Government of Yukon
Department of Community Services
Community Development Division
Community Infrastructure Branch

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COMPREHENSIVE SOLID WASTE STUDY FOR YUKON TERRITORY UNINCORPORATED WASTE FACILITIES VOLUME 1: REVIEW OF EXISTING PRACTICES

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EXECUTIVE SUMMARY

EBA Engineering Consultants Ltd. (EBA) was retained by Yukon Government (YG) to conduct a comprehensive study of the waste management practices at Yukon solid waste facilities located in unincorporated communities.

This study was divided into a number of tasks based on the proposal that was accepted by YG Community Infrastructure Branch on July 29, 2008. These tasks included:

- Task 1 – Review of Current Waste Management Practices.
- Task 2 – Protection of Human and Environmental Health.
- Task 3 – Cost Analysis of Proposed and Existing Practices.
- Task 4 – Public and Stakeholder Meetings.
- Task 5 – Analysis of Third Party and Community Management of Solid Waste Facilities.
- Task 6 – Develop a Sustainability Model for Various Waste Management Practices.
- Task 7 – Updating the Yukon Solid Waste Management Strategy and Guidelines.

The waste facility alternatives that were considered within this study included the burning of waste in a trench and burial of ash, the burning of waste in a burning vessel and the burial of ash, transfer stations, regional landfills, and incinerators. Each alternative was reviewed according to environmental and human safety risks, carbon footprints, costs and future cost projections, and relative political viability.

Over the course of this work, additional components have been identified as being necessary for inclusion. Specifically, air dispersion modelling was added to better understand the risks associated with the burning of wastes, and the review of current waste management practices was expanded to include incorporated communities to provide a more complete picture of waste in the Yukon.

Public and stakeholder meetings are currently being conducted to inform the public of the progress to date and receive feedback. The objectives pertaining to the public and stakeholder meetings included:

- identification of public and stakeholder concerns;
- identification of public understanding of waste management; and
- identification of public perceptions and waste management priorities.

EBA understands that the public and stakeholder meetings will be completed in late spring 2009. The results of these public and stakeholder meetings will supplement the findings to date and be incorporated into future volumes of reporting.

In the interest of transparency, YG has decided to release to the public the progress to date and provide information on future direction. As such, the reporting has been divided into volumes:

- "Volume 1: Review of Existing Practices" – Includes an overview of the waste management operations in the Yukon, focusing on the existing practices of unincorporated communities (costs, carbon footprint, etc.) – Target Date for Release: April 30, 2009.
- "Volume 2: Stakeholder Views" – Will represent an update to Volume 1, including the comments from the public meetings, results from the air dispersion modelling, and comments from meetings with local advisory committees (LACs), First Nations (FNs), and Municipal Governments, and will outline opportunities for partnerships – Target Date for Release: June 2009.
- "Volume 3: Yukon Strategy for Solid Waste" – Will represent an update to Volume 2, including the review of the existing practices of incorporated communities and will use the information in the two previous volumes and synthesize the information into a new strategy (direction) for the Solid Waste Management in the Yukon – Target Date for Release: August 2009.

This document represents Volume 1 of the reporting, and will be updated in subsequent volumes as per the schedule outlined above. As additional input is anticipated from the ongoing components of the study (i.e., public and stakeholder meetings and incorporated community review), the information presented in this report is subject to change.

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APPENDICES

1.0 INTRODUCTION

EBA Engineering Consultants Ltd. (EBA) was retained by the Government of Yukon (YG) to conduct a comprehensive study of the waste management practices at Yukon solid waste facilities in unincorporated communities.

It is EBA's understanding that the solid waste permits for solid waste facilities operated by YG Community Infrastructure were renewed in April 2009. As part of this renewal process, YG intends to revisit current solid waste practices. YG desires a standard approach across the Yukon that considers new approaches for the solid waste facilities it operates (not those operated by incorporated municipalities). For example, a potential new approach is to compare the carbon footprint of hauling wastes back to Whitehorse versus burning on site. YG would also like to compare waste management practices in other jurisdictions, and provide input on how to segregate and handle certain types of wastes (like electronic wastes).

2.0 METHODS

This study was divided into a number of tasks based on the proposal that was accepted by YG Community Infrastructure Branch on July 29, 2008. These tasks included:

- Task 1 – Review of Current Waste Management Practices.
- Task 2 – Protection of Environment and Human Health.
- Task 3 – Cost Analysis of Proposed and Existing Practices.
- Task 4 – Public and Stakeholder Meetings.
- Task 5 – Analysis of Third Party and Community Management of Solid Waste Facilities.
- Task 6 – Develop a Sustainability Model for Various Waste Management Practices.
- Task 7 – Updating the Yukon Solid Waste Management Strategy and Guidelines.

This document has been structured in accordance with the tasks as outlined above, though it is to be understood that certain tasks are still being completed at this time.

Over the course of this work, additional components have been identified as being necessary for inclusion. Specifically, air dispersion modelling was added to better understand the risks associated with the burning of wastes, and the review of current waste management practices was expanded to include incorporated communities to provide a more complete picture of waste in the Yukon.

In the interest of transparency, YG has decided to release to the public the progress to date and provide information on future direction. As such, the reporting has been divided into volumes:

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This document represents Volume 1 of the reporting, and will be updated in subsequent volumes as per the schedule outlined above. As additional input is anticipated from the ongoing components of the study (i.e., public and stakeholder meetings and incorporated community review), the information presented in this report is subject to change.

3.0 SCOPE OF WORK

EBA's scope of work for this study involved an examination of current practices, which included an assessment of the capacity for change of existing waste facilities (such as shifting from a burning vessel operation to a transfer station) and an evaluation of each site's relative functionality (i.e., how well the site is maintained and operated). In completing this study, EBA has accomplished the following objectives:

- Review of current operational practices.
- Preparation of cost analysis for current capital and operational expenditures.
- Evaluation of environmental impact and human health effects.
- Exposure assessments for each waste management facility.
- Carbon footprint calculations relating to transfer stations.
- Environmental and economic comparison of facility alternatives.
- Cost analysis that considers both present and 20 year horizons for each waste management practice.

- Identification of resource requirements.
- Identification of best practices across waste management facility types.

A major component in achieving the objectives of this study is to produce a waste model capable of evaluating the different waste facilities in the Yukon and determining which waste operation alternative is most practical on a case by case basis. This model is to incorporate the majority of study components and as is referred to throughout this report as an integral resource. As components of the study are still ongoing, this model is still under development and will be updated and finalized with future drafts of reporting.

The public and stakeholder meetings are currently being conducted to provide a contrast between public opinion and the research compiled. The objectives pertaining to the public and stakeholder meetings included:

- identification of public and stakeholder concerns;
- identification of public understanding of waste management; and
- identification of public perceptions and waste management priorities.

EBA expects that the public and stakeholder meetings will be completed in late spring 2009. The results of these public and stakeholder meetings will supplement the findings to date and be incorporated into future volumes of reporting.

4.0 TASK 1 – REVIEW OF CURRENT WASTE MANAGEMENT PRACTICES

4.1 PAST RELEVANT DOCUMENTS

The documents that were reviewed as part of the background information for this project included:

- Solid Waste Management Procedures & Guidelines, Community Services 1996.
- Evaluation of a Ban on Burning as a Means of Garbage Disposal in the Yukon, Community Services 1997.
- Solid Waste Strategy, Gartner Lee 2001.
- Solid Waste Management Plans for each site (**Dawson**[1], **Mayo**, Ross River, **Watson Lake**, **Faro**, Beaver Creek, Burwash Landing/Destruction Bay, Stewart Crossing, Pelly Crossing, **Carmacks**, **Haines Junction**, **Teslin,** Carcross, Tagish, Marsh Lake, Braeburn, Mt. Lorne, Deep Creek, Champagne, and Old Crow).

A summary table for each facility, provided by YG, was used as the starting point for summarizing the information available. This table was expanded upon for the purposes of

[1] Bold text indicates that the facility in part of an incorporated community and not under Community Infrastructure's jurisdiction.

the model (discussed in Section 9.0), and incorporates all the information that is required to analyze each site as a whole, or as part of a network.

4.2 OTHER RELEVANT DOCUMENTS

Other documents utilized by EBA for this study included similar waste oriented research projects that EBA has conducted recently for the YG. These documents included:

- EBA – Summary Report on e-Waste Research (March 2008) – This study involved a review of the various e-waste programs throughout Canada and provided recommendations for the establishment of such a program in the Yukon, taking into consideration the unique challenges faced.
- EBA – Yukon Solid Waste Operations Research (October 2008) – In this study, EBA collected the solid waste regulations for every waste governing jurisdiction in Canada, as well as the State of Alaska, and evaluated each in terms of landfill siting and construction standards, waste handling practices at remote camps, and environmental monitoring requirements. From this review, a framework for Yukon waste regulations was recommended and a collection of Canadian best practices are currently under consideration with the YG Department of Environment.

4.3 YUKON WASTE FACILITY TYPES

There are presently 19 unincorporated communities for which YG operates solid waste facilities. The current solid waste management practices in the Yukon, dependant on the geographical area and needs of the surrounding communities, typically fall into one of the following categories:

- burial of waste in a trench;
- open trench burning and burial;
- burn vessels and burial of the ash;
- unmanned transfer station disposal; or
- manned transfer station disposal.

This study involved visiting representative sites from the facility types outlined above and observing the efficiencies and deficiencies associated with each. The intent being to evaluate whether or not the current operations should change, and to provide recommendations that would improve the waste management at YG solid waste facilities.

4.4 YUKON WASTE FACILITY SITE VISITS

EBA visited a number of waste facilities in the Yukon accompanied by Community Infrastructure Branch staff. These sites included:

- Marsh Lake (manned transfer station);

- Johnson's Crossing (burning vessel);
- Taku Subdivision (Tagish) (burning vessel);
- Carcross (open trench burning);
- Mt. Lorne (manned transfer station);
- Braeburn (burning vessel);
- Deep Creek (unmanned transfer station);
- Canyon Creek (burning vessel);
- Champagne (burning vessel);
- Burwash Landing (burning vessel);
- Destruction Bay (metals deposit); and
- Silver City (burning vessel).

Through these site visits, EBA gained a first hand understanding of current waste handling processes in the Yukon. In many cases, the timing of the site visits was beneficial, as the majority of sites visited were being used by the public during visits.

In addition to the unincorporated facilities, EBA also observed the operations at the Whitehorse and Haines Junction landfills, as well as the recycling operations of Raven Recycling and P&M Recycling.

The following provides a summary of the types of Yukon waste facilities observed.

4.4.1 Burning Vessels and Burial of the Ash

In most instances, burning vessels were relatively new additions at the respective waste facilities. The burning vessels are constructed of large, used, steel fabricated underground or above-ground storage tanks that have been modified with doors and vents to accept varying capacities of waste. It should be noted that these facilities were not engineered to any specifications (because such specifications do not exist), and that no controls are in place regarding temperature or emissions (i.e., these vessels do not constitute incinerators).

