



MEMORANDUM

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DATE: September 28, 2021

SUBJECT: REFUSE TRUCK LIFE CYCLE & FUNDING ANALYSIS

INTRODUCTION

Neilson Strategies Inc. and ERPIE Advisory Inc. were asked to develop a business case for the replacement of three aging diesel refuse trucks owned by the sanitation department, along with funding analysis for inclusion in the fleet funding model. Additionally, they were tasked with reviewing the existing life cycle of the fleet owned refuse trucks to ensure viability of replacement funding at their end of life. This *Memorandum* presents the consultants' assessment and recommendations.

The *Memorandum* begins with a description of the approach taken by the consultants to complete the work and the route optimization completed by City staff in early 2021. The text then outlines the replacement analysis, the life cycle analysis and high-level user fee impacts. The *Memorandum* ends with a summary of the consultants' recommendations and a note on implementation.

BACKGROUND

The City of Nanaimo completed implementation of an automated residential solid waste collection service in 2018, which resulted in considerable service efficiencies and benefits. In 2020, Neilson Strategies Inc. was asked to conduct a post-implementation review to address challenges experienced in the first two years of the renewed program. The City has implemented many of the recommendations from the *Collection Service Post-Implementation Review*, including various aspects of route optimization, cart management, driver training, data collection and resident education. The City is now interested in addressing the fleet life cycle, a point included in the final set of recommendations titled "Recommendations Beyond 2021".

The review conducted relates to the amortization period of refuse trucks using a data-based analysis of standard useful lives across the industry and how the City's particular context might impact the application of that average useful life. This analysis will determine recommendations for

amortization, replacement timing, asset management and funding. The City's *Green Fleet Strategy*, reserve funding status and present accounting treatment and debt funding of refuse trucks will all be considered in this analysis. There is some urgency in the business case as there are three fully amortized diesel fueled refuse trucks that require review for potential replacement.

CONSULTANTS' APPROACH

The consultants began their work on this project at the end of May. As the first stage of the review, an evaluation of all relevant information on the current fleet was conducted including: the purchase history, funding model, capitalization policy, *Green Fleet Strategy*, maintenance costs and other financial information. Key staff were also interviewed, including the Fleet Operations Manager, Manager of Sanitation, Maintenance Supervisor, and the Director of Finance. In addition to interview time and notes, City staff also provided extensive data regarding repair and maintenance costs. This data enabled analysis to determine key issues and options for solutions.

In addition, the consultants connected with solid waste operational comparators and compiled data from other municipal governments, a large private sector operator, and data from a large research lab maintained at the University of Toronto. As a final note, the consultants spoke with Fortis BC about Fortis' perspective on funding, the fuelling market and rebates, as well as their outlook on compressed natural gas (CNG) fleet.

IMPLEMENTATION OF OPTIMIZATION PROGRAM

As recommended in Neilson Strategies' *Collection Service Post Implementation Review*, City staff undertook a routing analysis in late 2020 and implemented a revised routing system mid-January 2021. The collection schedule now leaves one vehicle available as operational and maintenance spares four days per week, with two available on the fifth day – this will increase in July when the newest truck arrives. There is also a smaller spare diesel truck, Unit 301, that is used to complete missed collections and other small pickups but cannot be used as a full spare due to size.

Significant improvements are noted as follows:

- *Service Failures* — 91% reduction in service failures, from an average of 22 monthly in 2020 to two per month in 2021
- *Labour Cost (per collected tonne)* — 10% drop at August 31, 2021, from 2020
- *Significant Repairs* — adding a spare arm to inventory to reduce repair related downtime
- *Overtime at August 31, 2021*
 - 41% reduction of OT expense for Collection staff compared to the 2017-2020 average expense
 - overtime for Fleet Staff also reduced based on enhanced truck availability

In addition to the 2021 improvements from optimization, safety trends resulting from automation have continued to improve, with approximately 80% fewer incidents and lost days in the first half of 2021, down from 21 incidents and 262 lost days in 2018. These improvements reduce spending on Insurance Corporation of British Columbia claims, vehicle repairs, staff coverage and WorkSafe

BC premiums. As well, based on a review of maintenance availability for the first half of 2021, time available for refuse trucks has been increased from 17 to 35 hours weekly. This improvement can be attributed to the route optimization, as well as the implementation of an earlier maintenance shift.

