be familiar with all dash indicator lights, operation of doors and wheelchair access, and safety procedures. Bus Operators will not perform vehicle maintenance on the BEBs but may be required to plug-in or unplug buses for use. Bus Operators are required to hold a valid Ontario Class C, D and Z Driver's License, and this requirement does not change with the introduction of BEB technology. At this time, there is no new license required for operating BEBs.

Thunder Bay Transit's Operations Staff Complement is presented in **Table 3**.

Table 2. Thunder Bay Transit Operations Staff Complement

Job Title	Role Category	# of Filled Positions	Notes	Union Affiliation
Conventional Operators FT	Operators	99		ATU
Specialized Operators FT	Operators	11		ATU
Operators PT	Operators	33	17 Dual positions (conventional and specialized); 16 are specialized only	ATU
General Admin & Support	Operations Support	18	Supervisors, Controllers, Specialists, Coordinators, Clerks, etc.	Non-union and CUPE

5.3.2 MAINTENANCE STAFF

Maintenance Support: Staff in this category include technical specialists who directly interact with the buses, and/or are responsible for the assignment and oversight of maintenance functions but do not perform the technical corrective and preventative maintenance. Bus Maintenance Support will only need specific portions of the training to familiarize themselves with the vehicles, components they will be interacting with and the hazards that may be present during their job duties. As they will not be directly interacting with as many components of the vehicle, they will not require full familiarity with all vehicle systems and mechanical components.

Maintenance: Staff in this category include technical specialists who directly interact with the buses and perform routine and unplanned maintenance functions. All Maintenance staff are required to complete 310T certification prior to hiring. 310T is a designation for Truck and Coach

Technicians that trains students in issue diagnosis, repair, and maintenance of commercial vehicles. In addition to this designation, duty-specific training is required for maintenance staff.

Thunder Bay Transit's Maintenance staff are categorized by function as presented in **Table 3**. Given their duties, it is anticipated that Maintenance staff will receive the most comprehensive training. Based on the required duty and function, Maintenance staff should undergo skills assessment to identify gaps and training should be catered based on duties.

Table 3. Thunder Bay Transit Maintenance Staff Complement

Job Title	Role Category	# of Filled Positions	# of Authorized Positions	Union Affiliation (if applicable)	Notes
Conventional Truck and Coach Technicians	Maintenance	5	5	ATU	100 % dedicated to Conventional
Lead hand Truck and Coach Technician for Conventional shop	Maintenance	1	1	ATU	100 % dedicated to Conventional
Lubricator	Maintenance Support	1	1	ATU	60% dedicated to Conventional; 40% to Specialized
Service Technician C - Fare Boxes Electronic, Specialized Transit Vehicle Support	Maintenance Support	1	1	ATU	25% of time dedicated to Conventional; 75% to Specialized
Bus Cleaner	Maintenance Support	1	1	ATU	90% of time dedicated to Conventional; 10% to Specialized
Service Technician A positions - Bus servicing, fueling, general cleaning, and on road support	Maintenance Support	12	12	ATU	75% of time dedicated to Conventional; 25% to Specialized
Supervisor Transit Maintenance	Maintenance Support	1	1	Non Union	70% of time dedicated to Conventional; 30% to Specialized

5.4 TRAINING PROGRAM IMPLEMENTATION

It is recommended that a limited number of Operators are trained on BEBs initially so that they can become familiar with their operation. As there will be relatively few BEBs in the fleet initially, having a limited group of Operators who are familiar with the vehicles is a strategy other transit agencies have used to let operators become familiar with the vehicles and provide feedback on any aspects of training that may need to be improved. Training all operators initially is also an option but with limited number of BEBs in the fleet initially, some operators may rarely operate BEBs and may not remember their training if it is not used regularly. Operator training should be increased incrementally to align with the composition of the fleet, as more battery electric vehicles are introduced more Operators can be trained.

As the number of BEBs entering service will be minimal in the early Phases of the transition, Maintenance could be trained in phases adopting a "Train the Trainer" approach. Train the Trainer approaches allow staff members with existing relationships and strong leadership skills to receive training from OEMs/training providers and transfer knowledge to other staff. It is recommended that Thunder Bay Transit identify candidates to receive training for the first Phase that can act as Trainer in subsequent phases and transfer knowledge to other staff as more BEBs enter the fleet. This approach is cost-effective as it reduces the initial and on-going cost of training as training can be provided in-house as the composition of the fleet changes.

It is recommended that training begins one or more months prior to the delivery of the first battery electric vehicles and includes hands-on experience with the vehicles. If possible, it is recommended that Thunder Bay Transit send staff to manufacturer facilities or other transit agencies to learn and receive training prior to delivery. This will ensure a level of familiarity when the vehicles are delivered.

When the vehicles arrive, it is recommended that Thunder Bay Transit have OEMs provide on-site support for a period after the delivery of vehicles, so knowledge can be transferred to Thunder Bay Transit staff. There is value in having OEM staff on-site for diagnosing issues, troubleshooting and problem-solving and the OEM can provide guidance and help Thunder Bay Transit staff operate independently.

5.5 TRAINING CURRICULUM

Operations and Maintenance staff differ in their daily interaction and function with battery electric vehicles and, therefore, require different training. While all staff should be familiar with safety protocols for interacting with battery electric vehicles, duty-specific training will be required. The following sections identify and outline recommended training programs for the safe operation and maintenance of battery electric vehicles.

A comprehensive battery electric training program should be integrated with existing training programs for operators and maintenance staff. The training curriculum should be jointly developed with and reviewed by Thunder Bay Transit and the ATU.

The development of a high-quality training program will require coordination with internal and external resources. The following list identifies potential resources that may assist Thunder Bay Transit with program development:

- Vehicle and charger OEM training curriculum purchased as part of new rolling stock procurements.
- Vehicle sub-system/sub-component training from component OEMs.
- Collaboration with transit agencies with operational zero emission fleets and in-house training programs.
- Partnership with local first responding agencies; and
- Membership through training consortiums, transit associations or unions.

5.5.1 OPERATOR TRAINING

Operators will interact with battery electric vehicles daily as the primary operators of the vehicles. Though they will not be performing any maintenance functions on the vehicles, they require a solid understanding of the operational functions – especially how they differ from conventional diesel buses. The training program for Operators is anticipated to be like existing conditions, with OEMs providing training to Operators when the vehicle is purchased and transitioned into the fleet. After OEM training is provided, orientation programs for new operators should be modified to include an orientation on BEBs that includes the additional aspects that are specific to BEBs.

The Operations Support team will require a strong understanding of the vehicle's battery life and operational range to appropriately assign buses to routes and send replacement buses when battery levels are low. Software system upgrades are described in the transition plan that will provide the necessary information to Operations Support staff to make real-time decisions on vehicles and service. With new variables and metrics introduced, it is important Operations Support are trained on new or upgraded software to assist the team in recognizing when vehicles are ready for service, need to be swapped, or require troubleshooting during operation.

Table 6 provides an example of the types of training that could be required for the different operations staff. In addition, any changes in procedures for refueling and recharging, hand-off at the garage, and dispatching should be discussed with operators as part of Thunder Bay Transit's standard operating procedures.

Table 4. Recommended Operations Staff Training

Training	Description	Estimated Time	Delivery Method	Operators	Operations Support
Vehicle Orientation	As with any new fleet type, operators will need to understand basics like start-up/ shut-down procedures, operator gauges and indicators, and how to operate vehicles systems (lights, heat, AC). Staff will also need to understand some new aspects like the state of charge of vehicle, regenerative braking and how to drive the vehicle efficiently.	6 hours	OEM OR in-house Certified Trainer	x	x
High Voltage System Safety	High-level overview of the safety system on the vehicle and procedures to follow in the event of an emergency. This should include the types of indicators that may signal that there is an issue with a battery electric vehicle and how to disconnect the traction power if an emergency occurs.	2 hours	OEM OR in-house Certified Trainer	x	x
Charging Procedures	How to charge the bus by connecting using either plug-in or overhead chargers. Setting the bus up for charging, starting the charger, safety features of charging equipment.	2 hours	OEM OR in-house Certified Trainer	x	x
Operations and Scheduling Systems	Staff will need an understanding of vehicle range and strategies for scheduling vehicles. Training on systems that staff may use to monitor vehicles (ex: understanding remaining range to determine if a vehicle needs to be return to the garage or not).	8 hours	OEM OR in-house Certified Trainer		x

5.5.2 MAINTENANCE TRAINING

Battery electric vehicles contain high-voltage batteries, requiring all maintenance staff who will be interacting with high-voltage components to be certified to work on high voltage systems. Thunder Bay Transit, in association with the ATU, should work to supplement any existing electrical safety programs with guidance from the Canadian Standards Association (CSA), OEMs, and industry best practices. At a minimum, safety training programs should include:

- Proper use and inspection of personal protective equipment.
- CPR and first aid training.
- High voltage onboard systems familiarization and identification; and
- Lock-Out-Tag-Out training and compliance.

Table 7 presents the recommended high voltage safety training curriculum. The proposed training curriculum accounts for maintenance staff who will be required to interact with high-voltage systems to have the appropriate training on what PPE is needed and how to use it. Staff who are mainly servicing vehicles (such as cleaners, managers, etc.) but not expected to work on high-voltage systems will only need a more limited training that describes the hazards and how to safely perform duties on the vehicles.

In addition to more general high-voltage safety training, specific technical training will be required for staff to understand how to work on the new systems that are a part of BEBs such electric drive trains and energy storage systems. Like the high-voltage training curriculum, staff who will be expected to work on specific systems will need more training that those servicing the buses or managing staff. A proposed maintenance training curriculum has been provided in **Table 8** based on the role.

This sample curriculum of known training modules should be used as a foundation for a comprehensive training program. Local colleges are also beginning to offer Electric Vehicle (EV) technician programs that may be another way to have staff become familiar with EVs. Colleges such as St Clair College, Red River College, and George Brown College all currently have EV technician programs.

Table 5. High Voltage Safety Training

System	BEBs	Estim. Time	Delivery Method	Special. Tech	Maintenance Support (incl. management)	Shift Supervisors
Fall Prevention	General description of the type of system that is required, with do's and don'ts that are specific to high voltage work	1 hour	OEM, Certified Inspector OR in-house Certified Trainer	X	X	X
Harness Use and Inspection	Designed to instruct the end user with the information they need to ensure the equipment is safe to use. For standard harness and arc-flash rated harness.	2 hours	OEM, Certified Inspector OR in-house Certified Trainer	X		X
High Voltage PPE and Inspection	This course will provide a description of the various forms of high-voltage PPE, its use, inspections, and certification	3 hours	OEM, Certified Inspector OR in-house Certified Trainer	X		X
Arc-Flash PPE, Inspection and Maintenance	Instruction on arc-flash range, protective barriers and PPE, and maintenance of required PPE. Note: Utility staff may only need the "instruction" part of the program pertaining to awareness of Arc-Flash	3 hours	OEM, Certified Inspector OR in-house Certified Trainer	X	X	X
Who Can Work on What?	Qualified/Certified Unqualified/Uncertified	1 Hour	OEM, Certified Inspector OR in-house Certified Trainer	X	X	X
Tool Inspection	Inspection process for various Hi-Voltage insulated tools	1 hour	OEM, Certified Inspector OR in-house Certified Trainer	X	X	X

Table 6. Recommended Maintenance Staff Training

System	Description	Course Duration	Delivery Method	Maintenance Technicians	Maintenance Support (incl. management)	Shift Supervisors
Preventative Maintenance & Inspections (PMI)	Designed to instruct technicians in the routine preventative maintenance procedures and repair of the electric bus	16 hours hands-on and classroom.	OEM or in-house Certified Trainer	X	X	X
Propulsion & Regenerative Braking System	Technicians gain familiarity with the Motor Drive system (Theory and Hands-On), and Regenerative Braking System	16 hours hands-on and classroom	OEM or in-house Certified Trainer	X		X
Bus Plug-In Charging	Instructs staff on the proper and safe use of plug-in charge stations, and inspections of receptacles	4 hours classroom and hands-on	In-House Certified Training	X	X	X
High Voltage Charging System – Battery	Extensive training covers High Voltage disabling, Lithium-Ion Battery Pack, Bidirectional "Vehicle to Grid", Inverter AC/DC Conversion (24V Charging System), Electrical Architecture, CAN bus, and Thermal Management System	48 hours hands-on and classroom	OEM or in-house Certified Trainer	X		X
Battery Management System	Technicians learn about the difference in the operation of the battery management system and software	8 hours-classroom and hands-on	OEM or in-house Certified Trainer	X		X

System	Description	Course Duration	Delivery Method	Maintenance Technicians	Maintenance Support (incl. management)	Shift Supervisors
HVAC High Voltage System	Technicians learn the major operating principles of the HVAC "High Voltage System" - Diagnose and repair, including system maintenance	8 hours hands-on and classroom	OEM or in-house Certified Trainer	X	X	X
Special Equipment & Tools	Instruction on how to use specialized High Voltage insulated tools and computers to assist with vehicle repair and maintenance.	8 hour hands-on and classroom	In-House Certified Trainer	X		X
High Voltage Accessory Motors	Technicians are trained in the operating principle, diagnosis, and repair of high voltage drive motors for air compressors, power steering pumps, etc.	8 hours hands-on and classroom	In-House Certified Trainer	X		X

5.6 INFRASTRUCTURE MAINTENANCE

A new aspect that City of Thunder Bay will need to consider will be maintaining the charging equipment and associated electrical infrastructure required to support the fleet. While some larger agencies may already have permanent electrical trades staff part of their facilities maintenance team, City of Thunder Bay does not. Depending on how the infrastructure is implemented and funded, City of Thunder Bay may want to partner with Synergy North for repair and maintenance. The agency will need to consider one of several models for preventative and corrective maintenance of charging infrastructure:

- Hiring of trades certified in-house staff to manage equipment.
- Engaging a local contractor
- Purchasing OEM warranties/service plans
- Contracted design/build/maintain models such as Charging as a Service (CaaS) and Energy as a Service (EaaS)

Larger agencies, such as the Toronto Transit Commission (TTC), are using CaaS/EaaS models as they feel it better allocates the risk to the party that is best able to manage it. Transit agencies are not naturally equipped to manage electrical infrastructure and optimize energy costs, as it is not part of their core business. EaaS/CaaS can allow for more consistent fuel/energy pricing for the transit agency, while shifting riskier aspects of infrastructure that the agency may not necessarily understand very well (like operations and maintenance) to the contractor.

The City of Thunder Bay should explore CaaS and/or EaaS models to focus on transit vehicle operations and rely on industry partners to maintain the charging infrastructure. While this approach is recommended, ultimately the decision to determine which model to adopt will depend on the capacity of the agency to manage those assets, the value offered by the contractor, and the organization's risk tolerance. The assumed costs for infrastructure maintenance are included in Appendix D: Budget & Financial Analysis.

6 PROJECT RISKS AND MITIGATION

The risk management process involves continual tracking, monitoring, and control of risk factors. The project risks identified below should be tracked and updated during the project lifecycle to ensure information is accurate. Effective risk management involves identifying, assessing, prioritizing, and mitigating potential risks that could impact an organization's objectives. It requires a systematic and ongoing process of analyzing potential risks, evaluating their likelihood and potential impact, and implementing measures to reduce or eliminate them. Effective risk management also involves clear communication and collaboration among stakeholders, including employees, management, and external partners. It should be integrated into the overall strategy with regular reviews and updates to ensure it remains relevant and effective. Ultimately, effective risk management allows an organization to anticipate and manage potential risks, minimize negative impacts, and capitalize on opportunities for growth and success. **Section 5.2** highlighted the need to have a dedicated staff member responsible for the management of the zero-emission fleet transition. Part of that role would be that this person could be responsible for monitoring and managing the risks associated with the fleet transition. **Table 9** highlights potential areas of risk identified during the implementation and operation of BEBs into the City of Thunder Bay's fleet and the recommended responses:

Table 7. Risk Matrix and Mitigation Strategies

Risk Title	Risk Description	Response
Infrastructure Transition	As diesel buses and the supporting infrastructure are phased out, there may be transitional challenges and delays due to transitioning from previous infrastructure to the new infrastructure required to service BEB.	Couple the phase out of diesel equipment with the commissioning of new BEBs and associated infrastructure. Ensure thorough testing and commissioning is carried out after installation of new infrastructure servicing BEBs.
En-route Charging Locations	To install charging infrastructure at terminal locations where the agency does not currently own property, discussion with property owners will need to happen to see if agreements can be reached. If suitable locations for installation of en-route charging infrastructure cannot be found, the transition plan will need to be adjusted.	Deferring the decision to evaluate en-route charging locations until 2030 allows the agency time to assess the sites where it does not own property and decide on its transition plan after it has additional information. If agreements cannot be reached with property owners, alternative locations could be evaluated or shifting to a plan that focuses more on in-depot only charging are possible alternatives that will need to be considered.
Internal Resource Availability to Support Implementation	The transition to BEB will require program management and support from operations during implementation and there may be insufficient resources (including both people and equipment which may result in additional operating costs for project support and delays.	Identify a resource who will be responsible for management of procuring the vehicles and infrastructure upgrades as a coordinated program. Supplementing of existing resources by identifying and hiring for new roles to address gaps identified in the Transition Plan Report and/or outsourcing of work where appropriate to contractors and consultants. Engage consultants as necessary to offer support during project delivery to support procurement, delivery, and construction.
Service Planning and Scheduling	The new electric fleet will introduce new variables and processes into service planning and scheduling which may require additional time for adoption and inclusion. These new variables and processes may also raise the cost of service delivery and potentially delay implementation if service planning and scheduling are unable to adapt to the new requirements.	Start early in adapting service planning practices to understand the characteristics and operating constraints of BEBs based on information from the Transition Plan study. Allow staff to identify information and tools that will be required and support staff in obtaining additional capabilities that will allow them to optimize schedules with BEBs to maximize fleet utilization and minimize operating costs. In the interim the agency may need to rely on consultant support to model routes and schedules until such a time that staff become familiar with how to schedule BEBs. There may be additional costs in making significant service changes or expansions in the near term.
Collective Bargaining Agreement Impacts	Changes in operations may result in impacts to the Collective Bargaining Agreement may increase operational costs. Operators may be asked to take on additional duties such as plugging-in and un-plugging buses from chargers. Driving behaviour heavily impacts vehicle range and it may be beneficial to monitor driver performance to correct inefficient driving practices.	Begin early and constructive engagement with unions on the coming changes to staff requirement to support BEB operations including staffing numbers, skillsets, and operational practices.
Operational Costs Assumptions	The base modelling forecasts the fleet size required to achieve current operations considering operator hours and associated operating cost. However, the underlying assumptions may not consider the full range of operations which may underestimate impacts to operations.	Start early in adapting service planning practices to the characteristics and operating constraints of BEBs based on information produced from this Transition Plan to reduce probability of negative impact. Begin early and constructive engagement with unions to reduce the impact of deviation from model expectations.
Supply Chain Disruptions	Ongoing global shortage of electrical subcomponents, replacement parts, and heightened production demand due to the increased funding available for zero emissions bus fleets may result in shortages of parts and tooling which would increase costs and delay procurement. Delays in vehicle procurement and delivery would also result in increased maintenance requirements for the current diesel fleets.	Applicable to both buses and fixed electrical infrastructure. Plan for adequate lead time to account for potential manufacturing and delivery delays. Ensure that enough local spare parts is maintained either through contracts or storage at the transit facility. Lists of types and quantities of critical spare parts should be provided by both vehicle and charging system suppliers.

Risk Title	Risk Description	Response
Resiliency	Utility blackouts, failure of primary and secondary utility infrastructure, natural disasters, or extreme weather events will more significantly impact operations and ability to support emergency services.	Assess the impact and frequency of power outages to evaluate mitigation options that will meet the organizations risk tolerance. Consider the options provided in the facilities report to determine what level of resiliency is required. During the transition, diesel buses will continue to remain a part of the fleet and will be able to operate as they do today in the event of a power outage. The plan includes a back-up generator to be installed in Phase 3 near the end of the transition to power three bus chargers in the event of a longer duration power outage. Having a plan to replace major critical electrical components with long lead times (such as transformers) should be evaluated.
Insufficient Grid Capacity	The planned fleet will require significant power demand which may not be available with current infrastructure and require additional costs to install new transmission lines or substations.	Begin early and constructive engagement with local utilities to ensure necessary infrastructure upgrades are in place in time to support the charging equipment. Engagement was done as part of the facilities assessment and currently there are not expected to be capacity constraints at the sites identified.
Technology Interoperability	Potential incompatibility between buses and chargers from different manufacturers may be discovered during testing and commissioning which would result in additional costs and delays.	Inquire and assess in detail the compatibility of the equipment to be procured during the procurement phase. Ensure contracts include testing and commissioning of vehicle with any equipment that expected to be used.
Technological Obsolescence	Technology for electric vehicles is quickly changing and current generation vehicles/chargers may not be compatible with newer chargers/vehicles. Changes may be driven by changes to charging standards, battery technology, or design philosophy which may result in additional costs and delays for retrofits to incorporate the latest available technology.	Regular and periodic market scans of the current state of the industry especially prior to procurement of additional vehicles and infrastructure. Vehicle and charging manufacturers should be expected to maintain spare components for the expected lifespan of vehicles and/or a sufficient supply of spare components should be purchased to ensure equipment is able to be kept serviceable.
Software Issues	The smart charging software available in modern chargers is subject to bugs and disruptions which would negatively impact operations.	Ensure thorough testing and commissioning is carried out after installation of new infrastructure servicing BEBs and that timely support is available for software that is essential to operations.
Software Adoption	Delays or a lack of adopting the required software tools to support electrification (i.e. smart changing, dispatch/control, planning/scheduling, depot management, fleet telematics) may result in associated implementation delays for electrification.	Ensure all wholistic assessment of software and data needs is done prior to the procurement stage and ensure thorough testing and commissioning is carried out after installation of new infrastructure servicing BEBs.

7 FINANCIAL PLANNING

Cost is a major consideration when embarking on a transit technology transition. Although capital costs are often estimated during the planning stage, the costs of operating and maintaining infrastructure over time, as well as the costs associated with periodic rehabilitations or replacements, are frequently left out of the decision-making process. These costs can become significant in the long-term and may influence the transition to transit electrification based on the long-term value to the agency. The financial analysis compared Thunder Bay Transit's existing diesel bus fleet to proposed BEB scenarios to define the best value alternative for Thunder Bay Transit to reach a 100% conversion to battery electric technologies by 2050.

The detailed results of the financial analysis can be found in **Appendix D: Budget & Financial Analysis**; results should be interpreted with caution as some revisions have been made to the Plan since completion of these analyses.

7.1 FLEET TRANSITION SCENARIOS

The financial analysis evaluated both capital costs (vehicles and infrastructure) and operational costs (Operators, fuel, maintenance, etc.) for the period of 2023 to 2050. A Baseline Scenario was developed to illustrate the cost that would be expected if the City of Thunder Bay continues operate diesel buses. The new BEB Scenario was then compared to the Baseline Scenario to determine what the net increase in cost would be for the transition. The analysis calculated the net present value of the Baseline Scenario and BEB Scenario, described below:

Baseline Scenario: No transition to zero emissions technology between 2023 and 2050. Continue to purchase and operate diesel buses indefinitely.

BEB Depot & En-Route Transition Scenario: Replace diesel vehicles at end of life with BEBs with a nameplate capacity of 525 kWh initially and then start to replace vehicles with 675 kWh buses in 2029. Vehicles will initially be supported by depot charging, and by both depot and en-route charging in Phase 3 and Phase 4.

7.2 LIFECYCLE COST ANALYSIS

The lifecycle cost analysis includes an analysis of capital, operations and maintenance (O&M), and fuel/electricity costs for each scenario during the study years 2023 to 2050. The lifecycle cost analysis uses an 8% nominal discount rate that accounts for both opportunity cost and inflation. The nominal rate combines a 3% inflation rate (based on guidance from the Bank of Canada) and a 5% real discount rate that is in line with what other transit agencies use.

7.2.1 CAPITAL COST COMPARISON

Table 10 compares total capital costs between the two scenarios. The comparison finds that the capital cost of implementing BEB technology is significantly higher than the Baseline Scenario due to differences in vehicle costs, equipment, and associated infrastructure investments required for implementation.

Table 8. Capital Cost Comparison, millions of 2023$ discounted at 8%

	Baseline	BEB
Diesel	$44.7	$4.3
BEB	-	$95.5
Bus Purchases	**$44.7**	**$99.7**
Additional Infrastructure	-	$27.2
Total	**$44.7**	**$126.9**

7.2.2 OPERATIONS AND MAINTENANCE COST COMPARISON

Table 11 compares total estimated operations and maintenance costs between 2023 and 2050, what it costs to drive and repair the vehicle (excluding fuel/energy). The primary unknown for O&M costs is the maintenance cost of BEBs as the technology is still relatively young and long-term detailed analyses for this type of vehicle maintenance is not yet available. While conceptually with fewer parts in an electric vehicle, it's expected that maintenance costs will be lower it is not guaranteed. Replacement parts may be more expensive and labour costs to replace components are not yet known. Using best assumptions and judgements, a slight discount was applied to current maintenance costs of the vehicles assuming there will be some efficiencies gained on the vehicle side.

A new aspect with BEBs is the cost of maintaining the charging infrastructure that previously was not required. Those estimated costs are shown and included in the overall O&M costs.

Incremental labour costs refer to the additional driver time it takes to deadhead a bus to and from the garage in the event of a bus swap. As mentioned previously, even with en-route charging there are still a few blocks that require swapping of vehicles and those costs for drivers to drive to/from the garage are also included in the comparison.

Overall, the comparison finds that while related infrastructure maintenance and incremental labour costs are slightly higher in the BEB scenario, maintenance costs are slightly lower resulting in very similar expected O&M costs for both scenarios.

Table 9. O&M Cost Comparison, millions of 2023$ discounted at 8%

	Baseline	BEB
Bus O&M Costs	$259.8	$255.5
BEB Charger Maintenance Costs	-	$2.0
Incremental Labour Costs	-	$2.6

Total	**$259.8**	**$260.1**

It is important to acknowledge that operationally, several costs remain uncertain and are excluded from the analysis as City of Thunder Bay is not yet able to determine how material those costs will be. These include expenses related to acquiring new tools or components, stocking new parts in inventory, labour time required for training personnel, managing communications, and software system upgrade costs. Those costs will be and will need to be assessed after operating BEBs for a period and will be re-evaluated at the transition plan update in 2029.

7.2.3 FUEL AND ELECTRICITY COST COMPARISON

The biggest savings that are typically expected in operating battery electric vehicles come from the fuel swapping from diesel to electricity. **Table 12** compares diesel fuel and electricity costs between 2023 and 2050 for the two scenarios. Based on the assumptions (described in detail in Appendix D), the BEB Scenario was found to have lower fuel and electricity costs during the study years by a significant margin.

Table 10. Fuel and Electricity Cost Comparison, millions of 2023$ discounted at 8%

	Baseline	BEB
Diesel Costs	$47.9	$26.0
Electricity Costs	-	$8.8
Total Costs	**$47.9**	**$34.8**

7.2.4 OVERALL TRANSITION PLAN COST COMPARISON

Adding each of the above sections together, we can consider the overall costs of each scenario. There is a significant cost increase of $69.5M over the Baseline Scenario for the BEB Scenario. While overall costs are higher, the lifecycle O&M costs for the BEB Scenario are $12.8M lower than the Baseline Scenario. If the agency can secure funding for the increased capital costs, the transition should result in a lower operating cost.

The costs in **Table 13** do not factor any potential government funding that is available to support zero emission fleet transitions or carbon credits that may be available to agencies that operate battery electric vehicles. Funding programs are discussed in the next section of the report and should be considered when comparing options.

Table 11. Total lifecycle cost of Diesel and Battery Electric Bus Scenarios

	Baseline	BEB
Life Cycle Capital Costs	**$44.7**	**$126.9**
Buses	$33.2	$76.7
Non-Revenue	$11.5	$23.1
Related Infrastructure	-	$27.2
Lifecycle O&M	**$307.7**	**$294.9**
Bus Operations & Maintenance	$259.8	$255.5
Propulsion	$47.9	$34.8
Related Infrastructure O&M	-	$2.0
Incremental Labour Costs	-	$2.7
Total	**$352.4**	**$421.9**

Additional details of the financial analysis such as assumptions and methods used for calculating costs can be found in **Appendix D: Budget & Financial Analysis**.

7.3 FUNDING OPPORTUNITIES

There are several funding and financing opportunities currently available to the City of Thunder Bay to secure funding for its zero emission vehicle (ZEV) fleet transition. The two primary funding sources are the Investing in Canada Infrastructure Program (ICIP) [6], and the Zero Emission Transit Fund (ZETF)[7].

The ICIP is administered by Infrastructure Canada and has invested $131 billion in over 85,000 projects. This program has already funded several other municipalities' transit fleet buses, including conventional transit and other mobility services. The federal government will invest up to 40% for most municipal public transit costs, though this may increase up to 50% for rehabilitation projects. Funding allocated to Infrastructure Canada is divided among the provinces who distribute funding by municipality.

The ZETF is administered by the Canadian Infrastructure Bank, and targets projects that enable or implement transit fleet electrification. The ZETF offers flexible financing solutions, including grants and loans to applicants. ZETF funding decisions are determined by project viability, estimated operational savings, and estimated GHG emission reduction. Over $2.75 billion in funding has been distributed through the ZETF program to numerous municipal transit agencies.

[6] https://www.infrastructure.gc.ca/plan/icp-pic-INFC-eng.html?wbdisable=true

[7] https://www.infrastructure.gc.ca/zero-emissions-trans-zero-emissions/zetf-applicant-guide-demandeur-ftcze-eng.html

Funding from either program may be used to offset planning, capital, and some operating costs associated with transitioning diesel fleets to BEBs or alternative fuel technologies. As this funding has not been secured by the City of Thunder Bay, it is not included in this analysis.

In addition to government support for capital funding, transit agencies that operate battery electric buses in Ontario can take advantage of the Canadian Low Carbon Fuel Standard (LCFS) by generating credits for the low-carbon electricity they use to charge their buses. [8] The LCFS is a performance-based regulation that sets carbon intensity reduction targets for fuel suppliers. Fuel suppliers that exceed their targets can generate credits that can be sold to other suppliers who are unable to meet their targets. Transit agencies that operate electric buses can generate credits by voluntarily reporting the amount of low-carbon electricity they use to charge their buses. These credits can be sold to fuel suppliers who are unable to meet their targets, generating additional revenue for transit agencies. The value of these credits is determined based on market forces and is affected by the supply and demand of credits. As the value of these credits are not yet known, the value they would generate are not included in the current financial analysis.

[8] https://www.canada.ca/en/environment-climate-change/services/managing-pollution/energy-production/fuel-regulations/clean-fuel-regulations/regulatory-design.html#toc1

8 ENVIRONMENTAL BENEFITS

The electrification of Thunder Bay Transit's fleet supports the City's climate goal to reach net-zero emissions by 2050 by reducing the GHG emissions of the transit fleet by more than 90%. A detailed GHG emissions analysis comparing a BEB Scenario to Baseline Scenario was conducted to quantify the impacts of BEB operations on GHG emissions.

GHG emissions are calculated on a full lifecycle "well to wheel" basis that compares the GHG emissions of diesel fuel being burned to GHG emissions of the electricity required to be generated to operate a BEB. A summary of the results is presented in the subsequent sections with more information on the methodology found in **Appendix E: GHG Analysis**.

8.1 GHG EMISSION REDUCTION IMPACTS

The results of the GHG Emissions Analysis (presented in **Table 14** shows that over the study period (2023-2050), BEB technology will help City of Thunder Bay avoid approximately 60,000 tonnes of GHG emissions.

Table 12. GHG Emissions, Baseline and BEB Scenarios, Selected Years and Total, tonnes

	2025	2030	2040	Total
Baseline	**3,884**	**3,884**	**3,884**	**108,763**
Diesel	3,884	3,884	3,884	108,763
BEB	-	-	-	-
BEB Scenario	**3,884**	**2,834**	**652**	**48,891**
Diesel	3,884	2,794	519	46,469
BEB	-	40	133	2,422

Figure 10 shows the annual GHG emissions as the fleet mix changes from diesel to BEB. The figure shows that the annual emissions will result in a more than 90% reduction compared to the baseline. The remaining GHG emissions in 2045 are coming from emissions resulting from electricity purchased through the grid as well as a small amount of diesel fuel which is used in the winter to power the auxiliary heaters on the bus. Renewable fuels for auxiliary heating or reductions in the GHG emissions of electrical grid would be needed to further reduce GHG emissions.

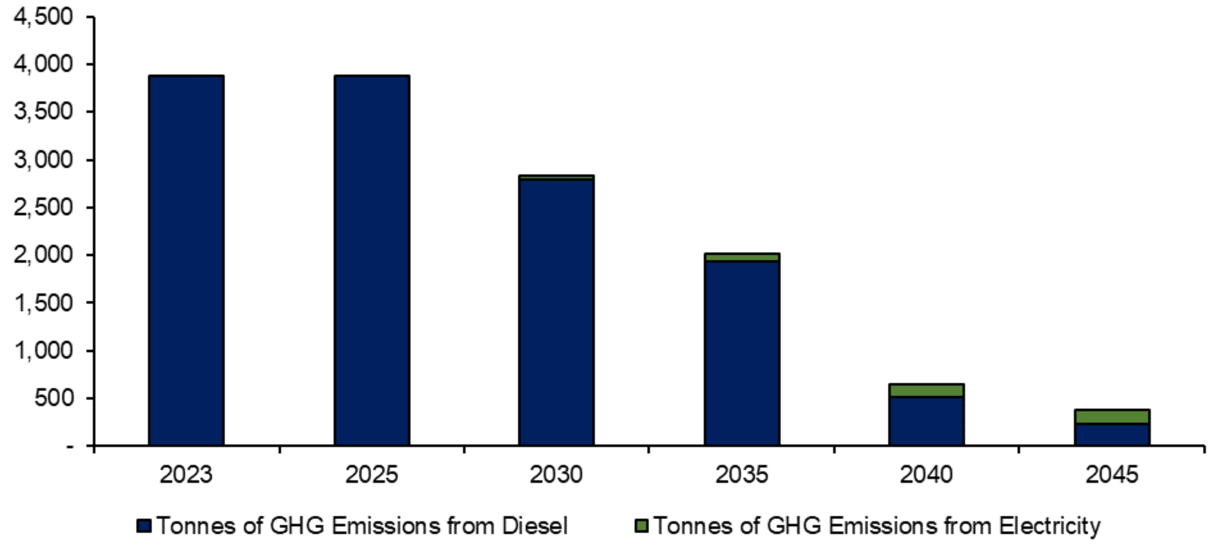


Figure 10. Annual GHG Emissions by energy source, BEB Scenario, tonnes

APPENDIX A: ENERGY MODELLING REPORT

This Report documents the process and analysis involved in the development, assessment, and recommendations for a transition pathway for Thunder Bay Transit's fleet from diesel internal combustion engine (ICE) buses to BEBs. The processes and analyses include:

- Review of current fleet composition, the existing capital replacement plan, and service operations for transit and paratransit services (Lift +)
- Estimation of energy consumption of the transit fleet using the Zero+ tool and the consolidation of the model results to identify feasible transition pathway(s)
- Recommendation of the optimal vehicle battery size required for the BEB deployments based on the energy consumption modelling results.
- Recommendation of a preferred transition pathway which shall guide future analysis of Thunder Bay Transit's transition from diesel buses to BEBs.
- Determination of charging infrastructure required to operate the vehicles based on the fleet's daily energy consumption profile.

This Report will evaluate Thunder Bay Transit's revenue fleet while the non-revenue transit fleet will be discussed in the subsequent Non-Revenue Municipal Fleet Energy Modelling Results Report.

A.1 EXISTING CONDITIONS

The first step in exploring battery electric vehicles is to document existing conditions and evaluate the current routes and fleet vehicles used to provide service. Key data includes:

- Operator blocks for weekdays and weekends.
- Block and bus-type assignments
- General Transit Feed Specifications (GTFS) data from post-COVID service for transit blocks on weekdays and weekends
- Fleet Replacement Plan

Adding this data to the Zero+ model creates an accurate energy consumption profile unique to Thunder Bay Transit's existing service. Below is a summary of the fleet composition, fleet replacement plan, and fixed route and paratransit service operations information that feeds into the modelling effort and analysis that follows.

A.2 FLEET COMPOSITION AND REPLACEMENT PLAN

A.2.1 CURRENT TRANSIT FLEET COMPOSITION

The current transit fleet includes a mix of full-size fixed route diesel buses and paratransit gasoline transit shuttles as shown in **Table 15**. Currently, there are a total of 48 fixed route transit buses in service. There were two LFS Nova transit buses ordered in 2022 that will replace two of the existing buses in service when they are delivered. There are 27 paratransit buses. Four paratransit buses are on order to arrive early 2023 and will replace four of the GMC 4500 Paratransit buses.

Table 13. Current Fixed Route and Paratransit Fleet Composition

Fleet Count	Vehicle Type	Vehicle Make	Model Year(s)	Fuel Type	Facility Assignment
Fixed Route Transit Fleet					
48	LFS	Nova	2005-2022	Diesel	570 Ft William Rd
Lift+ Paratransit Fleet					
14	4500	GMC	2016-2017	Gasoline	570 Ft William Rd
12	LF 4500	Chevrolet	2020-2022	Gasoline	570 Ft William Rd
1	Promaster	Dodge	2018	Gasoline	570 Ft William Rd

A.2.1.1.1 Existing Fleet Replacement Plan: 2023 - 2040

Thunder Bay Transit's fleet replacement plan outlines in which year(s) the current fleet will be replaced. For fixed route transit buses, there will be a total of 50 replacements for 48 buses between 2022 and 2040 (two buses with a 2022 construct year will be replaced again in 2040). There is an ICIP application to support the purchases from 2024-2026, after which the plan is for 3 bus replacements in each year between 2027 and 2038. **Figure 11** shows the replacement schedule. As a result of the COVID-19 pandemic-related decline in service level and ridership, no service expansion was included in the analysis between 2023 and 2040.

Thunder Bay Transit typically keeps its fixed route transit buses for 18 years. For Thunder Bay Transit to achieve the Net Zero Strategy (NZS)'s goal to transition to 100% zero emissions by the 2035 target, the agency would need to consider an accelerated replacement schedule for the fixed route transit fleet. In addition to the 11 diesel buses already in the fleet or on-order, any future diesel buses ordered over the coming years would also need to be retired early to meet the target.

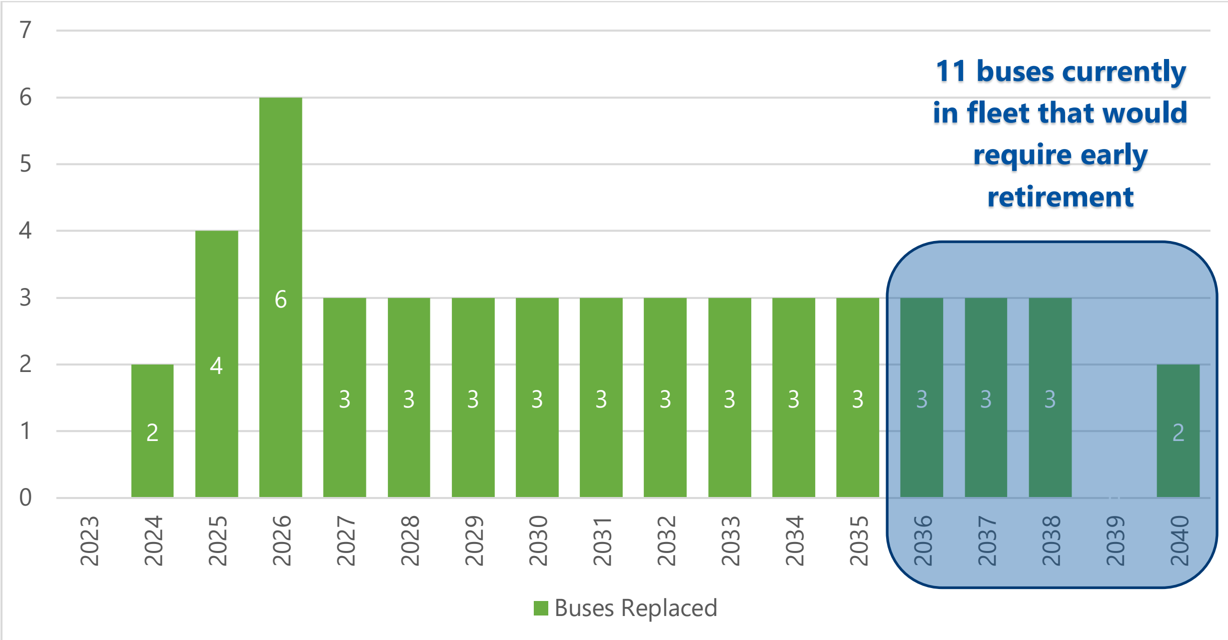


Figure 11. Fixed Route Transit Fleet Replacement Schedule

The Lift+ paratransit service will have buses replaced between 2022 and 2032. Those fleet types typically replaced after about eight years (depending on condition of the vehicle) as they're not as durable as the fixed route transit fleet. **Figure 12** shows the expected replacement schedule for the Lift+ paratransit fleet. Thunder Bay Transit typically replaces three Lift+ buses per year and with that strategy, the entire fleet will have been replaced by 2032.

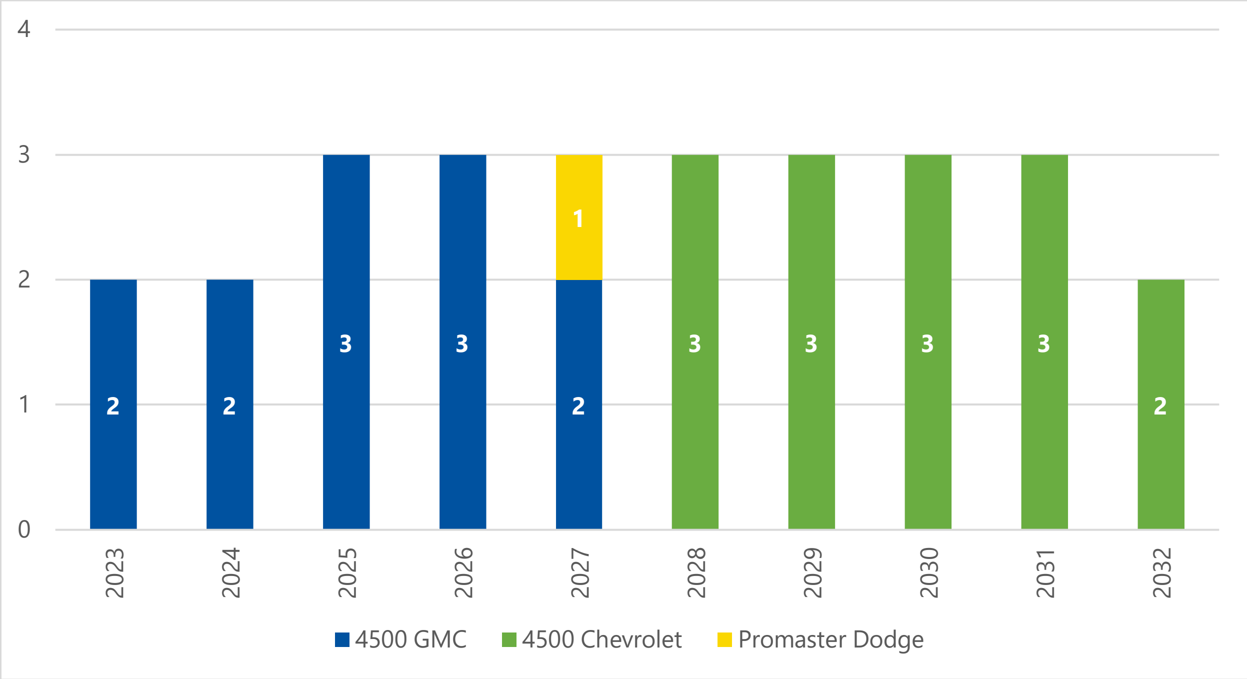


Figure 12. Lift+ Paratransit Fleet Replacement Schedule

Provided Thunder Bay Transit can purchase zero emission Lift+ paratransit shuttles as replacements by 2026, the fleet will be able to transition to zero emission within the normal lifecycle of those vehicles.

A.2.2 FIXED ROUTE & PARATRANSIT SERVICE OPERATIONS

A.2.2.1 Operating Schedules

A.2.2.1.1 Thunder Bay Fixed Route Transit

Thunder Bay Transit has 17 bus routes that operate within a large portion of the urban Thunder Bay area, including service to 5 major terminals and transfer hubs as shown on the following page in **Figure 13**. A piece of work for a transit bus is typically called a block which has information on the start/end time, routes on which it will operate and timetable of when it will be at various stops on the route. Thunder Bay Transit, like many other transit services, operates longer blocks where a bus may be used by multiple operators in a single block.

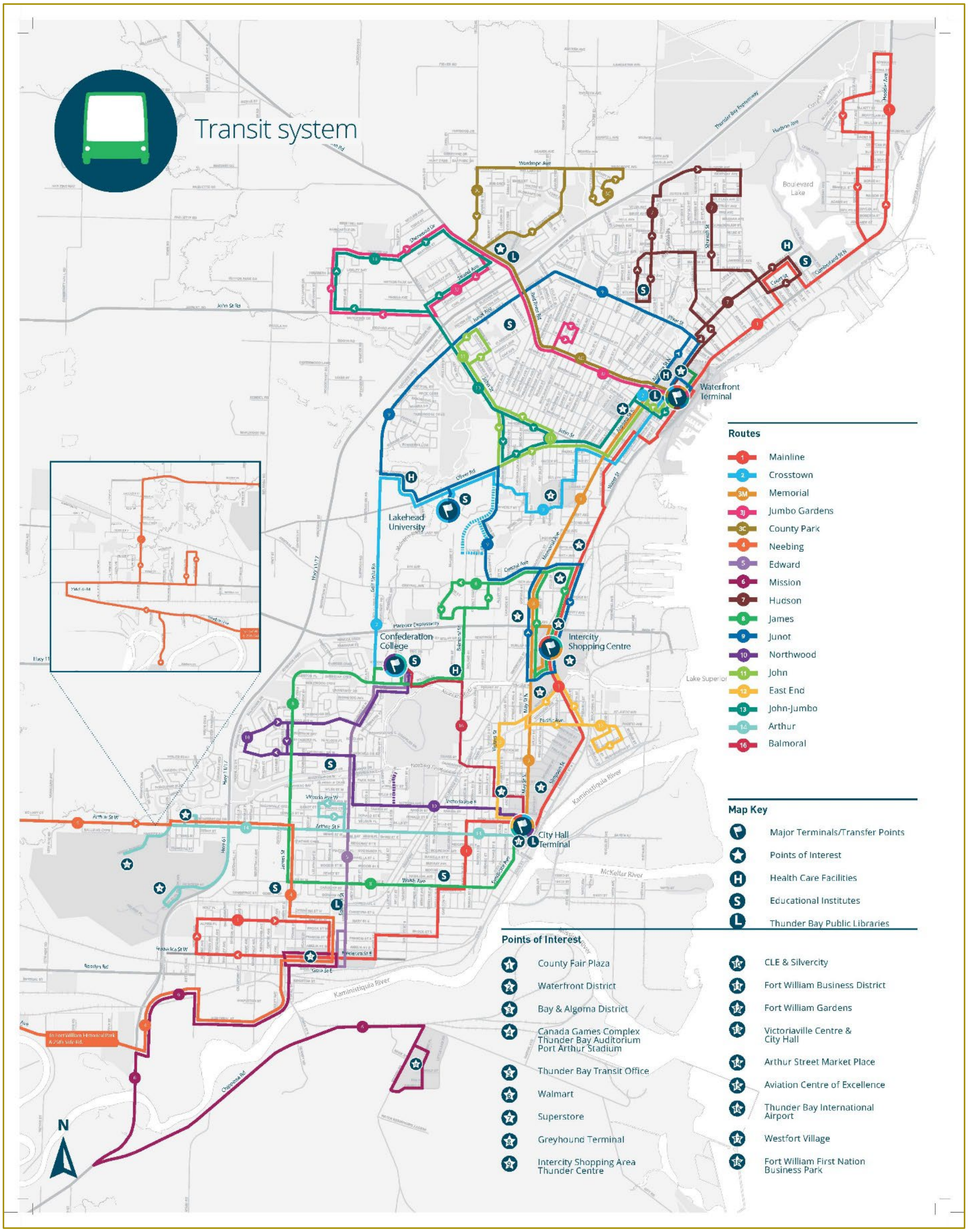


Figure 13. Thunder Bay Transit System

The operation of longer blocks makes it challenging to accommodate with today's battery electric buses. Based on GTFS data from Fall 2022, **Figure 14** and **Figure 15** shows the distribution of blocks for a typical weekday by block duration and distance, respectively. The feasibility of battery electric buses running on routes is confirmed with detailed route modelling, but a guideline of feasibility is that blocks at or below 200km are in range of what BEBs should be able to do in a single charge in the winter. Shorter blocks such as those under 200km should be feasible with electric vehicles on a single overnight charge, however most blocks are greater than 200km—which is in range of what BEBs should be able to do in a single charge in the winter – with some nearing 400km in length. Currently the longest blocks are about 17 hours.

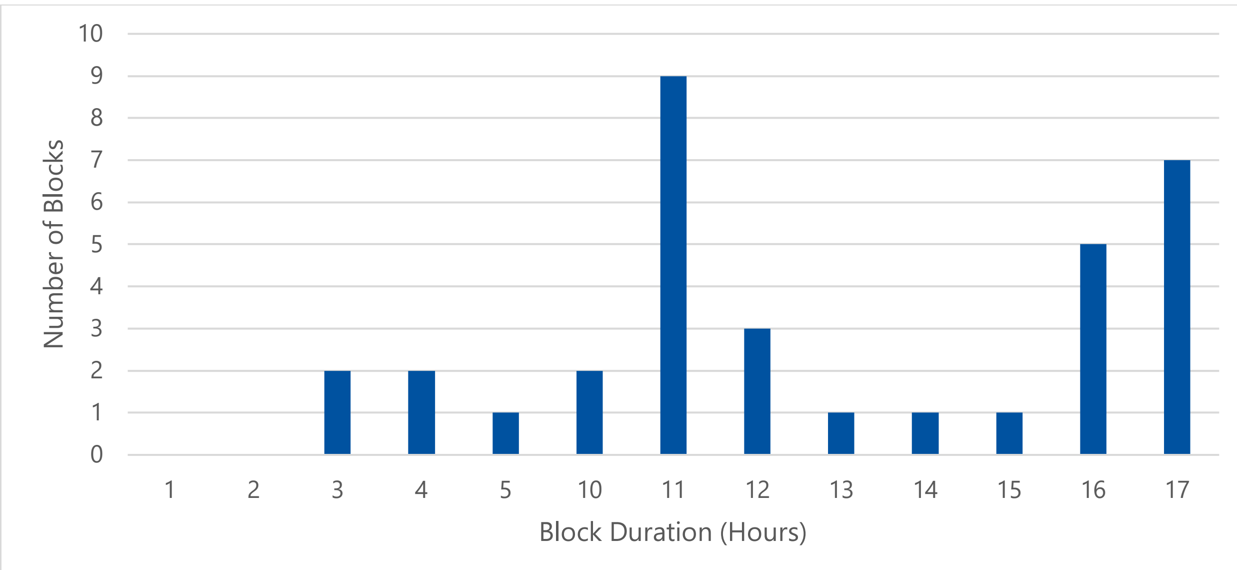


Figure 14. Distribution of Blocks by Duration

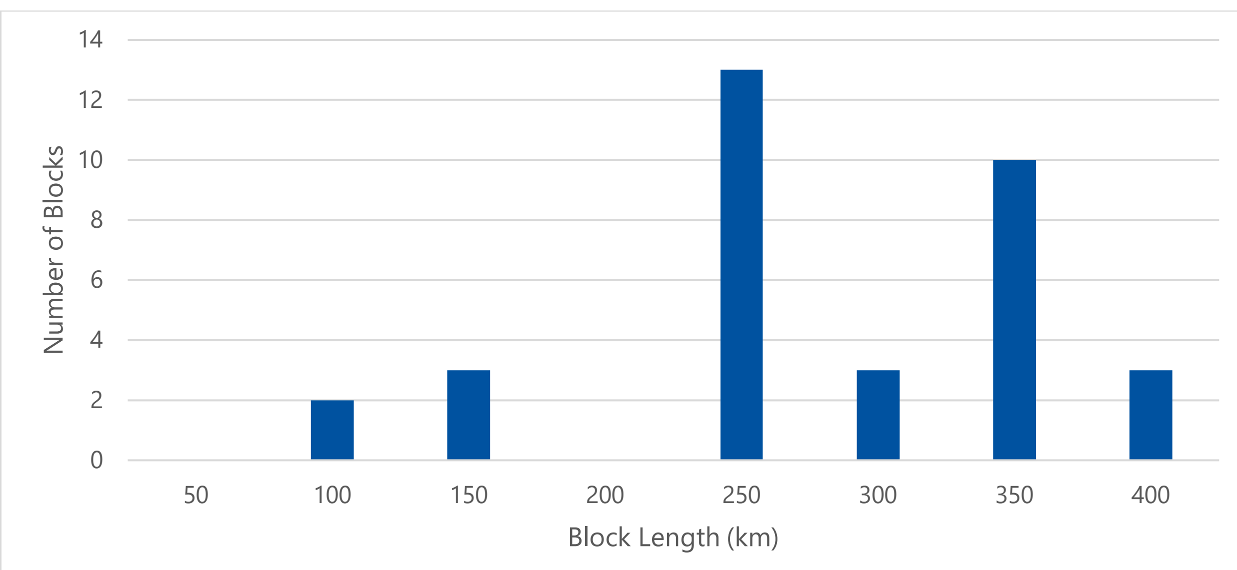


Figure 15. Distribution of Blocks by Distance

A.2.2.1.2 Lift+ Specialized Transit (Paratransit)

Lift+ is a door-to-door paratransit service for people with disabilities and/or who are unable to use the fixed route transit service. Lift+ demand response service is available on a first come, first served basis between 6:00am and 11:00pm Monday through Saturday and between 8:00am and 10:30pm on Sundays and holidays.

A.2.2.2 Vehicle Mileage and Fuel Consumption

A summary of 2018-2021 fuel usage and distance travelled for the Thunder Bay Transit fleet is shown in **Table 16** and **Table 17.** The vehicles used for fixed route transit comprise over 85% of the kilometres and litres of fuel used in 2020 and 2021, which is a slight 3-6% increase from 2018 and 2019. The fixed route transit also has consistently used more fuel per 100 kilometres than the paratransit vehicles between 2018 and 2021.

Table 14. Fixed Route Fuel Usage and Distance Travelled

Year	Fuel Type	Total Distance (Kilometres)	Total Fuel Consumption (Litres)	Average Fuel Economy (Litres per 100km)
2018	Diesel	3,081,482	1,796,483	58.30
2019	Diesel	3,153,997	1,796,483	54.96
2020	Diesel	2,658,036	1,460,843	54.96
2021	Diesel	2,673,742	1,462,689	54.71

Table 15. Paratransit Fuel Usage and Distance Travelled

Year	Fuel Type	Total Distance (Kilometres)	Total Fuel Consumption (Litres)	Average Fuel Economy (Litres per 100km)
2018	Gasoline	687,114	213,270	31.04
2019	Gasoline	700,284	228,691	32.66
2020	Gasoline	403,229	128,208	31.80
2021	Gasoline	377,201	121,979	32.34

A.3 ENERGY CONSUMPTION ANALYSIS

The energy consumption analysis for Thunder Bay Transit's fixed route fleet was done using Zero+ (**Figure 16**), HDR's proprietary energy consumption modelling tool, to provide a comprehensive understanding of the potential impacts BEB technology may have on Thunder Bay Transit's existing service. Energy consumption is impacted by several factors including slope and grade of the bus routes, number of vehicle stops, anticipated roadway traffic, and ambient temperature. Zero+ also analyzes variables known to impact lifetime vehicle performance like energy density, battery degradation, operating environment, auxiliary loads like heating and air conditioning, and lifecycle of bus batteries.

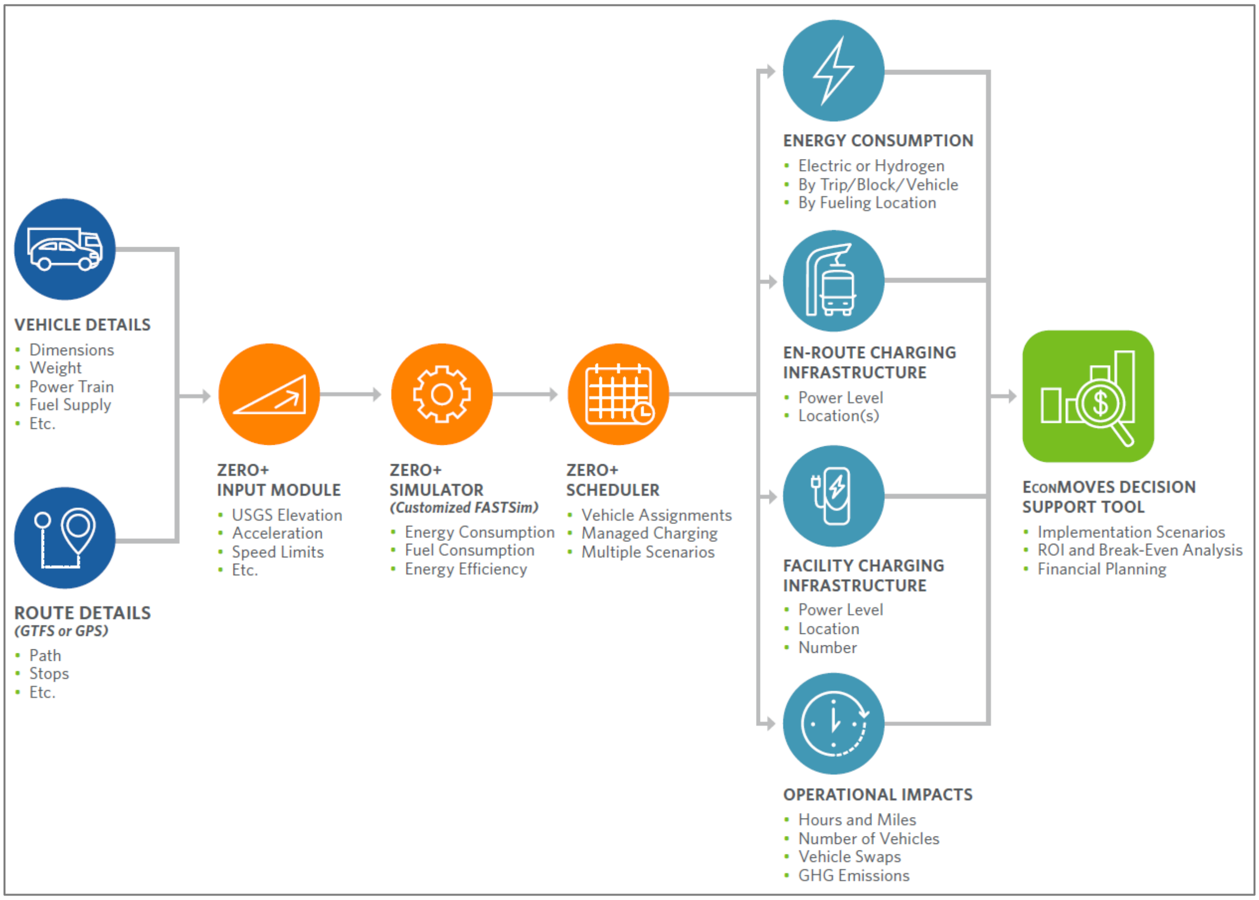


Figure 16. Zero+ Fleet Optimization Tool

The service data used was based on GTFS data for weekday service in Fall 2022, which is representative of reduced service due to COVID. All baseline scenarios are based on 2022 service, route structure and data. Future changes are likely imminent prior with full electrification being realized and may affect the actual vs anticipated outcomes of the modelling by the time full electrification is realized. Energy modelling for any paratransit vehicles that do not operate fixed routes was done using a high-level mathematical modelling analysis due to less available data and the less structured nature of the services. Three BEB scenarios were modelled: baseline, block split, and en-route charging. The scenarios are detailed below following discussion of key assumptions.

A.3.1 KEY ASSUMPTIONS

To develop a model relevant for City of Thunder Bay's fleet and operations, a set of assumptions and variables were identified (**Table 18**). It is noted that the assumptions regarding vehicle Original Equipment Manufacturer (OEM) attributes represent a typical, commercially available battery electric bus model. Subsequent procurement following this analysis may result in vehicle OEM specifications which differ from these assumptions, which may impact the results of this analysis. Additional energy consumption modelling based on the selected OEM should be conducted to confirm energy and infrastructure requirements.

Table 16. BEB Simulation Assumptions

Variable	Input
Service Data	Fall 2022
Battery Capacity	525 kWh
End-of-Life Battery State of Health	80% (max battery degradation)
Energy Reserve	20% state of charge (SOC)
Heating	Electric Heat, Diesel Heat
Ambient Temperature	-27C (Cold weather, 10^{th} percentile) +27C (Hot weather, 90^{th} percentile)
Passenger Capacity	100%
Depot Charger Power	150 kW @ 95% Efficiency
En-route Charger Power	450 kW (Peak 210 kW) @ 95% Efficiency

As shown in the table above, this model assumes a bus with a 525 kWh nameplate battery capacity, which is typical for a longer range BEB available on the market today. While some bus manufacturers offer BEBs with greater battery capacities, modelling service with a standard vehicle provides flexibility when selecting a vehicle manufacturer.

The depot charging scenario is modelled with 150 kW chargers with a 95% efficiency and the en-route charging scenario is modelled with 450 kW chargers with a 95% efficiency. The main vehicle modelled in the Zero+ modelling tool are the 40' New Flyer Xcelsior Charge with a 525-kWh battery.

A 20% reduction of battery capacity was applied to reflect end of life conditions. This is consistent with bus original equipment manufacturer (OEM) warranties which typically guarantee 80% of battery capacity for 12-years.

In addition to battery degradation, the model swaps out any vehicle that goes below the 20% state of charge (SOC) energy reserve. This is to account for both the fact that vehicles typically cannot use the last 10% SOC of a battery pack without performance reductions as well as acting as a factor of safety most agencies use to reduce range anxiety for operators.

Energy consumption was modelled for the 10^{th} percentile lowest temperature in Thunder Bay in February, which is about -27 °C[9]. The initial modelling scenario assumed the use of an electric heater (which requires a loading of about 24 kW). This is a relatively conservative assumption as a heater would likely not need to be run the full day, however the purpose of this modelling is to determine technical feasibility and so it is a reasonable assumption to make. A modelling scenario was also done assuming that a diesel auxiliary heater would be used to reduce the power requirement and increase the range of vehicles during cold weather.

It should be noted that while en-route chargers are capable of outputting 450 kW of power, the vehicle must be able to accept that level of power. As-is the case with most transit buses today that can accept fast charging, the actual charge rate of a bus using a 450 kw charger is typically lower. The rate of output of the charger is determined by the vehicle based on a variety of factors and will change based on the state of charge (SOC). The modelling factors in the charge curves (rate of charge vs SOC) are provided by manufacturers for each vehicle type. The achieved charging power in the Zero+ model is limited by both the charging curve for the vehicle and the maximum power of the charger.

A.3.2 BASELINE SCENARIO

The first modelled scenario assumes depot charging is allowed all day and night with no modifications to block schedules. Buses are reused if a vehicle has a minimum state-of-charge (SOC) of 60% or higher. In this scenario, if a short block is completed and the bus has at least 60% SOC, then the vehicle is used again in the same day to start another block that it can complete. This gives an indication of how feasible the blocks will be based on how Thunder Bay Transit currently operates. The results of the baseline scenario were that the vehicles were not able to complete the majority of the blocks, so this option was discounted as it is not a viable option.

A.3.3 DEPOT CHARGING ONLY SCENARIO

To develop a feasible alternative for Thunder Bay Transit, this scenario assumes that buses will be swapped out part way through the block with a fully charged vehicle when the first vehicle reaches 20% SOC. From a scheduling perspective, this would be done by splitting the buses, so they run in shorter blocks that are able to be completed by the BEB.

The model assumes that when swaps occur, the bus that would normally stay in service would return to the depot, and another bus and operator would drive from the depot to take its place.

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[9] https://weatherspark.com/d/12875/2/1/Average-Weather-on-February-1-in-Thunder-Bay-Canada#Figures-Temperature

This has impacts both on fleet size required (peak vehicle requirement) as well as operational costs due to the increased amount of deadhead (non-revenue hours and kilometres between the depot and the first/last stop).

The scheduled blocks have had swaps inserted once a vehicle falls below the parameters set in the model assumptions. This gives an idea of what a schedule would look like that is able to be completed by a full fleet of BEBs and how it impacts fleet size and operational costs.

The schedule developed in this section is only meant to be a minimum viable schedule. Schedulers will use their judgment when cutting blocks where it makes the most sense to do so. The 20% reserve is meant only as a guideline, but gives schedulers operational flexibility (unforeseen events, traffic, detours), improves battery life, and reduces driver range anxiety.

A.3.3.1 Depot Charging Only with Electric Heaters

A.3.3.1.1 Model Results

Below is a review of the main components of the transit service and operations that are likely to change and should be considered when transitioning to a BEB fleet. **Figure 17** shows an estimate of the increase in non-revenue hours and kilometres as well as the estimated number of vehicles required to continue the current transit service.

- Revenue Hours & Kilometres remain the same.
- Non-Revenue Hours: 142% increase
- Non-Revenue Kilometres: 146% increase
- Peak Vehicle Requirement: 84% increase
  Increase Fleet from 32 to 59 buses.
    - 27 more vehicles required.
- At least 8 Depot Chargers will be required.
- Thunder Bay transit can deploy 4 BEBs (electrifying 5 blocks) before fleet increases will be required.

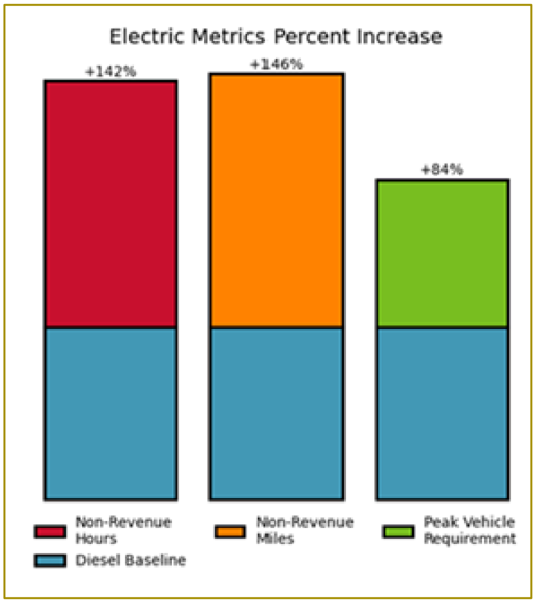

Figure 17. Depot-Only Charging, Bus Swap -- Electric Heating Outputs

The vehicle battery state of charge on each block during weekday service are shown in **Figure 18** for Thunder Bay Transit operated service. Weekend service was also modeled, but fleet and charging requirements are driven by weekday service which illustrates the most demanding operations for Thunder Bay Transit.

Each block is represented by a line on the chart with the color of the line corresponding to the state of charge of the vehicle. The color changes from green to yellow to red to black as the state of charge drops from 100 to 0 percent. Bus swaps (shown in blue) are introduced only between trips to minimize service impacts.

About 15% of blocks can be completed with no splitting when we assume the buses are using electric heaters, 41% can be done with only one split, and the remaining require 2 or more splits which will be operationally challenging. Operating this service as defined would require a sizable increase in non-revenue hours, kilometers, and peak vehicles required.

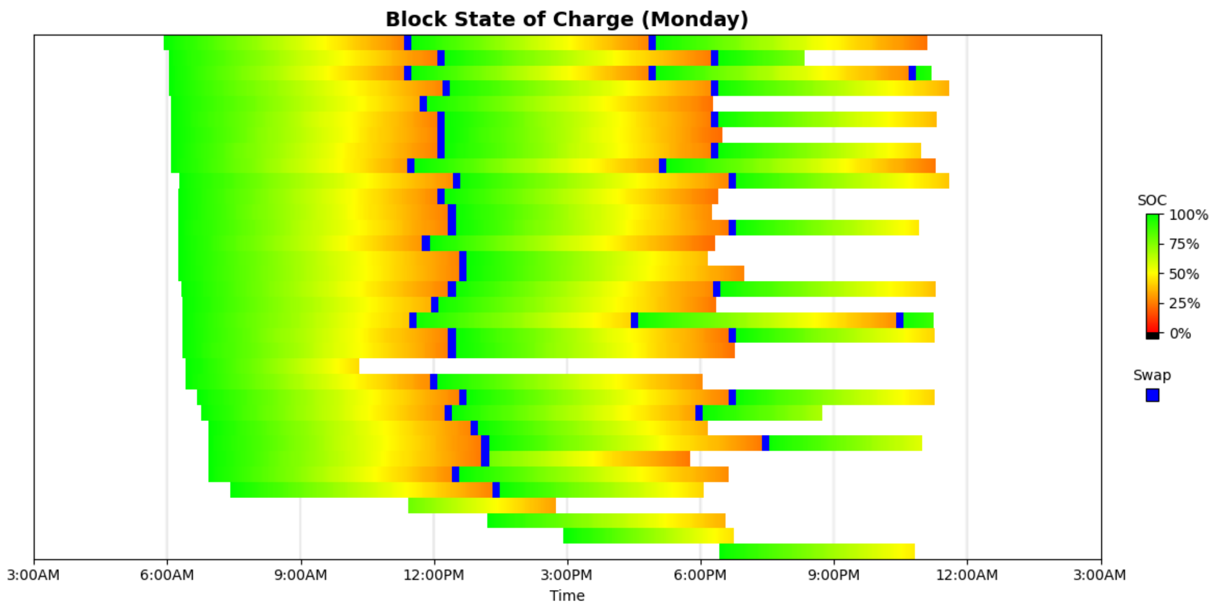

Figure 18. State of Charge with Electric Heating, Bus Swaps

A.3.3.1.2 Power Requirements

The modelling results provide estimates for both power demand and energy consumption at the Fort William depot. Using these results, a preliminary assessment of the required infrastructure can be made. Note that the baseline scenarios are not shown here as they were not determined to be viable options.

Below is the worst-case daily power demand, meaning the maximum load that would be required during weekday service with cold weather (10th percentile temperatures). Knowing the expected peak power demand is essential for beginning the conversation with the electric utility. Depending on the utility, the cost of energy depends not only on the peak power demand but also on the time of day when that peak demand occurs.

Electricity cost is typically billed based on two factors, peak power demand (kW) and amount of energy consumed (kWh). While consumption is based on the actual amount of energy consumed over the billing period, peak power demand is typically the maximum level seen over the billing period. While the City of Thunder Bay currently isn't on a tariff with Time-of-use charges, both factors can be impacted by tariffs that have TOU rates where costs fluctuate throughout the day.

The simulation results provide a power profile that can be used to understand when in the day the peak load occurs. **Figure 19** shows the managed load profile, meaning the model attempts to use the fewest chargers to have vehicles ready for service the next day. The peak power demand for the Fort William depot for a BEB fleet with electric heating and block splitting is around 1.2 MW assuming eight (8) 150 kW chargers would be required.

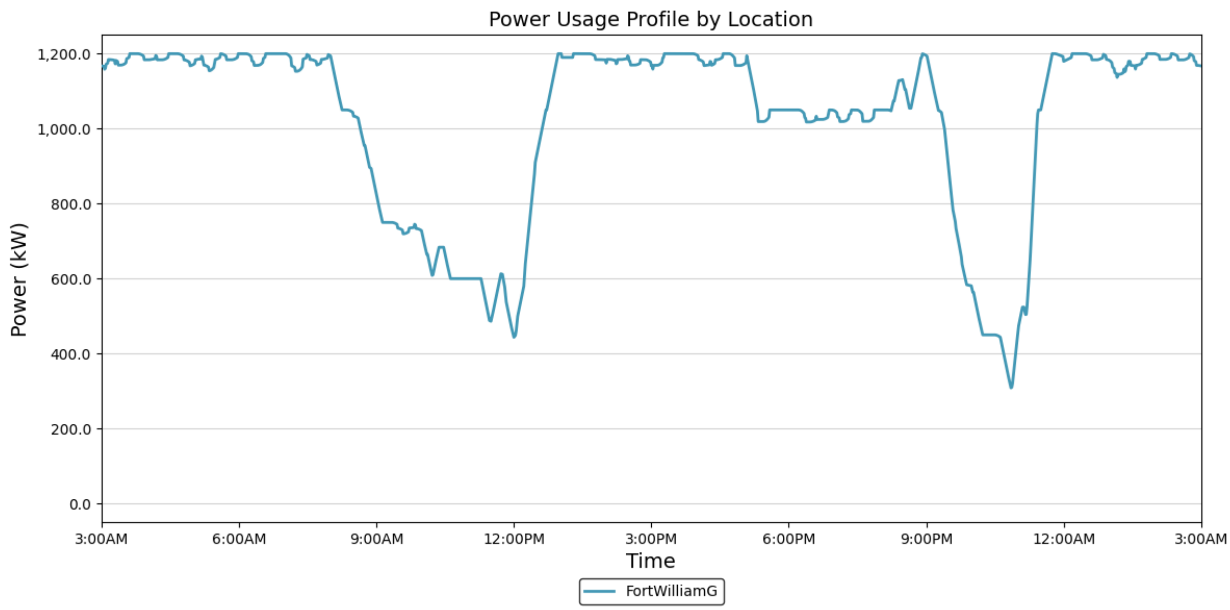

Figure 19. Charging Profile for Electric Heating, Block Splitting

A.3.3.1.3 Vehicle Battery Sizes

With technological advances expected in the coming years, it may be possible to improve the feasibility of some scenarios by purchasing buses with larger battery sizes. There are vehicles with a battery size of 738 kWh that may offer more range than the 525 kWh battery that was modelled. For the electric heating with bus swaps and depot charging only scenario **Figure 10** illustrates that there is relatively little gain in block feasibility when comparing a 525 kWh battery with a 738 kWh battery.

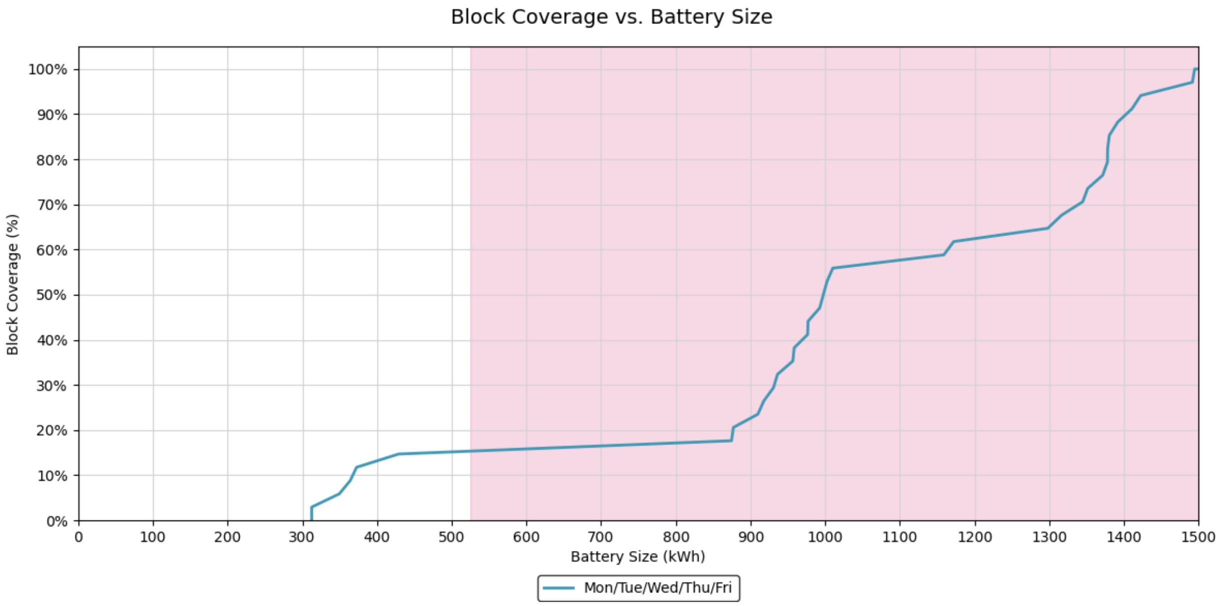

Figure 20. Battery Size Requirement, Electric Heating, Bus Swaps

A.3.3.2 Depot Charging Only with Diesel Heaters

A.3.3.2.1 Model Results

Including diesel heaters on the BEBs does offer significant operational improvements for Thunder Bay Transit service. 29% of blocks are now feasible without swapping buses, and 71% are feasible with only one swap. The state of charge of buses operating on each block are shown in **Figure 21**. Most blocks still require buses to be swapped out part way throughout the day resulting in increased deadhead time for the bus to return to the garage and a new one to come out and take its place. The increase in non-revenue hours, kilometres, and peak vehicle requirement while still high, isn't as substantial as with electric heating on board.

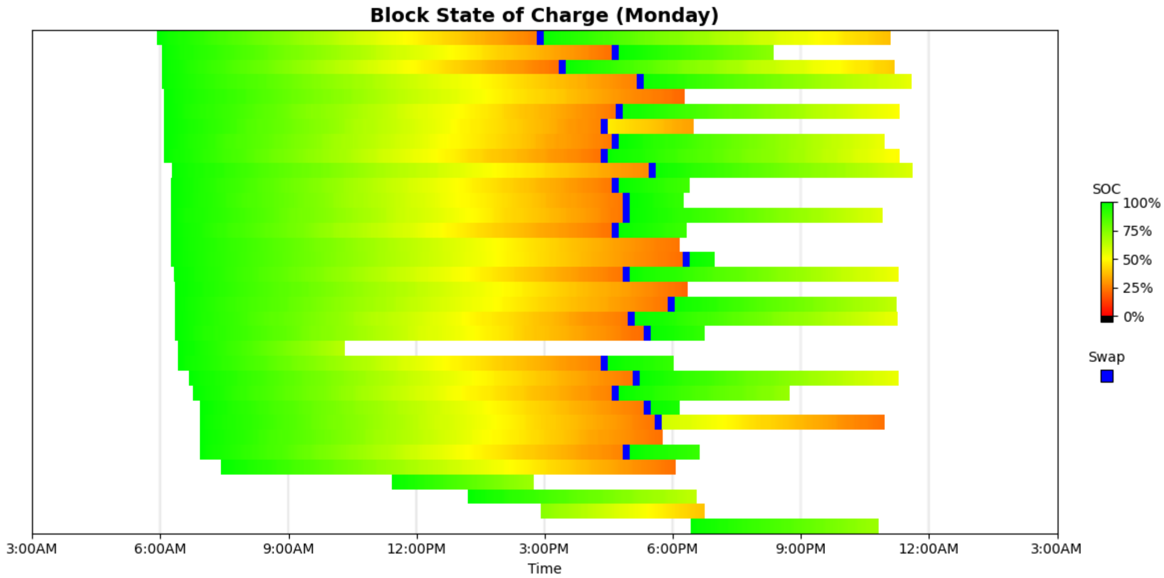

Figure 21. State of Charge with Diesel Heating, Bus Swaps

Below is a review of the main components of the transit service and operations that are likely to change and should be considered when transitioning to a BEB fleet. **Figure 22** shows an estimate of the increase in non-revenue hours and kilometres as well as the estimated number of vehicles required to continue the current transit service.

- Revenue Hours & Kilometres remain the same.
- Non-Revenue Hours: 73% increase
- Non-Revenue Kilometres: 76% increase
- Peak Vehicle Requirement: 62% increase
  Increase Fleet from 32 to 52 buses.
  - 20 more vehicles required.
- At least 6 Depot Chargers will be required.
- Thunder Bay transit can deploy 8 BEBs (electrifying 10 blocks) before fleet increases will be required.

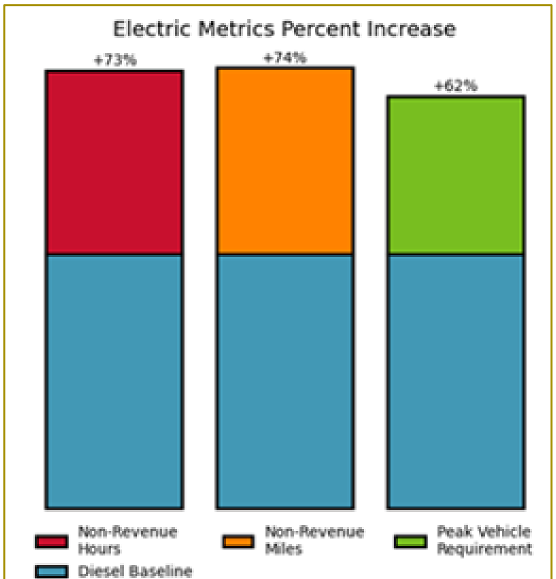

Figure 22. Depot-Only Charging, Bus Swap -- Diesel Heating Outputs

A.3.3.2.2 Power Requirements

The power profile for the Fort William depot is shown in **Figure 23** for buses with diesel heaters. Diesel heaters bring the power requirement down to about 0.9 MW at the depot. A minimum of six (6) 150 kW chargers would be required.