The configuration of these burning vessels varied only slightly from one another, but their size differed in proportion to the volume of waste expected at the respective facility. The wastes accepted and segregated at each site are generally the same, though some sites have better signage than others, and some are limited by the space available.

The burning vessels were observed as being very effective in containing the wastes accepted and minimizing the litter that escapes, not to mention the reduction in scavenging from animals and birds in comparison to open trench burning.

The difficulty, however, is that there are large quantities of non-burnable items (metals, mostly) that find their way into the vessel and later must be separated from the

ashes[2]. The possibility of a propane tank, paints, or car batteries entering the vessel is also a risk (due to the unmanned nature of the sites), and despite adequate warning signage, this poses a risk to the environment as well as the health and safety of those using the facility.

Additional risks of burning vessels include the warping of the tanks due to extreme heat generated by burning, the smoke resulting from burning, and the potential for a member of the public to burn themselves should they come into contact with the vessel after/during a fire.

Community Infrastructure staff also indicated a lack of policing capacity to enforce the rules at the burning vessel sites, which increases the likelihood of an incident resulting from the risks discussed above.

4.4.2 Manned and Unmanned Transfer Stations

When it comes to transfer stations, the major factor contributing to site performance is the level of staffing.

The Mt. Lorne and Marsh Lake facilities are manned transfer stations. Whilst operated differently, they were more or less kept tidy, with the waste well segregated into separate storage areas that were clearly identified. At both facilities, there is staff available during operating hours, and access to the site is limited to those hours only.

Deep Creek, on the other hand is an unmanned facility, and could greatly benefit from improved waste management practices. In principle, the site should operate as the Yukon's other transfer stations, but the absence of staff and the unlimited access to the facility has been detrimental to the operation. This combination provides no supervision, and the public has taken advantage of the consequence-free environment on a regular basis. Also, the absence of tipping fees, in contrast to Whitehorse, provides monetary incentive for unplanned use of the Deep Creek facility, particularly considering the site's proximity to the Whitehorse landfill. Compounding these challenges is that the site is located on a silt and clay subgrade, which provides for a less than ideal working area for site maintenance.

4.4.3 Open Trench Burning and Burial

One site viewed by EBA still utilized the open trench burning practice (Carcross). This, however, can be attributed to the surrounding community's reluctance to accept a burning vessel, due to concerns that this would delay the establishment of a transfer station[3].

Having viewed a number of the burning vessel sites first, the greater quantity of uncontrolled litter and the greater presence of scavenger birds at the open trench facility

[2] The removal of metal wastes from residual burning vessel ash is currently not practiced due to a lack of available resources (i.e., funding, equipment).

[3] Determined through discussions with Community Infrastructure staff.

was apparent. This particular site was divided into two parts – domestic waste (to be burned in the trench) and other wastes (including construction wastes, appliances, waste metals, batteries, tires, etc.). The domestic waste portion of the facility appeared untidy due to the abundance of litter scattered by wind and birds, but overall the site was well maintained, with the majority of wastes segregated in tidy piles, despite a lack of clear signage.

Overall, there is no apparent operational difference noted between a burning trench facility and burning vessel facility, other than litter control.

Burning time was the only other difference noted during the inspection. Burning vessels burn much more quickly and in a more controlled manner than in a trench. Open trench burning has greater potential to smoulder for longer periods of time, due to uneven temperatures and incomplete combustion of wastes. Exposure to the elements (i.e. wind, rain, and snow) increases this effect.

4.5 GENERAL OBSERVATIONS AND DISCUSSION

The following bullets denote a number of general observations and discussion points that have been taken into consideration for this study:

- At any site, there is a perceived mentality that the site should be treated as the site is viewed. If a site is not very well kept, users, in general, will dispose of their waste in an untidy fashion. Conversely, if a site is well organized, users will tend to respect the tidiness of the facility and dispose of their waste more appropriately.
- The contractor hired to manage each facility is directly responsible for each site's relative functionality and tidiness. Each contractor is hired as a result of a tendering process. There is often a learning curve associated with the contractors executing the waste management contracts, as there is no guarantee that a previous well-performing contractor would be successful on subsequent tender. At times, this can result in onerous micro-level management for the YG, where contractor performance has to be closely monitored, and often contracts either have to be renegotiated, cancelled, or reissued (as per communication with Community Infrastructure staff).
- Overall, signage appeared inconsequential at each site. While the number or clarity of signs varied from site to site, the waste disposal from the public was not dependant on directions, but more or less guided by the waste areas clearly identified through already deposited wastes. In addition, it seems as though facility users will only stop at so many areas before tiring of separating their wastes and leaving the remainder in one place. This is a universal problem with waste disposal, and is difficult to combat, even under supervision.
- The waste deposit practices are variable in the Yukon. Due to the remoteness of residents, and the lack of some services in the territory (i.e., affordable repair services), it is common that users store their wastes at their residences for an extended period of time and then unload a large quantity of waste at once, temporarily overloading a site's

capacity. This is particularly apparent when it comes to auto hulks, appliances, construction and demolition (C&D) waste, and tires.

- Another source of site overloading can be attributed to some residents of Whitehorse that choose to deposit their wastes at a facility other than the Whitehorse landfill. The tipping fee at Whitehorse landfill is $5 to $17 depending on the size and type of the load. Some residents choose to avoid this fee and deposit their wastes for free at another facility. Commercial waste deposits (though beyond the scope of this study) further illustrate this allure, as tipping fees range between $39 and $68 for such deposits, which are typically larger in size. Without charging a tipping fee at other facilities, this will remain problematic (this trend is particularly apparent at the Deep Creek facility).
- Throughout the Yukon, the level of community volunteerism varies quite significantly. It seems that some communities are attuned to environmental and solid waste issues in the Yukon, and the others are more inclined to "keep things the way they've always been". This presents challenges when adopting a common framework for standardizing waste management approaches.
- Recycling tends to be less developed at unincorporated communities since there is a lack of recycling facilities available nearby.
- Electric fences have apparently been effective in keeping wildlife out of the waste facilities, though their upkeep needs to be monitored constantly, as vegetation often shorts out the fencing, rendering it ineffective, and the solar battery packs require monitoring and maintenance.
- People that live outside of a municipality do not pay for garbage disposal, making waste deposits free for unincorporated community residents, thus making YG operated facilities an attractive alternative to municipal waste facilities.
- Waste management practices in southern Canada may not be practical or possible in the north due to smaller population and tax base, longer distances, and higher costs.

4.6 CAPITAL AND OPERATIONAL EXPENSES

EBA has prepared cost estimates that consider both capital and operational expenses for each type of facility alternative. These estimates were developed through communication with YG, with respect to known expenses and estimated unit costs, and supplemented by additional information found in published reports from similar jurisdictions.

For existing waste practices, EBA was supplied the annual contract values the YG has in place with each unincorporated community. These contracts were incorporated into the estimates developed in the waste model. Cost estimating is further discussed in Section 6.0.

4.7 YUKON SOLID WASTE LEGISLATION

The YG is examining the status of its regulations for waste facilities against those across the rest of Canada, with particular attention paid to northern, remote facilities. To this purpose, EBA was retained under separate contract by the YG Department of Environment to research and summarize solid waste management regulations across Canada and Alaska and to make recommendations for set of best management practices (BMPs) appropriate to the unique conditions of the Yukon (EBA 2008).

This section provides a summary of Yukon's current legislation with respect to solid waste management.

4.7.1 Current Yukon Legislation Applicable to Solid Waste Management

The YG has several acts and regulations that are used to address solid waste in the Yukon. Perhaps the most significant of these is the Environment Act (Yukon), within which can be found specific regulations addressing issues such as solid waste disposal facilities and special waste, among others.

Environment Act

The Environment Act (Yukon) consists of 14 parts, of which Parts 6 through 10 are the most pertinent with regards to the handling and management of waste. These parts are outlined as follows:

Part 6 – Development Approvals and Permits

Part 6 broadly outlines what information would be required to permit new regional solid waste facility.

Part 7 – Waste Management

Part 7 is perhaps the most important part, as it broadly outlines what is required in a solid waste management plan.

Part 8 – Waste Reduction and Recycling

Part 8 highlights the importance of waste reduction and recycling, and sets out the Recycling Fund. It provides a means for certain materials or products to be banned from sale or use if "If the Minister is satisfied that the normal use of a package or manufactured product will cause a significant impairment of the natural environment that cannot otherwise be prevented or mitigated".

Part 9 – Release of Contaminants

Part 9 discusses contaminated sites, and the actions required to address such sites. This part might apply to solid waste facilities that are improperly managed or designed, or where illegal dumping occurs due to a lack of policing capacity.

Part 10 – Hazardous Substances and Pesticides

Part 10 identifies substances that cannot be disposed of in a solid waste facility.

In addition to the above-cited parts of the Environment Act, there are also regulations developed pursuant to the Act that provide further detail. The pertinent regulations affecting solid waste management practices are described below:

- **Beverage Container Regulations (O.I.C. 1992/136):** Sets out how the Yukon's beverage recycling program is funded and operates.
- **Special Waste Regulations (O.I.C. 1995/47):** Defines what a special waste is, and how such wastes should be handled and transported. The regulations provide the requirements for special waste permits.
- **Air Emissions Regulations (O.I.C. 1998/207):** Provides specifics on allowable emissions in the Yukon, and defines what opacity of visible emissions is acceptable. It also states that "No person shall release or allow the release of any air contaminant to such extent or degree as may (a) cause or be likely to cause irreparable damage to the natural environment; or (b) in the opinion of a health officer, cause actual or imminent harm to public health or safety".
- **Solid Waste Regulations (O.I.C. 2000/11):** Outlines what is required in an application for a solid waste permit, and the subsequent monitoring and record keeping required to maintain the permit. Also provides details on the information required, solid waste management plan, and guidelines on the operation of solid waste facilities.
- **Contaminated Sites Regulation (O.I.C. 2002/171):** Provides requirements for identification and restoration of contaminated sites, and provides soil and water standards to help determine whether or not a site is considered contaminated.
- **Designated Materials Regulation (O.I.C. 2003/184):** Designates the materials for which retailers can collect recycling surcharges; currently, only vehicle tires are designated.

<u>Municipal Act</u>

- Under Section 248 of the Municipal Act, a municipality may own and operate a public utility as defined in the Public Utilities Act, but only with the approval of the Commissioner in Executive Council and if not prohibited under that Act or any other Act.
- Under Section 278 of the Municipal Act, the council of a municipality shall, within three years of formation or alteration of municipal boundaries, adopt or amend by bylaw an official community plan.
- Under Section 279 of the Municipal Act, the official community plan must address the development of utility and transportation systems.

Forest Protection Act

This Act regulates burning in or near forested areas.

Wildlife Act

Under Section 93 of the Wildlife Act, practices that cause wildlife to become a nuisance are discouraged. Such practices might include open storage of food wastes.