The route optimization initiative and the associated improvements were achieved using data collected by the Sanitation Division since 2018. Based on these data, and with some further fine-tuning of the optimization schedule, staff are confident that the current level of curbside service can be maintained without additional resources for the next three years. It should be noted, this expectation takes into account the increase in the weight and volume of curbside materials that has occurred in recent years as a result of working and consumption patterns related to COVID-19.¹

DIESEL REFUSE TRUCK REPLACEMENT

Refuse truck costs are tracked carefully by the City and were made available by finance and operations to the consultants for analysis. All repair and maintenance costs, overtime for collection staff, warranty schedules and maintenance data were provided. In addition, significant qualitative information was provided by staff to assist in understanding the history and status of the refuse trucks.

A summary of the CNG and diesel refuse trucks and their fleet status are as follows:

- *Acquisition* — Both truck types are built for automated curbside collection, and both were purchased at the outset of the transition from manual to automated collection.
 - The CNG trucks were purchased brand new through an extensive and careful RFP process.
 - The diesel-fuelled trucks were purchased as used vehicles within a short timeframe to ensure capacity as spares when rolling out the automated collection program.
- *Fleet Program* — The CNG trucks went through the formal budget and procurement process and were incorporated into the City's fleet program, which involves careful cost tracking by finance and incorporation of two specific costs (discussed below). The diesel trucks were not incorporated into the fleet program, and as such have not had these charges applied – they are 'owned' by the sanitation department. During interviews it was suggested that the trucks were not intended to be a long-term solution, as all three were effectively at end of life at the time of purchase and were thus excluded from the fleet program.

¹ COVID-related changes were noted in the *Collection Service Post-Implementation Review*.

- *Fleet Program Finances:* There are two costs incorporated into vehicle funding that assist the City in maintaining financial health, neither of which have been applied to the diesel trucks.
 - Replacement costs are estimated when a vehicle is purchased, and an annual charge is applied to fund a reserve for that eventual replacement. The annual charge is based on the anticipated useful life of the vehicle.
 - Overhead charges to recover the cost of operating the fleet maintenance program.
- *Kilometres Driven* — The diesel trucks have been driven far less than their CNG counterparts. This is due to their ‘backup’ status as fully amortized less reliable vehicles, and increases the cost per kilometre (KM) driven and well as the fleet flexibility.

The operating cost per KM is very different for the City’s CNG and diesel trucks both in absolute spending per year, and in relative cost per KM driven. Figure 1 shows an absolute difference of \$32,195 per year, which can be explained by the greater need for maintenance on and repairs to the diesel vehicles. Figure 1 also shows that diesel trucks on a relative per KM basis cost more than 250% of the CNG trucks. This difference can be explained by both the volume and cost of repairs as a result of age, but also to the KM driven. The diesel trucks, based on their poor reliability, are not used as a first choice for collection service — indeed, they are often not available for service because they are with the fleet maintenance team awaiting repairs. As a result, CNG trucks are driven an average of 155% more KM annually than the diesels.

Figure 1
Average Annual Operating Cost (per truck)
2017-2020

| Vehicle Type | Cost / Truck* | Cost / KM |
|--------------------------------------|------------------|----------------|
| Diesel Truck | \$ 82,187 | \$ 7.02 |
| CNG Truck | \$ 49,992 | \$ 2.78 |
| Difference (Diesel – CNG) | \$ 32,195 | \$ 4.24 |

* Active use years per truck used to calculate averages.
 Fleet charges not included.

Additional to the difference in operating cost in Figure 1 is the downtime impact, which is identified as the program cost of trucks being off the road for servicing. As the City’s current asset management program does not track the ‘downtime’ total *per se*, the consultants have created a proxy calculation that includes:

- overtime hours that are worked to compensate for vehicle shortages that occur when trucks are not out on the road, and staff are required to complete all routes with fewer vehicles
- extra "wear and tear" on vehicles that are required to be on the road for extended periods to service routes that cannot be serviced by vehicles under repair

Using data from 2017 to 2020, downtime cost has been calculated at an average of \$110,000 annually, with approximately 76% or \$84,000 of that cost attributable to overtime and the balance to "wear and tear".