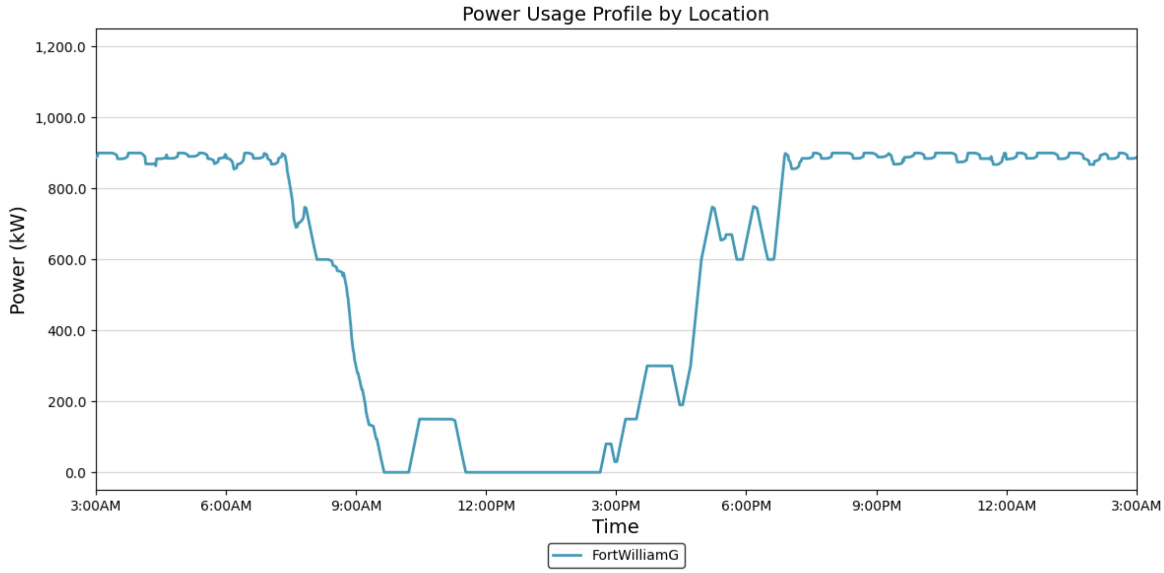

Figure 23. Charging Profile for Diesel Heating, Bus Swaps

A.3.3.2.3 Vehicle Battery Sizes

Unlike the electric heating depot charging scenario, there is significant improvement in block feasibility for the diesel heating depot charging scenario when purchasing buses with larger battery sizes. **Figure 24** shows that approximately 30% of blocks can be covered with a 525 kWh battery, whereas more than 50% of blocks can be covered with a 600+ kWh battery.

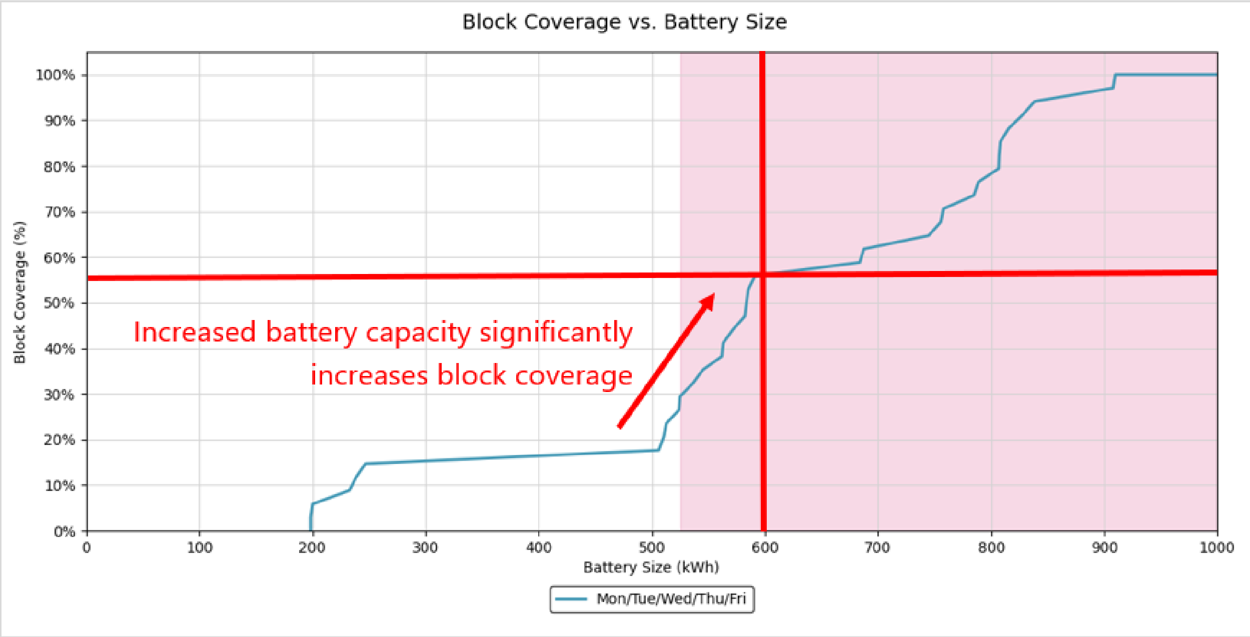

Figure 24. Battery Size Requirement, Diesel Heating, Bus Swaps

A.3.3.3 Longest Range Depot Charging With Diesel Heaters

To illustrate the impact of utilizing a 600+ kWh battery electric bus a Proterra ZX5 Max bus with a diesel fired auxiliary heater was modelled that has a battery capacity of 675 kWh.

A.3.3.3.1 Model Results

Figure 25 shows changes in non-revenue hours, non-revenue kilometers, number of vehicles, and number of chargers required when transitioning from a diesel fleet to a BEB fleet with larger 675 kWh batteries. Like the scenario with the 525 kWh batteries, these numbers represent the changes required to continue current revenue service.

- Revenue Hours & Kilometres remain the same.
- Non-Revenue Hours: 49% increase
- Non-Revenue Kilometres: 49% increase
- Peak Vehicle Requirement: 16% increase
  Increase Fleet from 32 to 36 buses.
    - 4 more vehicles required.
- At least 9 Depot Chargers will be required.
- Thunder Bay transit can deploy 16 BEBs (electrifying 19 blocks) before fleet increases will be required.

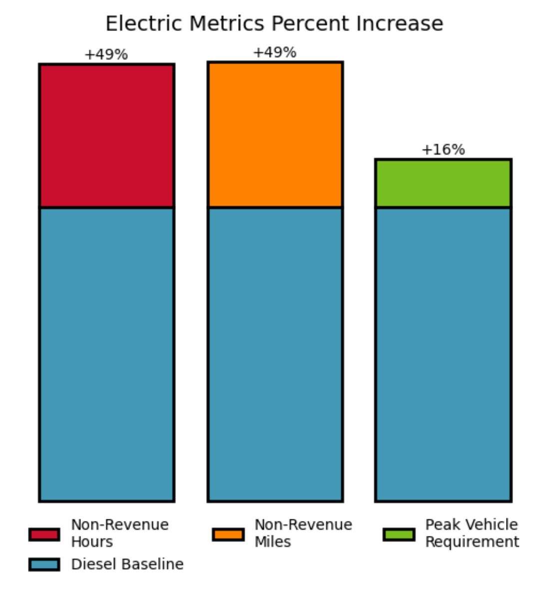

Figure 25. Depot-Only Charging, Bus Swap -- Diesel Heating and Larger Battery

What is most notable about this scenario is that compared to the 525 kWh scenario in **Figure 22**, is that the additional peak vehicles required is reduced from 20 (62% increase) to 4 (16% increase).

Figure 26 shows the state of charge graph for each block using the larger 675 kWh batteries. 19 out of the 34 blocks can now be electrified without requiring a bus swap, representing 56% of blocks. The remaining 15 blocks can be completed with only 1 bus swap. Using a fleet of 675 kWh BEBs will still require a sizeable increase in non-revenue hours and kilometers for the bus swaps.

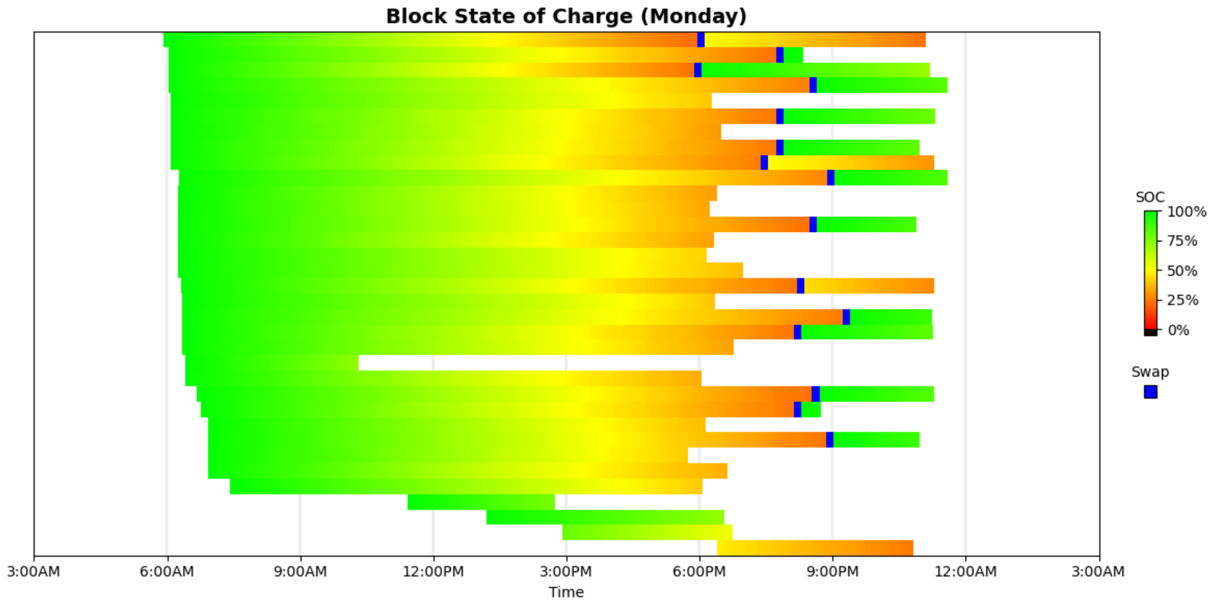

Figure 26. State of Charge with Diesel Heating and Larger Battery, Bus Swaps

A.3.3.3.2 Power Requirements

The power profile for the Fort William depot is shown in **Figure 27** for a fleet of 675 kWh BEBs. Larger batteries will require an increase in power demand, to roughly 1.4 MW at the depot. A minimum of nine (9) 150 kW chargers would be required.

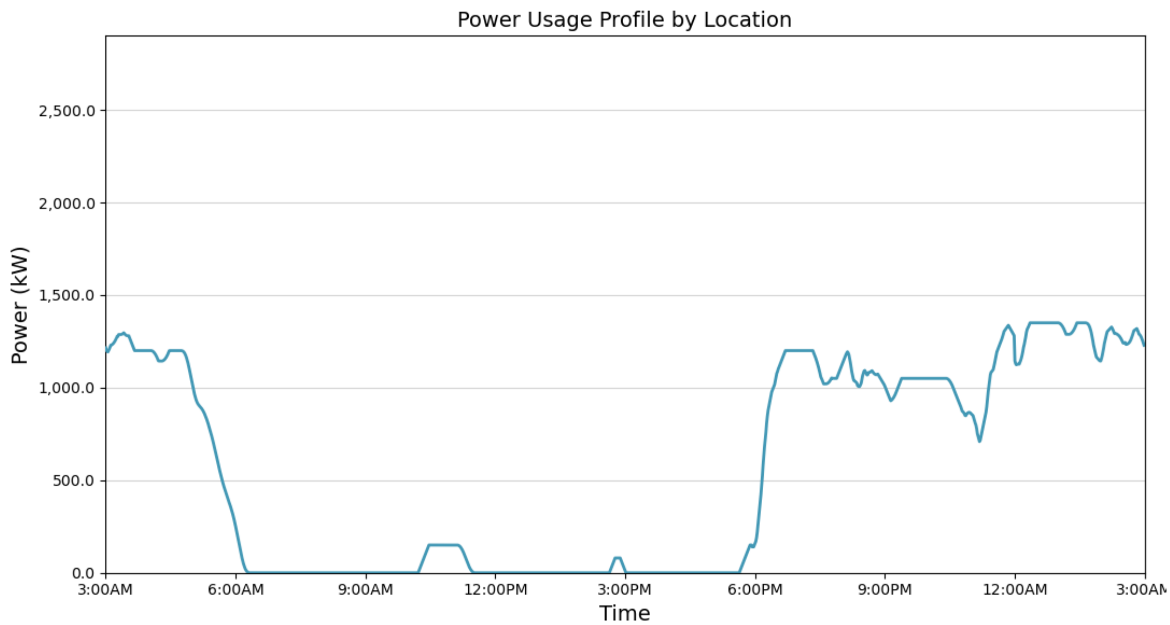

Figure 27. Charging Profile for Diesel Heating and Larger Battery, Bus Swaps

A.3.4 DEPOT AND EN-ROUTE CHARGING SCENARIO

En-route (opportunity) charging is an enhancement that can greatly improve the feasibility of BEBs in many situations. This is particularly helpful with circulatory routes where the same en-route charger can be used by a vehicle multiple times throughout the day. En-route charging involves allowing a bus to charge for a short period of time using a high-powered charger (450 kW or greater) while stopped along its route picking up passengers or otherwise laying over. The mixture of en-route charging and charging in the bus depot greatly extends the range of a BEB and facilitates one-to-one replacement of a larger number of diesel vehicles when the routes are conducive to this charging strategy.

A.3.4.1 En-Route Charger Locations

En-route charging infrastructure is ideally located at places such as transit centers where buses operating on multiple routes all have scheduled layover time. When identifying potential en-route charging locations, property ownership and available grid capacity determine feasibility while average layover times and number of buses and riders passing through each site influence preference over other potential location. Based on discussions with City of Thunder Bay staff on site feasibility and reviews of the current schedule for sites that have existing layover time, the locations below were selected for testing of opportunity chargers.

A.3.4.1.1 Waterfront Transit Hub

Waterfront Transit Hub is on the north side of Thunder Bay next to N Water St. There is a pedestrian overpass near the terminal that helps connect people to the transit service. The City owns the transit exchange as well as some adjacent parking areas. The routes that currently serve this terminal are 1, 2, 3M, 3J, 3C, 7, 9, 11 and 13.

A.3.4.1.2 Other Potential En-Route Charging Locations

To evaluate how en-route charging could be deployed to the rest of the city, placeholder locations were picked where service had existing layover time. The modelling is meant to evaluate if opportunity charging would have significant operational and range benefits for BEBs. No modifications are made to existing vehicle schedules to better take advantage of these chargers. It's important to note that a more detailed evaluation of site suitability for each location would need to be conducted before implementing any infrastructure including engagement with private property owners. If a nearby location to any one of the tested locations has more desirable attributes, it's reasonable to assume it would also lead to similarly improved operational benefits.

As candidate locations are not owned by the City of Thunder Bay, they will be referred to as Area A, Area B, Area C, and Area D as presented in the figure below.

Chargers capable of outputting up to 450 kW using an overhead pantograph were assumed at each en-route charging location. Most of the locations identified would only need a single charger, while some locations would require multiple chargers. The demand of an additional charger is determined based on how many routes stop at a given location and if existing layover times overlap between vehicles in need of charging.

A.3.4.2 Depot and En-Route Charging with Electric Heaters

A.3.4.2.1 Model Results

- Revenue Hours & Kilometres remain the same.
- Non-Revenue Hours: 73% increase
- Non-Revenue Kilometres: 76% increase
- Peak Vehicle Requirement: 44% increase
  Increase Fleet from 32 to 46 buses.
    - 14 more vehicles required.
- At least 3 Depot Chargers will be required.
- 9 En-route Chargers @ 5 locations required.

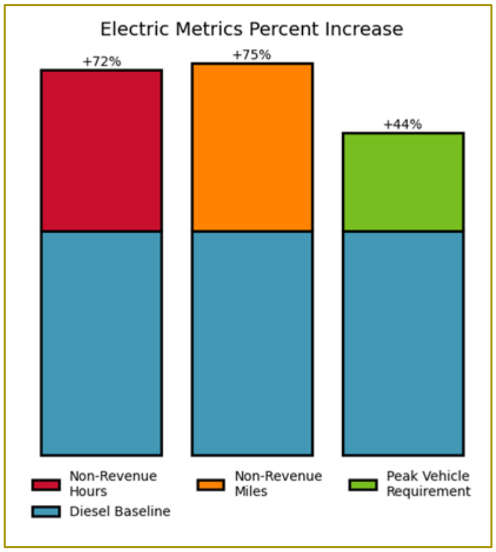

Figure 28. Electric Heating, En-Route and Depot Charging Outputs

Below is a review of the main components of the transit service and operations that are likely to change and should be considered when transitioning to a BEB fleet. **Figure 28** shows an estimate of the increase in non-revenue hours and kilometres as well as the estimated number of vehicles required to continue the current transit service.

With an electric heater on-board, opportunity charging would make a significant number of blocks more feasible. As shown in **Figure 29**, 32% of blocks would be feasible without any schedule modifications and 62% would be feasible with one bus swap, leaving only 6% of blocks that would require two bus swaps.

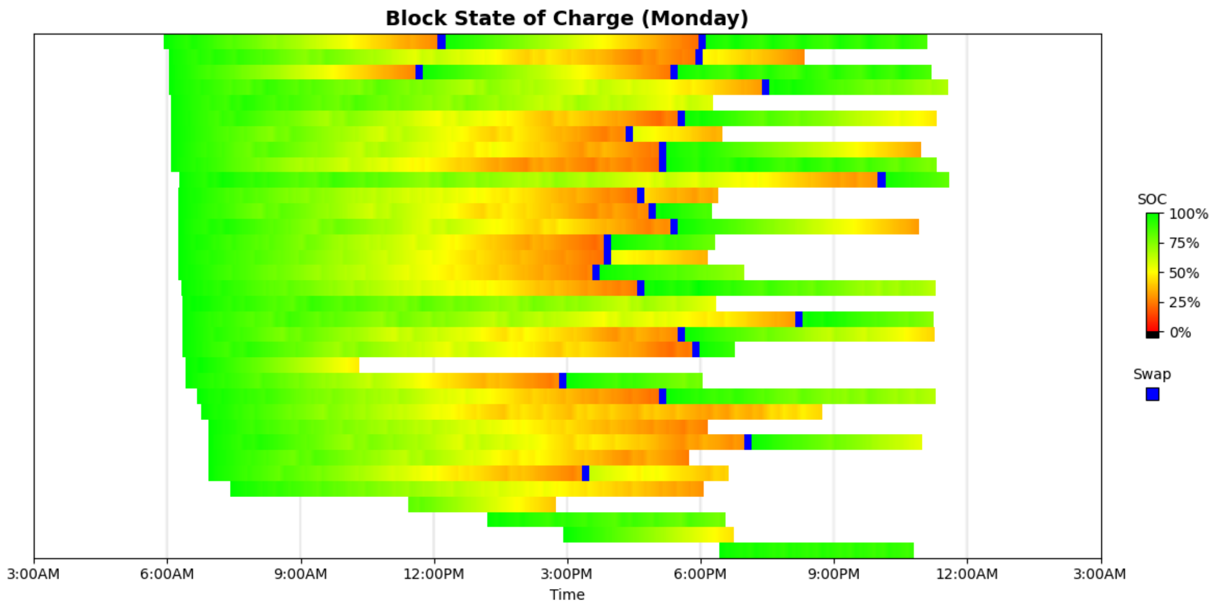

Figure 29. State of Charge, Electric Heating, Bus Swaps, En-Route Charging

A.3.4.2.2 En-Route Charger Utilization

The en-route charger utilization is shown in **Figure 30** and **Figure 31**. 42% of total energy could be provided by en-route chargers, with the rest being supplied in depot. Waterfront Transit Hub would be the most utilized charger and Area D would be the least utilized.

In general, this gives a good indication of the quantity and locations for equipment required. Further optimization could be done (removing less utilized locations) since all these locations are not going to provide the same benefits to service. It's recommended that this optimization be done after deciding on which vehicles will be purchased since battery size and charging speed will also impact how many charging stations are required.

The charger demand is likely high enough to justify four chargers at Waterfront Transit Hub and two chargers in Area C with one charger at each of the remaining locations. There are operational benefits to having more than one charger at any location as it provides additional redundancy in case one charger goes out of service (or is down for maintenance), then there is at least one functioning charger at that location.

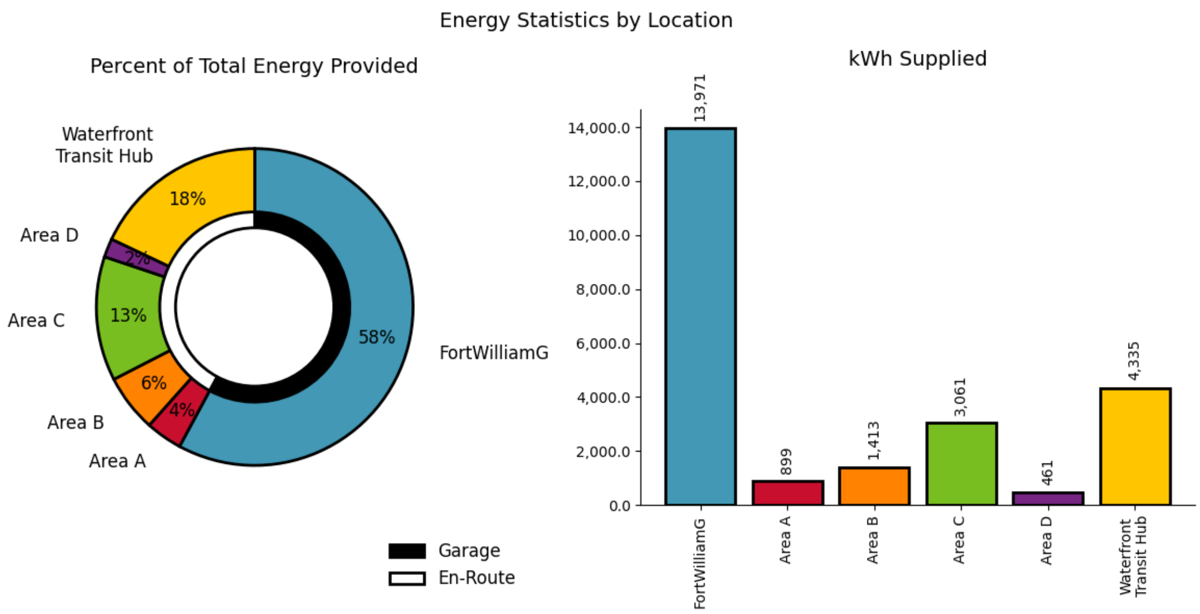

Figure 30. Energy Profile by Site, Electric Heating, Bus Swaps, En-Route Charging

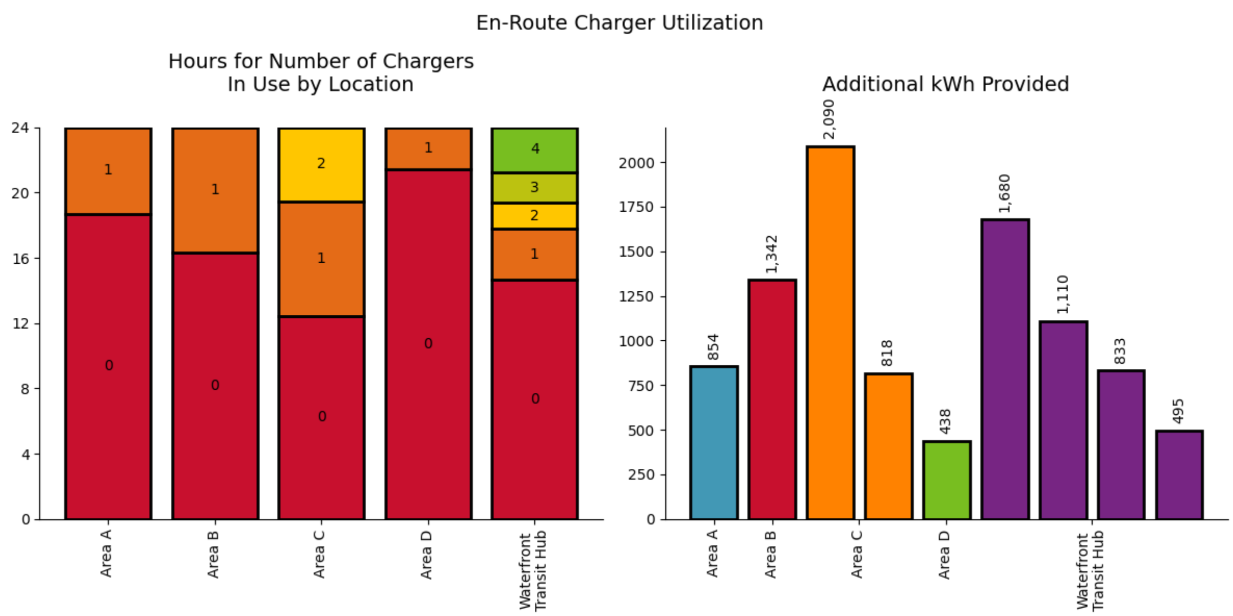

Figure 31. En-Route Charger Utilization, Electric Heating, Bus Swaps, En-Route Charging

A.3.4.2.3 Power Requirements

With en-route charging, the peak power requirement is reduced significantly at the depot. The peak power demand would be around 0.9 MW and three (3) 150 kW chargers would be the minimum required. While three chargers are the minimum that could theoretically be needed at the garage, it's recommended that more be installed to allow for all buses to be plugged in overnight (avoiding moving buses through a limited number of chargers) and for redundancy. The purpose of the figure below is to illustrate the power demand that would be expected if charge management were to limit only three chargers in operation at a single time. The power usage profile for the en-route charger scenario is shown in **Figure 32** and **Figure 33**.

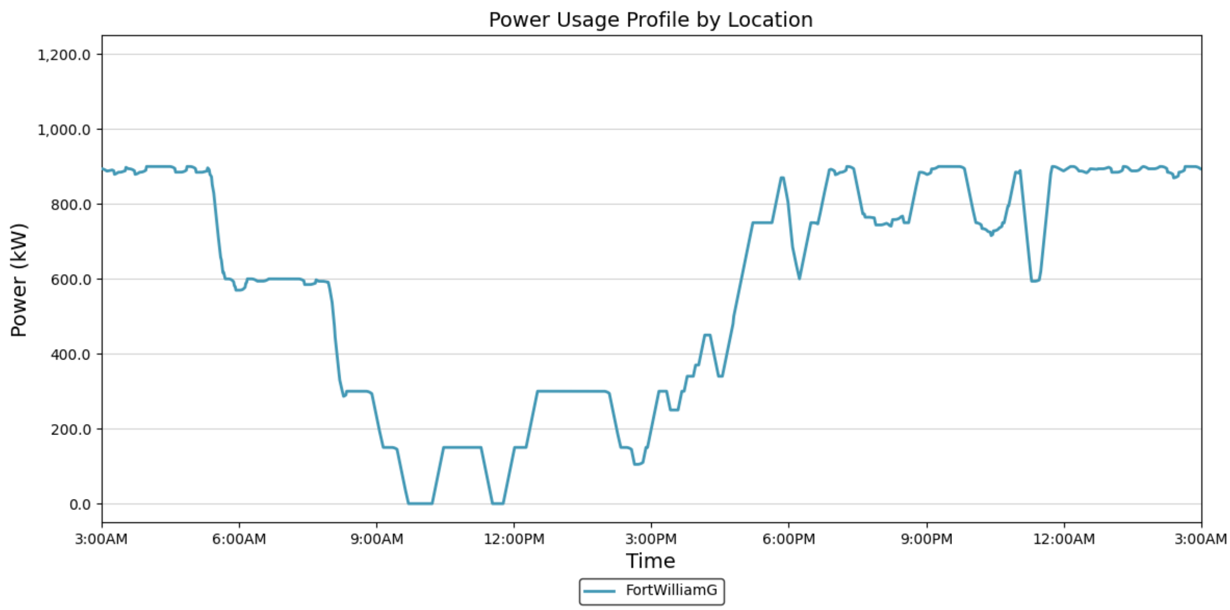

Figure 32. Charging Profile for Depot, En-Route Chargers, Electric Heating, Bus Swaps

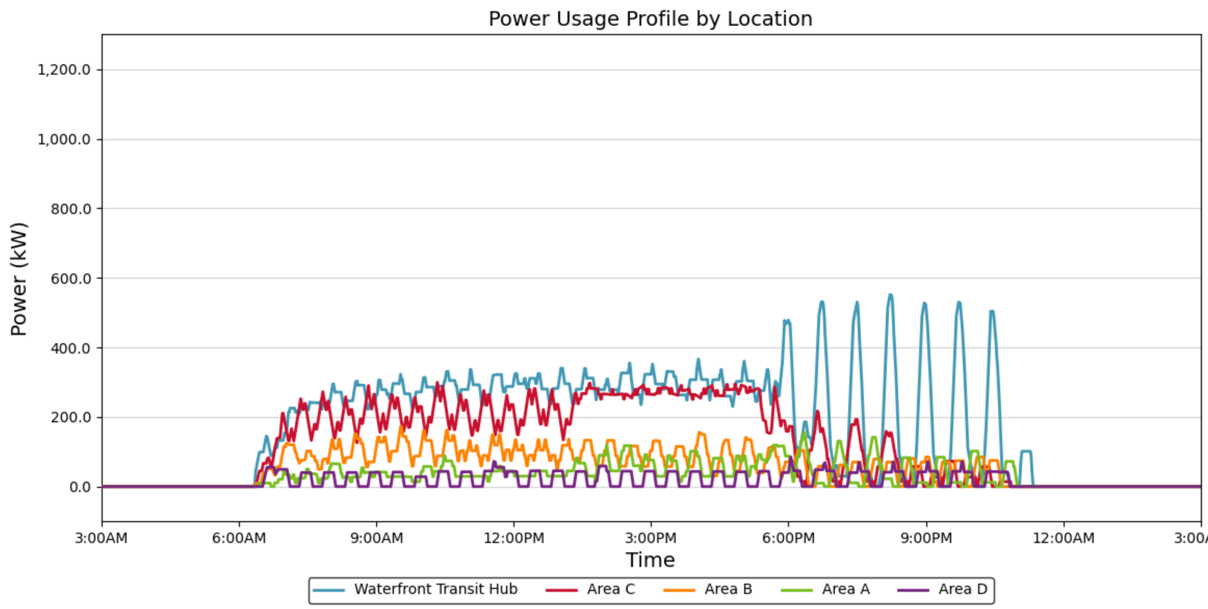

Figure 33. Charging Profile for En-Route Chargers, Electric Heating, Bus Swaps, En-Route Charging

A.3.4.3 Vehicle Battery Size

There is even more improvement block feasibility in the electric heating, en-route charging scenario than the depot only scenarios when purchasing buses with larger battery sizes. **Figure 34** shows block coverage with a 525 kWh battery is around 35%, whereas a 738 kWh battery can cover about 75% of blocks.

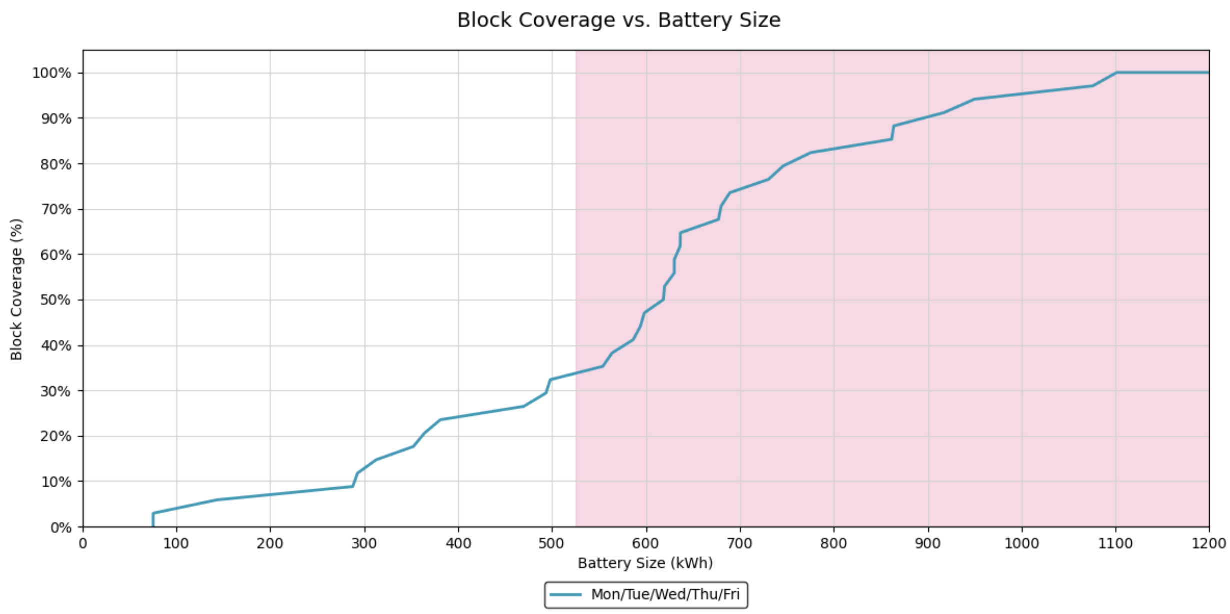

Figure 34. Battery Size Requirement, Electric Heating, Bus Swaps, En-Route Charging

A.3.4.4 Depot and En-Route Charging with Diesel Heaters

A.3.4.4.1 Model Results

With a diesel heater on-board instead of electric heating, the number of feasible blocks without any bus swaps increases from 32% to 94%, as shown in **Figure 35.** The reduced energy requirement from the buses allows for en-route charging to keep most buses at a relatively high level of charge for most of the day.

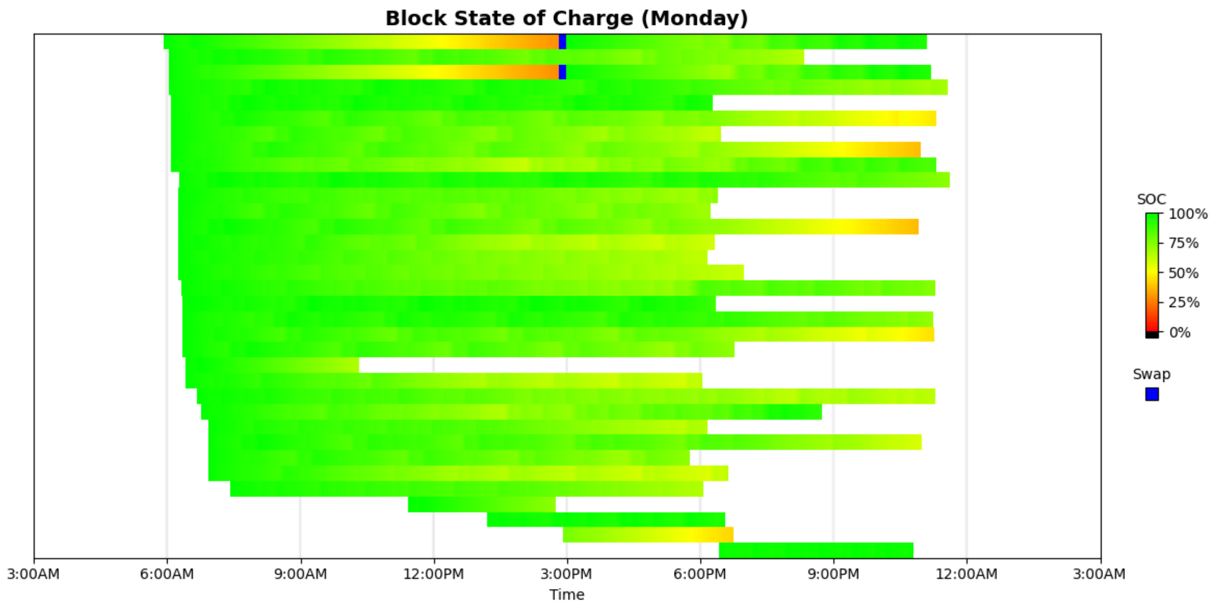

Figure 35. State of Charge with Diesel Heating, Bus Swaps, En-Route Charging

Below is a review of the main components of the transit service and operations that are likely to change and should be considered when transitioning to a BEB fleet. **Figure 36** shows an estimate of the increase in non-revenue hours and kilometres as well as the estimated number of vehicles required to continue the current transit service.

- Revenue Hours & Kilometres remain the same.
- Non-Revenue Hours: 5% increase
- Non-Revenue Kilometres: 5% increase
- Peak Vehicle Requirement: 3% increase
  Increase Fleet from 32 to 33 buses.
  - 1 more vehicle required.
- At least 3 Depot Chargers will be required.
- 8 En-route Chargers @ 5 locations required.

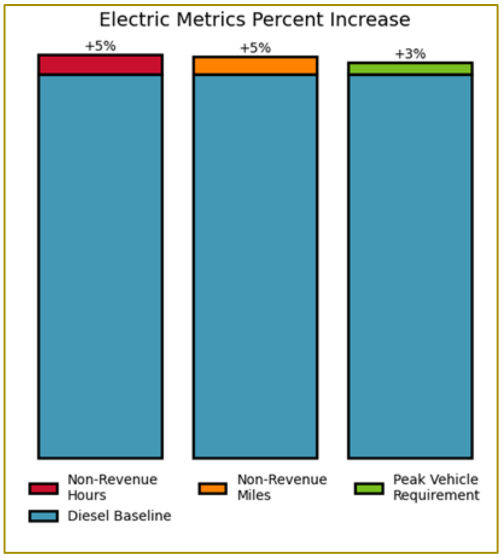

Figure 36. Electric Heating, En-Route and Depot Charging Outputs

A.3.4.4.2 En-Route Charger Utilization

The en-route charger utilization is shown in **Figure 37** and **Figure 38.** 62% of total energy could be provided by en-route chargers, with the rest being supplied in depot. Waterfront Transit Hub would be the most utilized charger and Area D would be the least utilized.

Like the electric heater scenario, further optimization could be done since all these locations are likely not necessary to get the same benefits to service.

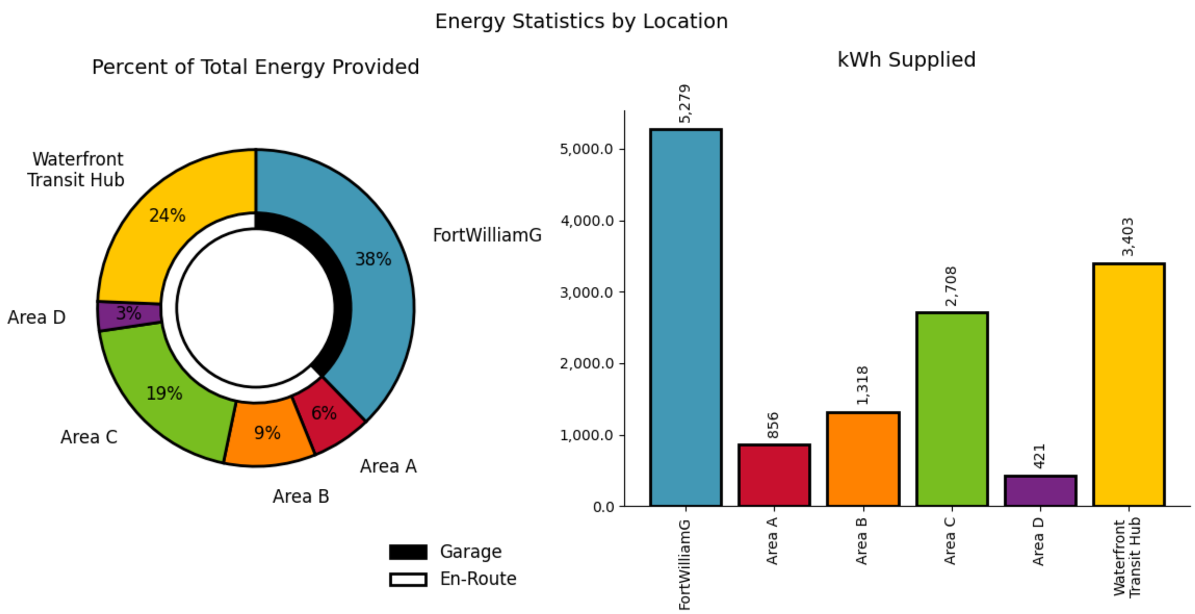

Figure 37. Energy Profile by Site, Diesel Heating, Bus Swaps, En-Route Charging

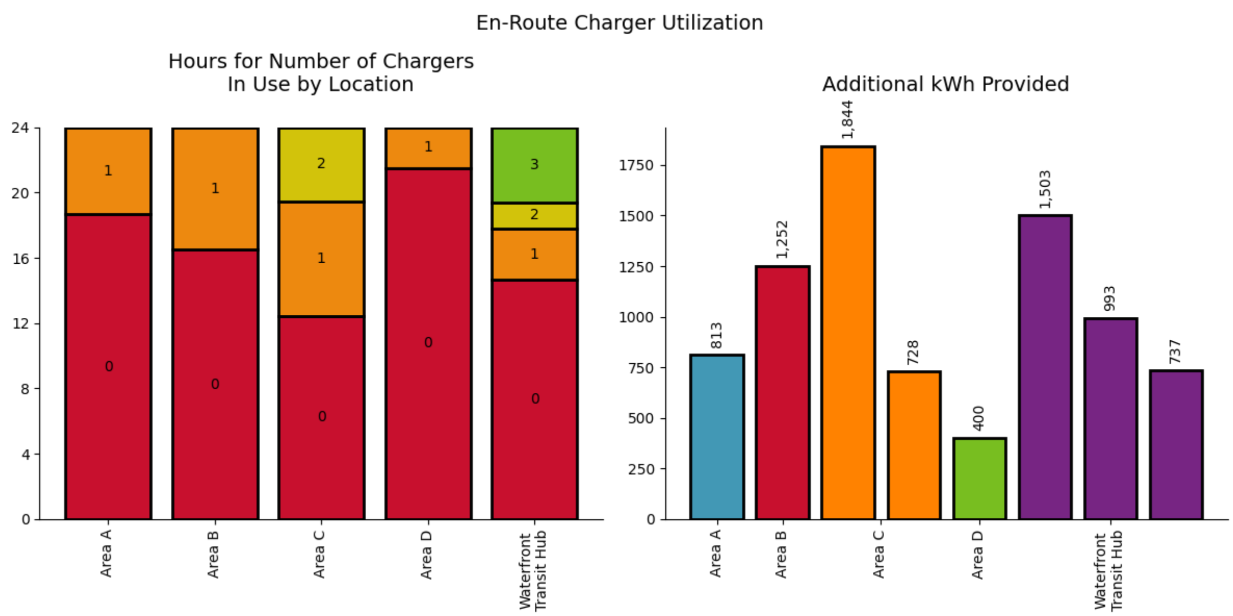

Figure 38. En-Route Charger Utilization, Diesel Heating, Bus Swaps, En-Route Charging

A.3.4.4.3 Power Requirements

With en-route charging and a diesel heater on-board, the peak power requirement is reduced even further in-depot as shown in **Figure 39.** The peak power requirement would be just over 0.4 MW at the Fort William Transit Garage. Only three (3) 150 kW chargers would be required at minimum, in addition to eight (8) en-route chargers. Like the other scenarios, although only three depot chargers are required, Thunder Bay Transit may choose to install more chargers to allow for one dispenser per bus (each charger can have up to 3-4 dispensers). This will avoid the need to move buses around throughout the night. The charging profile for en-route chargers is shown in **Figure 40.**

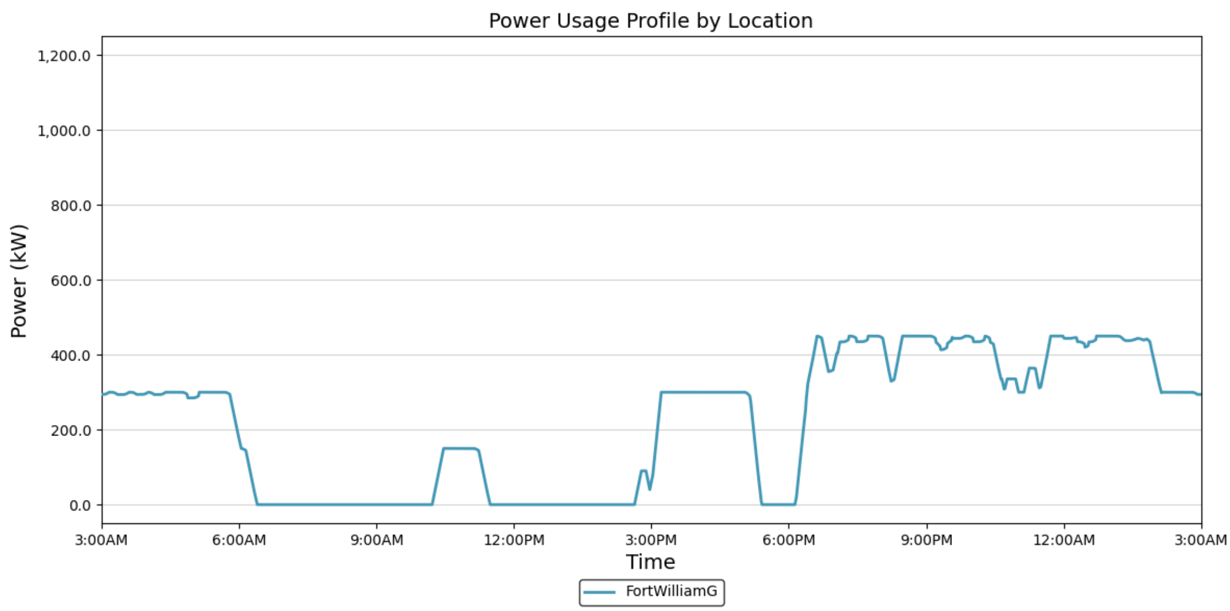

Figure 39. Charging Profile for Diesel Heating, Bus Swaps

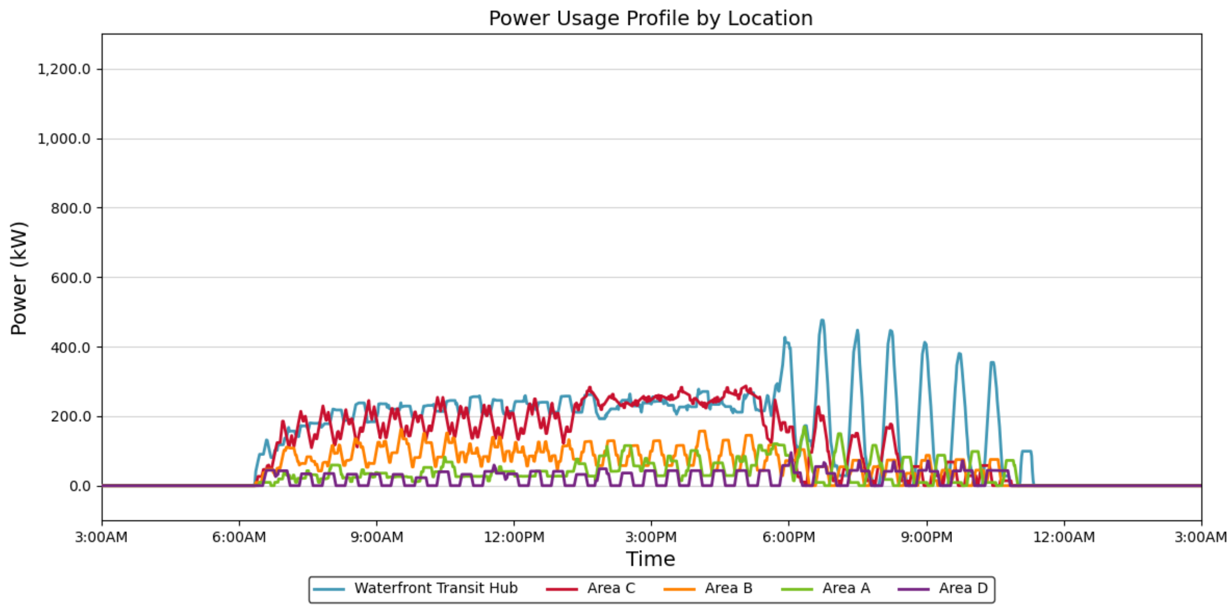

Figure 40. Charging Profile for En-Route Chargers, Diesel Heating, Bus Swaps, En-Route Charging

A.3.4.4.4 Vehicle Battery Size

The scenario with en-route charging and diesel heating has full block coverage at 525 kWh battery size, as shown in **Figure 41**, so there is no need to purchase buses with larger battery sizes.

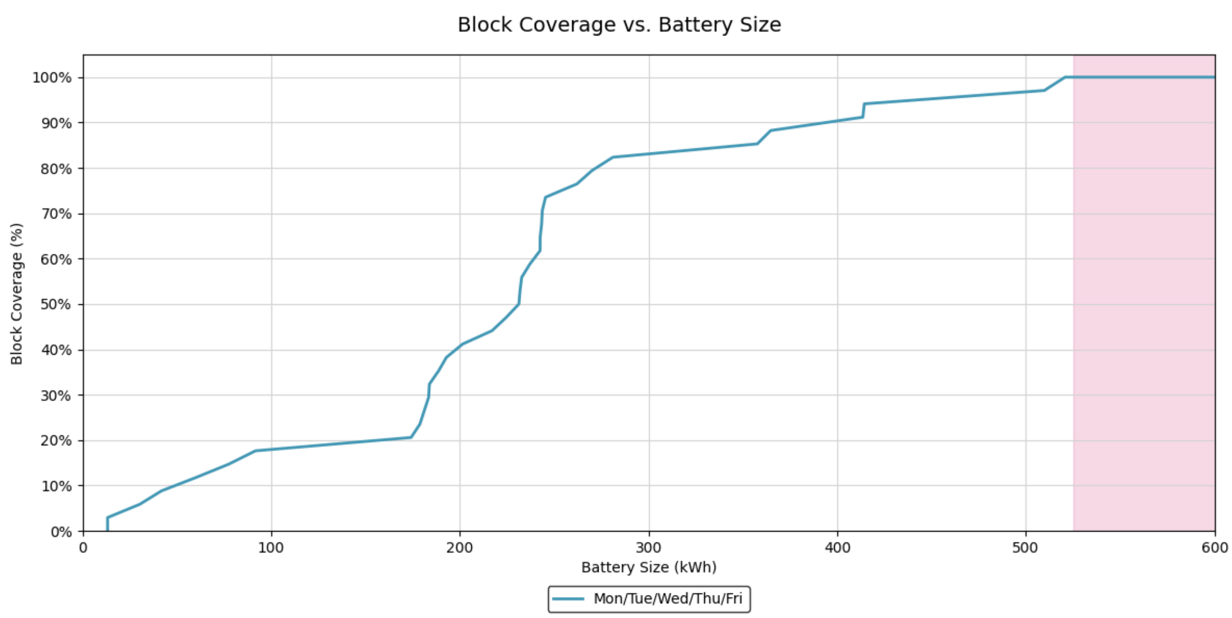

Figure 41. Battery Size Requirement, Diesel Heating, Bus Swaps, En-Route Charging

A.3.5 FIXED-ROUTE TRANSIT MODELLING SUMMARY

The modelled fleet requirement column in **Table 19** shows the peak number of buses without spares and the chargers columns show the minimum number of charges required. The block feasibility column notes the percentage of how feasible the blocks will be based on how Thunder Bay Transit currently operates.

Table 17. Fixed Route Modelling Summary

Scenario		Block Feasibility	Peak Vehicle Requirement	Depot Charger Quantity	En-Route Charger Quantity
Electric Heating	Baseline	15%	4	4	0
	Depot Only	100%	59	8	0
	Depot and En-route	100%	46	3	9
Diesel Heating	Baseline	29%	8	6	0
	Depot Only	100%	52	6	0
	Depot Only Larger Battery	100%	36	9	0
	Depot and En-Route	100%	33	3	8
Diesel		100%	32	-	-

A.3.6 PARATRANSIT MODELLING SUMMARY

An energy consumption analysis was also conducted for Lift+ Specialized Transit fleet and non-revenue vehicle fleet, as shown in **Table 20** and **Table 21** based on the average and maximum daily mileage provided by Thunder Bay Transit staff. All scenarios assumed that fuel fired heaters are used to provide in-cabin heat and keep range of vehicles more consistent between seasons. Analysis of this data against the range capability of the most similar EV equivalent showed that 69% of these paratransit vehicles can be replaced on a one-to-one basis by their EV counterpart and the fleet size will increase by 12 vehicles.

Table 18. Proposed Energy Consumption Plan for Paratransit

Service	Vehicle Type	Proposed EV Replacement Model	Average km	Maximum km
Lift+	Minibus	Lightning Electric E-450 129	146	274

Table 19. Chargers and Energy Demand Required for Paratransit Proposed Energy Consumption Plan

Total Charger Quantity	Total Power (kW)	Daily Energy Demand (kWh)	Required EV Fleet Size	Current Fleet Size
39	975	3,328	39 (+44.4%)	27

A.4 RECOMMENDATIONS

Based on the modelling conducted, HDRs provides the following recommendations to guide development of the fleet transition plan:

A.4.1 FIXED ROUTE TRANSIT FLEET

The energy modelling indicates that without diesel fired auxiliary heaters additional fleet would be required for both en-route and in-depot-only scenarios. Diesel fired auxiliary heaters are recommended given the cold climate in which the fleet operates and impacts it would have.

Energy modelling also suggests that en-route charging would provide a benefit for Thunder Bay Transit in deploying BEBs. Thunder Bay Transit could replace a large majority of its fleet one for one with a battery electric bus that are able to utilize a limited number of en-route chargers distributed throughout the city. It's recommended that installation of en-route charging infrastructure be investigated over the coming years as may be a more cost effective way of transitioning the fleet. While some longer blocks of the service will require en-route charging, the current service plan has blocks that are already compatible and can be transitioned using currently available BEBs using depot-only charging until en-route charging is installed. The recommendations for the fixed route transit are provided below:

- Implement BEBs with diesel fired auxiliary heaters that are capable of both plug-in & en-route charging and operate them as depot charged buses prior to 2030. The BEBs procured should be longer range (~600 kWh+) that can replace the current fleet 1:1 using depot charging in the near-term.
- Investigate adding en-route charging at Waterfront Transit Hub and other identified areas over the next 5 years. Become familiar with en-route charging technology and associated risk by learning from other transit agencies and/or testing the technology. Installing at least one pantograph charger at the depot that can validate the vehicle charging capability and allow Thunder Bay Transit to become familiar with its operation and maintenance prior to implementing it in revenue service.
- Conduct a follow-up evaluation in 3-5 years to confirm the number of buses and chargers required at each location based on actual performance in-service of the fleet

selected. Increases in battery capacity or vehicle charging capabilities may reduce the number of vehicles or infrastructure required.

A.4.2 LIFT+ PARATRANSIT FLEET

The transition of the paratransit vehicle fleet is based on the analysis of the range capabilities of a similar EV equivalent. The fleet size would be required to increase because the results of the analysis showed that only 69% of the Lift+ paratransit vehicles can be replaced on a one-to-one basis by their EV counterpart. This results in additional vehicles being required so that the remaining 31% of the fleet can have a fully charged vehicle on standby at the garage to complete the day. The analysis determined that an additional 12 vehicles would be needed if the entire fleet is replaced with the currently available electric models.

The Lightning Electric E-450 129 is currently the only similar style mini-bus that has been Altoona tested and is available on the market. It is the recommended model because it is the most similar in passenger capacity, physical dimensions, and range capability to the 4500 GMC and 4500 Chevrolet paratransit buses which are most of the current fleet. Although this model is currently the best option, other models with increased capability will likely become available in the coming years.

HDR recommends that Thunder Bay Transit start by replacing a portion of the fleet with currently available EV models and operate that fleet on the 69% of service that those vehicles are already able to complete on a single charge. Over the coming years the City of Thunder Bay should continue to scan the market for a battery electric vehicle that would be more compatible with longer (274+ km) service blocks.

APPENDIX B: FACILITIES ASSESSMENT REPORT

This report identifies planned infrastructure upgrades required to operate battery electric buses (BEBs) in the Thunder Bay Transit's fleet. The report takes the infrastructure requirements identified in **Appendix A: Energy Modelling Report** and determines how they would be deployed to accommodate Thunder Bay Transit's fleet transition. This report considers the Fort William Road Transit Garage as the main location for charging infrastructure and considers the Waterfront Transit Hub as a potential en-route charging location.

This report includes:

- Review of existing conditions at the Fort William Road Transit Garage and Waterfront Transit Hub.
- An overview of charging infrastructure.
- The recommended implementation plan for Thunder Bay Transit including infrastructure requirements and phasing, conceptual site layouts for the Fort William Road Transit Garage and Waterfront Transit Hub, and cost estimates.
- A review of facility constraints and opportunities.
- A review of other considerations including fleet and charger management systems, general facility considerations, solar and battery energy storage overview (including a solar generation analysis), and resiliency considerations.

B.1 ENERGY MODELLING RESULTS

Task 1 of HDR's scope involved conducting energy modelling of Thunder Bay Transit's existing transit service to identify feasible fleet transition pathways to a zero-emissions fleet. The results of the energy modelling for the conventional 40' bus and paratransit fleet (Lift+) indicated that while several options were available, the recommendations were:

- For the 40' bus fleet, implement longer-range (600 kWh+) BEBs with hybrid-diesel fired auxiliary heaters that are capable of plug-in and en-route charging. Buses should be capable of completing more than a half-day of scheduled service and will be able to replace a diesel bus 1 for 1 on more than 50% of the scheduled blocks.
- For the remaining longer service blocks, en-route charging or swapping of some buses mid-day will be required.
- For buses to be able to be replaced 1:1 with en-route charging, 8 en-route chargers would need to be located across five (5) locations which would enable service to be completed with a similar fleet size as today.
- Operating as depot-charged only is possible but would potentially require increasing the fleet size by about 60% to allow for the swapping of buses (52 peak buses vs 33 with en-route charging).

- It's recommended that Thunder Bay Transit operate BEBs as depot-charged buses prior to 2030 and investigate adding en-route charging at the Waterfront Transit Hub and other locations over the next five years.
- For the Lift+ paratransit fleet, 69% of the service can be replaced 1 for 1 with current technology. The class of vehicles used for paratransit do not currently support en-route charging which means the fleet size will need to increase if technology doesn't improve.

To accommodate charging for the current conventional fixed-route fleet at the Fort William Road Transit Garage, a minimum of nine 150 kW DC Fast Chargers are required for the worst case scenario modeled, "Depot Only with Larger Battery". This is the amount needed for the transit fleet to operate in a best-case scenario (all chargers working, and buses cycled through those six chargers) and should be seen as the bare minimum required to recharge the fleet each night. A total of 16 chargers (with three dispensers each) are suggested as this will allow for most vehicles to be plugged or connected to a pantograph when parked at the garage and avoid the labor costs to monitor and move fully charged buses through a limited number of charging points. The additional chargers also allow for redundancy when breakdowns or maintenance take charging equipment out of service. In addition to the charging required for the current fleet, an additional five (5) chargers are included in the concept plan for future fleet expansion of 15 buses for a total of 21.

For the Paratransit fleet, 39 22.5 kW chargers with one plug each would be adequate to charge the paratransit vehicles.

B.2 FACILITIES EXISTING CONDITIONS

Thunder Bay Transit's operations and maintenance facility is located at 570 Fort William Road in Thunder Bay, Ontario. A site visit was conducted in October 2022 to gain understanding of how the facility operates and determine how or if charging infrastructure could be integrated into the existing facility. The existing conditions section of the report is based on findings from both the on-site investigation and reviewing of technical drawings and plans provided by the City of Thunder Bay.

B.2.1 FORT WILLIAM ROAD TRANSIT GARAGE

A satellite image of the facility is shown in **Figure 42** with operations and maintenance functions labelled. The facility includes an administration building, a vehicle maintenance and servicing building, and a vehicle storage building.

Figure 42. Fort William Road Transit Garage

The parking and storage area currently hold 75 transit vehicles including 48 12m' conventional buses and 27 paratransit vehicles. The facility is currently at 100% capacity, though it is noted that increased storage is possible by moving the specialized fleet outdoors on the south side of the facility. The bus entrance to the facility is on the northeast side of the building and a fuel island is located outdoors, north of the entrance. The facility has solar photovoltaic (PV) panels above the operations portion of the Vehicle Maintenance and Servicing building.

An overhead 25 kV distribution powerline is located to the west of the garage on High Street South. The powerline currently provides power to the building through a 225 kVA transformer.

A facility site visit was conducted on October 17th, 2022, and consisted of a tour of the facilities at Fort William Road Transit Garage, discussion with maintenance staff, and a discussion about transit operations. At the facility, HDR was shown the main site electrical feed, parking and storage locations for the revenue and non-revenue fleet, existing maintenance bays, and potential electric vehicle charging infrastructure locations.

Figure 43. Fort William Road Indoor Bus Parking Area

Thunder Bay Transit indicated that the long term plan for transit will require expansion of the fleet and transit service which would be done by expanding the capacity of the current facility. To allow additional indoor storage and charging of vehicles, an area was provided by Thunder Bay Transit where the building is envisioned to be expanded to allow for those additional vehicles to be located and is highlighted in **Figure 44**.

Figure 44. Aerial photo highlighting area where building could be expanded for additional capacity.

B.2.2 WATERFRONT TRANSIT HUB

Waterfront Transit Hub is located off N Water St between Van Norman Street and Camelot Street in Thunder Bay. Waterfront Transit Hub is owned by the City of Thunder Bay and is a major terminal and transfer point.

Figure 45. Waterfront Transit Hub

The Camelot substation, owned by Synergy North, is located on the adjacent site, and is scheduled to be decommissioned in 2027. The building will be left in place and overhead wire and transformers will be removed. The Waterfront Transit Hub was selected as a potential en-route charging location in consultation with the City of Thunder Bay because many routes (1, 2, 3M, 3J, 3C, 7, 9, 11 and 13) utilize the terminal and demonstrated feasibility in energy modelling conducted in the Task 1 of the study. The City also owns the adjacent parking lot to the site which has potential as a space where charging infrastructure could be located.

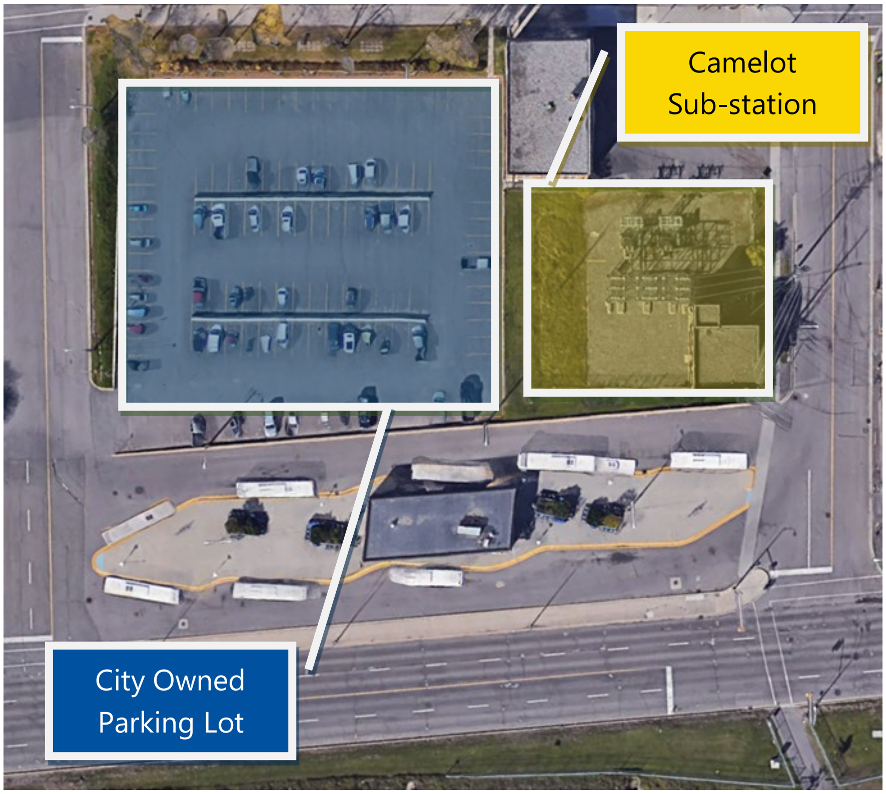

Figure 46. Waterfront Transit Hub Aerial Photo

B.2.3 OTHER EN-ROUTE CHARGING LOCATIONS

In addition to Water Street Terminal, other locations were identified in the **Appendix A: Energy Modelling Report** that would be required to operate in the en-route charging scenario. The areas where those en-route chargers would need to be located are shown in **Figure 47**.

Figure 47. Map showing the five areas (Yellow) where other en-route chargers would need to be located.

The areas were selected as they are locations where there are major terminals or transfer points are located that several routes stop at for layover. The City of Thunder Bay does not currently own property at the existing terminal locations.

B.3 CHARGING INFRASTRUCTURE OVERVIEW

The biggest infrastructure change for Thunder Bay Transit will be the incorporation of charging infrastructure into existing and future facilities. Unlike diesel buses which could be fueled within minutes and operate a full day's service, depleted BEBs can require several hours to charge. In addition to longer fueling periods, BEBs have a limited range when compared to their diesel counterparts.

In addition to having a more limited range to begin with, factors such as colder weather and hilly terrain also will affect BEB range. HDR's Zero+ tool considers these factors as well as many others to determine the charging infrastructure required for Thunder Bay's climate. Some BEBs will require recharging (at the transit garage or at an en-route location) throughout the day to complete their service.

This section provides an overview of electric vehicle charging infrastructure and describes how it can be applied to accommodate a fleet transition for Thunder Bay Transit.

B.3.1 CHARGING INFRASTRUCTURE

The main components of electric vehicle charging infrastructure are:

- Electrical Equipment: the equipment that powers the chargers such as transformers, meters, switchgear, etc.; and
- Charging Modules: equipment that connects with the vehicles and charges them such as dispensers.

Figure 48 is a diagram of the required electrical equipment and charging modules required to charge electric vehicles.

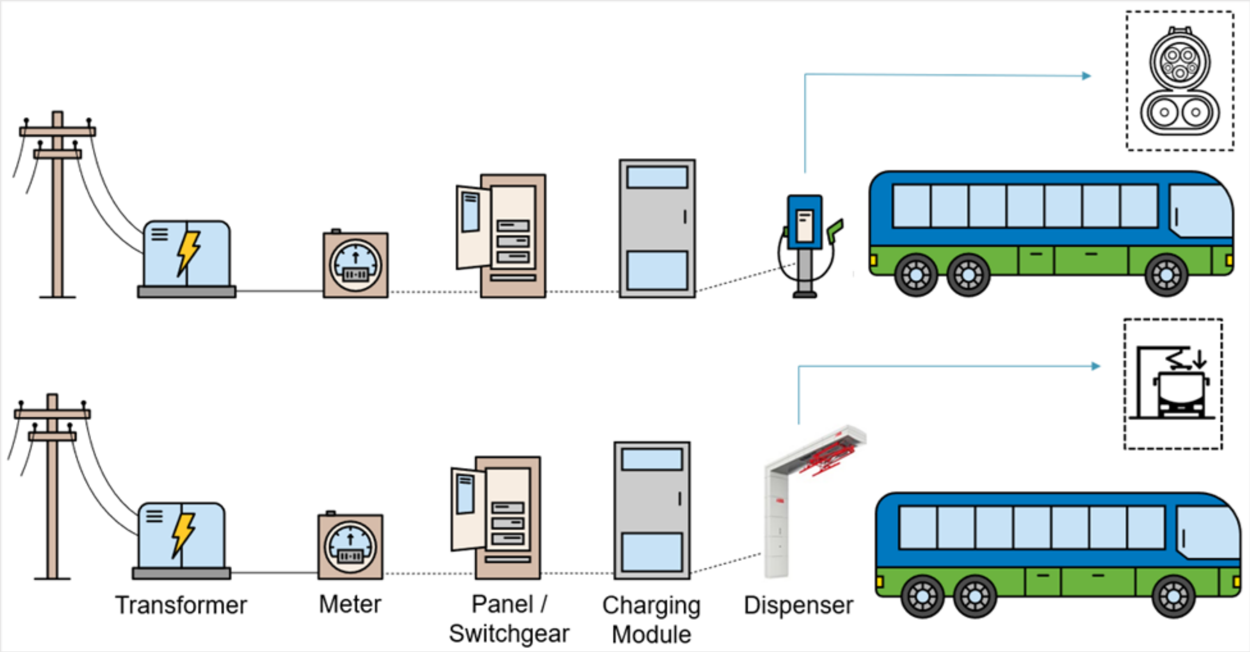

Figure 48. Typical Electrical Equipment and Charging Modules Required for Electric Vehicles

As shown in **Figure 49** and **Figure 50** there are different types of dispensers that can be used to charge electric vehicles. Cable charging using CCS1 (Combined Charging System 1 per SAE J1772) are common and require the user to plug the charger into the vehicle. Inverted pantograph chargers (overhead chargers) have charging infrastructure that connect with charging rails mounted to the top of the vehicles and require users to align the top of the bus with the dispenser to charge (per J3501-1) (**Figure 50**).

Figure 49. CCS1 Plug-in Charging Connector (SAE J1772)

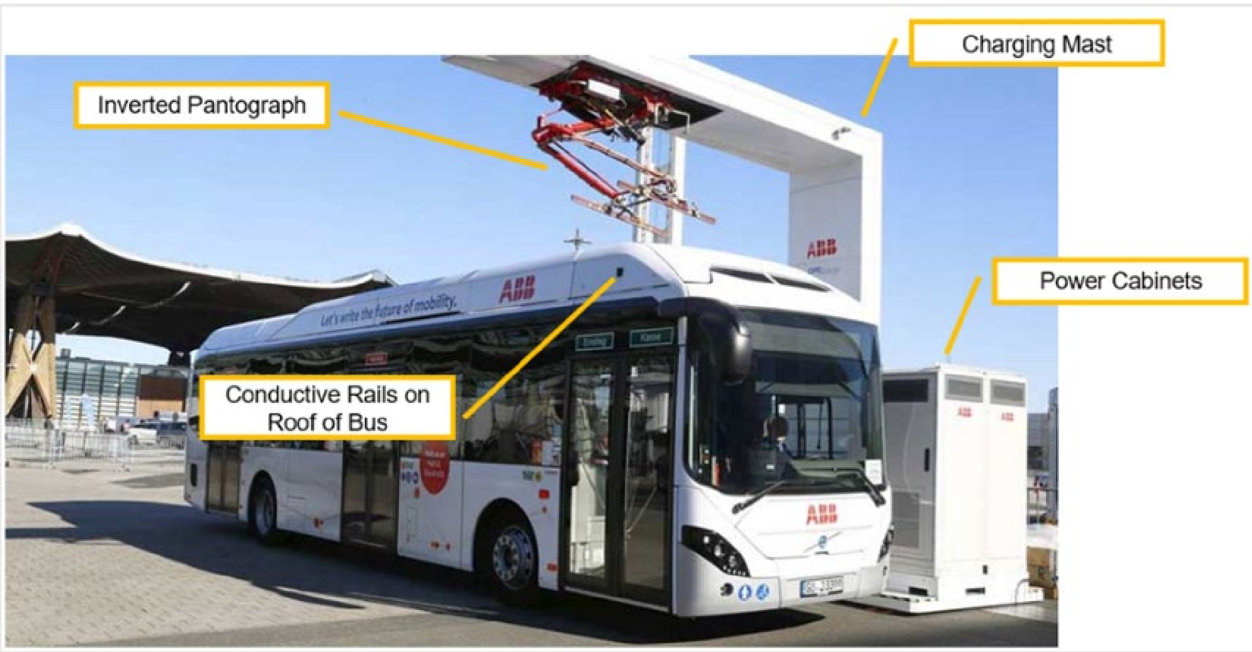

Figure 50. Inverted Pantograph Charger (SAE J3501-1)

While there are other connecting options available, such as roof-mounted pantograph-up and wireless inductive charging, they are either not currently available in North America or have limited adoption. The concepts presented below assume facilities are designed with CCS1 and pantograph down being the charging interface options.

B.3.2 DEPOT CHARGING

Depot Charging refers to the siting and use of charging infrastructure at the facility where buses are typically stored overnight. At the depot, both plug-in and pantograph charging can be installed. It is recommended that Thunder Bay Transit deploy a mix of both styles in the Fort William Road Garage to provide the best option of operator useability and cost performance. A detailed breakdown of the different dispenser types can be found below.

The main difference between plug-in and pantograph dispensers is the way the vehicle is connected to the charger. Charging speeds are similar because both dispensers use the same charging modules to deliver the same amount of energy.

Figure 51. Example of ETS in-depot pantograph chargers

There are trade-offs with picking either plug-in or pantograph as the connection option. Pantographs take up less space if mounted to existing overhead structures and offer an autonomous way to connect the vehicle to the charger. Pantographs can be configured to automatically deploy, meaning that an individual does not need to physically plug in the bus to charge. This reduces human-error and reduces the risk of a vehicle missing their charging window. Some of the drawbacks are that pantographs are heavier, purchase cost is higher, mechanical portions require maintenance, vehicle alignment under the pantograph can be a challenge, and interference with wireless communication between the dispenser and the bus can lead to challenges in successfully charging vehicles.

Plug-in charging has the benefits of typically being lower cost, fewer physical alignment issues, and fewer communication issues (since there is hard wired communication). The drawbacks are that someone must physically plug the bus in, it typically takes up more floor space (but can also be mounted to the ceiling), cable management needs to be considered, and plug-in connectors are more easily damaged. Additionally, plug-in chargers generally aren't recommended to be used in publicly accessible areas due to the risk of damage or vandalism.

The CCS plug-in charging standard (SAE J1772) has existed since 2011 and is a more established standard than pantograph charging. The first version of charging standard J3105-1 (pantograph down) was published in 2020; some aspects of this standard are currently being refined to address the drawbacks mentioned above. The standard is being updated to address situations where pantographs are in proximity and experience communication challenges between wireless communication the dispenser. This situation is common in depot charging settings.

Manufacturers have products that allow multiple dispensers to be fed from a single charging module. Some manufacturers achieve this through "sequential charging" where buses are put in a queue and charged individually. Other manufacturers employ "parallel charging" where power is shared between multiple connected vehicles. This infrastructure reduces the amount of charging modules required while providing multiple dispensers and charging options. Despite this advantage, the failure of a single charging module can impact the charging of multiple buses.

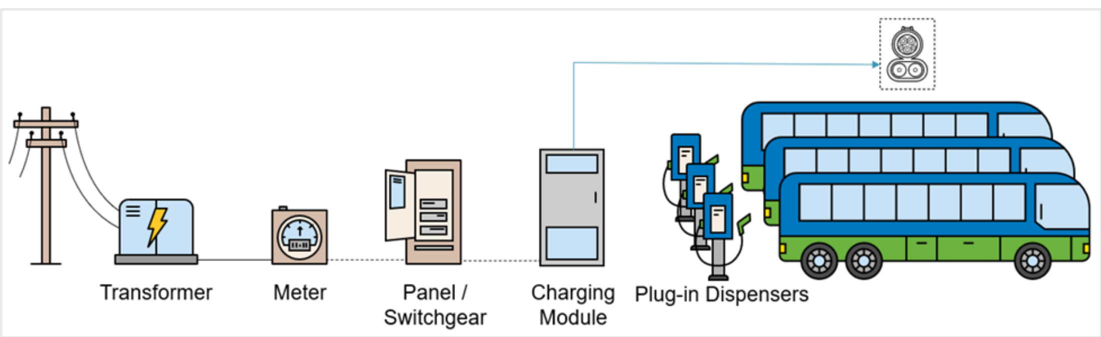

Figure 52. Example of Equipment Required to Feed a Single Charging Module With 3 Plug-In Dispensers

Depending on the amount of charging required, charging modules can come in different sizes with a variety of power levels. Some can serve 1-4 dispensers while some newer options offer larger charging modules that can provide charging to up to 40+ dispensers. Regardless of whether it is a large charging module or multiple smaller charging modules, the same principle applies that we recommend that the number of dispensers should match the number of vehicles stored at that facility.

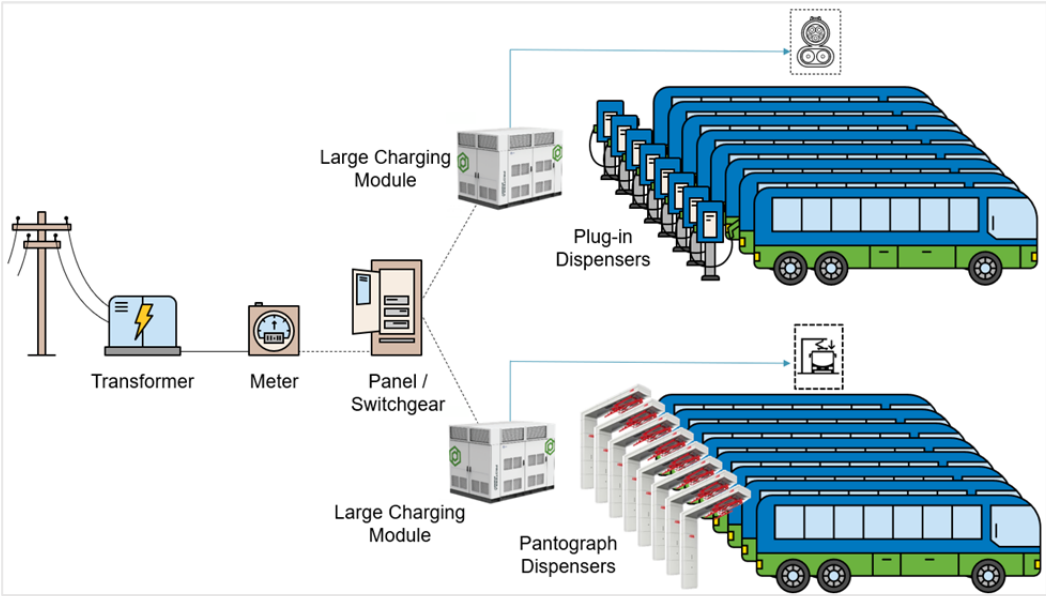

Figure 53. Example of a Larger Charging Module Able to Feed Either Pantograph or Plug-In Dispensers

B.3.3 PARATRANSIT VEHICLE CHARGING

While Paratransit vehicles connect using the same CCS1 connector, they are generally smaller and have smaller batteries that cannot fully utilize the same high-powered charging that the heavy duty transit fleet can. Either lower powered charging modules or smaller wall-box style chargers can be utilized to charge these vehicles. The concept plans in this study allocate these smaller 22.5 kW DC wall boxes due to their more limited power demand and lower cost.

Figure 54. Illustration of A 22.5 kW ABB Terra DC Wallbox

Some smaller vehicles like those for used for paratransit can utilize AC chargers which are able to charge up to 19.2 kW. This would be another option to consider if the vehicles purchased are able to accept AC charging. AC chargers are generally less expensive than lower power DC chargers and require less upstream electrical infrastructure but would not be compatible with the larger transit buses which don't accept AC charging.

B.3.4 EN-ROUTE CHARGING

En-route or layover charging refers to high-speed charging infrastructure sited along a bus route where BEBs can charge during layover time (as little as 5 minutes) to regain all or a portion of their energy. Facilities that have separate drop-off, layover and pick-up areas are ideal for en-route charging since a fast charger in the layover location can potentially serve multiple routes. Current en-route chargers are typically rated around 450 kW and may increase in the future. The current bottleneck for charging speeds are the vehicles which control the charging process and limit chargers (regardless of the rating) to what the vehicle can accept. If the current vehicles that are purchased will only accept a lower power charge rate, lower powered chargers (such as 300 kW) are also available at a lower cost but may limit the benefits of future vehicles being able to accept higher charging rates.

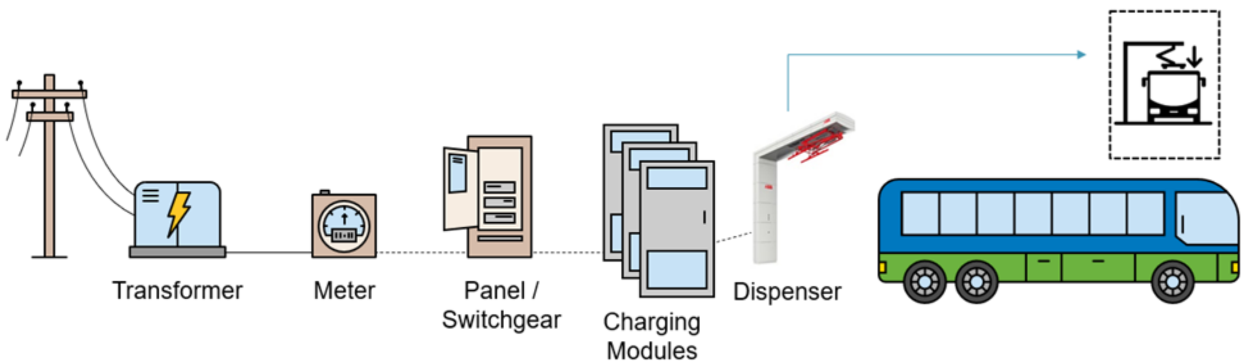

Figure 55. Example of Equipment Required to Feed a Single High-Speed Pantograph Charger

Typically, all the charging equipment (shown in **Figure 55**) will be required for each en-route site. Sites with multiple en-route chargers can share larger transformers and switchgear. Charging modules can be separated from the dispensers up to 150 meters allowing the modules to be stored in a "back of house" location away from passengers. Flexibility in location is preferable for maintenance, passenger safety and comfort as the modules generate heat and noise when in operation.

