ANNEX A: Environmental Life Cycle Considerations of Bag Alternatives

Plastic Bags – Waste Stream Information
The following information or estimates are related to plastic bag waste, with applicable, regional, information, where appropriate. It should be noted that much of the required statistics are not current or readily attainable.

- Plastic bag as a percent of overall waste (CRD and City of Vancouver): 0.79%\(^\text{16}\) - 2.11%\(^\text{17}\)
- Estimated bags used per capita in Canada: 200\(^\text{18}\)
  - Estimated bags used per capita in Seattle and the UK: 120\(^\text{19}\) - 450\(^\text{20}\)
- Annual City plastic bag usage
  - Estimated based on Globe and Mail (2012) totals: 17 million
- Portion of City bags recycled: Unknown.
  - California and other US cities\(^\text{21}\): estimate 3-12%
- Portion of City bags littered: Unknown
  - EU estimates of 4.6%\(^\text{22}\) of bags end up as litter. If similar rates were experienced in the City, more than 780,000 bags would escape collection yearly (based on the 200 per capita rate, above).
- Estimated Percent Reused Before Disposal (ex. bin liners or dog waste bags): >50%\(^\text{23}\)
- Portion of City bags made from recycled content: Unknown.

While overall waste proportions are low due to the density of plastic bags (ie. approximately 5 grams for a typical grocery bag), the very high usage rates, low recycling rates and high litter potential, are largely undefined and are cause for concern. Accurate, local or regional information is required to make informed and intelligent management decisions. Working collaboratively with local, regional and leading stakeholders should be pursued to ensure the strongest and most positive City policy outcomes.

Alternative Grocery Bags – Relative Impacts and Environmental Performance
Different alternatives to plastic grocery bags exist, and have been assessed as to their harm on the environment in a number of life cycle analyses (LCAs). The common types of grocery/carrier bags include the following:
- Conventional grocery bags made from High Density Polyethylene (HDPE),
- Paper bags;
- Sturdier, glossy, plastic retail bags made from Low-Density Polyethylene (LDPE) bags;
- Reusable, Non-Woven Polypropylene (NWPP) bags, and

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\(^\text{17}\) City of Vancouver, Waste Audit 2015 data. Total plastic film in single family garbage equals approximately 10%.
\(^\text{19}\) UK per person estimates (http://www.earth-policy.org/plan_b_updates/2014/update123)
- Reusable, cotton carrier bags.

**Biodegradable bags**
Numerous bio-based plastics have been applied to carrier bags, and can be either biodegradable or non-biodegradable. Some polymers used to make bags are manufactured using compostable polymers, and are designed to be processed in industrial composting facilities, using controlled temperature, oxygen levels and processing times.

Biodegradable bags would have to certified and labelled properly to avoid confusion with conventional plastic bags. To be an effective alternative, these biodegradable bags would have to be managed separately from plastic recycling streams, and be recovered in industrial composting facilities at the end of life. Adopting any biodegradable bag alternative may not result in a shift to more sustainable habits, and worse, could actually result in more littering due to a common misperception that the bag will degrade more quickly and pose little environmental damage.

**Life Cycle Assessments (LCAs)**
A better understanding of the relative, local environmental impacts of different carrier bags is required in order to adequately compare alternatives, and also to better understand any unintended consequences related to restricting the use of any one bag type. An LCA can be used to provide a scientific and repeatable measure of a product’s performance across a range of environmental impact categories, such as global warming potential, ecosystem impacts, water use / contamination, toxicity, eutrophication, and waste generation. Each LCA must make unique assumptions about a product’s manufacturing phases, use phase, material composition and end of life.

A peer reviewed, 2004 Price Waterhouse Coopers study compared paper and plastic grocery bags for a French supermarket chain (Carrefour) and indicated the following comparisons, which was subsequently used for policy guidance in the European Union.