Recommendations: Diesel Trucks Replaced

The recommendations for the three diesel trucks owned by the sanitation department are as follows:

- *Unit 301* — The City should consider retaining this smaller refuse truck. The vehicle is fitted with an arm for park and smaller missed pickup. As well, although the vehicle rarely goes out it provides a valuable service. A decision to retain this limited-use truck can be re-evaluated in 2023.
- *Units 317 and 318* — The City should consider replacing both full-size trucks with new CNG vehicles. This decision would reduce downtime cost as well as operating costs per KM. It would also result in the inclusion of the trucks in the City's fleet program so that proper replacement funding and overhead charges could be applied insuring appropriate contributions to financial stability are made. Additionally, the emissions reduction (approximately 30% by transitioning from diesel to CNG) to be recognized by this replacement would be beneficial as the City implements its *Green Fleet Strategy* to move toward established climate goals.

CNG REFUSE TRUCK USEFUL LIFE

As discussed in the *Collection Service Post-Implementation Review*, capital plans for solid waste systems are based on several assumptions including the useful life period over which collection vehicles are amortized. One of the recommendations from that report was to review the ten-year useful life period currently in use by the City to ensure it aligned with best practice. As stated in the report, refuse trucks can be made to last the full ten years, or longer, which was confirmed by the research conducted. The key is to understand how the City's operations, resources and model impact the costs of ownership.

The consultants spoke with two municipalities — the Cities of Abbotsford and Kamloops — that have geographic footprints and automated collection systems similar to those of Nanaimo. They also spoke with two non-municipal organizations: a large waste collection company in the Lower Mainland, and an office in charge of a large comparative-fuels database at the University of Toronto. A summary of key information is presented in Figure 2.

Figure 2
Comparison Data on CNG Vehicles

| Organization | Truck Fuel | Useful Life | Significant Issues | Average Annual KM |
|---|--------------------------------------|-------------|-----------------------|-------------------|
| City of Nanaimo | CNG | 10 | Arms | 17,000 |
| City of Abbotsford | Renewable Diesel | 7 | TBD | 25,000 |
| City of Kamloops | Diesel, one with electric truck body | 8 | Packer, Arms | 42,000 |
| Large Waste Collection Company (Lower Mainland) | CNG | 10 - 15 | Engine Rebuilds | 100,000 |
| University of Toronto Data Lab | CNG dataset (large fleets) | 10 - 12 | Arms, Engine Rebuilds | 110,000 |

The data from the University of Toronto were compared to actual City costs to provide a sense of the useful life expectations based on the City's particular information. The University's data are presented in Figure 3.

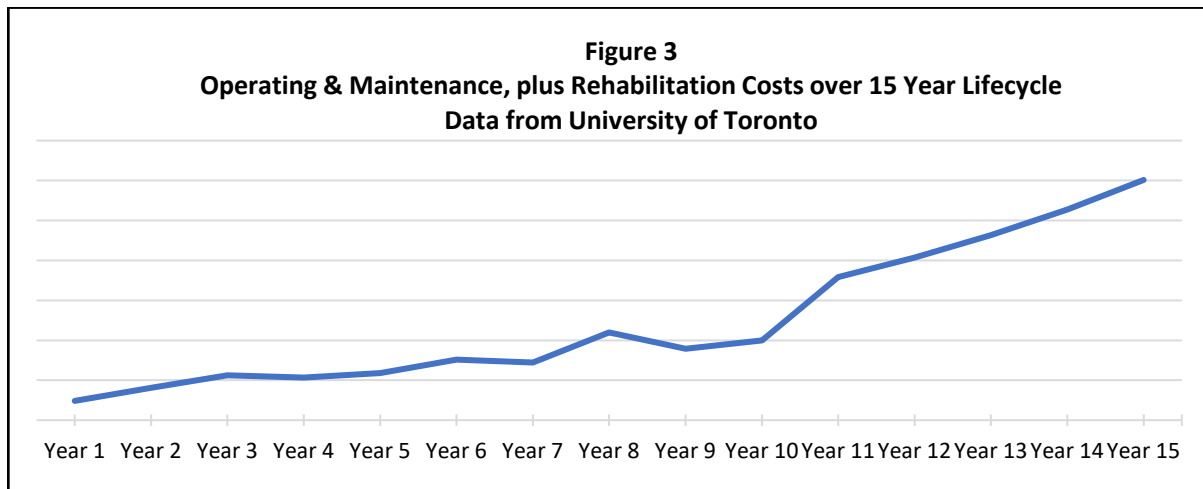


Figure 3 illustrates that maintenance costs can be expected to increase steadily as vehicles age. Figure 3 also suggests that a seven-year useful life period may be slightly short — eight years may be better, depending on the need for engine rebuilding.