B.3.5 CHARGING INFRASTRUCTURE CONSTRAINTS AND OPPORTUNITIES

The following sections list factors that were considered when developing the concept plans. They were developed using a combination of information obtained during the site visit, information determined from site plans provided by Thunder Bay Transit as well as industry best practices.

B.3.5.1 Depot Charger Selection

As explained in earlier sections, there are a variety of different chargers that would be compatible with a battery electric bus fleet. Selection of the type of charging system is dependent on agency preference in terms of the type of interaction their staff will have with the equipment, available space and impacts on the facility operation.

Fort William Road Transit Garage has a significant amount of area outdoors that is available for placement of the transformers and charging modules shown in **Figure 56** below. Having an open area for infrastructure is preferred since it provides the flexibility for charging equipment vendors to propose charging equipment and provide the best value to the city.

Figure 56. Fort William Transit Garage outdoor area for charging infrastructure.

While the larger electrical infrastructure that feeds the dispensers can be located outdoors and is flexible, because of the indoor nature of the bus parking area the dispenser type needs to consider available floor space. **Figure 57** shows the typical space between parked vehicles at the Fort William Road Transit Garage. Ground mounted charging dispensers have a footprint that isn't compatible with the current parking configuration. Placing islands for charging dispensers between buses would take away parking lanes which would significantly reduce the parking capacity inside the facility.

Figure 57. Limited space between vehicles at Fort William Road Transit Garage

Wall mounted dispensers could be used for the lanes that are adjacent to the walls while ceiling mounted dispensers (dispensers or pantograph) should be used for the interior parking lanes to avoid reducing parking capacity. Having a number of plug-in charging dispensers is recommended as there may be instances where buses have issues with pantograph charging and need to use plug-ins (such as communications issues, faulty charging rails, etc.). They could also potentially be used for fast charging light-duty fleet or other vehicles that accept CCS charging while they're not in use by the bus fleet.

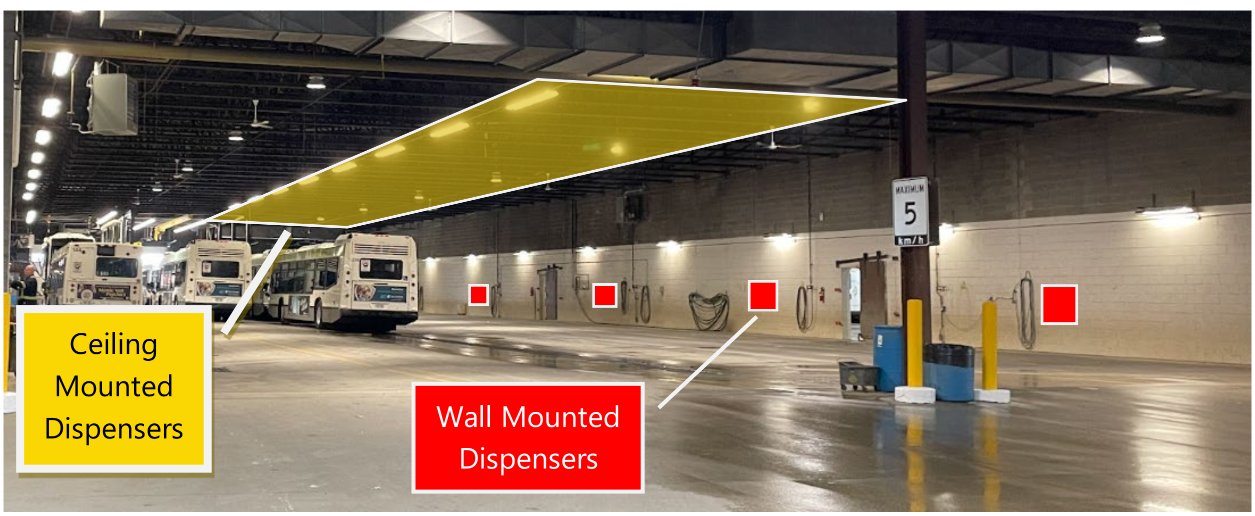

Figure 58. Fort William Road bus storage area showing where charging dispensers could be located.

Ceiling mounted plug-in chargers with mechanical retractors are a good option that could potentially be mounted to ceiling roof joists (**Figure 59**). A detailed design would be required to identify the specific locations and determine if conflicts with other infrastructure exist (air ducts, lights, garage doors, etc.) (**Figure 58**). Motorized cable reels that raise and lower the connectors when not in use are available. With motorized retractors, there also needs to be consideration as to how the reels will be activated either by pull cord, remote switch, or other automated custom solutions but there are several different options available.

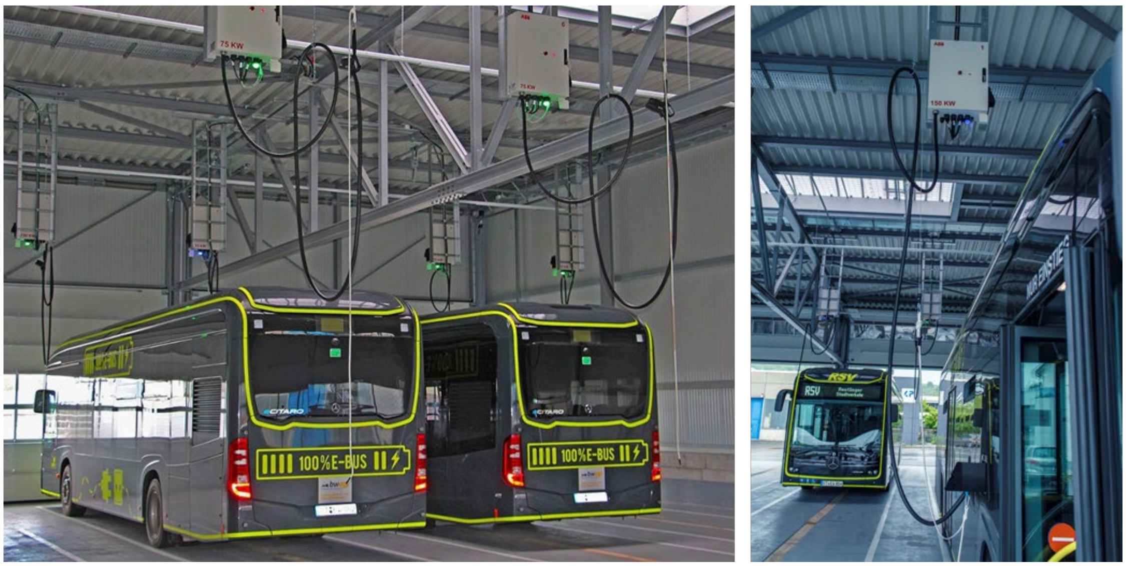

Figure 59. Examples of ceiling mounted chargers

Pantographs are another good option for areas that do not have adequate floor space for ground mounting of equipment. With pantographs, the ceiling height is a factor to consider since pantographs are required to be mounted about 4.5 m above the ground to be within the working range of the pantograph (**Figure 60**).

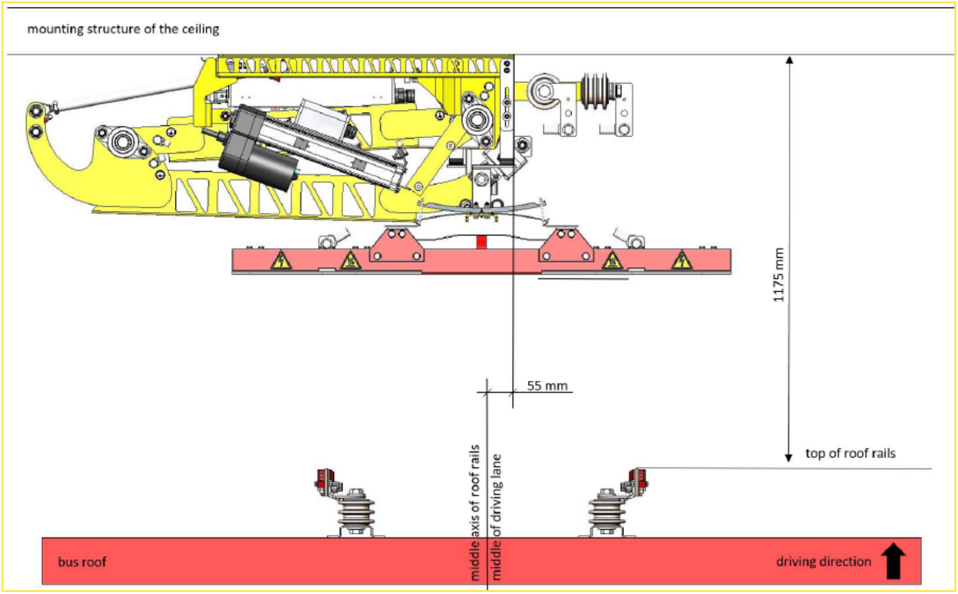

Figure 60. Wabtec - Optimal installation position of the DepotPANTO

As-built drawings of the Fort William Road Transit Garage indicate the interior joists are about 5.5 m above the ground which means there is adequate clearance for the pantographs to be mounted above the bus parking area but would likely require bracing to lower the pantograph to the appropriate height above the vehicles.

B.3.5.1.1 Roof Structural Loading

While there is adequate physical space for either hanging of plug-in dispensers or pantograph chargers, the structural capacity requires further investigation. A detailed design should be conducted to determine the feasibility (if there is structural capacity to support the weight) of ceiling mounted charging dispensers or pantographs and siting of appropriate locations. The weights of dispensers can vary significantly by manufacturer and may limit which types of dispensers could be used if mounting to the ceiling structure.

Figure 61. Example of wall mounted cable reel

Some of the powered cable reels can also potentially be wall mounted to avoid putting loads on the building ceiling (**Figure 61).** This may be another option that could be considered during detailed design if the roof capacity doesn't allow for additional weight in some locations. A similar analysis of the walls would need to be done to confirm they could handle the additional load.

Table 22 provides information gathered from manufacturer specification sheets. Note that the cable reel dispensers have a significant advantage in terms of useable range between the dispenser and the bus which can make them a good option for areas with high ceilings:

Table 20. Example dispenser weights and dimensions

Type	Manufacturer	Model	Weight	Useable Range	Dimensions
Pantograph	Wabtec	ChargePANTO	387 kg	1.50 – 1.7 m	2247 x 1250 x 574 mm
Pantograph	Wabtec	DepotPANTO	90 kg	1.0 m max	1524 x 825 x 475 mm
Pantograph	Schunk	SLS 301	90 kg	0.36 m max	1580 x 1020 x 1000 mm
Cable Reel	Wabtec	ChargeREEL	125 kg	6.7 m max	900 mm reel diameter

B.3.5.1.2 Paratransit Vehicle Charging

The 22.5 kW DC wall boxes that are provisioned for the paratransit fleet do not currently have a ceiling mounted option (**Figure 62**). For the initial roll-out of paratransit vehicles, exterior lanes that could use the walls for mounting of charging dispensers are a good option that doesn't take any additional floor space.

Figure 62. Wall space for DC wall boxes

With the current chargers available in the lower power category, ground mounting is the only available option. Based on the existing drawings provided, there appears to be adequate space for a single island between the two interior lanes where dispensers would be located (**Figure 63**).

Figure 63. Location of paratransit charging between lanes.

B.3.5.1.3 En-Route Pantograph Chargers

Where pantograph chargers are employed for en-route charging, it is important to have drivers correctly align the vehicle to the charger to secure a charge. A system to help drivers align the vehicles under the pantograph chargers should be employed like an indicator that drivers use for positioning. Some agencies have used markers both inside and outside the bus and/or speed bumps to help with positioning (see **Figure 64**). Considering the potential en-route charging locations at Transfer Points are located outdoors and will encounter snow, on-ground markers may not be the preferred method of positioning for Thunder Bay Transit. It may be preferable to use another method, such as aligning the front bumper to another landmark (such as the bus stop sign) that won't be covered by snow in the winter.

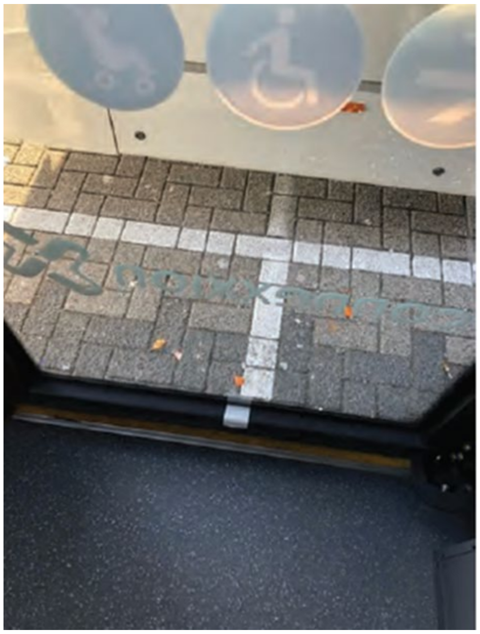

Figure 64. Example of alignment markers inside/outside the bus to help operators with positioning

Source: [Guidebook for Deploying Zero-Emission Transit Buses | Blurbs New | Blurbs | Publications (trb.org)]

B.3.5.1.4 Property Ownership

En-route charging is typically installed at terminus locations where vehicles layover between runs and already have time in the schedule to charge. Because transit agencies often locate stops on-street or on properties that are owned by third parties, it can be difficult to find space to install charging infrastructure at those locations. Selecting locations where the agency already owns property or engaging with those property owners to understand if agreements can be reached to locate infrastructure at those sites will be a key step prior to deploying en-route chargers.

While Water Street Terminal is property that is owned by the City of Thunder Bay, the City should begin to engage with property owners at the other potential en-route charging locations to determine how and if charging infrastructure could be located at those locations. While the locations identified as part of the **Appendix A: Energy Modelling Report** are preferred since it is where service currently operates, if agreements cannot be reached alternative sites with routes and/or schedules could also be evaluated.

B.4 RECOMMENDED IMPLEMENTATION PLAN

A phased approach is planned for converting the fleet, considering the end-state of the transition is important for sizing the electrical feed to ensure there is capacity for future phases.

The facilities implementation plan is phased such that as the transit fleet expands, additional charging infrastructure can be added to the facility without the need to upgrade primary equipment.

Net zero conversion of other parts of the facility may also have increased electrical demands in the future. If building heating and ventilation systems are converted to lower emission technologies like heat pumps, they may require additional electrical capacity to operate that equipment. Loading for these types of upgrades are excluded from the analysis as the scope and anticipated demands of those systems is not yet known.

B.4.1 FORT WILLIAM TRANSIT GARAGE

Conceptual site layouts for the Fort William Transit Garage and the Waterfront Transit Hub were developed based on charging requirements from the **Appendix A: Energy Modelling Report** and discussions with the City of Thunder Bay. Some of the requirements (for example total number of chargers) increased due to conditions at the site and utility feasibility observed through a site visit and conversations with the utility. The charging infrastructure was broken down into phases so that infrastructure could be purchased as the transit fleet is converted to electric vehicles. The charging infrastructure for each phase is presented below in **Table 23**.

At full build out the fixed route fleet will be supported by 21 DC fast chargers rated at 150 kW with two to three dispensers each (62 dispensers total) and the paratransit fleet will be supported by 25 DC wall-box style chargers rated at 22.5 kW with one plug-in connector for each wall-box. Although not shown on the concept plan, electrical capacity for an additional 14 additional DC chargers rated at 22.5 kW were included as they may need to be located on the site if the paratransit fleet size increases. **Table 23** shows at a high level the phasing and types of charging infrastructure that are planned for the facility.

Table 21. Required Infrastructure for Fleet Transition

Phase	Transit – 150 kW BEB Dispensers Installed	Paratransit – 22.5 kW BEB Dispensers Installed
Phase 1	10	4
Phase 2 (Building Expansion)	15	21
Phase 3	13	0
Phase 4	9	0
Phase 5 (Fleet Expansion)	15	0
Total	**62**	**25**

Figure 65 shows which portions of the garage would receive charging equipment in which

phases. A more detailed plan along with single line diagrams for infrastructure is included in **Appendix B1: Facility Concept Drawings**.

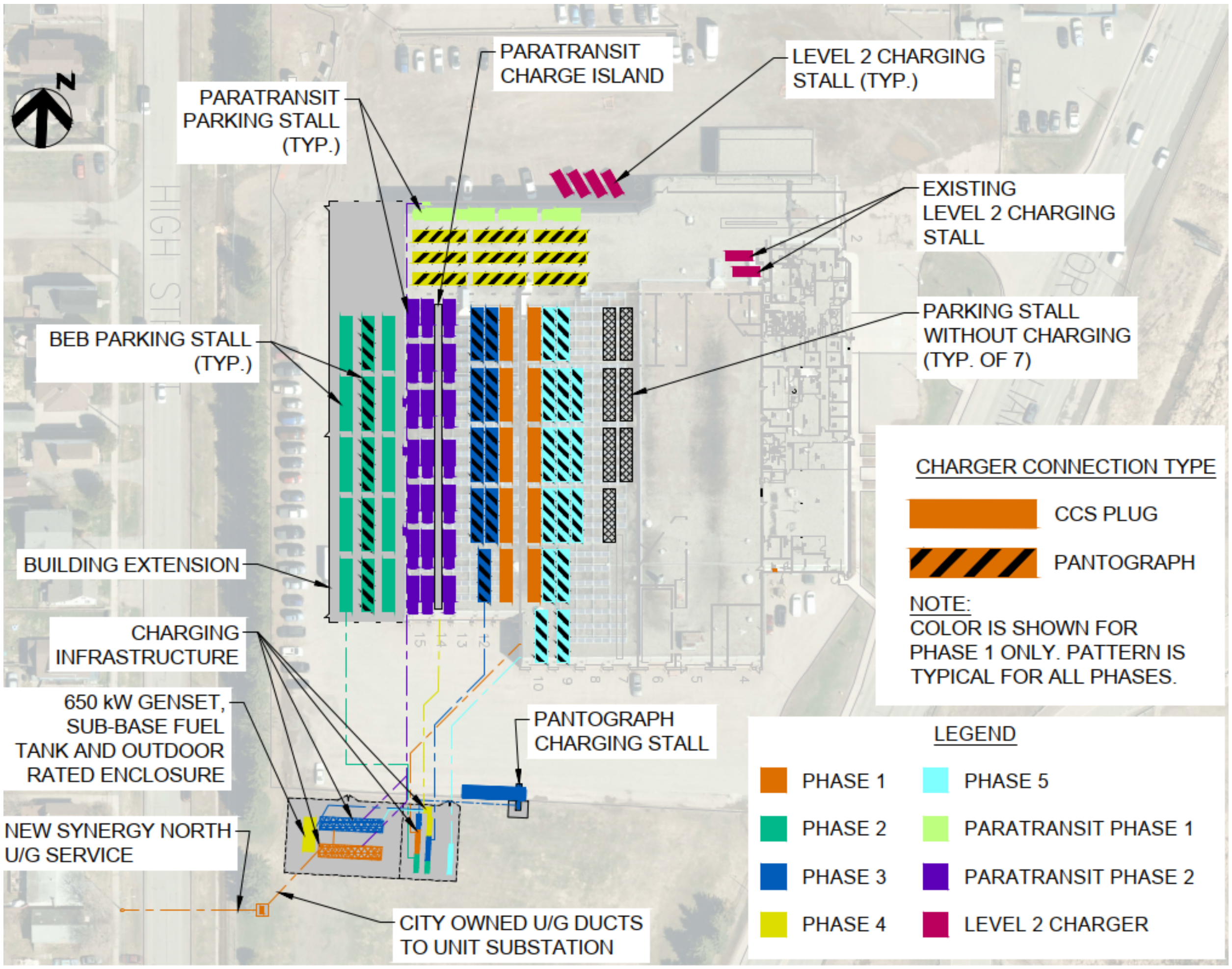

Figure 65. Fort William Transit Garage Conceptual Site Layout

B.4.1.1 Outside The Facility

Most of the larger charging infrastructure is proposed to be built on a new concrete pad in the field south of the garage, enclosed by a chain-link fence. There will be separate gates to enter the areas containing the unit substations and charging equipment respectively for employee safety. Recent discussions with Synergy North have indicated that they would prefer to use multiple 1 MVA transformers in place of the two large unit substations shown in the concept plan. This is to align the specified equipment with the types of equipment that Synergy North already provides to other customers that may have shorter lead times and potentially allow more granular increments when increasing the charging. The change is not captured in the current concept plan but could be incorporated into a future detailed design.

Underground ducts will need to be run between the garage and chargers. It is recommended that all routing of the ducts between buildings is completed during Phase 1. The ducts for Phases 1 through 5 of the fixed route can be run in a common trench and the ducts for the paratransit fleet can run separately due to their location.

The chargers installed in Phase 2 will be inside a new building expansion on the west side of the building. This expansion will eliminate some parking spots currently used by staff and light duty transit vehicles but will still allow for buses to drive along the west side of the site.

Capped spares for the unused ducts can be left to limit the construction costs and limit the impacts of installing future phases of charging infrastructure at the facility.

A 650 kW standby diesel genset will be installed in Phase 4 to provide power to only the three 150 kW chargers installed in that Phase. The genset will be within an outdoor rated enclosure and sub-base fuel tank capable of providing 24 hour runtime at 100% load and will be able to be refueled while operating to provide continuous runtime. The genset will have an automatic transfer that will detect a utility outage and start the genset. The automatic transfer switch will also transfer the load back to the utility power once the power is restored at the site and turn the genset off.

A single 450kW pantograph charger is recommended to be installed attached to a mast arm near the south exit. The purpose would be for Thunder Bay to be able to test en-route charging and the associated risks before deploying a larger number of chargers at sites throughout the city and to allow for rapid charging as a contingency if a vehicle is not fully charged in time for service. This charger could also be used for behind the wheel operator training to familiarize staff with charging procedures and vehicle alignment.

The pantograph is powered by the second unit substation installed as a part of Phase 3 that will have capacity for the fast charger up until the Phase 5 chargers are added to that substation. The fast charger was not factored into the final peak loading of the transformer as its intent was to only be used intermittently.

This is a highly unlikely scenario that would require all other connected chargers connected to unit substation 1 to be active and operate at 100% rated capacity including the Phase 5 chargers, all paratransit chargers, and level 2 chargers. For this to occur it would require an event like an extended power outage where the BEB's are not charged overnight and have a low state of charge (SOC). Vehicles with a low SOC have higher power demands, when vehicles get above approximately 80% SOC their power demand ramps down based on the vehicle's charge curve.

A Charge Management System would be needed to manage loads and avoid the risk of tripping the main breaker but has significant ongoing operational costs (estimated at $70,000 per year based on recent unit pricing from vendors). For more information on charge management software, see **Section B.6.1.1**. The recommendation is for a charge management system to be considered in Phase 4 when nearing the capacity of the electrical system and data can be obtained on the real-world demand that the sub-stations is known. The charge management system would be required to be in place for Phase 5 charging infrastructure to ensure the substation is not overloaded.

B.4.1.2 Inside The Facility

All phases use a 3:1 dispenser to charger ratio, meaning three dispensers will be fed from a single charger 150 kW charger and will charge sequentially based on the order the buses are connected. Pantograph chargers will be selected for buses that are not adjacent to an interior wall, but retractable cable reels are also a viable option. For the BEB stalls adjacent to walls, wall mounted dispensers will be used with overhead cable management to limit the cable tripping hazard and likelihood that the cables will be damaged by buses.

Depot Infrastructure Phase 1 (2025-2029): Phase 1 will consist of purchasing 525 kWh buses that will be able to replace existing fleet that operate on some of the shorter blocks that are compatible. Vehicle charging will be supported by wall mounted plug-in chargers at the depot powered by a new unit-substation and electrical service.

Phase 1 includes the starting of construction of a building expansion at the Fort William Transit Garage allowing for the storage and charging of 15 additional vehicles by 2030. In the near term, the facility expansion will allow Thunder Bay Transit space to relocate vehicles during upgrades to portions of the facility as well as supporting longer term fleet growth once the transition is complete.

Near the end of Phase 1, the City of Thunder Bay should re-evaluate the overall fleet transition plan based on learnings from having operated BEBs in the fleet and real-life performance data from chargers and vehicles. There may be other less tangible operational factors that will be better understood after operating BEBs in the fleet and may influence which direction is the best option for Thunder Bay.

The transition plan update should be based on the real world data, stakeholder input and technological developments to determine what mix of en-route and depot-only charging will be the best option for the remainder of the fleet. Below are factors that are expected to change during this re-evaluation for both en-route and depot-only charging strategies:

- If en-route charging is a viable option and still the best solution, an analysis should be done to validate the number and type of en-route chargers needed for that operating scenario with current vehicle and charger capabilities. It's expected that vehicle and charger technology developments will reduce the number of chargers required.
- If the obstacles and risks associated with en-route charging are too great, an analysis should be done to determine how many additional buses will be needed to facilitate bus swapping. With technology expected to improve over the coming years it's expected

that the number of vehicles needed will be reduced based on improvements in battery electric vehicle technology.

A detailed structural analysis of the roof of the building was outside the scope of this project but should be completed during Phase 1 to determine if the building structure can handle the additional load of the charging equipment such as dispenser reels or pantographs and cable tray for the new wiring for future phases 3-5.

Depot Infrastructure Phase 2 (2030-2032): BEBs that enter service during Phase 2 will have higher capacity 600+ kWh batteries that will be compatible with additional blocks that the 525 kWh buses could not complete on a single charger. Bus charging will be supported by additional plug-in and pantograph chargers in the newly complete building expansion.

During Phase 2, Thunder Bay Transit will operate with depot only charging and determine if they will adopt en-route charging by 2030 or if they will continue depot-charging only as a long-term strategy. If Thunder Bay Transit adopts en-route charging as a supplement to depot-charging, construction of en-route charging needs to be completed before 2033 to allow for en-route chargers to be ready for use in Phase 3. However, if the decision is to move forward with a depot charging only scenario, Thunder Bay Transit will modify schedules and confirm BEB purchase plans to align with the preferred charging strategy.

Depot Infrastructure Phase 3 (2033-2039): If an en-route charging strategy is adopted, Thunder Bay Transit will begin operations using a combination of depot and en-route charging using the en-route charging infrastructure installed in Phase 2. This strategy will require the purchase of one additional bus to allow for bus-swapping to cover routes that are not covered by the network of en-route chargers. The remaining BEBs purchased during Phase 3 will be one-to-one replacements with 525 kWh buses (slightly lower capacity than Phase 2 to take advantage of en-route charging capability). Vehicle charging will be supported by additional new chargers installed at the depot that are powered by one of the two existing unit-substations. Phase 3 will include installation of a backup-up generator for a portion of those new chargers to allow for vehicle charging during a sustained power outage.

Depot Infrastructure Phase 4 (2040+): By 2040, there will be sufficient charging infrastructure installed at the Fort William Transit Garage to support the existing fleet and the last diesel buses can be replaced with BEBs.

Initially, the focus will be installing charging infrastructure at the Fort William Road Transit Garage to allow Thunder Bay Transit to operate BEBs charged overnight and midday. With the high demand for BEBs and charging infrastructure, coordination required with local electrical utilities, it can often take two years or longer from the start of planning a deployment to infrastructure installation and vehicle delivery. The deployment plan assumes that the first two BEBs would be ordered in 2025 and arrive in 2027. The plan assumes that required infrastructure planning would begin at least two years prior to the arrival of the BEBs in 2027.

Depot Infrastructure Phase 5 (Future service expansion): The infrastructure plans and include capacity to accommodate the parking and charging needs of a service expansion of 15 buses. To accommodate a service expansion of 15 buses, Thunder Bay Transit will need to install charging infrastructure in the remaining indoor parking area of the garage using power from one of the two existing substations. The expanded parking and charging area do not account for other areas of the facility that may require additional expansion such as maintenance bays, parts storage or operations space for additional operators and support staff. These aspects of the facility would still need to be assessed to determine what would be required for those other functional areas of the facility.

B.4.1.3 Lift+ Paratransit Layout

Paratransit Phase 1 installation will include wall mounted chargers along the northwest corner of the building. Paratransit Phase 1 will require that the unit sub-station for Transit Phase 1 also be installed as they share the same power feed and transformer.

Paratransit Phase 2 will require a raised concrete island to be built inside the building for paratransit buses parked in lanes 14 and 15. Chargers will be pedestal mounted to the island as there is no current ceiling mounted option for 22.5 kW chargers at this time.

In the conceptual design package, the chargers for the paratransit fleet are shown to be added as part of Phases 1 and 2. However, depending on the needs of the transit agency at the time of the installation, the power capacity reserved for these chargers could instead be used on 150 kW chargers for BEBs. For example, the current paratransit chargers shown to be powered by the Phase 1 unit substation could be installed as part of the unit substation for Phase 2 to allow for more BEBs to be added to Phase 1. This allows for the transit agency to best adapt their infrastructure to their needs as the project progresses.

A new 150 kVA transformer will be floor mounted in the solar inverter room to power the Level 2 chargers to be used to charge the non-revenue fleet vehicles owned by the transit agency.

B.4.1.4 Fort William Road Transit Garage Capital Cost Considerations

Table 24 shows a breakdown of costs per phase for the charging infrastructure required for the 40' conventional fleet and includes all material and commissioning costs for the transit infrastructure. Phase 1 and 2 of the Paratransit plans are identified and relate to the conceptual site layout. The estimate is approximately a Class 5 estimate, engineering costs are assumed to be 10% of construction and a 20% contingency is included for each line item to allow for the risk of some of those costs materializing during detailed design. Costs are rounded up to the nearest $10,000.

This estimate excludes the costs for equipment for the additional 16 paratransit buses that are not shown on the drawing and marked as future charging infrastructure.

Table 22. Fleet Charging Infrastructure Cost Breakdown (2023$)

Phase	Description	Lump Sum Cost ($)
Utility Connection	- New power feed to site for charging infrastructure, includes metering and associated costs to bring connection to metering unit	$160,000
Transit Phase 1	- Unit Sub-station #1 - Automatic Transfer switch - (4x) 150 kW Chargers w/ Cabling - (10x) 150 kW Pedestal Dispensers - Underground ducting for Transit Phases 1-5 - Concrete pad and fence for charging infrastructure	$4,440,000
Transit Phase 2 Building Addition	- New building addition, includes costs for building services (lighting, HVAC, etc.) - Roughly 88.2 m x 15.3 m (1350 m^2) - Solar panels installed on the roof of building addition	$10,670,000
Transit Phase 2	- (5x) 150 kW Chargers w/ Cabling - (10x) 150 kW Wall Dispensers - (5x) 150 kW Indoor Pantograph Dispensers	$1,780,000
Transit Phase 3	- Unit Sub-station #2 - Automatic Transfer switch - (4x) 150 kW Chargers w/ Cabling - (13x) 150 kW Indoor Pantograph Dispensers - (1x) 450 kW Charger w/ Pantograph Dispenser and Cabling	$4,630,000
Transit Phase 4	- (3x) 150kW Chargers w/ Cabling - (9x) 150 kW Indoor Pantograph Dispensers - Charge Management System Purchase	$1,240,000
Standby Genset	- (1x) 650 kW Standby Diesel Genset w/ cabling - (1x) Automatic Transfer Switch - (1x) Outdoor rated Panelboard	$640,000
Transit Phase 5	- (5x) 150 kW Chargers w/ Cabling - (15x) 150 kW Indoor Pantograph Dispensers	$2,040,000
Paratransit Phase 1	- (4x) 22.5kW Charger w/ Wall Mounted Dispensers - Distribution Panelboard #1	$290,000

	- Underground Ducting and Cabling	
Paratransit Phase 2	- Distribution Panelboard #2, #3, #4 - (7x) 22.5kW Charger w/ Wall Mounted Dispensers - (14x) 22.5kW Charger w/ Pedestal Mounted Dispensers - Concrete Island for Chargers - Underground Ducting and Cabling	$1,830,000
	Grand Total	**$27,720,000**

While the fleet portion of the non-revenue transit vehicles are not part of the scope of this report, **Table 25** identifies the costs for the Level 2 chargers installed to support the non-revenue light-duty support vehicles located at the Fort William Road Transit Garage. For these chargers to be installed, Phase 1 of the transit infrastructure must first be installed as the unit substation provides power to these chargers. The 20% contingency is included to allow for the risk of some of those costs materializing during detailed design. The costs in the following table are rounded up to the nearest $10,000. A separate study is being completed that evaluates the non-revenue transit fleet vehicles as well as the other municipal fleet for the City of Thunder Bay.

Table 23. Municipal Level 2 Fleet Charging infrastructure Cost Breakdown

Phase		Lump Sum Cost ($)
Municipal 1 (Non-revenue fleet)	- 150 kVA transformer - (4x) 7.2 kW level 2 Chargers w/ Cabling - Underground ducting - Conduit runs through building	$230,000
	Grand Total	**$230,000**

B.4.2 WATERFRONT TRANSIT HUB – EN-ROUTE CHARGING

Based on the recommendations in the **Appendix A: Energy Modelling Report**, up to 4 charging stations will be required at the site and are shown in the charging infrastructure concept plan below. Detailed conceptual site layout drawings can be found in **Appendix B1**.

The concept plan (**Figure 66**) shows how the en-route charging equipment could be installed in 4 phases if needed. Phase 1 includes the installation of a unit substation capable of powering all subsequent Phases, a single pantograph dispenser and associated charging equipment. It's recommended that the conduit routing for all 4 Phases is completed in Phase 1 to limit the number of impacts to service at the terminal and reduce construction costs. The spare conduits can be stubbed-up into a traffic rated valve box flush on the island until they are needed in future phases. Phases 2 through 4 can be installed as required with minimal downtime to the terminal with only the charging equipment and associated concrete pad, pantograph dispenser and cabling as major procurement items for each Phase.

Due to the current configuration of the exchange with each bay providing drop-off/layover/pick-up, Thunder Bay Transit may wish to consider additional dispensers to avoid having to move buses through a limited number of charging bays. Although the design only allows for four dispensers to be active at once, multiple dispensers can be connected to the same charging cabinet. The dispenser arrangement at the terminal will need to be refined during the detailed design phase and after a charging infrastructure vendor is selected.

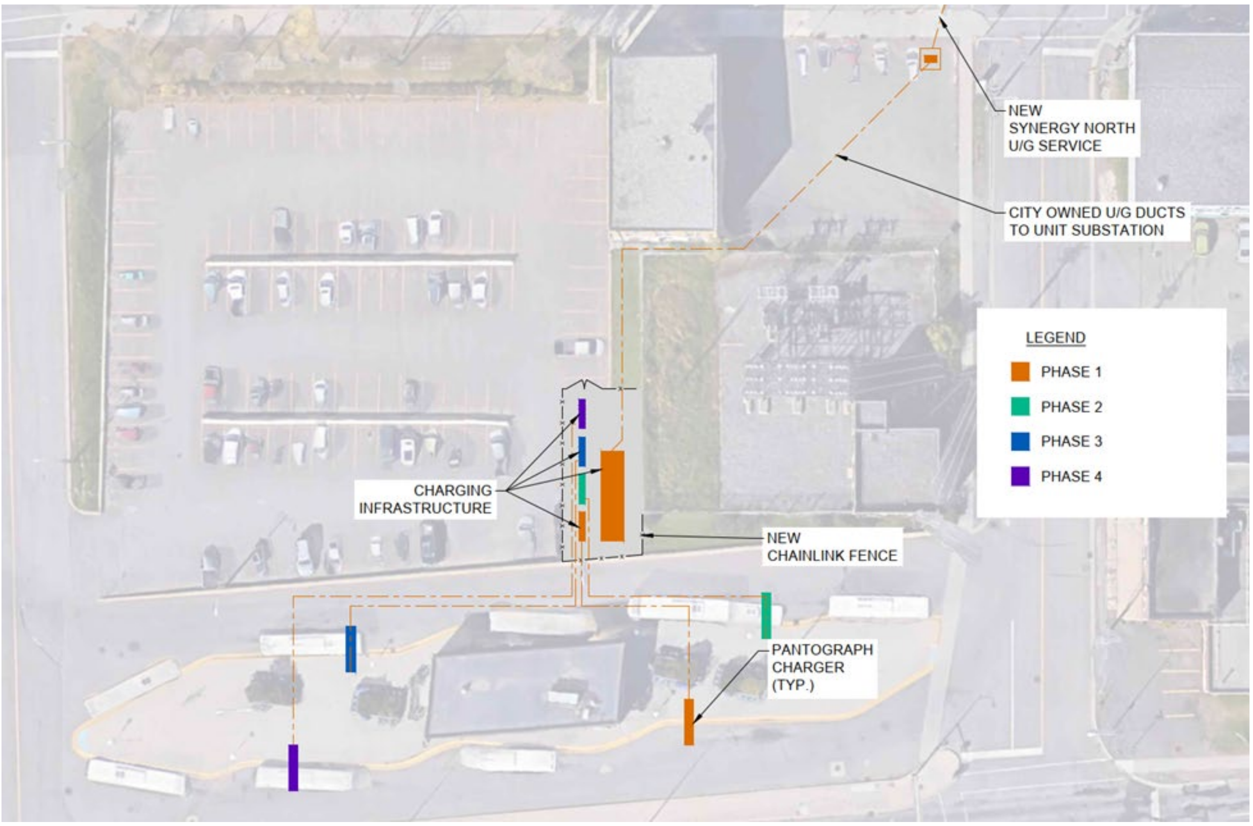

Figure 66. Conceptual Site Layout – Waterfront Transit Hub

B.4.2.1 Waterfront Transit Hub Capital Cost Considerations

Table 26 shows a breakdown of costs per phase for the charging infrastructure required for full build out at Water Street Terminal and includes all material and commissioning costs for the transit infrastructure. This estimate excludes the costs from Synergy North to bring the new power feed for the charging infrastructure. The 20% contingency is included to allow for the risk of some of those costs materializing during detailed design. Costs are rounded up to the nearest $10,000.

Table 24. Waterfront Transit Hub 40' Transit Fleet Charging Infrastructure Cost Breakdown (2023$)

Phase	Description	Lump Sum Cost ($)
Utility Connection	- New power feed to site for charging infrastructure, includes metering and associated costs to bring connection to metering unit	$300,000
Water Street 1	- Unit Substation - 3x150kW Chargers w/ Pantograph and cabling - Underground ducting for Phases 1-4 - Concrete pad and fence for charging infrastructure	$3,580,000
Water Street 2	- (1x) 450kW Chargers w/ Pantograph and cabling	$880,000
Water Street 3	- (1x) 450kW Chargers w/ Pantograph and cabling	$900,000
Water Street 4	- (1x) 450kW Chargers w/ Pantograph and cabling	$950,000
	Grand Total	**$6,610,000**

The other locations identified as requiring charging other than Waterfront Transit Hub are assumed to cost the average unit cost of the Waterfront Transit hub which is $1.66M per charger in 2023$ including engineering and contingency.

B.5 UTILITY COORDINATION

Synergy North is an electricity distribution company serving Thunder Bay, Ontario, and its surrounding region. It is owned by the City of Thunder Bay through its subsidiary, Thunder Bay Hydro Corporation. Synergy North distributes electricity to approximately 50,000 residential and 6,000 commercial customers located in Thunder Bay and Kenora including Thunder Bay Transit's facilities.

B.5.1 PRIMARY AND SECONDARY METERING

Typically, utilities provide service connections to clients either as primary or secondary metered services. Synergy North provides a maximum service size of 1,000 kVA for secondary metered connections; larger services require primary metered connections.

For a primary metered service connection, the utility brings power to the client at a higher distribution voltage. The client is responsible for designing, constructing, owning, operating, and maintaining a substation to step this voltage down and distribute it throughout the facility. Metering equipment for the client is done at the distribution voltage which is more costly than the equipment required for secondary metering but typically comes with a per kwh discount. The client may also choose a primary service even if their power requirement can be provided as a secondary service if the client needs a different voltage than what the utility can supply as a secondary service voltage.

Secondary metering service connections have a stepdown transformer owned and maintained by the utility that reduces the voltage from the primary distribution voltage to a standardized lower voltage, either 600 V three phase, 208 V three phase, or 120-240 V single phase. With a secondary metering service, a utility meter is then installed downstream of the transformer. Secondary services are preferred because they are less expensive and maintained by the utility but are limited to a maximum service size that is determined by each utility.

Utilities have different billing rates and structures for primary and secondary services.

B.5.2 REDUNDANT FEEDS

For critical infrastructure, redundant power feeds to a site increase the reliability of the utility service. This is commonly achieved by bringing a separate circuit to the site that is fed by the same substation off a different circuit and power line, or by a separate substation and powerline.

If the redundant feed comes from the same substation and a different circuit this only protects the site from an outage on one of the powerlines, such as a tree falling on the powerline or a pole breaking. In the event of an outage at the substation, both feeds would also experience an outage. For this application, a redundant feed from the same substation is only practical if an alternate circuit is already nearby the site, otherwise a new powerline would need to be brought to the site from the nearest location, which is expensive. A separate circuit could also be added from the existing powerline feeding the site. However, this is not very practical as it would only provide a redundancy for the run of cables leaving the powerline going to the site and does not provide much benefit since typically any outages along one of the powerlines would cause both circuits to trip.

A redundant feed from a separate substation provides the most robust utility feed for the site. However, this is also the most expensive option as substations are rarely geographically close to each other, requiring new powerlines to be installed which is extremely costly.

Except for very specific scenarios when there are already nearby substations or secondary circuits to the site, redundant feeds are not recommended as there are more cost-effective alternative power sources that can be utilized such as diesel generation or battery energy storage systems that also provide a better redundancy since they are entirely separate from the power grid. For a specific site, the nearby circuits and substation feeding them is usually only known by the utility and typically not shared with clients as it is rarely of concern.

In the utility discussion meeting, Synergy North noted that the substation currently feeding the Fort William Transit Garage is the only practical power source for the transit garage. A second circuit could be brought to the garage from a different substation, but it would likely be routed on the same poles as the existing feed which wouldn't provide much more redundancy for the required cost. If the City determines a secondary power source is required, diesel generation or battery energy storage should be considered instead, refer to **Section B.6.4** for more information about energy resiliency options.

B.5.3 ELECTRICAL INFRASTRUCTURE OWNERSHIP

Some municipalities in other regions have looked to partner with their local utilities to install and maintain electrical infrastructure and charging equipment. Business models such as Charging as a Service (CaaS) and Energy as a Service (EaaS) are two examples where a third-party service provider offers energy-related assets and services to customers.

CaaS focuses specifically on providing EV charging infrastructure, whereas EaaS encompasses a wider range of energy-related assets and services, including energy storage, renewable energy sources, and energy management systems. Working with local utilities there may be an opportunity to leverage their expertise to allow the transit agency to focus on its core business which is operating transit service. Utilities have expertise in electrical infrastructure maintenance, energy management, energy market trends, renewable energy and regulatory compliance that can ensure that charging infrastructure is installed and scaled to meet the demands of the transit agency, and that energy usage is optimized to minimize costs.

Reliability and backup power are also critical components that can be included in energy as a service (EaaS) agreements and are often factored into the service level agreements (SLAs) between the EaaS provider and the customer.

In our utility discussion with Synergy North, they indicated that the un-regulated part of their organization currently doesn't offer this type of service, but they would be open to discussing arrangements where they could own/operate infrastructure.

Recent discussions with Synergy North have indicated that if they were to manage the transformer infrastructure that they would prefer to design the system to utilize multiple 1.0 MVA 25 kV - 600V secondary service transformers in parallel instead of larger unit substations. The benefits of the multiple transformers are that the size of transformer is the standard size that Synergy North currently uses in their distribution system. In the event of a failure, they would have equipment in inventory that would allow them to respond more quickly. This would also allow for a more granular step up in power as the transition occurs, and demand increases. However, the transit agency would still need to purchase and stock their own 1 MVA 600V – 480V transformers to step down the voltage for the DC fast chargers as Synergy North is does not stock 480 V transformers. Alternatively, the transit agency could purchase and maintain their own 1 MVA 25 kV – 480 V transformers with a primary service connection from Synergy North. Further discussion between Synergy North and the transit agency should occur during the detailed design phase once an equipment vendor has been selected.

B.5.4 UTILITY RATE CONSIDERATIONS

Electrical costs are determined based on the utility's (Synergy North) approved rate tariff, regulated and approved by the Ontario Energy Board (OEB). In Ontario's energy system, customers are classified into two categories: Class A and Class B.

A Class A customer in Ontario's energy system refers to a larger business or industrial customer that has an average peak demand of more than 5 megawatt (MW) in any of the previous twelve months. These customers have the option to participate in the Industrial Conservation Initiative (ICI) program, which allows them to reduce their Global Adjustment (GA) charges by reducing their electricity consumption during periods of peak demand.

A Class B customer refers to a residential or smaller business customer that has an average peak demand of less than 5 MW in any of the previous twelve months. These customers are charged a regulated price for the electricity they consume, which is set by the OEB and is based on the Hourly Ontario Energy Price. Class B customers also pay a GA charge calculated on an hourly basis and is included in the overall electricity price that Class B customers pay.

Customers in Ontario also have the option of purchasing electricity from third party energy retailers approved by the OEB. When purchasing electricity through energy retailers, customers are still responsible for other aspects of electricity like delivery, regulatory and global adjustment charges.

Given its current fleet size and expected electrical demand, it's expected that Thunder Bay Transit will remain a Class B customer. There are three basic components that make up energy costs in each monthly billing cycle:

- **Monthly Service Charges** – These are base charges, assessed monthly that are included for every meter location.
- **Energy Consumption Charges** – These are charges that are based on the quantity of electrical energy consumed over a monthly period. These charges are based on the kWh that are used and the rate may include taxes, delivery, transmission, and global adjustment fees.
- **Demand Charges** – These are charges that are based on the highest electrical demand observed over the billing period. Demand is measured in kilowatts (kW) and is based on the highest kW level drawn in each month. This can be thought of as high-water mark type charge where once peak demand is reached once in a month, there are no additional costs for having any demand levels that are at or below that level.

B.5.5 APPLICABLE UTILITY CHARGES

Synergy North has different utility tariffs that change the cost of electricity depending on monthly average peak demand. In the first Phase of the project, the projected fleet charging loads are expected to be in the General Service Business Class greater than 50 kW to 999 kW.

Later phases will exceed this class and require a change to the General Service 1,000 kW or Greater Classification. The applicable rates and tariffs for Synergy North are available on their website.[10]

The three types of charges that are applicable to the Fort William Road site are:

- **Cost of electricity (Consumption)** - charged as the Hourly Ontario Energy Price (HOEP).
- **Global adjustment (Consumption)** - based on kWh usage and is a separate line item charged on 50kW and greater accounts.
- **Delivery/Noncompetitive Charges and Regulatory Charges (Demand & Service Charge)** - based on monthly demand kW that is set during the highest 15 minute avg usage of each month. This also includes a monthly service charge.

There is currently no time of use (TOU) rate that is applicable to the types of services that City of Thunder Bay requires for the fleet transition.

B.5.6 CHANGING UTILITY RATE STRUCTURES

Increasing electrical demand (in part due to the transition of fleets and building systems to clean electricity) is changing how some utilities structure their rates. Below are examples of ways utilities in North America have structured their rates to facilitate increasing demand. This is mainly to highlight how rates may change in the future.

B.5.6.1 Seasonal Considerations

Some utilities, including Synergy North (for residential and small-business customers) charge different rates during the summer and the winter. Some utilities vary both the demand and energy charges. In Ontario, commercial customers pay the Hourly Ontario Energy Price (HOEP) + Global Adjustment (GA) and seasonal considerations are already included in the fluctuating rates that are paid.

The Hourly Ontario Energy Price (HOEP) represents the wholesale price of electricity in Ontario. It is determined in real-time by the Independent Electricity System Operator (IESO). All electricity consumers in Ontario pay this wholesale price, except for those who have entered a retail contract. The IESO calculates the HOEP based on market clearing prices (MCP) set every five minutes. The average of the twelve MCPs within each hour determines the hourly price, weighted by the amount of electricity used throughout the province during that hour. There price paid for electricity over the years fluctuates, influenced by supply and demand dynamics.

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[10] https://synergynorth.ca/wp-content/uploads/2023/05/dec_rate-order_Synergy-North_20230323_eSigned.pdf

B.5.6.2 Time of Use (TOU)

Some utilities vary rates during different times of the day, often in a three-tiered structure. Utilities can often charge a peak rate, during the middle of the day when energy consumption is highest to decrease this peak usage. Shoulder periods, often one to two hours before and/or after the peak periods are billed at a slightly lower rate, while off-peak consumption is rewarded with the lowest rate. Off-peak periods are generally overnight and coincide nicely with depot charging of buses after they return from service. TOU will negatively impact the cost of en-route charging since it is typically done during the daytime peak hours.

Synergy North doesn't currently offer time of use rates for the service size and instead requires that consumers pay the HOEP+GA as a Class B customer or purchase electricity through a third party. If it were offered to Thunder Bay Transit, a time of use rate structure would provide an opportunity for the transit agency to plan its electrical usage to take advantage of overnight off-peak rates to handle most of the charging.

B.5.6.3 Electric Vehicle (EV) Charging Rates

Some utilities have elected to incentivize EV adoption by reducing demand charges to decrease the overall operational cost of ownership. Some of these EV rates are temporary, though the utility may elect to keep these indefinitely. Synergy North does not currently offer an EV rate applicable for the scale required.

In the upcoming months, the OEB will be unveiling an "ultra-low" overnight rate for residential and small business customers. This rate is currently not applicable for the transit fleet.

B.5.7 SEPARATE METERS/FEEDS FOR EV CHARGING

Many utilities have been employing a separate service and meter for electric vehicle charging. This meter is separate from the rest of the facilities at the site and means that it only measures the demand and consumption of EV charging. The current conceptual designs presented for Thunder Bay Transit employ separate meters and utility feeds for the EV charging equipment.

Separate meters allow for the utility to isolate the demand and consumption of vehicle charging compared to other loads at the site which can allow them to apply discounted EV electricity rates. Separate meters or sub-meters are typically recommended for EV charging infrastructure even if the utility does not currently offer an EV rate. Utility tariffs are constantly changing and if an EV charging rate becomes available in the future, additional metering will not be required.

Another reason this is preferable is that different departments within the transit agency are responsible for different expenses, such as bus operations for charging versus administration for building electrical and outside lighting. Separate meters or sub-meters will allow the agency to understand how much of their energy costs are going to move the fleet compared to normal building loads.

B.5.8 SOLAR ENERGY GENERATION RATES

Many utilities have elected to incentivize adoption of solar photovoltaic (PV) systems by adopting special rates for purchasing solar energy. This is only applicable for PV systems installed in a net metered arrangement, where the solar PV system directly offsets electricity usage from the utility, and utility buys any excess energy generated by the PV system. This only occurs at times when the PV system generates more power than the site is demanding.

Currently, Synergy North does not purchase surplus energy generated in a net metering agreement. However, they do permit the accumulation of credits for up to 12 months if a site generates more electricity than it consumes in a month. Synergy North purchases these credits back using the same rate structure that the energy is bought during the billing cycle.

B.5.9 FORT WILLIAM ROAD TRANSIT GARAGE UTILITY REQUIREMENTS

Concept plans for the charging infrastructure were shared with Synergy North to evaluate the logistics of delivering power to the site. The following explains the recommended utility connections that were identified based on those discussions.

An overhead 25 kV distribution powerline is located to the west of the garage on High Street South and provides power to the garage through a 225 kVA transformer. Synergy North recommends that power for the charging infrastructure comes from an independent underground service from the same distribution powerline on High Street South as a primary metered connection. Synergy North will supply and install ducts from the pole to the property line and the cables from the pole to the primary metering unit located within 10m of the property line. The city will need to supply and install ducts from the property line to the primary metering unit, the concrete pad for the metering unit, and cables from the metering unit to the unit substation.

Power delivered to the charging infrastructure would be fed from two 2,670 kVA unit substations, installed in Phases 1 and 2 respectively. Each unit substation will have an automatic transfer switch that will allow for the possibility of an alternative power source to be brought to unit substations.

The transformer installed in the Phase 1 unit substation will be sized to power nine 150 kW DC fast chargers, (14) 22.5 kW DC chargers, and a 150 kVA transformer simultaneously. The transformer installed in the Phase 2 unit substation will be sized to power chargers for both Phases 2 and 3 including seven 150 kW DC fast chargers, and (25) 22.5 kW DC fast chargers simultaneously. One 450 kW pantograph charger will also be connected to the Phase 2 unit substation, but the design assumes that it will only be used intermittently. Phase 4 assumes that charge management is implemented that will be able to regulate the demand existing charging stations and allow the additional chargers to be installed on the existing two sub-stations. For more information on charge management software, see **Section B.6.1.1.**

Based on the electrical requirements calculated using the Zero+ Model, six chargers are required as a minimum for typical transit fleet to operations. More chargers will be installed to avoid the need to hostel buses overnight and create redundancy. The Zero+ Model was not used to calculate the demand from the 22.5 kW DC fast chargers that are used for the paratransit fleet due to their irregular schedule. For these chargers, the demand was calculated as a worst case scenario, with all chargers being used at once to provide a conservative estimate.

B.5.10 WATERFRONT TRANSIT HUB UTILITY REQUIREMENTS

Based on discussion with Synergy North, the substation currently located on 185 Camelot Street adjacent to the terminal is scheduled to be removed within the next 10 years. Synergy North indicated that a feed for the en-route charging equipment would need to come from an existing 25 kV pole on the northwest corner of Cumberland Street North and Camelot Street. An underground dip service from this pole would need to go to a primary metering unit located within 10m of the property line in the same parking lot. Synergy North would be responsible to supply and install ducts from the pole to the property line and the cables from the pole to the primary metering unit. The City will need to supply and install ducts from the property line to the primary metering unit, the concrete pad for the metering unit, and cables from the metering unit to the unit substation.

If the City of Thunder Bay were to wait until this substation is replaced before installing the en-route charging infrastructure it may decrease the cost of the connection, but not significantly since it would mainly reduce the amount of underground cabling required.

A 2,670 kVA unit substation is required to power the four (4) en-route chargers simultaneously at the terminal for the full buildout. In Phase 1, a single unit substation will be installed to provide power for subsequent phases. The terminal design is split into four phases with each phase adding one additional 450 kW pantograph charger to the site.

Significant coordination with Synergy North about the installation of the Phase 1 infrastructure will be required to allow the utility to review substation and connection design drawings, procure any equipment (such as cable or meters), and to coordinate timing of the connection. Later phases of charger installation should require less coordination as the work will take place “behind the meter” and should not require any physical work to be performed by the utility. While equipment will be rated to handle those future phases, utilities should still be engaged during later phases to allow them to understand when those changes in load patterns might occur.

B.6 OTHER CONSIDERATIONS

B.6.1 FLEET AND CHARGER MANAGEMENT SYSTEMS

B.6.1.1 Charge Management System

It is recommended that during procurement, charging infrastructure that is compatible with charge management systems are chosen that enable the operator to remotely determine the status of a charging session, log error codes, and to reset equipment remotely. Manufacturers typically offer a proprietary system with their equipment that requires an annual subscription and can require internet connection/cellular connection as well as a computer with internet access to dashboards through a web browser.

Manufacturers also use these connections to troubleshoot issues remotely and push software updates that may be required to resolve issues or upgrade functionality. The information availability and capability of charge management systems varies by manufacturer, so it is important to understand the differences of what is being offered and if the specifications meet the City's needs.

Third party software is also an option if chargers are compatible with open standards like Open Charge Point Protocol (OCPP).[11] The benefit of a third party software is that it will be compatible with multiple charging vendors which can make it easier for staff to obtain information on all charging equipment from single dashboard. Third party software can also incorporate aspects of energy management systems discussed below.

B.6.1.2 Energy Management System

With electricity as the new "fuel" for the fleet, energy consumption will significantly increase. Transit agencies will become much more sensitive to changes in electricity rates and tariff structures. Having the capability to manage when vehicles are charged that matches with a given electricity tariff can significantly reduce energy costs. Manufacturers are now offering energy management systems that allow for the capability to manage electrical loads such as EV charging stations and/or incorporate other distributed energy resources at appropriate times to help reduce those costs. Having an energy management system with the ability to control both charging stations and distributed energy systems in a coordinated way to reduce electricity costs is recommended as it will allow flexibility in the future.

Beyond reducing peak demand by regulating charging, energy management systems can also potentially increase the number of chargers able to be installed at a facility without needing to upgrade the service. By limiting how many chargers are on at a given time, they can allow more

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[11] Home - Open Charge Alliance

chargers to be installed at a facility without the risk of exceeding the electrical capacity of the site.

While there are benefits to energy management systems, agencies also need to be aware of the cost of operating the systems and decide if they should be implemented based on a cost benefit analysis. Current energy management software providers often charge for services based on annual per dispenser subscriptions which need to be evaluated to determine if the cost of operating the system will provide savings through avoiding service upgrades or energy costs. It's recommended that the City of Thunder Bay evaluate an energy management system in Phase 4 before deploying the chargers for Phase 5 to determine if it is required and if it would be cost effective to implement.

B.6.1.3 Digital Yard Management Systems

With the added complexity of vehicle charging at the garage, knowing which vehicles are ready for service will become more difficult as the time to charge a bus will depend on how much energy it needs. Implementing a digital yard management system can help staff determine which buses are ready or not ready for service. Tools are now available that allow staff to know the real time location and status of vehicles in the yard. Some solutions can also help by providing parking information for the vehicle depending on the status and state of charge of the vehicle.

For example, a digital sign at the entrance of the facility can inform operators where to park vehicles based on their current state of charge (if they can continue operating or require charging). This tool could also be shared with operations to let them know where vehicles are parked in the yard, and whether a given vehicle is ready for service and/or if a substitution needs to be made.

B.6.2 GENERAL FACILITY CONSIDERATIONS

B.6.2.1 Outdoor Vehicle Storage

With extreme cold winter weather, it is not recommended that BEBs are stored outdoors. BEBs left in extreme cold can become cold soaked if not connected to a charging station which may affect the performance of the vehicle until vehicle components like battery packs reach proper operating temperatures which can take several hours. Outdoor charging dispensers can mitigate cold soaking by keeping the vehicle battery at operating temperature, but indoor parking is the preferred option for extreme cold climates as it eliminates the need for snow clearing, and the chance of frozen connector ports.

B.6.2.2 Limited Flexibility in Fleet Parking

A constraint that will be introduced to the facility by the adoption of battery electric vehicles is that there may be a reduction in the flexibility of where vehicles can park in the facility. Since different fleet types have different body lengths (and not all vehicles can accept pantographs), the spacing of dispensers will be different to maximize the number of vehicles stored in each lane. While all plug-in chargers can be used by any vehicle, the charging dispenser may not line up with the charge port on the vehicle or it may not have an adequate power level to charge the vehicle in a desirable amount of time.

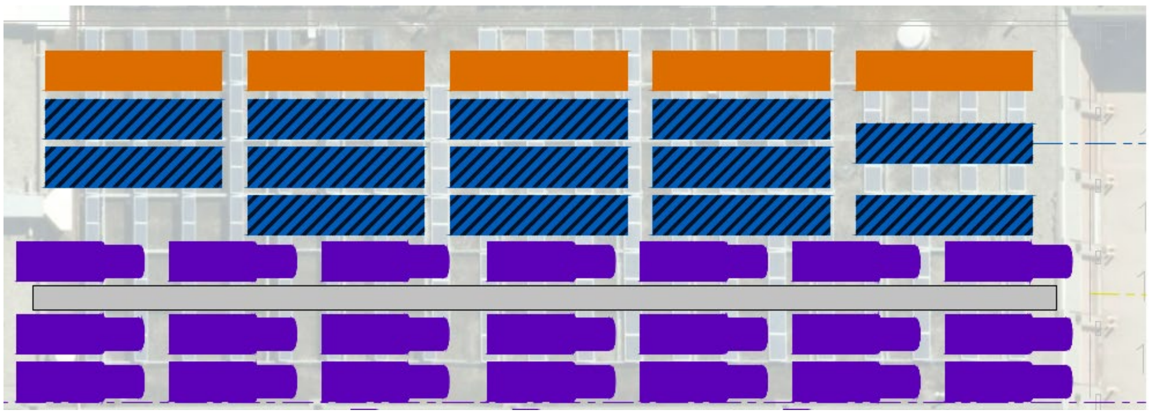

Figure 67. Spacing of 40’ Phase 1 (orange)Phase 2 transit buses (blue) next to Lift+ paratransit vehicles (purple)

For example, in **Figure 26**, the purple vehicles represent the paratransit fleet, and the teal represents the conventional 40’ fleet. The dispensers for the paratransit fleet do not line up with the rear of the 40’ buses and will only be able to provide 22.5 kW of charging power compared to the 150 kW of charging that the 40’ bus chargers may be able to provide.

B.6.2.3 Maintenance Bay Charging

While it is not envisioned that vehicles will necessarily be regularly charged in maintenance bays, there may be times when having some charging capability in the maintenance bays would be helpful. For instance, if there is a charging issue with a given vehicle it may be helpful to have it in a maintenance bay to diagnose that problem.

Portable chargers are available that could be shared between maintenance bays and deployed as needed. They would require appropriate power for the equipment be brought to the maintenance bays which could be connected by an industrial plug/receptacle connection (Mennekes, Meltric, etc.) and moved between maintenance bays as needed.

B.6.2.4 Vehicle Rooftop Access Platform

BEBs have a significant amount of equipment mounted on the roof of the vehicles including electrical converters, battery packs, and charging rails that will require access for servicing. Fall protection systems will need to be in place that enable staff to work safely. It is preferable to have permanent or portable scaffolding to provide access to vehicle rooftops, but personal fall protection equipment (harnesses and retractors) is also appropriate.

Thunder Bay Transit already has a rooftop access platform at the Fort William Road Transit Garage, as shown in **Figure 68**. With the deployment of additional BEBs, there is likely going to be a bigger demand for rooftop access equipment by maintenance staff. Additional portable or permanent scaffolding should be considered as Thunder Bay Transit becomes more familiar with maintaining BEBs.

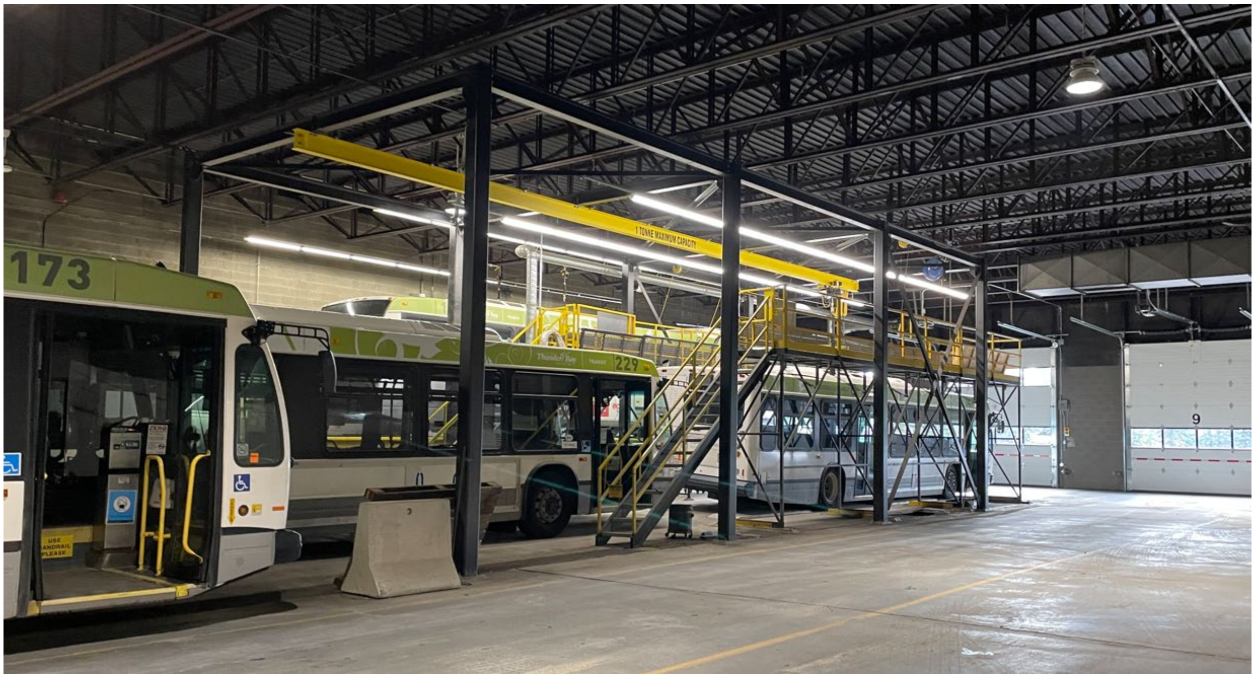

Figure 68. Rooftop Access Platform at the Fort William Road Transit Garage

B.6.2.5 Lifting Devices For Rooftop Equipment

Along with access to the roof of the vehicle, it may also be necessary to lift items like battery packs on or off the roof for service/replacement. Thunder Bay Transit already has a crane in the rooftop access bay, the capacity of which should be checked against the heaviest equipment that the manufacturer expects will need to be moved on or off the roof of the vehicle.

B.6.2.6 Spare Parts Storage

A reserve of spare parts for BEBs and charging infrastructure is recommended. With fewer vehicles on the road compared to internal combustion engine (ICE) vehicles, parts can have longer than normal lead times and having critical spares for both BEB and ICE vehicles will be necessary as the fleet transitions. Delay in retrieving spare parts could result in significant downtime for key equipment and reduce the service capacity of the BEBs. The space requirement for those additional spare parts should be evaluated once information from the supplier has been provided in terms of the recommended quantity and type of critical spares.

B.6.2.7 Floor And Vehicle Hoist Capacity

The empty vehicle weight of a BEB is typically heavier than that of diesel bus due to the significant weight of battery packs in the vehicle and vary by manufacturer and battery pack configuration. The posted curb weights of several diesel, hybrid and BEBs are listed in **Table 27** below to illustrate the magnitude of the weight difference between the different vehicle types.

Table 25. Curb Weight of Different Buses

Propulsion	Manufacturer	Model	Curb Weight
Diesel	Nova	LFS	12,981 kg
Battery Electric	Nova	LFSe+	16,002 kg
Diesel	New Flyer	Xcelsior	12,587 kg
Diesel-Hybrid	New Flyer	Xcelsior Hybrid	13,200 kg
Battery Electric	New Flyer	Xcelsior Charge NG	15,440 kg (480 kWh)*
Battery Electric	Proterra	ZX5 Max	15,131 kg (440 kWh)*
Battery Electric	BYD	K9MD	16,089 kg (496 kWh)*

**Note: Curb weights are from Altoona testing reports. Configuration options such as higher capacity battery packs can significantly impact vehicle weights.*

The structural capacity of the concrete floor inside the garage was confirmed by the City of Thunder Bay to be sufficient for the vehicle weights of BEBs. Asphalt areas outside the garage will also be susceptible to increased loading from heavier vehicles which may result in more rapid deterioration of those surfaces. The City of Thunder Bay should monitor those assets and evaluate if the existing asphalt design is adequate for the types of vehicles that will be operating on those surfaces or if modifications should be made when those surfaces are replaced.

Figure 69 from the Facility Site Visit shows the in-ground hoists at the Fort William Road Transit Garage. To evaluate the vehicle hoist capacity, the actual weight of vehicles purchased should be compared to the hoist capacity at the transit garage to ensure that the current equipment is capable of safely lifting the vehicles. Weight distribution of BEBs can be more disproportionate than diesel buses so it’s important that manufacturers are able to provide not only total curb weight but also the specific weight on a per axle basis.

Figure 69. In-Ground Vehicle Hoists at Fort William Road Transit Garage

B.6.2.8 Overhead Clearance

Table 28 displays the vehicle heights of current diesel and BEBs. While there is variation between vendors, the height of the vehicles is generally like those of their diesel equivalents.

Table 26. Vehicle Heights by Manufacturer and Propulsion Type

Propulsion	Manufacturer	Model	Height
Diesel	Nova	LFS	3.20 m
Battery Electric	Nova	LFSe+	3.30 m
Diesel-Hybrid	New Flyer	Xcelsior Hybrid	3.30 m
Battery Electric	New Flyer	Xcelsior Charge NG	3.38 m
Battery Electric	Proterra	ZX5 Max	3.29 m
Battery Electric	BYD	K9MD	3.40 m

Areas like garage doors and wash bays can often be the lowest clearance points at transit facilities. For Thunder Bay Transit, overhead clearance of the garage doors does not appear to be an issue with existing 4.26 m (14') tall openings, as shown in **Figure 70** from the Fort William Road Transit Garage site visit.

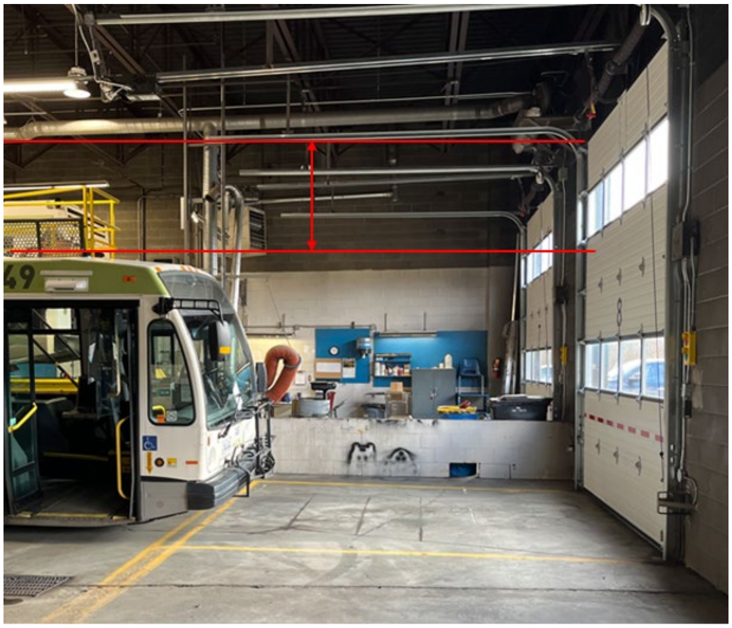

Figure 70. Overhead Clearance at Fort William Road Transit Garage

Though it is not expected to be an issue based on the known vehicle heights for BEBs, the maximum clearance of the wash bay should be checked against the intended vehicle being purchased to ensure that modifications or replacement of the bus wash is not required. **Figure 71** shows the existing bus wash at the Fort William Road Transit Garage relative to the ceiling height.

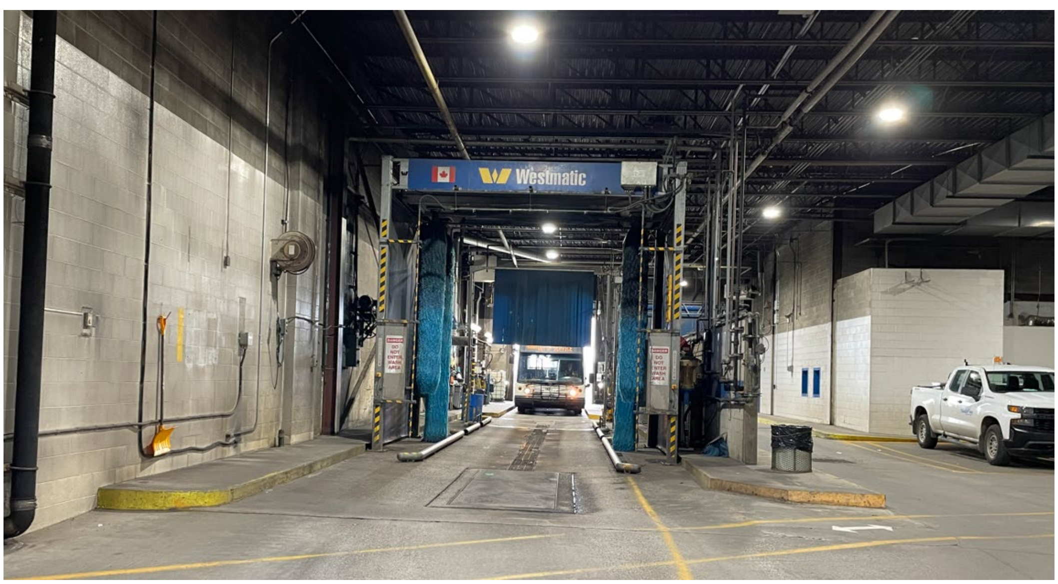

Figure 71. Existing Bus Wash at Fort William Road Transit Garage

B.6.3 SOLAR AND BATTERY ENERGY STORAGE

Some transit agencies deploying BEBs add distributed energy resources like solar panels and battery energy storage systems (BESS) for added benefit, redundancy and offsetting energy demand. Understanding how these resources could be deployed and operated at existing facilities will assist in determining the potential benefit for Thunder Bay Transit.

This report will look at the feasibility of implementing the below energy resources but will not comment on the economic viability. A full economic analysis is provided in **Appendix D: Budget & Financial Plan**.

B.6.3.1 Solar Photovoltaics (PV)

Solar PV provides a scalable choice for energy generation and produces no emissions or noise. Over the past decade solar PV has become more reliable and lifetime maintenance requirements have reduced. Solar PV requires a large area/footprint to achieve large power output and is subject to fluctuations in solar irradiance. Given the use case for Thunder Bay Transit, solar PV could be expanded on the roof of the Fort William Road Transit Garage provided there is structural capacity for hanging of charging infrastructure in addition to the weight of added PV panels. The overall solar PV system can be scaled depending on the available space or module size but may be subject to fluctuations depending on module tilt and azimuth angles.

Solar PV is typically not capable of offsetting the entire bus charging energy demand. However, PV can offset a portion of overall demand resulting in a "net load" that is lower than scenarios without PV. The overall impact of solar PV is also dependent on the bus charging schedule. A solar installation will have a greater impact if more of the charging occurs during peak solar generation hours. However, with the addition of net-metering or on-site energy storage, solar energy can be utilized even if the bus charging load is less than PV output during some daylight hours.

B.6.3.1.1 Solar Generation Analysis

PVWatts® Calculator was used to estimate the solar energy that could be generated at each of the sites. PVWatts® is a tool created by the National Renewable Energy Laboratory (NREL) and uses the location and weather data for each site to estimate a monthly generated power output of the solar PV system, including overall system efficiency losses.

The results generated by PVWatts® represents a best-case scenario and differs from the installations currently installed at the Thunder Bay Transit site by assuming the panels will be cleared of snow and have a denser installation of panels for the same given area than the current installation. The analysis for this project does not factor the structural limits of the roof and assumes the roof can handle the additional weight of the solar installation.

The Fort William Road Transit Garage has PV panels currently installed on a portion of the building roofs. The PV panels connect to an inverter connected directly to the grid. The current solar PV systems are owned and operated by Thunder Bay Hydro Renewable Power, a subsidiary of Synergy North, who pays to lease the roofing space from the City of Thunder Bay.

Any new installations would need to be done under a new contract as the existing installation under Feed-In Tariff (FIT) contacts cannot be expanded upon. Any new installations would be connected to the grid as net-metering where any excess generated energy not used by charging infrastructure or building loads would be sold back to the utility.

B.6.3.1.2 FORT WILLIAM ROAD TRANSIT GARAGE

Two scenarios for the Fort William Road Transit Garage were calculated to estimate the potential energy that could be generated at the facility. There are already solar panels installed at the garage, and new panels would need to be installed on a separate system.

The first scenario would be to cover the remaining roof space on the building with solar panels. This is shown in **Figure 72** below with an estimated yearly generation of 900,653 kWh.

Figure 72. Fort Williams Rd Scenario 1 - Enclosed area shows the additional coverage of solar panels over the remaining building space.

The second scenario covers the field south of the transit garage with solar panels, and an overhead gantry structure could be built to allow for solar PV panels to be installed over where the proposed electrical equipment would be sited. The proposed solar panels are shown as the enclosed space of **Figure 73** below with an estimated yearly generation of 1,202,129 kWh.

Figure 73. Fort Williams Rd Scenario 2 - Enclosed area shows the additional coverage of solar panels on the field.

B.6.3.1.3 WATERFRONT TRANSIT HUB

To add solar panels to the terminal, an overhead gantry would need to be constructed over the island of the bus pull-out for the panels to be placed on. There is not a solar PV system installed at this site, however, the construction of the gantry adds significant complexity for adding solar panels to this site. The proposed solar panels are shown as the enclosed space of **Figure 74** below with an estimated yearly generation of 178,216 kWh.

Figure 74. Enclosed area shows the additional coverage of solar panels for the site.

B.6.3.1.4 SOLAR GENERATION FINANCIAL ANALYSIS

While it is technically possible to install solar panels at the sites, an analysis cost of installing solar panels vs the energy produced of was done to determine the benefit-cost ratio of each of the sites. A benefit-cost ratio greater than 1 indicates that a project would be expected to save money over the lifespan of the asset.

Table 29 below shows the cost and that all three scenarios have a benefit-cost ratio. All the scenarios that were evaluated had a cost-benefit ratio significantly less than 1 and are not recommended as there is not expected to be an adequate return on investment in solar energy generation when compared to purchasing electricity from the grid. More information on the assumptions and can also be found in **Appendix F: Solar Analysis**:

Table 27. Solar Feasibility Analysis Results (2023$, millions)

	Fort William Road 1	Fort William Road 2	Water Street Terminal
Energy Cost Savings (PV)	$2.0	$2.7	$0.4
Capital Costs (PV)	$2.2	$3.0	$0.4
O&M Costs (PV)	$0.3	$0.4	$0.1
Net Present Value (NPV)	**-$0.6**	**-$0.7**	**-$0.1**
Cost-Benefit Ratio	0.75	0.75	0.78

B.6.3.2 Battery Energy Storage System

Energy storage devices can play a critical role within a microgrid or distributed energy resource (DER) system. Although energy storage systems (ESS) are not a generation method, they can provide greater reliability and resiliency for a microgrid, along with potential energy bill reduction applications. They are especially useful when utilizing renewable generation methods, as it can help reduce some of the intermittency issues and extract more value out of those types of assets. Battery energy storage systems (BESS) are the most prominent and mature technology for distributed scale systems and microgrids.

For transit buses, BESS systems are typically utilized for shifting loads in a strategic way that may help reduce demand charges and total energy costs associated with large charging loads that occur during peak rate hours. The size (kW) and capacity (kWh) of a potential BESS is heavily dependent on the available space for installation as size of the system will increase as the nameplate capacity and operational duration increases. BESS size will vary from vendor to vendor, but most solutions are typically of a containerized style. Systems of this nature are generally modular and flexible in terms of system size with footprints ranging from 8' x 12' upwards to 40' x 8' (40' ISO containers).

Fort William Road Transit Garage has a significant amount of space it could potentially use for BESS if it is required, at the south end of the site as shown in **Figure 75**.

Figure 75. Aerial highlighting area where BESS could potentially be located.

Agencies that are not subject to a tariff that has time of use charges and have access to net-metering may not require BESS since the grid effectively can act as that storage mechanism. Beyond the capital cost of purchasing BESS, they have a useable life and will need to be replaced after operating a certain number of cycles. There are also operating maintenance costs to consider and there are some efficiencies lost as energy is put into and taken out of the BESS.

For Thunder Bay Transit, the modelled electrical demand profile of charging (with a Charge Management System) already flattens the demand to be at a consistent level throughout the day as can be seen in **Figure 76**. There are not any peaks that would be avoided by incorporating a BESS. Because of this relatively flat demand profile and there not being a need to time shift the load; it's not recommended that a BESS be used with the current tariff structure.

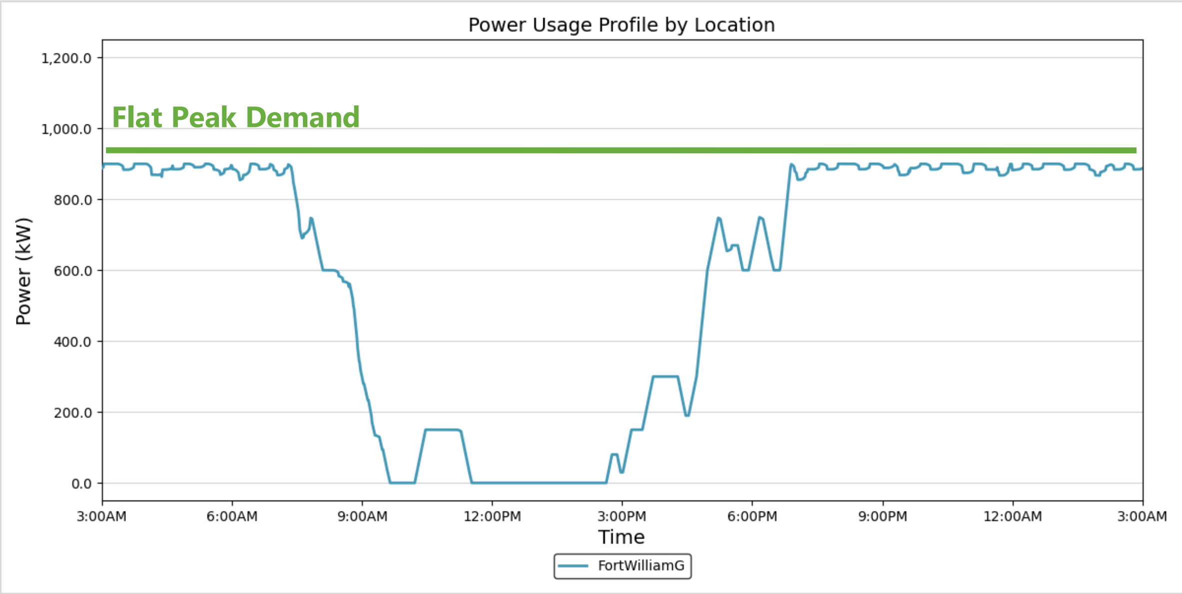

Figure 76. Thunder Bay Fort William Road Garage Zero+ bus charging electrical demand profile.