Public Health and Safety Act

- **General Regulations Respecting Public Health (C.O. 1958/79):** Under Section 13 (Dwellings) of the Regulation, no building used for human habitation shall be nearer than 500 yards to a waste disposal ground. Under Section 29 (Disposal of Garbage and Other Wastes), every incorporated municipality shall provide for the use of the inhabitants a scavenging system for the collection and disposal of garbage and refuse and such system shall be operated and maintained to the satisfaction of the Medical Health Office. Under Section 32, every incorporated municipality shall provide adequate waste disposal grounds for the disposal of all garbage, refuse, excreta, and other waste matter and shall cause such waste materials to be burned, buried, or covered with a layer of earth or other innocuous material as necessary to deodorize the matter or thing deposited thereon and prevent the breeding of flies. Under Section 33, every waste disposal ground shall be (a) located at least 100 yards from any public road allowance, railway, right-of-way, cemetery, highway or thoroughfare, (b) located at least 500 yards from any building used for human occupancy or for the storage of food, and (c) situated at such a distance from any source of water or ice for human consumption or ablution that no pollution shall take place.

Territorial Lands (Yukon) Act

- **Land Use Regulation (O.I.C. 2003/51):** Outlines what information is required in a land use permit application, land use restrictions/prohibitions, and the general permitting process.

Waters Act

Prohibits the depositing of waste into a waterbody.

Canadian Environmental Protection Act

Regulates the environmental protection of federal lands, federally funded projects, and projects that cross jurisdictional boundaries (i.e., the Yukon/Northwest Territories border).

4.7.2 Future Direction of Yukon Regulations Applicable to Solid Waste Management

The YG's Department of Environment (Environment Yukon) is examining the status of its regulations for permitting solid waste facilities in the Yukon. Many of the permits for the Yukon's solid waste facilities were renewed in the spring of 2009. Renewal of the solid waste permits will trigger environmental assessments under the Yukon Environmental and

Socio-economic Assessment Act (YESAA). As the issuer of the solid waste permits, Environment Yukon will be the decision body in the environmental assessment process; thus, there is additional onus on Environment Yukon to study best practices and regulations in other jurisdictions to harmonize and modernize approaches. Thus, Environment Yukon retained EBA to complete a study to solid waste best practices in the rest of Canada, with particular attention on jurisdiction that have northern and remote facilities similar to the Yukon.

4.7.3 Potential Legislation Changes and their Effects of Waste Handling Practices

Some of the possible regulation changes to come under consideration as a result of the study discussed in Section 4.2 include the following.

4.7.3.1 Controls on the Burning of Wastes

Currently, the Yukon is the only jurisdiction in Canada that does not prohibit the burning of waste. While in practice some areas in Canada do still use burning as a waste management alternative, the official stance, in general, is that the low temperature burning of wastes is no longer a preferred practice.

As mentioned in Section 4.4.1, the burning vessels in place are not engineered facilities, and no controls exist pertaining to heat and emissions. Without these controls, it is difficult to determine the effects these vessels may have on the environment or human health. As such, this unknown causes concern, and these concerns have presently become an area of contention within the Yukon (discussed further in Section 5.3).

Should a "no-burn" policy come into effect, the majority of the waste facilities in the Yukon will face a change. This should be taken into consideration when evaluating the results of the model (Section 9.0) as an argument for proactive planning.

4.7.3.2 Minimum Requirements for all New Facilities or Expansion of Existing Facilities

When considering the establishment of a new facility, it must be understood that current waste regulations in the Yukon do not require the level of engineering that most other jurisdictions in Canada must adhere. This may change, however, if the Yukon harmonizes its practices with the rest of Canada, and amends its waste regulations. The possible result is that new or expanding landfills will require stricter engineering controls, which will lead to both higher costs and better environmental protection. If the burning of wastes continues to be an acceptable practice, then additional controls may become necessary of burning vessels as well.

4.7.3.3 Environmental Monitoring

Minimum environmental monitoring (i.e., air quality, surface water, and groundwater) requirements may become a part of Yukon waste legislation in the near future. Currently, only three waste facilities in the Yukon are equipped with environmental monitoring (Carcross, Marsh Lake, and Upper Liard). Environmental monitoring is critical with respect

to waste facilities, as it is imperative that the risks associated with waste be monitored so that action can be taken to rectify any negative impacts that may occur (i.e., provide early warning).

Environmental monitoring would require additional funds with respect to both capital and operational expenses.

4.8 FUTURE MANAGEMENT OF SOLID WASTE IN YUKON

As discussed in Section 4.3 and Section 4.4., the existing waste management practices in the Yukon involve open trench burning and burial of ash, burn vessels and burial of ash, and manned or unmanned transfer stations. Moving forward, it is likely that the burning of waste will no longer be a viable waste option in the Yukon, and as such, additional alternatives will need to be considered.

The alternatives considered within this study beyond current operations in the Yukon included:

- Transfer Stations – With a number of these facilities in place already, transfer stations present a viable alternative for burn-based waste operations. It has been assumed that only manned transfer stations, for the most part, should be considered for larger sized unincorporated waste facilities. Unmanned transfer stations may be viable in communities with low population bases, though controlled access hours would likely still be necessary to ensure proper facility use.
- Incineration Facilities – An incinerator is a more technologically advanced burning vessel that uses fuel to burn wastes in a pair of chambers, where gases are filtered rather than being directly released into the atmosphere. Within an incinerator, waste burns at extreme temperatures, which generates cleaner residue gases as well as enough heat that could potentially be tapped as an energy source.
- Regional Landfills – Landfills operate as an anaerobic process[4] (that is, degradation occurs in the absence of oxygen), that encapsulates waste under cover of soil. Over time, the waste degrades and produces "landfill gas"; in fact a mix of gasses with high methane and carbon dioxide levels that penetrates the soil cover and enters the atmosphere. These gasses are known as "greenhouse gasses". A regional landfill is meant to operate as a single landfill facility accepting wastes from numerous contributing unincorporated waste facilities.

Within each site, there are also a number of other measures to be considered that would improve the current operations, but not necessarily change the overall operating structure or operating cost. Such recommendations for improvements will be incorporated into subsequent reporting volumes.

[4] Note that landfills only operate as an anaerobic process once the oxygen within the landfill has dissipated (i.e., once aerobic processes are exhausted).

In addition to these alternatives, waste facility closures are also to be seriously considered in some cases.

Each facility alternative discussed above was evaluated as part of this study based on environmental and human safety risks, carbon footprints, costs and future cost projections, and relative political viability. The following waste sections describe the methods used in conducting these evaluations.

5.0 TASK 2 – PROTECTION OF ENVIRONMENT AND HUMAN HEALTH

As part of the assessment prepared for Yukon's existing waste management facilities, EBA evaluated the impact that these facilities have on the surrounding environment from two perspectives: relative effect on the environment and human health and safety, and carbon footprints.

The following sections describe the relative risks that facility alternatives might pose to the environment and/or human health and safety, as well as the assumptions made for the carbon footprint calculations. This information forms the basis upon which the waste model will evaluate these factors, as later discussed in Section 9.0.

5.1 RELATIVE IMPACT ON THE ENVIRONMENT AND HUMAN HEALTH AND SAFETY

In evaluating the extent of environmental and human health effects related to each waste facility alternative, three categories of exposure were examined:

- **Wastes Accepted** – These considerations represent the relative risks associated with the acceptance of select waste types. Each type of waste accepted at a waste facility poses certain risks to both the environment and the health and safety of those using the facility. While domestic wastes and yard trimmings should have minimal risks associated with them, wastes such as car batteries, household hazardous waste (HHW), and propane tanks fall into a more severe risk category.
- **Operational Risks** – The activities and day-to-day operations of a waste facility vary from site to site, and each process poses a certain risk to site users and the surrounding environment. For example, the absence of environmental monitoring (i.e., groundwater or air quality) poses a risk because the impacts of the waste facility are unknown and cannot be compared against any baseline data. A burning vessel also causes a hazard due to the potential for a user to burn him/herself on the unit.
- **Distance to Sensitive Receptors** – These risks are those related to a waste facility's proximity to sensitive receptors. Considered within the model are the distances to waterbodies, water wells, and residences. Also considered as a risk within the model is the potential for illegal dumping where users would have to travel a greater distance to their waste facility. Within the waste model, these calculations are evaluated on a relative scale from 0 to 10 as distances increase or decrease, respectively.

Additional factors not included in this analysis, due to a lack of published information, include the volumes and concentration of select waste types, which would require an in depth auditing process at each facility. Also discounted from evaluation are site conditions such as groundwater depths, which are not available due to the absence of environmental monitoring controls at the majority of facilities.

5.1.1 Model Incorporation of Environmental Assessment

The environmental and human safety risk calculations made in the model (discussed further in Section 9.0) are based on a scoring system according to the relative risk associated with the environmental and safety hazards present at any given facility or alternative.

The risk ratings (low, moderate, and high) are assigned to each potential hazard by the user. The user is also able to assign a weighting scheme to the risk ratings to establish the desired level of disparity between scores. At the present time, default weighting for low, moderate, and high risk ratings have been set at 1, 5, and 10, respectively.

In general, the environmental risks at a landfill (air, groundwater, and surface water concerns) are calculated as being half of those present at a burning operation, due to the engineering controls in place. A transfer station also has less associated risk as the waste materials are not permanently stored at the facility, and operations are relatively safe and environmentally friendly, assuming that there is controlled and supervised access to the facility.

It should be noted that the scoring system utilized in these calculations is relative, and only provides an indication of how environmentally unfriendly a particular facility may be in comparison to another. The results do not reflect a scientific quantification. Please refer to Table 1 for a typical environmental risk calculation summary.

5.2 CARBON FOOTPRINTS

The carbon footprints for each facility and the available alternatives are based upon recently published information on greenhouse gases and how they relate to waste management. Specifically, the document entitled *Determination of the Impact of Waste Management Activities on Greenhouse Gas Emissions: 2005 Update Final Report, Submitted to: Environment Canada and Natural Resources Canada, IFC Consulting, October 31, 2005* (IFC Consulting 2005) was used almost exclusively for equivalent carbon dioxide (eCO_2)[5] release factors to be applied to the Yukon's waste practices.

The carbon footprints examined in this study are representative of GHG inventories consistent with the methodology established by the Intergovernmental Panel on Climate Change (IPCC), as clarified in the following excerpt (IFC Consulting 2005):

[5] Equivalent Carbon Dioxide (eCO2) is the term preferred by the Intergovernmental Panel on Climate Change to denote the emission inventory of a particular process. All emissions are put in terms of carbon dioxide equivalence in order to establish a standardized unit quantity of emissions (e.g., methane emissions are equivalent to 21 to 27 times that of carbon dioxide, or 21 to 27 eCO2 on a unit to unit basis). Positive eCO2 values denote a release of emissions above and beyond the natural carbon cycle, whereas negative eCO2 values denote a negative emission of carbon dioxide (i.e., carbon dioxide equivalents are actually removed from the atmosphere).