When establishing an ideal useful life period for the City of Nanaimo's CNG vehicles, several factors must be considered:

- *Kilometres Driven* — The number of KM driven by refuse trucks is attributable to a variety of factors including length of workday, distance to and from fuelling and transfer stations, and the geographic spread of service areas. Notably, higher annual KM is often a sign of lower wear & tear per KM as more driving is highway based, and involves far fewer lifts or active collection work per KM.
- *Engine Rebuilds* — Significant overhaul work is a key determining factor in useful life evaluations as the capacity to complete the work in-house drives the cost of this work. For organizations with smaller fleets and less capacity to complete the work and absorb the associated downtime, the increased frequency of major maintenance and repair works as trucks age reduces the number of years it is practical to keep them in service.
- *Operations & Maintenance Schedules* — The degree of overlap between working hours of collection and maintenance teams reduces the ability to service vehicles when they are not required for service delivery. The degree of overlap directly increases the downtime costs of regular preventative maintenance and repairs.
- *Active Collection Hours* — The number of collection hours each day impacts the efficiency of truck ownership. Many municipalities are constrained in their ability to have more than six hours of active collection time on account of collective agreements and work conditions. Private companies in non-unionized environments are able to run their fleet for much longer periods each day, which helps to reduce the cost per household of collection activities.

Figure 4 considers these factors together to help identify a preferred useful life for the City of Nanaimo.

Figure 4
Consideration of Useful Life for
City of Nanaimo CNG Vehicles

| Factors to Consider | Useful Life Options (years) | | | |
|---|--------------------------------|---|---|---|
| | 10 | 9 | 8 | 7 |
| Kilometres Driven Annually | ✓ | | | |
| Engine Rebuilds (contracted out) | | | | ✓ |
| Operations & Maintenance Schedule Overlap | | | ✓ | |
| Active Collection Hours | | | ✓ | |

Recommendation: CNG Truck Eight Year Useful Life

Based on the assessment in Figure 4 — an assessment that recognizes the need for the City to contract-out the rebuilding of its vehicles' engines — it is recommended that the City consider reducing the useful life of its CNG vehicles from ten years to eight years.

This recommendation represents a departure from the 2016 business case prepared by the Sanitation Division. That business case identified the ten-year useful life period that the City has been following to date. The new recommendation benefits from data that have been collected since the inception of the automated system.

It should also be noted that the original business case estimated a total annual operating cost of \$91,000 per CNG truck, which adjusted for inflation is approximately \$105,000. The 2020 annual average cost is \$128,000, for a difference of \$23,000. The current figure reflects:

- capacity constraints for completion of repairs and maintenance in-house
- overlap of sanitation and maintenance department schedules
- 12% higher than planned KM driven, almost double the tips anticipated and a 20% increase in waste collected since 2020
- need for higher-than-anticipated frequency of arm rebuilds (the City now plans arm rebuilds every three years, not every five)
- higher-than-expected parts costs

USER FEE IMPACTS & COMPARISON**Diesel Trucks Replaced**

To provide a thorough analysis for the cost of replacing diesel trucks 317 and 318 with CNG and bringing them into the fleet program, two items have been calculated. The first is the budget impact to the user fees, and second is an estimate of cost per household considering actual truck costs averaged between 2017 and 2020.

The budgeted fee impact calculated by the City's Finance Department is \$11.00 annually. This fee impact contains internal assumptions regarding capital funding, fleet and user rate setting practice, as well as budgeted operating costs.

For further analysis, the consultants have provided a comparison in Figure 5 that shows the net new cost to households based on actual costs incurred for diesels and CNG trucks, averaged over 2017-2020.

Figure 5
Actual Costs Offset: Replace Two Diesel Vehicles

| Cost Components | Costs (two vehicles) |
|--|-------------------------|
| Avoided Costs | |
| Annual Operating Cost Differential (Diesel minus CNG) | \$ 64,000 |
| Portion of Downtime* | \$ 5,000 |
| Annual Costs Avoided | \$ 69,000 |
| New Fleet Costs | |
| Reserve Transfers** | \$ 138,000 |
| Overhead Charges | \$ 34,000 |
| Annual New Fleet Costs | \$ 172,000 |
| Net Annual Cost (avoided costs minus new costs) | \$ 103,000 |
| Cost (per household) | \$ 3.50 |

* Downtime from 2017-2020 averaged \$110,000 per year, this assumes \$33,000

** Assume useful vehicle life (10 years), funding and fleet charges associated with newest CNG truck in City's current fleet + 30% for discount/borrowing

Figure 5 shows a markedly lower number than the internal City finance calculation of \$11.00. There are two reasons for the difference:

- there is an approximately \$6.00 per household cost to finance the trucks, as they have not been part of the fleet program to date and therefore have no reserve funding to draw from for the purchase and outfit
- there are differences in budget versus actual operating costs used for this calculation

Figure 6 reconciles the differences.