B.6.4 RESILIENCY

B.6.4.1 Grid Reliability

Before considering adding additional infrastructure to mitigate power outages, it is important to understand the context as to how many outages typically occur and how long they last. Short duration outages (less than an hour) will have minimal impact on operations whereas sustained outages (over one hour) would be more likely to cause a disruption to the service provided by the transit agency. If sustained outages are more common for a facility, a backup power source should be considered for the facility to limit the impact of outages on the transit network.

Upon HDR's request, Synergy North provided data on the outage frequency and duration for the circuit that powers Fort William Road Transit Garage over the past five years. Fort William Road Transit Garage has a very reliable service history based on the observed data. The garage had a combined outage time of 2 hours and 20 minutes over the past five years excluding a few momentary outages which would have negligible impacts on charging infrastructure.

Although historical usage data cannot guarantee the same future reliability at the garage, it indicates that the types of outages experienced at the garage would be manageable with operational adjustments. If operational plans mitigate these disruptions, backup power may not be required as the reliability of the electrical grid should not impact emergency management.

B.6.4.2 Internal Combustion Engine (ICE) Generation

More traditional energy generation methods usually include combustion turbines and ICE driven generators. Both technologies are proven to be effective at both a large and distributed scale for main power generation or backup power. Typically, combustion turbines have a larger power output (500 kW to 25 MW) but can still be utilized to meet larger distributed loads. These machines require hydrocarbon fuel input (i.e.: natural gas, oil, or fuel mix).

ICE generators come in a variety of sizes making them highly scalable. These machines have a high degree of reliability and can operate on demand but also require fuel input and maintenance. This provides high degrees of reliability and some resilience, but they may fall short in terms of environmental concerns due to the utilization of fossil fuels.

ICE generation is typically not an ideal solution to offset battery electric bus (BEB) charging load as the fuel input, high maintenance costs, and emissions are not suitable for consistent use. These generation methods can serve as backup generation to allow reduced transit operations to continue in the event of an electric service outage.

The large ICE generator footprint is an important consideration. A typical stationary diesel ICE backup generator will require a footprint of approximately 6.97 m^2/MW (75 ft^2/MW). Therefore, a 650 kW stationary backup generator would require approximately 4.5 m^2 (49 ft^2), not including ancillary equipment such as transfer switches or noise reduction enclosures.

In addition to stationary ICE generators, there are also portable ICE generators available in a variety of sizes up to about 2 MW. Charging infrastructure at facilities can be designed with capacity to connect portable generators. Having a portable generator on-site at the transit facility may be a good option as it could also be relocated to other facilities (such as en-route or municipal facilities) as needed in the event of power disruption without the need to have individual generators located at each site. This also allows the option to scale up backup generation in the future by purchasing additional generators if reliability continues to be a challenge.

B.6.4.3 Hydrogen Fuel Cell Generation

Hydrogen fuel cells can provide a large amount of power in a smaller footprint than other renewable sources and do not suffer from intermittency. Fuel cells also have low to no emissions depending on the fuel utilized but do require fuel input, additional infrastructure, and safety equipment to maintain high temperatures within the device and safely store potentially volatile fuels.

Fuel cells have historically operated using hydrogen as the fuel source. Hydrogen fuel cells can be procured if a hydrogen fuel source is available at the intended site. Hydrogen delivery can be completed either through on-site or off-site generation. On-site generation requires the raw components be available at the site. These raw components typically include either water or natural gas, and electricity. The electricity source determines hydrogen's cleanliness as most consider coal or hydrocarbon generation less desirable than hydropower or renewable sources.

On-site generation requires much more infrastructure that would be taking up space that could otherwise be used for transit purposes such as bus storage and maintenance. Thunder Bay Transit has a significant amount of unused space as shown in **Figure 75** that could also potentially be used for hydrogen production if not used for other purposes.

Off-site generation would only require storage tanks and pumps to store and deliver the fuel to the fuel cells. Off-site generation requires a facility that can produce and ship hydrogen and typically uses a truck-and-tank delivery system. Pipelines are another possibility but hydrogen pipelines capable of supporting a 1 MW or larger generator are not likely available locally.

The fuel cell footprint is dependent on the vendor, system size, and form factor. Fuel cell stacks can be deployed as a containerized unit or as modular units mounted to a foundation. A 440 kW containerized fuel cell will have a space requirement of 8.53m x 3.35m x 2.74m (28′ x 11′ x 9′) or an approximate footprint of 0.065 m^2/kW (0.7 ft^2/kW). The estimated footprint includes only the space required for the fuel cell stacks and does not include the required space for ancillary equipment such as fuel storage or electrolyzers. A 650 kW containerized fuel cell installation would utilize 2 units and requires an approximately 42 m^2 (455 ft^2) footprint.

Similarly, a modular installation would have an approximate space requirement of 4.57m x 2.74m x 2.13m (15′ x 9′ x 7′) for a 250 kW unit for an approximate footprint of 0.050 m^2/kW (0.54 ft^2/kW). A 650 kW modular installation would require 3 x 250 kW units with an estimated footprint of 33 m^2 (351 ft^2). These estimates do not include the necessary space for fuel storage and maintenance access.

Additionally, fuel cells are generally not well suited for typical emergency generator application where the asset is stored and only operated for a limited number of hours per year. Fuel cells require high operating temperatures to maintain effective and efficient operation. A cold fuel cell can take as long as 10 hours to be heated to optimal temperature, which is typically unacceptable for emergency generation applications. A solution that fuel-cell manufacturers have proposed to mitigate this startup time involves equipping the fuel cell to serve either a small portion or the entirety of the full load during normal operation. This means the fuel cell is always operating and maintains its ability to operate during an outage. Operating in this fashion could effectively swap the primary and backup power sources so that the electrical grid provides a backup to the fuel cell to reach the desired level of resiliency.

The ramp rate of an operating fuel cell is extremely fast, and a fuel cell operating in hot standby and ramped to full load during an outage would be able to meet similar starting characteristic as ICE generators. It should be noted that operating the fuel cell in hot standby will require the consumption of natural gas or hydrogen during normal operation.

B.6.4.4 Reduced Bus Services

In the case of an outage, a viable resiliency practice includes reducing the amount of bus services offered for the duration of the outage or while the buses affected by the outage are completely charged. Services can be reduced to a maintainable level depending on the severity, type, and outage duration (utility, local, software, etc.) and then returned to baseline operation once an outage is restored and buses are fully charged for operation. Different plans can be developed to optimize services for different outage categories to streamline service reductions. It should be noted that in the event of a large-scale outage, such as those caused by a large natural disaster, the overall demand for different transit service will likely decrease as the disaster has larger regional impacts beyond transit services. This should be considered if reduced operations plans are developed in the future. Overall, service reduction plans are dependent on the type and scale of an outage and are a viable option as a primary or secondary method of operation resiliency.

B.6.4.5 Spare Bus Capacity

Maintaining a fleet of spare buses (BEB or diesel) is a viable option to maintain a higher percentage of operational transit routes in the event of an outage. Depending on the type and length of a potential outage, buses can be swapped with fully charged spares for a reserve fleet once they reach a low state of charge. Maintaining a reserve fleet of BEBs would allow for the City of Thunder Bay to maintain their emissions goals while enabling a greater sense of resiliency for transit operations. However, a reserve fleet of this style is still limited by the charging infrastructure which may be impacted by the potential outage.

A reserve fleet containing diesel buses can provide a greater amount of bus swaps as they are not limited by potential charging outages. While this method may be viable during a phased fleet conversion, this would no longer be viable once the entire fleet became battery electric.

While a reserve bus fleet can provide a greater sense of resiliency and allow for increased transit operations during an outage, there are significant costs and space requirements associated with purchasing and maintaining a reserve fleet that should be weighed against the benefits of developing and storing one.

B.6.4.6 Redundant Grid Sources

Depending on the base location another method to increase resiliency is to employ a redundant feeder from the utility grid. Ideally, this secondary redundant source is served by a separate circuit than the primary feeder and could provide power to the transit base in the event the primary source experiences an outage or fault. There are several main grid components that affect the grid source reliability.

B.6.4.6.1 Substations

The electric utility typically takes service from the generation and transmission grid at the utility's substation. The substation converts electricity from a high transmission voltage to the local medium voltage system. Due to land constraints and large load requirements, the local utilities generally operate multiple transformers within each substation and each transformer is connected to multiple medium voltage, distribution feeders. Most outages at the substation level are localized to a single substation transformer. The presence of multiple substation transformers provides redundancy during most normal operations. The utility usually plans maintenance outages to avoid impacting the entire substation; however, when planning for redundant power to the transit base chargers, Thunder Bay Transit should request redundant distribution feeders be fed from separate substations or at the least from separate substation transformers.

B.6.4.6.2 Distribution Feeders

Medium voltage distribution feeders are installed and operated by the utility to supply electricity to their customers. Utility planners work to ensure that the grid will operate as reliably and efficiently as possible. Utility planners consider how to add new loads to the grid and how to best operate the local grid when maintenance or other outages impact an area or customer. In most cases, impacts to the distribution feeders are seldom known or experienced by the utility customer.

Unexpected outages at the distribution level are often localized and able to be fed from a separate distribution feed. Underground distribution feeder outages are most caused by digging into the line. Underground feeder outages do not happen frequently but occur for a longer duration. To avoid long-duration underground outages, utilities typically operate a loop system that can be switched from one source to another to avoid lengthy delays.

Overhead distribution feeders are installed nearer to the ground than transmission lines, so they are more likely to be impacted by tree branches and animals contacting the bare conductors and shorting the system. Overhead distribution feeders are also not built to the same strength as the transmission lines, so wind and downed trees can also impact these overhead feeders. Overhead feeder outages occur more frequently than underground outages but are repaired much quicker because they are more accessible. Overhead feeders are often configured to allow multiple sources to back feed the line in the event of outage or maintenance.

Some factors for consideration of the distribution feeders may include:

- Does the charging infrastructure require a 100% redundant backup source? If 100% redundancy is required, this will increase cost and on-site space required for the utility to provide this level of redundancy.

- Providing separate distribution sources from two separate substations is most desirable but also most costly. If redundant distribution feeds are installed, consider utilizing sources from a single substation but from separate transformers within that substation.

B.6.4.7 Resiliency Recommendations

Although past usage data cannot guarantee the same future reliability, the reliability information indicates that the typical types of outages experienced at the garage would be manageable with operational adjustments. If operational plans can mitigate these disruptions, backup generation should not be required to improve reliability of the electrical grid when operating normally as it should be able to keep the City's transit system at an acceptable level of service. Provisioning for incorporating a back-up generation source is still recommended at this stage as it is a low cost option that will allow Thunder Bay Transit to add back-up power down the road if grid reliability changes or operational workarounds are found too not be adequate.

While typical power outages are manageable, Thunder Bay Transit's business continuity plan has expectations that Thunder Bay Transit provide some services during an emergency scenario. As the City of Thunder Bay's Emergency Operations Centre (EOC) includes a component for Thunder Bay Transit to provide transportation assistance as required. The City of Thunder Bay discussed with the EOC what services would need to be sustained in the event of a significant outage. Approximately 10 buses would be needed to facilitate transport for EOC needs during a major event (such as a sustained system wide power outage). The resiliency recommendations are based on maintaining at least 10 buses operational during a major event.

For the near term, diesel buses will remain part of the fleet and can be used for emergency response during a power outage. It is recommended that to provide resilient service in the long term that three 150 kW chargers be connected to a backup generator. HDRs calculations sized this genset to be a 650 kW size unit that would be contained in an outdoor winterized enclosure and 24 hour sub-base fuel tank. The fuel tank would be sized to allow for 24 hour runtime at 100% load and is capable of being re-filled while the genset is operational to provide continuous runtime. The genset is shown to be installed as part of Phase 3 infrastructure towards the end of the transition before the last diesel buses are retired.

Another recommendation from HDR is to have both the unit substations come with automatic transfer switches installed that will allow for the unit substations to be put on backup power if more backup power is deemed necessary in the future. Compared to the overall costs of the electrical infrastructure the automatic transfer switches are modest if incorporated now and would be more costly to add to the system after the equipment is installed.

While technically feasible, back-up power for en-route charging locations is not recommended as there is a potential to fall back to a depot charging only scenario where buses are swapped out mid-day in the event of a power disruption. While there will be a potential impact on service, it will not be as significant since they primarily provide top-ups and there will still be a significant amount of stored energy from charging at the transit garage. With most of the power disruptions being relatively short and infrequent, it's expected that this would be manageable with temporary operational adjustments.

B.6.5 BUILDING CODE & FIRE SAFETY

The introduction of BEVs introduces new risks to facilities. Regulatory authorities are still working to determine if additional requirements will be needed. The biggest change with the introduction of battery electric vehicles and charging infrastructure is the increase in high voltage electrical equipment that is now being installed and the possibility of a lithium ion battery fire on vehicles stored inside of facilities.

Each province and territory in Canada have their own building code, which may adopt the National Building Code of Canada (NBCC) or modify the Code to suit local requirements. Ontario follows the Ontario Building Code. These codes may include specific provisions related to fire safety in buildings that house BEVs or other hazardous materials. While the NBCC does not specifically address battery electric vehicles currently, it sets standards for fire safety, electrical systems, ventilation, and other aspects that would apply to any building.

The Canadian Electric Code (CEC) is a national standard for electrical installations in Canada. It provides requirements for the safe installation and use of electrical equipment, including charging stations for BEVs. Electrical codes are already in place that dictate measures that would be required for installation of high voltage electrical equipment and their required safety devices. Electrical designs will need to be done by qualified professionals and will be reviewed through the building permit process to ensure designs meet electrical code requirements.

Fire safety standards for BEVs is an emerging area and some codes have not yet caught up to determine what the requirements should be for facilities that house BEVs. Vehicle fires are not a new concept for buildings and while to date, battery electric vehicle fires are statistically less common than internal combustion vehicles they do happen and behave differently. For example, if thermal runaway occurs in a battery pack, the fire can be difficult to extinguish and may take hours to put out.

Fleet operators have been proactive in thinking about how to mitigate these risks and while the current building codes may not explicitly dictate requirements, there are suggestions transit agencies have provided based on experience as to what agencies should consider in terms of additional fire safety measures:

- Develop a fire safety plan with the local fire department that addresses how to deal with a vehicle fire.
- Performing a facility fire safety risk assessment to evaluate aspects such as:
  - Rating of the building fire suppression system in vehicle storage areas
  - Availability of water for the fire department to be able to extinguish fires.

    - Emergency power shut offs for charging equipment.
    - Manual HVAC controls to exhaust smoke and fumes from a vehicle fire.
- Having an ongoing dialogue with first responders after implementation so that first responders are familiar with the facility, vehicles, and tools available to deal with fires at the facility.

Engaging with insurance underwriters is another recommended way to make sure that buildings and/or fleet will be covered by existing insurance coverage. Insurance underwriters may also have recommendations or additional requirements as to how risks could be mitigated that are not captured by current building or electrical codes.

APPENDIX B1: FACILITY CONCEPT DRAWINGS

APPENDIX C: STAFFING & TRAINING PLAN

With the introduction of battery electric technology, it is critical to provide proper training on unique systems and subcomponents for battery electric vehicles to ensure the safe, efficient operation and maintenance of the electric fleet. Thunder Bay Transit should work with internal training departments and in close coordination with Original Equipment Manufacturers (OEMs) to acclimate the existing workforce to the new technology, empowering them to become champions of the BEB technology, and avoiding displacement of the existing workforce.

It is recommended that the City of Thunder Bay review the following considerations and take action to ensure a safe workplace, capable workforce, and successful fleet transition:

- **Safe Battery Electric Workplace and Risk Assessment:** Develop and implement safe work procedures for battery electric vehicles. This includes procedures for de-energizing and re-energizing high voltage systems, lockout/tagout procedures, and personal protective equipment (PPE) requirements. Involve current workforce in program development.
- **Training Program:** Provide workforce training regarding safe work procedures for operating and maintaining battery electric vehicles. This should include training on the risks associated with high voltage systems, safe work practices, and the use of PPE. Ensure that BEB equipment is properly inspected, maintained, and tested. This includes equipment such as battery packs, chargers, and cables.
- **Staffing:** Continuously evaluate staffing needs as they relate to the introduction of battery electric vehicles and monitor the market for specific training and qualifications that can be added to job postings and recruiting materials. Work with unions to ensure work requirements are consistent with the collective agreements.
- **Emergency Response:** With the local first responders, establish an emergency response plan for incidents involving battery electric vehicles, such as battery fires or explosions. The plan should outline the procedures for evacuating the area and responding to the emergency.

This Staffing and Training Plan (Plan) provides a starting point for the City of Thunder Bay as they consider a transition to battery electric vehicles. This Plan will review the four considerations listed above and discuss, provide insight, and make recommendations as it relates to training and staffing for a battery electric workplace and service.

C.1 A SAFE BATTERY ELECTRIC WORKPLACE

C.1.1 SAFE WORKPLACE POLICY AND STANDARDS

In Ontario, employers have a legal obligation, through the Occupational Health and Safety Act, R.S.O. 1990 (OHSA) to develop and implement a workplace safety program that ensures the health and safety of their workers. This includes a written policy, hazard identification and control, worker training, worker involvement in program development, procedures for accidents and illness, and regular review and updates. Failure to comply with the OHSA can result in harm to workers and penalties for the employer.

The Canadian Standards Association (CSA) developed CSA Z462:21, an electrical safety standard for Canadian workplaces to prevent electrical injuries and fatalities. It provides guidelines and requirements for identifying and assessing electrical hazards, selecting, and using personal protective equipment (PPE), establishing safe work procedures, and training workers. CSA Z462:21 is updated periodically to reflect changes in technology, regulations, and best practices. The standard is widely adopted in Canada by a variety of industries where electrical hazards exist, including manufacturing, construction, and utilities.

CSA Z462:21 is largely based on its American counterpart, developed by the National Fire Protection Association (NFPA), called NFPA 70E. Both standards are focused on fixed electrical infrastructure (such as charging infrastructure) and do not directly address "mobile" high-voltage systems such as the battery drivetrains in battery electric vehicles. Transit agencies are identifying principles from these standards to apply to battery electric workplaces, and it is possible that updated versions of the standards will include consideration of battery electric vehicles.

C.1.2 PROCUREMENT

It is recommended that the City of Thunder Bay incorporate a "safety by design" principle into their procurement process. Instead of holding only the user accountable for safety, safety by design ensures that the vehicles and equipment were designed and built with safety in mind. The City of Thunder Bay should assess and compare original equipment manufacturers' (OEM) products and encourage manufacturers to demonstrate how their products consider the needs of all users, including passengers, operations, and maintenance staff.

Manufacturers with well-developed training programs and products that engineer hazards away from employees, minimizing the amount of PPE required for maintenance activities are indicators that safety is of importance to the manufacturer. Products that protect employees from hazards simplify maintenance and reduce the need for safety procedures (ex. Lock-out, tag-out) are preferable to ones that require PPE from hazards.

C.1.3 RISK ASSESSMENT

It is recommended that the City of Thunder Bay work with Synergy North or internal workplace safety resources to assess the risks associated with working in a battery electric workplace and take steps to minimize or eliminate those risks. This includes identifying hazards related to high voltage systems, flammable electrolytes, and other potential dangers. The City of Thunder Bay, during and after procurement, should engage with the OEMs for information related to risk, safe handling, operation, and maintenance of new equipment and infrastructure. Staff will become aware of the risks associated with battery electric vehicles through training. It is important to ensure staff are knowledgeable about the risks, understand the best mitigation and protection procedures, and are constantly working to eliminate hazards and maintain a safe workplace. The City of Thunder Bay's risk register should be updated continuously for any department working on the transition to battery electric vehicles.

C.1.4 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal Protective Equipment (PPE) is designed to protect users from health and safety hazards. PPE must be implemented when elimination, substitution, engineering, and administrative controls are insufficient at removing or reducing hazards.[12]

Under Canadian and Ontarian law, PPE is required to be provided by the employer and worn by the employees to maintain safe working conditions. The following policies and standards related to PPE are applicable:

Canada Labour Code (R.S.C., 1995, c. L-2)

- Section 122.2 states that "Preventive measures should consist first of the elimination of hazards, then the reduction of hazards and finally, the provision of personal protective equipment, clothing, devices, or materials, all with the goal of ensuring the health and safety of the employees."
- Section 125 (l) requires the employer to provide the prescribed safety materials, equipment, devices, and clothing and Section 126 (1) requires employees to use safety materials, equipment, devices, and clothing intended for their protection.

Occupational Health and Safety Act, R. S. O. 1990

- Section 25 of the Act outlines the duties of the employer requiring them to provide equipment, materials and protective devices in good condition ensuring safety measures and procedures are enforced in the workplace.
- Section 27 of the Act outlines the duties of the supervisor to ensure that protective devices, measures, and procedures are conducted and that they wear equipment, protective devices or clothing required by the employer.
- Section 28 outlines the duties of the worker to work within the provisions of the Act and use or wear equipment, protective devices or clothing required by the employer.

As previously referenced, CSA Z462:21 is the electrical safety standard and identifies appropriate PPE for workplaces operating electrical equipment to protect workers from high voltage

[12] https://www.ccohs.ca/oshanswers/hsprograms/hazard/hierarchy_controls.pdf

incidents and arc-flash. The Institute of Electrical and Electronics Engineers (IEEE) 1584-2002 is another reference guide that provides techniques and calculations for understanding arc flash risks in the workplace.[13]

Battery electric buses are considered high voltage systems and require additional tools and PPE that are not typically required when working the typical low or medium voltage systems on diesel buses. Examples of the types of additional PPE that may be required to work on high voltage systems. The Transportation Learning Center provides a list of typical tools and PPE that are expected to be needed to work on BEBs which are shown in the tables below: [14]

Table 28. Recommended Insulated Tools

Tool	Recommended Quantity
Category III rated digital multimeter(s) (rated up to 1000 VDC)	1 for each BEB technician
Insulated hand tools that follow American Society for Testing and Materials F1505-01 and IEC 900 standards and compliance with OSHA 1910.333 (c)(2) and NFPA 70E standards (as recommended by the BEB OEM)	1 set for each BEB technician that could be working on a BEB at any given time

13 IEEE SA - IEEE 1584-2002

14 ITLC_ZEB_Report_Final_2-11-2022.pdf (transportcenter.org)

Table 29. Recommended Personal Protective Equipment (PPE)

Tool	Recommended Quantity	Notes
ASTM Class 0 insulated gloves with red label	1 pair, properly sized for each BEB technician	Insulated gloves need to be tested and replaced at specified intervals.
Leather gloves to be worn over ASTM insulated gloves	1 pair, properly sized for each BEB technician	
Insulated EH Rated Safety Shoes	1 pair, properly sized for each BEB technician	
NRR 33 rated ear plugs	Ample supply for each BEB technician that could be working on a BEB at any given time	
NRR 331 rated (overhead) earmuffs	Ample supply for each BEB technician that could be working on a BEB at any given time	Note: Combining NRR 33 rated ear plugs with NRR 31 earmuffs can provide a NRR protection level of 36.
Arc flash suits	Ample supply for each BEB technician that could be working on a BEB at any given time	
Combination arc flash shield and hardhat	Supply for each BEB technician that could be working on a BEB at any given time with attic stock	
Arc flash hoods	Ample supply for each BEB technician that could be working on a BEB at any given time	Arc flash shield, hardhat and hood may be procured as one integrated item depending on manufacturer and agency preference.
Insulated electrical rescue hook(s) (Sheppard's Hook) sized for use on BEBs	1 set for each BEB technician that could be working on a BEB at any given time (certain HV operations require a second worker to be available to extricate primary worker in an emergency)	

For more information about PPE, visit the Canadian Centre for Occupational Health and Safety website: CCOHS: Designing an Effective PPE Program.

C.2 TRAINING PROGRAM

C.2.1 LABOUR CATEGORIZATION, SKILLS ASSESSMENT AND GAP IDENTIFICATION

This section outlines the workplace responsibilities of staff based on skills, qualifications and assigned duties. It is acknowledged that existing staff do not currently engage with battery electric vehicles and are unfamiliar with their operation in a revenue service setting. The current qualifications for labour do not include pre-existing training with battery electric vehicles and while some new staff may have some in-class or on-the-job battery electric vehicle training, the agency will need to provide a comprehensive training program to operate as a zero emissions operation successfully and safely. **Section C.2.3** identifies a prospective training curriculum for Thunder Bay Transit's staff.

Generally, staff can be grouped into two main categories: Operations and Maintenance.

C.2.2 OPERATIONS

Operations staff can further broken down into two main groups who will require different levels of training based on their roles: Operations Support and Operators.

Operations Support: Staff in this category include those who are critical to bus operations but do not directly interact with the buses. As it relates to BEBs, minimal training is required as staff only need to have a high-level understanding of the technology and its capabilities. Operations Support may require training related to BEB's operational range as it relates to dispatching, scheduling, and assigning vehicles to appropriate routes.

Operators: Staff in this category include those who directly interact with the buses but do not perform any vehicle maintenance. Bus Operators require more training than Operations Support staff given their direct interaction with the vehicles. For example, Bus Operators must be familiar with all dash indicator lights, operation of doors and wheelchair access, and safety procedures. Bus Operators will not perform vehicle maintenance on the BEBs but may be required to plug-in or unplug buses for use. Bus Operators are required to hold a valid Ontario Class C, D and Z Driver's License, and this requirement does not change with the introduction of BEB technology. At this time, there is no new license required for operating BEBs.

Thunder Bay Transit's Operations Staff Complement is presented in **Table 4**.

Table 30. Thunder Bay Transit Operations Staff Complement

Job Title	Role Category	# of Filled Positions	Notes	Union Affiliation
Conventional Operators FT	Operators	99		Amalgamated Transit Union (ATU)
Specialized Operators FT	Operators	11		ATU
Operators PT	Operators	33	17 Dual positions (conventional and specialized); 16 are specialized only	ATU
General Admin & Support	Operations Support	18	Supervisors, Controllers, Specialists, Coordinators, Clerks, etc.	CUPE and Non-Union

C.2.2.1 Maintenance

Maintenance staff consist of Maintenance Support and Maintenance.

Maintenance Support: Staff in this category include technical specialists who directly interact with the buses, and/or are responsible for the assignment and oversight of maintenance functions but do not preform the technical corrective and preventative maintenance. Bus Maintenance Support will only need specific portions of the training to familiarize themselves with the vehicles, components they will be interacting with and the hazards that may be present during their job duties. As they will not be directly interacting with as many components of the vehicle, they will not require full familiarity with all vehicle systems and mechanical components.

Maintenance: Staff in this category include technical specialists who directly interact with the buses and perform routine and unplanned maintenance functions. All Maintenance staff are required to complete 310T certification prior to hiring from an accredited college or apprenticeship program. 310T is a designation for Truck and Coach Technicians that are trained in issue diagnosis, repair, and maintenance of commercial vehicles. In addition to this designation, duty-specific training is required for maintenance staff.

City of Thunder Bay's Fleet Maintenance staff are categorized by function as presented in **Table 5**. Given their duties, it is anticipated that Maintenance staff will receive the most comprehensive training. Based on the required duty and function, Maintenance staff should undergo skills assessment to identify gaps and training should be catered based on duties.

Table 31. Thunder Bay Transit Maintenance Staff Complement

Job Title	Role Category	# of Filled Positions	# of Authorized Positions	Union Affiliation (if applicable)	Notes
Conventional Truck and Coach Technicians	Maintenance	5	5	ATU	100 % dedicated to Conventional
Lead hand Truck and Coach Technician for Conventional shop	Maintenance	1	1	ATU	100 % dedicated to Conventional
Lubricator	Maintenance Support	1	1	ATU	60% dedicated to Conventional; 40% to Specialized
Service Technician C - Fare Boxes Electronic , Specialized Transit Vehicle Support	Maintenance Support	1	1	ATU	25% of time dedicated to Conventional; 75% to Specialized
Bus Cleaner	Maintenance Support	1	1	ATU	90% of time dedicated to Conventional; 10% to Specialized
Service Technician A positions - Bus servicing, fueling, general cleaning, and on road support	Maintenance Support	12	12	ATU	75% of time dedicated to Conventional; 25% to Specialized
Supervisor Transit Maintenance	Maintenance Support	1	1	Non Union	70% of time dedicated to Conventional; 30% to Specialized

C.2.3 TRAINING CURRICULUM

Operations and Maintenance staff differ in their daily interaction and function with battery electric vehicles and, therefore, require different training. While all staff should be familiar with safety protocols for interacting with battery electric vehicles, duty-specific training will be required. The following sections identify and outline recommended training programs for the safe operation and maintenance of battery electric vehicles.

A comprehensive battery electric training program should be integrated with existing training programs for operators and maintenance staff. The training curriculum should be jointly developed with and reviewed by Thunder Bay Transit and the ATU.

The development of a high-quality training program will require coordination with internal and external resources. The following list identifies potential resources that may assist Thunder Bay Transit with program development:

- Vehicle and charger OEM training curriculum purchased as part of new rolling stock procurements.
- Vehicle sub-system/sub-component training from component OEMs.
- Collaboration with transit agencies with operational zero emission fleets and in-house training programs.
- Partnership with local first responding agencies; and
- Membership through training consortiums, transit associations or unions.

C.2.3.1 OEM Training

The Original Equipment Manufacturers (OEMs) offer training programs with the purchase of vehicles. It is recommended that City of Thunder Bay's Fleet Maintenance utilize these programs and support from the OEMs as they bring new vehicles into their fleet. A sample curriculum from New Flyer is presented below:

- Operator Orientation (4 hours)
- Maintenance (Mechanic Training) (128 hours)
  - Orientation
  - Multi-plex System
  - Entrance & Exit Doors including wheelchair ramp.
  - Braking System & Axles
  - Front & Rear Suspension & Steering
  - Air System & ABS
  - Body & Structure
  - Propulsion & ESS Familiarization / HV Safety and Troubleshooting
  - Depot charger familiarization
- Towing and Emergency Responder Training (4 hours)

C.2.3.2 Ontario Public Transportation Authority ZEB Training

In 2021, the Ontario Public Transportation Authority (OPTA) established a Zero Emission Bus (ZEB) Committee. The Committee was created in response to the needs expressed by members for knowledge transfer as revenue and non-revenue fleets in Ontario transition to zero emission technology. The OPTA ZEB Committee's mandate is to establish a forum for OPTA members to develop and share best practices, lessons learned, standard documentation, and key metrics for the implementation of zero emissions vehicle technology.

The OPTA ZEB Committee forum has three workstreams:

- WS1 - Operations and Maintenance Work Plan
    - WS1A – ZEB Planning, Scheduling, and Operations
    - WS1B – ZEB Safety, Training, and Maintenance
    - WS1C – ZEB Performance, Monitoring, and Reporting
- WS2 - Engineering Work Plan
    - WS2A – ZEB Light & Heavy Duty Vehicle Requirements
    - WS2B – ZEB Infrastructure Requirements
    - WS2C – NA Technical Working Group
- WS3 - Procurement and Vendor Engagement Work Plan
    - WS3A – Engage Vendor Community
    - WS3B – Commercial Bus Management
    - WS3C – Paratransit EV Commercial Management
    - WS3D – Non-Revenue Vehicle Commercial Management

Workstream 1B – ZEB Safety, Training and Maintenance include the following courses:

- WS1B-1: ZEB Safety
    - EV Systems Electrical: Arc Flash & High Voltage Work (LOTO, SOPs, etc.)
    - BEB Thermal Events: Theory, Risk, and Mitigation (in collaboration with WS2 – Engineering)
    - BEB EMI: Theory, Risk, and Mitigation (in collaboration with WS2 – Engineering)
- WS1B-2: ZEB Training
    - Operator BEB Training Considerations & Guidelines
    - Maintenance BEB Training Considerations & Guidelines
    - ZEB Academia & Certifications/Endorsements (OPTA Maintenance Committee; eMobility Training Subcommittee reporting in; STO)
- WS1B-3: ZEB Maintenance
    - BEB PM Program Elements
    - BEB Maintenance-Specific KPIs and Comparative Analysis (Feeds WS1C: ZEB Performance Monitoring & Reporting
    - HV System Inspection Requirements (MTO NSCC11B)

It is recommended that the City of Thunder Bay continue to participate in the ZEB Committee's Workstream 1B and refer to training courses as a resource when developing their training programs and refer to other workstreams for information related to engineering requirements and procurement as required. The Appendix has more information on the WSIB modules. Participating in this committee is a good opportunity for City of Thunder Bayto engage with other Ontario transit agencies, learn the challenges they're facing and the solutions they've developed. It's also an opportunity for the City of Thunder Bay to share their experiences and solutions they have developed.

C.2.3.3 Operations

Operators will interact with battery electric vehicles daily as the primary operators of the vehicles. Though they will not be performing any maintenance functions on the vehicles, they require a comprehensive understanding of the operational functions – especially how they differ from conventional diesel buses. The training program for operators is anticipated to be like Thunder Bay Transit's existing training program with OEMs providing training to Operators when the vehicle is purchased and transitioned into the fleet. After OEM training is provided, orientation programs for new operators should be modified to include an orientation on BEBs that includes the additional aspects that are specific to BEBs.

The **Operations Support** team will require a strong understanding of the vehicle's battery life and operational range to appropriately assign buses to routes and send replacement buses when battery levels are low. Software system upgrades related to vehicle scheduling, automated vehicle location, vehicle state-of-charge and monitoring (described in the Transition Plan) will provide the necessary information to Operations Support staff to make real-time decisions on vehicles and service. With new variables and metrics such as a vehicle's state-of-charge introduced, it is important Operations Support are trained on new or upgraded software to assist the team in recognizing when vehicles are ready for service, need to be swapped, or require troubleshooting during operation.

Table 34 provide an example of the types of training that could be required for the different operations staff. In addition, any changes in procedures for refueling and recharging, hand-off at the garage, and dispatching should be discussed with operators as part of Thunder Bay Transit's standard operating procedures.

Table 32. Recommended Operations Staff Training[15]

Training	Description	Estimated Time	Delivery Method	Operators	Operations Support
Vehicle Orientation	As with any new fleet type, operators will need to understand basics like start-up/ shut-down procedures, operator gauges and indicators, and how to operate vehicles systems (lights, heat, AC). Staff will also need to understand some new aspects like the state of charge of vehicle, regenerative braking and how to drive the vehicle efficiently.	6 hours	OEM OR in-house Certified Trainer	x	x
High Voltage System Safety	High-level overview of the safety system on the vehicle and procedures to follow in the event of an emergency. This should include the types of indicators that may signal that there is an issue with a battery electric vehicle and how to disconnect the traction power if an emergency occurs.	2 hours	OEM OR in-house Certified Trainer	x	x
Charging Procedures	How to charge the bus by connecting using either plug-in or overhead chargers. Setting the bus up for charging, starting the charger, safety features of charging equipment.	2 hours	OEM OR in-house Certified Trainer	x	x
Operations and Scheduling Systems	Staff will need an understanding of vehicle range and strategies for scheduling vehicles. Training on systems that staff may use to monitor vehicles (ex: understanding remaining range to determine if a vehicle needs to be return to the garage or not).	8 hours	OEM OR in-house Certified Trainer		x

[15] International Transportation Learning Center, Providing Training for Buses: Recommended Expanded RFP Language

C.2.3.4 Maintenance

Battery electric vehicles contain high-voltage batteries, requiring all maintenance staff who will be interacting with high-voltage components to be certified to work on high voltage systems. Thunder Bay Transit, in association with the ATU, should work to supplement any existing electrical safety programs with guidance from the Canadian Standards Association (CSA), OEMs, and industry best practices. At a minimum, safety training programs should include:

- Proper use and inspection of personal protective equipment.
- CPR and first aid training.
- High voltage onboard systems familiarization and identification; and
- Lock-Out-Tag-Out training and compliance.

Local colleges such as George Brown College, St. Clair College and Red River College offer Electric Vehicle (EV) Technician programs. Sending staff to local colleges for training is another potential option for familiarizing staff with how to work on EVs so that they can get some hands on experience prior to vehicles arriving.

Table 35 presents the recommended high voltage safety training curriculum. The proposed training curriculum accounts for maintenance staff who will be required to directly with high-voltage systems to have the appropriate training on what PPE is needed and how to use it. Staff who are mainly servicing vehicles (such as cleaners, , etc.) but not expected to work on high-voltage systems will have limited training that a more limited training that describes the hazards and how to safely perform duties on the vehicles.

In addition to generalized high-voltage safety training, specific technical training will be required for maintenance staff to understand how to work on the new systems that are a part of BEBs such electric drive trains and energy storage systems. Like the high-voltage training curriculum, staff who will be expected to work on specific systems will need more training that those that are servicing the buses or managing staff. A proposed maintenance training curriculum has been provided in **Table 36** based on the role.

Table 33. High Voltage Safety Training

System	BEBs	Estimated Time	Delivery Method	Specialized Tech	Maintenance Support (incl. management)	Shift Supervisors
Fall Prevention	General description of the type of system that is required, with do's and don'ts that are specific to high voltage work	1 hour	OEM, Certified Inspector OR in-house Certified Trainer	X	X	X
Harness Use and Inspection	Designed to instruct the end user with the information they need to ensure the equipment is safe to use. For standard harness and arc-flash rated harness.	2 hours	OEM, Certified Inspector OR in-house Certified Trainer	X		X
High Voltage PPE and Inspection	This course will provide a description of the various forms of high-voltage PPE, its use, inspections, and certification	3 hours	OEM, Certified Inspector OR in-house Certified Trainer	X		X
Arc-Flash PPE, Inspection and Maintenance	Instruction on arc-flash range, protective barriers and PPE, and maintenance of required PPE. Note: Utility staff may only need the "instruction" part of the program pertaining to awareness of Arc-Flash	3 hours	OEM, Certified Inspector OR in-house Certified Trainer	X	X	X
Who can work on what?	Qualified/Certified Unqualified/Uncertified Note: Determining who is qualified or certified for specific tasks will require consultation with the ATU.	1 Hour	OEM, Certified Inspector OR in-house Certified Trainer	X	X	X
Tool Inspection	Inspection process for various High-Voltage insulated tools	1 hour	OEM, Certified Inspector OR in-house Certified Trainer	X	X	X

Table 34. Recommended Maintenance Staff Training

System	Description	Estimated Time	Delivery Method	Specialized Techs	Maintenance Support (incl. management)	Shift Supervisors
Preventative Maintenance & Inspections (PMI)	Designed to instruct technicians in the routine preventative maintenance procedures and repair of the electric bus	16 hours hands-on and classroom.	OEM or in-house Certified Trainer	X	X	X
Propulsion & Regenerative Braking System	Technicians gain familiarity with the Motor Drive system (Theory and Hands-On), and Regenerative Braking System	16 hours hands-on and classroom	OEM or in-house Certified Trainer	X		X
Bus Plug-In Charging	Instructs staff on the proper and safe use of plug-in charge stations, and inspections of receptacles	4 hours classroom and hands-on	In-House Certified Training	X	X	X
High Voltage Charging System – Battery	Extensive training covers High Voltage disabling, Lithium-Ion Battery Pack, Bidirectional "Vehicle to Grid", Inverter AC/DC Conversion (24V Charging System), Electrical Architecture, CAN bus, and Thermal Management System	48 hours hands-on and classroom	OEM or in-house Certified Trainer	X		X
Battery Management System	Technicians learn about the difference in the operation of the battery management system and software	8 hours-classroom and hands-on	OEM or in-house Certified Trainer	X		X
HVAC High Voltage System	Technicians learn the major operating principles of the HVAC "High Voltage System" - Diagnose and repair, including system maintenance	8 hours hands-on and classroom	OEM or in-house Certified Trainer	X	X	X
Special Equipment & Tools	Instruction on how to use specialized High Voltage insulated tools and computers to assist with vehicle repair and maintenance.	8 hour hands-on and classroom	In-House Certified Trainer	X		X
High Voltage Accessory Motors	Technicians are trained in the operating principle, diagnosis, and repair of high voltage drive motors for air compressors, power steering pumps, etc.	8 hours hands-on and classroom	In-House Certified Trainer	X		X

C.2.4 TRAINING PROGRAM IMPLEMENTATION

It is recommended that all operators are trained on BEBs initially to maximize driver route assignment. As new vehicles enter service, the OEM should always provide initial training for new vehicles. In addition to new vehicle training, the City of Thunder Bay should mandate periodic refresher courses to ensure operator compliance, comfortability, and safety.

As the number of BEBs entering service will be minimal in the early Phases of the transition, maintenance should be trained in phases adopting a "Train the Trainer" approach. Train the Trainer approaches allow staff members with existing relationships and strong leadership skills to receive training from OEMs/training providers and transfer knowledge to other staff. Thunder Bay Transit should identify candidates to receive training for the first Phase that can act as trainer in subsequent phases and transfer knowledge to other staff as more BEBs enter the fleet. This approach is cost-effective as it reduces the initial and on-going cost of training as training can be provided in-house as the composition of the fleet changes.

Training should begin one or more months prior to the delivery of the first battery electric vehicles and includes hands-on experience with the vehicles. If possible, it is recommended that Thunder Bay Transit send staff to manufacturer facilities or other transit agencies to learn and receive training prior to delivery. This will ensure a level of familiarity when the vehicles are delivered.

When the vehicles arrive, the City of Thunder Bay should have OEMs provide on-site support for a period after the delivery of vehicles, so knowledge can be transferred to the City of Thunder Bay staff. There is value in having OEM staff on-site for diagnosing issues, troubleshooting and problem-solving and the OEM can provide guidance and help staff operate independently.

C.2.4.1 Budget and Funding Opportunities

The cost of initial training will be higher at the onset of the transition as there will be no internal knowledge of BEBs within the City of Thunder Bay's staff. At the onset of the transition, it is recommended that the City of Thunder Bay engage with other transit agencies undergoing this transition to determine appropriate budgeting requirements.

The cost of workforce training will fluctuate in response to the wider adoption of battery electric vehicles. Funding for training is anticipated to emanate from several sources including procurement, where training costs are incorporated into the allocated budget for vehicle or infrastructure procurement, as well as existing funding streams dedicated to training. Additionally, financial support is anticipated from federal, provincial, and local funding allocations.

As highlighted by the International Transportation Learning Center, the following costs should be considered when budgeting for workforce training:

- Instructor hours.
- Mentorship hours.
- Facility rental (if applicable).
- Training materials; and
- Course content[16]

If the City of Thunder Bay adopts a phased training program for Maintenance staff, budget should be allocated to align with the years where vehicles will arrive and enter service.

C.2.4.2 Recordkeeping

It is recommended that the City of Thunder Bay understand the requirements for recordkeeping outlined in OHSA and develop practices to ensure staff records are updated as they progress through the training program. Tracking training requirements is useful as the training program is developed and modules are added or removed as technology advances and as the workforce becomes more familiar with the new technology. Recordkeeping ensures that workforce is up to date on required training for safety, efficiency, and excellence in service delivery.

As the industry becomes more knowledgeable about BEVs and BEBs, the City of Thunder Bay may be able to include education or certification requirements for training prior to hiring for technicians. A strong recordkeeping program will assist the City of Thunder Bay in communicating its expectations for future employees and budget appropriately for training hours when hiring new staff. It is recommended that the City of Thunder Bay monitor college and apprenticeship programs for inclusion of BEV training that can be used to shape requirements. The City of Thunder Bay should also consult with the union on hiring requirements.

C.3 STAFF RIGHT-SIZING

It is recommended that the City of Thunder Bay re-evaluate staffing needs on a rolling basis based on overall fleet growth and approve additional maintenance positions as necessary. **Table 37** displays the composition of the City of Thunder Bay's existing operations and maintenance staff supporting transit operation.

[16] Building Skills to Keep America Moving | Transportation Learning Center (transportcenter.org)

Table 35. Thunder Bay Staff Complement

Job Categorization	Role Category	# of Filled Positions	Union Affiliation
Operations Support	Manager, Supervisors, Controllers, Specialists, Coordinators, Clerks, etc.	18	CUPE and Non-Union
Operators	Conventional and Specialized (Full time and part time)	143	ATU
Maintenance & Maintenance Support	Technicians, Lubricator, Cleaner, Service, Supervisor, etc.	22	ATU (Supervisors are non-Union)

The City of Thunder Bay Transit Operators and Fleet Maintenance staff belong to the Amalgamated Transit Union (ATU) and the transition to battery electric vehicles may result in impacts to the existing Collective Bargaining Agreement which may increase operational costs. It is important that unions are engaged early in the transition to assist and support the upskilling and transitioning of the workforce. For example, Operators may be asked to take on additional duties such as plugging-in and un-plugging buses from chargers. It is recommended that the City of Thunder Bay initiate constructive engagement with ATU on the forthcoming changes to support battery electric operations.

The sections below describe the expected impacts and recommendations to the various types of staff within the City of Thunder Bay:

C.3.1 MANAGEMENT STAFF

In addition to impacts to the more hands-on aspects of operations and maintenance, there is also a significant amount of effort that will be required to manage the changes that will be required for the City to successfully adopt battery electric buses. Beyond the project management that will be required to initially procure the vehicles and infrastructure, once in operation, BEBs will need to be monitored and have a resource that can track and resolve issues.

Many Canadian transit agencies, such as those in Toronto, Brampton, and Vancouver, have begun to consider the adoption of BEBs and have begun to include staff dedicated to the fleet transition to their complements. While the transition to zero emission vehicles is important, it's also important that current staff can continue to focus on delivering quality transit service to customers while the transition takes place.

Given the significance of the impact to the organization, it's recommended that the City of Thunder Bay include a dedicated Energy Project Manager. The Energy Project Manager will focus on the implementation of the Transition Plan. The position will be able to retain the technical knowledge that will be gained through on-boarding of the initial vehicles and infrastructure that can then be used to refine and improve future deployments of BEBs. The budget for the transition includes the cost of the salary for the additional resource. Examples of some of the additional responsibilities that this position could be responsible for are:

- Project management during construction and procurement of vehicles and infrastructure
- Change management of internal and external stakeholders
- Organizing BEB training programs for operations and maintenance staff
- Assessing existing systems like scheduling, dispatch, and in-service vehicle monitoring
- Monitoring data from in-service vehicles and having a resource for operations and maintenance staff to discuss issues and coordinate solutions.
- Long term in-house subject matter expert that can stay informed on industry developments and able to share with the broader team.
- Managing charging infrastructure operations and maintenance staff or contractors
- Coordination with local utility

This role will focus on getting the vehicles and infrastructure in place, after the vehicles begin to go into service, the position will transition to more of a support role of existing operations and maintenance departments. Support will still be required after vehicles arrive to ensure success of the transition. Ensuring that the vehicles delivered operate as expected and having an internal resource that understands how the agency operates and someone who staff can contact when issues arise will be key.

C.3.2 OPERATIONS STAFF

In general, the modelling scenarios for bus electrification result in more service hours than the existing conditions. It is recommended that Thunder Bay Transit review the terms of the operators' collective agreements and the number of service hours travelled to determine if any increase in the number of Operators would be required, though it is not anticipated that there will be a need to increase the number of Operators in the short to medium term.

Increases in staff may come because of service expansion that may occur over the transition period. Thunder Bay Transit should continue to evaluate its Operator staffing needs on a rolling basis as BEBs are introduced to the fleet. In addition to service increases, other areas of the operation such a planning and scheduling may also require additional support. With the limited number of buses in operation in Phase 1, the existing staff are expected to be able to manage the fleet and operation but should be re-evaluated in 2029 when transition plan is updated, and the City of Thunder Bay has a better understanding of long term needs.

C.3.3 MAINTENANCE STAFF

It is noted as transit fleet transitions are in their infancy, there is a lack of data to support a conclusion regarding increases or decreases in vehicle maintenance staffing levels currently. This lack of conclusive data to support increases coupled with the fact that there is no significant increase in Thunder Bay Transit's fleet size, it is not anticipated that additional maintenance staff will be required unless the mechanic-to-vehicle industry standard increases. As with any service expansions that are planned, Thunder Bay Transit should evaluate their maintenance needs as they would typically do at that time.

While there are not increases expected to be required in the near term for trades staff, it is recommended that additional BEB Maintenance Supervisor be added to support the existing supervisor of equipment when the BEBs arrive to address the increase to operational and maintenance complexity. This role will have a strong focus on the technical aspect of the BEBs, workforce training and transitioning maintenance operations.

Specifically, this new maintenance role will be responsible for the following tasks:

1. **Clerical/Administrative Support**:
    - Support person to assist the existing Supervisor with new aspects of the BEB transition.
    - This support role will allow the Supervisor to continue to focus on existing technical matters with the existing fleet and handle daily duties.
2. **Technical Expertise Coordination**:
    - Training development, monitoring, and actioning.
    - Coordinate high voltage personal protective equipment (PPE) and tooling.
    - Addressing labor relations matters arising from business changes.
    - BEB performance management.
    - Collaboration with the CTB Zero Emission Transition Working Group.
    - Change management (e.g., shop layout modifications, process updates, equipment specifications).
    - BEB diagnostics (software setup, IT coordination, licensing, hardware maintenance).
    - BEB charging infrastructure management (diagnostics, meetings, OEM updates, training).
    - Review, update, and training for the preventative maintenance program.
    - Risk mitigation, risk assessments, and emergency response planning.

These tasks will recur throughout each month and year as part of the ongoing BEB operations and maintenance cycle.

It is recommended thatCity of THunder Bay monitor this transition and make appropriate decisions based on observed conditions when the vehicles arrive and evolving industry best practices. The initial BEB deployment will be small and expected to largely be manageable for the existing staff. It's expected that when the transition plan is re-evaluated in 2029 that this will be an opportunity to assess how things have performed to date, understand if there are any new needs, re-evaluate those needs and adjust plans accordingly so that resources are in place to insure a successful transition.

C.3.4 INFRASTRUCTURE MAINTENANCE

A new maintenance aspect that CIty of THunder Bay will need to consider will be maintaining the charging equipment and associated electrical infrastructure required to service the battery electric vehicles. While larger agencies may already have permanent electrical trades staff as part of their facilities maintenance team, the City of Thunder Bay does not. The City will need to consider one of several models for preventative and corrective maintenance of charging infrastructure:

- Hiring of trades certified in-house staff to manage equipment.
- Engaging with a local contractor to be responsible.
- Purchasing OEM warranties/service plans; or
- Contracted design/build/maintain models like Charging as a Service (CaaS) and Energy as a Service (EaaS).

There is precedent that larger agencies such as the Toronto Transit Commission are adopting CaaS/EaaS models as it allocates the risk to the party that is best able to manage it. Transit agencies are not naturally equipped to manage electrical infrastructure and optimize energy costs, as it is not part of their core business. EaaS/CaaS can also allow for more consistent fuel/energy pricing for the transit agency, while shifting riskier aspects of infrastructure that the agency may not necessarily understand very well (such as certain operations and maintenance including periodic checks or upgrades) to the contractor.

Ultimately the decision to determine which model to adopt will depend on the capacity of the agency to manage those assets, the value offered by the contractor, and risk tolerance.

C.3.5 EMERGENCY RESPONSE

It is recommended that the City of Thunder Bay engage local emergency responders (like the fire department) to provide education and training on BEB technology and safety.

A sample engagement plan to educate the fire department on battery electric vehicles is presented below:

1. **Contact the local fire department:** The City of Thunder Bay's Transit Operations and Maintenance should work with the Fire Services to develop a training and information plan to be presented to all staff. The training can include a presentation and hands-on training session.
2. **Provide information on the BEB technology:** The City of Thunder Bay should prepare an information package on battery electric technology including information on the battery systems and charging infrastructure based on information from the OEMs. This

information will be used by the fire department to identify risks associated with battery electric vehicles and develop appropriate response strategies.

3. **Identify key safety features:** The City of Thunder Bay, in coordination with OEMs, will identify the key safety features of the battery electric vehicles (emergency shut-off switches, access points for battery disconnection). This information can helpemergency responders respond to incidents involving battery electric vehicles more effectively.
4. **Offer hands-on training:** The City of Thunder Bay should offer hands-on training opportunities for fire departments to familiarize them with battery electric vehicles and their safety features. This could involve simulations of emergency situations or demonstrations of how to disconnect a vehicle's battery system.
5. **Encourage ongoing collaboration:** The City of Thunder Bay should encourage ongoing collaboration with emergency responders to ensure that they are kept up to date on any changes to BEB technology or safety features.

Coordination and knowledge-sharing with first responders ensures that all parties are prepared to respond to incidents involving battery electric vehicles and protect passengers and employees.

APPENDIX C1: OPTA ZEB CIRRICULUM

C.4 WS1B-1: ZEB SAFETY

EV Systems Electrical: Arc Flash & High Voltage Work – LOTO, SOPs, etc.

- Developing and overseeing industry guidelines related to working around all high voltage (HV) components.
- Perform a hazardous/arc flash risk assessment on high voltage work.
- Create SOPs on specific procedures when conducting HV work.
- Electrical hazards & employee protection strategies
- Regulations & Standards (NFPA 70E / CSA Z462-21)
- Understand the approach distances and determining factors for shock and arc boundaries.
- PPE and tools for shock protection
    - Voltage rated (VR) gloves.
    - Hard hats (Class E)
    - EH & DI footwear.
    - insulated tools.
    - insulated barriers.
    - VR garments)
- Understanding and implement Lockout/Tagout (LOTO) procedures.
- Vehicle rooftop safety

BEB Thermal Events: Theory, Risk, & Mitigation

- Definition of thermal runaway.
- Determine the temperature trigger point set in the OEM software.
- Know the main causes of a thermal event.
- Determine the type of risks involved when a thermal event has occurred.
- How to deal with a thermal runaway event on property or on route – employee & public safety
- Involve First Responders – quick reference guides, annual facility walk-throughs and offer first responder training on your BEB bus technology.
- How do we park the BEB inside your facility
- After a BEB bus fire determine who, when & where should the unit be staged.

BEB Electromagnetic Interface (EMI): Theory, Risk & Mitigation

- Definition of EMI
- How to identify different types of hazards & risks with EMI
- Who would be affected with EMI (operators or maintenance technicians)

C.5 WS1B-2: ZEB TRAINING

Operator BEB Training Considerations & Guidelines

- What type of training do the operators require to safely operate a ZEB?
- Quick reference guides to follow and understand with starting procedures, instrumentation and controls, dashboard signs, and the LCD screen indicators.
- Operator vehicle Inspection/circle check
- Driver's area safety checks
- Charging on-route – loading & unloading passengers
- Emergency vehicle evacuation & shutdown
- Vehicle operation
- Operator safety Information

Maintenance BEB Training Considerations & Guidelines

- What type of HV training is involved for all maintenance staff (forepersons/supervisors & managers)
- HV certification training for authorized technicians (BEB)
- HV and low voltage basic, intermediate, and advanced electricity
- HV and low voltage electrical systems of the vehicle
- Shop safety practices and procedures
- First aid including CPR and the use of the shop defibrillator (AED)
- Quickest method of shutting down HV
- HV and arc flash safety

ZEB Academia & Certifications/Endorsements (OPTA Maintenance Committee; eMobility Training Subcommittee reporting in; STO)

- OEM – HV Safety training
- OEM - HV certification training
- Skilled Trades Programs

C.6 WS1B-3: ZEB MAINTENANCE

BEB PM Program Elements

- Visually inspecting and maintaining:
  - Inverters
  - On-board chargers
  - High voltage cabling & connections
  - Overhead charging rails – cleaning and measuring (special grease)
  - Battery casing & batteries rack inspection
  - Plug in charging ports – connector lock function, rubber plugs.

- Traction motor (special grease)
- Cooling and heating
- Weekly, monthly, quarterly, six month and yearly maintenance

BEB Maintenance-Specific KPIs and Comparative Analysis (Feeds WS1C:

- Energy Consumed Driving + Energy Idled - Energy Regenerated/Distance Driven

HV System Inspection Requirements (MTO NSCS11B)

- Scheduled semi or annual inspections on all HV BEB
- Standard/guidelines on what a qualified technician will need to complete on an BEB inspection.

APPENDIX D: BUDGET & FINANCIAL ANALYSIS

This technical report evaluates the lifecycle costs associated with the zero emissions bus (ZEB) technology currently being considered by the City of Thunder Bay as part of a fleet transition to support the City's net zero emissions climate target. As identified in the **Appendix A: Energy Modelling Report**, battery electric buses (BEB) are feasible for the City of Thunder Bay and the preferred option for the fleet transition. This report evaluates the lifecycle costs (capital, operations and maintenance, and fuel/electricity) associated with BEBs and compares them to the costs associated with continued operation of conventional diesel buses through 2050. The BEB Scenario also includes en-route charging infrastructure. As described in more detail in Sections 3 through 5, the two scenarios reflect the following:

- Baseline Scenario: Reflects the scenario where no transition to BEBs occurs. All replacements of the current diesel fleet are with additional diesel buses.
- BEB Scenario: This scenario reflects the full transition of Thunder Bay Transit's fleet to BEBs, beginning in 2025. The end of the analysis period is 2050.

Table 38 provides a comparison of projected fleet mix and operating statistics for selected years under each scenario based on the results of the Zero+ model outputs.

Table 36. Comparison of Fleet Mix and Service Levels by Vehicle Type

	2025	2030	2040
	Fleet Mix		
Baseline	**48**	**48**	**48**
Diesel	48	48	48
BEB	-	-	-
BEB	**49**	**50**	**50**
Diesel	49	37	6
BEB	-	13	44
	Kilometres Travelled		
Baseline	**3,053,840**	**3,053,840**	**3,053,840**
Diesel	3,053,840	3,053,840	3,053,840
BEB	-	-	-
BEB	**3,053,840**	**3,016,238**	**3,112,118**
Diesel	3,053,840	2,143,754	209,592
BEB	-	872,484	2,902,526
	Hours of Operation		
Baseline	**144,512**	**144,512**	**144,512**
Diesel	144,512	144,512	144,512
BEB	-	-	-
BEB	**144,512**	**145,031**	**146,897**
Diesel	144,512	104,121	8,943
BEB	-	40,909	137,954

The remainder of the technical report reflects the following:

- Key Cost Assumptions provides an overview of the capital and O&M cost assumptions used in the analysis of both scenarios.
- The Baseline Scenario and BEB Scenario sections describe key assumptions and costs drivers for each scenario. Lifecycle Cost Comparison compares the lifecycle cost results for the Baseline and BEB scenarios.
- Solar Feasibility Analysis contains cost-benefit analyses for various potential solar array installations at Thunder Bay Transit facilities.
- Finally, the Supplementary 10-Year Capital Plan Tables section displays projected capital expenditure in the BEB Scenario from 2023-2032.

D.1 KEY COST ASSUMPTIONS

The analysis relied on several assumptions to bus operating statistics and purchase schedule under the Baseline and BEB Scenarios.

The analysis presents all dollar values in net present value (NPV) terms, unless otherwise noted. NPV analysis accounts for the "time value of money": the principle that a dollar today is worth more than a dollar tomorrow. NPV is used to present costs incurred over the 2023-2050 study period on a consistent basis.

Year of expenditure (YOE) costs are discounted to 2023-dollar terms by applying a discount factor of 8%. The 8% nominal discount rate accounts for both opportunity cost and inflation. It combines a 3% inflation rate (based on guidance from the Bank of Canada) and a 5% real discount rate that is in line with what HDR's experience has been with what other transit agencies use.

D.1.1 CAPITAL COST ASSUMPTIONS

Table 39 presents the unit cost assumptions for buses and BEB charging equipment common to both scenarios.

Table 37. Bus and BEB Infrastructure Capital Cost Assumptions (2023$)

Conventional Fleet Capital Assumptions	Costs
Diesel Bus Cost	$700,000
Battery Electric Bus Cost (525 kWh)	$1,600,000
Battery Electric Bus Cost (675 kWh)	$1,874,286
Diesel Lift+ Vehicle Cost	$191,192
Battery Electric Lift+ Vehicle Cost	$400,000
En-route charger unit cost	$1,660,000

Further details on these assumptions include:

- **Planned costs between 2023 to 2050:** As described in more detail in the BEB Scenario section, Thunder Bay Transit is planning to have BEBs enter operations starting in 2027. Costs associated with this procurement were included in the BEB Scenario and reflect vehicle and BEB equipment cost estimates completed to date by City of Thunder Bay Transit staff and the consultant team. Cost estimates produced in support of the active procurement of the BEBs, and associated equipment reflect the City of Thunder Bay's current grant application for ICIP funding.
- **Annual Cost Growth Assumptions:** Capital cost estimates are in year of expenditure dollars (YOE $) and reflect a base 3 percent annual inflation assumption. The annual inflation assumption is consistent among both scenarios.
- **Bus Unit Costs:** Diesel bus costs reflect recent City of Thunder Bay procurement of 40-foot conventional buses. The BEB cost estimate was based on the current procurement process for the City of Thunder Bay's initial BEB purchases.

- **Mid-Life Bus Rehabilitation Costs:** Consistent with Thunder Bay Transit's existing operating data, this analysis assumed all bus types will have a 16-year useful life. Additionally, consistent with the current mid-life rehabilitation schedule for diesel buses, it was assumed that all vehicle types will go through one mid-life rehabilitation during the 16-year period. The mid-life rehabilitation for diesel buses reflects costs associated with diesel engine replacements, including exhaust aftertreatment replacement costs. Given the recent and on-going implementation and evolution of BEB propulsion systems, there is limited information on mid-life rehabilitation requirements for these technologies. The analysis assumed there would need to be battery replacements for the BEBs. The cost associated with these changes were assumed to be included in the purchase cost for these vehicles, based on the Metrolinx RFP for BEBs released in November 2023.
- **BEB Charging Equipment and Installation:** Cost estimates for BEB charging equipment and the installation of the charging equipment reflect recent actual costs from other agencies implementing BEB equipment. Chargers are assumed to be re-purchased after 16 years, in line with the replacement cycle for buses.
- **Update to the Transit Fleet Transition Plan in 2029:** The plan includes an update to the transit fleet transition plan after gaining experience operating BEBs in Thunder Bay. This study is planned to occur in 2029 and assumes an estimated cost of $100,000 in 2023$.

Infrastructure cost assumptions are shown in **Table 40** below. The costs shown include a 20% contingency and 10% percent engineering cost. The implementation year was assumed based on the deployment of BEBs in the conventional fleet. The detailed components and work required for each phase are detailed in the **Appendix B: Facilities Assessment Report**.

Table 38. Infrastructure Phasing Assumptions (2023$)

Project Name	Schedule	Cost	Key Infrastructure
Transit Garage Infrastructure Phase 1	Start 2025 Complete 2027	$4,890,000	Unit Sub-station #1 (4) 150 kW chargers (10) Charging dispensers (4) Lift+ chargers and dispensers
Transit Garage Infrastructure Phase 2	Start 2027 Complete 2030	$14,280,000	**(15) Bus Building expansion** + (5) 150 kW chargers (15) Charging dispensers (21) Lift+ chargers and dispensers
En-Route Charging	Start 2031 Complete 2033	$13,250,000	(4) 450 kW En-route chargers @ Waterfront Transit Hub (4) 450 kW En-route chargers at 4 other locations TBD
Transit Garage Infrastructure Phase 3	Start 2033 Complete 2035	$4,630,000	Unit Substation #2 (4) 150 kW chargers (13) Charging dispensers
Transit Garage Infrastructure Phase 4	Start 2038 Complete 2040	$1,880,000	(3) 150 kW chargers (9) Charging dispensers 650 kW backup generator for vehicle charging
***Transit Garage Infrastructure Phase 5 (Fleet Expansion)**	TBD based on expansion need	$2,040,000	(5) 150 kW chargers (15) charging dispensers
	Total	**$40,970,000**	**(62) 150 kW Charging Dispensers** **(8) 450 kW En-route Chargers** **(25) Lift+ chargers and dispensers**

Capital costs and assumptions reflect are consistent with Thunder Bay Transit's current vehicle acquisition and replacement plan. Tables in the Baseline Scenario and BEB Scenario sections summarize the annual costs of acquisition and replacement under each scenario.

D.1.2 O&M COST ASSUMPTIONS

Details on assumptions used to estimate O&M costs, fuel and electricity costs include the following:

- **Bus Operations and Maintenance:** The cost per kilometre for diesel buses was calculated from Thunder Bay Transit's 2018-2021 maintenance cost and kilometres travelled data. Annual cost data was escalated to 2023 dollars then divided by total kilometres travelled to calculate average cost per kilometre. The cost per kilometre reflects total vehicle maintenance expenses excluding fuel costs allocated to vehicle maintenance and total kilometres of service provided. A literature review of maintenance costs for BEBs identified a range of 10%-30% cost savings relative to diesel, primarily due to fewer part replacements and simpler drivetrain maintenance.[17] For BEB annual maintenance costs, a 10% cost savings assumption was applied to remain conservative.

- **Maintenance of BEB Charging Equipment:** Costs shown in the table reflect discussions with Thunder Bay Transit and values used in projects with other transit agencies to provide on-going maintenance of BEB charging equipment.
- **Annual Growth Rate for Bus O&M, and Maintenance of EV Charging:** Annual O&M costs in this analysis are in YOE dollars and reflect an annual growth of 3 percent.
- **Fuel efficiency:** Litres per 100 kilometres (L/100km) was estimated based on Thunder Bay Transit's 2022 litres per kilometre estimate and total annual kilometres travelled.
- **Propulsion Cost Assumptions:** Estimated annual diesel fuel and electricity reflect a combination of growth rate assumptions. Additionally, the following assumptions and sources were used to estimate projected change in cost of diesel and electricity.
  - **Diesel Fuel Costs:** The analysis assumed diesel fuel costs in 2023 were $1.60 per litre. This assumption was based on the average wholesale price for diesel fuel in the City of Thunder Bay in 2023 and adding federal and provincial taxes. Most taxes were assumed to remain constant on a per litre basis over the study period. The provincial carbon levy was added to the wholesale cost of diesel and escalated by the scheduled increase in federal carbon prices per tonne until 2030.[18] For this analysis, the US Energy Information Administration's Annual Energy Outlook 2023 forecast for diesel prices provided the additional annual cost rate change assumption. Prices were escalated by 3 percent annually to be converted to YOE dollars. The analysis assumed a 5% efficiency loss between chargers and BEBs.
  - **Electricity Costs:** There are two categories of electricity costs that were included in the analysis: per kilowatt hour (kWh) usage fee and a peak demand charge per kilowatt. The values shown in the table below were obtained from Thunder Bay Transit's electricity invoice from March 22, 2023, issued by Synergy North. The dollar per kWh ($/kWh) usage fee is based on the average Hourly Ontario Energy Price and the Global Adjustment Factor for 2023. Annual electricity costs for the BEB Scenario reflect the energy usage outputs from the Zero+ Model applied to these rates.

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[17] publications.anl.gov/anlpubs/2021/05/167399.pdf

[18] Update to the Pan-Canadian Approach to Carbon Pollution Pricing 2023-2030 - Canada.ca

- **Staff right-sizing:** Two additional roles were identified in the staffing and training plan and the costs of those roles are included in plan to support the fleet transition. The two roles are an Energy Project Manager and BEB Maintenance Supervisor role. Both roles begin in 2026, and the combined salary for both positions is $202,150 per year, which escalates annually at a rate of 3%.

Similar to capital costs, for both scenarios, annual O&M costs that will be incurred between 2023 and 2050 reflect the annual hours and miles of service by bus type shown in **Table 41** as well and the equipment and infrastructure needed for BEBs shown previously in **Table 40.**

Table 39. Annual Operating and Maintenance Cost Assumptions (2023$)

Conventional Fleet Operating Assumptions	Diesel	BEB
Operating Cost ($/hr)	$95.85	$95.85
Maintenance Cost ($/km)	$0.67	$0.61
BEB Maintenance Cost Efficiency Factor	-	10%
Depot Dispenser Maintenance Cost ($/year)	-	$1,986
Charger Maintenance Cost ($/year)	-	$12,000
Charger Efficiency	-	95%
Average Useful Life of New Bus	12	12
Bus Fuel Efficiency (L/100 km)	56.2	-
Spare Bus Ratio (Peak Fleet/Total Fleet)	33%	33%
Average BEB:Diesel Transition Ratio	-	1.20
Additional Labor Cost for Transition Plan	-	$202,150
Mid-Life Rehabilitation Cost ($)	$92,578	-

It is important to acknowledge that operationally, several costs remain uncertain and are excluded from the analysis as City of Thunder Bay is not yet able to determine how material those costs will be. These include expenses related to acquiring new tools or components, stocking new parts in inventory, labour time required for training personnel, managing communications, and software system upgrade costs. Those costs will be and will need to be assessed after operating BEBs for a period and will be re-evaluated at the transition plan update in 2029.

D.1.3 PARATRANSIT ASSUMPTIONS

In addition to the conventional fleet, Thunder Bay Transit also operates a paratransit fleet, Lift+. Lift+ capital and operating expenses are presented separately from the conventional fleet. Lift+ vehicle operating statistics were calculated from Thunder Bay Transit data for 2022. The average daily kilometres driven, hours utilized, and utilization factor were combined to calculate the operating statistics for the fleet on an annual basis. The Lift+ fleet is expected to grow from 27 vehicles to 39 vehicles to meet future service needs and accommodate vehicle swaps for battery electric replacements. **Table 42** shows the operating assumptions for the Lift+ fleet.

Table 40. Operating and Maintenance Assumptions for the Lift+ Fleet.

Paratransit Fleet Operating Assumptions	Diesel	BEB
Maintenance Cost	$0.61	$0.55
Average Useful Life of New Vehicle	8	8
Gasoline Fuel Efficiency (L/100 km)	32	-
Daily Energy Usage for Lift + Vehicles (kWh)	-	57
Lift + Weekly Utilization Factor		
Lift + Average Daily Kilometres Driven	146	146
Lift + Average Daily Hours Utilized	9	9
Average Lift + Extra Trips to Charge BEVs	-	2
Roundtrip Distance to/from Depot (km)	-	20
Average Speed to/from Depot (km/h)	-	40

D.2 BASELINE SCENARIO

As described above, the Baseline Scenario refers to no transition to electric vehicles over the study period and the current diesel fleet is replaced by new diesel buses on as an-needed basis.

D.2.1 CAPITAL COST ASSUMPTIONS AND ESTIMATES

Under the Baseline Scenario, the fleet mix remains entirely diesel for the duration of the study period. The City of Thunder Bay provided a fleet retirement schedule on November 15, 2022, which was used to determine the capital purchase assumptions by year. **Table 43** illustrates the annual capital purchase assumptions for diesel buses based on the fleet retirement schedule. Over the 2023 to 2050 period, total diesel bus capital costs for the Baseline Scenario were estimated to be $33.2 million in discounted 2023$ terms.

Table 41. Annual Capital Purchases / Infrastructure Implementation Assumptions, Selected years

	2023 - 2030	2031 - 2040	2041 - 2050
Diesel Bus	24	27	34
Peak Service	16	18	23
Spares	8	9	11
BEBs	-	-	-

Table 44 presents the annual costs estimates based on the unit cost and growth rate assumptions and the annual fleet needs described in **Table 43**. The values are in YOE dollars, meaning they are escalated to reflect anticipated actual costs in a future year.

Table 42. Annual Capital Cost Estimates, Selected years, (YOE $, millions)

	2023 - 2030	2031 - 2040	2041 - 2050
Diesel Bus	$18.9	$27.0	$45.9
BEBs	-	-	-
Total	**$18.9**	**$27.0**	**$45.9**

D.2.2 O&M COST ASSUMPTIONS AND ESTIMATES

Under the Baseline Scenario, as shown in **Table 45** the total of annual hours and miles operated by diesel buses remains at the 2023 service levels through 2050. The study considered what it would take to convert the current fleet to BEBs. Any future ridership or service expansions were not included in the analysis.

Table 43. Annual Service Levels by Bus Type

	2023-2050
KMs Travelled	3,053,840
Hours of Operation	144,512
Litres of Fuel Consumed	1,717,234

The annual operating and vehicle maintenance costs between 2023 and 2050 were calculated based on multiplying the kilometres travelled by diesel buses by the estimated maintenance cost per kilometre. Under the Baseline Scenario, the estimated total operating and maintenance costs were projected to be $254.8 million in discounted 2023 dollars over the entire study period. **Table 46** displays the annual O&M costs by year of expenditure.

Table 44. Annual O&M Costs, Selected years, (YOE$, millions)

	2023	2025	2030	2035	2040	2045
Cost per Kilometre	$0.67	$0.71	$0.83	$0.96	$1.11	$1.29
Cost per Hour	$95.85	$101.69	$117.88	$136.66	$158.42	$183.66
Annual Maintenance Cost	**$2.1**	**$2.2**	**$2.5**	**$3.7**	**$3.9**	**$4.5**
Annual Operations Cost	**$13.9**	**$14.7**	**$17.0**	**$19.7**	**$22.9**	**$26.5**
Total	**$15.9**	**$16.9**	**$19.6**	**$23.5**	**$26.8**	**$31.0**

It's important to note that while most costs are captured here, some operational costs such as staff time to attend training, stocking new parts inventory, operations software subscription costs have been excluded from the analysis as there is currently not enough information to accurately determine what those costs are and if they will be required.

D.2.3 DIESEL FUEL COST ASSUMPTIONS AND ESTIMATES

Under the Baseline Scenario, diesel fuel costs are considered the only driver of propulsion cost estimates over the period.

The annual diesel fuel costs were calculated based on the annual kilometres travelled included in **Table 45** above. The estimated diesel fuel consumed by buses was calculated by multiplying the average fuel economy (litres/km) from the City of Thunder Bay fleet data and the total kilometres travelled. The litres of fuel were then multiplied by the average price per litre of diesel detailed in the O&M Cost Assumptions section above. The diesel cost calculation is shown in **Table 47** below.

Table 45. Annual Diesel Costs, (YOE$, millions)

	2023	2025	2030	2035	2040	2045
Average Cost per Litre of Diesel	$1.60	$1.80	$1.97	$2.34	$2.77	$3.25
Carbon Levy for Diesel Fuel	$0.13	$0.20	$0.35	$0.35	$0.35	$0.35
Annual Diesel Fuel Cost	**$2.7**	**$3.1**	**$3.4**	**$4.0**	**$4.8**	**$5.6**

D.3 BEB SCENARIO

D.3.1 CAPITAL COST DRIVERS AND ANNUAL COST ESTIMATES

The focus for the BEB Scenario is the financial impact of the changes in fleet mix and associated capital infrastructure and service plans over the 2023 to 2050 period. **Figure 77** and **Figure 78** present the incremental replacement of all diesel buses with BEBs over this period in terms of the fleet mix and annual levels of service.

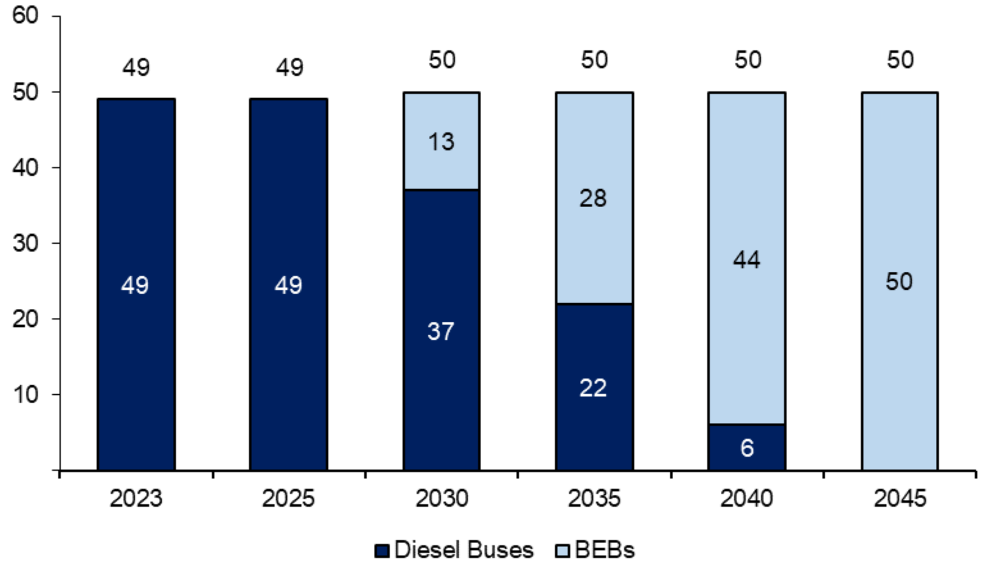


Figure 77. Annual Fleet Mix Assumptions, Selected Years

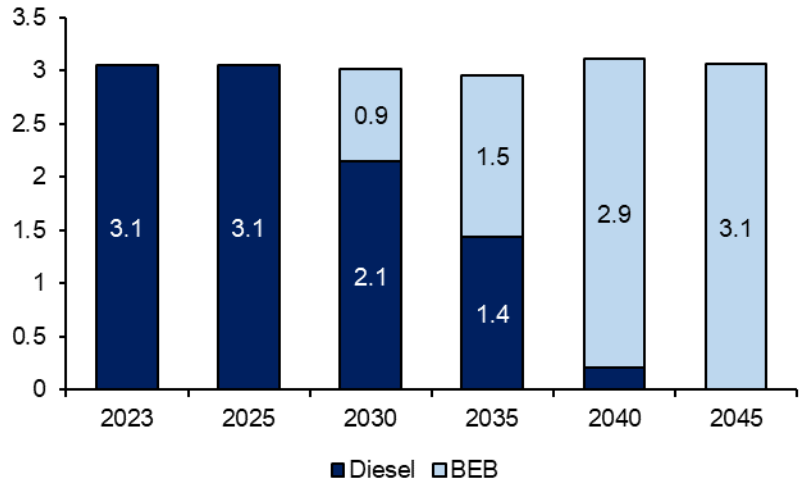


Figure 78. Annual Kilometres of Service by Bus Type, Selected years (millions)

Table 48 summarizes the capital purchases that will occur between 2023 and 2050 within each decade and indicates most capital costs will be associated with on-going replacement of diesel buses, and the acquisition and implementation of EV charging equipment. The last diesel buses purchased occur in 2026.

Table 46. BEB Capital Purchase Assumptions

	2023 - 2030	2031 - 2040	2041 - 2050
Diesel Bus	6	-	-
Battery Electric Bus	19	27	35
In-Depot Charger	25	22	-
En-route Charger	-	4	-

BEBs are purchased two years prior to entering service. **Table 49** presents the annual costs estimates for selected periods based on the unit cost, growth rate assumptions and the annual capital needs.

Table 47. Annual Capital Cost Estimates, Selected years, (YOE $, millions)

	2023 - 2030	2031 - 2040	2041 - 2050
Diesel Bus	$4.5	-	-
Battery Electric Bus	$29.8	$61.2	$96.9
Additional Infrastructure	$20.9	$18.7	$20.1
Total	**$55.1**	**$79.9**	**$117.0**

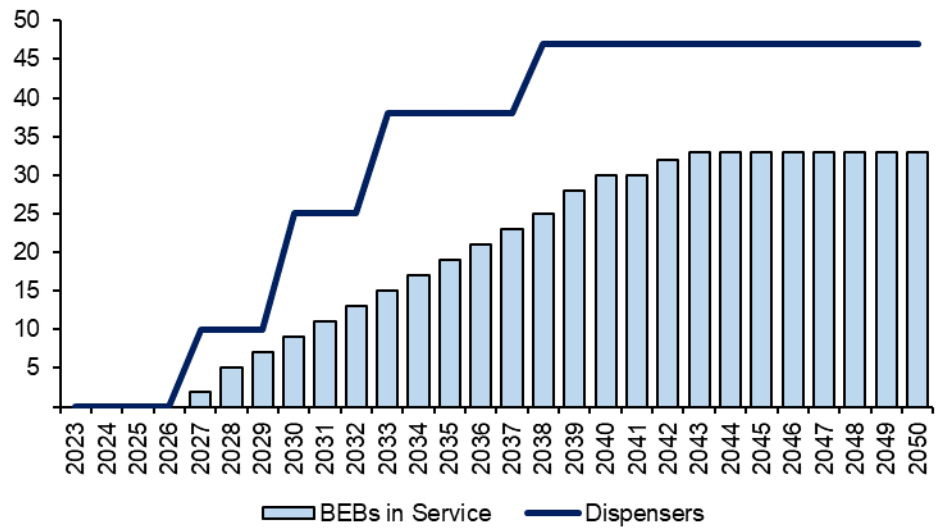


Figure 79 below shows the implementation of BEBs in line with the number of dispensers in service based on the three-stage fleet phasing plan.