CO_2 Emissions from Biogenic Sources

Canada and all other parties to the Framework Convention on Climate Change agreed to develop inventories of GHGs for purposes of (1) developing mitigation strategies and (2) monitoring the progress of those strategies. The Intergovernmental Panel on Climate Change (IPCC) developed a set of inventory methods to be used as the international standard. (IPCC, *Guidelines for National Greenhouse Gas Inventories* (three volumes), 1997.) The methodologies used in this project to evaluate emissions and sinks of GHGs will be consistent with IPCC's guidance.

The IFC Consulting document provides a waste-by-waste breakdown of eCO_2 based on waste disposal practices (recycling, combustion, landfilling, etc.). Additionally, the document provides emission factors on a per tonne of waste basis for landfill equipment, transportation, and energy use. Refer to Table A for a sample selection of the information utilized.

TABLE A: IFC CONSULTING: IMPACT OF WASTE MANAGEMENT ACTIVITIES ON GREENHOUSE GASES – SAMPLE TABLE

Waste Type (Samples Only)	Net Recycling Emissions (tonnes eCO_2/tonne of waste)	Net Composting Emissions (tonnes eCO_2/tonne of waste)	Net Combustion Emissions (tonnes eCO_2/tonne of waste)	Landfill Without Landfill Gas Collection (tonnes eCO_2/tonne of waste)
Newsprint	-0.3	0	-0.05	0.32
Cardboard	-0.21	0	-0.04	1.66
Steel	-1.18	0	-1.03	0.01
Glass	-0.1	0	0.01	0.01
HDPE	-2.27	0	2.89	0.01
Food Scraps	0	0.02	0.02	1.23
Yard Trimmings	0	0.02	0.01	0.59

Of note for carbon footprint calculations is the definition used in Canada as to what contributes to emissions (IFC Consulting 2005):

> "[…] for processes with CO_2 emissions, if (a) the emissions are from biogenic materials (i.e., organics), and (b) the materials are grown on a sustainable basis, then those emissions are considered to simply close the loop in the natural carbon cycle – that is, they return to the atmosphere CO_2 which was originally removed by photosynthesis. In this case, CO_2 emissions *are not* counted."

This distinction is of particular importance when considering the burning of organic wastes versus the burial of these wastes. Following this methodology, the burning of organic wastes "closes the loop" of the natural carbon cycle, whereas the burial of organic wastes in a landfill generates methane that is above and beyond the emissions of the waste's natural carbon cycle. This trend is evident in examining the emission factors from the sample table above.

The components that make up the carbon footprint for each waste facility evaluated in the model are discussed in the following sections.

5.2.1 Waste Acceptance and Handling

The carbon footprint calculation for waste acceptance and handling at a facility is based on three parameters: total waste (in tonnes) deposited at the facility, the waste stream composition (currently represented by 1994 Whitehorse landfill waste audit data), and emission factors (in tonnes eCO_2/tonne of waste) according to the waste handling practice employed for each respective waste type (i.e., burn, bury, recycle, compost). For example, in a burning vessel facility, food scraps are burned, whereas in a landfill, they are buried. Each handling procedure has a respective eCO_2 factor applied to it (IFC Consulting 2005), and the respective totals are tallied along with the other materials.

Example Calculation:

Note: Upper Liard, a burning vessel facility located approximately 15 km away from Watson Lake (an incorporated community that would likely accept Upper Liard's waste if Upper Liard were to function as a transfer station) has been used as the basis for all carbon footprint calculations.

Total tonnes of waste received at the Upper Liard facility, annually – 215 tonnes

Waste composition sample (as per 1994 Whitehorse landfill waste audit):

Newsprint – 5.2% = 11.2 tonnes

Food Scraps – 27.8% = 59.8 tonnes

Glass – 5.4% =11.6 tonnes

Note: The wastes included in the list above only represent a sample of the entire waste stream and are used to depict the typical calculations that are made for every waste type within Yukon's waste stream.

Burning Vessel Sample Calculation:

11.2 tonnes newsprint, burned = 11.2 tonnes x (-0.05 eCO_2tonnes/tonne) = -0.56 tonnes eCO_2

59.8 tonnes food scraps, burned = 59.8 tonnes x (0.02 eCO_2 tonnes/tonne) = 1.20 tonnes eCO_2

11.6 tonnes glass, recycled = 11.6 tonnes x (-0.1 eCO_2 tonnes/tonne) = -1.16 tonnes eCO_2

Total waste acceptance eCO_2 for newsprint, food scraps, and glass: **-0.52 tonnes eCO_2**

Landfill Sample Calculation:

11.2 tonnes newsprint, buried = 11.2 tonnes x (0.32 eCO_2 tonnes/tonne) = 3.58 tonnes eCO_2

59.8 tonnes food scraps, buried = 59.8 tonnes x (1.23 eCO_2tonnes/tonne) = 73.55 tonnes eCO_2

11.6 tonnes glass, recycled = 11.6 tonnes x (-0.1 eCO_2 tonnes/tonne) = -1.16 tonnes eCO_2

Total waste acceptance eCO_2 for newsprint, food scraps, and glass: **75.97 tonnes eCO_2**

In performing these calculations, one assumption that has been made is that a transfer station will have the same carbon footprint as a landfill (for waste acceptance and handling totals only), as the waste collected at a transfer station is delivered to a landfill and experiences the same anaerobic digestion process discussed in Section 4.8.

The landfill eCO_2 factors are based on a Canadian landfill average, and while the Yukon may have less methane generation than the average Canadian landfill, this cannot be confirmed without a separate study. In general, the methane generation may be delayed somewhat in the dry and frozen climate, but over time, methane generation capacity is expected to be similar.

Table 2 presents a typical carbon footprint summary for a typical Yukon waste facility (Upper Liard). As seen in this table, the lowest carbon footprints are actually associated with burning of wastes (assuming that recycling is a separate waste handling process employed in a community regardless of the facility type in place). Conversely, transfer stations represent the most significant carbon footprint generation, largely due to the burial of wastes and generation of methane at the waste's final destination (i.e., a landfill). These calculations are based on the assumption that the waste burned in the burning vessels comprises 65.7% biogenic material and 8.7% non-biogenic material (plastic containers, bags, etc.). The remainder of the waste stream is considered bulk or recyclable waste that is transported to a municipal landfill and handled separately.

Waste Model Assumptions

For the purposes of the carbon footprint calculations within the model, the waste materials are assumed to be handled as follows.

TABLE B: WASTE TYPES AND ASSUMED HANDLING PRACTICES

Waste Type	Handling Practice
Newsprint	Burn/Bury
Cardboard	Burn/Bury
Other Paper	Burn/Bury
Aluminum	Recycled
Steel	Recycled
Copper Wire	Recycled
Glass	Recycled
HDPE	Burn/Bury
PET	Burn/Bury
Other Plastic	Burn/Bury
Food Scraps	Burn/Bury
Yard Trimmings	Burn/Bury
White Goods	Recycled
Personal Computers (Estimated – No Data Available)	Recycled
Televisions (Estimated – No Data Available)	Recycled
Microwaves (Estimated – No Data Available)	Recycled

TABLE B: WASTE TYPES AND ASSUMED HANDLING PRACTICES (CONTINUED)	
Waste Type	Handling Practice
VCRs (Estimated – No Data Available)	Recycled
Tires (Estimated – No Data Available)	Recycled

The immediate question that comes to mind when examining the list in Table B likely pertains to why paper and plastics are not considered as recyclables. This is due to the perspective from which the waste model is examining the waste stream.

The waste audit data that is being used (1994 Whitehorse landfill survey data) represents the waste that was received at the landfill at that time. It is fair to assume, however, that "traditional recyclables" (e.g., newsprint, paper, cans) have since been removed from this waste stream and are not buried at the landfill any longer; either the recyclables are diverted at the landfill itself, or diverted by the community at recycling depots. As such, the 1994 data is not ideal for use in the model, but it is the only data presently available.

The wastes that are treated as recyclables for the carbon footprint calculations (e.g., white goods, metals) are those wastes which are not to be deposited in a burning vessel if an average user makes a trip to their local waste facility. These are wastes that are segregated at the facilities themselves and collected separately.

If a burning vessel facility were to be converted to a transfer station, the assumption has been made that the facility will operate in the same manner, except that instead of depositing wastes into a burning vessel, the user is instead putting the waste in transfer station bins. As such, there is no increase in recycling after the conversion.

Certainly, there are ways to increase diversion, and thereby lower the carbon footprint of a facility, regardless of whether it is a transfer station or burning vessel. Keeping in mind that that the model is looking at the waste stream from the facility acceptance level, staff at the facility can direct recyclable waste deposited by users into special areas, as presently occurs at Mt. Lorne and Marsh Lake. If these wastes are then taken from the transfer station to Raven Recycling rather than the Whitehorse landfill, the carbon footprint associated with their disposal will be reduced.

The model does not look at this reduction potential, however. It is generalized to assume that the only practice that changes from current operations to transfer station operations is that the burning vessel is swapped out for transfer bins. As Mt. Lorne and Marsh Lake do operate more responsibly, however, it is fair to perform more reflective carbon footprint calculations specific to their waste diversion practices.

Please refer to Table 2A that highlights the changes that come into effect for Marsh Lake and Mt. Lorne, assuming 60% diversion of "traditional recyclables", and 60% diversion of compostable food scraps and brush. These diversion rates are conservatively generous. Looking at the results, the carbon footprints can be drastically reduced based on diversion efforts, if the same diversion tactics are employed at a burning vessel facility, the burning

vessel still reflects the lower score. It is clear, however, that diversion efforts are critical to lowering a facility's overall carbon footprint total.

5.2.2 Energy Use

Energy use in the landfill scenario is the amount of electricity required to operate the facility on a per tonne of waste equivalent basis (IFC Consulting 2005). Incineration energy use is based on the amount of diesel fuel required to operate the incinerator. Energy consumption is assumed to be zero for facilities that don't incinerate or landfill.

Example Calculation:

Energy use at waste management facilities = 0.6 kilograms eCO_2/tonne waste

Waste acceptance at Upper Liard: 215 tonnes

Total energy use at landfill: 0.6 kilograms eCO_2/tonne x 215 tonnes = 0.13 tonnes eCO_2

5.2.3 Landfill Heavy Equipment

"Landfill heavy equipment" has been taken to mean compactors and grading equipment utilized at a landfill for the burial of wastes. As such, this calculation only applies to landfills, and is calculated from a per tonne of waste factor meant to represent the carbon footprint of the heavy equipment required to operate a landfill (IFC Consulting 2005). It should be noted that while this factor's contribution to the overall carbon footprint is small, it may still be overestimated due to the Yukon's northern setting and limited heavy equipment requirements in comparison to a typical Canadian landfill. Also note, however, that cold weather typically decreases fuel efficiency and increases air emissions.