Figure 6
Reconciling City User Fee Calculation

| Cost Components | Fee Impact |
|---|------------|
| City Calculated Fee Impact | \$11.00 |
| Cost of Financing | \$6.00 |
| Budget to Historical Actual Cost Fleet charges vs actual costs | \$1.50 |
| Consultant Cost Calculation | \$3.50 |

CNG Truck 8 Year Useful Life

As noted earlier, the fee impact from the replacement of two diesel trucks (Units 317 and 318) with two new CNG trucks is \$11.00 per household. To this base increase must be added the cost impact of reducing the useful life period from ten to eight years. This cost impact can be managed in a number of ways, each of which would have a different impact on user fees. Consider the following options:

- *Option 1* — Under this option, the City would adjust the useful life for all CNG refuse trucks to eight years in 2022. The City would also increase the amount of funding transferred to reserves to provide for vehicle replacement, and to compensate for retroactive reserve shortfalls that would arise as a result of shortening the life period.
 - This option would result in a one-time, ongoing fee adjustment of \$12.00 per household. This fee impact has been calculated by the City Finance Department and has been smoothed over multiple years using the Sanitation Levelling Reserve Fund.
- *Option 2* — Under this option, the City would adjust the useful life and related replacement reserve funding to eight years beginning with the two replacement trucks purchased to replace the existing diesel trucks. The existing CNG vehicles would be left at ten-year useful life periods, which would require the City to risk-manage significant (upwards of \$1.5 million) in replacement funding shortfall over a four-year period. On the assumption that trucks would be replaced at eight years, despite having a ten-year useful life amortization period, the funding shortfall would occur between 2024 and 2027. Operational decisions on replacing poor performing trucks at eight years and pushing out high-performing trucks would have the potential to smooth the impacts over a four-year period.
- *Option 3* — This option would be a hybrid approach that would consider the City's financial practice and internal capacity and results in a combination of Options 1 and 2.

INTERIM MEASURES

In the latter part of July and into August, while finalizing this report, there were multiple breakdown events for the existing fleet resulting in significant downtime. There was an increase in overtime paid during this time period and, more importantly, a 400% increase in service failures in August specifically. The diesel trucks are now 12 years into service and are proving out the arc in maintenance costs shown in Figure 3 of this report.

With the timeline for the procurement, purchase and outfitting of a new refuse truck stretching 15-18 months, the consultants recommend a short-term lease to allow the Sanitation Department to remove one diesel truck from the road in the immediate term. This measure has been confirmed as possible for November 1, 2021 — the total cost impact is presented in Figure 7, and the user fee impact is not part of the 2021 budget. It is anticipated that the lease would allow for significant downtime costs to be avoided.