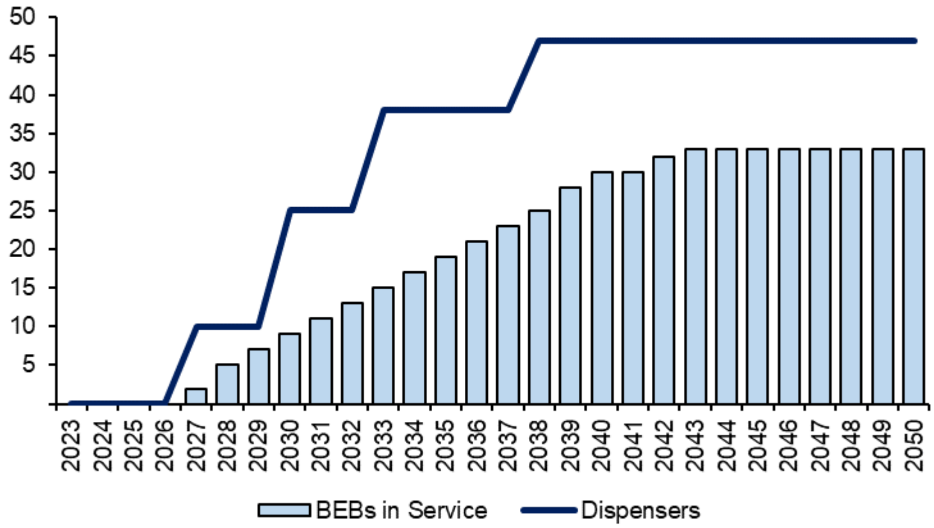


Figure 79. Peak Service BEBs & Dispensers in Service

Over the 2023 to 2050 period, total capital costs for the BEB Scenario were estimated to be $126.9 million in discounted 2023$. As shown on the previous figures and tables, the BEB fleet transition would occur between 2027 and 2044. To accommodate the BEB fleet, a total of 47 150kW in-depot dispensers and eight (8) 450kW en-route chargers will be acquired between 2024 and 2038.

D.3.2 O&M COST ASSUMPTIONS AND ESTIMATES

Figure 80 summarizes the change in annual O&M cost allocation among the fleet mix under the BEB Scenario. In the model, blocks were converted from diesel to electric buses using a two-step prioritization method. Blocks were prioritized first if they can be converted without the need for en-route charging infrastructure. After all blocks that meet the en-route criterion were transitioned to electric buses, the second step prioritizes blocks based on total kilometres travelled in descending order.

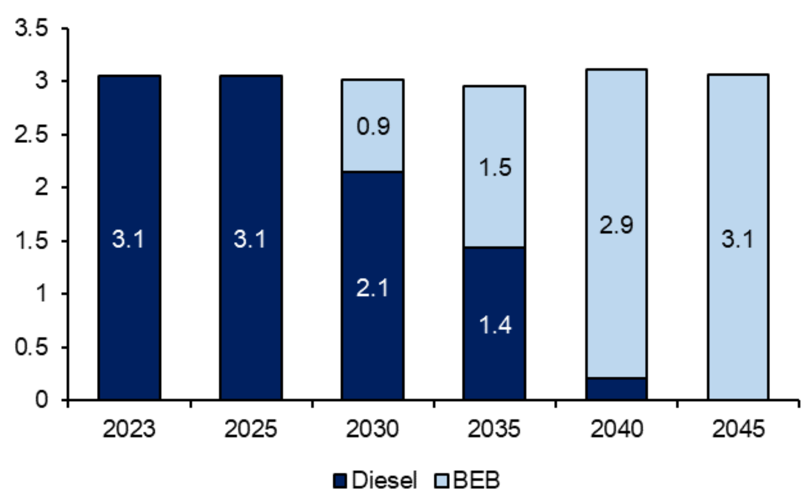


Figure 80. Annual Kilometres Travelled Levels by Bus Type, millions.

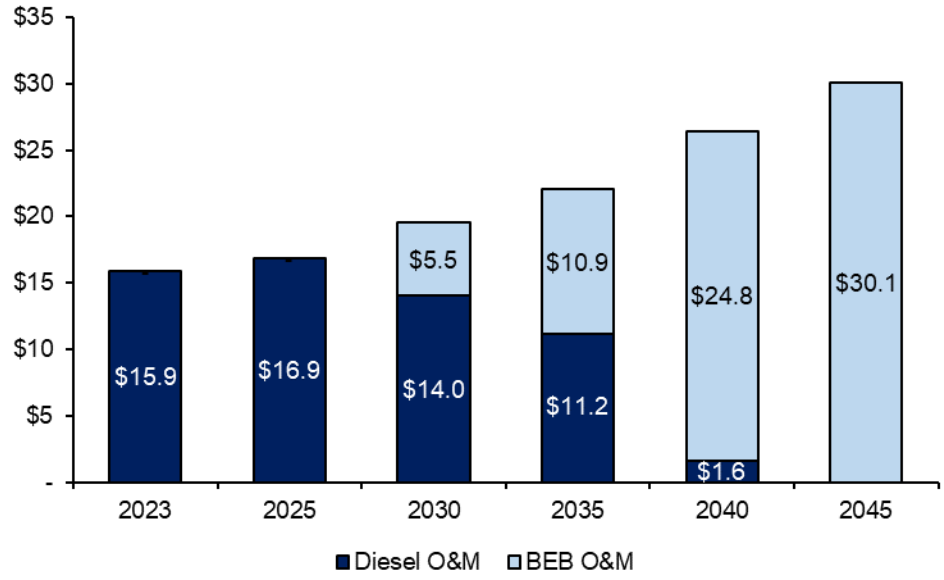


Figure 81 below summarizes the incremental transition from diesel to BEBs and the associated change in the allocation of O&M costs among the vehicle types.

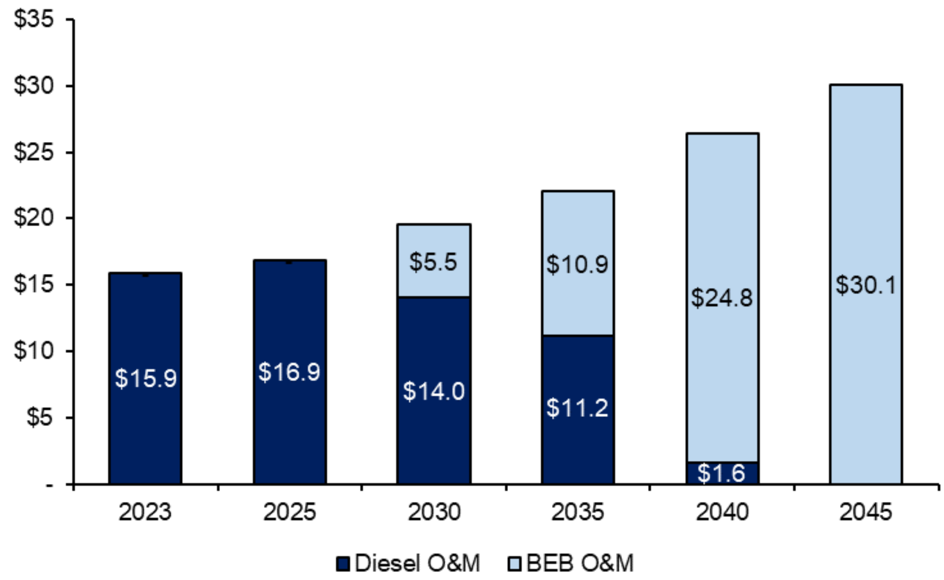


Figure 81. Annual O&M Costs by Bus Type, (YOE$, millions)

Table 50 summarizes the annual vehicle maintenance costs, incremental labour costs, mid-life rehabilitation costs, and the annual EV chargers' maintenance costs between 2023 and 2050. As noted above, by 2040 the entire fleet has been transitioned to BEBs.

Table 48. Annual O&M Costs by Bus Type, (YOE$, millions)

	2023	2025	2030	2035	2040	2045
Diesel O&M	$2.1	$2.2	$1.8	$1.6	$0.3	-
BEB O&M	-	-	$0.6	$1.3	$2.8	$3.5
Incremental Labour	-	-	$0.2	$0.3	$0.3	$0.4
Enroute Charger Maintenance	-	-	$0.1	$0.3	$0.4	$0.5
Total	**$2.1**	**$2.2**	**$2.7**	**$3.6**	**$3.8**	**$4.4**

Under the BEB Scenario, it was estimated that operating and maintenance costs will total $255.3 million and reflect a combination of $219.2 million for vehicle operating, $31.2 million for vehicle maintenance, $2.6 million in incremental labour and planning costs, and $2.0 million in depot and en-route charger maintenance, all in discounted 2023$ terms.

D.3.3 DIESEL FUEL AND ELECTRICITY USAGE COST ESTIMATES

Based on the methodology described in O&M Cost Assumptions, **Table 51** summarizes the fuel and electricity cost estimates for the BEB scenario for selected years over the 2023 to 2050 period. These costs were estimated to be $25.0 million for diesel and $8.2 million for electricity, discounted which includes the kWh usage charges and peak demand charges. Note that the remaining diesel costs in the 2045 period are estimating the fuel consumption of the diesel fired heaters.

Table 49. Fuel and Electricity Cost Drivers and Annual Cost Estimates (YOE $, millions)

	2023	2025	2030	2035	2040	2045
kWh Usage	-	-	1,324,996	2,293,042	4,584,864	4,822,287
Litres of Fuel Consumed	1,717,234	1,717,234	1,235,363	858,397	217,287	104,734
Annual Diesel Fuel Costs	$2.7	$3.1	$2.4	$2.0	$0.6	$0.3
Annual Electricity Costs	-	-	$0.3	$0.6	$2.0	$2.3
Total	**$2.7**	**$3.1**	**$2.8**	**$2.6**	**$2.6**	**$2.7**

Electricity and fuel costs change substantially over time under the BEB Scenario. This is illustrated in **Figure 82** below.

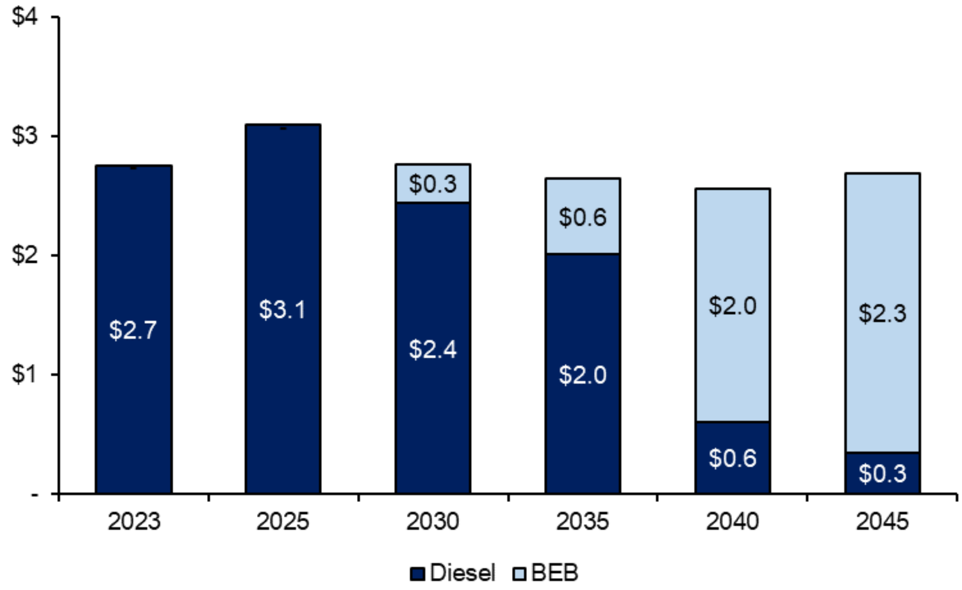


Figure 82. Electricity and Diesel Costs, Selected Years, (YOE $, millions)

D.3.4 PARATRANSIT OPERATIONS

Thunder Bay Transit operates a paratransit service fleet along with its conventional fleet. Capital purchases for the Lift+ fleet based on the projected retirement of existing Lift+ vehicles and the planned introduction of new vehicles to the fleet are shown in **Table 52**. Additional infrastructure requirements prepared by HDR are included in these estimates.

Table 50. Paratransit Capital Purchases, Selected Years, YOE$ millions

	2023 - 2030	2031 - 2040	2041 - 2050
Gasoline	2	-	-
BEB	24	45	33
Lift + Chargers	25	-	-

Figure 83 below displays the paratransit fleet composition by vehicle type for selected years in the study period. Based on the planned retirement of current diesel vehicles, the entire fleet is expected to be converted to BEVs by 2033.

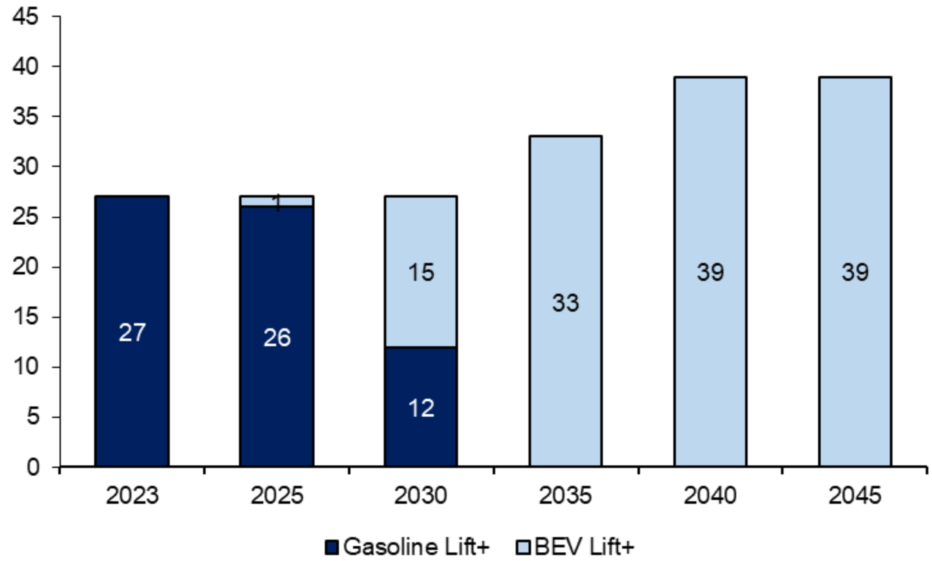


Figure 83. Lift+ Fleet Composition, Selected Years

Table 53 below displays the costs associated with the purchase schedule of BEV Lift+ vehicles in **Table 52**.

Table 51. Paratransit Capital Costs, Selected Years, YOE$ millions

	2023 - 2030	2031 - 2040	2041 - 2050
Gasoline	$0.4	-	-
BEB	$8.0	$23.9	$23.1
Lift+ Chargers	$1.9	-	-
Total	**$10.3**	**$23.9**	**$23.1**

Table 54 contains the annual maintenance costs for the Lift+ vehicles indicating the planned introduction of BEVs, and the maintenance associated with the chargers used for the Lift+ BEV fleet.

Table 52. Annual Maintenance Costs, Selected Years, YOE$, millions

	2023	2025	2030	2035	2040	2045
Gasoline	$0.3	$0.3	$0.2	-	-	-
BEV	-	$0.01	$0.2	$0.4	$0.5	$0.6
Lift+ Charger Maintenance	-	-	$0.01	$0.1	$0.1	$0.1
Total	**$0.3**	**$0.3**	**$0.4**	**$0.5**	**$0.6**	**$0.7**

D.3.5 SUMMARY

Under the BEB Scenario, the total cost of implementation is $421.9 million in discounted 2023 dollars. The total capital costs are $127.2 million. Total lifecycle O&M costs of $295.3 million include operations, maintenance, incremental labour, and propulsion costs. Operations and maintenance make up the largest fraction of lifecycle costs with approximately $255.3 million in costs in discounted 2023 dollars.

Table 53. BEB Scenario Summary, (discounted 2023$, millions)

Net Present Value, 2023$	Baseline	BEB
Lifecycle Capital Costs	**$44.7**	**$126.9**
Buses	$33.2	$76.7
Non-Revenue	$11.5	$23.1
Related Infrastructure	-	$27.2
Lifecycle O&M	**$308.3**	**$295.5**
Operations & Maintenance	$259.8	$255.5
Propulsion	$47.9	$34.8
Related Infrastructure O&M	-	$2.0
Incremental Labour Costs	-	$2.7
Total	**$352.4**	**$421.9**

D.4 LIFECYCLE COST COMPARISON

This section provides a comparison of the capital, O&M, and fuel/electricity cost estimates for the two scenarios over the entire 2023-2050 period. All values are presented in NPV terms, unless otherwise noted.

D.4.1 CAPITAL COST COMPARISON

Table 56 provides a comparison of total capital costs among the two scenarios. As shown in the table, the BEB Scenario is more than twice as expensive due primarily to the difference in vehicle costs as well as the additional equipment and infrastructure investments that would be required for BEB implementation.

Table 54. Capital Cost Comparison, 2023$ millions

	Baseline	BEB
Diesel	$44.7	$4.3
BEB	-	$95.5
Bus Purchases	$44.7	$99.7
Additional Infrastructure	-	$27.2
Total	**$44.7**	**$126.9**

D.4.2 OPERATIONS AND MAINTENANCE COSTS COMPARISON

Table 57 provides a comparison of total operating and maintenance cost estimates over the 2023 to 2050 period based on the assumptions described in the prior sections. As mentioned earlier the primary unknown for O&M costs is vehicle maintenance costs for BEBs. The technology is still relatively new and long-term detailed analysis of vehicle maintenance and operating costs is not available.

Table 55. O&M Cost Comparison, 2023$ millions

	Baseline	BEB
Bus O&M Costs	$259.8	$255.5
BEB Charger Maintenance Costs	-	$2.0
Incremental Labour Costs	-	$2.6
Total	**$259.8**	**$260.1**

D.4.3 FUEL AND ELECTRICITY COSTS COMPARISON

Finally, **Table 58** provides a comparison of total costs for diesel fuel and electricity over the 2023 to 2050 period. Based on the assumptions in this analysis, BEBs would have lower fuel and electricity costs on a discounted basis.

Table 56. Fuel and Electricity Cost Comparison, 2023$ millions

	Baseline	BEB
Diesel Costs	$47.9	$26.0
Electricity Costs	-	$8.8
Total Costs	**$47.9**	**$34.8**

D.4.4 NET PRESENT VALUE ANALYSIS

A net present value (NPV) and payback period analysis was conducted to compare the BEB Scenario to the Baseline Scenario. This analysis included capital costs (vehicles, charging equipment, infrastructure needs, and mid-life rehabilitation) and O&M costs (operations, maintenance, and fuel) for both the BEB Scenario and the Baseline Scenario. Cost savings over the 2023 to 2050 period are presented in 2023 dollars and discounted at eight percent.

The purpose of this analysis is to determine if the upfront capital costs can be overcome by operating cost savings being driven by reduced maintenance and fuel costs. This analysis assumes no changes to ridership or service levels. The analysis only looks at direct cost impacts to Thunder Bay Transit and does not attempt to monetize public benefits to society.

Additionally, the analysis assumes that capital costs will not be offset by grant or incentive funding. Including additional funding sources, such as ICIP or ZETF, may affect the results of the analysis. However, since these funds have not been applied for or secured by the City of Thunder Bay, they are not included in this analysis.

The transition to BEBs is anticipated to cost $69.5 million (discounted) more than maintaining a fully diesel fleet. The result shows that the higher capital costs of BEB buses is not offset by

O&M and propulsion cost savings relative to the Baseline Scenario. Therefore, by 2050, the investment in the BEB transition will have not yet broken even.

Table 57. Lifecycle Costs - All Scenarios

	Baseline	BEB
Life Cycle Capital Costs	**$44.7**	**$126.9**
Buses	$33.2	$76.7
Non-Revenue	$11.5	$23.1
Related Infrastructure	-	$27.2
Life Cycle O&M	**$308.3**	**$295.5**
Bus Operations & Maintenance	$259.8	$255.5
Propulsion	$47.9	$34.8
Related Infrastructure O&M	-	$2.0
Incremental Labour Costs	-	$2.7
Total	**$352.4**	**$421.9**

D.5 SUPPLEMENTARY 10-YEAR CAPITAL PLAN TABLES

This section provides a more detailed year by year capital plan for the BEB Scenario (40' buses only), and supplemental charts to illustrate the impact on the fleet mix. As noted above in the BEB Scenario section, the capital plan aligns with the expected regular retirement of the current fleet and the vehicle and infrastructure purchases are assumed to be made two years in advance of vehicles or infrastructure entering service.

D.5.1 INITIAL TRANSITION SCENARIO

This section considers the "normal" transition schedule that adheres to the planned retirement of diesel vehicles. **Table 60** contains an annual breakdown of capital purchases from 2023-2032.

Table 58. Capital Purchase Assumptions, 2023-2032

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Diesel Bus	-	2	2	2	-	-	-	-	-	-
Battery Electric Bus	-	-	2	4	3	3	3	3	3	3
In-Depot Charger	-	-	10	-	15	-	-	-	-	-
En-route Charger	-	-	-	-	-	-	-	-	8	-

Figure 84 contains the total fleet composition from 2023-2032, indicating the changes to fleet mix based on the purchase schedule presented in **Table 23**.

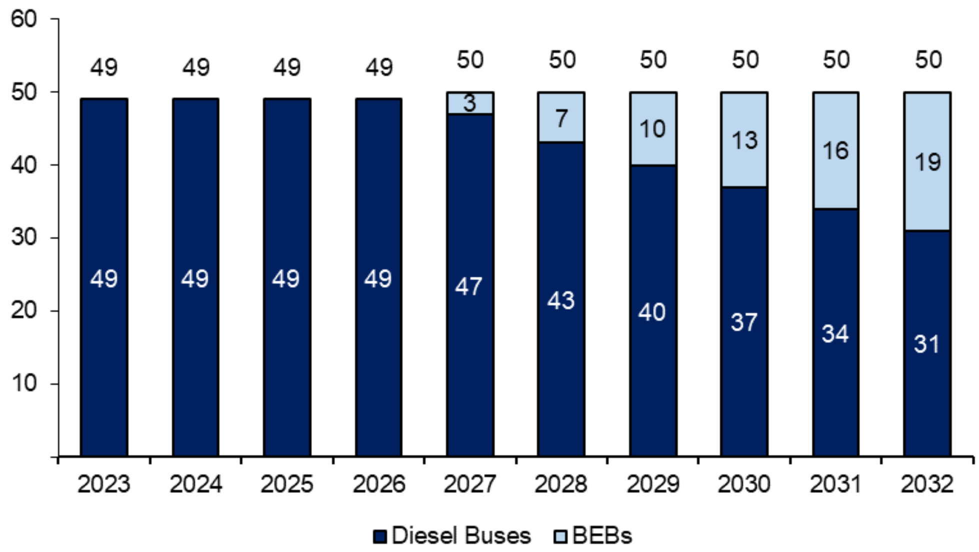


Figure 84. Total Fleet Composition, 2023-2032

Table 61 applies the assumed capital costs to the capital purchase schedule presented above.

Table 59. Capital Cost Assumptions, 2023-2032, YOE$ millions

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Diesel Bus	-	$1.4	$1.5	$1.5	-	-	-	-	-	-
Battery Electric Bus	-	-	$5.1	$7.0	$5.4	$5.6	$6.7	$6.9	$7.1	$7.3
Additional Infrastructure	-	$0.3	$5.3	-	$13.7	$1.6	-	-	-	-
En-route Charger	-	-	-	-	-	-	-	-	-	-
Total	**-**	**$1.8**	**$11.9**	**$8.5**	**$19.1**	**$7.1**	**$6.7**	**$6.9**	**$7.1**	**$7.3**

Figure 85 contains the necessary in-service schedule for dispensers relative to the number of BEBs in service. Both items are assumed to be purchased two years ahead of entering service. Dispensers are introduced based on a five phase plan included in the facility assessment. The plan ensures that introductions of BEBs in will have sufficient access to in-depot charging. Phase 5 includes charging that would be installed for expansion buses that would be procured after 2040. The buses procured after 2040 are not reflected in the "BEB in Service" as the exact year or route assignment of those vehicles is not known.

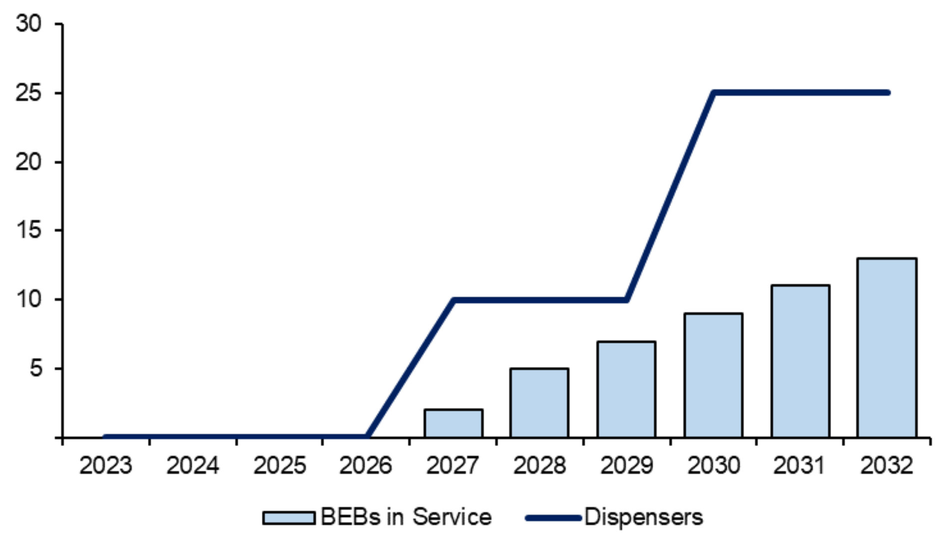


Figure 85. Peak BEBs and Dispensers in Service, 2023-2032

APPENDIX E: Greenhouse Gas Analysis

With the City of Thunder Bay working towards it's net-zero goal by 2050, an important consideration are the potential greenhouse gas (GHG) emission reductions that may be realized from the transition to BEBs. HDR performed supplementary calculations to quantify the impacts of BEB operations on GHG emissions relative to the Baseline Scenario. The analysis does not consider the GHG emissions associated with constructing new BEB infrastructure or emissions associated with the resource extraction and construction required for BEBs.

E.1 ASSUMPTIONS AND METHODOLOGY

The analysis quantifies GHG impacts based on estimates of diesel fuel and electricity usage by conventional transit buses over the 2023-2050 period. The following assumptions were used to quantify emissions based on litres of fuel and kWh of electricity consumed.

The emission rate for diesel fuel was assumed to be 2.262 kilograms (kgs) of carbon dioxide (CO_2) per litre of fuel. This value was obtained from the Canadian National Inventory Report, 2023. The emission rate was multiplied by the annual litres of fuel consumed to calculate the annual kgs of CO_2 emitted. This value was then converted to tonnes. To quantify the impact of electricity usage on GHG emissions, the total kWh of electricity used per year was multiplied by the corresponding Electricity Emission Intensity factor for Ontario from 2023 to 2050. This factor represents the kg of CO_2 per kWh based on the average electricity grid mix for the province each year. The intensity factor declines over time due to anticipated introduction of new renewable power generation sources. The values for electricity emissions were then converted to tonnes.

E.2 GHG EMISSION REDUCTION IMPACTS

Based on the assumptions above, the GHG emissions from BEB operations are summarized in **Table 62** below. Over the study period, BEBs would reduce emissions by approximately 60,000 tonnes.

Table 60. GHG Emissions, Baseline and BEB Scenarios, Selected Years and Total, tonnes

	2025	2030	2040	Total
Baseline	**3,884**	**3,884**	**3,884**	**108,763**
Diesel	3,884	3,884	3,884	108,763
BEB	-	-	-	-
BEB Scenario	**3,884**	**2,834**	**652**	**48,891**
Diesel	3,884	2,794	519	46,469
BEB	-	40	133	2,422

This reduction is due to the dramatically lower operating emissions of BEBs relative to diesel buses. **Figure 86** below shows the annual GHG emissions from operations as the fleet mix changes in the BEB Scenario. There is a substantial decline from nearly 4,000 tonnes of GHGs per year to nearly 400 tonnes per year in the BEB Scenario.

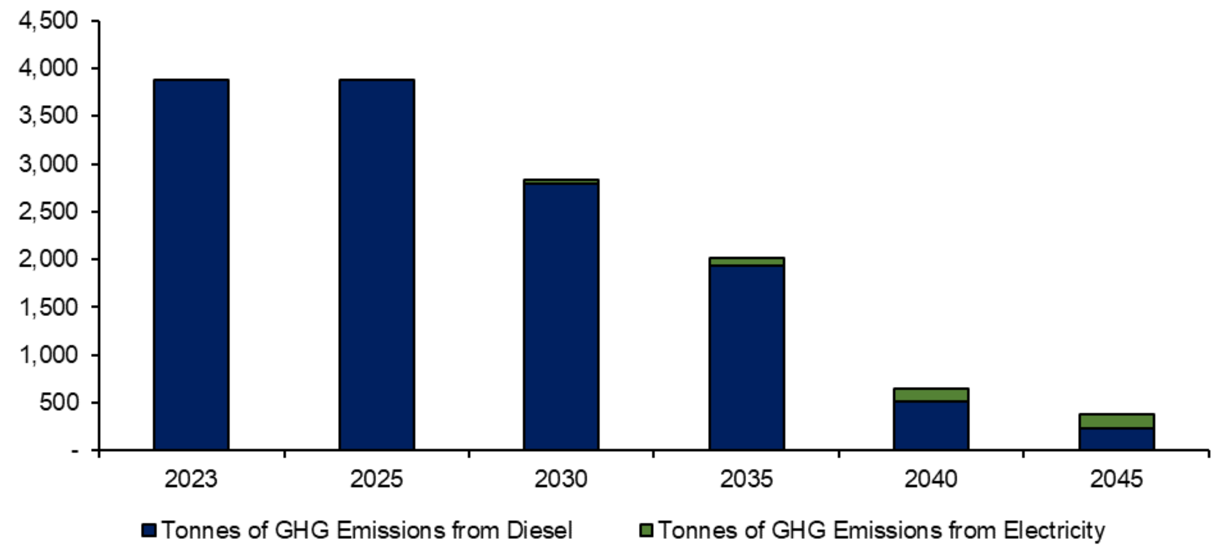


Figure 86. Annual GHG Emissions, BEB Scenario, tonnes

The cumulative reduction in GHG emissions in percentage terms is shown in **Figure 87** below:

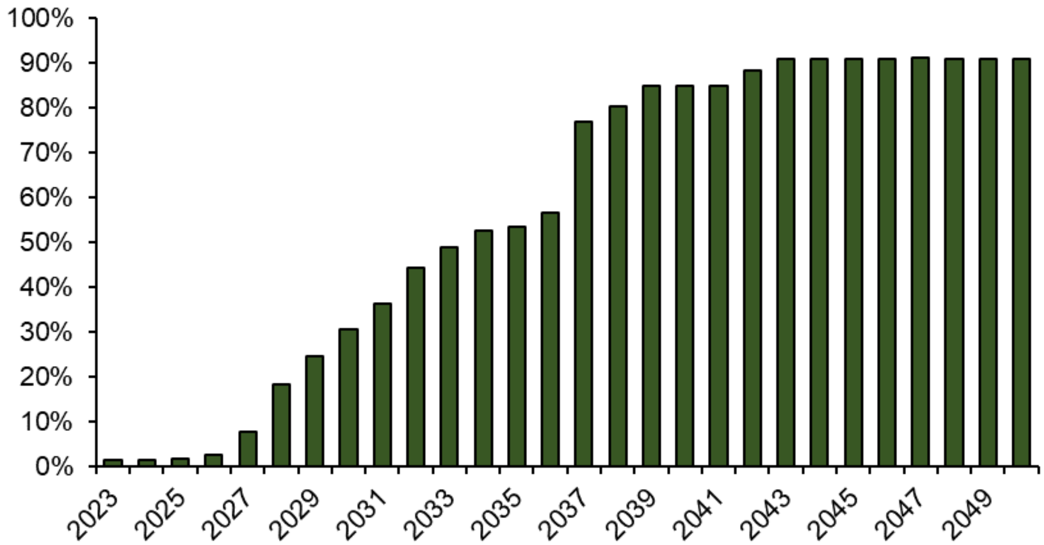


Figure 87. Cumulative GHG Reductions in BEB Scenario, percent

The annual reduced emissions grow substantially over time as the diesel fleet is converted to BEBs. At the end of the transition, GHG emissions have been reduced by approximately 91%. The remaining GHG emissions are a result of the GHG emissions from electricity production and the emissions from the diesel fired auxiliary heaters.

As the energy grid transitions to cleaner sources of electricity, Thunder Bay will see some of these emissions reduce but unless the electrical grid eliminates its emissions, there may always be some emissions from electricity production.[19]

Emissions from the diesel auxiliary heaters will require that the City of Thunder Bay monitor the bus market and evaluate other options for heating of the bus in colder weather. Another option may be switching to a more sustainable drop-in fuels such as renewable diesel in diesel fired heaters to reduce lifecycle carbon emissions.[20]

While the transition plan addresses the revenue vehicle emissions, other aspects of the operation such as the non-revenue vehicles and building systems will also need to be transitioned over the coming years. The transition to BEBs gets the City of Thunder Bay's revenue transit fleet more than 90% towards its goal of having the transit fleet be net-zero by 2050. Net-zero allows for some emissions to remain and be offset, the remaining GHG emissions

[19] Powering Canada Forward: Building a Clean, Affordable, and Reliable Electricity System for Every Region of Canada

[20] REC – Market Snapshot: New Renewable Diesel Facilities Will Help Reduce Carbon Intensity of Fuels in Canada (cer-rec.gc.ca)

can be addressed either by working to improve the remaining two sources of GHG emissions mentioned above or potentially looking at utilizing carbon offsets.

APPENDIX F: SOLAR FEASIBILITY ANALYSIS

HDR prepared a solar feasibility analysis to assess the cost effectiveness of installing solar photovoltaic (PV) units on various the City of Thunder Bay transit properties. **Table 63** below contains the general assumptions used in the solar feasibility analysis. HDR performed the solar analysis to estimate the nameplate capacity in kW and annual generation in kWh based on the characteristics of the facilities.

Table 61. Solar Analysis Assumptions

General Inputs	Value	Notes/Source
Base Year	2023	
Study Period	30	Assumed
End Year	2053	Calculated using base year and study period
Discount Rate	8%	Assumed
Price Escalation	2%	Assumed
Solar Degradation	-0.5%	Assumed
O&M Escalation	2%	Assumed
$/kW CapEx (Cdn Source)	$3,000	Natural Survey Report of PV Power Applications in Canada suggests value of $2.10 per Watt (W), increased with contingency to $3/W value.
$/kW OpEx	$28.80	Index | Electricity | 2022 | ATB | NREL
2020 USD/CAD Conversion	1.3415	Annual exchange rates - Bank of Canada
Watt to Kilowatt Conversion	1,000	Known conversion
2023 Average Electricity Price	$	Average HOEP, summed with Average Global Adjustment Factor, TB $/kWh rate per 2023 invoice, units $/kWh
Solar Panel Density	150	Watt per square meter (W/m^2)

There are four options considered in the analysis including two at Fort William Road Transit Garage, and one at Waterfront Transit Hub. Annual kWh demanded, and solar generation was prepared by HDR for each option:

- Fort William Road Transit Garage (1): Under this option, new solar panels are installed to cover remaining surface area of the facility roof, leftover from existing installation. Nearly 5,000 square meters would be available for solar panels, allowing for a nameplate capacity 750 kilowatts (kW). Annual generation would be approximately 900,000 kWh.
- Fort William Road Transit Garage (2): Under the second Fort William Road option, new solar panels are installed in the empty field south of the transit garage. The installed

capacity would be about 1000 kW and occupy a space of approximately 6,700 square meters. Annual generation would be approximately 1.2 MWh.

- Waterfront Transit Hub: Under the Waterfront Transit Hub option, new solar panels are installed on a new overhead gantry structure above the bus loop area. The installed capacity would be about 144 kW and occupy a space of 961 square meters. Annual generation would be approximately 178,200 kWh.

A summary of assumptions by project is shown below in **Table 64**. The capital and annual O&M costs are calculated using the $/kWh values in **Table 63** above.

Table 62. Project-Specific Assumptions

Variable	Ft William Road Transit Garage 1	Ft William Road Transit Garage 2	Waterfront Transit Hub
Capital Cost ($)	$2,245,800	$3,000,000	$432,300
Annual O&M ($)	$21,559	$28,799	$4,150
BEB Demand (kWh)	2,971,465	2,971,465	354,780
Solar Generated (kWh)	900,653	1,202,129	178,216
Grid Energy Required (kWh)	2,070,812	1,769,336	176,564
Net Capacity Factor	13.7%	13.7%	14.1%
Construction Year	2023	2023	2023
Nameplate Capacity (kW)	748.6	1,000	144.1

F.1 METHODOLOGY

To estimate the benefits of installing solar PV arrays at each location, the analysis defines a No Build and a Build case for each option defined above. The No Build is defined as where no solar PV is installed, and total electricity demand is supplied by the electricity grid, charged at the Hourly Ontario Energy Price plus any global adjustment charges. The Build case assumes that the solar PV is built, and the solar PV array supplies part of the total electricity demand, with the remainder of the electricity needed supplied by the grid. While there are O&M costs associated with maintaining the solar PV array, the electricity generated from it reduces the costs of electricity purchased from the grid. The analysis assumes a degradation factor on installed solar PV output of 0.5% per year, compounding. The analysis compares the total costs under the No Build less total costs under the Build case to determine whether cost savings are realized from the installation of a solar PV array.

F.2 RESULTS

The estimated benefits are presented for each scenario below, using the calculated present value (PV) of costs to estimate the benefit cost ratio (BCR).

Table 63. Solar Feasibility Analysis Results (2023$, millions)

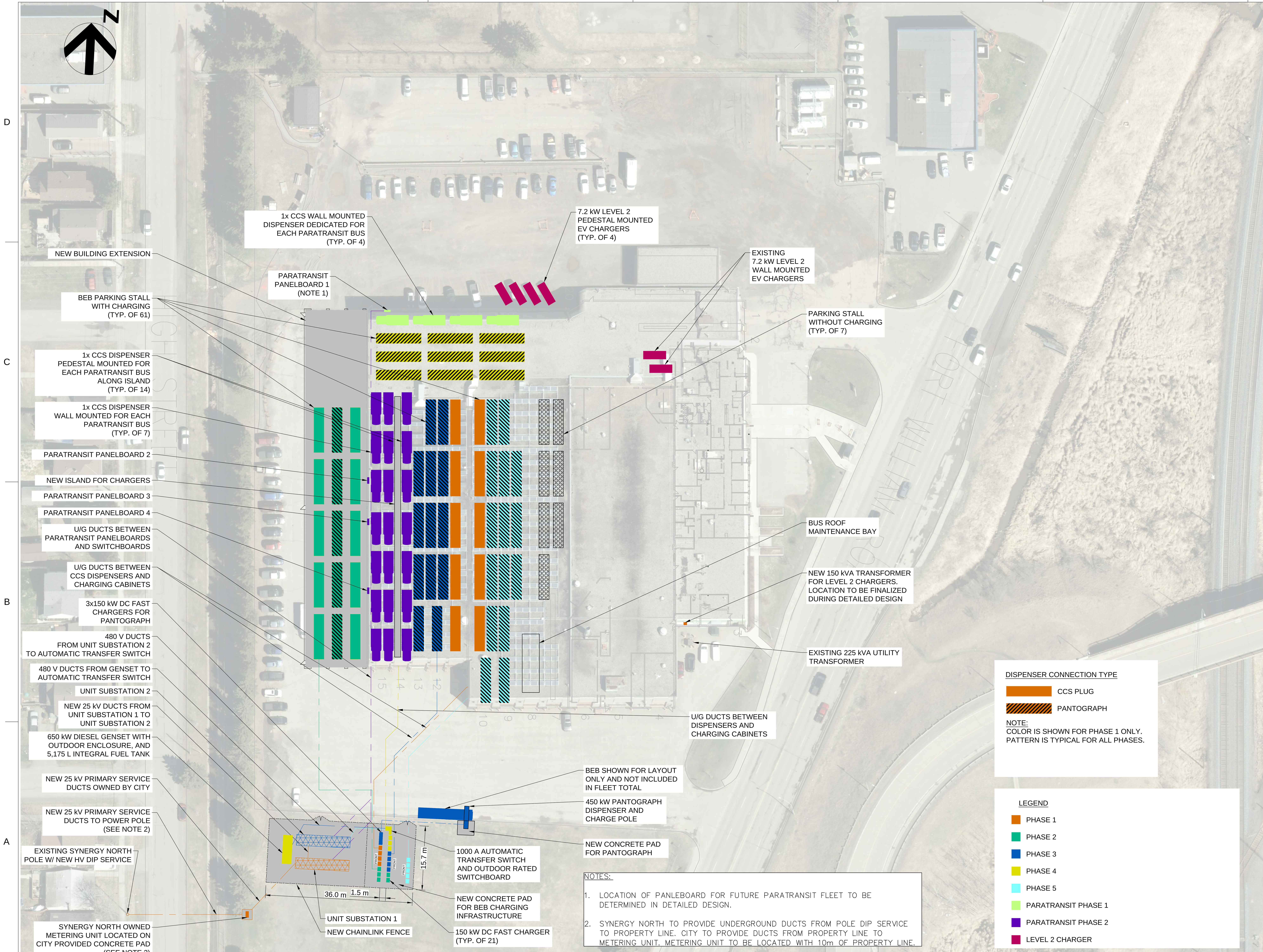
	Fort William Road Transit Garage 1	Fort William Road Transit Garage 2	Waterfront Transit Hub
Energy Cost Savings (PV)	$2.0	$2.7	$0.4
Capital Costs (PV)	$2.2	$3.0	$0.4
O&M Costs (PV)	$0.3	$0.4	$0.1
Net Present Value (NPV)	-$0.6	-$0.7	-$0.1
Cost-Benefit Ratio	0.75	0.75	0.78

Under Fort William Road Transit Garage (1), the discounted electricity cost savings are $2.0 million over the study period. The total capital costs are $2.2 million. The NPV of this option is -$0.6 million, and the project has an estimated cost-benefit ratio of 0.75. For every dollar spent on constructing the project, the project will only yield 75 cents of savings, discounted.

Under Fort William Road Garage (2), the discounted electricity cost savings are $2.7 million over the study period. The total capital costs are $3.0 million. The NPV of this option is -$0.7 million, and the project has an estimated cost-benefit ratio of 0.75.

Under the Waterfront Transit Hub scenario, the discounted electricity cost savings are $0.4 million over the study period. The total capital costs are $0.4 million. The NPV of this option is -$0.1 million, and the project has an estimated cost-benefit ratio of 0.78.

Given that all the scenarios evaluated have a cost benefit ratio that is less than 1.0, it is not recommended that solar be implemented at any of the sites with the current as there is not expected to be a return on that investment.



BEB CHARGING INFRASTRUCTURE

STAGE	QUANTITY OF DCFC 150 kW DISPENSERS	QUANTITY OF DCFC 22.5 kW DISPENSERS W/ CCS PLUGS
PHASE 1	10	4
PHASE 2	15	21
PHASE 3	13	0
PHASE 4	9	0
PHASE 5	15	0
TOTAL	**62**	**25**

FUTURE BEB CHARGING INFRASTRUCTURE CAPACITY

STAGE	QUANTITY OF DCFC 150 kW DISPENSERS FOR FUTURE USE	QUANTITY OF DCFC 22.5 kW DISPENSERS FOR FUTURE USE
FUTURE	0	14

NON-REVENUE CHARGING INFRASTRUCTURE

PHASE	QUANTITY OF 7.2 kW LEVEL 2 DISPENSERS W/ J1772 PLUGS
PHASE 1	6

FUTURE NON-REVENUE CHARGING CAPACITY

PHASE	QUANTITY OF 7.2 kW LEVEL 2 DISPENSERS FOR FUTURE USE
PHASE 1	11

HDR

ISSUE	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY
P6	12/08/2023	UPDATED PHASING	AB	AB	DK
P5	10/04/2023	DRAFT REVIEW UPDATES	AB	AB	DK
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P2	03/20/2023	DRAFT ISSUED TO UTILITY	AB	AB	DK
P1	03/09/2023	ISSUED FOR INFORMATION	AB	AB	DK

PROJECT NUMBER 10353316

PRELIMINARY FOR DISCUSSION PURPOSES ONLY

CITY OF Thunder Bay Superior by Nature

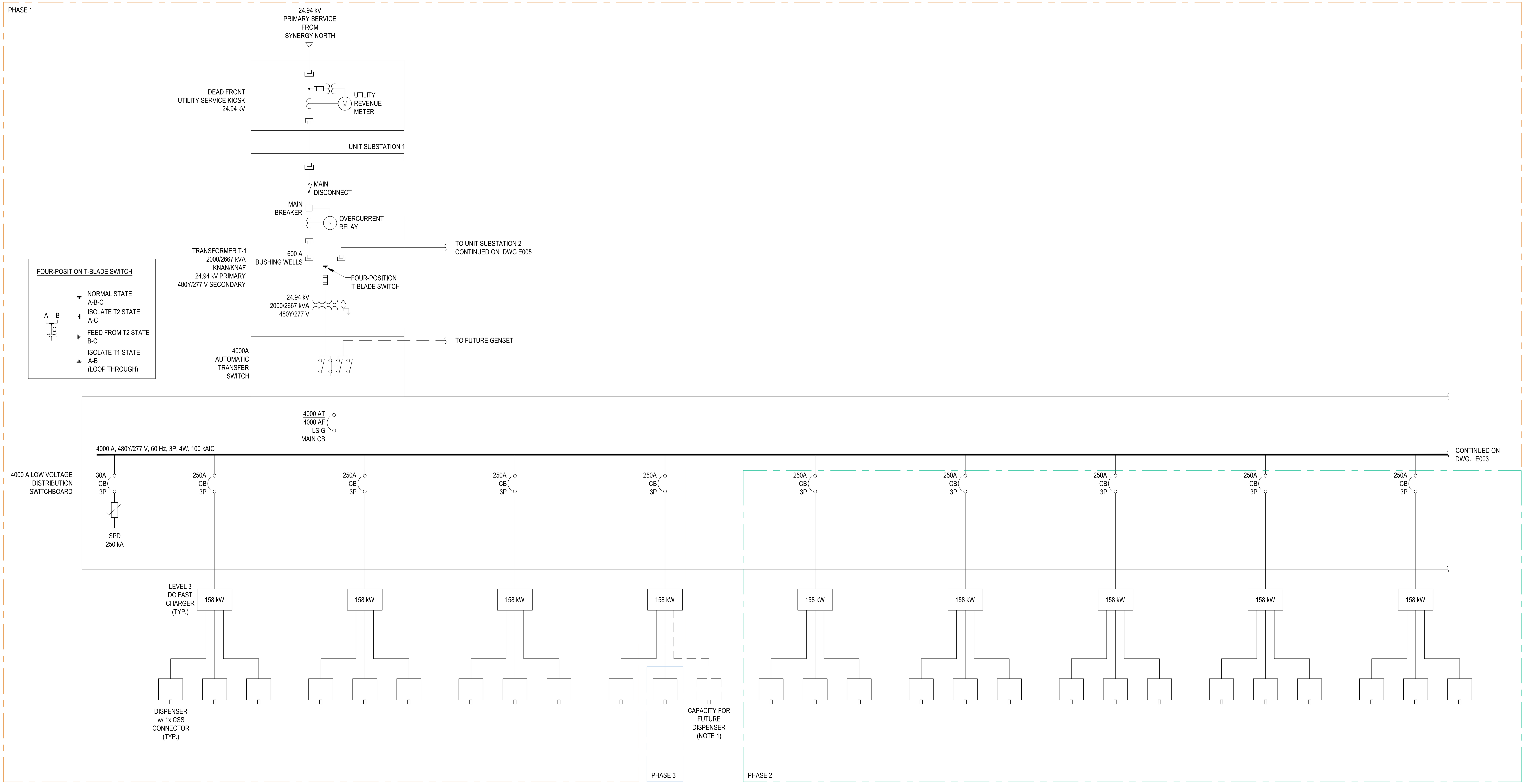
METROLINX - THUNDER BAY
FORT WILLIAMS TRANSIT GARAGE
ELECTRICAL SITE PLAN
INDICATIVE DESIGN

1:500 0 5 10 15 20m

FILENAME

SCALE 1:500

SHEET E001



NOTES:

1. INDICATES AVAILABLE CAPACITY FOR FUTURE EXPANSION BEYOND PHASE 5.

ISSUE	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY
P6	12/08/2023	UPDATED PHASING	AB	AB	DK
P5	10/04/2023	DRAFT REVIEW UPDATES	AB	AB	DK
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PROJECT NUMBER 10353316

PRELIMINARY
FOR DISCUSSION
PURPOSES ONLY

CITY OF Thunder Bay
Superior by Nature

METROLINX - THUNDER BAY
FORT WILLIAMS TRANSIT GARAGE
SINGLE LINE DIAGRAM
INDICATIVE DESIGN

FILENAME

SCALE N.T.S.

SHEET
E002

HDR

ISSUE	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY
P6	12/08/2023	UPDATED PHASING	AB	AB	DK
P5	10/04/2023	DRAFT REVIEW UPDATES	AB	AB	DK
P4	07/31/2023	DRAFT REVISED FOR UTILITY	AB	AB	DK
P3	06/16/2023	CHANGE ORDER UPDATES	AB	AB	DK
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PROJECT NUMBER 10353316

PRELIMINARY FOR DISCUSSION PURPOSES ONLY

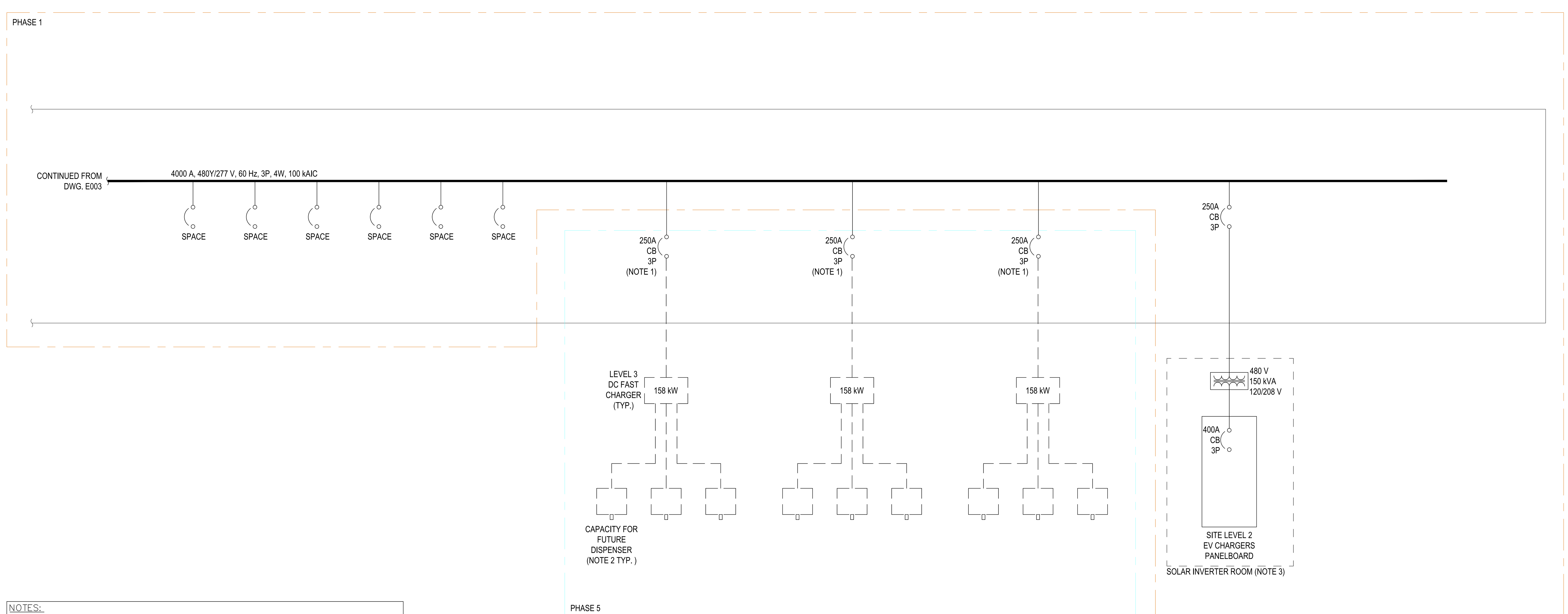
CITY OF Thunder Bay Superior by Nature

METROLINX - THUNDER BAY
FORT WILLIAMS TRANSIT GARAGE
SINGLE LINE DIAGRAM
INDICATIVE DESIGN

FILENAME

SCALE N.T.S.

SHEET E003



NOTES:

1. 250A CIRCUIT BREAKER FOR FUTURE CHARGER TO BE ADDED TO SWITCHBOARD DURING FUTURE PHASE. SPACE FOR 3P CB TO BE LEFT AVAILABLE IN SWITCHBOARD DURING PRIOR PHASES.
2. INDICATES AVAILABLE CAPACITY FOR FUTURE EXPANSION BEYOND PHASE 4. CAPACITY HAS NOT BEEN RESERVED FOR PHASE 5 CHARGER ADDITIONS, LOAD ANALYSIS NEEDS TO BE RECALCULATED OR LOAD MANAGEMENT SOFTWARE USED BEFORE CONNECTING CHARGER
3.
4. LOCATION OF LEVEL 2 EV CHARGING INFRASTRUCTURE EQUIPMENT TO BE DETERMINED.

ISSUE	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY
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P1	03/09/2023	ISSUED FOR INFORMATION	AB	AB	DK

PROJECT NUMBER 10353316

PRELIMINARY FOR DISCUSSION PURPOSES ONLY

CITY OF Thunder Bay Superior by Nature

METROLINX - THUNDER BAY
FORT WILLIAMS TRANSIT GARAGE
SINGLE LINE DIAGRAM
INDICATIVE DESIGN

FILENAME

SCALE N.T.S.

SHEET E004

P6	12/08/2023	UPDATED PHASING	AB	AB	DK
P5	10/04/2023	DRAFT REVIEW UPDATES	AB	AB	DK
P4	07/31/2023	DRAFT REVISED FOR UTILITY	AB	AB	DK
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P2	03/20/2023	DRAFT ISSUED TO UTILITY	AB	AB	DK
P1	03/09/2023	ISSUED FOR INFORMATION	AB	AB	DK
ISSUE	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY

PROJECT NUMBER 10353316

PRELIMINARY FOR DISCUSSION PURPOSES ONLY

CITY OF Thunder Bay Superior by Nature

METROLINX - THUNDER BAY
FORT WILLIAMS TRANSIT GARAGE
SINGLE LINE DIAGRAM
INDICATIVE DESIGN

FILENAME

SCALE N.T.S.

SHEET E005

1 2 3 4 5 6 7 8

D C B A

ISSUE	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY
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PRELIMINARY FOR DISCUSSION PURPOSES ONLY

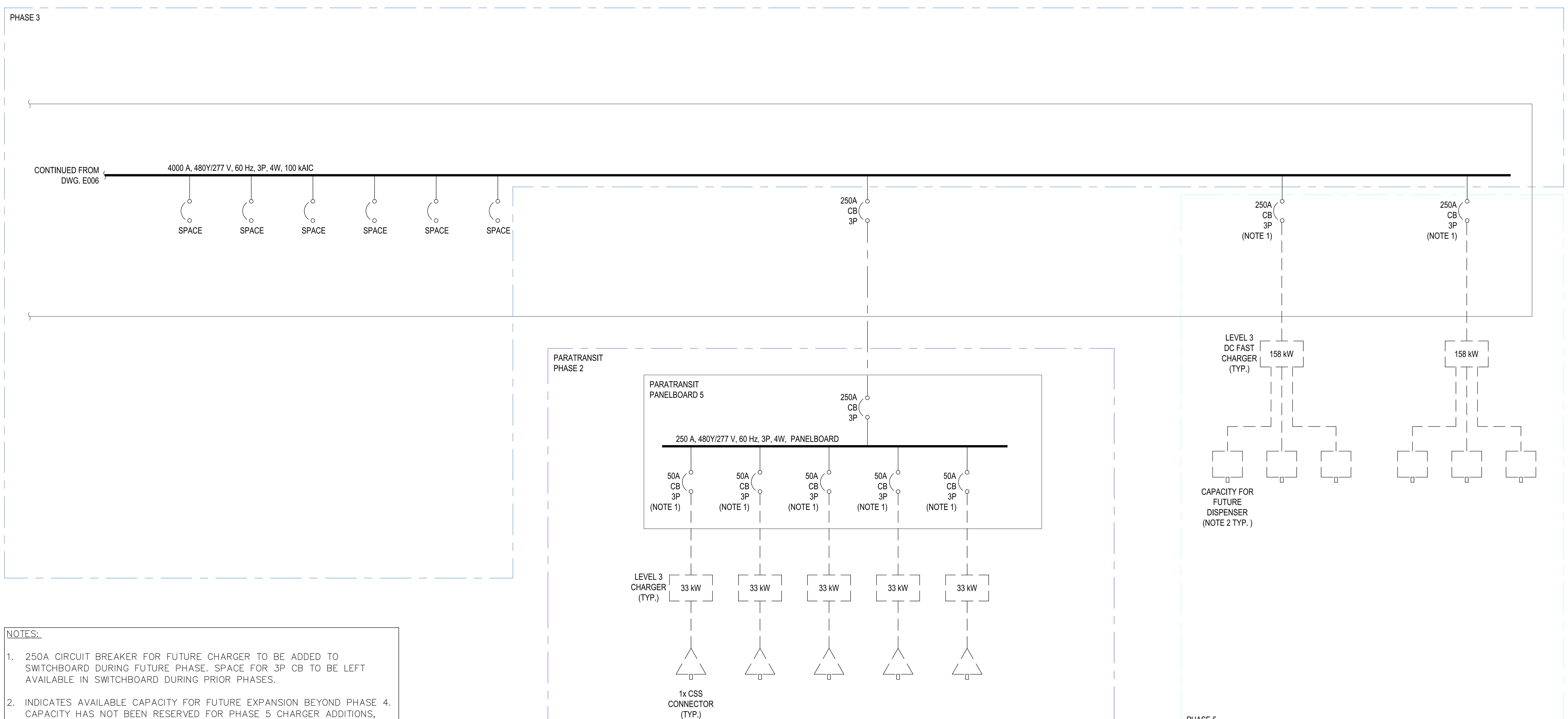
CITY OF Thunder Bay Superior by Nature

METROLINX - THUNDER BAY
FORT WILLIAMS TRANSIT GARAGE
SINGLE LINE DIAGRAM
INDICATIVE DESIGN

FILENAME

SCALE N.T.S.

SHEET **E006**



NOTES:

1. 250A CIRCUIT BREAKER FOR FUTURE CHARGER TO BE ADDED TO SWITCHBOARD DURING FUTURE PHASE. SPACE FOR 3P CB TO BE LEFT AVAILABLE IN SWITCHBOARD DURING PRIOR PHASES.

2. INDICATES AVAILABLE CAPACITY FOR FUTURE EXPANSION BEYOND PHASE 4. CAPACITY HAS NOT BEEN RESERVED FOR PHASE 5 CHARGER ADDITIONS, LOAD ANALYSIS NEEDS TO BE RECALCULATED OR LOAD MANAGEMENT SOFTWARE USED BEFORE CONNECTING CHARGER

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PROJECT NUMBER 10353316

PRELIMINARY FOR DISCUSSION PURPOSES ONLY

CITY OF Thunder Bay Superior by Nature

METROLINX - THUNDER BAY
FORT WILLIAMS TRANSIT GARAGE
SINGLE LINE DIAGRAM
INDICATIVE DESIGN

FILENAME

SCALE N.T.S.

SHEET E007

NOTES:

1. UNDERGROUND DUCTS FOR ALL PHASES TO BE RUN IN PHASE 1. DUCTS TO BE STUB UP IN TRAFFIC RATED VALVE BOX FOR FOLLOWING PHASE INSTALLATION OF PANTOGRAPHS.
2. SYNERGY NORTH TO PROVIDE UNDERGROUND DUCTS FROM POLE DIP SERVICE TO PROPERTY LINE. CITY TO PROVIDE DUCTS FROM PROPERTY LINE TO METERING UNIT. METERING UNIT TO BE LOCATED WITH 10m OF PROPERTY LINE.

LEGEND

- PHASE 1
- PHASE 2
- PHASE 3
- PHASE 4

HDR

ISSUE	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY
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P2	03/20/2023	DRAFT ISSUED TO UTILITY	AB	AB	DK
P1	03/09/2023	ISSUED FOR INFORMATION	AB	AB	DK

PROJECT NUMBER 10353316

CITY OF Thunder Bay Superior by Nature

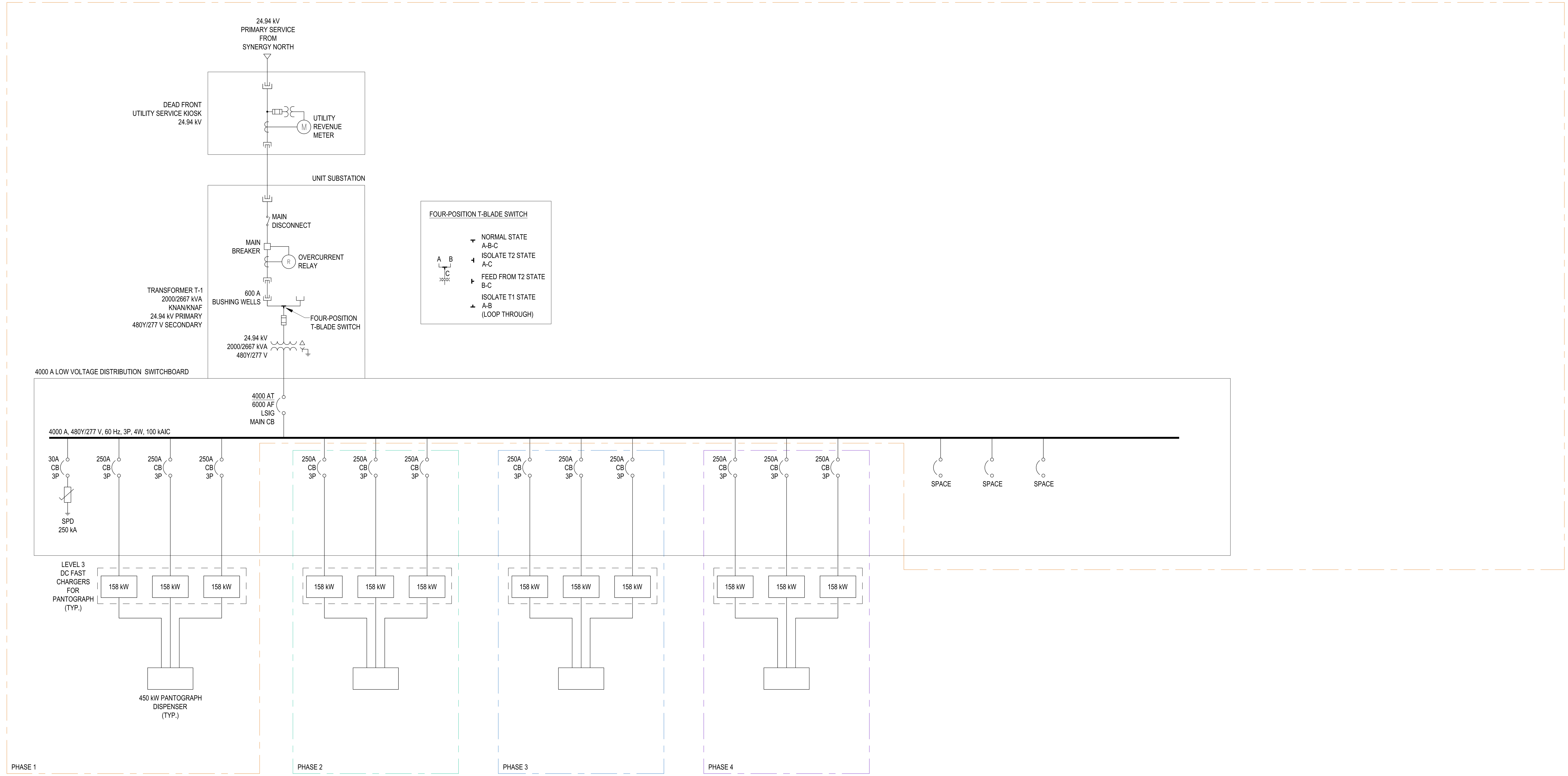
METROLINX - THUNDER BAY WATERFRONT TERMINAL ELECTRICAL SITE PLAN INDICATIVE DESIGN

1:200 0 1 2 3 4 5 8m

FILENAME

SCALE 1:200

SHEET E001



ISSUE	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY
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P2	03/20/2023	DRAFT ISSUED TO UTILITY	AB	AB	DK
P1	03/09/2023	ISSUED FOR INFORMATION	AB	AB	DK

PROJECT NUMBER 10353316

PRELIMINARY
FOR DISCUSSION
PURPOSES ONLY

CITY OF Thunder Bay
Superior by Nature

METROLINX - THUNDER BAY WATERFRONT TERMINAL SINGLE LINE DIAGRAM INDICATIVE DESIGN

FILENAME

SCALE N.T.S.

SHEET E002

MUNICIPAL FLEET ZERO EMISSION TRANSITION PLAN

TASK 4 DRAFT REPORT

3/1/2024

Contents

Tables

Figures

EXECUTIVE SUMMARY

Transitioning to a zero emission fleet involves more than simply buying vehicles and charging infrastructure; the transition introduces new technology and processes into day-to-day operations. A successful fleet transition considers existing site conditions, current vehicle operations, market conditions, and costs. This Thunder Bay Municipal Fleet Transition Plan outlines a roadmap to electrify a significant portion of its municipal fleet by 2040 in alignment with its climate goals.

The City of Thunder Bay has a wide variety of vehicles in its municipal fleet. Certain types of vehicles have commercially viable battery electric vehicle replacements ready on the market. Other types of specialty and heavy equipment, from garbage trucks to graders, currently have limited battery electric replacements. These vehicle types often have heavy duty cycles, operate in cold temperatures, and require large amounts of power to operate successfully. Thunder Bay should continue to watch closely as this vehicle market matures. Technological improvements will likely lead to bigger and cheaper batteries, providing a diverse portfolio of vehicle types to choose from. When it makes operational and financial sense to do so, Thunder Bay can begin to electrify this portion of its fleet.

The Thunder Bay Municipal Fleet Transition Plan reviews vehicles ready to electrify at Mountdale Public Works Yard (PWY), Front Street PWY, Parks North, the City of Thunder Bay Solid Waste and Recycling Facility (Landfill) and the Fort William Road Transit Garage (Transit) [1], which make up the majority of the City's fleet. This plan recommends a charging strategy that reflects the unique and diverse needs of Thunder Bay's fleet and climate. The recommended approach to installing charging infrastructure allows Thunder Bay the flexibility to react to technological progress in the electric vehicle market and continue to replace ICE vehicles with electric vehicles wherever possible.

As modeled in this report, the transition will begin in 2025 with initial construction efforts to prepare for the first Priority 1 vehicles being delivered the following year in 2026. In reality, construction at each of the facilities will occur between 2026 and 2031, as budgets permit.[2] Beginning with this first delivery, the city will cease purchasing gasoline and diesel vehicles as replacements for Priority 1 vehicles and will only purchase electric vehicles in alignment with its vehicle replacement schedule. The full transition to a 100% battery electric fleet of Priority 1 vehicles will be reached in 2040, with a full transition of the Priority 2 vehicles reached in a later year depending on market maturity and financial feasibility. At any or all facilities, if rooftop solar is desired, construction and installation of these systems should be installed in alignment with planned roof replacements to maximize financial benefits. Further analysis and review will be required at each facility.

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[1] Vehicles studied at this municipal fleet transition plan at the Transit garage are non-revenue vehicles.

[2] For the purposes of financial modeling, it is assumed that the City will cease purchasing gasoline and diesel vehicles as replacements for Priority 1 vehicles in alignment with its replacement with its replacement schedule. The City of Thunder Bay has flexibility to reassign electric vehicles that are procured prior to charging infrastructure being installed at its originally assigned location.

Under the BEV Scenario, the total cost of electrifying Priority 1 vehicles is $44.2 million in discounted 2023 dollars. The total capital costs are $29.5 million. The total maintenance costs are $5.9 million. The total lifecycle fuel and electricity costs are $8.8 million. The transition to BEVs is anticipated to cost **$12.5 million** (discounted) more than maintaining a fully ICE fleet.

The transition to electrifying Priority 1 vehicles would reduce GHG emissions by approximately 18,000 tonnes across the study period. The cost per ton of GHG avoided is $694 on a $/tonne value.

This transition plan reflects Thunder Bay's municipal fleet, and not its transit fleet. The Thunder Bay transit fleet transition strategy is outlined in a separate report, and statements and observations made in this report do not necessarily reflect the fleet electrification strategy outlined in the transit report.

INTRODUCTION

In 2021, the City of Thunder Bay adopted the Climate Forward City: Thunder Bay Net-Zero Strategy, which highlighted key climate concerns in the city and efforts to address them. Transportation systems which produce zero emissions are an important part of this effort: Overall, strategies to reduce emissions resulting from transportation make up 22% of the estimated reductions as part of plan implementation.[3] Detailed efforts include:

- By 2030, 50% of existing buildings will have installed rooftop solar PV.[4]
- By 2035, 100% of the municipal transit fleet will be electric and by 2040, 100% of the non-transit municipal fleet will be electric.
- By 2040, 100% of vehicle sales will be EVs and 100% of heavy-duty commercial vehicles will be using low-carbon fuels.

In addition, Council set two climate targets: 56% below 2016 levels by 2030, and net-zero by 2050. Thunder Bay is committed to the UN Cities Race to Zero Initiative and confirmed target with Global Covenant of Mayors for Climate and Energy.

Section 1 provides an overview of the current electric vehicle market, including specialty vehicles, as it relates to Thunder Bay's municipal fleet. Section 2 analyzes existing conditions and site considerations at each of the locations that may host charging infrastructure. Section 3 provides an energy modeling analysis to ensure that modeled battery electric vehicle (BEV) replacements will be able to meet the operational metrics that current ICE vehicles do. Section 4 summarizes the procurement strategy outlining when Thunder Bay should start to replace ICEs with BEVs. Section 5 outlines conceptual electric infrastructure plans at the studied facilities. Section 6 summarizes operational planning considerations for city staff, operators, and first responders in the transition to BEVs. Section 7 includes a financial analysis comparing the costs associated with transitioning a specific number of BEVs in Thunder Bay's fleet compared to a business-as-usual scenario. Finally, Section 8 presents a risk mitigation matrix, outlining common risks associated with a BEV fleet transition, and actions Thunder Bay can take to mitigate these risks. Appendices attached to this plan provide further supporting detail. Appendices include an inventory of current EV market availability, a detailed financial analysis, a GHG emissions analysis, a solar PV feasibility analysis, and detailed conceptual plans and single-line drawings

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[3] Climate-Forward City: Thunder Bay Net-Zero Strategy, pg. 9

[4] Climate-Forward City: Thunder Bay Net-Zero Strategy, pg. 37

1 TECHNOLOGY & INDUSTRY REVIEW

New battery electric vehicles (BEVs) are continually being added to the market today. BEV technology has rapidly progressed over the last few decades, and the adoption of BEVs both by mainstream consumers and public agencies with diverse vehicle fleets has grown exponentially.

BEVs utilize lithium-ion batteries, the same battery technology used in cell phones and computers, to generate the power needed to drive. A BEVs electric battery stores and outputs direct current (DC) power. The DC power gets converted into alternating current (AC) power by the vehicle's inverter, which powers the vehicle's electric motor by alternating between positive and negative charges and utilizing electromagnetics to ultimately rotate the vehicle's drive shaft and turn the wheels.

Battery packs are becoming more "energy dense," or able to contain more energy within their given volume. Lithium-ion battery pack densities have tripled over the last decade, significantly improving BEV ranges. Many new passenger BEVs report ranges over 480 km. Further improvements in battery chemistry and cell design will continue increasing ranges, which could exceed 600 km in the next few years. As vehicle technology improves and the market continues to develop, range capabilities will increase, and more BEV vehicle types will become commercially viable.

This technology and industry review includes the following:

1.1 **Current BEV Market:** Details currently available battery electric models for a variety of vehicle types and the current state of electrification in each market.

1.2 **Three Year Market Outlook:** Provides an outlook on new battery electric vehicle types currently in development or prototype status and electrification goals of several specialty vehicle manufacturers.

1.3 **Case Studies for Specialty BEV Deployments**: Includes several examples of specialty BEV deployments in public and private agencies across North America including construction equipment, medium and heavy-duty trucks, and other specialty vehicle types identified for electrification in Thunder Bay's fleet.

1.4 **Charging Infrastructure Overview:** Summarizes the types of commonly used plug-in charging equipment used to charge BEVs and includes a review of BEV charging standards in North America as well as discusses the importance of Charge Management Software

1.1 Current BEV Market

Many light- and medium-duty vehicles have adequate electric vehicle equivalents available today; larger vehicles and those with more intense uses or working conditions (such as extreme cold, which negatively impacts a battery's ability to store and use energy) are less likely to have an electric equivalent available. Since these vehicles require a higher battery capacity in order to fulfill operations similar to conventional diesel or gasoline vehicles, both the size and weight of the vehicle battery, as well as the cost to produce it, can be prohibitive in bringing to market a viable electric alternative.

Table 1 outlines the state of electrification for a variety of vehicle types used in Thunder Bay's municipal fleet. For a full list of vehicle manufacturers and available models for these vehicle types, see *Appendix A. EV Market Availability f*or a detailed breakdown of currently available options.

Table 1: State of Electrification Overview

Vehicle Type	Viable BEV Replacements	BEV Replacements in Prototype Phase	Electrification Overview
Asphalt Roller		✓	Limited models available
ATV/UTV	✓		Variety of BEV replacements
Backhoe Loader		✓	Limited models available, intense vehicle use
Excavator		✓	Limited models available, intense vehicle use
Forklift	✓		Variety of BEV replacements
Grader		✓	Limited models available, intense vehicle use
Loader		✓	Limited models available, intense vehicle use
Half Ton Truck	✓		Variety of BEV replacements
Heavy Truck		✓	Limited models available, intense vehicle use
Medium Truck		✓	Limited models available, intense vehicle use
One Ton Truck	✓		Variety of BEV replacements and repower options
Skid Steer	✓		Variety of BEV replacements available
Street Sweeper	✓		Several BEV replacements available
Three Quarter Ton Truck	✓		Variety of BEV replacements available
Tractor		✓	Limited models available
Van	✓		Widely tested in real-world operations, variety of repower options

Despite the limited selection of current OEM (original equipment manufacturer) offerings for some vehicle types, such as one-ton trucks and vans, these vehicles are still classified as "Ready to Convert" due to the wide availability of vehicle repower options. Created by replacing the OEM's standard internal combustion engine (ICE) with one powered by an electric battery, repowered vehicles are often medium or heavy-duty vehicles missing from the current OEM selection. Several vehicle manufacturers are beginning to contract with companies that design and produce electric powertrains custom to the OEM's vehicle chassis. The vehicles can be sold 'whole' and, as they are produced in conjunction with OEMs, features like tow capacity are minimally compromised.

1.2 Three-Year Vehicle Market Outlook

Many of North America's biggest manufacturers of construction and specialized work equipment are beginning to set electrification goals for their vehicle line-up. John Deere has pledged to offer at least 20 electric or hybrid-electric construction equipment models by 2026[5], while Mack Trucks plans for 35% of all vehicle sales to be zero emission by 2030.[6] Today, prototypes for many medium and heavy-duty vehicles with unique work functions are being developed and refined. Within the next three years, many of these prototypes will have become market ready.

Currently, there are a number of electric paver/asphalt rollers which are either in prototype status or beginning to become available in Europe. The battery capacity of these vehicles ranges from 48 kWh (LeeBoy 8520C Electric Paver Prototype[7]) to 270 kWh (Royal BAM Dynapac SD2500CS, featuring two 270kWh batteries[8]). Earlier this year, John Deere debuted a prototype for an electric backhoe loader, the 310 X-Tier E-Power, which is currently being tested in the field by utility provider National Grid and is expected to be able to complete an 8-12 hour workday without the need to recharge.[9] Komatsu, a Japanese manufacturer of specialized work equipment, has developed two electric excavators which will be introduced to the Japanese and European markets by the end of 2023, prior to an eventual introduction to the North American market.[10] Volvo has also recently debuted a 23-ton electric excavator, the EC230, which is tentatively planned to be available for sale in North America sometime in 2024.[11] Caterpillar also has a number of electric prototypes in development, including both a mini and medium excavator, and a compact wheel loader and medium wheel loader.[12] Late last year, Caterpillar also demonstrated its first battery electric dump truck in the field.[13] XCMG, a Chinese manufacturer of heavy machinery, has developed a pure electric dump truck, the E700; however, the model is not yet available in North America.[14] Fendt, a German manufacturer of agricultural machinery, is shortly debuting an electric tractor (expected November 2023) which can operate for up to 5 hours on a single charge.[15]

[5] Electrification of Construction Equipment | John Deere US

[6] Mack Trucks Highlights Commitment to Sustainability at the Green Transportation Summit & Expo | Mack Trucks

[7] LeeBoy Debuts Prototype 8520C Electric Asphalt Paver at CONEXPO 2023 | For Construction Pros

[8] Royal BAM announces 'world's first' fully electric asphalt road paver (electrek.co)

[9] Here's what I found out in Texas about John Deere's electric backhoe (electrek.co)

[10] - Working to Create a Market for Electric Construction Equipment - Komatsu Ready to Launch New 20—ton Class Electric Excavators with Lithium-ion Batteries | Newsroom | Komatsu global site

[11] EC230 Next Level (volvoce.com)

[12] Cat® Battery Electric Prototypes | Cat | Caterpillar

[13] Caterpillar | Caterpillar Successfully Demonstrates First Battery Electric Large Mining Truck and Invests in Sustainable Proving Ground

[14] XCMG electric vehicle fleet exported to Oceania high-end market! -XCMG NewsXuzhou Construction Machinery Group Global

[15] https://www.fendt.com/int/agricultural-machinery/tractors/fendt-e100-v-vario

1.3 Case Studies for Specialty BEV Deployments

Below are several examples of public and private agencies across North America deploying construction equipment, medium and heavy-duty trucks, and other specialty vehicle types that are applicable to Thunder Bay's fleet.

1.3.1 Refuse Trucks

In New York City, refuse trucks serve a dual purpose by hauling waste and acting as snowplows in the winter. New York recently piloted the use of a Mack LR Electric truck over the course of a year.[16] The electric truck was able to successfully complete 12-hour garbage collection shifts; however, the city also learned through the pilot that the truck was unable to complete snow clearing tasks. During the pilot project, the electric trucks were only able to last four hours when plowing snow, much less than the expected 12-hour shift. Future advances in battery technology are expected to extend this operating time.

In Portland, Oregon, COR Disposal and Recycling has also recently added the first electric garbage truck to their fleet, a Peterbilt 520EV. The 520EV is expected to operate for twice the amount of time as a diesel truck before needing to refuel, but also comes with a price tag nearly double that of a diesel model: $675,000 ($USD) for the 520EV, compared to $350,000 ($USD) for a diesel truck.[17]

1.3.2 Backhoe Loader

National Grid, a utility provider in the northeastern United States, tested the operations of electric backhoes in typical field work.[18] During testing, the electric backhoe was found to perform as well or better than traditionally used diesel equipment. Notably, noise reductions from vehicle operations improved communication between crew members on site, thereby significantly reducing the risk of workplace injuries. The electric backhoe also had the advantage of providing peak torque even at minimal operating speeds.

1.3.3 Street Sweeper

Electric street sweepers have been deployed in many North American cities, including New York City, Chicago, Los Angeles, and were recently demoed in Vancouver. In addition to the quiet operation and zero emissions of these electric alternatives, they also have the benefit of needing less maintenance than their ICE counterparts due to the comparative simplicity of the electric motor. Street sweepers can be maintenance-heavy vehicles with high service needs, and reductions in regular maintenance can allow agencies to better maintain a regular street cleaning schedule.[19]

1.3.4 ATVs and UTVs

As part of Alberta's MCCAC (Municipal Climate Change Action Centre) grant programs, several municipalities have received funds and purchased electric ATVs and UTVs to be used for tasks such as snow-clearing and recreational trail maintenance. With the addition of the new electric off-road vehicles,

---

[16] NYC electric truck scores big on trash collection | Commercial Carrier Journal (ccjdigital.com)

[17] Portland's first electric garbage truck will hit eastside streets soon - OPB

[18] National Grid Uses Electric Backhoe in Field Work to Test the Fleet Equipment of the Future

[19] Vancouver Public Works sees potential in demo of all-electric street sweeper - The Columbian

municipalities are finding the consistent return-to-base of vehicles has simplified charging and the transition to an EV fleet.[20]

1.4 Charging Infrastructure Overview

There are three types of charging equipment used to charge EVs—Alternating Current (AC) Level 1, AC Level 2, and Direct Current (DC) Fast Chargers.