Example Calculation:

Landfill heavy equipment use emission factor = 4 kilograms eCO_2/tonne waste

Waste acceptance at Upper Liard: 215 tonnes

Total emissions at landfill: 4 kilograms eCO_2/tonne x 215 tonnes = 0.86 tonnes eCO_2

5.2.4 Waste Collection and Transportation

The waste collection and transportation carbon footprint calculation is based on the distance a large haul truck would have to travel to collect the waste at a burning facility, transfer station, or incineration facility and take it to a landfill. This vehicle is assumed to be a large diesel truck with an efficiency of 7 miles per gallon (GHG 2005). There is no haul distance required for a regional landfill, as the users of the facility would deposit the waste themselves. It has been assumed that a transfer station would require twice the number of hauls in comparison to other waste management alternatives, as there will be more waste to transport if organics (e.g., food scraps, brush) are not burned on site.

Example Calculation:

Distance from Upper Liard to nearest incorporated community (Watson Lake): 15 km

Number of haul loads per year: 12

Emission factor for diesel truck with fuel efficiency of 7 mpg: 0.9226 kg eCO_2/km

Total waste collection emissions: 15 km x 2 (roundtrip) x 12 loads x 0.9226 kg eCO_2/km = 0.3 tonnes eCO_2

5.2.5 Average User Distance Travelled

This factor assumes that the average waste facility user operates a pickup truck with a gasoline engine and efficiency of 14 miles per gallon. The roundtrip distance is multiplied against an eCO_2/km factor (GHG 2005).

The user distance calculated for most facilities is conservatively based on half the distance between the respective facility and the closest other facility. For a regional landfill, the roundtrip distance is based on the distance from the respective facility to the nearest incorporated community (i.e., where a regional landfill would likely be located). The number of trips that have been assumed on an annual basis is 26 (bi-weekly). As many of the users share their waste facility trips (i.e., as families), however, a factor of 0.5 has been applied to the number of trips assumed for a total of 13, annually.

Example Calculation:

Distance from Upper Liard to nearest incorporated community (Watson Lake): 15 km

Number of users: 250

Number of trips per year: 26 x 0.5 = 13

Emission factor for gasoline pickup truck with fuel efficiency of 14 mpg: 0.4002 kg eCO_2/km

Total waste collection emissions: (15 km/2) x 2 (roundtrip) x 250 users x 13 trips per year x 0.4002 kg eCO_2/km = 19.5 tonnes eCO_2

5.3 CARBON FOOTPRINT VERSUS AIR QUALITY

When considering emissions, there is sometimes confusion over the terms "carbon footprint" and "air quality", though these topics are largely independent of one another.

As explained in Section 5.2, carbon footprints represent an inventory of greenhouse gases in terms of equivalent carbon dioxide (eCO_2), based on methodology derived from the IPCC. Air quality, on the other hand, is a more subjective parameter that relates to pollutants in the atmosphere that may have an adverse effect on the environment and human health. These pollutants include a number of different particles and gases, but not necessarily greenhouse gases, and it is this distinction that is at times counter intuitive when comparing the terms.

In considering the combustion of organic materials such as brush, for example, burning releases carbon dioxide into the atmosphere, but this type of release is classified as being biogenic (see Section 5.2). It is not counted through carbon footprint methodology because it is not a release of "fossil" CO_2 but rather the return of absorbed carbon dioxide (through photosynthesis) to the atmosphere as part of the natural carbon cycle. Conversely, the degradation of organics in a landfill produces methane that would otherwise not enter the atmosphere, and produces a significant carbon footprint total (tonnes eCO_2) as a result. Methane is an especially potent greenhouse gas, considered to be 21 to 27 times more potent than CO_2.

Both carbon footprint and air quality have been taken into consideration in this study, and while carbon footprints are an important factor that should be targeted for reduction (e.g., through increased diversion of recyclables), it is not to outweigh or to be confused with air quality. Each effect has its own environmental impact, but carbon footprint is the topic of major discussions across the globe presently, largely because of its quantifiable nature.

5.4 AIR DISPERSION MODELLING

An important consideration for air quality arguments in the Yukon is that some of the solid waste facilities are located in valley depressions. These depressions can cause temperature inversions, which preclude dispersion of smoke and results in accumulation of airborne pollutants at these facilities. To this effect, EBA has retained SENES Consulting Limited (SENES) on behalf of the YG to conduct air quality modelling for a number of representative waste facilities. These results should provide further insight as to the environmental and human health concerns associated with the burning of waste.

6.0 TASK 3 – COST ANALYSIS OF PROPOSED AND EXISTING PRACTICES

The cost estimates prepared as part of this study, which are incorporated into the waste model later discussed in Section 9.0, included following waste alternatives:

- Open trench burning and burial.
- Burn vessels and burial of the ash and unburned waste.
- Regional landfills.
- Transfer stations and regional solid waste disposal.
- Incineration.

Based on these Class C estimates, site specific totals were developed for each facility and the available alternatives. A Class C cost estimate is meant to provide a budgetary indication of the costs to be expected. The accuracy of this level of estimate is not to be relied upon for quotation purposes, but is typically indicative of the order of magnitude anticipated. The methodology used to prepare these calculations is discussed in the following sections.

The Burwash Landing facility was consistently used in the sample calculations as a representative facility.

6.1 BURN AND BURY IN TRENCH

Capital Costs – As only one such waste facility currently operates in the Yukon (Carcross), the capital cost for this option is considered to be zero. Burn and bury in trench is considered to be the least engineered alternative available, and so the other waste alternatives are not permitted to regress within the model.

User Cost – There is no additional user cost associated with the burn and bury in trench option than is currently present.

Operational Expense – The operational expenses are based on the 2007/2008 contract price the YG has in place with the Carcross burn and bury in trench facility. Please refer to Table 3 for a summary of these annual contracts that Community Infrastructure has in place for its unincorporated facilities.

6.2 BURN IN A BURNING FACILITY (I.E., BURNING VESSEL) AND BURY IN TRENCH

Capital Costs – As only one waste facility in the Yukon utilizing a burn and bury operation does not have a burning vessel in place (Carcross), the capital cost for this option is considered to be zero in all cases, barring the exception, where a $10,000 lump sum would be required to upgrade the facility.

User Cost – There is no additional user cost associated with the burn in a burning facility and bury in trench option than is currently present.

Operational Expense – The operational expenses are based on the 2007/2008 contract prices the YG has in place with the burning vessel facilities. For evaluating Carcross as a burning vessel facility, these contracts have been averaged out by taking the total price of the contracts for burning vessel facilities and dividing by the total number of users at the burning vessel facilities. Please refer to Table 3 for a summary of these costs.

Example Calculation

Average Burning Vessel Contract: $24,166.62

Average Number of Burning Vessel Users: 156.2

Average Per User Cost of Burning Vessel Facility: $24,166.62/156.2 = $154.72

6.3 REGIONAL LANDFILL

A regional landfill considers a circuit network of surrounding waste facilities, and assumes that these facilities would all close in favour of a regional landfill. This landfill's location is based on a "circuit capital", which is the largest incorporated community within the circuit (i.e., Haines Junction, Whitehorse, Carmacks, and Mayo).

For the Mayo circuit, it has been assumed that a new landfill would not be required, and that both Stewart Crossing and Keno City (since these are small facilities) would be able to deposit their wastes at the Mayo facility at an annual cost based on a per tonne deposition (i.e., $75/tonne). However, the other circuit capitals would likely require the construction of new regional landfills, since use of existing landfills is not guaranteed.

All landfill costs represent the portion of the total landfill that a specific facility would have to pay as a fraction of the circuit's total (i.e., Burwash Landing represents 77 m^3 of 355 m^3 total waste volumes in the Haines Junction waste circuit, which is equal to 21.7% of the total price to construct and operate a landfill in Haines Junction).

Capital Costs – The capital cost for a landfill is based on a Class C cost estimate that was prepared by EBA for landfill construction costs. This cost does not include land acquisition. Please refer to Table 4 for this estimate.

User Cost – This cost is based on the round-trip distance a user would have to travel should their waste facility be closed in favour of a regional landfill. The scoring system used to reflect this cost is based on a scale from 0 to 10 according to the respective cost associated with the travel distance (i.e., if the cost is under $5, the score is 2, if the cost is under $20, the score is 6, and if the cost is over $50, the score is 10).

Example Calculation:

Distance From Burwash Landing to Haines Junction: 125 km

Price of Gas: $1.20/L (as of October 2008)

Vehicle Efficiency: 14 mpg (Pickup truck) = 5.95 km/L

Cost to User: 125 km x 2 x $1.20/L x (1/5.95 km/L) = $60.50

Operational Expense – The operational components of a landfill are divided into the following.

Annual Contract: This cost has been estimated as being the annual costs required to build a portion of a landfill cell to maintain the waste bearing capacity of the landfill. Please refer to Table 5 for this cost estimate.

Example Calculation:

Cost to Build Landfill Cell (8,000 m^3 Capacity): $286,000

Note: 8,000 m^3 is meant to represent a five year waste capacity for the entire waste circuit.

Total Annual Volume for Haines Junction Circuit: 355 m^3

355 m^3/8,000 m^3 = .044375

Burwash Landing Waste Volume = 77 m^3

77 m^3/355 m^3 = 0.2169

Annual Cost to Burwash Landing for Landfill Cell: 0.044375 x 0.2169 x $286,000 = $2,752.72

Operation and Maintenance: This has been estimated from the actual average cost from larger waste facilities currently operating in the Yukon that receive similar volumes of waste to those expected (e.g., Mayo, Carmacks, Faro). Added to this cost are items that apply to an engineered landfill (e.g., litter control, leachate management, daily cover) as well as one full-time staff member required to operate a scale house. Please refer to Table 6 for the cost estimate utilized in these calculations.

Example Calculation:

Operation and Maintenance Cost per tonne of waste deposited: $69.27 (includes O+M contract, litter control, leachate management, etc.)

Staffing Cost: $60,000/yr/landfill

Waste Quantity at Burwash Landing: 110 tonnes/year

Waste Quantity in Haines Junction Circuit: 507 tonnes/year

Operation Cost At Burwash Landing: $69.27 x 110 tonnes/year + [(110/507) x $60,000)] = $20,650

Operation Cost for Full Haines Junction Landfill: $69.27 x 507 tonnes/year + $60,000 = $95,150

Haul Costs: Are assumed to be zero, as users will be required to transport the waste to the landfill themselves.

6.4 TRANSFER STATION AND REGIONAL SOLID WASTE DISPOSAL

All costs for transfer stations assume only those costs for the actual transfer station, and does not include any costs associated with the construction or operation of a regional landfill.

Capital Costs – The transfer station capital costs were projected based on the cost estimates provided in the 2001 Solid Waste Strategy prepared by Gartner Lee (Gartner Lee 2001). These costs have been verified using updated costs from a 1996 British Columbia Ministry of Environment publication entitled "Guidelines for Establishing Transfer Stations for Municipal Solid Waste", which provides a detailed examination of many different sized facilities for different anticipated waste volumes. These estimates are based on using two 40 yd^3 (30.6 m^3 x 2 = 61.2 m^3) containers. At a minimum, the two containers will be required, and this price is scaled upwards depending on the amount of waste received at a facility. Please refer to Table 7 for the cost estimate prepared for this study.