**Table 1. PwC / Ecobilan (2004) Impact Assessment of Carrefour Plastic Carrier Bags**

<table>
<thead>
<tr>
<th>Indicator of environmental impact</th>
<th>HDPE bag (lightweight)</th>
<th>Reusable LDPE bag (used X2a)</th>
<th>Reusable LDPE bag (used X4a)</th>
<th>Reusable LDPE bag (used X30a)</th>
<th>Paper bag (single use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption of non-renewable primary energy</td>
<td>1.0</td>
<td>1.4</td>
<td>0.7</td>
<td>0.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Consumption of water</td>
<td>1.0</td>
<td>1.3</td>
<td>0.6</td>
<td>0.1</td>
<td>4.0</td>
</tr>
<tr>
<td>Emission of greenhouse gases</td>
<td>1.0</td>
<td>1.3</td>
<td>0.6</td>
<td>0.1</td>
<td>3.3</td>
</tr>
<tr>
<td>Atmospheric acidification</td>
<td>1.0</td>
<td>1.5</td>
<td>0.7</td>
<td>0.1</td>
<td>0.9</td>
</tr>
<tr>
<td>Ground level ozone formation</td>
<td>1.0</td>
<td>0.7</td>
<td>0.3</td>
<td>0.1</td>
<td>1.3</td>
</tr>
<tr>
<td>Eutrophication</td>
<td>1.0</td>
<td>1.4</td>
<td>0.7</td>
<td>0.1</td>
<td>14.0</td>
</tr>
<tr>
<td>Solid waste production</td>
<td>1.0</td>
<td>1.4</td>
<td>0.7</td>
<td>0.1</td>
<td>2.7</td>
</tr>
<tr>
<td>Risk of litter</td>
<td>1.0</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.2</td>
</tr>
</tbody>
</table>
The PwC comparison of plastic and paper bags, suggests that the production of paper bags causes 14 times the impact on water quality and consume 4 times the water, has 3 times the waste generation, and 3 times more greenhouse gas emissions than HDPE plastic bags24. This study also highlights the environmental benefit of the heavier duty plastic bags (LDPE), which are preferred to many alternatives, but only if reused 4 or more times.

A 2011 UK government LCA study compared several bag types, and determined that a cotton bag had to be re-used 131 times25 to match the equivalent greenhouse gas emissions from the production of a single use HDPE bag. This study stated that LDPE and NWPP bags posed 3,4 and 11 times more global warming potential, (respectively), than a HDPE bag26. The NWPP bags are designed to be used more than 100 times, and if reused, would pose the least overall environmental impact.

Life Cycle Analysis Commentary

All of these studies suggest that HDPE plastic grocery bags pose less environmental risks than other single-use, bag types, especially if recycled at end of life. These studies also conclude that single use paper bags are less environmentally friendly due to the large impacts on energy use, and water contamination during processing. These studies all conclude that in order to maximize the environmental benefits of reusable bag alternatives, a bag should be made from enviro-friendly or recycled materials, avoid landfill, and be used a “sufficient” number of times27.

Specific bag impact results have to be carefully considered, since each study makes unique and numerous assumptions that define the bag material, size/volume, usage rates, manufacturing processes, recycled content, system boundaries, production and transportation energy mix, and end-of-life scenarios. All of these assumptions pose different environmental impacts in each category. During this review, no local study was found that contained a representative mix for BC made and used materials, which could potentially modify the comparative impacts between single-use bag alternatives.

Ocean Plastic Pollution Concerns

The Surfrider Foundation is an international coastal and ocean environmental advocacy group with a strong presence in the Pacific Northwest. Surfrider has locally championed their corporate “ban the bag” campaign, which is nominally targeted at eliminating plastic bags at retailers, in support of reducing ocean litter.