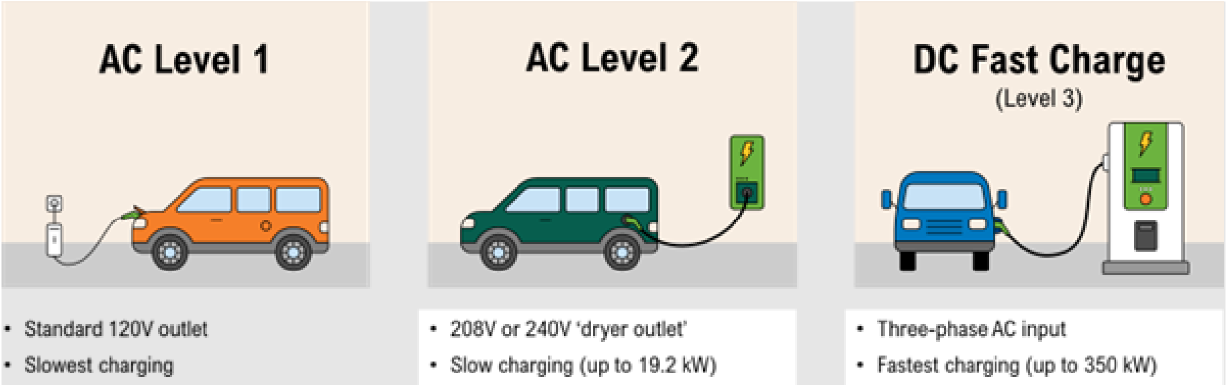

Figure 1: EV Charging Infrastructure Types

Level 1 is the slowest and most inexpensive charging option. It uses a dedicated 120-volt (V) outlet and can usually replenish a battery at a rate of up to eight kilometers of range per hour. Some larger, higher-use fleet vehicles may not be able to reach a full charge overnight using Level 1 chargers but may be able to reach a sufficient charge to satisfy the next day's service. No electrical upgrades are usually needed to support Level 1 charging.

Level 2 charging stations are most common in daily EV charging. Level 2 chargers can use a 208V or 240V outlet or be 'hardwired' directly to the electrical panel (i.e., no outlet). The power output of these chargers ranges between 3.5 kilowatts (kW) and 19.2 kW. The most common Level 2 chargers (7.2kW) can replenish about 30 kilometers of range per hour of charging. An electrician is needed to safely install the breaker and wall outlet and complete the proper permitting process. An electrician will also review the service size to confirm whether a service upgrade is necessary. A service upgrade will require the involvement of the utility.

DC Fast Chargers represent the fastest, but most expensive, method of charging. The power output of a DC Fast Charger (DCFC) can range up to 450 kW, though the most common size for these chargers is between 50 kW and 150 kW. With a 50 kW DCFC, roughly 235 kilometers of range can be added through an hour of charging, while a 150 kW DCFC could replenish roughly 690 kilometers per hour of charging. The maximum DC fast charging rate of an electric vehicle is determined both by the power output of a DCFC, as well as the maximum charge acceptance rate of the vehicle. DCFCs are typically used for public highway charging or industrial applications, and they require engineering, permitting, construction, and possibly electrical system upgrades.

[20] Municipal work vehicles targets to electrify as more models hit the market (electricautonomy.ca)

Mobile DCFC stations are also being offered now by several charger manufacturers. These solutions offer fleets the ability to bring rapid charge capabilities to a diverse set of work sites, while avoiding permitting delays and construction costs associated with permanent DCFC installations. Additionally, these mobile DCFC stations, essentially functioning as large batteries, can be recharged using Level 2 charging. Currently, mobile DCFC stations are being offered with battery capacities ranging from 40 kWh to 420 kWh.

1.4.1 Charging Standards

Currently, there are several charging standards, or plugs, used by electric vehicle manufacturers in North America. The J1772 (used for AC charging), CCS (used for DC charging), and Tesla's NACS (used for both AC and DC charging) have been the most widely used by vehicle manufacturers to date. Recently, several auto manufacturers, such as Ford, General Motors, and Kia, have announced plans to adopt Tesla's NACS charging standard. By doing so, their vehicles can make use of Tesla's reliable and well-developed Supercharger network. For fleet vehicles with a consistent return-to-base schedule, prioritizing EVs which use the NACS charging standard may not be as advantageous for those frequently on the road or which need to rely on public DCFCs; however, simplified charger and vehicle interoperability should be a consideration as agencies seek to transition their fleet to electric vehicles.

1.4.2 Charging Management Software

Charging management software can help depots manage and optimize energy usage throughout the day and especially during peak demand hours when it is most needed. A key feature of charging management software is the ability to limit energy usage during peak demand periods when electricity rates are highest. Charging management software can also balance the amount of power that is supplied to a site at any given time by staggering charging schedules for vehicles, so that high demand charges, resulting from a high amount of power being supplied at once, can be avoided. Charge management software can also ensure better utilization of distribution system assets, by either retaining existing assets or ensuring the minimum size of transformation needed. This reduction in size reduces the capital costs to customers and balances the consumption of electricity on the system.

Charging management can be supplied by the charger OEM or through third-party providers, depending on the level of sophistication required and the level offered by the OEM. The charger OEMs typically provide basic charger analytics which record equipment characteristics while charging; however, full charger management offers active control. Both systems typically offer 24/7 monitoring to detect, review, and triage potential issues prior to service calls to the customer.

OEM management tools may provide some level of fleet analytics such as which vehicle is charging and at what location. Others may have some power management capabilities and offer increased security as to whom can use the charger or other cybersecurity issues. The OEM tools are typically cloud-based which performs remote updates, monitoring, and maintenance. The degree to which the chargers can be controlled and monitored typically affects the cost of the service.

Third-party programs partner with charger OEMs through vendor-neutral infrastructure typically provided by the charger manufacturer. These third-party suppliers often work with multiple charger manufacturers at the same site, if needed, and provide a single portal to interface with all of the charging equipment.

Some third-party programs also interface with other electrical components such as battery energy storage equipment or building energy management systems. The third-party programs assist in managing energy analytics, charging times, station access, and even CO_2 savings. Third-party systems are typically required to provide effective charge management and limit peak utility demand consumption and charges.

The charger system can be set up to reduce the peak demand using sequential or dynamic charging. This occurs by connecting a single charger to multiple vehicles instead of charging all vehicles in at the same time. Overnight charge windows typically allow for two to three vehicles to utilize the same charger through the use of multiple dispensers from that charger. OEM management software typically allow a simple program scheme such as first in, first out or to limit charging to start after a certain time of day. This may be as complicated as some charging programs need to be, while also limiting peak energy consumption.

Third-party management solutions can evaluate the overall battery need on each vehicle, when the vehicle will be needed for service, and even the expected load required for the next day. The software then balances that input and determines how much power to draw and when. This combination can further reduce the peak power demand, resulting in potential utility cost savings.

It's important to note that charging operations which require a short vehicle dwell time or multiple vehicles sequentially using the same charger, may not be able to efficiently utilize managed charging while still meeting the daily service requirements.

2 EXISTING CONDITIONS

The existing conditions section includes a review of Thunder Bay's existing fleet and the five locations analyzed throughout this report. Section 2.1 reviews Thunder Bay's existing fleet. Section 2.2 reviews key site and parking considerations that should be incorporated into final electrical designs as Thunder Bay begins to transition its fleet to BEVs.

2.1 Existing Fleet

The equipment asset list provided by the City of Thunder Bay includes 530 assets housed at 27 locations across the city. This plan focuses on the assets assigned to the 5 locations studied in this plan: Mountdale Public Works Yard (PWY), Front Street PWY, Parks North Yard and Traffic Control and Street Lighting, City of Thunder Bay Solid Waste & Recycling Facility (Landfill), and the Fort William Road Transit Garage. The 459 assets assigned to these locations include a variety of handheld asset types unlikely to electrify, such as compressors, hoists and lifts, line lazers, and snowblowers. This miscellaneous equipment was filtered out in coordination with the City of Thunder Bay. *Table 2* reflects the 249 vehicles studied for electrification across the five identified facilities.

Table 2: Thunder Bay Site Locations and Vehicles Studied for Electrification

Site	Abbreviated Site Name	Address	Number of vehicles studied at each site
Mountdale Public Works Yard	Mountdale	410 Mountdale Avenue Thunder Bay, ON P7E 6G8	109
Front Street Public Works Yard	Front Street	155 Front Street Thunder Bay, ON P7A 7W7	83
CTB Solid Waste & Recycling Facility	Landfill	5405 Mapleward Road Thunder Bay, ON P7G 1L4	14
Parks North Yard and Traffic Control & Street Lighting Facility	Parks North	625 and 645 Cumberland Street Thunder Bay, ON P7A 4S2	36
Fort William Transit Garage	Transit	570 Fort William Road Thunder Bay, ON P7B 2Z8	7
Total			**249**

In coordination with Thunder Bay staff, the vehicle types below were grouped into Priority 1 and Priority 2 vehicles. Priority 1 vehicles are vehicle types with commercially viable battery replacements on the market today. Priority 2 vehicles are vehicle types that Thunder Bay wishes to electrify in its own fleet, but which are dependent on further advancements in BEV equivalents, a more reliable and documented operating history, and reduced costs. This includes specialty construction equipment and medium or heavy-duty trucks. *Table 3* groups Vehicle Types into Priority 1 and Priority 2 vehicles. The Vehicle Types are listed as identified in the Thunder Bay Asset List.

Table 3: Priority 1 and Priority 2 Vehicle Types

Vehicle Type*	Priority 1: Vehicle Types with commercially viable replacements	Priority 2: Vehicle Types to consider as market develops
Asphalt Roller		✓
ATV/UTV	✓	
Backhoe Loader		✓
Excavator		✓
Forklift	✓	
Grader		✓
Loader		✓
Half Ton Truck	✓	
Heavy Truck		✓
Medium Truck		✓
One Ton Truck	✓	
Skid Steer	✓	
Street Sweeper	✓	
Three Quarter Ton Truck	✓	
Tractor		✓
Van	✓	
Totals	**133**	**116**

2.2 Existing Facilities

The five locations studied in this municipal fleet plan, and the vehicles assigned to them, make up the majority of Thunder Bay's vehicle inventory. Focusing efforts on vehicle and equipment electrification at these five locations will allow Thunder Bay to make significant progress towards its 2040 transportation electrification goals. Thunder Bay municipal and operations supervisors provided a high-level overview of how the fleet currently works, unique operational characteristics of specific vehicle types, and site-specific considerations for each of the five studied locations. Key themes include:

- **Hybrid Parking Approach:** Many of the studied facilities employ a hybrid parking approach, where vehicles change parking locations depending on the day or the season. For example, diesel garbage trucks may be parked indoors in the winter to reduce the need for snow removal and help ensure vehicles can start, but outdoors in the summer to allow odors to dissipate.
- **Multiple Vehicle Use Cases:** Certain vehicles have different operational needs on different days and environmental conditions that may impact charging. For example, ½ ton and ¾ ton vehicles assigned to Parks North frequently haul trailers to and from the lot each day that may have to be disconnected from the vehicle prior to charging. These same ½ ton and ¾ ton vehicles can operate as snowplows in the winter. These dual purposes may require flexible charging infrastructure locations, and more frequent charging sessions depending on the ambient temperature.
- **Seasonal Equipment:** Certain vehicle types operate seasonally, including street sweepers and graders. When these particular vehicles are moved to a remote location at the facility in the offseason, either indoors or outdoors, they will still need access to 'low-power' charging infrastructure (level 2) to keep batteries warm. Keeping batteries warm will protect battery life and improve reduced range in cold weather conditions. Shared charging between vehicles may also work well to maintain battery life while also reducing power consumption and infrastructure needs.
- **Power Reliability of Select Study Locations:** Power reliability data received from Synergy North revealed limited power outages at select study locations in 2023.
    - a. **Parks North Yard and Traffic Control Street Lighting:** 1 hour 16 minutes total.
    - b. **Landfill:** 1 hour 38 minutes total
    - c. **Front Street:** 2 hours 49 minutes total

The facility concept plans in Section 5 reflect these common findings across all locations as well as site-specific findings for each site outlined below.

2.1 Mountdale Public Works Yard

Mountdale PWY is the base of operations for several of Thunder Bay's municipal services. There are currently 109 total vehicles assigned to this facility. This includes 50 Priority 1 vehicles and 59 Priority 2 vehicles. *Figure 2* highlights parking areas at Mountdale PWY considered for charging. Key site considerations include:

- **Hybrid Parking Approach:** Garbage trucks frequently park indoors in the winter to avoid snow removal and keep vehicles warmer, and outdoors in the summer, due to odors. The facility recommendations and concept plans in Section 5 reflect this hybrid approach by allocating charging dispensers both inside and outside where possible, allowing for the flexibility required in Thunder Bay's day-to-day and seasonal operations.

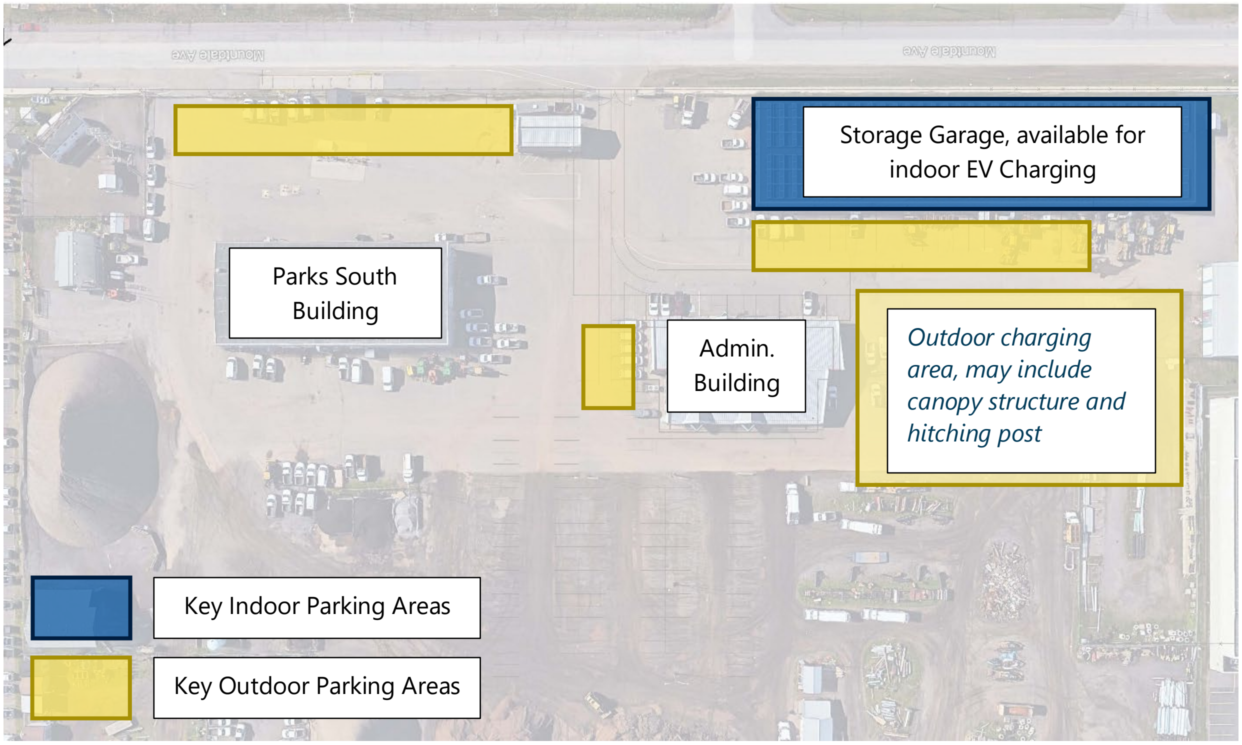

Figure 2. Mountdale PWY Site Overview

2.2 Front Street Public Works Yard

The Front Street PWY has a large administrative building, a storage garage, and a south garage. The 83 vehicles assigned to Front Street PWY primarily park outside. These include 43 Priority 1 vehicles and 40 Priority 2 vehicles. *Figure 3* highlights the key parking areas at Front Street PWY. Key site considerations include:

- **Fuel Tanks:** The City of Thunder Bay has plans to replace the current, in-ground fuel tanks with above ground fuel tanks in the coming years. The final location of the above ground fuel tanks hasn't been determined yet but may impact the locations of future charging infrastructure located on the site.
- **The Storage Garage and South Garage:** These garages are primarily used for equipment storage. Currently, five street sweepers are located at Front Street, and are considered Priority 1 vehicles as part of this plan. Street sweepers are typically stored and unused for colder winter months. Best practices from peer cities concerning storage of electrified vehicles in winter months include providing access to trickle charging. Trickle charging is a charger with a low-level power output designed to be left plugged into a vehicle for an extended period of time. It slowly adds charge to the battery, preventing it from being depleted through weeks or months of non-use.

The south garage may be a future option to store street sweepers in colder months. Thunder Bay's selected manufacturer will provide specific cold weather best practices for its vehicle model.

- **Retaining Wall and Grade Change Requirement:** In order to store vehicles south of the Storage Garage, a retaining wall may need to be installed in order to protect both vehicles and charging equipment. There is a significant grade change south of the Storage Garage. A retaining wall may also be required to accommodate charging on a hitching post.

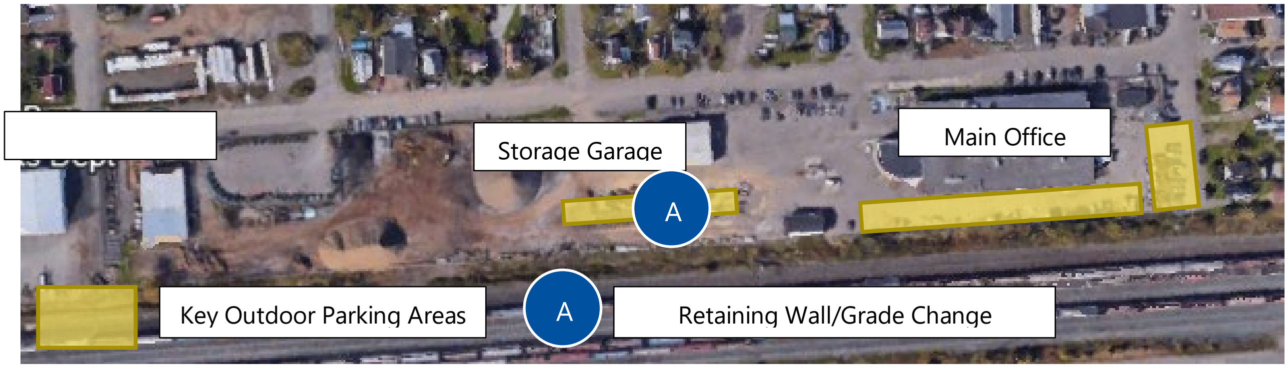

Figure 3. Front Street PWY Site Overview

2.3 Parks North

The Parks North and Traffic Control & Street Lighting (TCSL) sites are two adjacent properties that share a single entrance. In total, 36 vehicles are assigned to Parks North Yard and the TCSL complex. Between both complexes, there are 24 Priority 1 vehicles and 12 Priority 2 vehicles. Figure 4 highlights key parking areas at the site. Key site considerations include:

- **Shared Electrical Feed for Both Buildings:** Each of the larger buildings have their own transformer and meters but are fed from a common electrical feed that comes from the east end of the site near the railway tracks. This common electrical feed and shared parking lots between the two buildings allow for flexibility in charger siting.
- **Preference for Outdoor Parking:** Based on feedback from city staff, parking vehicles outside at both complexes is preferred as there is plenty of parking capacity across the site, and vehicles can be consolidated along fence lines.
- **Vehicle Storage Adjacent to the Railroad:** Areas adjacent to the fence line on the south side may be ideal for vehicle storage as they are out of the way, and current equipment that is currently stored there can be relocated.

Figure 4. Parks North Yard Site Overview

2.4 City of Thunder Bay Solid Waste & Recycling Facility (Landfill)

Vehicles at the landfill primarily park inside the building. There are 9 Priority 1 vehicles and 5 Priority 2 vehicles.

Figure *5* reflects parking configurations at the Landfill site. Key site considerations include:

- **Power Limitations to the Site:** The City of Thunder Bay is currently having discussions about moving the packers currently assigned to Mountdale PWY out to be stored at the Landfill site. Conversations with Synergy North revealed that while there is capacity on the existing transformer to provide power to the Landfill, there currently isn't enough power to deliver the load required to electrify medium and heavy-duty packers at the landfill. Due to the landfill's site location, which is on the outskirts of the city and on a rural 12 kV electrical feed, any upgrades to the service at Landfill would require a significant utility investment, the cost of which would be passed on to the City of Thunder Bay.
  Figure *5* reflects where Thunder Bay may park the packers should the decision be made to reassign these vehicles from Mountdale PWY.

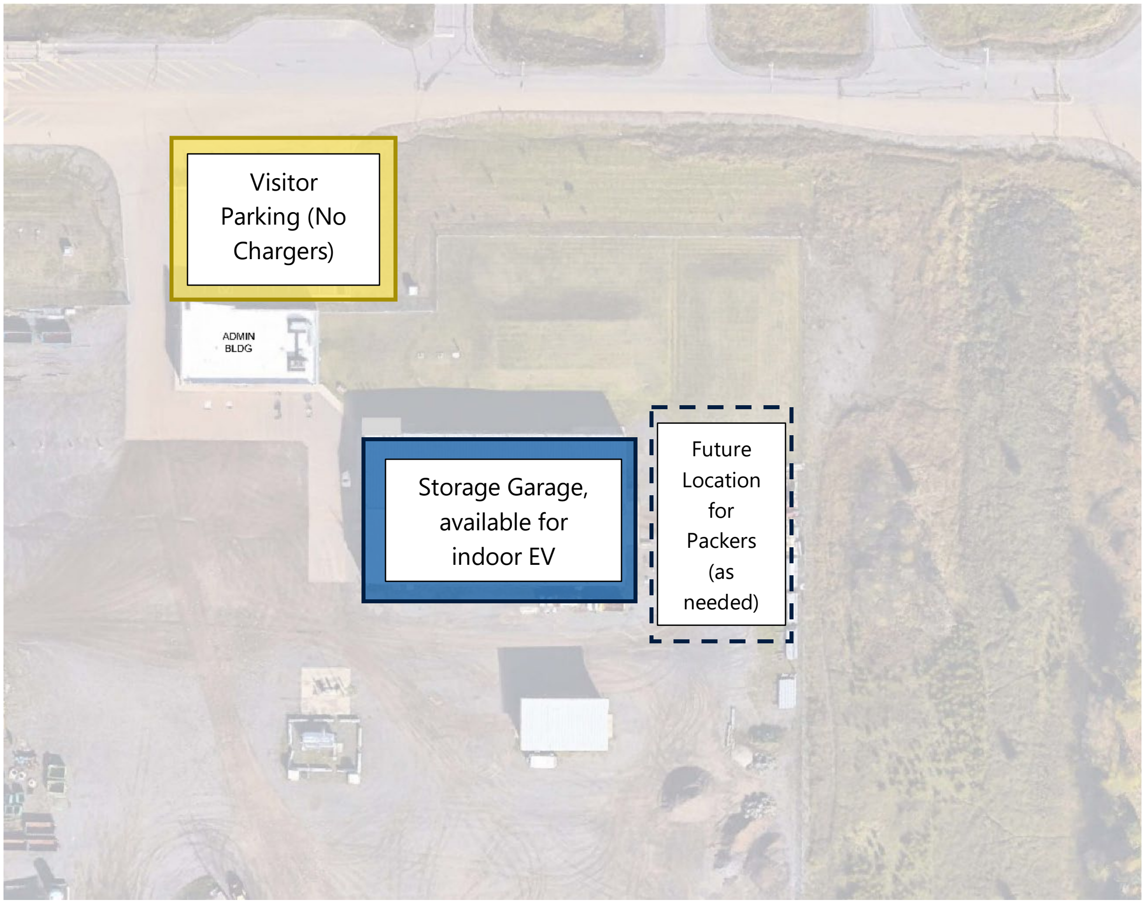

Figure 5. Landfill Site Overview

2.5 Fort William Road Transit Garage

The Fort William Road Transit Garage is the operations, maintenance, and storage facility for the transit bus fleet for Thunder Bay as well as the Lift+ specialized transit fleet. In addition to the revenue vehicles, the transit facility operates 7 non-revenue supporting vehicles. These 7 non-revenue vehicles are all incorporated into this transition plan and are considered Priority 1 vehicles. Infrastructure costs associated with charging these vehicles are included in the financial analysis section of this report. The Fort William Road Transit Garage does have two EV charging stations currently deployed, reflected on the conceptual plan outlined in *Section 5 (Facility & Infrastructure Plan)*.

3 FLEET MODELING ANALYSIS

3.1 Overview

The energy modeling analysis has been conducted to understand the feasibility of maintaining current operations with a battery electric fleet and to forecast the charging infrastructure required to support this transition. Section 3.2 highlights the modeling methodology, inputs and assumptions. Section 3.3 identifies the modeled BEV replacement for each vehicle type in Thunder Bay's fleet, and operational data (provided and assumed) by vehicle type. Section 3.4 models the charging infrastructure required for all Priority 1 and Priority 2 vehicle types. Additionally, it includes the estimated monthly electric consumption and peak demand at each site for Priority 1 vehicles, which is used in the financial analysis in Section 7. Finally, Section 3.5 provides a recommended charging strategy based on modeling assumptions, provided and assumed operational data, and the energy modeling results.

3.2 Methodology & Assumptions

Factors considered in the energy modeling analysis include:

Daily Distance Traveled: This input is used to calculate the amount of energy used to move a vehicle over a shift.

Daily Hours: This analysis reflects the total time in a service day that each vehicle's engine is turned on, including both motive and idle time. This input is used to calculate the energy used for non-motive purposes, such as running the HVAC system.

Shift Length: The length of time most vehicles are away from each facility, and thus unable to be plugged into a charger.

Battery Life and State of Charge (SOC): A minimum state of charge (SOC) of 20% is assumed to avoid range anxiety, and a maximum SOC of 90% is assumed to protect the life of the BEV's battery. These assumptions are reflected in the analysis by assuming a usable battery capacity equal to 70% of the vehicle's nameplate battery capacity.

Average Case and Maximum Case Scenario: Vehicles have average daily operating requirements (hours, distance, etc.) and maximum-case scenarios, which reflect the anticipated highest use operations of a vehicle. The required charging infrastructure for each vehicle outlined in the section below reflects a maximum-case scenario.

1:1 Vehicle Replacement: When a battery electric vehicle can't meet daily operational requirements due to battery constraints, some agencies consider a fleet expansion and will replace one ICE vehicle with two BEV vehicles. Due to the price premiums associated with vehicles that may require a fleet expansion, this was not considered. A 1:1 vehicle replacement is modeled.

3.3 Modeled BEV Replacements

The vehicles chosen for modeling are shown below in *Table 4* and represent BEV equivalents from *Appendix A. EV Market Availability* with available specifications that most closely match the use case and operational profile of Thunder Bay's existing fleet.

Table 4: Modeled Battery Electric Vehicle Replacements by Vehicle Type

Vehicle Type	Battery Electric Replacement Model
Priority 1 Vehicles	
ATV	Polaris Ranger XP Kinetic
Forklift	Toyota Electric Forklift
Half Ton	Ford F-150 Lightning XLT
One Ton	Lightning Electric Ford F-550
Skid Steer	Bobcat T7X Skid Steer
Sweeper/Vacuum	Elgin Broom Bear
Three Quarter Ton	Rivian R1T
Van	Lightning Electric E-450 129
Priority 2 Vehicles	
Asphalt Roller	Volvo DD25 Electric Asphalt Roller
Backhoe Loader	Case Backhoe Loader 580 EV
Excavator	TBD
Grader	MacLean Gr5 EV Grader
Loader	TBD
Medium Truck	Mack Electric Truck
Heavy Truck	Mack Electric Truck
Tractor	Solectrac e70N Electric Tractor

3.3.1 Municipal Fleet Operational Data

Thunder Bay provided specific operating metrics, such as hours and maximum kilometers, for the select equipment listed in *Table 5*:.

Table 5: Thunder Bay Operational Data for Select Vehicle Types

Vehicle Type	Max KM per Day	Max Hours per Day
Asphalt Roller	-	4
Excavators	-	10
Forklifts	-	4
Half Tons	150	7
Loaders	-	14
Medium/Heavy Trucks	200	14
One Ton Trucks	120	7
Sweeper	-	7
Three Quarter Tons	150	7
Vans	160	7

3.4 Model Results

For vehicles where specified operating characteristics are unknown, maximum service hours and maximum km were estimated based on provided operating characteristics and conversations with staff. These assumptions are outlined in *Table 6*, which reflects the modeling results. Certain types of equipment performance are typically measured in operating hours, rather than daily distance traveled. A max km input was estimated to model required charging infrastructure.

- **Multiple Chargers Recommended Per Vehicle Type:** As outlined in the existing conditions, the power required to serve Thunder Bay's Priority 1 and Priority 2 vehicles vary by season and ambient temperature. The modeling results reflected in *Table 6* recommend a dedicated Level 2 AC dispenser per vehicle, while also indicating which heavy-duty equipment will likely need access to DC fast charging in order to complete daily operations. This ensures that all vehicles will have access to 'low-power' charging during off seasons or periods of low use, while also meeting operational requirements during heavy duty cycles.

3.4.1 Vehicle Modeling Results

Table 6: Charging Infrastructure Recommendations by Vehicle Type

Vehicle Type	BEV Equivalent	Max KM	Avg. Hours	Max Hours	Dedicated Overnight Charging Dispenser	DCFC for Daily Operational Needs, Including Mid Day Charging
Asphalt Roller	Volvo DD25 Electric Asphalt Roller	64	7	10	15 A, 3.6 kW	
ATV	Polaris Ranger XP Kinetic	16	7	10	15 A, 3.6 kW	
Backhoe Loader	Case Backhoe Loader 580 EV	32	7	10	15 A, 3.6 kW	50 kW
Excavator	Volvo ECR25 Compact Excavator	32	7	10	15 A, 3.6 kW	50 kW
Forklift	Toyota Electric Forklift	16	4	4	15 A, 3.6 kW	
Grader	MacLean Gr5 EV Grader	32	7	7	15 A, 3.6 kW	50 kW
Loader	Volvo L20 Electric Compact Wheel Loader	32	7	10	15 A, 3.6 kW	50 kW
Half Ton	Ford F-150 Lightning XLT	150	7	7	15 A, 3.6 kW	
Medium Truck	Mack Electric Truck	200	7	10	50 KW	50 kW
Heavy Truck	Mack Electric Truck	200	7	14	50 KW	50 kW
One Ton	Lightning Electric Ford F-550	120	7	7	15 A, 3.6 kW	
Skid Steer	Bobcat T7X Skid Steer	16	7	10	15 A, 3.6 kW	
Sweeper/Vacuum	Elgin Broom Bear	64	7	10	15 A, 3.6 kW	50 kW
Three Quarter Ton	Rivian R1T	150	7	7	15 A, 3.6 kW	
Tractor	Solectrac e70N Electric Tractor	24	7	10	15 A, 3.6 kW	
Van	Lightning Electric E-450 129	160	7	7	30 A, 7.2 kW	

3.4.2 Site Electricity Demand and Consumption Modeling Results

Based on the actual and assumed operational data above, monthly electricity consumption (detailed in *Table 7*) and monthly peak demand have been modeled for each of the study locations. Due to the high variability in operations and uncertain procurement schedule for Priority 2 vehicles, this analysis is limited to Priority 1 vehicles. The results of this analysis are used in the financial analysis in Section 7. Assumptions for monthly peak demand and monthly electricity consumption include:

- **Peak Demand:** The peak demand is calculated assuming every dispenser is plugged into a vehicle, and the vehicle is receiving power at the peak of its load curve. Charging management solutions summarized in Section 1 provide strategies for consideration on reducing peak demand charging when introducing BEVs into a fleet but are not included in the peak demand analysis here. This peak demand is used to size the utility infrastructure reflected in the concept plans in Section 5.
- **Modeled Monthly Electricity Consumption:** The following approach was used to calculate monthly electricity consumption by vehicle.
    - Each vehicle's efficiency was modeled in kWh/km. This is kWh required to move each specific vehicle one km.
    - Vehicles are unlikely to travel their max km each day. Vehicles are assumed to travel on average 60% of the maximum provided or assumed daily km.
    - Vehicles will work 21 average working days per month.
    - The monthly kWh modeled per vehicle was multiplied by the number of specific vehicles assigned to each location to arrive at a modeled monthly electricity consumption.

Table 7: Monthly Electricity Consumption Required per Priority 1 Vehicle

Vehicle Type	BEV Equivalent	Avg. KM	Battery Size (kWh)	kWh required to drive one KM	Avg. KM traveled per month	Avg kWh required per vehicle per month
ATV	Polaris Ranger XP Kinetic	10	15	0.5	210	105
Forklift	Toyota Electric Forklift	10	24	0.8	210	168
Half Ton	Ford F-150 Lightning XLT	90	98	0.7	1890	1323
One Ton	Lightning Electric Ford F-550	72	131	0.7	1512	1058
Skid Steer	Bobcat T7X Skid Steer	10	60	1	210	210
Sweeper/Vacuum	Elgin Broom Bear	38	400	4.3	798	3431
Three Quarter Ton	Rivian R1T	90	83	0.5	1890	945
Van	Lightning Electric E-450 129	96	129	1.9	2016	3830

Table 8 reflects modeled electricity consumption at each of the studied sites based on the results of the energy modeling analysis in *Table 6* and the assumptions outlined above.

Table 8: Estimated Electricity Consumption and Peak Demand by Site, Priority 1 vehicles.

Site	Monthly Electricity Consumption (kWh)	Modeled Peak Demand (kW)	150 kW Charger w/ 3 Dispensers and Cabling	Total Level 2 AC Charging Dispensers**
Mountdale PWY	99,645	673	1	50
Front Street PWY	83,619	337	1	43
Parks North	34,220	222	1	24
Landfill	7,182	182.4	1	9
Transit*	12,590	57.6	-	4

**Transit vehicles limited to non-revenue supporting vehicles. **This includes a combination of dual port 19.2 kW and 7.2 kW chargers, along with single port 3.6 kW dispensers.*

3.5 Recommended Charging Strategy

The results of the both the existing conditions and the modeling analysis inform conceptual plans and the quantity of charging infrastructure required at each facility. The recommend charging strategy based on these analyses include:

- **Priority 1 vehicles can meet most operational needs with overnight Level 2 charging**. Given provided operational data, Priority 1 vehicles will be able to meet operational needs using overnight Level 2 charging. It is unlikely that most vehicles will need to charge every night; however, given the outdoor storage location for most vehicles, a Level 2 dispenser is recommended for each vehicle.

- **Operational variability with Priority 1 vehicles may require one DCFC station per facility:** The operational requirements for some vehicles, particularly half-tons to one tons, vary depending on the season. Half-ton to one-ton trucks that pick-up snow plowing duties in the winter will require more frequent and higher levels of charging than is needed during other months, both to the load of snow that needs to be removed and the colder temperatures. Access to DC Fast charging will help these vehicles meet specific operational needs.

- **Medium/Heavy Trucks will rely primarily on DC Fast Charging:** A 1:1 ratio of DCFC charging dispenser to medium and heavy trucks is recommended to meet daily operational needs. The DC charging configuration recommended in this plan includes a product that enables several dispensers to be powered from a single charging cabinet. This can be achieved either through "sequential charging," where vehicles are put in a queue and charged individually, or through "parallel charging," where power is shared among multiple connected vehicles. This infrastructure reduces the amount of charging modules required and provides flexibility to charge multiple vehicles. For example, a 150 kW DC charger with one charging cabinet and 3 dispensers can charge one Mack Electric Truck in 2 hours at 150 kW, or 3 Mack Electric Trucks simultaneously at 50 kW, which would take approximately 6 hours.[21]

- **A 1:1 ratio of DC Fast Charging dispensers to Medium/Heavy Duty vehicles will help serve other vehicle needs for DC Fast Charging.**

    - **Construction and specialty equipment will likely need access to Level 2 and DC Fast Charging:** While BEV replacements have been modeled for specific construction and specialty equipment, the operational history of this equipment remains limited. Heavy construction equipment will likely rely on DC Fast Charging during periods of heavy operation. All construction equipment has also been assigned a 1:1 AC Charging Dispenser ratio and is located at sites with access to DC dispensers. Specific construction equipment, such as heavier graders, may require and share DC charging dispensers with

[21] LR Electric Specs | Mack Trucks

the medium and heavy-duty trucks outlined below. A mobile DCFC unit is recommended for consideration of electric construction equipment operating at job sites.

- **Emergency/Backup Vehicles:** In the case of a power outage, Thunder Bay plans to have DC dispensers each at both Front Street PWY and Mountdale PWY to serve its electric fleet across the city. The recommended configuration is to provide four (1x) 150 kW Charger w/ 3 Dispensers and Cabling at each site to serve emergency/backup vehicles. This configuration would allow Thunder Bay to charge up to 12 vehicles with 50 kW power each simultaneously. These dispensers have been accounted for in the site plans, but exact timing of installation would depend on the pace of fleet electrification. As Thunder Bay's fleet electrifies, it will determine which electric vehicles it will consider to be emergency or backup vehicles.

The conclusions from the existing conditions and energy modeling analysis inform both the procurement recommendations in section 4 and the facility conceptual plans in section 5.

4 VEHICLE AND PROCUREMENT RECOMMENDATIONS

The City of the Thunder Bay will evaluate current BEV technology as it continues to evolve and transition to BEVs, and as it is operationally and fiscally responsible to do so. Thunder Bay will focus on the procurement of Priority 1 vehicles beginning in 2026, in alignment with the replacement schedule provided in November 2022. For the purposes of this analysis, it is assumed that any ICE vehicle (Priority 1 or Priority 2) due for replacement before the year 2026 will be replaced with an ICE vehicle. Thunder Bay should continue to closely monitor the availability and viability of battery electric replacements of Priority 2 vehicles and begin procurement accordingly when it makes operational and financial sense to do so.

4.1 Vehicle Replacement Schedule

The City of Thunder Bay will begin allocating budget for both vehicle purchases and charging infrastructure in 2024. Construction is modeled to begin in 2025, with vehicle procurement beginning in 2026 in alignment with Thunder Bay's vehicle replacement schedule. Thunder Bay staff do have short-term flexibility in moving vehicles between assigned locations to meet operational requirements.

Table 9 and Figure 6 summarizes the anticipated vehicle replacement schedule for all Priority 1 vehicles across all five locations. 60% of all Priority 1 vehicles are due for replacement between 2026 and 2030.

Table 9: Replacement Schedule for Priority 1 Vehicles by Site

Time Period	Priority One Vehicles Scheduled for BEV Replacement	Mountdale PWY	Front Street PWY	Parks North	Landfill	Transit
2026-2030	78	35	25	16	1	1
2031-2035	34	10	12	6	3	3
2036-2040	21	5	6	2	5	3
Total	133	50	43	24	9	7

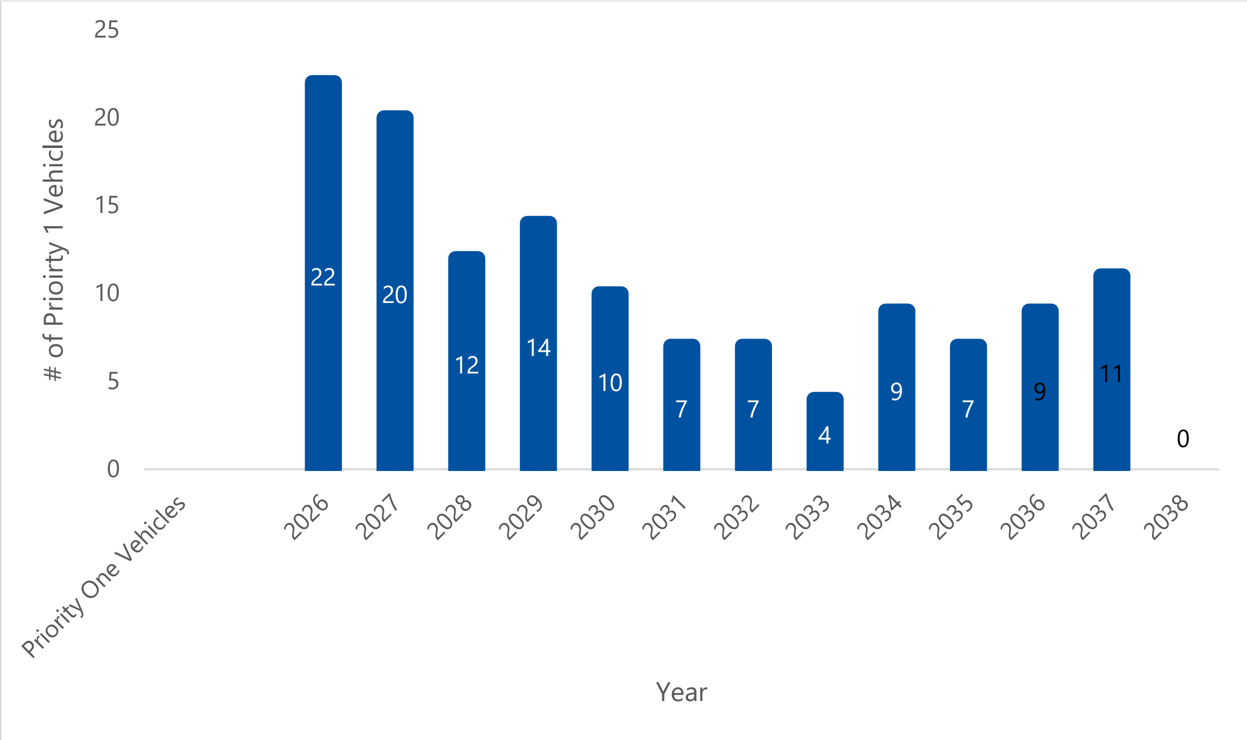

Figure 6. Schedule of Priority 1 Vehicle Replacements Across Studied Thunder Bay Locations.

The energy modeling results dictate the level of charging infrastructure required at each facility, and the recommended charging dispenser for each vehicle. However, there are economies of scale and efficiencies associated with installing much of the underground infrastructure required at full build out, for both Priority 1 and Priority 2 vehicles, at initial project construction. These strategies are outlined in Section 5.

5 FACILITY & INFRASTRUCTURE PLAN

This section details the conceptual infrastructure layouts for the Mountdale PWY, Front Street PWY, Parks North, Landfill, and Fort William Road Transit Garage facilities. These conceptual layouts are primarily informed by the existing conditions, fleet modeling analysis, and coordination with Synergy North.

At all locations, the charging infrastructure recommended is sized to support Priority 1 vehicles, with supporting utility infrastructure sized to support a full buildout of Priority 1 and 2 vehicles. All supporting utility infrastructure required for charging Priority 1 vehicles, including conduit, junctions, and equipment pads, should be installed at the beginning of construction to minimize construction costs, facility operational impacts, and the need for rework. Supporting electric utility equipment like transformers should be sized appropriately to support the peak charging load at full build-out. Initial construction should include conduit runs to all parking stalls that will be electrified and stubbed off, with additional chargers being installed in later years as vehicles are delivered. This approach should eliminate the need for additional construction phases, utility trenching, concrete saw cutting, repair and replacement, and parking lot restriping.

5.1 Mountdale Public Works Yard

The conceptual layout in Figure 7 reflects the need for a hybrid parking approach at the facility, where trucks and heavy construction equipment, in addition to lighter duty vehicles, will have different parking assignments depending on the day and the season.

A 25 kV overhead distribution powerline is located west of Mountdale Avenue and currently provides power to the garage building through a 225 kVA transformer. The charging infrastructure's electric service would come from an independent underground service from the same distribution power line on Mountdale Avenue as a secondary metered connection.

Site-specific Priority 1 charging equipment and related infrastructure at this facility will include:

- Underground Ducting for Storage Garage and Administration building
- Hitching Post concrete pad
- (1x) 1000 kVA 600 V – 480 V Transformer
- (1x) 480 V Outdoor Rated Switchboard
- (1x) 150 kW Charger w/ 3 Dispensers and Cabling
- (2x) 150 kVA 480 V – 208 V Mini Unit Substation
- (6x) Dual Port 7.2 kW Level 2 Chargers and Dispensers
- (38x) Single Port 3.6 kW Level 2 Chargers and Dispensers

Table 10 and *Table 11* summarize the quantity and location of Level 2 and DCFCs recommended to support Priority 1 and Priority 2 vehicles, respectively.

Table 10: Mountdale PWY Priority 1 Recommended Chargers

Area	Quantity of 150 kW DCFC Chargers w/ 3 Dispensers and Cabling	Quantity of Dual Port 7.2 kW Level 2 Chargers w/ 2x J1772 Plugs	Quantity of Single Port 3.6 kW Level 2 Chargers w/ 1x J1772 Plugs
Storage Garage - Inside	3	2	4
Storage Garage – Outside	0	3	10
Admin. Building	0	1	21
Admin. Building - Hitching Post	0	0	3
Total	**3**	**6**	**38**

Table 11: Mountdale PWY Priority 2 Recommended Chargers

Area	Quantity of 150 kW DCFC Chargers w/ 3 Dispensers and Cabling	Quantity of Dual Port 7.2 kW Level 2 Chargers w/ 2x J1772 Plugs	Quantity of Single Port 3.6 kW Level 2 Chargers w/ 1x J1772 Plugs
Storage Garage - Inside	2	0	0
Admin. Building - Hitching Post	7	0	0
Fleet Maintenance Building	0	0	18
Fleet Maintenance Building - Hitching Post	4	0	0
Total	**13**	**0**	**18**

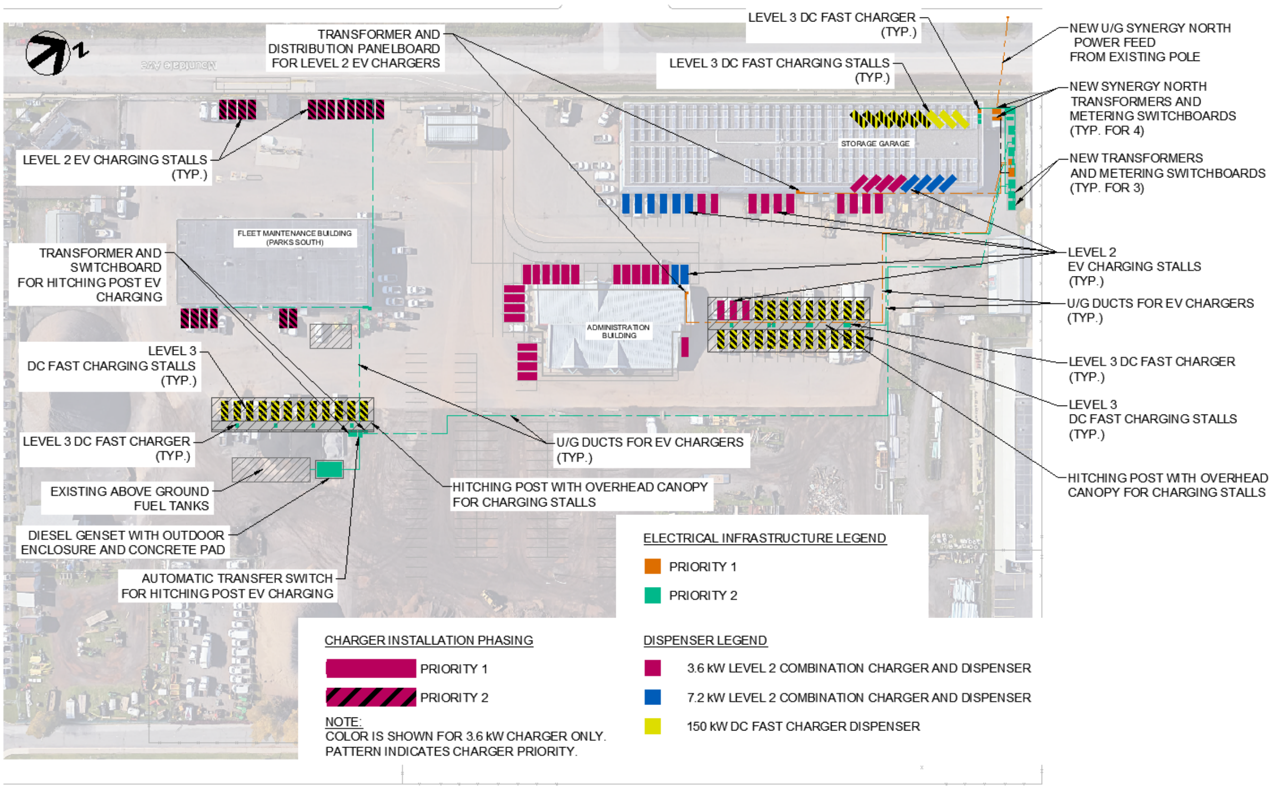

Figure 7. Mountdale PWY Conceptual Site Plan

5.2 Front Street Public Works Yard

The conceptual layout in Figure 8 reflects a preference for outdoor parking in underutilized areas of the site, along with considering the site grade changes and retaining walls necessary to build out this site.

A 25 kV overhead distribution powerline is located west of Front Street and currently provides power to the garage building through a 225 kVA transformer. The charging infrastructure's electric service would come from an independent underground service from the same distribution power line on Front Street as a secondary metered connection. Site-specific Priority 1 charging equipment and related infrastructure at this facility will include:

- Underground Ducting for Priority 1 Equipment
- (1x) 1000 kVA 600 V – 480 V Transformer
- (1x) 480 V Outdoor Rated Switchboard
- (1x) 150 kW Charger w/ 3 Dispensers and Cabling
- (1x) 150 kVA 480 V – 208 V Mini Unit-substation
- (1x) 112 kVA 480 V – 208 V Mini Unit-substation
- (5x) Dual Port 7.2 kW Level 2 Chargers and Dispensers
- (34x) Single Port 3.6 kW Level 2 Chargers and Dispensers

Table 12 and *Table 13* summarize the quantity and location of Level 2 and DCFCs recommended to support Priority 1 and Priority 2 vehicles, respectively.

Table 12: Front Street PWY Priority 1 Recommended Chargers

Area	Quantity of 150 kW DCFC Chargers w/ 3 Dispensers and Cabling	Quantity of Dual Port 7.2 kW Level 2 Chargers w/ 2x J1772 Plugs	Quantity of Single Port 3.6 kW Level 2 Chargers w/ 1x J1772 Plugs
Garage - Inside	1	5	0
Storage Garage – Outside	0	0	34
Total	1	5	34

Table 13: Front Street PWY Priority 2 Recommended Chargers

Area	Quantity of 150 kW DCFC Chargers w/ 3 Dispensers and Cabling	Quantity of Dual Port 7.2 kW Level 2 Chargers w/ 2x J1772 Plugs	Quantity of Single Port 3.6 kW Level 2 Chargers w/ 1x J1772 Plugs
Storage Garage - Inside	2	0	0
Hitching Post	5	0	16
Total	7	0	16

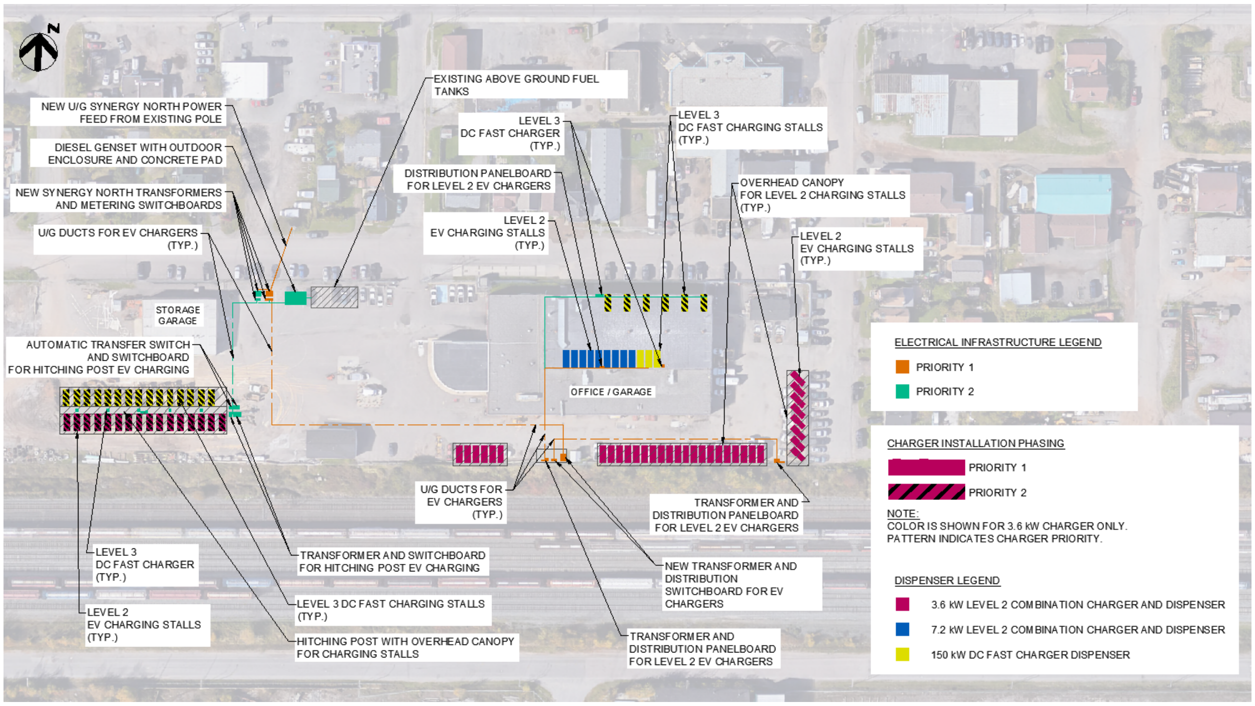

Figure 8. Front Street PWY Conceptual Site Plan

Note that the central garage currently stores graders in the winter; moving forward electric street sweepers may also be stored there during the summer.

5.3 Parks North

The Parks North site consists of both the Parks North Building and the Traffic Control and Street Lighting Building (TCSL). The shared electrical feed between both buildings allows for cost efficiencies in installing infrastructure, as DCFCs needed to support heavy equipment at the TCSL building can be tied to the electric infrastructure planned for the Parks Building. This removes the need for an electric service upgrade at the TCSL building. The conceptual layout in Figure 9 reflects a preference for outdoor parking, utilization of an underutilized parking area on the southern fence.

A 25 kV overhead distribution powerline runs parallel to the rail line southeast of the site. This powerline currently provides power to the building through a 75 kVA transformer. A new electric service is required for the EV charging infrastructure. This new service would be sized for all EV infrastructure and the existing building load. The new power feed would act as the main meter for the site. The parks building would be sub-fed to allow for separate billing.

Site-specific Priority 1 charging equipment and related infrastructure at the Parks North building will include:

Underground Ducting for EV Equipment
(1x) 750 kVA 600 V – 480 V Transformer
(1x) 480 V Outdoor Rated Switchboard
(1x) 75 kVA 480 V – 208 V Transformer

(1x) Building Electrical Upgrades for New Metering Configuration
(1x) 150 kW Charger w/ 3 Dispensers and Cabling
(1x) 150 kVA 480 V – 208 V Mini Unit-substation
(1x) Dual Port19.2 kW Level 2 Chargers and Dispensers
(15x) Single Port 3.6 kW Level 2 Chargers and Dispensers

Site-specific Priority 1 charging equipment and related infrastructure at the TCSL building will include:

Underground Ducting for Priority 1 Equipment
(1x) Secondary Meter for EV Charging Loads
(1x) Concrete Pad for New Level 2 Parking Stalls
(1x) 208 V Panelboard
(1x) Dual Port 7.2 kW Level 2 Chargers and Dispensers
(5x) Single Port 3.6 kW Level 2 Chargers and Dispensers

Table 14 and *Table 15* summarize the quantity and location of Level 2 and DCFCs recommended to support Priority 1 and Priority 2 vehicles at the Parks North and TCSL buildings, respectively.

Table 14: Parks North Recommended Chargers

Area	Quantity of 150 kW DCFC Chargers w/ 3 Dispensers and Cabling	Quantity of Dual Port 19.2 kW Level 2 Chargers w/ 2x J1772 Plugs	Quantity of Single Port 3.6 kW Level 2 Chargers w/ 1x J1772 Plugs
Priority 1	1	1	15
Priority 2	1	0	4

Table 15: TCSL Recommended Priority 1 Chargers

Area	Quantity of Dual Port 7.2 kW Level 2 Chargers w/ 2x J1772 Plugs	Quantity of Single Port 3.6 kW Level 2 Chargers w/ 1x J1772 Plugs
Priority 1	1	5

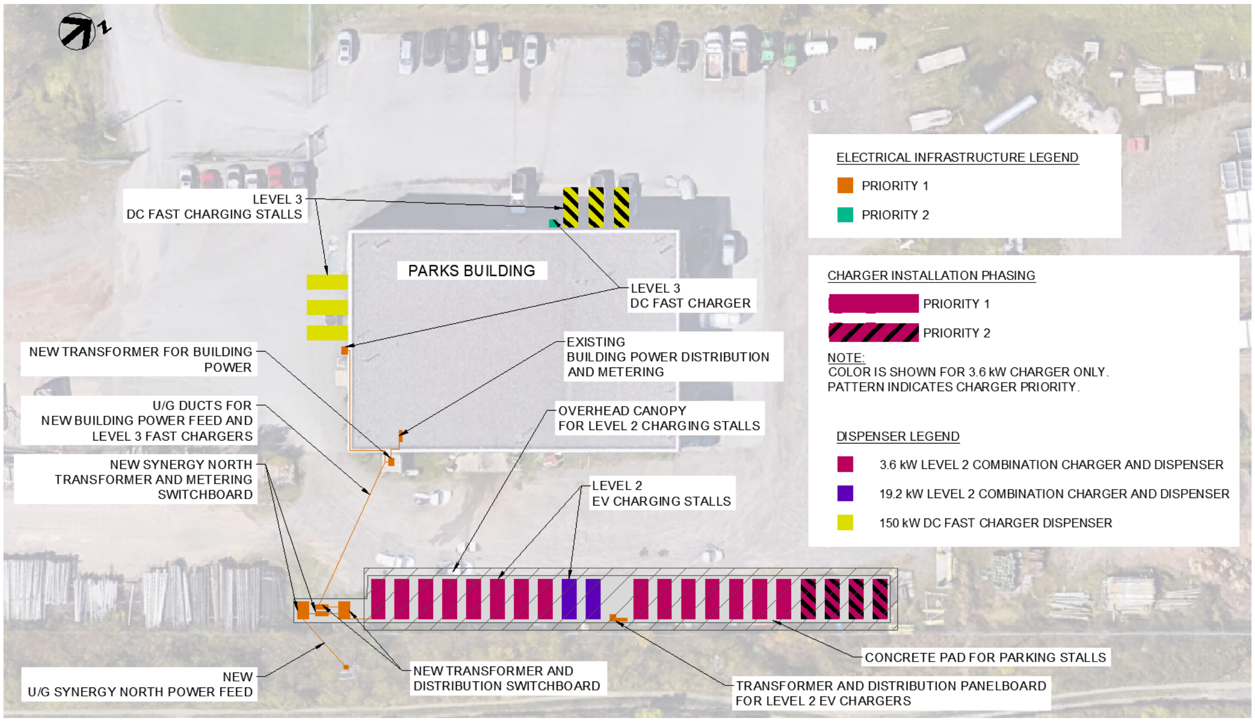

Figure 9. Parks North Conceptual Site Plan – Parks Building

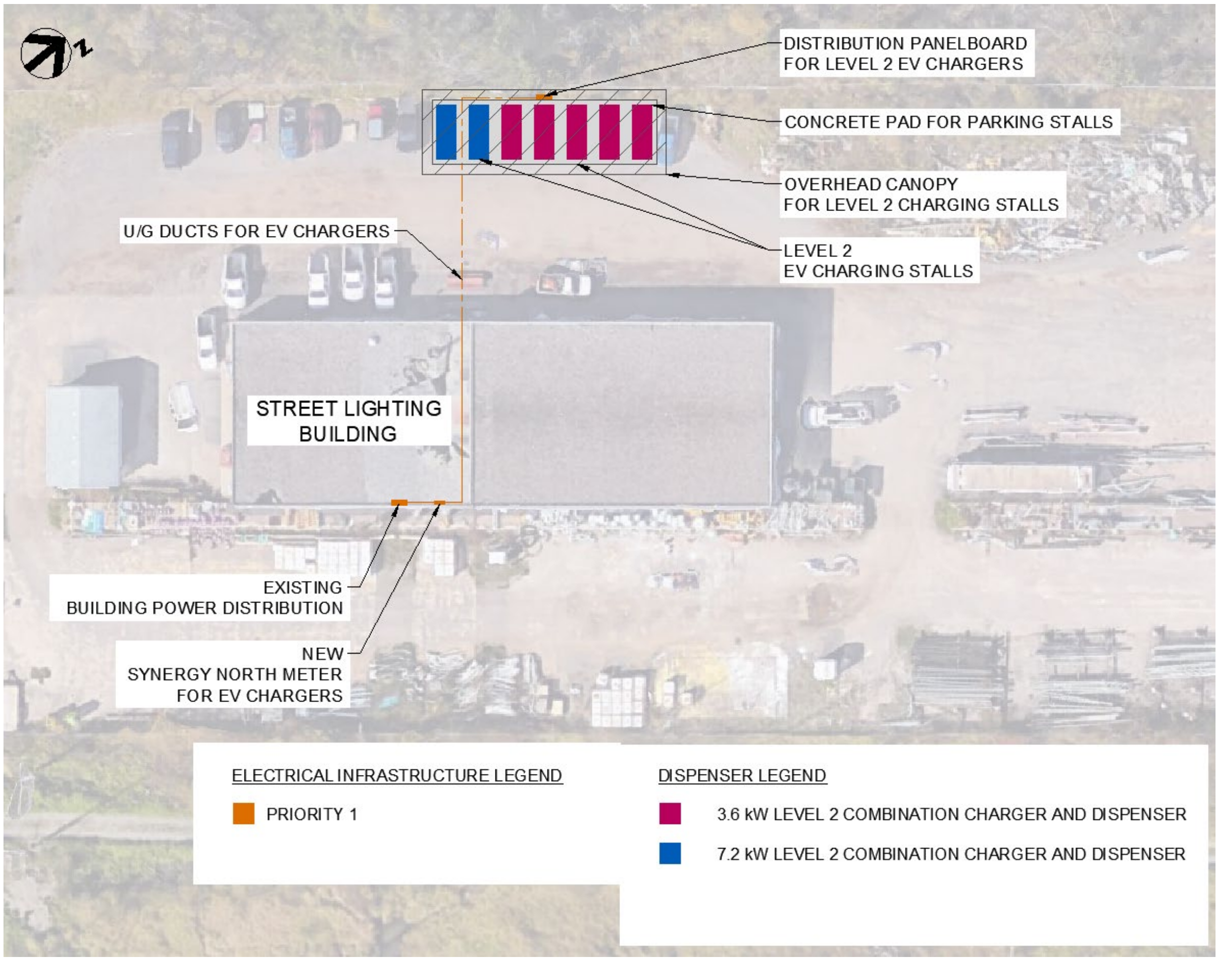

Figure 10. Traffic Control and Street Lighting Conceptual Site Plan

5.4 City of Thunder Bay Solid Waste and Recycling Facility (Landfill)

The recommended layout for the Landfill site is identified in
Figure *11*. All current parking will occur indoors in the existing facility. Should the packers be relocated from Mountdale PWY to Landfill, an expansion of this facility may be required, as identified in the location shown on
Figure *5*.

A 12 kV overhead distribution powerline borders the east side of the site on the west side of Mapleward Road. This powerline currently provides power to the building through a 500 kVA transformer. The power for the charging infrastructure would be sub-fed by the existing building transformer with a new meter to allow for separate billing of the EV infrastructure. An upgrade to the building service will not be required at this site.

Site-specific Priority 1 charging equipment and related infrastructure at this facility will include:

Underground Ducting for Priority 1 Equipment
(1x) Secondary Meter for EV Charging Loads
(1x) 500 kVA 600 V – 480 V Transformer
(1x) 480 V Panelboard
(1x) 150 kW Charger w/ 3 Dispensers and Cabling
(1x) 50 kVA 480 V – 208 V Transformer and 208 V Panelboard
(9x) Single Port 3.6 kW Level 2 Chargers and Dispensers

Table 16 summarizes the quantity of Level 2 and DCFCs recommended to support Priority 1 and Priority 2 vehicles.

Table 16: Landfill Recommended Priority 1 and Priority 2 Chargers

Priority	Quantity of 150 kW DCFC Chargers w/ 3 Dispensers and Cabling	Quantity of Single Port 3.6 kW Level 2 Chargers w/ 1x J1772 Plugs
Priority 1	1	9
Priority 2	1	1
Total	**2**	**10**

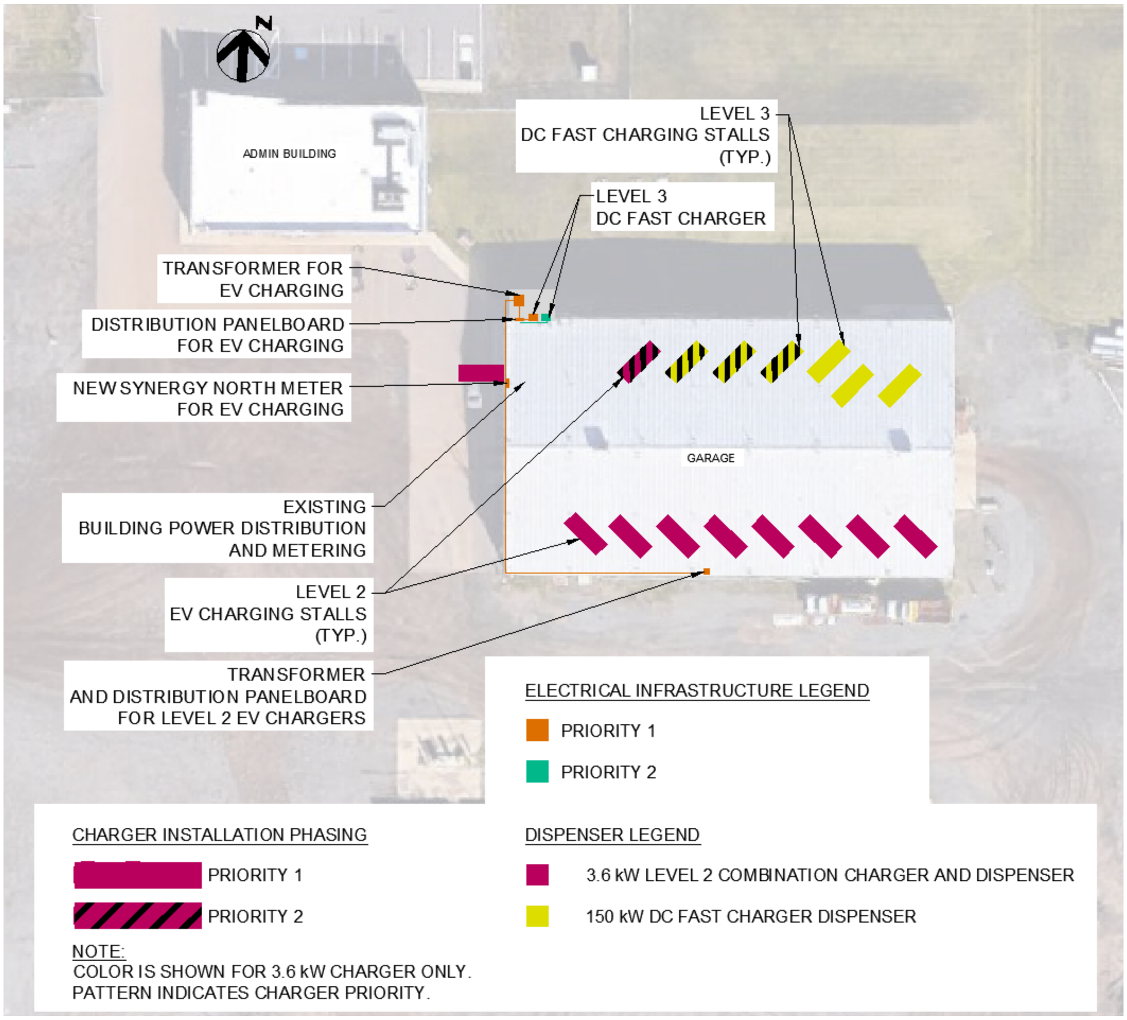

Figure 11. Landfill Conceptual Layout

5.5 Fort William Road Transit Garage

The Fort William Road Transit Garage's conceptual plan was developed in conjunction with Thunder Bay's Transit Fleet Transition Plan. The limited number of Level 2 chargers are assigned to the non-revenue transit vehicles that support the day-to-day operations of the transit fleet. Costs specific to the construction of these chargers are included in the financial analysis.

Site-specific Priority 1 charging equipment and related infrastructure at this facility will include:

150 kVA 480-208V transformer
(2x) Dual port 7.2 kW level 2 Chargers and Dispensers w/ Cabling
Underground Ducting Conduit Runs through Building

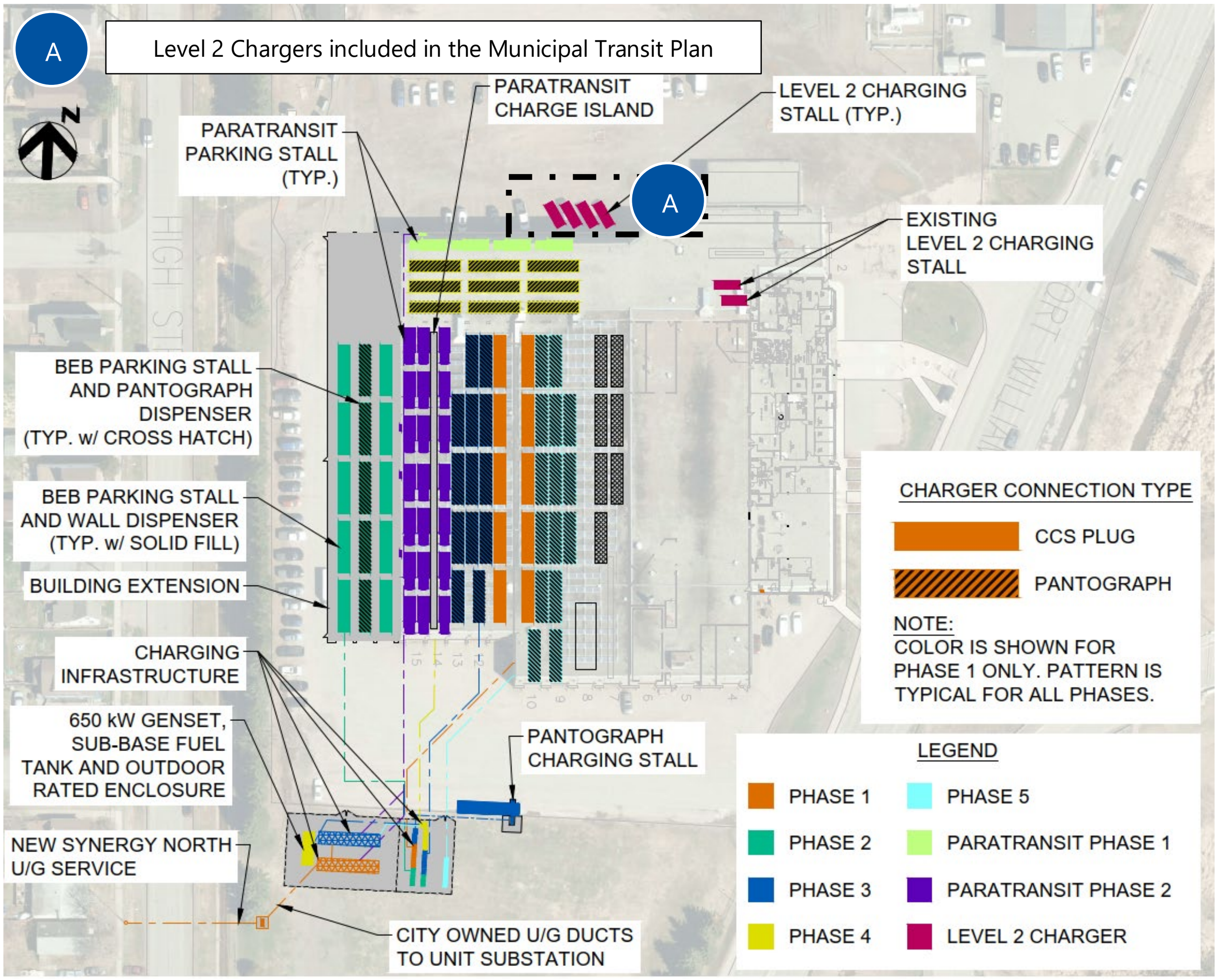

Figure 12. Fort William Road Transit Garage Conceptual Plan

6 OPERATIONAL PLANNING

Proper training on electric vehicle systems and subcomponents is essential to a successful fleet transition in order to ensure the safe and efficient operation and maintenance of the new EV fleet. As part of the transition, Thunder Bay should encourage coordination between operations departments, maintenance departments, and vehicle OEMs, to ensure staff are acclimated to the new technology. This section provides a high-level overview of steps needed to develop a plan to train both vehicle operators and maintenance personnel, as well as local first responders.

6.1 Developing a Training Program

Agencies undergoing a fleet transition will typically add EVs to their fleets through a phased schedule, which allows for a focused subset of staff to first become familiarized with vehicles and chargers and pass along knowledge to additional employees as the fleet expands, utilizing a 'train the trainer' model. While vehicle operators and maintenance personnel comprise the key staff in an electric vehicle transition, any staff members with regular access to vehicle storage or maintenance areas should also receive basic electric vehicle safety training.

The City of Thunder Bay should work to develop a training program that integrates an EV and EVSE curriculum with its existing training programs. This program includes maintenance technical training and vehicle behind-the-wheel training. Technical training would need to include system familiarization and operations, safety, troubleshooting, diagnostics and preventative maintenance. This program will entail coordination with internal and external resources.

When first adding any electric vehicle to a fleet, it is best practice to utilize OEM support. OEMs offer many resources (some included with the vehicle purchase with additional resources available at an extra cost) to ensure that their vehicles are successful. Thunder Bay should explore these options while making purchasing decisions regarding new vehicles and chargers. An additional resource would be partnership or co-ordination with local first responding agencies

The City of Thunder Bay has also recommended the development of a zero emissions vehicle technology and training cluster with local colleges and trade organizations within *Climate-Forward City: Thunder Bay Net-Zero Strategy* as a near-term tactic to support reaching low-carbon transportation goals.[22] As this technology and training cluster eventually becomes developed, Thunder Bay should take full advantage of any potential training, hiring or apprenticeship opportunities that may arise locally for their EV fleet.

Training programs should be selected to satisfy and combine with the prerequisite knowledge and expertise required for developing a skilled workforce and robust operational planning. Examples of trainee preparation and prerequisite knowledge include, but are not limited to:

- Understanding of the processes related to periodic inspection and preventive maintenance as well as the operating procedures for repair and maintenance.
- How to record and report faults and the spare requirement to be sourced for the repair activities.

[22] Climate-Forward City: Thunder Bay Net-Zero Strategy, pg. 42

- Performance of periodic checks of electrical systems.
- Proper use and inspection of personal protective equipment (PPE).
- CPR and first aid.
- High voltage systems.
- Lock-Out-Tag-Out training and compliance.

6.2 Vehicle Operators

Training needs for vehicle operators will vary based on the specific vehicle type, and some vehicle types, such as ATVs and light-duty pickup trucks, will require little to no operator training, while specialty and heavy-duty equipment, such as backhoe loaders and excavators, will require more operator training. Generally, training will be focused on operators gaining familiarity with all dash indicator lights, safety procedures, and any operational differences in vehicles (e.g., instantaneous torque when using a specialty vehicle's auxiliary functions, such as the boom and bucket). Depending on the vehicle type, staff may also need training on charging protocols and basic charger system elements.

Basic vehicle familiarization trainings are typically offered by the vehicle OEM, and completing these trainings is standard practice when new vehicles are introduced. Depending on the vehicle type, it may be recommended to purchase additional training from the OEM if available. When applicable, operators should also be trained to drive BEVs differently than they do ICE vehicles in order to leverage the regenerative braking system in a way that maximizes battery efficiency and driving range. If operators are tasked with charging the BEVs at a garage facility or pulling onto on-route charging spots, additional training should be conducted to ensure safety near high voltage systems. Operators are also responsible for emergency response and would benefit from emergency response training offered by OEMs.

Training for vehicle operators is essential to ensuring the success of electric vehicles in daily operations. Operators are the first line of defense in proactively identifying vehicle issues that will require corrective service. With the addition of new electric vehicles, it's recommended to consider purchasing extended warranties and preventative maintenance packages through OEMs to ensure working order of equipment.

6.3 Vehicle and Charger Maintenance

Agencies may choose to perform both preventative and corrective maintenance for electric vehicles and chargers in-house, perform only preventative maintenance in-house with corrective maintenance performed by a third-party, or have both preventative and corrective maintenance performed by third parties. Thunder Bay may also choose to pursue a combination of these strategies depending on vehicle type (such as passenger vehicle vs. specialty equipment), labor availability, and the relative cost-effectiveness of each option.

While electric vehicles require significantly less maintenance than their ICE counterparts, regular maintenance of some vehicle components is still necessary, such as the liquid coolant systems present in heavy-duty EVs which maintain safe battery temperatures. If vehicle maintenance will be performed in-house, maintenance staff will typically require the most training as they have frequent, in-depth interactions with the electric vehicles. Staff should be individually assessed on current skills and assigned to training modules as necessary. Maintenance staff will need vehicle familiarization training that include drive train theory, on-board energy storage system, regular maintenance procedures, system diagnostics, troubleshooting, and repairs. Once this understanding is in place, maintenance staff will need to become high voltage certified, if not already. Mechanics would need to learn procedures for the proper use and inspection of personal protective equipment (PPE) and Lock-Out-Tag-Out (LOTO) procedures for BEVs.

Thunder Bay will also need to consider the maintenance of chargers used to support EVs. Maintenance staff could be tasked with charger maintenance, or they could coordinate repairs with charger OEMs or local electricians. Agencies can also choose to outsource monitoring, operations, and management activities by choosing a Charging as a Service (CaaS) solution, which provides equipment, installation, software, maintenance, and customer support for a fixed monthly fee.

6.4 Operational Resources

As Thunder Bay transitions its municipal fleet to BEVs, there will be likely be operational changes not accounted for within this report as they are still unknown. It's recommended that Thunder Bay begin the transition with at least one full-time employee dedicated to coordinate, train, and monitor the transition. The transition coordinator can also be responsible for evaluating existing and emerging BEVs to recommend when as Thunder Bays moves beyond Phase 1 of the transition.

6.5 First Responders

Throughout the electric fleet transition, Thunder Bay should also coordinate training with local first responders. While agencies would not be responsible for training local first responders, it is best practice to provide them training materials and work with them on-site to establish an emergency response plan. This ensures that in case of emergency, the first responders are familiar with the facilities and vehicles.

6.6 Procurement Planning

Effective operational and maintenance strategies can be specified before the chargers are procured and included in procurement documents to ensure a successful working relationship with the original equipment manufacturer (OEM). When issuing an RFP, Thunder Bay can include language that specifies maintenance needs for the EVs and charging equipment. This can include items such as providing a preventive maintenance check list and conducting trainings with employees. Specifying these aspects in RFPs, procurement contracts and service agreements will enable Thunder Bay to define their operational, training and maintenance needs and create opportunity for reciprocal action in the event of needs not being met by the OEMs.

7 FINANCIAL ANALYSIS

The cost to procure both BEVs and the associated charging infrastructure remains a significant challenge for many public agencies. The financial analysis in this transition plan includes capital costs associated with new vehicle purchases, on-site charging infrastructure, and service upgrades required by Synergy North to deliver the necessary power to the site. Additionally, it includes a side-by-side comparison of fueling and electricity costs, along with estimated cost savings associated with ongoing operations and maintenance of the vehicles. Given the uncertainty around future market availability of Priority 2 vehicles, this financial analysis is limited to the capital and lifecycle costs associated with procuring Priority 1 vehicles. A high-level summary is provided below, while a detailed analysis of assumptions and results can be found in *Appendix B. Financial Analysis*.

7.1 Fleet Transition Scenarios

The financial analysis considers two scenarios for Thunder Bay's municipal fleet transition. Each scenario evaluates the capital, operating, maintenance, and fuel/electricity costs required between 2024 and 2040.

- **Baseline (Business as Usual):** This reflects the scenario where no transition to BEVs occurs. All replacements of existing ICE vehicles are with new ICE vehicles.
- **BEV Scenario:** This reflects a full transition of Thunder Bay's Priority 1 vehicles to BEVs in alignment with the existing replacement schedule, beginning in 2026.

7.2 Lifecycle Cost Analysis

The analysis presents all dollar values in net present value (NPV) terms, unless otherwise noted. NPV analysis accounts for the "time value of money", or the principle that a dollar today is worth more than a dollar tomorrow. NPV is used to present costs incurred over the 2024-2040 study period on a consistent basis. A discount rate of 8% was applied to all costs back to the initial year 2024. A general 3% escalation rate was applied to estimate future capital expenditures, based on the Bank of Canada's long-term inflation target of 1-3%. Cost estimates for the procurement of BEVs and associated charging infrastructure can be used for budget planning and upcoming funding opportunities.