It should be noted that while the number of bins required at each site will vary, it has been assumed that the volume of waste accepted each year will reflect the number of bins required. This assumption is based on an understanding that the transfer station bins will be collected on a regular basis, but also that there will be a need for additional bins designated to receive different wastes.

Example Calculation:

Burwash Landing Annual Waste Volume (Uncompacted): 127 m^3

Containers Required: 127 m^3/61.2 m^3 = 2.075

Cost of Transfer Station for Two Bins = $88,650

Cost Component to Increase as a result of More Bins: $43,900 (includes retaining wall, concrete pad and bin and lid costs)

Cost of Transfer Station for Burwash Landing = ($43,900 x 2.075) + ($88,650 – $43,900) = $135,850

User Cost – There is no additional user cost associated with the transfer station option.

Operational Expense – The operational components of a transfer station are divided into the following.

Annual Contract: The annual contract prices are based on the 2007/2008 contract price the YG has in place with existing transfer stations (Table 3), assuming that staffing would be required for any transfer station to operate effectively.

Operation and Maintenance: Assumed to be a part of the contract price.

Haul Costs: Haul costs are based on a $0.75/km haul charge. Landfill tipping fees, if applicable, are assumed to be part of the contract price.

6.5 INCINERATION

Costs developed for an incineration facility assume that the incinerator would replace a burning vessel or burn and bury operation, and would accept wastes in a similar fashion to current practices.

Capital Costs – Costs for incineration facilities are balanced based on two estimates received; one from a Canadian company that has previously supplied an incinerator to Skagway, Alaska, and the other from an Alaska report on the burning of wastes (Alaska 2004). Please refer to Table 8 for the cost estimate prepared for incinerator facilities.

User Cost – There is no additional user cost associated with the incineration option.

Operational Expense – The operational components of an incinerator facility are divided into the following.

Annual Contract: These costs are amalgamated with the operation and maintenance costs.

Operation and Maintenance: These costs are based on the fuel and labour required to perform 140 burns throughout the year.

Example Calculation:

Diesel Fuel Required for Burn: 100 Gallons (378.5 L)

Price of Fuel: $1.20/L (October 2008)

Incinerator Capacity: 1 tonnes/day (burnable materials)

Amount of Waste at Burwash Landing: 110 tonnes/yr (Burnable Composition 65.7%)

Number of Burns Required Per Year: 110 x 65.7% = 72.3

Length of Burn: 5 hrs

Staffing Cost: $25/hr

Annual Training Cost: $500

Total Incineration Cost: (378.5 L x $1.20/L x 72.3) + (72.3 x 5 hrs x $25/hr) + $500 = $42,400

Additional Cost = Half of contract required with a burning vessel facility for upkeep, maintenance, and collection of the materials that cannot be burned.

Haul Costs: Haul costs are based on a $0.75/km haul charge for the bulk wastes that cannot be burned at the facility.

6.6 FUTURE COST PROJECTIONS

Table 9 and Table 10 depict the future cost projections determined for each waste facility alternative. The following sections discuss the methodology used in determining these projections.

Projecting the costs of starting up and operating the Yukon's solid waste disposal alternatives over a 20 year period has a number of challenges, some common to all long-term projections and some particular to solid waste disposal. Three major factors will drive the cost projections:

1. projected population;
2. expected per capita waste generation rates; and
3. cost inflation.

6.6.1 Population Projections

Population is the single largest factor driving the quantity of solid waste produced in the Yukon; therefore, the costs of handling and disposing of the waste. Because we are projecting the costs of existing facilities and possible scenarios over a 20-year time horizon, the estimated population over that period becomes the key assumption.

Statistics Canada (Stats Can) provides a number of population projections for the Yukon based on different demographic and migration scenarios. It is also possible to do a linear projection following existing long-term trends. Finally, the Yukon Bureau of Statistics (YBS) provides three population projections for 2018 only that act as a cross-check for the other approaches. Summarized in the table below are a number of possible population projections for the Yukon, each with its own strengths and weaknesses.

YUKON POPULATION PROJECTION SUMMARIES

Year	Stats Can Scenario 4	Stats Can Scenario 5	Linear Projection	YBS Medium Growth Scenario	YBS High Growth Scenario
2013	33,300	28,700	33,673	-	-
2018	34,700	27,900	36,086	35,107	38,606
2023	36,100	27,500	38,672	-	-
2028	37,400	27,300	41,444	-	-

Notes:

1. The Stats Can Scenario 4 produces the highest population figures of the 13 offered by the agency. It is based on medium natural population growth assumptions, a constant national immigration rate of 0.7% and the relatively high inter-provincial migration patterns seen between 1988 and 1996 for the Canadian west coast.
2. Stats Can Scenario 5 is based on the same natural population growth assumptions as Scenario 4 and the same national immigration rate, but a lower inter-provincial migration pattern seen in central-west regions of the country.
3. The linear projection figures come from applying the Yukon's average annual population growth rate from 1971 through to 2007 (1.39%) to the territory's current population.
4. The YBS medium growth scenario assumes that current demographic trends continue but holds net migration at zero.
5. The YBS high growth scenario assumes a 10% increase in the birth rate, a 10% decrease in the death rate, and a net in-migration of 300 people annually to the Yukon.

For this report, the Stats Can Scenario 4 projection has been used for these reasons:

- The linear projection has the advantage of including the effects of past population swings caused by abrupt changes in the territorial economy, and particularly the closing and reopening of the Faro mine in the 1980s and 1990s. However, using straight line projections from past data for extended future projections is inherently problematic. In particular, it locks in the effects of past demographic patterns that have since substantially changed (i.e., total fertility rates dropped by 13% between 1974 and 2006).
- Both of the Stats Can projections rely on prudent demographic assumptions such as a fertility rate lower than the current one and a steady level of immigration.
- The higher inter-provincial migration assumption that drives the large difference between Stat Can Scenario 4 and Scenario 5 presupposes a reasonable degree of economic growth attracting newcomers to the Yukon but, given that the YBS is projecting a higher population in 2018 by natural growth alone, it does not appear

excessive (Stats Can is using a total fertility rate of 1.50, while the YBS is projecting that the 2006 Yukon rate of 1.69 will continue).

- In summary, Scenario 4 appears to strike the most reasonable balance between the key factors that will drive population changes in the Yukon over the next 20 years.

For specific Yukon communities, EBA will be assuming that each scenario will contain the same proportion of the Yukon's population as it did in June 2008.

6.6.2 Per Capita Waste Production and Trends

In 2001 and 2002, waste surveys were undertaken in Whitehorse, Haines Junction, Watson Lake, and Carmacks[6]. The average of these surveys was a figure of 0.795 tonnes per person per year. This is higher than the average of 0.620 tonnes per capita found in British Columbia in the same two years, but quite comparable to the 0.879 tonnes in British Columbia in 1990[7].

The City of Whitehorse landfill shows wide variations in the amount of waste entering the landfill, ranging from just over 15,000 tonnes in 2000 to 30,000 tonnes in 2002, with an average of approximately 22,500 tonnes from 2000 to 2005[8]. The average population of the Whitehorse area over those six years was 22,614 according to the YBS. This implies an average waste production of 0.995 tonnes per person per year but varying from 0.664 tonnes to 1.352 tonnes.

The trend of per capita solid waste production in British Columbia was very stable between 2001 and 2005, averaging 0.632 tonnes with a variation of +4.9% to -3.6%, after having fallen substantially from the 1990 baseline of 0.879 tonnes. The large decline to a relatively stable average is attributed to a substantial province-wide effort to divert waste, largely through recycling. The pattern that British Columbia has followed shows that it is unwise to project smooth changes in per capita waste production over time. The recent abrupt and precipitous plunge in the price of a wide variety of waste that is now commonly recycled, including cardboard, paper, and metals, also provides a warning that reductions in per capital waste production are not necessarily permanent.

From the above data and trends, we believe it is prudent to use a per capita waste production estimate of 0.9 tonnes per year.

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6 Access Consulting Group, 2001 and 2002 and G.J. Bull & Associates 2001.

7 Recycling Council of British Columbia. BC Municipal Solid Waste Tracking Report, 2003 to 2005.

8 Posted at: www.city.whitehorse.yk.ca.

6.6.3 Cost Inflation

Long-term cost projections are particularly sensitive to assumptions about how much costs will increase over time. Because Canada has not experienced a generalized decrease in prices (deflation) since the 1930s, assuming that costs will remain stagnant or decline over the long term would not be prudent.

The consumer price index (CPI) is the standard measure of inflation in the economy. In Whitehorse, the average annual inflation rate for 2000 to 2007 has been 1.7%. The CPI measures the prices of a basket of standard consumer goods, a basket that is gradually adjusted as new products and services become standard or popular items.

A better measure of inflation for projects such as incinerators or a transfer station is the industrial product price index (IPPI) tracked by Stats Can. No separate data is available for the Yukon, but the Canadian IPPI showed average annual price increases of 2.1% from 2003 through 2007. The IPPI includes a wide variety of categories including: metal fabricated products, machinery and equipment, and petroleum products. We have used the average IPPI as our measure of cost inflation.

7.0 TASK 4 – PUBLIC AND STAKEHOLDER MEETINGS

(To be prepared as part of future volumes of reporting)

8.0 TASK 5 – ANALYSIS OF THIRD PARTY AND COMMUNITY MANAGEMENT OF SOLID WASTE FACILITIES

8.1 COMMUNITY INVOLVEMENT IN WASTE MANAGEMENT

Under the Municipal Act (Yukon), municipalities are able to operate solid waste disposal facilities for their residents. Outside of incorporated municipalities, however, the YG is responsible for managing all waste facilities. Given that unincorporated communities are not taxed for these services, the allotted budget for facility operation and maintenance is not ideal and must be offset by volunteerism in the respective unincorporated communities.

Not surprisingly, larger communities in the Yukon have a larger volunteer base to draw support from, and many communities have committees that lead waste initiatives and planning.

Marsh Lake and Mt. Lorne, not coincidentally the only staffed transfer stations in the Yukon, have the highest community participation.

The Marsh Lake site was converted into a transfer station by the community in order to eliminate the burning of waste there. The community was involved in the design of the new system through the use of community surveys, and community members participated in the construction of the new facility. Similar participation is drawn in Mt. Lorne, where the Mt. Lorne transfer station is run by the Lorne Mountain Community Association.

(Additional information to be prepared as part of future volumes of reporting)

8.2 AVAILABLE FUNDING

Each facility outside of an incorporated community is funded by YG. The majority of this funding goes towards maintenance contracts with various contractors throughout the Yukon to upkeep the respective facilities and remove the bulk wastes to areas better suited to accepting them.

There are a number of funding resources available in the Yukon that can help to offset government expenses. These funding alternatives include:

- Gas Tax Fund (GTF);
- The Green Municipal Fund;
- Infrastructure Canada Program; and
- First Nation Infrastructure Fund (FNIF).