According to recent ocean-plastics report from the Ocean Conservancy, the amount of plastic waste in the ocean is rising past dangerous levels, with significant impact to ocean ecosystems, food chains and global health28. Most plastic enters the ocean from landfills or littering, and is especially a problem in coastal nations suffering poor-quality waste management systems. The Ocean Conservancy report highlights the urgency of the ocean-plastic problem, which states that by 2025, there will be one ton of plastic debris in the ocean, for every three tons of finfish, quickly rising from 12.7 Mt to 250 Mt - an order of magnitude more than in 201529. Science magazine’s 2015 report

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25 Ibid.
26 Ibid.
27 Note: Seattle states 20 reuses as an acceptable minimum27, while the UK is suggesting that heavier duty LDPE bags must be used 4 times to be considered as a suitable alternative to conventional grocery bags. San Francisco states that any reusable grocery bag must be designed to last at least 125 times to considered an environmentally preferred option.
states that roughly 2-5% of all plastic waste generated in 192 coastal countries is ending up in the ocean, which represents 32% of all plastic packaging escaping collection and management systems. This report also states that over half of this waste comes from just five rapidly growing economies – China, Indonesia, the Philippines, Thailand and Vietnam, and 83% of all waste, coming from 20 nations\textsuperscript{30}. Canada is not on the list of top 20 plastic-ocean-polluters, and has one of the lowest instances of mismanaged plastic "leakage" into the ocean.

Ocean plastic facts, taken directly from Science's report are as follows:

- Plastics do not biodegrade in the ocean, but merely fragment into smaller and smaller pieces as a result of weathering and exposure to ultraviolet light.
- Plastic debris has been found in all areas of the ocean, from the ocean gyres to the deep sea, on coastal shores and frozen in Arctic sea ice.
- Impacts from plastic debris has been documented in more than 660 species, from entanglement and ingestion.
- Plastics can concentrate toxic chemicals from seawater up to 1 million-fold. Ingestion of these contaminated plastic particles may deliver these chemicals to the ocean animals which eat them, potentially resulting in negative effects on their health and survival.
- A direct link between plastics input to the ocean and human health through consumption of contaminated seafood has not yet been made. Seafood toxicity from plastics is an area of active research.

An Ocean Conservancy 2015 report suggests that plastic bags make up approximately 3% of the all litter collected during global, organized beach clean-up events, with the most prevalent items being cigarette butts, plastic food wrappers and bags, beverage containers, straws and screw caps\textsuperscript{31}.

**Risks of Exporting Pollution to Overseas Markets**

While statistics suggest that Canada maintains 'tight' waste management systems and is not a major contributor to ocean plastic debris, concerns have been raised that any exportation of local recycling to buyers in overseas markets may mean that Canadian materials could potentially leaking from mismanaged, foreign landfills. China’s "Green Fence" policy of 2011 was implemented to prevent the importation of other nation's wastes not suitable for their own domestic recycling markets. Since the implementation of these restrictions, exported wastes are supposed to be blocked from entering China, and returned to the originating country, under potential penalty.

This staff review has not been able to determine if Victoria’s plastics enter foreign landfills that may have 'leakage' problems. More investigation would be required in order to understand if there is any risk that Canadian wastes may be entering the ocean environment via overseas recycling or waste markets.

**Consumer Behaviour Trends (USA Study 2014)**

A Clemson University study in 2014 reviewed the life cycle impacts of different carrier bag alternatives, and summarized a national USA survey of over 3000 residents, which revealed the following trends in grocery bag usage\textsuperscript{32}:

- 28% of people had acquired a reusable grocery bag;
- 87% of those had used reusable bags for groceries;

\[ \text{doi:10.1126/science.1260352.} \]

\textsuperscript{30} Ibid.


• Consumers forgot to bring their reusable bags 40% of the time;
• LDPE grocery bags are designed for approximately 125 uses, but are used on average, only 3.1 times, which poses greater consumption rates and higher environmental impacts than a conventional plastic retail bag;
• Less than 10% of people are using the LDPE the recommended number of times (125);
• Between 25-40% of people are reusing their NWPP bags enough times to warrant the per-bag environmental impact; and
• 15% of consumers wash their reusable bags, and 23% never wash them.

These results show actual data pertaining to the bag re-use trends in the United States. Lower re-use rates continue to trend below the intended targets, due to less consistent adoption of reusable bag alternatives. These conclusions suggest that a ban on HDPE plastic bags could potentially pose an overall environmental penalty rather than benefit, unless usage rates can be lifted above desired levels.

33 Assumed plastic bag is made from 30% recycled content (ibid).