7.3 Capital Costs

Capital costs include vehicle costs, BEV charging infrastructure costs, and the required electric service upgrades. (**Note:** Cost estimates for electric service upgrades are currently being finalized by Synergy North. Placeholder estimates included are reflective of previous edits provided by Synergy North for similar electric service upgrades.)

7.3.1 Vehicle Capital Costs

Table 17 presents the unit cost assumptions for vehicles. The municipal vehicle fleet size is expected to remain the same after transitioning Priority 1 vehicles to BEVs. Note: this plan focuses on capital purchases of vehicles.

Table 17: BEV Capital Cost Assumptions (2023$)

Vehicle	ICE Cost	BEV Cost	Vehicles in Fleet
ATV	$25,336	$30,499	2
Forklift	$46,065	$30,000	5
Half Ton	$51,198	$58,595	37
One Ton	$96,622	$121,085	10
Skid Steer	$109,405	$270,000	1
Street Sweeper	$233,206	$932,275	10
Three Quarter Ton	$57,745	$98,550	41
Van	$57,513	$72,510	27

7.3.2 Infrastructure Capital Costs

Table 18 identifies the capital costs associated with charging infrastructure required for Priority 1 vehicles. As noted in the Energy Modeling section, each site has been designed to phase in additional infrastructure primarily including substations, 3.6 kW and 150 kW charging equipment, circuit breakers, and other infrastructure needed to facilitate charging for the BEV fleet. The following estimates exclude costs associated with the overhead canopies outlined in Section 5 for any outdoor vehicle parking.

Table 18. Infrastructure Capital Costs Assumptions

Site	Year Construction Begins[23]	Overall Cost To Serve Priority 1 Vehicles	Key Equipment Required
Front Street Public Works Yard	2026-2031	$3,289,000	- Underground Ducting for Priority 1 Equipment - (1x) 1000 kVA 600 V – 480 V Transformer - (1x) 480 V Outdoor Rated Switchboard - (1x) 150 kW Charger w/ 3 Dispensers and Cabling - (1x) 150 kVA 480 V – 208 V Mini Unit-substation - (1x) 112 kVA 480 V – 208 V Mini Unit-substation - (5x) Dual Port 7.2 kW Level 2 Chargers and Dispensers - (34x) Single Port 3.6 kW Level 2 Chargers and Dispensers
Landfill	2026-2031	$1,222,000	- Underground Ducting for Priority 1 Equipment - (1x) Secondary Meter for EV Charging Loads - (1x) 500 kVA 600 V – 480 V Transformer - (1x) 480 V Panelboard - (1x) 150 kW Charger w/ 3 Dispensers and Cabling - (1x) 50 kVA 480 V – 208 V Transformer and 208 V Panelboard - (9x) Single Port 3.6 kW Level 2 Chargers and Dispensers

[23] The years indicated show the range of potential construction dates for these improvements. In the financial analysis it was assumed these occur in 2025 since the planned implementation has not been established. The City of Thunder Bay has flexibility in aligning vehicle procurement and construction schedules.

Site	Year Construction Begins[23]	Overall Cost To Serve Priority 1 Vehicles	Key Equipment Required
Parks North Yard	2026-2031	$2,119,000	- Underground Ducting for EV Equipment - (1x) 750 kVA 600 V – 480 V Transformer - (1x) 480 V Outdoor Rated Switchboard - (1x) 75 kVA 480 V – 208 V Transformer - (1x) Building Electrical Upgrades for New Metering Configuration - (1x) 150 kW Charger w/ 3 Dispensers and Cabling - (1x) 150 kVA 480 V – 208 V Mini Unit-substation - (1x) Dual Port19.2 kW Level 2 Chargers and Dispensers - (15x) Single Port 3.6 kW Level 2 Chargers and Dispensers
Mountdale Public Works Yard	2026-2031	$3,523,000	- Underground Ducting for Storage Garage and Administration building - Hitching Post concrete pad - (1x) 1000 kVA 600 V – 480 V Transformer - (1x) 480 V Outdoor Rated Switchboard - (1x) 150 kW Charger w/ 3 Dispensers and Cabling - (2x) 150 kVA 480 V – 208 V Mini Unit Substation - (6x) Dual Port 7.2 kW Level 2 Chargers and Dispensers - (38x) Single Port 3.6 kW Level 2 Chargers and Dispensers -
TCSL	2026-2031	$169,000	- Underground Ducting for Priority 1 Equipment - (1x) Secondary Meter for EV Charging Loads - (1x) Concrete Pad for New Level 2 Parking Stalls - (1x) 208 V Panelboard - (2x) 7.2kW Level 2 Chargers and Dispensers - (5x) 3.6 kW Level 2 Chargers and Dispensers
Fort William Road Transit Garage	2026-2031	$230,000*	- 150 kVA transformer* - (2x) Dual port 7.2 kW level 2 Chargers and Dispensers w/ Cabling - Underground Ducting Conduit Runs through Building

**This cost reflects additional power needs adjacent to the planned Level 2 chargers as outlined in the transit plan.*

7.3.3 Anticipated Service Upgrade Costs from Synergy North

Table 19 identifies the estimated costs associated with receiving upgraded electric service at each of the sites that require service. Note that each of the anticipated service upgrade costs include upgrades required to serve Priority 2 vehicles in addition to the Priority 1 vehicles in this analysis. The landfill cost estimate covers the cost estimate required to upgrade service to move the packers from Mountdale to Landfill and electrify them.

Table 19: Estimated Service Upgrade Costs

Site	Year	Cost
Front Street PWY	2025	$363,500
Landfill	2025	$2,850,000[24]
Parks North Yard	2025	$164,000
Mountdale PWY	2025	$132,000

7.3.4 Capital Cost Comparison by Scenario

Table 20 below displays a comparison of capital costs between the Base and BEV Scenarios in discounted dollars.

Table 20. Capital Cost Comparison, Baseline versus BEV Scenario ($, millions)

	Base	BEV
ICE Vehicles	$11.8	$1.5
BEVs	-	$19.9
Infrastructure	-	$8.1
Total	**$11.8**	**$29.5**

7.4 Fueling and Maintenance Costs

Ongoing fueling and maintenance costs for Thunder Bay's traditional ICE vehicles and their modeled BEV replacements are part of this analysis.

7.4.1 Fueling Costs

These costs include the fueling and electricity costs assumed for transitioning ICE vehicles to BEVs. Based on the methodology described in O&M Cost Assumptions, *Table 21* summarizes the fuel and electricity cost estimates for the Baseline and the BEV scenario over the 2024 to 2040 period. These costs were estimated to be $14 million for diesel or gasoline in the base scenario and $8.9 million total in the BEV transition scenario. The $2.7 million for electricity assumes a rate which includes the kWh usage charges and peak demand charges.

Table 21: Fueling Cost Comparison, Baseline versus BEV Scenario, ($, millions)

	Base	BEV
ICE Vehicles	$14.0	$6.1
BEVs	-	$2.7
Total	**$14.0**	**$8.8**

[24] Cost estimate associated with providing electric service to power electric packers relocated from Mountdale to Landfill.

7.4.2 Maintenance Costs

Based on research by the Argonne National Laboratory, BEV maintenance costs are estimated at 30-40% below comparable ICEVs. As such, we have applied a 35% reduction to Thunder Bay municipal fleet maintenance cost data to calculate the benefit of lower BEV maintenance costs.

Table 22 reflects estimated annual maintenance costs.

Table 22: Estimated Annual Maintenance Costs by Vehicle Type, ICE versus BEV

Vehicle	ICE Cost	BEV Cost
ATV	-	-
Forklift	$1,183	$769
Half Ton	$2,598	$1,689
One Ton	$3,488	$2,267
Skid Steer	$6,716	$4,365
Street Sweeper	$15,884	$10,325
Three Quarter Ton	$2,978	$1,936
Van	$2,250	$1,463

7.5 Financial Summary

Under the BEV Scenario, the total cost of implementation is $44.2 million in discounted 2023 dollars. The total capital costs are $29.5 million. The total maintenance costs are $5.9 million The total lifecycle fuel and electricity costs are $8.8 million. The transition to BEVs is anticipated to cost **$12.4 million** (discounted) more than maintaining a fully ICE fleet. The result shows that the higher capital costs of BEV vehicles are not offset by O&M and propulsion cost savings relative to the Baseline Scenario. The cost of carbon abatement is $1,446 on a levelized $/tonne basis, which takes into account the cost of future emissions reduced by transitioning to BEVs. The total fuel costs shown in 7.4 Fueling and Maintenance Costs include carbon levy taxes, which are escalated in line with the Canadian federal carbon price. Thunder Bay is not currently eligible to monetize its carbon usage since it is not a large emitter under Ontario's Emission Performance Standard. The benefits of carbon abatement are realized through reducing fossil fuel consumption in favour of electricity.

Table 23: Total Lifecycle Costs, Baseline versus Transition Scenario ($, millions)

	Base	Transition	Variance
Capital Expenses	**$11.8**	**$29.5**	**$17.7**
ICE Vehicles	$11.8	$1.5	-$10.2
EVs	-	$19.9	$19.9
Infrastructure	-	$8.1	$8.1
Maintenance Costs	**$6.0**	**$5.9**	**-$0.1**
ICE Vehicles	$6.0	$2.9	-$3.1
EVs	-	$2.0	$2.0
Infrastructure	-	$1.0	$1.0
Fuel Costs	**$14.0**	**$8.8**	**-$5.2**
ICE Vehicles	$14.0	$6.1	-$7.9
EVs	-	$2.7	$2.7
Carbon Tax	$2.5	$1.1	-$1.4
Total	**$31.7**	**$44.2**	**$12.5**

8 PROJECT RISKS & MITIGATION

Transitioning to a zero emission vehicle fleet involves many steps, some of which can be complicated, delayed or stopped altogether by contextual factors related to the utility provider, Thunder Bay's administration, or outside supplier and economic factors, such as supply chain issues. *Table 24* highlights key elements of a zero emission fleet transition which have the potential to delay or derail project timelines and discusses ways to mitigate the impact of these project risks.

Table 24: Project Risks & Mitigation Matrix

Risk	Owners	Status	Risk Description	Risk Response
Infrastructure Transition	Fleet Operations Synergy North Charging Manufacturers	In Progress	As EVs are introduced to the fleet, it's essential that the necessary infrastructure is in place to enable their integration into service. Coordination with third parties, such as utilities and infrastructure manufacturers, can often result in lengthy timeframes and disruptions to current operations.	Promptly commence infrastructure planning and ensure construction considerations are made while maintaining current operations. See that infrastructure upgrades are completed at least six months in advance of vehicles arriving. Following infrastructure installation, it is critical to conduct comprehensive testing and commissioning before placing vehicles and infrastructure into active service.
Agency Resource Availability to Support Implementation	Asset Management Human Resources	Not Started	EV implementation will require operational support and may result in resource limitations, additional costs, and delays.	Identify key personnel who will be responsible for procuring vehicles and coordinating infrastructure upgrades. Supplement existing resources by hiring new roles to address any identified gaps. Engage consultants as needed to offer support in procurement, construction, delivery and commissioning.
Collective Bargaining Agreement Impacts	Fleet Operations Human Resources	Not Started	Following the transition to EVs, impacts to any Collective Bargaining Agreements may increase operational costs. Operators may be asked to take on additional duties, such as plugging in and unplugging EVs from chargers.	Begin early and productive communication with labour unions regarding any anticipated modifications to staffing needs to facilitate EV operations skillsets and operational procedures.

Risk	Owners	Status	Risk Description	Risk Response
Supply Chain Disruptions	Asset Management Fleet Operations	Ongoing	The ongoing global shortage of electrical subcomponents, replacement parts, and heightened production demand due to the increased funding available for zero emissions vehicles may result in shortages of parts and tooling which would increase costs and delay procurement. Delays in vehicle procurement and delivery would also result in increased maintenance requirements for the current diesel fleets.	Note that supply chain disruptions are applicable to both vehicles and fixed electrical infrastructure. Plan for adequate lead time to account for potential manufacturing and delivery delays. Ensure that enough local spare parts are maintained either through contracts or storage at facilities. Lists of types and quantities of critical spare parts should be provided by both vehicle and charging system suppliers.
Resiliency	Synergy North Fleet Operations	Not Started	Utility blackouts, primary and secondary infrastructure failures, as well as natural disasters or extreme weather events, have the potential to significantly disrupt operations.	Assess the impact and frequency of power outages to evaluate mitigation options that will meet the organization’s risk tolerance. Consider the options provided in the facilities report to determine what level of resiliency is required. Having a plan to replace major critical electrical components with long lead times, such as transformers, should be evaluated.
Insufficient Grid Capacity	Synergy North Fleet Operations	In Progress	The planned fleet will require significant power demand which may not be available with current infrastructure and require additional costs to install new transmission lines or substations.	Begin constructive engagement with Synergy North to ensure necessary infrastructure upgrades are in place in time to support the charging equipment in early stages.
Technology Interoperability	Asset Management Fleet Operations	Not Started	Potential incompatibility between vehicles and chargers from different manufacturers may be discovered during testing and commissioning which would result in additional costs and delays.	Inquire and assess in detail the compatibility of the equipment to be purchased during the procurement phase. Ensure contracts include testing and commissioning of vehicles with any equipment that is expected to be used. Plan would be to standardize on infrastructure provider and develop Service Level Agreement.

Risk	Owners	Status	Risk Description	Risk Response
Technology Obsolescence	Asset Management Fleet Operations	Ongoing	EV technology is quickly evolving, and older generation vehicles and chargers may not be compatible with newer ones. These changes can be driven by updates to charging standards, advancements in battery technology, or changes in design philosophy.	Prior to the procurement of additional vehicles and infrastructure, regular and periodic market scans of the industry are recommended. Vehicle and charging manufacturers should be expected to maintain spare components for the expected lifespan of vehicles. Additionally, a sufficient supply of spare components should be purchased to ensure equipment is able to be kept serviceable. Evaluate options to lease or finance infrastructure through third parties.
Software Issues	Asset Management Fleet Operations	Ongoing	Smart charging software available in modern chargers is subject to bugs and disruptions which can negatively impact operations.	Ensure thorough testing and commissioning are carried out after installation of new infrastructure servicing EVs and that timely support is available for software essential to operations. Utilize consultants as needed to assist with contract administration and language surrounding obsolescence, reliability and parts availability. Utilize charge management software to proactively alert of any charging faults or other issues. Consider options to have a third party manage charging infrastructure under a service contract.
Software Adoption	Asset Management Fleet Operations	Not Started	Delays or failure to adopt necessary software tools for electrification, such as smart charging, depot management, and fleet telematics, may cause implementation delays for electrification.	Before procuring new infrastructure for EVs, conduct a comprehensive assessment of software and data needs. Once installed, thoroughly test and commission the new infrastructure.

9 APPENDICES

Appendix A. EV Market Availability

Table 25: Market Available BEV Models, Organized by Vehicle, Manufacturer, and Mode

Vehicle Type	Manufacturer	Model	Vehicle Range (in hours or kilometers)	Battery Capacity	Max Charge Rate		Charge Time
					AC	DC	
Asphalt Roller	Volvo	DD25	-	20 kWh	-	-	3 hours
ATV/UTV	Crossfire	E1	-	-	-	-	-
	Cushman	Hauler Pro	-	-	-	-	-
	DRR USA	EV Stealth	56 kilometers	-	-	-	4-6 hours
	DRR USA	EV Adventure	80 kilometers	-	-	-	6-8 hours
	DRR USA	EV Safari 4x4	56 kilometers	-	-	-	4-6 hours
	DRR USA	EV Pathfinder	80 kilometers	-	-	-	5-8 hours
	Greenworks	U500SB	64 kilometers	8 kWh	1.5 kW	-	7 hours
	Greenworks	U800SB	120 kilometers	16 kWh	1.5 kW	-	11 hours
	Hisun	Sector E1	72 kilometers	-	1.2 kW	-	6-10 hours
	Huntve	Game Changer	40 kilometers	-	-	-	-
	Huntve	Game Changer Crew	-	-	-	-	-
	Intimidator	Classic EV	32-72 kilometers	-	-	-	-
	John Deere	TE 4x2 Electric	-	12 kWh	-	-	-
	Polaris	Ranger XP Kinetic Premium	72 kilometers	14.9 kWh	3 kW	-	5 hours
	Polaris	Ranger XP Kinetic Ultimate	128 kilometers	29.8 kWh	6 kW	-	5 hours
	Tracker Off Road	EV IS	25 kilometers	-	-	-	8-12 hours
	Tracker Off Road	OX EV	96 kilometers	-	-	-	
	Volcon	Stag	160 kilometers	42 kWh	7.2 kW	-	6 hours
Backhoe Loader	Case	580 EV	8 hours	90 kWh	-	-	8 hours

Vehicle Type	Manufacturer	Model	Vehicle Range (in hours or kilometers)	Battery Capacity	Max Charge Rate		Charge Time
					AC	DC	
Compactor, Refuse Truck	Battle Motors	LNT	100 kilometers	240-400 kWh	9.6-19.2 kW	50-175 kW	-
	Battle Motors	LET II	100 kilometers	240-400 kWh	9.6-19.2 kW	50-175 kW	-
	BYD	6R	-	111 kWh	-	120 kW	2.5 hours
	BYD	8R	-	281 kWh	-	120 kW	2.5 hours
	Mack	LR Electric		376 kWh	-	150 kW	90 minutes
	Peterbilt	520EV	10 hours	400 kWh	19.2 kW	150 kW	18.5 hours (AC), 3 hours (DC)
Excavator	Bobcat	E10e	4 hours	11.52 kWh	-	-	10-12 hours
	JCB	19C-1E	4-5 hours	19.8 kWh	-	-	8 hours (AC), 2 hours (DC)
	Volvo	ECR25 Electric	4 hours	20 kWh	-	-	6 hours
	Wacker Neuson	803	-	-	-	-	-
	Wacker Neuson	EZ17e	-	23.4 kWh	-	-	-
Forklift	BYD	7 models available	-	-	-	-	-
	Caterpillar	22 models available	-	-	-	-	-
	Hyster	19 models available	-	-	-	-	-
	JCB	4 models available	-	-	-	-	-
	Kalmar	37 models available	-	-	-	-	-
	Linde	9 models available	-	-	-	-	-
	Toyota	7 models available	-	-	-	-	-
	Yale	19 models available	-	-	-	-	-
Grader	MacLean	GR5 EV GRADER	-	90 kWh	-	-	-
	Miller Technology	E-Grader	-	-	-	-	-
Loader	MultiOne	EZ 5	5-6 hours	10.8 kWh	7.2 kW	-	0.5-1 hour
	MultiOne	EZ 7	2-3 hours	16.5 kWh	7.2 kW	-	-
	MultiOne	EZ 8	5-6 hours	21.5 kWh	7.2 kW	-	0.5-1 hour
Skid Steer	Bobcat	T7X	-	60.5 kWh	-	-	-
Street Sweeper	Boschung	Urban-Sweeper S2.0	10 hours	54.4 kWh	4.8 kW	23.1 kW	1 hour, 40 minutes (DC)

Vehicle Type	Manufacturer	Model	Vehicle Range (in hours or kilometers)	Battery Capacity	Max Charge Rate		Charge Time
					AC	DC	
	Dulevo	D.Zero[2]	-	53.7 kWh	-	-	-
	Elgin	Electric Broom Bear	8 hours	400 kWh	-	125 kW	3 hours
	Global Environmental Products	M3EV	10-12 hours	210 kWh	-	-	9-11 hours
	Global Environmental Products	M4EV	8 hours	210 kWh	-	-	9-11 hours
	MaxVac	Smartwind	8-10 hours	-	-	-	-
	MaxVac	Electra 1.0	8-9 hours	-	-	-	-
	MaxVac	Electra 2.0	8-10 hours	-	-	-	-
Tractor	New Holland	T4 Electric Power	-	110 kWh	19 kW	120 kW	-
	Monarch	MK-V	14 hours	-	9.6 kW	-	5 hours
	Solectrac	e25G Gear	8-10 hours	60 kWh	13.3 kW	-	5.5 hours
1/2-Ton Truck	Ford	F-150 Lightning Pro	386 kilometers	98 kWh	11.3 kW	150 kW	8 hours (AC), 45 minutes (DC)
	GMC	Hummer EV Pickup	571 kilometers	200 kWh	11.3 kW	350 kW	16 hours (AC), 35 minutes (DC)
3/4-Ton Truck	Rivian	R1T	643 kilometers	135 kWh	11.3 kW	225 kW	12 hours (AC), 1 hour (DC)
Van	Mercedes-Benz	eSprinter	400-500 kilometers	113 kWh	9.6 kW	115 kW	13 hours (AC), 42 minutes (DC)

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Appendix B. Financial Analysis

This financial analysis appendix includes the financial analysis summary in Section 7, along with supporting details and assumptions.

The cost to procure both BEVs and the associated charging infrastructure remains a significant challenge for many public agencies. The financial analysis in this transition plan includes capital costs associated with new vehicle purchases, on-site charging infrastructure, and service upgrades required by Synergy North to deliver the necessary power to the site. Additionally, it includes a side-by-side comparison of fueling and electricity costs, along with estimated cost savings associated with ongoing operations and maintenance of the vehicles. Given the uncertainty around future market availability of Priority 2 vehicles, this financial analysis is limited to the capital and lifecycle costs associated with procuring Priority 1 vehicles.

B.1 Fleet Transition Scenarios

The financial analysis considers two scenarios for Thunder Bay's municipal fleet transition. Each scenario evaluates the capital, operating, maintenance, and fuel/electricity costs required between 2024 and 2040.

- **Baseline (Business as Usual):** This reflects the scenario where no transition to BEVs occurs. All replacements of existing ICE vehicles are with new ICE vehicles.
- **BEV Scenario:** This reflects a full transition of Thunder Bay's Priority 1 vehicles to BEVs in alignment with the existing replacement schedule, beginning in 2026.

B.2 Lifecycle Cost Analysis

The analysis presents all dollar values in net present value (NPV) terms, unless otherwise noted. NPV analysis accounts for the "time value of money", or the principle that a dollar today is worth more than a dollar tomorrow. NPV is used to present costs incurred over the 2024-2040 study period on a consistent basis. A discount rate of 8% was applied to all costs back to the initial year 2024. A general 3% escalation rate was applied to estimate future capital expenditures, based on the Bank of Canada's long-term inflation target of 1-3%. Cost estimates for the procurement of BEVs and associated charging infrastructure can be used for budget planning and upcoming funding opportunities.

B.3 Capital Costs

Capital costs include vehicle costs, BEV charging infrastructure costs, and the required electric service upgrades. (**Note:** Cost estimates for electric service upgrades are currently being finalized by Synergy North. Placeholder estimates included are reflective of previous edits provided by Synergy North for similar electric service upgrades.)

B.3.1 Vehicle Capital Costs

Table 26 presents the unit cost assumptions for vehicles. The municipal vehicle fleet size is expected to remain the same after transitioning Priority 1 vehicles to BEVs.

Table 26: BEV Capital Cost Assumptions (2023$)

Vehicle	ICE Cost	BEV Cost	Vehicles in Fleet
ATV	$25,336	$30,499	2
Forklift	$46,065	$30,000	5
Half Ton	$51,198	$58,595	37
One Ton	$96,622	$121,085	10
Skid Steer	$109,405	$270,000	1
Street Sweeper	$233,206	$932,275	10
Three Quarter Ton	$57,745	$98,550	41
Van	$57,513	$72,510	27

B.3.2 Infrastructure Capital Costs

Table 27 identifies the capital costs associated with charging infrastructure required for Priority 1 vehicles. As noted in the Energy Modeling section, each site has been designed to phase in additional infrastructure primarily including substations, 3.6 kW and 150 kW charging equipment, circuit breakers, and other infrastructure needed to facilitate charging for the BEV fleet. The following estimates exclude costs associated with the overhead canopies outlined in Section 5 for any outdoor vehicle parking.

Table 27: Infrastructure Capital Costs Assumptions

Site	Year Construction Begins[25]	Overall Cost To Serve Priority 1 Vehicles	Key Equipment Required
Front Street Public Works Yard	2026-2031	$3,289,000	- Underground Ducting for Priority 1 Equipment - (1x) 1000 kVA 600 V – 480 V Transformer - (1x) 480 V Outdoor Rated Switchboard - (1x) 150 kW Charger w/ 3 Dispensers and Cabling - (1x) 150 kVA 480 V – 208 V Mini Unit-substation - (1x) 112 kVA 480 V – 208 V Mini Unit-substation - (5x) Dual Port 7.2 kW Level 2 Chargers and Dispensers - (34x) Single Port 3.6 kW Level 2 Chargers and Dispensers
Landfill	2026-2031	$1,222,000	- Underground Ducting for Priority 1 Equipment - (1x) Secondary Meter for EV Charging Loads - (1x) 500 kVA 600 V – 480 V Transformer - (1x) 480 V Panelboard - (1x) 150 kW Charger w/ 3 Dispensers and Cabling - (1x) 50 kVA 480 V – 208 V Transformer and 208 V Panelboard

[25] The years indicated show the range of potential construction dates for these improvements. In the financial analysis it was assumed these occur in 2025 since the planned implementation has not been established.

Site	Year Construction Begins[25]	Overall Cost To Serve Priority 1 Vehicles	Key Equipment Required
			- (9x) Single Port 3.6 kW Level 2 Chargers and Dispensers
Parks North Yard	2026-2031	$2,119,000	- Underground Ducting for EV Equipment - (1x) 750 kVA 600 V – 480 V Transformer - (1x) 480 V Outdoor Rated Switchboard - (1x) 75 kVA 480 V – 208 V Transformer - (1x) Building Electrical Upgrades for New Metering Configuration - (1x) 150 kW Charger w/ 3 Dispensers and Cabling - (1x) 150 kVA 480 V – 208 V Mini Unit-substation - (1x) Dual Port19.2 kW Level 2 Chargers and Dispensers - (15x) Single Port 3.6 kW Level 2 Chargers and Dispensers
Mountdale Public Works Yard	2026-2031	$3,523,000	- Underground Ducting for Storage Garage and Administration building - Hitching Post concrete pad - (1x) 1000 kVA 600 V – 480 V Transformer - (1x) 480 V Outdoor Rated Switchboard - (1x) 150 kW Charger w/ 3 Dispensers and Cabling - (2x) 150 kVA 480 V – 208 V Mini Unit Substation - (6x) Dual Port 7.2 kW Level 2 Chargers and Dispensers - (38x) Single Port 3.6 kW Level 2 Chargers and Dispensers -
TSCL	2026-2031	$169,000	- Underground Ducting for Priority 1 Equipment - (1x) Secondary Meter for EV Charging Loads - (1x) Concrete Pad for New Level 2 Parking Stalls - (1x) 208 V Panelboard - (2x) 7.2kW Level 2 Chargers and Dispensers - (5x) 3.6 kW Level 2 Chargers and Dispensers
Fort William Road Transit Garage	2026-2031	$230,000*	- 150 kVA transformer* - (2x) Dual port 7.2 kW level 2 Chargers and Dispensers w/ Cabling - Underground Ducting Conduit Runs through Building

B.3.3 Anticipated Service Upgrade Costs from Synergy North

Table 28 identifies the estimated costs associated with receiving upgraded electric service at each of the sites that require service. Note that each of the anticipated service upgrade costs include upgrades required to serve Priority 2 vehicles in addition to the Priority 1 vehicles in this analysis.

Table 28: Estimated Service Upgrade Costs

Site	Year	Cost
Front and Egan	2026-2031	$100,000
Landfill	2026-2031	-
North Yard	2026-2031	$100,000
Mountdale PWY	2026-2031	$100,000

B.3.4 Capital Cost Comparison by Scenario

Table 29 below displays a comparison of capital costs between the Base and BEV Scenarios in discounted dollars.

Table 29: Capital Cost Comparison, Baseline versus BEV Scenario ($, millions)

	Base	BEV
ICE Vehicles	$11.8	$1.5
BEVs	-	$19.9
Infrastructure	-	$8.1
Total	**$11.8**	**$29.5**

B.4 Fueling and Maintenance Costs

Ongoing fueling and maintenance costs for Thunder Bay's traditional ICE vehicles and their modeled BEV replacements are part of this analysis.

B.4.1 Fueling Costs

These costs include the fueling and electricity costs assumed for transitioning ICE vehicles to BEVs. Based on the methodology described in O&M Cost Assumptions, this summarizes the fuel and electricity cost estimates for the BEV scenario over the 2024 to 2040 period. These costs were estimated to be $14 million for diesel or gasoline in the base scenario and $8.8 million total in the BEV transition scenario. The $2.7 million for electricity assumes a rate which includes the kWh usage charges and peak demand charges.

Table 30: Fueling Costs, Baseline versus BEV Scenario ($, millions)

	Base	BEV
ICE Vehicles	$14.0	$6.1
BEVs	-	$2.7
Total	**$14.0**	**$8.8**

B.4.2 Maintenance Costs

Based on research by the Argonne National Laboratory, BEV maintenance costs are estimated at 30-40% below comparable ICEVs. As such, a 35% reduction in Thunder Bay municipal fleet maintenance cost data has been applied to calculate the benefit of lower BEV maintenance costs.

Table 31 reflects estimated annual maintenance costs.

Table 31: Estimated Annual Maintenance Costs by Vehicle Type, ICE vs. BEV

Vehicle	ICE Cost	BEV Cost
ATV	-	-
Forklift	$1,183	$769
Half Ton	$2,598	$1,689
One Ton	$3,488	$2,267
Skid Steer	$6,716	$4,365
Street Sweeper	$15,884	$10,325
Three Quarter Ton	$2,978	$1,936
Van	$2,250	$1,463

B.4.3 Fuel and Maintenance Costs Assumptions

The assumptions used to estimate maintenance costs, fuel, and electricity costs include the following:

- **Vehicle Maintenance:** Based on research by the Argonne National Laboratory, BEV maintenance costs are estimated at 30-40% below comparable ICEVs. A 35% reduction in maintenance costs has been applied to Thunder Bay.[26]
- **Fuel efficiency:** Fuel efficiency was calculated separately either on a litre per 100-kilometre (L/100km) or litre per hour (LPH) basis. Fuel efficiency of BEV replacements was calculated on a kilowatt-hour (kWh) per kilometre (kWh/km) or kWh per hour (kWh/hr) basis.
    - **ICE Fuel Efficiency:** The fuel efficiency of ICE vehicles was calculated based on historical operating data provided by Thunder Bay for each vehicle type. In cases where historical operating data was not available for given vehicles, the published fuel efficiency from the manufacturer's specifications was used instead.
    - **BEV Fuel Efficiency:** The fuel efficiency of BEV replacements was calculated using a proprietary Excel model based on current fleet operating statistics.
- **Propulsion Cost Assumptions:** The following assumptions and sources were used to estimate projected change in cost of diesel and electricity.
    - **Diesel Fuel Costs:** The analysis assumed diesel fuel costs in 2023 were $1.45 per litre. Average gasoline fuel costs for 2023 were $1.30. This assumption was based on the average wholesale price for diesel fuel in Thunder Bay for 2023. For this analysis, the US Energy Information Administration's Annual Energy Outlook 2023 forecast for diesel

[26] publications.anl.gov/anlpubs/2021/05/167399.pdf

prices provided the additional annual cost rate change assumption. Prices were escalated by 3 percent annually to be converted to YOE dollars.

- **Carbon Tax Costs:** The carbon tax was calculated using the 2023 cost per litre for diesel and gasoline, $0.17 and $0.14 respectively.[27] This was escalated for future years based on prescribed increases to Canada's federal carbon tax price, which will increase to $170 per tonne by 2030.[28]
- **Electricity Costs:** There are two categories of electricity costs that were included in the analysis: per kilowatt hour (kWh) usage fee and a peak demand charge per kilowatt. The values used in the analysis were obtained from a Thunder Bay utility bill issued by Synergy North. The dollar per kWh ($/kWh) usage fee is based on the average Hourly Ontario Energy Price and the Global Adjustment Factor for 2023. Annual electricity costs for the BEV Scenario reflect the energy usage outputs from the Excel model applied to these rates. The analysis also applies a premium of 30% to approximate the portion of each electricity invoice of demand charges. This 30% premium was applied based on a sample electric bill provided by Synergy North. As a conservative estimate, this is assumed to be constant for future years. The analysis assumed a 5% efficiency loss between chargers and BEVs.

The expected fuel and electricity consumption by vehicle type is shown in the table below.

Table 32: Estimated Annual Fuel/Electricity Consumption by Vehicle Type

Vehicle	Annual Fuel Consumption (L)	Annual Electricity Consumption (kWh)
ATV	282	1,326
Forklift	3,024	2,547
Half Ton	4,491	16,712
One Ton	6,080	13,369
Skid Steer	19,272	2,635
Street Sweeper	10,438	43,344
Three Quarter Ton	6,584	11,937
Van	5,927	48,384

[27] Fuel Consumption Levies in Canada

[28] Update to the Pan-Canadian Approach to Carbon Pollution Pricing 2023-2030 - Canada.ca

B.5 Baseline Scenario Assumptions

As described above, the Baseline Scenario refers to the current ICE fleet being replaced by new ICE vehicles based on the current fleet retirement schedule with no BEV replacements.

B.5.1 Baseline Scenario Capital Cost Assumption and Estimates

Under the Baseline Scenario, the fleet mix remains entirely ICE for the duration of the study period. A fleet retirement schedule was prepared based upon the known service life and purchase date for vehicles in the municipal fleet, which was used to determine the capital purchase assumptions by year. *Table 33* illustrates the annual vehicle purchase assumptions for ICE vehicles based on the fleet retirement schedule. These vehicle purchases represent Priority 1 replacements, but also assume that some vehicles are replaced more than once between now and 2040, thus a total that is larger than the 133 Priority 1 vehicles.

Table 33: Annual ICE Vehicle Purchase Assumptions Based on the Fleet Retirement Schedule

	2024 2030	2031 2035	2036 2040
ICEs	99	41	99
EVs	-	-	-

Table 34 presents the annual costs estimates based on the unit cost and growth rate assumptions and the annual fleet needs described in *Table 33*. The values are in YOE dollars, meaning they are escalated to reflect anticipated actual costs in a future year.

Table 34: Annual Capital Cost Estimates, Selected Years, (YOE $, millions)

	2024 2030	2031 2035	2036 2040
ICEs	$7.4	$4.5	$10.5
EVs	-	-	-
Total	**$7.4**	**$4.5**	**$10.5**

B.5.2 Maintenance Cost Assumptions and Estimates

Table 35 summarizes the vehicle maintenance costs and the EV charger maintenance costs in the selected year. As noted above, by 2040 the entire fleet has been transitioned to BEVs. Estimated maintenance costs will total $6.0 million for vehicles in discounted 2023 dollars.

Table 35: Annual Vehicle Maintenance Costs, Selected Years, 2023-2040

	2025	2030	2035	2040
Maintenance Costs	$0.5	$0.6	$0.7	$0.8

B.5.3 Fuel Cost Assumptions and Estimates

Under the Baseline Scenario, diesel and gasoline fuel costs are considered the only driver of propulsion cost estimates over the period.

The annual fuel costs were calculated based on the annual kilometres travelled. The estimated diesel fuel consumed by vehicles was calculated by multiplying the average fuel economy (liters/km) from Thunder Bay's municipal fleet data and the total kilometres travelled. The liters of fuel were then multiplied by the average price per litre of diesel detailed in the O&M Cost Assumptions section above. The fuel cost calculation is shown in *Table 36* below.

Table 36: Annual Fuel Costs (YOE$, millions)

	2025	2030	2035	2040
Gasoline Fuel Price	$1.36	$1.79	$2.12	$2.49
Diesel Fuel Price	$1.48	$1.89	$2.23	$2.64
Gasoline Fuel Cost	$0.8	$1.0	$1.2	$1.4
Diesel Fuel Cost	$0.2	$0.2	$0.2	$0.3
Gasoline Levy Cost	$0.1	$0.3	$0.3	$0.3
Diesel Levy Cost	$0.03	$0.1	$0.1	$0.1
Total Fuel Cost	**$1.1**	**$1.1**	**$1.4**	**$1.7**

B.6 BEV Scenario Assumptions

The BEV Scenario quantifies the transition to BEVs based on the current fleet retirement schedule and includes capital costs for new vehicles purchases and infrastructure required to support the new EV fleet, including facility upgrades and depot chargers.

B.6.1 Capital Cost Assumptions and Estimates

The BEV Scenario includes an analysis of changes in capital costs resulting from BEV purchases, associated infrastructure costs, and service plan upgrades over the 2024 to 2040 period. *Figure 13* presents the incremental replacement of all ICE vehicles with BEVs over this period in terms of the fleet mix.

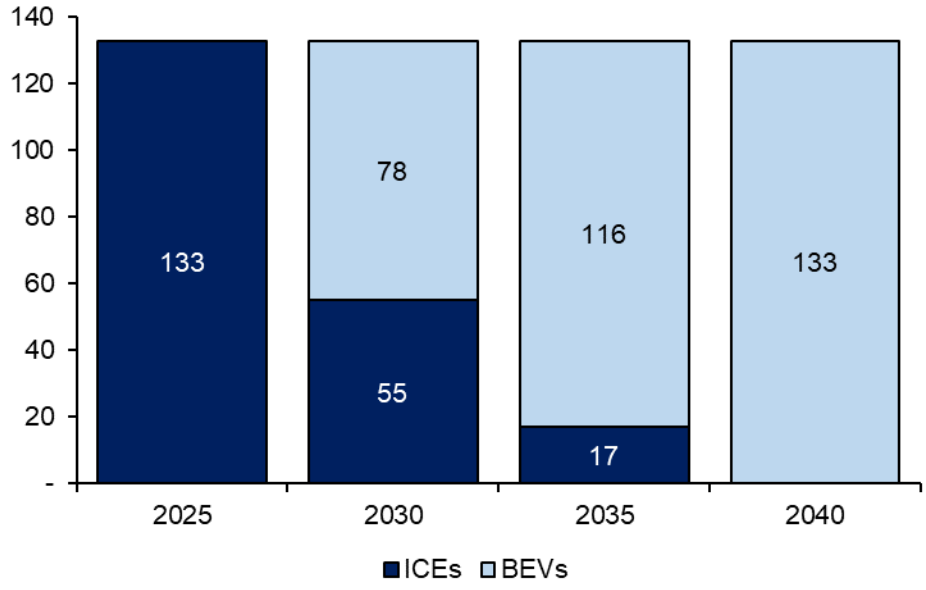

Figure 13: Annual Fleet Mix Assumptions, Selected Years

Table 37 summarizes the capital purchases that will occur between select time periods between 2024 and 2040.

Table 37: Capital Purchase Assumptions, Selected Years

	2024 2030	2031 2035	2036 2040
ICEs	21	-	-
EVs	78	41	99

BEVs are purchased the same year they enter service. *Table 38* presents the annual cost estimates for selected periods.

Table 38: Annual Capital Cost Estimates by Year (YOE$, millions)

	2024 2030	2031 2035	2036 2040
ICEs	$1.6	-	-
EVs	$10.0	$10.5	$20.3
Infrastructure Costs	$8.4	-	-
Total	**$20.0**	**$10.5**	**$20.3**

Over the 2024 to 2040 period, total capital costs for the BEV Scenario were estimated to be $40.1 million in discounted 2023$. As shown on the previous figures and tables, the BEV fleet transition would occur between 2026 and 2040.

B.6.2 Maintenance Cost Assumptions and Estimates

Figure 14 summarizes the change in annual O&M cost allocation among the fleet mix in the BEV Scenario.

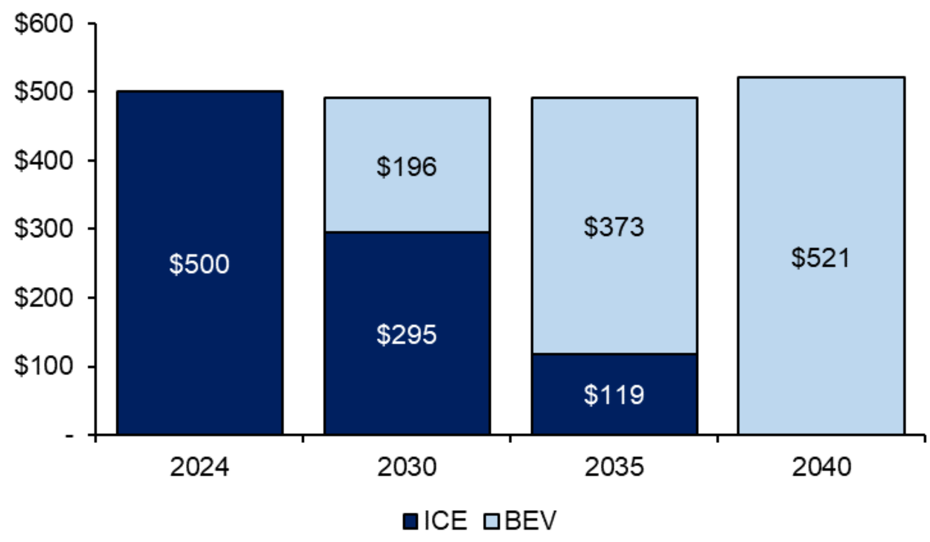

Figure 14: Annual O&M Costs by Vehicle Type, (YOE$, thousands)

Table 39 summarizes the annual vehicle maintenance costs, and the annual EV charger maintenance costs between 2023 and 2040. As noted above, by 2040 the entire fleet has been transitioned to BEVs.

Table 39: Annual O&M Costs by Vehicle Type, (YOE$, millions)

	2025	2030	2035	2040
ICEs	$0.5	$0.3	$0.1	-
EVs	-	$0.2	$0.4	$0.5
Dispenser Maintenance	-	$0.1	$0.2	$0.2
Total	**$0.5**	**$0.6**	**$0.7**	**$0.8**

Under the BEV Scenario, it was estimated that maintenance costs will total $5.9 million in discounted 2023$ terms.

B.6.3 Fuel and Electricity Cost Assumptions and Estimates

Based on the methodology described in O&M Cost Assumptions, *Table 40* summarizes the fuel and electricity cost estimates for the BEV scenario for selected years over the 2023 to 2040 period. These costs were estimated to be $6.2 million for diesel or gasoline and $2.7 million for electricity, both discounted which includes the kWh usage charges and an assumed 30% premium on the $/kWh consumption charge to capture peak demand charges. [29] The total propulsion cost reflects the estimated decline in costs from 2025 to 2040 needed to operate Priority 1 vehicles.

Table 40: Fuel and Electricity Cost Drivers and Annual Cost Estimates (YOE $, millions)

	2025	2030	2035	2040
Gasoline Fuel Price	$1.36	$1.79	$2.12	$2.49
Diesel Fuel Price	$1.48	$1.89	$2.23	$2.64
Electricity Price	$0.14	$0.16	$0.19	$0.23
Diesel Fuel Cost	$0.2	$0.2	$0.09	-
Gasoline Fuel Cost	$0.9	$0.4	$0.2	-
Electricity Cost	-	$0.28	$0.47	$0.7
Total Propulsion Cost	**$1.1**	**$0.9**	**$0.8**	**$0.7**

Electricity and fuel costs change substantially over time under the BEV Scenario. This is illustrated in *Figure 15* below.

[29] Rates - Synergy North. Sample bill provided by Synergy North reflects a ~30% premium to capture peak demand charges.

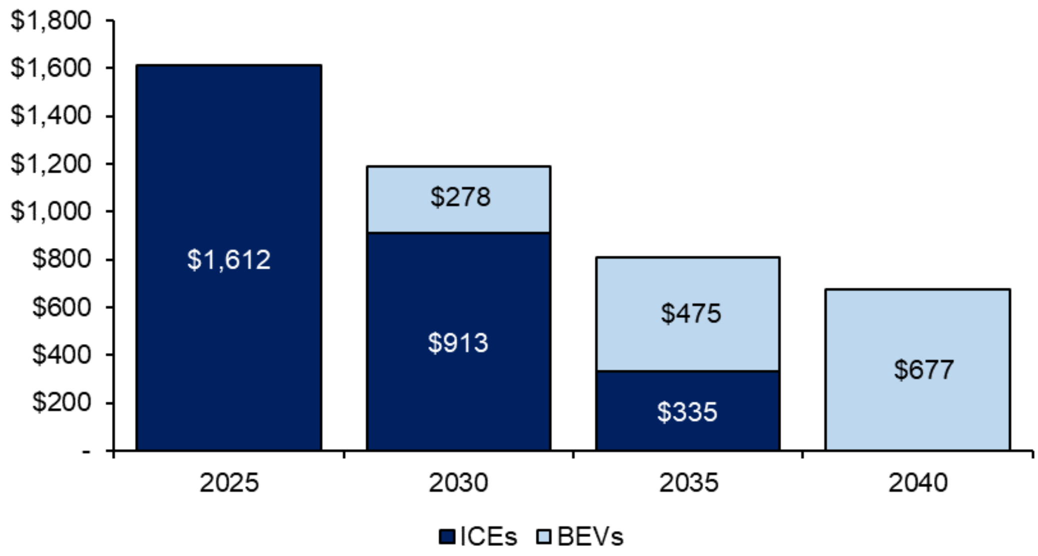

Figure 15: Electricity and Diesel Costs, Selected Years (YOE $, thousands)

B.6.4 Summary

Under the BEV Scenario, the total cost of implementation is $44.2 million in discounted 2023 dollars. The total capital costs are $29.5 million. The total lifecycle fuel and electricity costs are $8.8 million.

Table 41: BEV Scenario Summary, (discounted 2023$, millions)

	Base	Transition	Variance
Capital Expenses	**$11.8**	**$29.5**	**$17.7**
ICE Vehicles	$11.8	$1.5	-$10.2
EVs	-	$19.9	$19.9
Infrastructure	-	$8.1	$8.1
Maintenance Costs	**$6.0**	**$5.9**	**-$0.1**
ICE Vehicles	$6.0	$2.9	-$3.1
EVs	-	$2.0	$2.0
Infrastructure	-	$1.0	$1.0
Fuel Costs	**$14.0**	**$8.8**	**-$5.2**
ICE Vehicles	$14.0	$6.1	-$7.9
EVs	-	$2.7	$2.7
Carbon Tax	$2.5	$1.1	-$1.4
Total	**$31.7**	**$44.2**	**$12.5**

B.7 Lifecycle Cost Comparison

This section provides a comparison of the capital, O&M, and fuel/electricity cost estimates for the two scenarios over the entire 2024-2040 period. All values are presented in NPV terms, unless otherwise noted.

B.7.1 Capital Cost Comparison

Table 42 provides a comparison of total capital costs between the two scenarios. As shown in the table, the BEV Scenario is more than twice as expensive due primarily to the difference in vehicle costs as well as the additional equipment and infrastructure investments that would be required for BEV implementation.

Table 42: Capital Cost Comparison, 2023$ millions

	Base	BEV
ICE Vehicles	$11.8	$1.5
EVs	-	$19.9
Infrastructure	-	$8.1
Total	**$11.8**	**$29.5**

B.7.2 Maintenance Cost Comparison

Table 43 provides a comparison of total maintenance costs over the 2024 to 2040 period. Based on the assumptions in this analysis, BEVs would have lower maintenance costs on a discounted basis.

Table 43: O&M Cost Comparison, 2023$ millions

	Base	BEV
ICE Vehicles	$6.0	$2.9
EVs	-	$2.0
Infrastructure	-	$1.0
Total	**$6.0**	**$5.9**

B.7.3 Fuel and Electricity Cost Comparison

Table 44 provides a comparison of total costs for diesel fuel and electricity over the 2024 to 2040 period. Based on the assumptions in this analysis, BEVs would have lower fuel and electricity costs on a discounted basis.

Table 44: Fuel and Electricity Cost Comparison, 2023$ millions

	Base	BEV
ICE Vehicles	$14.0	$6.1
EVs	-	$2.7
Total	**$14.0**	**$8.8**

B.7.4 Net Present Value Analysis

A net present value (NPV) and payback period analysis was conducted to compare the BEV Scenario to the Baseline Scenario. This analysis included capital costs (vehicles, charging equipment, and infrastructure needs) and fuel costs for both the BEV Scenario and the Baseline Scenario. Cost savings over the 2024 to 2040 period are presented in 2023 dollars and discounted at eight percent.

The purpose of this analysis is to determine if the upfront capital costs can be overcome by operating cost savings being driven by reduced maintenance and fuel costs. The analysis only looks at direct cost impacts to Thunder Bay and does not attempt to monetize public benefits to society.

Additionally, the analysis assumes that capital costs will not be offset by grant or incentive funding. Including additional funding sources, such as ICIP or ZETF, may affect the results of the analysis. However, since these funds have not been applied for or secured by the City of Thunder Bay, they are not included in this analysis.

The transition to BEVs is anticipated to cost **$12.5 million** (discounted) more than maintaining a fully ICE fleet. The result shows that the higher capital costs of BEV vehicles are not offset by O&M and propulsion cost savings relative to the Baseline Scenario. Therefore, by 2040, the investment in the BEV transition will not yet have broken even.

Table 45: Lifecycle Costs – All Scenarios, 2023$, millions

	Base	Transition	Variance
Capital Expenses	**$11.8**	**$29.5**	**$17.7**
ICE Vehicles	$11.8	$1.5	-$10.2
EVs	-	$19.9	$19.9
Infrastructure	-	$8.1	$8.1
Maintenance Costs	**$6.0**	**$5.9**	**-$0.1**
ICE Vehicles	$6.0	$2.9	-$3.1
EVs	-	$2.0	$2.0
Infrastructure	-	$1.0	$1.0
Fuel Costs	**$14.0**	**$8.8**	**-$5.2**
ICE Vehicles	$14.0	$6.1	-$7.9
EVs	-	$2.7	$2.7
Total	**$31.7**	**$44.2**	**$12.5**

Appendix C. GHG Emissions Analysis

Reductions in greenhouse gas (GHG) emissions are an additional benefit of transitioning from ICE vehicles to BEVs. Supplementary calculations were completed to quantify the impact of BEV operations on GHG emissions relative to a baseline scenario. This analysis only includes reductions of well-to-wheel GHG emissions, and it does not account for GHG emissions associated with the construction of BEV infrastructure, or manufacturing of BEVs.

C.1. Methodology & Assumptions

The analysis quantifies GHG impacts based on estimates of diesel fuel and electricity usage by conventional municipal vehicles over the 2024-2040 period.[30] The following assumptions were used to quantify emissions based on liters of fuel and kWh of electricity consumed.

The emission rate for diesel fuel was assumed to be 2.681 kilograms (kgs) of carbon dioxide (CO_2) per litre of diesel fuel and 2.65 kgs of CO_2 per litre of gasoline. This value was obtained from the Canadian National Inventory Report, 2023.[31] The emission rate was multiplied by the annual liters of fuel consumed to calculate the annual kgs of CO2 emitted. This value was then converted to tonnes. To quantify the impact of electricity usage on GHG emissions, the total kWh of electricity used per year was multiplied by the corresponding Electricity Emission Intensity factor for Ontario from 2023 to 2050. This factor represents the kg of CO_2 per kWh based on the average electricity grid mix for the province. The intensity factor declines over time due to anticipated introduction of new renewable power generation sources. The Electricity Emission Intensity Factor was obtained from the Average Grid Electricity Emission Intensities table in the ZETF GHG+ Guidance Modules, Annex C.

C.2. GHG Emission Reduction impacts

Based on the assumptions above, the GHG emissions from BEV operations are summarized in *Table 46* below. Over the study period, BEVs would reduce emissions by approximately 19,000 tonnes. This reduction is due to the dramatically lower operating emissions of BEVs relative to ICE vehicles.

Table 46: GHG Emissions, Select Year, and Total by 2040, Tonnes

	2025	2030	2040	Total
Baseline	1,864	1,864	1,864	31,695
ICE	1,864	1,864	1,864	31,695
BEV	-	-	-	-
BEV Scenario	1,864	866	90	13,281
ICE	1,864	812	-	12,317
BEV	-	53	90	964

[30] While the EV transition starts in 2026, the full lifecycle analysis starts in 2024.

[31] Canada's official greenhouse gas inventory - Canada.ca

Figure 16 below shows the annual GHG emissions from operations as the fleet mix changes in the BEV Scenario. There is a substantial decline from nearly 1,900 tonnes of GHGs per year to below 100 tonnes per year in the BEV Scenario.

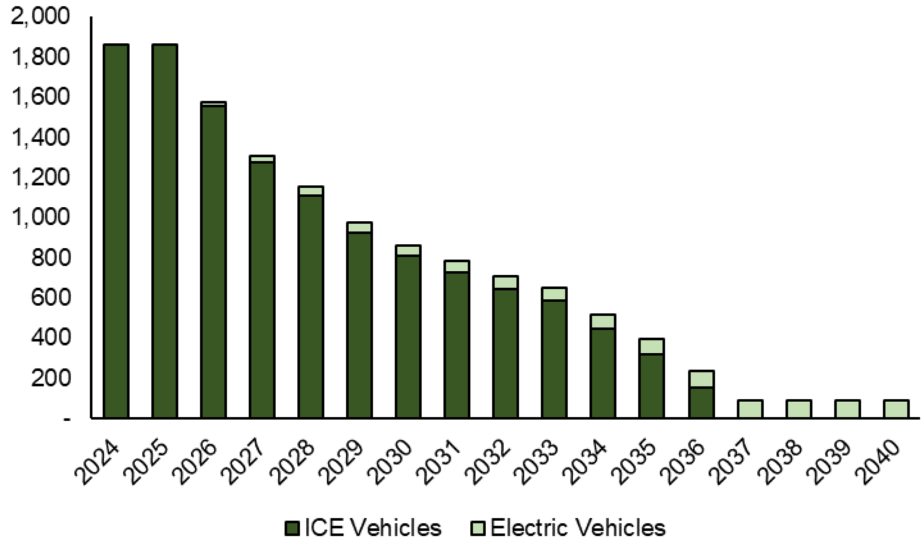

Figure 16: Annual GHG Emissions, BEV Scenario, Tonnes

The annual reduced emissions grow substantially over time as the diesel fleet is converted to BEVs. At the end of the transition, GHG emissions have been reduced by approximately 95%.

As the energy grid transitions to cleaner sources of electricity, Thunder Bay will see reductions in emissions from electricity consumption; however, there may always be some emissions associated with electricity production unless entirely non-carbon sources are used for electricity generation in the future.

Appendix D. Solar Photovoltaic (PV) Feasibility Analysis

A solar feasibility analysis was prepared to assess the cost effectiveness of installing behind-the-meter solar photovoltaic systems at each of the studied Thunder Bay municipal locations. This analysis defined a no-build versus build case for each option to estimate the total benefits of installing solar PV arrays. At each of the four studied locations, the benefit cost ratio was less than 1, meaning for every dollar spent in project construction, less than a dollar was saved over the operating lifetime of the asset.

Table 47: Solar Modelling Assumptions includes the general assumptions used to model this solar analysis.

Table 47: Solar Modelling Assumptions

General Inputs	Value	Notes/Source
Base Year	2024	
Study Period	30	Assumed
End Year	2054	Calculated using base year and study period
Discount Rate	8%	Assumed
Price Escalation	3%	Assumed
Solar Degradation	-0.5%	Assumed, panels produce .5% less power per year (compounding)
O&M Escalation	3%	Assumed
$/kW CapEx (CAN Source)	$3,000	Natural Survey Report of PV Power Applications in Canada suggests value of $3.00 per Watt (W)
$/kW CapEx (US Source)	$2,578	Sensitivity - US Data converted to CAD and inflated; Index | Electricity | 2022 | ATB | NREL
$/kW OpEx	$27.80	Index | Electricity | 2022 | ATB | NREL
2020 USD/CAD Conversion	1.3415	Annual exchange rates - Bank of Canada
Watt to Kilowatt Conversion	1,000	Known conversion
2023 Average Electricity Price	$0.10	Average HOEP, summed with Average Global Adjustment Factor, and Thunder Bay-specific utility charges; units in $ per kilowatt-hour ($/kWh)
Solar Panel Density	150	Watt per square meter (W/m^2)

Table 48 includes the site-specific cost estimate used for each of the four sites.

Table 48: Site-Specific Cost Estimates for Solar

Variable	Mountdale PWY	Front St	Parks North	Landfill
Capital Cost ($)	$782,140	$1,073,424	$799,630	$707,693
Annual O&M ($)	$9,697	$13,309	$9,914	$8,774
Solar Generated (kWh)	428,002	593,903	433,868	399,255
Grid Energy Required (kWh)	5,086,403	2,618,336	402,858	190,188
Net Capacity Factor	14.0%	14.2%	13.9%	14.4%
Construction Year	2023	2023	2023	2023
Nameplate Capacity (kW-DC)	348.8	478.7	356.6	315.6

D.1. Methodology

The analysis defined a No Build case and a Build case for each site defined above to estimate the benefits of installing solar PV arrays. The No Build was defined as where no solar PV is installed, and total electricity demand is supplied by the electricity grid and charged at the Hourly Ontario Energy Price plus any global adjustment charges. The Build case assumes that the solar PV is built, and the solar PV array supplies part of the total demand from vehicle charging with the remainder of electricity supplied by the grid. While there are O&M costs associated with maintaining the solar PV array, the electricity generated from it reduces the cost of electricity purchased from the grid. The analysis assumes a degradation factor on installed solar PV output of 0.5% per year (compounding). This is a typical degradation factor for most Tier 1 panels across the solar industry. The total costs under the No Build case are compared against the total costs under the Build case to determine whether there are cost savings.

The PVWatts® Calculator was used to estimate the solar energy that could be generated at the conceptual site. PVWatts® is a tool created by the National Renewable Energy Laboratory (NREL) and uses the location and weather data for each site to estimate a monthly generated power output of the solar PV system, including overall system efficiency losses. The analysis for this project does not factor in each facility's roof age or ability to structurally support a solar PV array, which may add unaccounted for costs in completing each project or maximizing solar yield.

D.2 Solar Generation Analysis Summary

Table 49 below summarizes the sites that were considered and how much of the overall energy could be provided by solar generation across the four sites:

Table 49: Annual Solar Generation by Site (in kWh)

Location/Scenario	Annual Solar Generation (kWh)
Mountdale PWY	428,002
Front St.	593,903
Parks North	433,868
Landfill	399,255
Total	**1,855,028**

**Note: Ft. William Transit Garage was not included in this table as a solar analysis was done as part the transit fleet's zero emission transition plan.*

D.3 Benefit Cost Analysis Results

The estimated benefits are presented for each scenario below using the calculated present value of costs to estimate the benefit cost ratio (BCR).

Table 50: Solar Feasibility Analysis Results (2022$, millions)

	Mountdale PWY	Front St	Parks North	Landfill
Energy Cost Savings (PV)	$0.6	$0.9	$0.6	$0.6
Capital Costs (PV)	$0.8	$1.1	$0.8	$0.7
O&M Costs (PV)	$0.1	$0.2	$0.1	$0.1
NPV	-$0.3	-$0.4	-$0.3	-$0.3
BCR	0.61	0.62	0.60	0.64
Payback Period	19.6 years	19.3 years	19.7 years	18.9 years

In each of the four instances above, each site has a BCR, or Benefit Cost Ratio, of under 1 over a 30-year study period. This means that for each site, on a discounted basis, a $1 spent in construction would yield between 60 and 65 cents in savings.

Appendix E. Detailed Conceptual Plans and Single Line Diagrams

Detailed Conceptual Plans and Single Lines Diagrams are attached in a zipped file.

Memorandum

TO:	Krista Power, City Clerk **FILE:**
FROM:	Kelvin Jankowski, Manager- Capital Facilities Construction Infrastructure, Development & Operations- Engineering & Operations
DATE:	06/14/2024
SUBJECT:	Transit and Municipal Fleet Zero Emissions Transition Plan
MEETING & DATE:	Committee of the Whole – 06/24/2024

At the May 13, 2024 Committee of the Whole meeting, Report 144/2024 (Infrastructure, Development & Operations- Engineering & Operations)- Transit and Municipal Fleet Zero Emissions Transition Plan was presented as a First Report to be represented for Council's consideration at the July 15, 2024 Committee of the Whole.

Due to scheduling conflicts, Administration will now be bringing Report 144/2024 to the July 22, 2024 Committee of the Whole for Council's consideration. The extension will also allow the team to consider feedback if received.

Administration provides the following for Council's consideration:

> WITH RESPECT to the Memorandum from Manager Kelvin Jankowski dated June 14, 2024 and Report 144-2024 – Infrastructure, Development & Operations – Engineering & Operations – Transit and Municipal Fleet Zero Emissions Transition Plan, we recommend that the re-presentation date for the First Report be changed from July 15, 2024 to July 22, 2024.

Memorandum

TO:	Krista Power, City Clerk	**FILE:**	
FROM:	Kelvin Jankowski, Manager- Capital Facilities Construction Infrastructure, Development & Operations- Engineering & Operations		
DATE:	07/11/2024		
SUBJECT:	Transit and Municipal Fleet Zero Emissions Transition Plan		
MEETING & DATE:	Committee of the Whole - 07/22/2024		

At the May 13, 2024 Committee of the Whole meeting, Report 144-2024 Infrastructure, Development & Operations- Engineering & Operations: Transit and Municipal Fleet Zero Emissions Transition Plan was presented as a First Report to be re-presented for Council's approval at the July 22, 2024 Committee of the Whole.

A summary of questions and feedback received to date is included in Attachment A.

Sincerely,

Kelvin Jankowski
Manager- Capital Facilities Construction

Attachments:

Attachment A: Summary of Questions and Responses

Attachment A - Summary of Questions and Responses

1. **Do municipal systems face the same problems with electrification as homeowners – ie access to power – does the City have direct line or connection for power from Hydro?**
   - The City of Thunder Bay (City) does not have direct access to Synergy North (SN) or Hydro One
   - The City continues to work with SN to ensure the City's Transit and Municipal Fleet Zero Emissions Transition Plans (Plans) are known to them to be factored into their future work and to identify any future constraints in the system that would need to be addressed. SN has not identified any issues with the proposed plans; costs for the City's required electrical upgrades are included in the plan.
   - The private market is more mature and advanced than commercial and industrial, thus more issues at present.

2. **How many different suppliers of Battery Electric Buses (BEBs) are there?**
   - There are two (2) main suppliers for BEB currently in Canada – Nova and New Flyer – both Canadian manufacturers.

3. **Will there be an impact to our road infrastructure?**
   - Electric vehicles are heavier but are required to maintain the rated Registered Gross Vehicle Weight (RGVW) to be on roadways.
   - Studies show that there will be impacts, but more research is required.

4. **Has there been thought given to trying hybrids first? There is currently one in the City's Fleet.**
   - Hybrids are very user dependent and do not offer much savings. It would not be feasible to use hybrids to achieve the City's aggressive emission targets. Hybrids were not included in the scope for the Plans.
   - Future purchases of Priority 2 vehicles may consider hybrid or hydrogen where Battery Electric Vehicles cannot meet requirement.
   - One of the two suppliers of hybrid buses in Canada have indicated that they will no longer be offering hybrids, only BEB's from 2025 on.

5. **What is the rate of return for taxpayers? What is the City paying back to the taxpayers?**
   - The projected savings are primarily environmental emission reduction savings as required by the City's Net-Zero targets.
     - The project in its entirety is projected to cost more than business as usual, however offset by outside funding sources where available. Once the investment in infrastructure and buses is made, the ongoing cost of operations should decrease based on current fuel projections and lower overall Operations and Maintenance costs.

6. **Does the City have qualified mechanics to perform the required maintenance? Does the City have training programs?**
   - The City does not currently have qualified mechanics; training will be provided for mechanics and other staff working directly/indirectly with Battery Electric Vehicles (BEV). Training recommendations are outlined within the Plans.

7. **Community buy-in – How did other communities that are further along deal with early skepticism? How does the community deal with misinformation and skepticism?**
   - We realize that there are headlines all over the news regarding electric vehicles which can be negative. The City will have an education campaign developed ahead of launching the changes, both internally to staff who will be impacted the most and to the public.
   - Technology and understanding of electric vehicles continue to evolve as the industry is growing exponentially.
   - A phased approach to the transition is recommended with community engagement to be undertaken as project starts and through implementation.

8. **Where do the Plans put the City compared to other municipalities – early adopters or late starters?**
   - The City is not considered an early adopter; many municipalities have moved forward and have BEVs within their fleet currently as well as BEBs.
   - Some cities began to integrate hybrids in 2017 and are now moving toward fully electric for future purchases.
   - The City is inline with other comparable municipalities in the phased approach.

9. **Priority 1 vehicles are ok, but what about Priority 2 – concerns with availability and costs and success.**
   - Prototypes are being developed and trialed as the market continues to evolve at a rapid rate.
   - The City will continue to monitor markets for Priority Two vehicles and determine what BEVs will integrate into the City's fleet.
   - The Plans concentrate on Priority 1 vehicles, with infrastructure adapted to Priority 1 and 2 (based on what is known today).

10. **Thermal events – concerned with putting out fires.**
   - The City recognizes the concern of putting out fires. There will be related new challenges that need to be monitored.
   - The City continues to work with Provincial and Federal working groups on the topic of fires.
   - Thunder Bay Fire Rescue was consulted on the Plans and have been included in the transition plan.
   - Currently, there is technology available to monitor for thermal runaway events allowing BEVs to be to moved to minimize the impact.
   - Electric vehicles fires are uncommon; fires can also occur with Internal Combustion Engine vehicles.

11. **Appears that we are jumping in with both feet but think that this approach is tentative with the 2035 goal approaching. With the current weather conditions changing due to climate change, should we have a sense of urgency – understand that this is a roadmap, but what if we were to hasten the plan if there is a financial opportunity to do so?**
    - There may be opportunity to advance additional BEBs earlier into the existing schedule should funding be available. The City does not want to retire current transit fleet prior to their retirement date (end of useful life).
    - There are also concerns with the ability for the City to acquire and expedite due to supply chain issues.

12. **In terms of non-transit, what is the expected date for complete replacement of Priority 1 vehicles?**
    - As outlined in the Plans, all Priority 1 vehicles are planned to be replaced by 2040.

13. **Landfill site – is it a dream to run our waste fleet from garbage?**
    - Outside scope of project- currently capturing some biogas, but not enough to power electric Packers.

14. **Energy savings and funding opportunities – how does this affect ridership policy? Currently limiting routes on weekends and holidays – with cost savings is City looking to add or reinstate routes – or staying with old philosophy?**
    - The City will review future ridership and service levels. The study was based on point in time data (2019).
    - The Plans will be reviewed and updated based on new technology and information; future changes to routes or service levels will be considered at that time.

15. **Does the plan provide a plan for residents beyond the urban routes? Rural taxpayers pay for services they do not receive.**
    - The Plans were created using point-in-time data and analysis (2019). The Plans will be reviewed and updated in 5 years using data specific to Thunder Bay.

16. **Funding strategy – what is funding provided by Zero Emission Transit Fund (ZETF) or Investing in Canada Infrastructure Program (ICIP)?**
    - ZETF – The maximum contribution towards capital projects is up to 50% of the total eligible costs.
    - ICIP – The program has provided up to 73% combined Provincial and Federal funding to date. Intake for ICIP ended in March 2023, but may reappear in 2026.

17. **Capital and Operating costs – why are operating costs higher when it's been thought that it was cheaper to operate a BEB vs. ICE (Internal Combustion Engine)?**
    - Operating and capital costs were combined in the lifecycle costs to show the total cost of the transition plan to BEBs as compared to business as usual.
    - As detailed in the plan, there is a higher capital cost due to initial infrastructure requirements – chargers, facility expansions, power infrastructure additions etc.
    - There is expected to be a future operational savings, however many operation and maintenance costs are still unknown due to the relatively immature market and that a long-term detailed analysis for our operations is not available.

18. **Operator uptake – do the BEBs drive differently, and is further operator training required?**
    - Yes, staff working directly and indirectly with BEBs will be provided with the required training. The training strategy is outlined within the Plans.

19. **From City operations – has Administration had conversations regarding the transition to BEBs with the Transit staff's union, ATU?**
    - Some initial conversations with ATU regarding the project have been held. Future meetings will be scheduled at key points throughout the transition.
    - Administration has had informative discussions with operators and staff in other municipalities that have adopted BEBs. The lessons learned by the other municipalities have been considered when preparing the Plans.

20. **Vehicle manufacturing – are the BEVs manufactured in Canada or the United States?**
    - The primary manufacturers that the City of Thunder Bay has contracts with are Novabus and New Flyer which have facilities in Quebec and Manitoba respectively.

21. **Ford F150 Lightning – will there be a report to Council regarding the status of the BEV that is currently part of the City of Thunder Bay's fleet?**
    - A report back to Council is planned in one year to allow further monitoring of its progress and to provide information on the full cycle of operations.

22. **Will vehicles be permitted to go home with staff overnight? Will the City of Thunder Bay provide charging capabilities at staff's homes?**
    - Policies such as this will need to be discussed internally with HR and affected departments.

23. **What is the purchase price difference (at this time) for the BEB vs. that Diesel bus. What is the projected cost savings by operating BEBs?**
    - Current prices from the supplier Metrolinx (New Flyer Buses) are as follows:
        - 12 Meter Diesel $875,000
        - 12 Meter BEB $1,550,000
        - These values fluctuate based on available options, however there is a price variance between the two types of vehicles.
        - Regarding cost savings, HDR projects an annual operating and maintenance savings of approximately $2 million per year or around 35% once the fleet has transitioned to BEBs.

24. **Will there be an opportunity to participate in a joint procurement within the province?**
    - We do currently work with Metrolinx TPI (Transit Procurement Initiative) for Transit procurement when opportunities arise, which provides the City with preferred pricing. For example, they recently completed procurement of chargers and we opted in, although we are not required to complete the purchase. Recently, we worked with Metrolinx for preferred pricing on buses under this initiative.

- The original Transit Electrification Plan was completed through a Metrolinx TPI initiative with 13 municipalities.

25. Anticipated BEVs will cost $12.5 million more than ICE vehicles- Does the government have municipal incentives to purchase these buses?

- $12.5 million is for other priority 1 vehicles throughout the municipal fleet, excluding buses.
- Yes - there is a current grant/loan funding program offered through FCM – Green Municipal Fund for municipal vehicles that we are reviewing for future purchases. We will also continue to monitor the landscape for other funding initiatives as they arise.
- In particular, we have been successful in funding buses with both ICIP funding and ZETF funding and will continue to pursue those opportunities.

26. Will all transit mechanics be provided the necessary training for maintaining BEBs?

- Yes - there are OEM courses/training provided by the BEB manufacturers as well as some colleges offering EV training.
- We are looking at several options for training and as well as investigating the concept of the 'train the trainer' approach over the long term.
- Further details are being considered as the availability of such training evolves.

CITY OF Thunder Bay
Superior by Nature

Memorandum

Office of the City Clerk
Fax: 623-5468
Telephone: 625-2230

TO: Mayor & Council

FROM: Krista Power, City Clerk

DATE: Tuesday, July 9, 2024

SUBJECT: Outstanding List for Planning Services Session as of July 9, 2024
Committee of the Whole – July 22, 2024

The following items are on the outstanding list for Planning Services:

Reference Number (yyyy-nnn-MTG)	**Department/Div**	**Outstanding Item Subject**	**Resolution Report Back Date - (on or before date)**	**Revised Report Back Date - (on or before date)** (Memos presented at COW updating or delaying Item)
2023-010-DEV	Infrastructure, Development & Operations - Realty Services	Hillcourt Estates	Mar-18-2024	Mar 31 2025
2024-001-DEV	Infrastructure, Development & Operations - Realty Services	Downtown Fort William Strategic Renewal Plan - Implementation Options	Jun-16-2025	
2024-002-DEV	Infrastructure, Development & Operations - Planning Services	Housing Accelerator Fund - Affordable Rental Housing Funding Program - Results of Program & Potential Adjustments	Jun-16-2025	

2024-003-DEV	Infrastructure, Development & Operations - Planning Services	Strategic Core Areas Community Improvement Plan - Results of Program & Potential Adjustments	Jun-16-2025	
2024-003-DEV	Infrastructure, Development & Operations - Planning Services	Strategic Core Areas Community Improvement Plan - Results of Program & Potential Adjustments	Jun-16-2025	

MEETING: THE NINETEENTH SESSION OF THE FIFTY-FOURTH THUNDER BAY POLICE SERVICES BOARD

DATE: OCTOBER 17, 2023

TIME: 9:00 A.M.

PLACE: VALHALLA HOTEL & CONFERENCE CENTRE
1 VALHALLA INN ROAD, THUNDER BAY

CHAIR: MS. K. MACHADO

PRESENT:
Mr. W. Bahlieda
Ms. D. Baxter
Mayor K. Boshcoff
Councillor K. Etreni
Ms. K. Machado
Mr. M. Mercer

ATTENDING BY ZOOM:
Mr. T. Gervais, Ministry of the Solicitor General

OFFICIALS:
Mr. D. Fleury, Chief of Police
Mr. R. Hughes, Deputy Chief of Police
Ms. D. Paris, Director – Financial Services & Facilities, Thunder Bay Police Service
Detective Inspector J. Pearson, Thunder Bay Police Service
Inspector G. Snyder, Thunder Bay Police Service
Inspector D. West, Thunder Bay Police Service
Staff Sgt. J. Dampier, Thunder Bay Police Service
Mr. J. Hannam, Secretary – Thunder Bay Police Services Board
Ms. L. Douglas, Assistant to the Secretary - Thunder Bay Police Services Board

1. DISCLOSURES OF INTEREST

There were no disclosures of interest declared at this time.

2. CONFIRMATION OF AGENDA

Under New Business, the following items were added:

- a report from the John Howard Society relative to an update on how Board funding was used; and
- a request for funding from Pink Mafia Productions.

MOVED BY: Councillor K. Etreni
SECONDED BY: Mayor K. Boshcoff

With respect to the Nineteenth Session (Regular) of the Fifty-Fourth Thunder Bay Police Services Board held on October 17, 2023, we recommend that the agenda as printed, including any additional information and new business, be confirmed.

CARRIED

3. CONFIRMATION OF MINUTES

The Minutes of the Seventeenth Session (Regular) of the Fifty-Fourth Thunder Bay Police Services Board held on September 19, 2023, to be confirmed.

MOVED BY: Ms. D. Baxter
SECONDED BY: Mayor K. Boshcoff

THAT the Minutes of the Seventeenth (Regular) of the Fifty-Fourth Thunder Bay Police Services Board held on September 19, 2023 be confirmed.

CARRIED

4. DEPUTATION

Jason Veltri, President of the Rainbow Collective of Thunder Bay, and Scotia Kauppi, Chair of the Thunder Pride Association, provided an update to the Thunder Bay Police Services Board on the safety and security concerns facing the Queer, Trans and Non-Binary communities in Thunder Bay, and shared their security concerns and threats faced by those communities during the 2023 Pride month.

Copies of several threatening email and on-line bullying to the Rainbow Collective were provided for Board members. Concerns were raised about an increase in threatening and abusive email coming through Anonymousemail.me.

It was noted that members of the Rainbow Collective and the Thunder Pride Association are volunteers who have to deal with abuse and threats on behalf of the Community.

An overview of the counter-rally at City Hall against a "hate mob" was provided.

Discussion about hate crimes, which are on the rise, and the lack of reporting were discussed. The importance of reporting hate crimes was noted, as the Police Service needs to gather data.

Chief D. Fleury responded to follow-up questions regarding when the Service is called about bullying and hate crimes. He noted that he would be meeting with Jason Veltri and Scotia Kauppi on October 20, 2023. He also noted that the Anonymousemail.me website is being investigated.

Jason Veltri and Scotia Kauppi were thanked for bringing this matter to the Board's attention.

5. REPORTS OF COMMITTEES

a) Thunder Bay Police Service – Joint Health & Safety Committee

Report No. 30/23 (Police) relative to the semi-annual report from the Joint Health and Safety Committee (January – September, 2023), was provided for the Board's information.

Inspector Derek West, Management Co-Chair of the TBPS Joint Health and Safety Committee, provided an overview of the activities of the TBPS Joint Health and Safety Committee for the period January 1, 2023 to September 30, 2023.

The Board asked Inspector West to provide a more comprehensive breakdown of the data on the summary for future reports. This will allow the Board to make better decisions.

b) Governance Committee

Mr. J. Hannam, Secretary to the Thunder Bay Police Services Board, reported that the Working Groups continue to meet, and that the Governance Committee has recently engaged a researcher and a facilitator.

c) Labour Relations Committee

Mr. J. Hannam, Secretary to the Thunder Bay Police Services Board, provided an update relative to the activities of the Labour Relations Committee.

Discussion was held relative to Committee meeting minutes being provided to the full Board. Mr. Hannam noted that issues will be brought forward to the Board as required, particularly policy recommendations.

6. REPORTS OF THE THUNDER BAY POLICE SERVICE

a) Inquest – Seven First Nation Youths - Annual Report

The Annual Implementation Status Report of the Thunder Bay Police Service, relative to the Inquest into the Deaths of Seven First Nation Youths, was provided for the Board's information.

Chief D. Fleury provided an overview relative to the above noted and responded to questions. Work is ongoing. Chief Fleury noted that the Service has a permanent liaison at Matawa and that Service's CORE group rotates through Dennis Franklin Cromarty (DFC), staying in contact with the youth.

b) Quarterly Complaints

Report No. 29/22 (Police) relative to the summary of complaints for Q3 of 2023 (July, August and September, 2023), was provided for the Board's information.

Staff Sgt. Joe Dampier, Thunder Bay Police Service, provided a preamble of the report for the new Board members, and then the summary of complaints.

Staff Sgt. Dampier responded to questions about all outstanding complaints, as opposed to outstanding complaints for the quarter being reported on. Another section on all outstanding complaints will be added to future reporting.

It was noted that Closed Session reporting on specific complaints will start again for the next reporting cycle.

c) Thunder Bay Police Service – Third Quarter Variance Report

Report No. 31/22 (Police) relative to an update on the status of the Operational Budget of the Thunder Bay Police Service as of September 30, 2023, was provided for the Board's information.

Ms. D. Paris, Director – Financial Services & Facilities, Thunder Bay Police Service, provided an overview relative to the above noted. She noted that overtime is trending higher than anticipated, as well as WSIB costs.

d) BriefCam Video Analytics Software

At the May 24, 2022 Regular Session of the Board, the use of Artificial Intelligence by the Thunder Bay Police Service was presented to the Board. At the February 21, 2023 Regular Session of the Board, the BriefCam Project Report was presented.

The Police Services Board was asked to develop a policy to ensure proper oversight regarding artificial intelligence and the use of video analytics.

Memorandum to the Thunder Bay Police Services Board from Detective Inspector J. Pearson, dated October 10, 2023, relative to a request to use BriefCam video analytics software, was provided for the Board's information.

Detective Inspector Pearson provide an overview relative to the above noted, and noted that there have been previous presentations to the Board on this topic.

The Service is confident in this software and in the testing, and is requesting approval and direction on the use of the BriefCam video analytics software.

An overview of the internal training and the trained individuals was provided. Detective Inspector Pearson confirmed that the software will not be used for automated use of identifying individuals. He noted that none of the Services using BriefCam have enabled facial recognition and confirmed that the Thunder Bay Police Service will not be enabling the facial recognition feature. He also confirmed that this software will only be applied to video that the Service has legally and lawfully obtained pursuant to ongoing investigations. A brief overview was provided on the type of items they will be searching for. The Service is waiting for the Board to develop their policy regarding proper oversight of the use of video analytics and artificial intelligence.

Mr. J. Hannam confirmed that the Board is cognizant of the fact that they need to develop a policy on this matter. Accordingly, since the policy has not been developed, an amendment was made to the motion presented.

MOVED BY: Ms. D. Baxter
SECONDED BY: Mr. W. Bahlieda

> With respect to the use of the BriefCam video analytics software, the Thunder Bay Police Board approves and directs the use of software by trained members of the Thunder Bay Police Service, for the purpose of assisting in the lawful execution of their duties.

Amending Motion – BriefCam Video Analytics Software

MOVED BY: Mr. W. Bahlieda
SECONDED BY: Ms. D. Baxter

> THAT the motion be amended by adding the following phrase after the word "software": at the direction of the Chief of Police, with reporting experience and lessons learned to the Board, in support of future policy development.
>
> CARRIED

Amended Motion – BriefCam Video Analytics Software

MOVED BY: Ms. D. Baxter
SECONDED BY: Mr. W. Bahlieda

> With respect to the use of the BriefCam video analytics software, we recommend that the Thunder Bay Police Board approves and directs the use of the BriefCam software, at the direction of the Chief of Police, with reporting on experiences and lessons learned to the Board in support of policy development;
>
> AND THAT BriefCam only be used by trained members of the Thunder Bay Police Service, for the purpose of assisting in the lawful execution of their duties.
>
> CARRIED

7. GENERAL MATTERS

a) 2023 Board Budget Status Report

Memorandum to the Thunder Bay Police Services Board from John S. Hannam, Secretary, relative to the status of the 2023 Board Budget, was re-presented for the Board's information.

At the September 19, 2023 Regular Session of the Board, the above noted memorandum was presented. Newly-appointed Board Members Bahlieda and Councillor Etreni requested more background information on how Board expenses are communicated to Board members.