Please refer to Appendix A for additional information on these programs.

(Additional information to be prepared as part of future volumes of reporting)

8.3 FUNDING TRIGGERS

(To be prepared as part of future volumes of reporting)

8.4 BEST COMMUNITY PRACTICES

The practices employed at each waste facility are largely dependant on the quality of the contractor that maintains the facilities, as well as the care demonstrated by the contributing public. The majority of burning vessel based facilities rely almost entirely on the contractor alone, so it is difficult to establish best practices outside of ensuring appropriate waste segregation is facilitated through space and signage, and that the burning vessel doors are closed between waste deposits. Waste diversion within communities, as well as volunteer aid and initiatives will be discussed as part of the public consultation process.

(Additional information to be prepared as part of future volumes of reporting)

9.0 TASK 6 – SUSTAINABILITY MODEL FOR VARIOUS WASTE MANAGEMENT PRACTICES

9.1 MODEL DEVELOPMENT

A waste model is currently under development for the Yukon's unincorporated waste sites, based upon readily available information and the aim to provide a medium where waste alternatives can be compared against one another on a site by site basis.

Adding to the model premise is the idea that a decision should be guided by the information presented, and as such, the model has been built to feed into a Kepner-Tregoe decision matrix. A Kepner-Tregoe decision matrix is a decision making tool that is based around a user defined scoring system that compares how well the available alternatives meet the desired goals, as well as any limitations that may arise. Here, the YG is able to assign relative weighting factors (see Section 9.2.1) to the parameters in the model and the results can be used to make a decision as to whether or not a change is necessary at a waste facility (e.g., economics, carbon footprint, environmental health and safety).

The alternatives explored within the model include:

- open burn and bury in trench;
- burning vessel and burial of ash in trench;
- regional landfill operations;
- transfer station and regional landfill operations; and
- incineration.

Also to be considered as an option, though not quantified in the model, is site closure. This option is highlighted through two main points of information: distance to other waste facility, and average cost per user. Further discussion related to site closure will be provided in future volumes of reporting.

9.2 MODEL SENSITIVITY AND ASSUMPTIONS

The waste model is a qualitative tool meant to identify the rationale and justification for making a change in solid waste management practices at a particular facility, and the assumptions made within the model have been explained in previous sections (i.e., the methodology used in calculating environmental risks, carbon footprints, and costs).

It is important to understand that, when completed, the model will merely provide a relative ranking of the waste management alternatives available, and that this ranking does not mean a change is necessary. The results of the model are to be used with judgement when evaluating the potential for change.

Further, the model is sensitive to certain user inputs that significantly impact model outputs, and some of these factors are subjective considerations that may vary depending on the user. The model parameters that hold the greatest bearing on model outputs are discussed further in the following sections.

9.2.1 Weighting Factors

The weighting factors used within the model are to be applied to the following decision making categories according to the level of importance the user places on the considerations, respectively:

- the facility should be economically viable (considering capital and operational costs, respectively);
- the facility's carbon footprint should be limited;
- the facility's environmental health and human safety should be deemed acceptable;
- industry and public process efforts required on the government's behalf for the facility's use or establishment should be reasonable; and
- user costs should be taken into consideration.

While the weighting factors will give a numerical indication of which decisions may work best for a waste facility, it must be understood that barriers may still exist. For example, "Industry/Public Process Effort Required" and "Environmental Protection and Human Health and Safety" may be weighted heavily during the model's run, and a particular option may be indicated as being most reasonable based on these priorities, but the cost of the resultant waste management option may still be prohibitive.

The weighting factors discussed above are to be incorporated in the public consultation program and finalized in future reporting volumes once input has been received.

9.2.2 Facility Imperatives

Within the model, there are three categories of evaluation that must be met by the facility being evaluated in order for different waste alternatives to be considered. These categories include:

- Facility must be able to accommodate expected waste volumes – if a waste alternative for a particular facility cannot meet the expected waste volumes for the surrounding community, then this alternative is not ranked as an available option. An example would be for an incinerator or burning vessel that is no longer large enough to support the contributing community. Another example would be if there was no longer room available at a site for the burial of ash.
- Facility must be capable of implementing change – if a particular facility is incapable of implementing a change to a specific waste alternative, then that alternative cannot be considered. An example would be if an existing facility is too small to convert to transfer station.
- Facility must meet regulatory standards in the Yukon – the particular facility must meet the Yukon's regulations to be established in the Territory. If a ban on burning were to be implemented, the model would remove the burning options from consideration.

Within the model, the user must answer "yes" or "no" to the above facility imperatives in order to remove all "no" answers from consideration.

9.2.3 Waste Composition

The waste compositions currently in place for the model are either sourced from a 1994 City of Whitehorse SWAP report, or estimated based on industry information where specific published information is lacking. It is recommended that these numbers be updated through a waste audit that should be conducted at a number of unincorporated facilities to make the information more reflective of actual wastes deposited.

9.3 MODEL RESULTS

(To be finalized with public and stakeholder input has been received for solid waste management)

10.0 TASK 7 – UPDATING THE YUKON SOLID WASTE MANAGEMENT STRATEGY AND GUIDELINES

The following sections represent the initial structure of the solid waste strategy currently under development. These sections will be expanded and updated as appropriate in future volumes of reporting.

10.1 STRATEGIC VISION

EBA has developed a vision statement on Community Infrastructure's behalf that is to act as the single defining principle upon which all waste management decisions are to be based.

> "The Yukon Government will operate its unincorporated waste facilities in a cost effective, sustainable manner, placing paramount importance on environmental protection, human health, and safety, both now and for generations to come."
>
> - OR -
>
> "Yukon will have a sustainable solid waste management system that is environmentally, economically, and socially responsible, and that meets the needs of Yukon people, both now and for generations to come."

(The strategic vision for the solid waste strategy is to be finalized in subsequent report volumes based on ongoing components of work)

10.2 GUIDING PRINCIPLES

In preparing this solid waste strategy, a number of objectives were identified as guiding principles for developing the recommendations found within this document. These principles were developed in 2001 by Gartner Lee Ltd. and Community Operations (formerly Community and Transportation Services), and include:

- protect the environment, human health, and safety;
- minimize costs;
- address public and stakeholder needs; and
- be sustainable.

While these principles still apply to the Yukon today, EBA recommends that they should be updated and refined with Community Infrastructure upon completion of the public consultation component of this study. This update will be reflected in the finalized document.

10.3 GOALS OF STRATEGY

In addition to following a set of guiding principles, the solid waste strategy was also developed with specific goals in mind. The goals included:

- Improving current waste management operations at existing waste facilities within given operating budgets.
- Building a more standardized approach to waste management at unincorporated waste facilities.
- Developing a foundation upon which to build for a more regionalized approach to waste management in anticipation of future growth.
- Increasing awareness and understanding of waste management challenges and the importance of public participation and cooperation.

The following sections present a summary of the existing waste management practices in the Yukon and evaluation of potential improvements that can be made based on the goals and principles outlined above.

10.4 REVIEW OF EXISTING WASTE FACILITIES

10.4.1 Current Waste Management Practices

Refer to Section 4.0 for discussion of current waste management practices in the Yukon.

10.4.2 Waste Diversion in the Yukon

Waste diversion in the Yukon is variable across the territory, and is largely dependent on the resources available in any given community. The following sections provide a brief description of the existing diversion initiatives in place at present time.

Recycling

Many of the communities throughout the Yukon have their own recycling societies that spearhead initiatives and manage their community's recyclables, though this is largely managed on a volunteer basis.

The Marsh Lake and Mt. Lorne facilities have areas on their sites where recycling is facilitated. This involves a number of segregated areas for the temporary storage of various recyclables, but also includes a bottle return where deposits are refunded to the public by staff.

A number of other facilities have a "Free Store" where users can take or leave items they feel are reusable (e.g., chairs, cd towers). In many cases though, these stores are underutilized, and do not necessarily address the materials normally considered as "recyclables".

Raven Recycling represents the largest organization for processing of recyclables in the Yukon. It collects, separates, bails, and hauls the majority of all potential recyclable materials (e.g., newsprint, paper, cardboard, plastics, aluminium, glass metals) in the territory for shipment to southern processing facilities. Additionally, P&M Recycling (another depot and processing facility) accepts bottles, cans, and several other recyclable materials. However, the recent volatility and fall in commodity prices have made recycling an unprofitable business for Raven Recycling. Recyclables are currently accumulating in the hopes that commodity prices will rise. If the prices remain depressed, there is a risk that the local recycling options could be put in jeopardy[9].

The beverage container recycling program in the Yukon has one of the highest user participation rates in Canada. Yukon Environment, its Recycling Fund, and participating businesses sponsor a recycling club that encourages children to collect recyclables and turn them in at recycling depots for points that can be collected and later exchanged for prizes. This program captures the interest of Yukon residents at a young age and establishes a desirable behaviour that continues into the future.

A prominent challenge with recycling in the Yukon is apparent when it comes to transportation costs. It is inherently expensive to ship collected recyclables out of the territory, and as such, many recycling options are limited. To this end, there is a common stream of thought that suggests backhauling (i.e., shipping of products or wastes through use of trucks that have deposited goods in the Yukon and are heading back to their place

[9] Raven Recycling has recently received municipal and territorial financial assistance.

of origin) of recyclables should be an attainable goal in relation to the supply of materials that come from outside the territory, but this has yet to become a reality.

(Recommendation to be included in subsequent volumes of reporting)

Composting

Composting is the aerobic process through which organic materials are biodegraded at an increased rate and mixed with soil to provide a nutrient rich topsoil. Compostable wastes include food wastes, "contaminated" paper products (i.e., paper towels), non-recyclable paper products, yard waste, hair, and wood shavings or sawdust. Oxygen and water are also important components in the composting process, which requires that compost be turned and watered regularly so that air and moisture are distributed throughout.

The City of Whitehorse encourages backyard composting as a means of reducing the amount of waste collected from curbside collection that enters the landfill. Recently, the City of Whitehorse has initiated a pilot project in the community of Porter Creek that requests residents to separate their waste into two bins; a green, ventilated bin for compostables and a black cart for garbage. Waste trucks collect these bins and deposit the garbage into the landfill and the compostable wastes into large windrows (i.e., "log rolls" of compost that can be turned regularly by heavy equipment). The compost is screened using a ¼" mesh, tested annually, and sold at Alberta Grade A quality to Yukon residents. Given the success of this pilot, the project will be expanding in the near future.

Rural Yukon, and even more urbanized areas such as Carmacks, that do not have curbside collection programs pose a challenge to this level of participation and waste capture. Nevertheless, compostable waste is still generated at similar rates and has the potential for capture. The challenges associated with remoteness of facilities are discussed further in Section 10.5.3.

10.4.3 "Troublesome" Waste Management

Household Hazardous Waste (HHW)

HHWs comprise a wide range of wastes. They include waste oil, antifreeze, aerosol cans, paints and thinners, solvents and cleaners, pesticides, car batteries, and medication. The Yukon Environment website describes the preferred handling and disposal for such wastes. These wastes are considered hazardous because of the adverse affects that they have on the environment if not disposed of properly, and require special handling above and beyond that required for regular household wastes.