Figure 7
Interim Measure — Short-term Lease

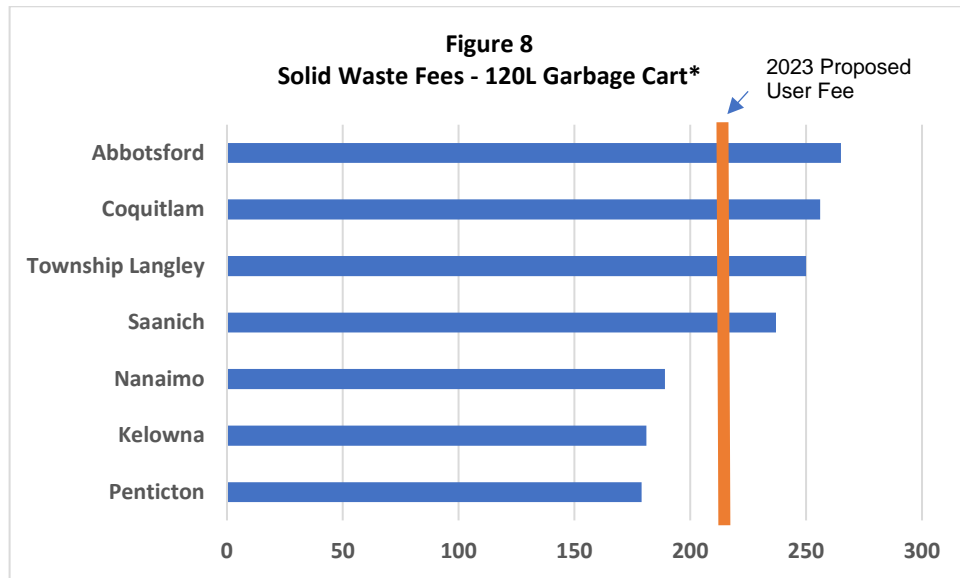
| Cost Components* | Costs (One leased vehicle) |
|---|-------------------------------|
| Avoided Costs | |
| Reduced Diesel Operating Cost (Annual average, one truck) | \$ 82,187 |
| Annual Costs Avoided | \$82,187 |
| New Costs | |
| CNG Vehicle Lease | \$ 114,000 |
| CNG Truck Maintenance, Fuel, GPS (average first year costs historically) | \$ 52,000 |
| Annual New Costs | \$ 166,000 |
| Net Annual Cost (Avoided costs minus new costs) | \$ 83,813 |
| User Fee Impact (per household, rounded) | 3.00 |

*historical costs are 2017-2020 averages

FEE COMPARISON

Solid Waste user fees have been increased in recent years. These increases, coupled with the changes presented in this memorandum, make it important to consider how Nanaimo's fees compare against those of other municipalities. Figure 7 presents a comparison. As shown in the figure, Nanaimo's fees are third lowest of the range of closest comparative municipalities in BC.²

² The range of local options for comparison is small as not all local governments have modernized their collection to automated service. Also, among municipalities that are automated, not all collect the three waste streams.



* 82% of Nanaimo's households have and pay for the default 120L garbage cart option.

FLEET FUNDING

With the user fee impact of the recommendations of this report it is clear there are significant costs to the acquisition, maintenance and replacement of fleet (sanitation in particular is a high risk area for fleet management). The relatively significant costs can be attributed to many factors, including:

- KM Driven and type of driving
- Cost of vehicles to purchase and outfit
- Cost, skill sets and facilities to maintain
- Certainty of ongoing maintenance trends for vehicles as they age

As a result, it is critical to ensure funding availability at time of replacement, as debt servicing adds such a burden to the rate as seen in Figure 6. This need is particularly important with the shortening of the useful life to eight years, with a significant amount of funding required to "catch up" reserve balances. Finance has a sophisticated and detailed process for planning for fleet replacements and operational costs — this process will support that funding requirement.

SUMMARY OF RECOMMENDATIONS

Recommendations made throughout the report are summarized here, along with the fee impacts presented in Figure 9.

- *Refuse Truck Analysis* — Replace two diesel trucks with new CNG units, numbers 317 and 318; keep Unit 301 and re-evaluate use in 2023.
- *Interim Measures* — Lease a new CNG truck to replace one of the diesel trucks on an interim basis while procurement and outfitting of two new CNG trucks takes place.
- *Useful Life* — Reduce useful lives of the refuse trucks from ten to eight years, adjusting user fees to account for the increased reserve transfers required to fund a nearer replacement date.

These program changes aimed at sustaining the curbside collection program would result in user fee increases as shown in Figure 9, which do not consider any other program costs that may change as part of the normal budget process. The fee increases are a direct result of cost drivers noted earlier in this report, particularly the truck usage due to the increased volume of waste since 2020.³

TOTAL FEE IMPACT & TIMING

The total increase in user fees to account for both the replaced diesel trucks and the shortened life cycle of all CNG trucks is \$23.00, phased in over two years as seen in Figure 9.

Figure 9
Implementation of User Fee Change

| Change Recommended | 2022 | 2023 |
|-----------------------------------|----------------|---------------|
| CNG Truck Replacement | | \$11.00 |
| CNG Truck Lease – Interim | \$3.00 | (\$3.00) |
| Eight-Year Useful Life (Option 1) | \$12.00 | |
| Annual Fee Impact | \$15.00 | \$8.00 |
| Total 2022 & 2023 | \$23.00 | |

* All impacts are one-time, ongoing.

³ The 20% increase in waste has resulted in 12% higher-than-planned KM driven. Additional kilometres have been incurred in making additional trips to the recycling depot, and in performing almost double the number of annual lifts originally anticipated.