Mr. J. Hannam, Secretary to the Thunder Bay Police Services Board, reported that after the September 19, 2023 Regular Session of the Board, additional information was distributed to the new Board members.

Councillor Etreni requested more detail on the format of the subject report. Mr. Hannam noted that he is open to suggestions on the format for ongoing presentations, and encouraged input on the presentation of the report. Board members were asked to email Mr. Hannam their suggestions.

MOVED BY: Ms. D. Baxter
SECONDED BY: Mayor K. Boshcoff

With respect to the reporting of invoices paid and charged against the annual operating budget, we recommend that the Thunder Bay Police Services Board direct Administration cease the practice, replacing it with a monthly budget summary.

CARRIED

b) Thunder Bay Police Services Board – Third Quarter Variance Report

Memorandum to Members of the Thunder Bay Police Services Board from John S. Hannam, Secretary, dated October 11, 2023, relative to an update on the status of the Operational Budget of the Thunder Bay Police Services Board as of September 30, 2023, was provided for the Board's information.

Mr. J. Hannam, Secretary to the Thunder Bay Police Services Board, provided an overview of the Variance Report and noted that the variance was almost entirely due to legal costs of inquests and general indemnifications. The year-end variance is now projected at a $210,000 unfavourable variance for this operating year.

c) Special Account Policy

Memorandum to the Thunder Bay Police Services Board from Malcolm Mercer, Administrator, dated October 12, 2023, relative to a proposed policy for the Board's Special Account, was distributed separately with the Agenda on October 12, 2023.

At the September 15, 2023 meeting of the Governance Committee, the above-noted memorandum was presented and discussed at length. The Governance Committee is recommending adoption of the proposed policy being presented.

A revised version of Appendix "A" was emailed to Board members on October 15, 2023.

Mr. M. Mercer provided an overview of the memorandum and noted that intent of the policy is to delegate the decision-making to a 2-person panel in order to make the process more efficient and to prioritize more pressing matters for the Board. The policy would also provide a framework for the use of the Special Account and would allow for public transparency and guidance.

MOVED BY: Ms. D. Baxter
SECONDED BY: Councillor K. Etreni

With respect to the Memorandum to the Thunder Bay Police Services Board from Malcolm Mercer, Administrator, dated October 12, , 2023, relative to a proposed policy for the Board's Special Account, as presented at the October 17, 2023 Regular Session of the Board;

THAT the Thunder Bay Police Services Board approves the Special Account Policy.

With regard to the proposed policy, Administrator Mercer responded to questions relative to concerns about the Board losing interaction with the Police Service (if they don't have the opportunity to attend Board meetings for sponsorship requests, etc.).

Mr. Hannam noted that, under the proposed policy, responses to requests would be provided in a more timely manner (without waiting for the next Board meeting).

Discussion was held relative to the creation of an application form and the requirement that a follow-up report or deputation to the Board be triggered by requests over a set amount.

MOVED BY: Councillor K. Etreni
SECONDED BY: Mayor K. Boshcoff

THAT the proposed policy for the Board's Special Account, as presented at the October 17, 2023 Regular Session of the Board, be referred back to the Board's Governance Committee for further revisions.

CARRIED

d) OIPRD Report Recommendations

Chief D. Fleury provided a verbal overview of the status of the recommendations as well as the meeting held with the OIPRD, the Board and representatives of the Police Service on September

22, 2023.

The Police Service is working on enforcement, engagement with the community, and human resources.

Progress on the Sinclair Report will continue as an Annual Report.

Administrative M. Mercer commented that the meeting with the OIPRD was very constructive, and he congratulated the Service on a productive presentation and delivery of the status of the recommendations.

e) Indigenous Grand Chief's Forum

Memorandum to the Thunder Bay Police Services Board from Chief D. Fleury, dated October 10, 2023, relative to the Indigenous Grand Chief's Forum, was provided for the Board's information.

Chief D. Fleury provided an overview relative to the above noted. Plans are tentatively scheduled for November 9, 2023. If the date needs to be changed to accommodate schedules, the event will be pushed to the beginning of 2024.

The actual cost of the event could not be provided, as it will be based on responses from invitees.

MOVED BY: Councillor K. Etreni
SECONDED BY: Mr. W. Bahlieda

With respect to the Indigenous Grand Chief's Forum being hosted by the Thunder Bay Police Service and the Anishinabek Nation, the Thunder Bay Police Services Board agrees to support and assist the Thunder Bay Police Service with the costs of this forum.

Amending Motion – Indigenous Grand Chief's Forum

MOVED BY: Councillor K. Etreni
SECONDED BY: Mr. W. Bahlieda

THAT Indigenous be changed to First Nations, financial assistance come from the Board's Special Account, and that "excluding travel and accommodation for guests" be added.

CARRIED

Amended Motion – Indigenous Grand Chief's Forum

MOVED BY: Councillor K. Etreni
SECONDED BY: Mr. W. Bahlieda

With respect to the First Nations Grand Chief's Forum being hosted by the Thunder Bay Police Service and the Anishinabek Nation, the Thunder Bay Police Services Board agrees to support and assist the Thunder Bay Police Service with the costs of this forum from the Board's Special Account, excluding travel and accommodation for guests.

CARRIED

Ms. D. Baxter noted that it is traditional to bring gifts, and that the costs of the gifts should also be included in the costs. The Board was in consensus to include the costs of gifts with the costs being approved today.

f) Remembrance Day 2023

Mr. J. Hannam, Secretary to the Board, provided an overview relative to the local ceremonies scheduled for Saturday, November 11, 2023. Board representation at local ceremonies was requested.

There will be Board representation for the laying of Remembrance Day wreaths at the Fort William Gardens, Fort William First Nation, the Slovak Legion, and Waverley Park.

g) 2024 Meeting Dates

Copies of the 2024 calendar were provided for the Board's information in order to determine their meeting dates in 2024.

The following meeting dates, on the 3rd Tuesday of each month in 2024, were proposed:

- Tuesday, January 16, 2024;
- Tuesday, February 20, 2024;
- Tuesday, March 19, 2024;
- Tuesday, April 16, 2024;
- Tuesday, May 21, 2024;
- Tuesday, June 18, 2024;
- Tuesday, July 16, 2024 (tentative);
- Tuesday, August 20, 2024 (tentative);
- Tuesday, September 17, 2024;
- Tuesday, October 15, 2024;
- Tuesday, November 19, 2024; and
- Tuesday, December 17, 2024.

MOVED BY: Mayor K. Boshcoff
SECONDED BY: Councillor K. Etreni

With respect to the 2024 meeting dates presented at the October 17, 2023 Regular Session of the Thunder Bay Police Services Board, we recommend proceeding with the proposed dates.

CARRIED

h) Website Launch

At the May 23, 2023 Regular Session of the Board, Mr. J. Hannam, Secretary, provided an overview of proposed changes and updates to the Board's website. The Board approved the expenditure required to update the website, and it was noted that, once completed, a presentation would be made to the Board on the new features and design changes.

Using the projector screen, Mr. J. Hannam provided a visual overview of the new features on the Board's website.

Councillor K. Etreni asked about a possible internal feature for Board members to access. Mr. Hannam will follow up with KPW Communications.

8. PETITIONS AND COMMUNICATIONS

a) Tracking Board Reports

There are *no updates* for the following outstanding Board reports/standing agenda items.

i. Emmanuel Oruitemeka Inquest

Board Responses to Jury Recommendations for the Ministry of the Solicitor General, due January 19, 2024.

ii. Governance Committee – Policy Development

Policy responding to recommendations #2 through #4 of the Epstein Report – Missing and Missed.

iii. Governance Committee – Policy Development

At the May 24, 2022 Regular Session of the Board, the use of Artificial Intelligence by the Thunder Bay Police Service was presented to the Board. At the February 21, 2023 Regular Session of the Board, the BriefCam Project Report was presented.

The Police Services Board was asked to develop a policy to ensure proper oversight regarding artificial intelligence and the use of video analytics.

iv. OCPC Chart – Summary of Recommendations

Summary of status/progress of OCPC Recommendations was last presented for the Board's information on June 28, 2022.

9. NEW BUSINESS

a) John Howard Society

At the May 23, 2023 Regular Session of the Thunder Bay Police Services Board, a funding request from the John Howard Society was authorized in the amount of $10,000.00 from the Board's Special Account.

A report to the Thunder Bay Police Services Board from the John Howard Society of Thunder Bay, relative to the Recreation Therapy Program, was emailed to Members of the Board on October 15, 2023 as Additional Information.

Mr. J. Hannam provided a brief overview relative to the above noted report.

Chair Machado will send a letter acknowledging the Recreation Therapy Program and thanking the John Howard Society for their follow-up report.

Mr. J. Hannam noted that there is a standing invitation for Board members to visit the office of the John Howard Society to observe their operations.

b) Pink Mafia Productions

A request for sponsorship from Pink Mafia Productions, dated October 9, 2023, was emailed to Members of the Board on October 15, 2023 as Additional Information.

Mr. J. Hannam provided a brief overview relative to the above noted request.

Discussion was held on the request and if sponsorship can be justified, based on the draft proposed policy on the Board's Special Account.

MOVED BY: Ms. D. Baxter
SECONDED BY: Councillor K. Etreni

> With respect to a request for sponsorship from Pink Mafia Productions, as presented at the October 17, 2023 Regular Session of the Board, we authorize sponsorship in the amount of $500.00;
>
> AND THAT the sponsorship be paid from the Board's Special Account.

CARRIED

10. CONFIRMING BY-LAW

MOVED BY: Mayor K. Boshcoff
SECONDED BY: Councillor K. Etreni

THAT the following By-law be introduced, read, dealt with individually, engrossed, signed by the Chair and Secretary to the Thunder Bay Police Services Board, sealed and numbered:

1. A By-law to confirm the proceedings of a Regular Session of The Thunder Bay Police Services Board, this 17th day of October, 2023.

   Explanation: Confirmation of the proceedings and each motion, resolution and other action passed or taken by the Thunder Bay Police Services Board at this meeting is required, adopted, ratified and confirmed as if all such proceedings had been expressly embodied in this By-law.

   BY-LAW NUMBER: PC21– 2023

   CARRIED

11. ADJOURNMENT

The meeting adjourned at 11:14 a.m.

MEETING: THE TWENTY-SECOND SESSION OF THE FIFTY-FOURTH THUNDER BAY POLICE SERVICES BOARD

DATE: NOVEMBER 21, 2023

TIME: 10:30 A.M.

PLACE: VALHALLA HOTEL & CONFERENCE CENTRE
1 VALHALLA INN ROAD, THUNDER BAY

ACTING CHAIR: MS. D. BAXTER

PRESENT:
Mr. W. Bahlieda
Mayor K. Boshcoff
Councillor K. Etreni

ATTENDING BY ZOOM:
Ms. D. Baxter
Mr. M. Mercer

REGRETS:
Ms. K. Machado

OFFICIALS:
Mr. R. Hughes, Deputy Chief of Police
Ms. D. Paris, Director – Financial Services & Facilities, Thunder Bay Police Service
Mr. J. Hannam, Secretary – Thunder Bay Police Services Board
Ms. L. Douglas, Assistant to the Secretary - Thunder Bay Police Services Board

ATTENDING BY ZOOM:
Mr. T. Gervais, Ministry of the Solicitor General

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1. DISCLOSURES OF INTEREST

There were no disclosures of interest declared at this time.

2. CONFIRMATION OF AGENDA

MOVED BY: Councillor K. Etreni
SECONDED BY: Mr. W. Bahlieda

With respect to the Twenty-Second Session (Regular) of the Fifty-Fourth Thunder Bay Police Services Board held on November 21, 2023, we recommend that the agenda as printed, including any additional information and new business, be confirmed.

CARRIED

3. CONFIRMATION OF MINUTES

The Minutes of the Nineteenth Session (Regular) of the Fifty-Fourth Thunder Bay Police Services Board held on October 17, 2023, to be confirmed.

MOVED BY: Councillor K. Etreni
SECONDED BY: Mr. W. Bahlieda

THAT the Minutes of the Nineteenth (Regular) of the Fifty-Fourth Thunder Bay Police Services Board held on October 17, 2023 be confirmed.

CARRIED

4. REPORTS OF COMMITTEES

a) Governance Committee

Memorandum to the Thunder Bay Police Services Board from John S. Hannam, Secretary, dated November 14, 2023, relative to an update on the activities of the Governance Committee, was provided for the Board's information.

Mr. J. Hannam, Secretary to the Thunder Bay Police Services Board, provided an overview relative to the above noted.

i. Special Account Policy

At the September 15, 2023 meeting of the Governance Committee, a memorandum from Malcolm Mercer, Administrator, relative to the development of a policy for the Board's Special Account, was presented and discussed at length. The Governance Committee recommended adoption of the proposed policy, which was presented at the October 17, 2023 Regular Session of the Board.

At the October 17, 2023 Regular Session of the Board, after discussion, the proposed policy was referred back to the Board's Governance Committee for further review.

Proposed Special Account Policy was provided for the Board's information.

Mr. M. Mercer, Administrator, reported that the draft was circulated to the Governance Committee after the October 17, 2023 meeting, and only one comment was received. That comment was in support of the original proposal.

MOVED BY: Councillor K. Etreni
SECONDED BY: Mr. W. Bahlieda

With respect to the Special Account Policy, as presented at the November 21, 2023 Regular Session of the Board;

THAT the Thunder Bay Police Services Board approves adoption of the Special Account Policy.

CARRIED

ii. Missing Persons Policy and Use of Force Policy

Proposed Missing Persons Policy and Use of Force Policy, was provided for the Board's information.

Mr. J. Hannam provided an overview of both policies, and noted that there will be extensive procedures associated with these policies from the Police Service.

Deputy Chief of Police R. Hughes noted that there is no reference to dispatching animals in the Use of Force policy. Discussion followed and amendments were suggested. Mr. T. Gervais, Police Services Advisor – Ministry of the Solicitor General, provided additional information on discharging a firearm and regulatory requirements. He noted that injury or death (as a result of discharging a firearm) must be reported to the Board, and it is a regulatory requirement that the Chief of Police launch an investigation. Mr. Gervais also noted that references to the Chief of Police also include the Deputy Chief of Police.

MOVED BY: Councillor K. Etreni
SECONDED BY: Mayor K. Boshcoff

With respect to the Missing Persons Policy and the Use of Force Policy, as presented at the November 21, 2023 Regular Session of the Board, we recommend that the Thunder Bay Police Services Board approves adoption of both policies, as amended.

CARRIED

Mr. J. Hannam noted that Chief Fleury has advised that there will be public engagement on the procedures for the Missing Persons Policy.

iii. Policies for Consideration

Memorandum to the Board from Malcolm Mercer, dated November 12, 2023, relative to proposed policies for Board – Chief Relationship and Information Sharing, was distributed separately with the Agenda, for the Board's information.

The subject draft policies were presented for comments and discussion purposes only.

- Proposed Information Sharing Policy
- Proposed Indigenous Relationship Policy
- Proposed Role and Responsibility Policy

Mr. J. Hannam, Secretary to the Thunder Bay Police Services Board, noted that the above polices are being presented as an introduction to the Board; he asked that Board members review and advise of any suggested changes.

Administrator Mercer provided an overview of his memorandum. With respect to the Role and Responsibility Policy, he noted that the Board needs to be clear on its role and responsibility, as well as the Chief's role and responsibility and how they differ. Well defined policies on roles and responsibilities can be of great value when a crisis occurs.

The Information Sharing Policy is being driven by the Epstein Report and other reports, and is designed to ensure the Board gets the information it needs.

The Indigenous Relationship Policy follows from Senator Sinclair's Report and its recommendations, and sets out the importance for the Board to engage with Indigenous representatives and for the community to have an opportunity to see what is being proposed.

Acting Chair D. Baxter noted that there will be one uniform look/template for the policies when they are finalized.

b) Labour Relations Committee

Mr. J. Hannam, Secretary, provided an update relative to the activities of the Labour Relations Committee, and noted that the Committee will be meeting with representatives of the Police Association on December 5, 2023 as an introductory meeting, and to begin discussions on the health and well-being of Service members.

5. REPORTS OF THE THUNDER BAY POLICE SERVICE

a) 2024 Budget – Thunder Bay Police Service

Report No. 33/22 (Police) relative to the proposed 2024 Operating and Capital Budgets of the Thunder Bay Police Service, was provided for the Board's information.

Ms. D. Paris, Director – Financial Services & Facilities, Thunder Bay Police Service, provided a high level overview of the proposed budget and responded to questions. She noted that approximately 92% of the Operating Budget is wages.

Ms. Paris noted that an operational review is being proposed. An outside organization would come in and meet with Chief Fleury and the community, and conduct an operational review for analysis.

Discussion was held relative to concerns about staffing levels, freeing up time spent at the hospital and in emergency and ways of mitigating the number of calls that end up at the hospital. Concerns were also raised about WSIB costs and ways of reducing those costs.

MOVED BY: Councillor K. Etreni
SECONDED BY: Mr. W. Bahlieda

With respect to Report No. 33/23 (Police), as presented at the November 21, 2023 Regular Session of the Board, we recommend that the Thunder Bay Police Services Board approve the 2024 Operating and Capital Budgets, as presented.

CARRIED

6. GENERAL MATTERS

a) 2023 Budget – Thunder Bay Police Services Board

Memorandum to the Thunder Bay Police Services Board from John S. Hannam, dated November 15, 2023, relative to an up-to-date summary of the Police Services Board's Budget, was provided for the Board's information.

Mr. J. Hannam noted that the year-end projection is an unfavourable variance of $210,000, a reduction from earlier projections.

b) Beau Aaron Baker Inquest

Verdict Explanation and Recommendations relative to the Inquest into the death of Beau Aaron Baker, was distributed separately with the Agenda.

Matter deferred to the December 19, 2023 Regular Session.

c) Policing Services to the Municipality of Oliver Paipoonge

Report No. 34/23 (Police) relative to entering into an agreement with the Municipality of Oliver Paipoonge to provide policing services, was provided for the Board's information.

Mr. J. Hannam provide a brief overview, and noted that the Municipality of Oliver Paipoonge is prepared to enter into this agreement.

MOVED BY: Councillor K. Etreni
SECONDED BY: Mr. W. Bahlieda

With respect to Report No. 34/23 (Police), we recommend that the Thunder Bay Police Services Board support the renewal of the contract to provide Policing Services to the Municipality of Oliver Paipoonge and recommend to City Council the execution of the five (5) year contract.

CARRIED

7. PETITIONS AND COMMUNICATIONS

a) Thank You Letter for Sponsorship

On June 21, 2023, Administrator Malcolm Mercer, Thunder Bay Police Services Board, approved a request from Staff Sergeant J. Dampier for sponsorship at the 2023 World Police and Fire Games in Winnipeg. A cheque, in the amount of $700.00, was issued from the Board's Special Account.

Correspondence to the Thunder Bay Police Services Board from Staff Sergeant Joe Dampier, dated October 17, 2023, relative to a thank you for Board sponsorship for his participation in the 2023 World Police and Fire Games in Winnipeg, was provided for the Board's information.

b) Follow-Up Report on Funding

At the January 17, 2023 Regular Session of the Board, a funding initiative proposal from Thunder Bay and Area Victim Services was presented to the Board. A motion was approved to fund the initiative, and a cheque in the amount of $10,000 was issued from the Board's Special Account.

Copies of a follow-up report from Thunder Bay and Area Victim Services (TBAVS), relative to funding received from the Board, were provided for the Board's information.

c) Tracking Board Reports

There are *no updates* for the following outstanding Board reports/standing agenda items.

i. Emmanuel Oruitemeka Inquest

Board Responses to Jury Recommendations for the Ministry of the Solicitor General, due January 19, 2024.

ii. Governance Committee – Policy Development

At the May 24, 2022 Regular Session of the Board, the use of Artificial Intelligence by the Thunder Bay Police Service was presented to the Board. At the February 21, 2023 Regular Session of the Board, the BriefCam Project Report was presented.
The Police Services Board was asked to develop a policy to ensure proper oversight regarding artificial intelligence and the use of video analytics.

iii. OIPRD Report Recommendations

Summary of status/progress of OIPRD Recommendations: a verbal update was presented to the Board on October 17, 2023.

iv. OCPC Chart – Summary of Recommendations

Summary of status/progress of OCPC Recommendations was last presented for the Board's information on June 28, 2022.

8. NEW BUSINESS

There was no New Business presented.

9. CONFIRMING BY-LAW

MOVED BY: Councillor K. Etreni
SECONDED BY: Mr. W. Bahlieda

THAT the following By-law be introduced, read, dealt with individually, engrossed, signed by the Chair and Secretary to the Thunder Bay Police Services Board, sealed and numbered:

1. A By-law to confirm the proceedings of a Regular Session of The Thunder Bay Police Services Board, this 21st day of November, 2023.

   Explanation: Confirmation of the proceedings and each motion, resolution and other action passed or taken by the Thunder Bay Police Services Board at this meeting is required, adopted, ratified and confirmed as if all such proceedings had been expressly embodied in this By-law.

   BY-LAW NUMBER: PC24– 2023

   CARRIED

10. ADJOURNMENT

The meeting adjourned at 11:20 a.m.

MEETING: THE FIRST SESSION OF THE FIFTY-FIFTH THUNDER BAY POLICE SERVICES BOARD

DATE: DECEMBER 19, 2023

TIME: 10:45 A.M.

PLACE: VALHALLA HOTEL & CONFERENCE CENTRE
1 VALHALLA INN ROAD, THUNDER BAY

CHAIR: MS. K. MACHADO

PRESENT:
Mr. W. Bahlieda
Ms. D. Baxter
Mayor K. Boshcoff
Ms. K. Machado
Mr. M. Mercer

ATTENDING BY ZOOM:
Councillor K. Etreni

OFFICIALS:
Mr. D. Fleury, Chief of Police
Mr. R. Hughes, Deputy Chief of Police
Inspector G. Snyder, Thunder Bay Police Service
Mr. J. Hannam, Secretary – Thunder Bay Police Services Board
Ms. L. Douglas, Assistant to the Secretary - Thunder Bay Police Services Board

ATTENDING BY ZOOM:
Mr. T. Gervais, Ministry of the Solicitor General

The meeting was called to order at 10:43 a.m.

On behalf of the Thunder Bay Police Services Board, Chair K. Machado offered sincere condolences to the family of Mackenzie Moonias.

1. <u>DISCLOSURES OF INTEREST</u>

There were no disclosures of interest declared at this time.

2. <u>CONFIRMATION OF AGENDA</u>

Under Reports of the Committees, Ms. Denise Baxter, Chair of the Governance Committee, will provide an overview of the Committee's activities.

Under New Business, Mr. T. Gervais, Police Services Advisor – Ministry of the Solicitor General, will provide a brief update on the *Community Safety and Policing Act*, which is scheduled to be enacted on April 1, 2024.

MOVED BY: Councillor K. Etreni
SECONDED BY: Mayor K. Boshcoff

With respect to the First Session (Regular) of the Fifty-Fifth Thunder Bay Police Services Board held on December 19, 2023, we recommend that the agenda as printed, including any additional information and new business, be confirmed.

CARRIED

3. CONFIRMATION OF MINUTES

The Minutes of the Twenty-Second Session (Regular) of the Fifty-Fourth Thunder Bay Police Services Board held on November 21, 2023, to be confirmed.

MOVED BY: Councillor K. Etreni
SECONDED BY: Mr. W. Bahlieda

THAT the Minutes of the Twenty-Second Session (Regular) of the Fifty-Fourth Thunder Bay Police Services Board held on November 21, 2023 be confirmed.

CARRIED

4. REPORTS OF COMMITTEES

a) Governance Committee

Ms. Denise Baxter, Chair of the Governance Committee, provided an overview of the Committee's activities. She noted that policies are being developed. A meeting was held with a researcher from Lakehead University, who is working on the EDI piece and will also support policy research going forward. The Committee will be consulting with the community and developing a process for vetting all policies to ensure they are sound.

Memorandum to the Thunder Bay Police Services Board from John S. Hannam, Secretary, dated December 11, 2023, relative to a Report Recommendations Work Plan, was provided for the Board's information.

Mr. J. Hannam provided a brief overview relative to the above noted.

i. Policies for Adoption

Memorandum to the Board from Malcolm Mercer, dated November 12, 2023, relative to proposed policies for Board – Chief Relationship and Information Sharing, was distributed separately and presented to the Board at the November 21, 2023 Regular Session.

The proposed Indigenous Relationship Policy will be presented at the January, 2023 Regular Session, following public consultation.

The following policies were presented at the November 21, 2023 Regular Session of the Board for discussion purposes only. They are now being presented for adoption.

- Proposed Information Sharing Policy
- Proposed Role and Responsibility Policy

Administrator M. Mercer noted that one of the priorities of the Governance Committee was to establish the above noted policies. He provided some background information on the reports of the G20 Summit in Toronto, and the Freedom Convey event in Ottawa, and how those reports underlined the importance of sharing information between the Chief of Police and the Police Services Board. The report from Justice Epstein on the McArthur murders in Toronto was also cited.

Chair Machado thanked Administrator Mercer for his role and assistance with educating the Board on these policies.

MOVED BY: Councillor K. Etreni
SECONDED BY: Mayor K. Boshcoff

With respect to the Information Sharing Policy and the Role and Responsibility Policy, as presented at the December 19, 2023 Regular Session of the Board, we recommend that the Thunder Bay Police Services Board approves adoption of the above noted policies, as presented.

CARRIED

ii. <u>Use of Force Policy By-Law</u>

At the November 21, 2023 Regular Session of the Board, a Use of Force Policy was presented for the Board's information and was subsequently adopted.

MOVED BY: Mr. W. Bahlieda
SECONDED BY: Councillor K. Etreni

With respect to the Use of Force Policy for the Board, as adopted at the November 21, 2023 Regular Session of the Board, we recommend that By-law PC26-2023, a by-law to establish a Use of Force Board Policy, be adopted;

AND THAT the Chair and Secretary to the Board be authorized to execute the by-law.

CARRIED

iii. <u>Missing Persons Policy By-Law</u>

At the November 21, 2023 Regular Session of the Board, a Missing Persons Policy was presented for the Board's information and was subsequently adopted.

Mr. J. Hannam, Secretary, provided a brief overview and noted that this is a policy of the Police Services Board, not the Police Service. The Service is working on procedures related to this policy.

MOVED BY: Mayor K. Boshcoff
SECONDED BY: Councillor K. Etreni

> With respect to the Missing Persons Policy for the Board, as adopted at the November 21, 2023 Regular Session of the Board, we recommend that By-law PC27-2023, a by-law to establish a Missing Persons Board Policy, be adopted;
>
> AND THAT the Chair and Secretary to the Board be authorized to execute the by-law.
>
> CARRIED

b) Labour Relations Committee

Mr. W. Bahlieda, Chair of the Labour Relations Committee, provided a brief overview relative to the activities of the Labour Relations Committee, as well as the meeting between the Labour Relations Committee and the Thunder Bay Police Association. One of the areas of discussion at the meeting was the importance of mental health for the members of the Association and how the Police Services Board can assist.

The Committee is hoping to move together in harmony and foster better relationships with the Police Association.

i. Delegation of Authority – Appointment of New Hires

At the December 15, 2020 Regular Session of the Board, a resolution was passed to delegate authority to Kristen Oliver and Michael Power to appoint members and special constables to the Thunder Bay Police Service. It is now deemed necessary to amend By-law PC26-2020 by replacing named individuals with the Chair of the Thunder Bay Police Services Board and the Chair of the Thunder Bay Police Services Board's Labour Relations Committee.

Mr. J. Hannam, Secretary, provided a brief overview relative to the above noted.

MOVED BY: Mayor K. Boshcoff
SECONDED BY: Councillor K. Etreni

> With respect to the Delegation of Authority By-law for the Thunder Bay Police Services Board, we recommend that By-law PC26-2020 be amended to replace delegation of authority to appoint new hires to the Chair of the Thunder Bay Police Services Board and the Chair of the Thunder Bay Police Services Board's Labour Relations Committee;

AND THAT the Chair and Secretary to the Board be authorized to execute the by-law.

CARRIED

5. REPORTS OF THE THUNDER BAY POLICE SERVICE

a) Annual Report – Thunder Bay Police Service

The 2022 Annual Report for the Thunder Bay Police Service was distributed separately on desks at the December 19, 2023 Regular Session of the Board.

Inspector G. Snyder provided an overview of the Annual Report using a PowerPoint presentation and responded to questions.

He noted that violent crime continues to increase in the community year over year. Thunder Bay has 6 times the number of homicides (based on population) compared to the national average. The severity of crime has a direct impact on the workload of the officers.

He also noted that the clearance rate is significantly higher for Thunder Bay compared to province and national averages.

The full report will be posted to the Police Service's website after this meeting.

Chief D. Fleury noted the incredible work that the officers are doing, as indicated by the Service's clearance rates. They are doing quality work and investigations on behalf of the whole community. Chief Fleury responded to questions about regional policing, and noted that a collaboration with the Minnesota State Police has been initiated.

Chair Machado thanked Inspector Snyder and the Police Service for their good work and for the Annual Report.

A brief discussion followed regarding the actual population of Thunder Bay, as well as the population of the Municipality of Oliver Paipoonge (serviced by the Thunder Bay Police Service), and the impact on the Police Service.

Mr. J. Hannam noted that the Annual Report will also be shared with City Council.

6. GENERAL MATTERS

a) Beau Aaron Baker Inquest

Verdict Explanation and Recommendations relative to the Inquest into the death of Beau Aaron Baker, were distributed separately for the Board's information.

Inspector G. Snyder, Thunder Bay Police Service, provided a brief overview of the death and the resulting inquest. He noted that three (3) recommendations were specific to police services in Ontario.

The Thunder Bay Police Service has provided their response. An overview of the Service's responses to Recommendations #13, #15, and #24 was provided.

b) Board Staffing Needs

Memorandum to the Thunder Bay Police Services Board from John S. Hannam, Secretary, dated October 13, 2023, relative to additional resources for the Board, re-presented for the Board's information.

Mr. J. Hannam noted the 115 recommendations (from various reports) to the Board, the ongoing work of the Board, as well as the need for additional support staff to complete work that needs to be accomplished at a more reasonable rate of progress. Additional staffing is particularly necessary for policy development, for building the Board's capacity on key community relationships and to be more fiscally responsible. He reported that a part-time individual has been hired to support the Governance Committee.

Discussion followed on staffing needs of the Board as well as the staffing model being presented. Several Board members were of the opinion that a full time employee is needed for the Board.

The current staffing model being recommended was not supported by the Board. The Board will need to determine which staffing model best suits their needs.

MOVED BY: Councillor K. Etreni
SECONDED BY: Ms. D. Baxter

With respect to the staffing needs of the Thunder Bay Police Services Board, we recommend that the Board approve the staffing model, as re-presented at the December 19, 2023 meeting of the Board;

AND THAT the positions be filled through independent contracts, in form and content satisfactory to the Board's Legal Counsel;

AND THAT the Chair of the Board be authorized to execute any such contracts.

LOST

MOVED BY: Ms. D. Baxter
SECONDED BY: Councillor K. Etreni

With respect to the staffing needs of the Board, we recommend that Karen Machado, Denise Baxter and Donna Smith revisit the matter, taking into account the feedback of the Board members, and return a new proposal for the Board's consideration.

CARRIED

b) Board Member Orientation

A draft policy on Board and Committee – Orientation and Training was distributed separately on desks at the meeting, for discussion purposes only.

Councillor K. Etreni provided an overview of the proposed Board orientation and responded to questions.

She asked for input from Board members, and asked that their comments be forwarded to her by January 6, 2024. She would like to finalize this policy at the January 16, 2024 Board meeting.

c) Budget Summary – Thunder Bay Police Services Board

Memorandum to the Thunder Bay Police Services Board from John S. Hannam, dated December 11, 2023, relative to an update on the status of the Board's operational budget, was provided for the Board's information.

Mr. J. Hannam, Secretary, provided a brief overview relative to the above noted.

d) Approval of 2024 Budget – Thunder Bay Police Services Board

Memorandum to Thunder Bay Police Services Board from John S. Hannam, Secretary, dated December 13, 2023, relative to the proposed 2024 budget for the Thunder Bay Police Services Board, was provided for the Board's information.

Mr. J. Hannam, Secretary, provided a brief overview relative to the above noted, and noted that the 2024 budget is largely unchanged from the Board's 2023 budget. However, additional funds for community engagement and proposed increase in staffing resources have been added to the budget. He was satisfied that the legal fees budget should be sufficient going forward. It was noted that the 2024 budget has been submitted to City Council.

MOVED BY: Councillor K. Etreni
SECONDED BY: Ms. D. Baxter

With respect to the 2024 Operating Budget for the Thunder Bay Police Services Board, as presented at the December 19, 2023 meeting, we recommend that the Board approve the budget.

CARRIED

e) Website Updates

Mr. J. Hannam, Secretary, noted that the costs involved with the development of Members Only access to the Board's website were forwarded by email to Board members prior to this meeting.

Development is underway.

f) Indigenous Chiefs Forum

On Tuesday, December 12, 2023, Chief D. Fleury hosted an Indigenous Chiefs Forum. Members of the Thunder Bay Police Services Board attended.

Chief D. Fleury was pleased with the outcome. The overall intent of the Forum was to have an open discussion on expectations of the community at large as well as the Indigenous community.

Chief Fleury is hoping to make this an annual event, and would like to have different people presenting different areas of discussion at the next one. He would also like to explore opportunities for one-on-one conversations with people experiencing homelessness and other hardships.

The Chief was congratulated on initiating this event.

7. PETITIONS AND COMMUNICATIONS

a) Nominations for the 2023/2024 Attorney General's Victim Services Award of Distinction

All Chiefs Memo Index No. 23-0077, relative to nominations for the 2023/2024 Attorney General's Victim Services Awards of Distinction, was provided for the Board's information.

Mr. J. Hannam, Secretary, will follow up on this opportunity, and will nominate groups brought forward by the Board, as appropriate.

b) Tracking Board Reports

There are *no updates* for the following outstanding Board reports/standing agenda items.

i. Emmanuel Oruitemeka Inquest

Board Responses to Jury Recommendations for the Ministry of the Solicitor General, due January 19, 2024.

ii. Governance Committee – Policy Development

At the May 24, 2022 Regular Session of the Board, the use of Artificial Intelligence by the Thunder Bay Police Service was presented to the Board. At the February 21, 2023 Regular Session of the Board, the BriefCam Project Report was presented.

The Police Services Board was asked to develop a policy to ensure proper oversight regarding artificial intelligence and the use of video analytics.

iii. OIPRD Report Recommendations

Summary of status/progress of OIPRD Recommendations: a verbal update was presented to the Board on October 17, 2023.

iv. OCPC Chart – Summary of Recommendations

Summary of status/progress of OCPC Recommendations was last presented for the Board's information on June 28, 2022.

8. NEW BUSINESS

Community Safety and Policing Act, 2019

Mr. T. Gervais, Police Services Advisor – Ministry of the Solicitor General, provided an overview of All Chiefs Memo Index No. 23-0085, the In-force date of the *Community Safety and Policing Act, 2019* (CSPA).

He noted that there are significant changes in the Act that will affect the Police Service and the Board. On behalf of the Ministry of the Solicitor General, Mr. Gervais will be the primary support to the Board through the transition. He suggested a project management approach. The Board should consider a transition lead on the work that will need to be done. Inspector G. Snyder will be the contact for the Service.

A subcommittee of the Board was suggested; however, there was no decision made on how the Board will deal with the work that needs to be in place prior to enactment of the CSPA.

9. BY-LAWS

a) Use of Force Policy By-Law

MOVED BY: Mayor K. Boshcoff
SECONDED BY: Councillor K. Etreni

THAT the following By-law be introduced, read, dealt with individually, engrossed, signed by the Chair and Secretary, sealed and numbered:

1. A By-law to establish a Use of Force Board Policy as adopted at the November 21, 2023 Regular Session of the Thunder Bay Police Services Board.

   Explanation: A By-law to establish a Use of Force Policy for the Thunder Bay Police Services Board, and to amend By-law Number PC10-2001 by removing the Use of Force Policing Standards Policy from Schedule "A" of the Adequacy Standards Policies for the Thunder Bay Police Service Board. References and amendments to Use of Force in By-Law PC10-2001 and its Attachment "A" for Adequacy Standard Policies in PC2-2008, in PC32-2018, or in other By-laws of the Board since the enactment of PC10-2001, or in any policies or procedures of the Thunder Bay Police Service, are hereby repealed, effective the passing of this By-law PC26-2023.

   BY-LAW NUMBER: PC26-2023

   CARRIED

b) Missing Persons Policy By-Law

MOVED BY: Ms. D. Baxter
SECONDED BY: Mr. W. Bahlieda

THAT the following By-law be introduced, read, dealt with individually, engrossed, signed by the Chair and Secretary, sealed and numbered:

1. A By-law to establish a Missing Persons Board Policy as adopted at the November 21, 2023 Regular Session of the Thunder Bay Police Services Board.

   Explanation: Further to the Senator Murray Sinclair Report, and its recommendations, it is necessary and expedient to establish a Missing Persons Policy for the Thunder Bay Police Services Board, as adopted at the November 21, 2023 Regular Session of the Board.

   BY-LAW NUMBER: PC27-2023

   CARRIED

c) Delegation of Authority to Appoint New Hires By-Law

MOVED BY: Councillor K. Etreni
SECONDED BY: Ms. D. Baxter

THAT the following By-law be introduced, read, dealt with individually, engrossed, signed by the Chair and Secretary, sealed and numbered:

1. A By-law to amend By-law PC26-2020, to delegate authority for the appointment of new hires for the Thunder Bay Police Service.

   Explanation: A By-law to amend By-law PC26-2020, with respect to delegation of authority to appoint new hires, from named individuals to the Chair of the Thunder Bay Police Services Board and the Chair of the Thunder Bay Police Services Board's Labour Relations Committee.

   BY-LAW NUMBER: PC28-2023

   CARRIED

10. CONFIRMING BY-LAW

MOVED BY: Councillor K. Etreni
SECONDED BY: Ms. D. Baxter

THAT the following By-law be introduced, read, dealt with individually, engrossed, signed by the Chair and Secretary to the Thunder Bay Police Services Board, sealed and numbered:

1. A By-law to confirm the proceedings of a Regular Session of The Thunder Bay Police Services Board, this 19th day of December, 2023.

   Explanation: Confirmation of the proceedings and each motion, resolution and other action passed or taken by the Thunder Bay Police Services Board at this meeting is required, adopted, ratified and confirmed as if all such proceedings had been expressly embodied in this By-law.

   BY-LAW NUMBER: PC29– 2023

   CARRIED

11. ADJOURNMENT

The meeting adjourned at 12:07 p.m.

Official Recognition Committee Meeting Minutes

Thursday, February 29, 2024, 4:00 p.m.
Martin Room - 3rd Floor, City Hall

1. Official Recognition Committee Meeting 01-2024

Chair: Anthony Foglia

2. Members

Councillor Michael Zussino
Anthony Foglia
Tiffany Gervasi
Elaine Lynch
Matthew Villella

3. Officials

Dana Earle, Deputy City Clerk
Katie Piché, Council & Committee Clerk

4. Disclosures of Interest

The Chair called the meeting to order. There were no disclosures of interest.

5. Agenda Approval

MOVED BY: Councillor Michael Zussino
SECONDED BY: Matthew Villella

WITH RESPECT to the February 29, 2024 meeting of the Official Recognition Committee, we recommend that the agenda as printed, including any additional information and new business, be confirmed.

CARRIED

6. Confirmation of Previous Minutes

The Minutes of Meeting 07-2023 Official Recognition Committee, held on December 13, 2023, to be confirmed.

MOVED BY: Councillor Michael Zussino
SECONDED BY: Matthew Villella

THAT the Minutes of Meeting 07-2023 of the Official Recognition Committee, held on December 13, 2023, be confirmed.

CARRIED

7. Election of Chair & Vice-Chair

The Deputy City Clerk called for nominations for Chair and Vice-Chair for the 2024 calendar year.

MOVED BY: Matthew Villella
SECONDED BY: Elaine Lynch

WITH RESPECT to the Chair of the Official Recognition Committee, we recommend that Anthony Foglia be appointed Chair of the Committee for the remainder of the 2024 calendar year and until such time as a replacement has been appointed, as required annually.

CARRIED

MOVED BY: Elaine Lynch
SECONDED BY: Anthony Foglia

WITH RESPECT to the Vice-Chair of the Official Recognition Committee, we recommend that Matthew Villella be appointed Vice-Chair of the Committee for the remainder of the 2024 calendar year and until such time as a replacement has been appointed, as required annually.

CARRIED

Anthony Foglia assumed the Chair for the remainder of the meeting.

8. Resolution to Resolve into Closed Session

MOVED BY: Matthew Villella
SECONDED BY: Councillor Michael Zussino

THAT the Official Recognition Committee resolve into closed session in order to receive information pursuant to *Municipal Act* (Section 239 (2)):

(b) personal matters about an identifiable individual, including municipal or local board employees.

CARRIED

9. Citizens of Outstanding Achievement Monthly Awards

9.1 Current Nominations

The Office of the City Clerk provided an update relative to the current nominations.

It was consensus of committee to proceed as directed in Closed Session.

9.2 New Nominations

A discussion was held relative to the above noted.

It was consensus of Committee to proceed as directed in Closed Session.

The Open Session meeting reconvened.

10. Annual City of Thunder Bay Official Recognition Awards

At the December 13, 2023 meeting, a resolution was passed that Administration report back with updates to committee policies and Terms of Reference. The draft nomination application form and draft Report to Council were also included, for Committee review.

A discussion was held relative to planning the next Official Recognition Awards event with no Committee budget. Potential gifts for Spirit of Thunder Bay Award recipients were also discussed.

MOVED BY: Councillor Michael Zussino
SECONDED BY: Tiffany Gervasi

WITH RESPECT to the Official Recognition Committee's Terms of Reference and Policies update, we recommend approval of all documents presented at the February 29, 2024 meeting;

AND THAT the updated documents be presented at the March 18, 2024 Committee of the Whole meeting, for Council's consideration.

CARRIED

11. Next Meeting

As per the revisions to the Terms of Reference, the next meeting will be scheduled when required.

12. Adjournment

The meeting adjourned at 4:27 p.m.

Clean, Green and Beautiful Committee Meeting Minutes

Thursday, April 25, 2024, 10:02 a.m.
McNaughton Room - 3rd Floor, City Hall

1. Clean, Green and Beautiful Committee Meeting 03-2024

Chair: Stephen Margarit

2. Members

Councillor Rajni Agarwal, City Council
Biljana Baker, Local Artist
Matthew Hills, Thunder Bay Art Gallery
Kyle Jessiman, Medium Business Representative
Stephen Margarit, Large Business Representative
Andy Puiatti, Architectural
Andrei Rosario, Youth Representative
Morgan Staal, Small Business Representative
Kennedy Bucci, Eco Superior
Heidi Strobl, Heritage Advisory Committee

3. Officials

Cynthia Olsen, Director - Strategy & Engagement
Stacey Levanen, Supervisor - Corporate Communications & Community Engagement
Laurie Abthorpe, Cultural Development & Public Art Coordinator
Lori Wiitala, Council & Committee Clerk

4. Welcome and Disclosures of Interest

At 10:02 a.m. the Chair called the meeting to order, quorum was not achieved and started as an information session; at 10:06 a.m. quorum was achieved.

5. Agenda Approval

MOVED BY: Biljana Baker
SECONDED BY: Councillor Rajni Agarwal

WITH RESPECT to the April 25, 2024, meeting of the Clean, Green and Beautiful Committee, we recommend that the agenda as amended, including any additional information and new business, be confirmed.

CARRIED

6. Minutes of Previous Meeting

The Minutes of Meeting 02-2024 of the Clean, Green and Beautiful Committee, held on March 20, 2024, to be confirmed.

MOVED BY: Councillor Rajni Agarwal
SECONDED BY: Heidi Strobl

THAT the Minutes of Meeting 02-2024 Clean, Green and Beautiful Committee, held on March 20, 2024, be confirmed.

CARRIED

7. Emerging Projects

7.1 Emerging Projects - Fort William Business Improvement Area (FWBIA) Grant Update

Memorandum from the Fort William District Board of Directors providing an update relative to the Emerging Projects grants received, for information.

7.2 Current and Outstanding Projects

An update will be provided relative to the above noted.

Director - Strategy & Engagement Cynthia Olsen provided the following update relative to the above noted.

Budget ratified: allocation of $220,000 for Clean, Green & Beautiful, detailed outline will be provided at the next meeting.

<u>2023 Emerging Projects</u>

- Fort William Country Club: centennial garden – update still required
- Rainbow Collective: progress pride crosswalks - will not proceed, an alternate request for benches may be received.
- EcoSuperior: litter prevention around cigarette disposal - complete
- Walleye: beautification of 61 Court St. S. including rain garden, flower boxes and painting planters - complete
- EarthCare Advisory Committee: public event and travelling art display - complete
- Cultural Development, Community Programming and Events: art bus themed "Women's History in Thunder Bay" - complete
- Solid Waste & Recycling: community clean up trailer - update still required
- Fort William BIA: luminated arch at VictoriaVille moved to Paterson Park and street banners – ongoing

Discussion was held relative to a Remembrance Day Banner Project. The following members agreed to form a working group to gather additional information, and the following motion was passed:

MOVED BY: Councillor Rajni Agarwal
SECONDED BY: Biljana Baker

WITH RESPECT to the Remembrance Day Banner Project (2018), the following Clean, Green & Beautiful Committee Members will form a working group to gather additional information, and will bring a recommendation to the Committee:
Councillor Rajni Agarwal
Lauri Abthorpe
Stephen Margarit

CARRIED

Updates on the following projects were provided:

- WWI Legacy: $72,482 remains in this budget line, interpretive signs should be printed this summer for installation. This will require approximately $25-30K, leaving $42,000. Should the Committee wish to use remaining funds for WWI Remembrance Day commemorative banner project for 2024, funds from this project line could be allocated.

- Accessible Intersections: $10,000 is allocated; no projects were completed.. Administration can identify improvements for the Committee’s consideration for 2024.
- Tree Planting: $62,488 is allocated; work at Pool 6 waterfront trail and cruise ship site is ongoing.
- Image Route: $266,723 total including contingency
  - Northcore Streetscape – ongoing
  - Bay & Water Street: $120,000 - project did not happen, funds can be released
  - Decorative bench: $60,000 - project did not happen, funds can be released
  - Centennial Park: two projects are ongoing
  - Gateway: $50,000 – project is ongoing
- Public Art Committee: $15,000 annually, $45,000 accrued, approximately $13K used for art bus.
- Waterfront Trail – Image Route: $85,000 – project is ongoing
- Waterfront Trail - Outlook: $75,000 – project is ongoing
- Centennial Park – Image Route: $50,000 – project is ongoing
- Gone Too Soon Garden: $50,000 – project completed and funds can be released
- Spirit & Healing Garden: $10,000 – project is ongoing
- Awards & Promotion: $16,871 remains in this budget; rebrand project complete, with some ongoing components, annual Chamber Awards

7.3 Application Review

Cynthia Olsen, Director - Strategy & Engagement to provide an update relative to the above noted.

The revised application with the new logo will be posted to the CGB section of the City’s website. The deadline to receive applications is June 24, 2024; an advertisement will be done through social media.

The Committee lost quorum at 11:10 a.m. and the meeting continued as an information session.

8. Next Meeting

The Clean, Green & Beautiful Committee Meetings will be held the 4th Thursday of each month with the exception of July and August, in the McNaughton Room, at 10:00 a.m., unless otherwise noted, as follows:

- Thursday, May 23, 2024
- Thursday, June 27, 2024
- Thursday, September 26, 2024
- Thursday, October 24, 2024
- Thursday, November 28, 2024
- December – TBD

9. Adjournment

The meeting adjourned at 11:15 a.m.

Thunder Bay District Health Unit

Board of Health Meeting Minutes

MINUTES OF THE MEETING: MAY 15, 2024

TIME OF MEETING: 1:00 PM

PLACE OF MEETING: FIRST FLOOR BOARDROOM / VIDEOCONFERENCE

CHAIR: MR. DON SMITH

BOARD MEMBERS PRESENT:

Mr. Grant Arnold
Ms. Kasey Etreni
Ms. Lucy Belanger
Ms. Cindy Brand
Ms. Cynthia Olsen
Ms. Donna Peacock
Mr. Paul Malashewski
Mr. James McPherson
Mr. Jim Moffat
Mr. Don Smith
Mr. Todd Wheeler
Ms. Kristine Thompson

REGRETS:

Mr. Allan Mihalcin
Dr. Mark Thibert

ADMINISTRATION PRESENT:

Dr. Janet DeMille, Medical Officer of Health and Chief Executive Officer
Mr. Dan Hrychuk, Director – Corporate Services
Ms. Shannon Robinson, Director – Health Promotion
Ms. Dana Wilson, Associate Director – Communications & Strategic Initiatives
Mr. Phil Avella, Manager of Information Systems and Property
Ms. Rosemary Scofich, Manager of Healthy Babies Healthy Children
Ms. Tammy Lee Royer, Administrative Assistant – Health Protection

RECORDER:

Ms. Lila McNeice, Executive Assistant and Secretary to the Board of Health

1. CALL TO ORDER AND LAND ACKNOWLEDGEMENT

The Chair called the meeting to order at 1:01 PM.

2. ATTENDANCE AND ANNOUNCEMENTS

The Chair presented regrets from the above noted.

3. DECLARATIONS OF CONFLICT OF INTEREST

There were no declarations of conflict of interest.

4. AGENDA APPROVAL

The meeting agenda was presented for approval.

Resolution No. 50-2024

Moved By: T. Wheeler
Seconded By: P. Malashewski

"THAT the Agenda for the Regular Board of Health Meeting to be held on May 15, 2024, be approved."

CARRIED

5. INFORMATION SESSION

5.1 Measuring Chronic Disease Prevention Program Performance - A Locally Driven Collaborative Project (LDCP)

A presentation on the Measuring Chronic Disease Prevention Program Performance LDCP was provided to the Board by Ms. Shannon Robinson, Director of Health Promotion.

6. MINUTES OF THE PREVIOUS MEETINGS

6.1 Thunder Bay District Board of Health

The minutes of the Thunder Bay District Board of Health (Special and Regular Session) meetings held on April 17, 2024, were presented for approval.

Resolution No. 51-2024

Moved By: T. Wheeler
Seconded By: P. Malashewski

"THAT the Minutes of the Thunder Bay District Board of Health (Special and Regular Session) meetings held on April 17, 2024, to be approved."

CARRIED

7. MATTERS ARISING FROM THE MINUTES

There were no matters arising from the previous minutes.

8. BOARD OF HEALTH (CLOSED SESSION) MEETING

Resolution No. 52-2024

Moved By: T. Wheeler
Seconded By: P. Malashewski

"THAT the Board of Health move into closed session to discuss information related to negotiations carried on behalf of the Board (Municipal Act, S.O. 2001, c.25, S. 239 [1])."

CARRIED

At 1:19 PM, the Board moved into a closed session and the following individuals left the meeting:

- Phil Avella, Manager of Information Systems and Property
- Lila McNeice, Executive Assistant and Secretary to the Board of Health
- Rosemary Scofich, Manager of Healthy Babies Healthy Children
- Tammy Lee Royer, Administrative Assistant – Health Protection

At 1:27 PM, the Board moved out of closed session and the above noted individuals returned to the meeting.

8.1 Closed Session Report

During the closed session, the Board received information relative to negotiations carried on behalf of the Board.

9. DECISIONS OF THE BOARD

9.1 alPHa Annual General Meeting and Conference

A memorandum from Dr. J. DeMille (MOH/CEO) was presented, containing a resolution for approval of Board member volunteers to attend the 2024 alPHa Annual General Meeting and Conference in Toronto on June 5-7.

Resolution No. 53-2024

Moved By: P. Malashewski
Seconded By: T. Wheeler

"THAT the following members of the Board be authorized to attend the alPHa 2024 Annual Conference to be held in Toronto, Ontario, on June 5-7, 2024:

1. Don Smith (Tentative)
2. Grant Arnold (Tentative)

3. Kristine Thompson (Tentative)
4. ______________________________

AND THAT all expenses be paid in accordance to Policy No. BH-02-04 - Board Members' Reimbursement."

CARRIED

9.2 Policy and Procedure Reviews

A memorandum from Dr. J. DeMille (MOH/CEO) was presented relative to approval of Board of Health policy and procedure updates.

Resolution No. 54-2024

Moved By: C. Brand
Seconded By: J. McPherson

"THAT the following Board of Health Policies and Procedures be approved:

- BH-02-19 Communications Policy and Procedure **(Amendment as discussed: update to Section 2.8.2)**
- BH-02-13 Smoke and Vapour Free Workplace Policy and Procedure

AND THAT Administration be authorized to finalize and publish the approved policies and procedures."

CARRIED, AS AMENDED

9.3 Healthy Babies Healthy Children Budget

Report No. 20-2024 (HBHC) was presented, relative to approval of the program budget for April 1, 2024 to March 31, 2025 for the Healthy Babies Healthy Children program.

Resolution No. 55-2024

Moved By: J. McPherson
Seconded By: C. Brand

"THAT with respect to Report No. 20-2024 (Healthy Babies Healthy Children), we recommend that the Healthy Babies Healthy Children (HBHC) program budget for April 1, 2024 to March 31, 2025 be approved at $1,296,335 for submission to the Ministry of Children, Community and Social Services;

AND THAT the base program staffing be set at 12.75 full-time equivalents for the HBHC program;

AND THAT the Director of Corporate Services and Manager of Finance be authorized to complete any administrative requirements of the budget submission process, as required."

CARRIED

9.4 Contract Award for Server and Storage Technologies

Report 18-2024 (Information Systems and Property) was presented, relative to recommendations for approval of the contract award for Server and Storage technologies. Mr. Phil Avella, Manager of Information Systems and Property, responded to questions from the Board.

Resolution No. 56-2024

Moved By: J. McPherson
Seconded By: C. Brand

"THAT with respect to Report No. 18-2024 (Information Systems and Property), we recommend that the contract for Server and Storage Technologies be renewed with Dell Inc., effective June 1, 2024 to June 1, 2029, for $304,442 (taxes extra);

AND THAT the Director of Corporate Services and the Manager of Finance be authorized to complete any administrative requirements of the Server and Storage Technologies contract award as required."

CARRIED

9.5 Reserve Fund Expenditures

Report 21-2024 (Corporate Services) was presented by Mr. Dan Hrychuk, Director of Corporate Services, relative to recommendations to enhance operational efficiencies and staffing to address ongoing public health programming pressures and recovery work.

Resolution No. 57-2024

Moved By: C. Brand
Seconded By: J. McPherson

"THAT with respect to Report No. 21-2024 (Corporate Services), we recommend:

- Approval of the use of Capital Reserve funds for the completion of renovations to the Video Conference Room and Boardroom up to a total cost of $60,000 (taxes extra);
- AND approval of the use of the Program Contingency Reserve fund for vaccine programming up to a total cost of $200,000;
- AND THAT the Director of Corporate Services and Manager of Finance be authorized to complete any related administrative requirements for the Reserve Fund Expenditures."

CARRIED

10. COMMUNICATIONS FOR INFORMATION

10.1 First Quarter Interim Financial Statements

Mr. Dan Hrychuk (Director of Corporate Services) presented report 19-2024 (Finance) relative to providing the Board of Health with the interim financial report for the quarter ended March 31, 2024, for information, and responded to comments from the Board.

10.2 MOH/CEO Update on Strengthening Public Health

Dr. Janet DeMille (MOH/CEO) presented report 22-2024 containing an update on the province's Strengthening Public Health strategy, for information, and responded to comments from the Board.

11. NEXT MEETING

The next regularly scheduled meeting will be held on Wednesday, June 19, 2024 at 1:00 PM.

12. ADJOURNMENT

Resolution No. 58-2024

Moved By: J. McPherson
Seconded By: C. Brand

"THAT the Board of Health meeting held on May 15, 2024, be adjourned at 2:10 p.m."

CARRIED

Corporate Report

REPORT NUMBER	271-2024-Corporate Services-Licensing & Enforcement		
DATE PREPARED	July 5, 2024	***FILE***	
MEETING DATE	July 22, 2024		
SUBJECT	Report Back: Resident Parking Consultation		

RECOMMENDATION

WITH RESPECT to Report 271-2024-Corporate Services-Licensing & Enforcement, we recommend that a Downtown Core resident rate be established for the parkades at $52.28 +HST per month, a 25% discount from the listed rate, effective August 15, 2024;

AND THAT a Downtown Core resident rate be established for the Crooks and Courthouse Daily Lots at $46.47 +HST per month, a 25% discount from the listed rate, effective August 15, 2024;

AND THAT current Schedule D of the User Fee By-law 28-2007 be repealed and replaced with the amended Schedule D, as appended to this report;

AND THAT By-law 245-2024 be repealed;

AND THAT By-law 075-2024 be amended to include a Temporary Construction Exemption as outlined in this report;

AND THAT the Outstanding Item 2024-003-ADM-Corportate Services Report Back – Parking Authority Financial Plan – Resident Consultation be removed from the Outstanding list;

AND THAT any necessary by-laws be presented to City Council for ratification on August 12, 2024.

LINK TO STRATEGIC PLAN

This report aligns with the **Sustainability** pillar identified in “Maamawe, Growing Together: City of Thunder Bay Strategic Plan 2023-2027.” The Parking Financial Plan supports the goal to deliver cost-effective services to the community while improving long-term sustainability of Municipal Parking Services.

The recommendations in this report also align with the **Growth** pillar in the Strategic Plan, as it supports urban density by incentivizing affordable and equitable mixed-use neighbourhoods in the downtown cores.

The contents of this report also directly support the Asset Management Plan Phase Two: All Assets (Report 134-2024) by supporting the delivery of sustainable community services now and in the future. It also supports the Official Plan by incentivizing residential intensification in the downtown cores and by working towards parking facilities that are well integrated with the transportation system, adequate for the land uses they support, and developed to a standard that promotes accessibility, compatibility with adjacent land uses, and consistency with the Urban Design and Landscape Guidelines.

EXECUTIVE SUMMARY

Further to the resolution on June 17, 2024, requesting Administration to consult with residents on issues related to the newly implemented parking changes, focus groups were held with residents and businesses of the downtown cores. In response to feedback gathered, immediate action has been taken at the parkades to increase security measures and additional measures are being assessed.

To incentivize urban infill and support people choosing to live in the urban cores, a new discount for downtown residents at the parkades and at two daily rate surface lots is also proposed.

The community continues to voice concerns over safety and security in the parkades and at metered parking and surface lots; especially during hours of darkness. Several measures have already been initiated with more to follow. Initial emphasis will be on security and safety enhancements to the parkades, but measures will also be introduced over time for surface lots and metered street parking.

To support business through major City revitalization projects, an amendment is proposed to By-law 075-2024 Parking Regulation to delegate the authority to the City Manager or designate to create a Temporary Construction Exemption for parking fees during major municipal construction and renewal projects.

DISCUSSION

To address sustainability of the operations and to inform budget decisions, an external financial review of parking was conducted, including a review of historic and comparable city data, and revenue generating opportunities. This work was to ensure Municipal Parking Services (previously the Parking Authority) will be better positioned to cover its ongoing operating costs, plan for future capital requirements, and reduce the reliance on the tax base.

Through the process of the Financial Plan, Municipal Parking Services set out to:

1. Achieve financial viability;

2. Limit overall parking costs and remain affordable;
3. Enable the long-term plan for capital renewal to be realized; and
4. Work towards becoming a self-sustainable operation to limit the future requirement for internal loans.

Historically, Municipal Parking Services had generated enough revenue to cover operating expenses but not enough to address obligations related to parking infrastructure capital maintenance and upgrades, requiring the City to rely on internal loans.

The City of Thunder Bay has a robust plan for Asset Management and identifying long term infrastructure risks. The Parking Financial Plan, approved by City Council on January 22, 2024 (Report 309-2023), supports changes to shift the system to self-stainability, reducing the burden on the tax base, and planning for infrastructure renewal, aligning with the Asset Management Plan (Report 134-2024). These solutions included increases to fees to align with market rates, extended hours, closing underutilized lots, and implementing paid parking at the Marina, with an effective date of June 1, 2024.

In response to feedback from residents and businesses since, Marina 4-hour and all-day passes were created, and short term stay rates at parking meters were reintroduced as of June 25, 2024.

Continued consultation from businesses and residents have shown the need for increased safety and security measures in the downtown cores, specifically at the Victoriaville and Waterfront Parkades. As an immediate response to safety concerns at the Waterfront Parkade, Municipal Parking Services has turned off the energy saving motion-activation feature on the lighting, forcing them to remain at 100% illumination whenever lit. Security officer hours have also been increased at both parkades to noon to midnight on Sunday to Thursday, and noon until 2:00am on Friday and Saturday.

To promote urban densification per the City of Thunder Bay's Official Plan, it is important to incentivize the use of the parkades in the downtown cores. To further address concerns and make the parkades, surface lots and metered street parking desirable options for use, more upgrades to safety and security systems are currently being assessed, including:

- Adding cameras integrated with the Eye on the Street program;
- Adding more security presence and patrols in the parkades;
- Increased frequency of cleaning;
- Augmenting lighting to be even brighter;
- Increasing signage;
- Introducing artwork/murals for added colour and atmosphere;
- Increasing Enforcement Officer presence and patrols in the area of surface lots and metered street parking;
- Installation of "distress call buttons" in key locations.

While the increased fees and extended hours of paid parking are projected to cover some of the costs of these modifications, for the parking system to continue to be financially sustainable, Administration will bring forward a rate-based levy for parkade users during Budget 2025 to offset the cost of these modifications.

Administration will continue to work with residents who come forward to find an appropriate space to park, either in a parkade (available all year) or in a surface lot near their home, outside of winter control dates (November 15 to April 30, when winter parking restrictions are in effect).

Administration is recommending the introduction of a new discount for residents of the downtown core of 25% for access to the parkades, effective August 15, 2024, to incentivize use of the parkades by more residents, and increase the presence of people in the area, thereby increasing safety. The parkade rate is currently $69.70 +HST per month; the proposed discounted resident pass rate is $52.28 +HST per month in 2024, and subject to proportional user fee increases in the future.

Administration is also recommending the introduction of a new discount for residents of the downtown core of 25% for access to specific daily use surface lots:

- the Crooks lot, located off Red River Road; and
- the Courthouse lot, located off Archibald Street.

The surface lot rate is currently $61.95 +HST per month; the proposed discounted resident pass rate is $46.47 +HST per month in 2024, and subject to proportional user fee increases in the future.

In the City of Thunder Bay Official Plan, lands designated as Strategic Core consist of the City’s two traditional downtowns, and adjacent areas that are considered appropriate for some core area functions. These areas are intended to provide a full range of amenities accessible to residents and visitors, including vibrant streetscapes, shopping, business, entertainment, housing, transportation connections, and educational, health, social, and cultural services. These areas are viewed as significant assets, important to the City as a whole, and shall function as identifiable, walkable, mixed-use districts of symbolic and physical interest. These are the areas the City focusses on for development and infill.

Within the Strategic Cores, Administration has identified the highest need for parking in the Main Street Zone in the downtown north core (in proximity to Red River Road) and the Downtown Zone in the south downtown core (in proximity to the Victoriaville Parkade) in Zoning By-law 1-2022. The purpose of the Main Street Zone is to create a continuous and vibrant commercial street. Active uses such as shopping and restaurants will be permitted on all storeys, while housing is restricted to upper floors only. The purpose of the Downtown Neighbourhood Zone is to permit a wide range of uses to support the Main Street Zone. Residential parking requirements in this area are low, with buildings containing more than 10 homes requiring 0.2 per home.

Resident Pass eligibility will be extended to people living in the Main Street Zone in the north downtown core (in proximity to Red River Road) and the Downtown Zone in the south downtown core (in proximity to the Victoriaville Parkade), outlined in the attached maps. This will support the continued development of housing, urban infill, and use of the amenities in these areas.

In response to the concerns from the businesses in the Waterfront District regarding the impact of the current construction, and to further support the revitalization of the downtown cores, Administration is proposing an amendment to By-law 075-2024 Parking Regulation in Thunder Bay, with the addition of Temporary Construction Exemptions:

> 4.14 Temporary Construction Exemption: The City Manager, or assigned delegate, may designate any area where paid parking is required as a Temporary Construction Exemption Zone while major municipal construction or renewal projects are in progress, for a period not to exceed the required construction/maintenance period. While an area is designated as a Temporary Construction Zone, vehicles may park in designated metered parking spaces, without payment, for a maximum of 2 hours. No persons shall park or permit the parking of any vehicle for a continuous period that exceeds 2 hours in a single space, where temporary signage, including designated meter covers, are on display. Any such approved Temporary Construction Exemption Zones shall, during the approved period, be displayed and described on the City's website and identified at street-level through signage and/or marked meter-head covers.

City Council retains the authority over parking related decisions not currently delegated via by-law. The above amendment would delegate, to the City Manager, the ability to designate a Temporary Construction Zone where no payment would be required for parking. This exemption would be used for large municipal construction projects to relieve pressure on businesses, for example, during the current downtown North core construction.

Municipal Parking Services is currently delegated authority for parking signage, which would help facilitate a decision made by the City Manager to designate a Temporary Construction Exemption Zone per the proposed provision.

CONSULTATION

In 2023, during the development of the Financial Plan, stakeholder consultation was conducted with current and past Parking Authority Board members, Administration, and members of the City’s business community, particularly in the Waterfront area. The Financial Plan was then brought forward to Committee of the Whole as a First Report on December 11, 2023, and posted on the City’s Get Involved site for public comment. This input was shared at the Committee of the Whole and the Financial Plan was approved on January 22, 2024.

In June and July 2024, Administration conducted two focus groups as a follow up from the memorandum from Jonathan Paske, Supervisor – Municipal Parking Services, dated June 10, 2024, presented at the June 17, 2024 Committee of the Whole that reintroduced short term stay rates at parking meters, and in response to the resolution approved on June 17, 2024 contained in a memorandum from Councillor Kasey Etreni dated June 5, 2024, that Administration review the concerns relating to residential parking in the downtown cores.

The first focus group/discussion was held on June 25, 2024, at a business in the Waterfront District to discuss the impact on area businesses. The Waterfront BIA assisted with a contact list for this discussion. 12 people attended on behalf of nine businesses. BIA members were also told they could submit further feedback through email to Administration. One business submitted an email. In total, Administration received feedback from 10 businesses.

The main themes in the business discussion included:

- Concerns surrounding timing of the implementation of parking changes with the construction on Red River Road, as that was already having an impact on businesses;

- Concerns with the impact of extended paid hours:
    - acting as a significant deterrent to people going downtown;
    - impacting staff who park on-street, having to pay an extra $6 per day;
    - possibility of more drinking and driving if patrons will receive tickets early in the morning;
    - competing businesses have access to free parking based on their location during extended hours;

- Generally supportive of the rate increases and the parkade rates, considering them fair;

- Safety concerns and maintenance issues at the parkades. Businesses were generally supportive of promoting the use of the parkades if safety concerns were addressed.

- Businesses were against any type of exemption (i.e. resident pass) for parking at meters.

The second focus group/drop-in session was held on July 3, 2024, at a Waterfront District hotel to discuss the impact on residents who live in the downtown cores. This session was advertised with a media release and on social media to increase the engagement of the community. 30 people attended the resident drop in; people in attendance included residents from all over the City of Thunder Bay and business owners. Nine people identified as living in a downtown core. Residents who were unable to attend were also told they could submit further feedback through email to Administration. Seven emails were received. Combining drop-in feedback and email submissions, Administration received 11 responses from residents of the downtown cores, and 26 responses from residents living elsewhere in the City of Thunder Bay.

Of the residents who did not live in one of the downtown cores, 16 people commented on parking at the marina, including concerns about decreased foot traffic, impacts to the businesses, and the removal of the secondary boater parking pass. It should be noted that the decision to eliminate the secondary boater pass was initiated by the Marina Advisory Committee (MAC) in November 2023, and was in no way related to the Parking Financial Plan. Boaters at the Marina still receive one Pier Pass to park on the pier near their slip. Marina parking passes were implemented in May 2024 to support frequent Marina users and assist boaters with these concerns. As of July 10, 2024, 156 of these passes have been sold.

Some of the attendees were staff of the businesses in the downtown core, stating that the higher on-street parking fees are difficult to manage on minimum wage salaries. The parkade is not currently seen as a viable alternative option as they feel the area is not safe in the evenings. One business owner mentioned enforcement of parking infractions seems to be focused on certain areas, and that more even enforcement is necessary. Other business owners echoed the messaging from the business focus group discussion.

Of the 11 residents of the downtown cores, the themes of the feedback included:

- Concerns about the safety of the parkades and walking in late evening/overnight hours in the downtown areas;

- Requests to have a resident pass or to pay to park in surface lots in the area to alleviate the impact of extended hours as it has increased costs;

- Two residents provided feedback in support of the parking changes, stating that the downtown cores should be more pedestrian and bike friendly, should disincentivize vehicles, and have less parking available.

Downtown core residents in attendance at the focus group were given an informal questionnaire to gather supplemental information to support the discussions. Five of the residents reported not having a parking space with their housing unit. Four of these residents do not use the parkade, either because it is too far from their home or because of the perception of safety concerns. The other resident does not own a vehicle and has no need for a parking space. The remaining residents that filled out the questionnaire have a parking space included with their home. For winter control months, when on-street parking is not permitted overnight, those who currently rely on meter parking for overnights report either renting a private parking space or continuing to park on-street illegally.

FINANCIAL IMPLICATION

Given the small number of residents who have self-identified as needing a parking solution, Administration cannot estimate the financial impact of a discounted resident pass, although it is anticipated to be minimal. This change, along with the continued implementation of actions identified in the Financial Plan, will support the Municipal Parking Services to achieve full cost recovery and remove the need for future contributions from the City.

Administration will continue to monitor and report back through Quarterly Variance Reports as well as within the comprehensive Financial Plan review and report back planned for June 2026.

Following Council's direction regarding the recommendations in this Report, the Parking Financial Plan will be finalized and published to the City's website.

CONCLUSION

It is concluded that Administration has completed extensive consultation with residents and businesses and will continue to work with residents who come forward to address concerns.

It is further concluded that a resident pass at a 25% discount should be adopted for the parkades and at the Crooks and Archibald daily rate surface lots to promote urban infill by making parking easier for residents in the downtown cores.

It is further concluded that a Temporary Construction Exemption should be added to By-law 075-2024 Parking Regulation to support businesses during major municipal construction and renewal projects.

BACKGROUND

At the October 18, 2021, Committee of the Whole meeting, a memorandum from Councillor Ruberto was received pertaining to the divestment of parking structures and report R 140/2021 - Parking Structures Information Requested and Recommendations was presented. Resolutions to divest the parking structures did not carry and Council decided to continue to operate the structures, recognizing the public benefit of municipal ownership of the parkades.

On June 26, 2023, Committee of the Whole received Report R 196-2023 Report Back – 2024 Budget Amendments which identified the Parking Review and Financial Plan as an additional opportunity under review for potential savings. This departmental initiative was undertaken in March 2023 after additional support from the Stabilization Reserve Fund was required in 2022 due to support increasing expenses that declining parking revenues could not sustainably maintain.

On December 11, 2023, Report 309-2023 Parking Authority Financial Plan was presented to Committee of the Whole as a first report. Subsequently, it was posted on the City's Get Involved platform for public comment.

On January 22, 2024, Report 309-2023 Parking Authority Financial Plan was brought forward and approved.

To implement the Parking Financial Plan, new user fees for the increases to parking rates and additional parking at Marina Park were brought forward with the 2024 Budget.

On March 25, 2024, Report 71-2024 Parking By-law & Governance was presented to the Committee of the Whole, dissolving the Parking Authority Board, and consolidating By-laws to align with the Financial Plan.

On May 13, 2024, to support people who use the Marina more frequently, a 4-hour and an All-Day Marina Parking Pass were approved in By-law 141-2024. These changes came into effect on June 1, 2024. In response to feedback from residents and businesses since, short term stay rates at parking meters were reintroduced as of June 25, 2024, in By-law 245-2024.

REFERENCE MATERIAL ATTACHED

Attachment 1 – Maps for Resident Discount Eligibility
Attachment 2 – Draft Amended User Fee By-law Schedule D

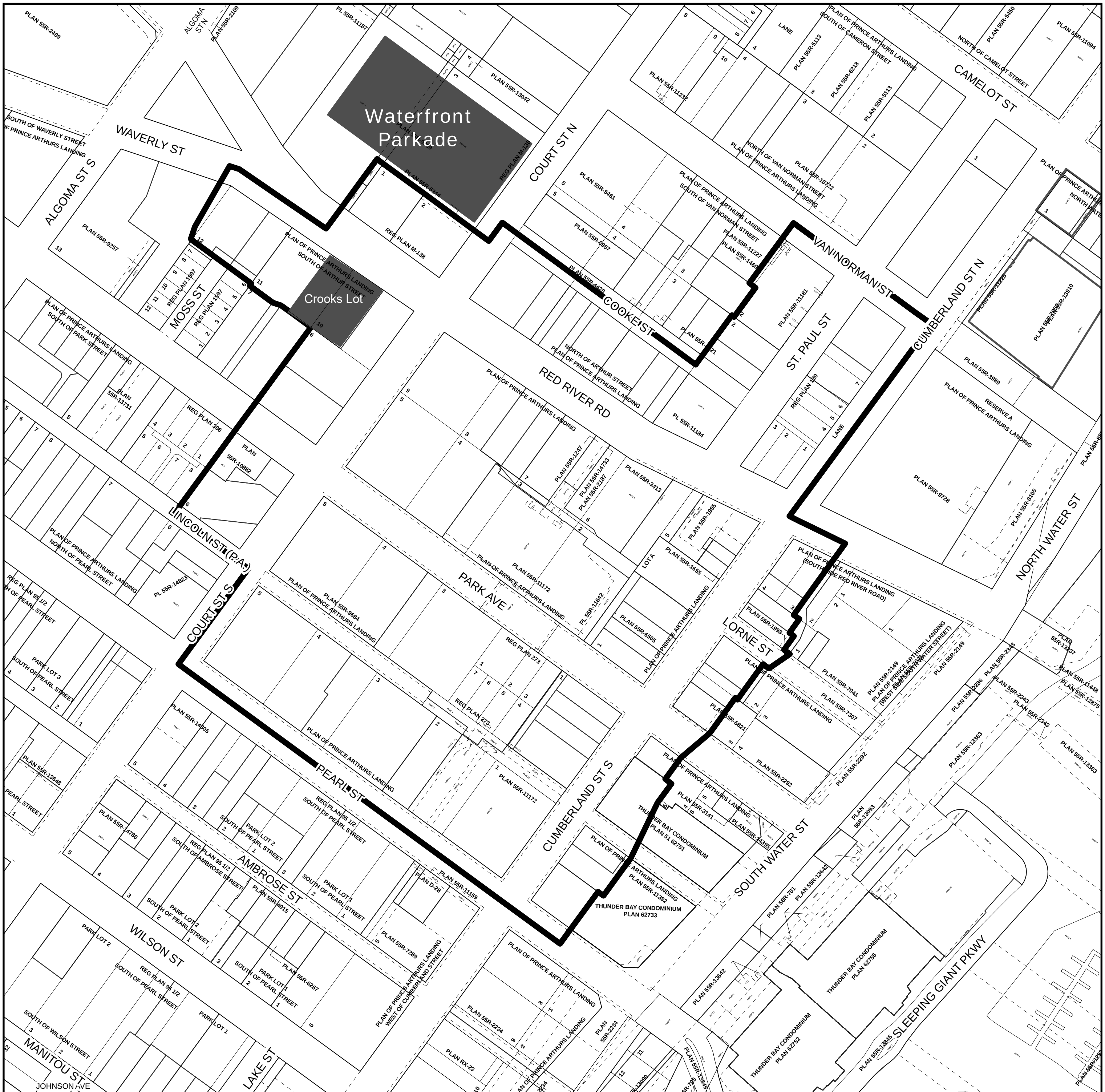
REPORT PREPARED BY

Kristyn Lovato-Day, Policy & Research Analyst – Corporate Services
Jonathan Paske, Supervisor - Municipal Parking Services - Corporate Services
Andrea Morrison, Deputy City Treasurer

REPORT SIGNED AND VERIFIED BY

Karen Lewis, General Manager – Corporate Services

July 15, 2024



Property Location

North Parking

0 80 160

SCALE IN METRES

THIS IS EXHIBIT ONE TO BY-LAW NUMBER ___________

MAYOR ________________

CITY CLERK ________________

Property Location

South Parking

0 130 260
SCALE IN METRES

THIS IS EXHIBIT ONE TO BY-LAW NUMBER ___________

MAYOR _______________

CITY CLERK _______________

SCHEDULE D - CORPORATE SERVICES					
Division	**User Fee Description**	**2023 Approved User Fee ($)**	**2024 Proposed User Fee ($)**	**Change ($)**	**Change (%)**
Municipal Parking Services	Parking Meter Spaces	0.25/10 minutes	0.50/15 minutes	0.008/minute	33.33%
		1.50/60 minutes	2.00/60 minutes	0.008/minute	33.33%
	Marina Parking Spaces (excluding Market Square) - Rate in effect Monday to Saturday from 7am until 9 pm (free on Sunday)	-	2.00/60 minutes	2.00/60 minutes	100.00%
	Marina Market Square Parking Spaces - Rate in effect Monday to Saturday from 7am until 9 pm (free on Sunday)	-	3.00/60 minutes	3.00/60 minutes	100.00%
	Marina Market Square Lot - Overnight Rate (Monday through Sunday)	-	17.70	17.70	100.00%
	Marina Summer Pass – June 1 to September 30, up to 4 hours per day	-	70.80	70.80	100.00%
	Marina Off-Season Pass – October 1 to May 31, up to 4 hours per day	-	70.80	70.80	100.00%
	Marina Annual Pass – June 1 to May 31, up to 4 hours per day	-	115.04	115.04	100.00%
	Session Parking – Marina Spaces (excluding Market Square) – select one option	-	1 hour - $2.00 3 hours - $3.00 6 hours - $4.00	1 hour - $2.00 3 hours - $3.00 6 hours - $4.00	100.00%
	Session Parking – Marina Market Square Spaces – select one option	-	1 hour - $3.00 3 hours - $5.00 6 hours - $6.00	1 hour - $3.00 3 hours - $5.00 6 hours - $6.00	100.00%
	Parkade Charge - flat rate due at exit (per 24 hrs)	-	4.43	4.43	100.00%
	Parkade Monthly Rate - exclusive of HST	59.74	69.70	9.96	16.67%
	Surface Lot Monthly Rate - exclusive of HST	48.68	61.95	13.27	27.26%
	Parkade Monthly Rate – Resident exclusive of HST Residents eligible if they live in the Main Street Zone in North Core (in proximity to Red River Road) or the Downtown Zone in the South Core (in proximity to Victoriaville Parkade) per Zoning By-law 01-2022		**52.28**	**52.28**	**100.00%**

Surface Lot Monthly Rate – Resident for Crooks or Courthouse lots exclusive of HST Residents eligible if they live in the Main Street Zone in North Core (in proximity to Red River Road) or the Downtown Zone in the South Core (in proximity to Victoriaville Parkade) per Zoning By-law 01-2022		**46.47**	**46.47**	**100.00%**
Residential Parking Permit	5.00/permit	5.00/permit	-	0.00%
Mobile Parking App Convenience Fee	0.15	0.15	-	0.00%
Online Ticket Payment Convenience Fee	3.50	3.50	-	0.00%

CITY OF Thunder Bay
Superior by Nature

Memorandum

Office of the City Clerk
Fax: 623-5468
Telephone: 625-2230

TO: Mayor & Council

FROM: Krista Power, City Clerk

DATE: Tuesday, July 9, 2024

SUBJECT: Outstanding List for Administrative Services Session as of July 9, 2024
Committee of the Whole – July 22, 2024

The following items are on the outstanding list for Administrative Services:

Reference Number (yyyy-nnn-MTG)	Department/Div	Outstanding Item Subject	Resolution Report Back Date - (on or before date)	Revised Report Back Date - (on or before date) (Memos presented at COW updating or delaying Item)
2009-028-ADM	Corporate Services & Long Term Care / Financial Services	Landfill Gas Generation Project	Apr-01-2012	Dec-22-2025
2023-003-ADM	City Manager's Office	TBPL Master Facilities Plan	Jun-24-2024	Jul-22-2024

2023-006-ADM	Corporate Services - Superior North EMS	Work Plan Annual Update – Superior North EMS 2021-2023 Master Plan	Mar-30-2025	
2023-007-ADM	City Manager's Office	Referral - Advocacy to the Province of Ontario to Adopt the Proximity Principle	TBD	
2021-114-DEV	Development & Emergency Services/Licensing & Enforcement	Fence Related Bylaws	Mar-28-2022	Apr-28-2025
2023-007-DEV	Development & Emergency Services/Licensing & Enforcement	Comprehensive Review of the Sign By-law	Q4 - 2024	
2024-003-ADM	Corporate Services	Parking Authority Financial Plan - Financial Performance Update	Jun-22-2026	Jul-22-2024
2021-115-DEV	Development & Emergency Services/Licensing & Enforcement	Boulevard Policy/Obstruction Bylaw	Jun-27-2022	Sep-23-2024
2024-004-ADM	Corporate Services	Request for Review - Municipal Accommodation Tax	Sep-23-2024	