According to the Environment Yukon website, "The Department of Environment ships special wastes out of the Yukon once a year. The Department pays for collecting and transporting the wastes, while the generator of the wastes is responsible for the disposal costs. This service is available to special waste generators in all Yukon communities."

Only a limited number of unincorporated facilities legitimately accept HHWs. In practice, however, the sites likely do accept these materials due to a lack of policing and continuous monitoring.

The reasons for this type of facility misuse are varied. The majority of instances amount to either uncertainty/unawareness as to what comprises HHW (not to mention the environmental risks or hazards) or general disinterest where users are not motivated to make a separate trip to dispose of the wastes properly. Finally, there may be a lack of awareness or desire to participate in the Yukon Environment's annual HHW roundup program.

(Recommendation to be included in subsequent volumes of reporting)

Litter (e.g., Plastic Bags, Packaging)

The transfer station facilities that are staffed are effective in managing the litter that accumulates at their sites. While the staff cannot supervise 100% of the waste loads deposited, they can direct a fair number of users appropriately, and are able to walk around regularly to pickup loose and windblown wastes.

The single unmanned transfer station (Deep Creek) was not as tidy. Whether it is due to a lack of supervision or a lack of regular maintenance (above and beyond what is required or can be reasonably expected of the contractor), the litter at the Deep Creek facility was widespread at the time of our visit. It is clear that a facility of this size, particularly in such close proximity to Whitehorse, requires supervision or limited access hours to mitigate the misuse of the facility, as well as the operational matters such as windblown and scattered litter.

The burning vessel sites were noticed to be relatively tidy. The burning vessels contain the waste deposited within them, and are not susceptible to wind concerns. This greatly assists in limiting windblown litter.

The open trench burning facility in Carcross was also fairly litter blown, and many birds were present there in comparison to other sites. The other side of the site that is not accepting domestic waste was quite tidy, on the other hand. The nature of the open trench lends to an untidy operation since wastes remain uncovered and uncompacted.

(Recommendation to be included in subsequent volumes of reporting)

White Goods

White goods refer to major appliances such as refrigerators, washing machines, etc., which are bulky and consist largely of metal and plastic that is not easily separated.

At nearly every facility visited, there was a considerable quantity of white goods deposited. The majority of these white goods included refrigerators, ovens, washers, and dryers.

While nearly every facility has a separate area designated for white good disposal, the bulk of these sorts of waste deposits are a burden on many of the facilities due to size limitations.

The current practice for removal of such goods is on an "as-needed" basis, but it is difficult to predict and costly to manage.

Refrigerators must be drained of CFC/HFCs before they are recycled/disposed, and are currently flagged at their respective facilities to indicate whether or not this draining has taken place.

It is thought that one of the biggest reasons for the quantity of white goods being deposited is the relative cost of repair versus purchasing a new product. This concern is compounded by the fact that there is also a lack of repair capacity (i.e., lack of service technicians) in communities outside of Whitehorse.

(Recommendation to be included in subsequent volumes of reporting)

Auto Body Hulks

Auto hulks were present at a number of facilities in varying degrees of salvage. Current British Columbia legislation (British Columbia being the end location for these wastes) dictates that all fluids must be drained from an auto hulk before it will be accepted in the province for salvaging and recycle.

Due to the infrequency of auto hulk deposits, it is not cost efficient to institute a regular collection of these wastes, and most facilities operate on an "as needed" basis for their removal. The trouble, however, is that auto hulks take up a lot of area, as they cannot be stacked, and a substantial amount of available land is lost, limiting the ability of a site to operate normally.

(Recommendation to be included in subsequent volumes of reporting)

Scrap Metal

During EBA's site visit tour, there were considerably sized scrap metal (i.e., metals outside of auto hulks and white goods) deposited at many of the waste facilities. One of the biggest concerns with scrap metal is that it often requires further segregation into such categories as steel, aluminium, copper wire, etc. Scavenging of metal also creates a hazard and liability due to the size, weight, and rigidity of the material.

Scrap metal recycling can be a profitable endeavour, but due to the remoteness of the facilities, it is difficult to manage a feasible pickup schedule, and waste deposits are irregular and potentially unsustainable.

(Recommendation to be included in subsequent volumes of reporting)

Scrap Metal Recovery Study

In a 2007 study conducted by the Recycling Council of British Columbia (RCBC), the scrap metal recovery industry was investigated in northern British Columbia and Yukon Territory (British Columbia 2007). The purpose of the study was to quantify the extent of metal stockpiles and investigate potential market solutions.

In northern British Columbia, there are a number of scrap metal markets available, and given the recent value increase of metals, there has been an increase in material recovery, though previously some regional districts provided subsidies for the transport and processing of these goods.

The study indicates that there are several companies in lower mainland British Columbia interested in recovering metals from northern communities. Additionally, there are a number of northern British Columbia businesses (in Prince George and Dawson Creek, particularly) that have market connections.

In general, northern British Columbia faces the same challenges with white goods and auto body hulks, and ensuring that fluids are drained and metal is appropriately recovered. Transportation costs are the primary barrier to recovering these materials.

(Recommendation summary to be included in subsequent volumes of reporting)

Tires

There currently exists a deposit charge in the Yukon for all new tires at time of purchase, and disposal of tires at the Whitehorse landfill, and everywhere else in the territory, is free of charge.

Despite no longer charging a tipping fee for tire acceptance at the Whitehorse landfill, it has been observed that many residents still bypass this facility to deposit their tires at other nearby facilities that are not as well equipped to manage these wastes. It is estimated that more tires are deposited at the Yukon's waste facilities each year than there are people in the territory (per communication with Community Infrastructure staff). Furthering the difficulty in handling such quantities is the requirement that the steel rims must be removed from the tires before they can be shipped and recycled.

(Recommendation to be included in subsequent volumes of reporting)

Construction and Demolition (C&D) Wastes

C&D wastes are unique in that they are rare, unpredictable, and immense in size. The majority of the waste facilities in the Yukon would be hard pressed to make room for a large deposit of C&D wastes.

These wastes consist of such materials as asphalt shingles, concrete, wood (potentially treated), drywall, etc., and while each material can be collected and recycled in some capacity, the difficulty is that the wastes are commingled when deposited, making salvage of the material near impossible.

(Recommendation to be included in subsequent volumes of reporting)

e-Waste

Electronic waste (e-waste) is waste consisting of any broken or unwanted electronic appliance. E-waste has concerned landfill operators, as many components of such equipment are toxic and non-biodegradable.

The Yukon Territory is currently without a year-round e-waste program. Instead, Yukoners rely heavily on Computers for Schools (Yukon) to provide a disposal option during the HHW collection days hosted twice annually by the City of Whitehorse, and occasionally by other communities. A recent study has provided Yukon Environment with an outline of other e-waste programs in Canada, and the development of a Yukon based program is currently underway as a result.

The Mt. Lorne and Marsh Lake facilities do provide a separate area for e-waste products to be deposited, but outside of the Whitehorse area, e-waste handling is not managed as a special waste stream.

Across Canada, there are currently five e-waste programs in existence, enacted under various regulatory regimes governing the handling and disposal of e-waste. Each program was developed for a region after taking into account regional considerations such as the local economy, industry input, retailer participation, and convenience for the consumer; with the common goal being diverting e-waste from landfills. Programs currently in place in Canada follow a similar industry-based stewardship model with subtle differences. The Canadian Council of Ministers of the Environment's (CCME's) 12 principles for electronics product stewardship form the basis for the e-waste programs currently in existence in Canada. These programs are relatively new, and it is difficult to fully assess performance at this point.

Propane Tanks

There is an inherent danger in the disposal of propane tanks, and a further risk associated with the improper disposal of these wastes, both environmentally and with respect to human health and safety, as they could explode in a burning vessel.

(Recommendation to be included in subsequent volumes of reporting)

Lead Acid Batteries

At most facilities, there is a pallet available for vehicle batteries. These pallets are only labelled in some instances, however, and they are exposed to the elements in nearly all cases.

(Recommendation to be included in subsequent volumes of reporting)

10.4.4 Waste Programs and Initiatives in the Yukon

Within Appendix B of this report, a number of waste programs available in the Yukon have been summarized. These initiatives include:

- beverage container recycling program;

- used tire management program;
- HHW collection; and
- special waste collection.

These programs offer Yukon residents the opportunity to handle their wastes in an appropriate manner and do a good job of communicating their respective effects on the environment.

Noticeably absent from this list of programs in comparison to provincial Canada, however, includes:

- e-waste recycling program (discussed in Section 4.3.8); and
- white goods program (discussed in Section 4.3.3).

10.4.5 Budgets and Financing

The 2008 budget for all 19 solid waste sites operated by YG is $1.2 M. This annual budget is directed at maintaining the contracts required for site maintenance, and covers staff salary (including Community Infrastructure staff salary) where applicable. The remainder then is put towards any capital spending that may be required. YG Community Infrastructure has observed that this budget is not sufficient to provide an appropriate level of service for all existing waste facilities in terms of meeting public demands and protecting the environment.

Only municipalities with incorporated waste facilities collect taxes from Yukon residents that help fund local waste operations, and these facilities are further funded in most cases by charging tipping fees. Outside of these municipalities, the use of waste facilities is free of charge, with the onus for funding solid waste programs being on the YG. This disparity creates a situation where residents of a community with a tipping fee facility choose to utilize a "free" YG operated facility, which burdens the already limited capacities at the facilities even further. Currently, this practice cannot be monitored or controlled, and as such, taxing and tipping fee regimes in the Yukon may have to be re-examined in the future.

10.5 WASTE MANAGEMENT CHALLENGES

10.5.1 Waste Segregation

The commingling of wastes is major challenge for waste management initiatives. Each waste type (e.g., plastics, glass, paper) requires separate handling for the various processes that must be undertaken to reuse, recycle, or recover the materials, respectively. Commingling of wastes, such as a tin can in amongst food scraps, essentially contaminates a "clean" waste stream, and additional efforts are then needed to "purify" that stream. In order to avoid these efforts, it is necessary to facilitate waste segregation so that waste streams can be better encapsulated towards their own end.

At every waste facility currently in operation, there is some level of waste segregation taking place. The level of sorting varies significantly from site to site, however, and is often dependant on space availability and the size of the community served. The performance of the waste segregation program is also directly related to the level of public participation. Regardless of the barriers faced, waste segregation is imperative in capturing waste streams destined for whatever end they are designated.

(Recommendation to be included in subsequent volumes of reporting)

10.5.2 Inconsistency and Unpredictability of Waste Deposits

Due to the small size of the existing waste facilities, and the size of the community that each site serves, unpredictable spikes in the waste stream are more prevalent and difficult to handle than at a large scale landfill such as in Whitehorse. For example, a simple lodge renovation could more than double the waste stream at a remote facility for a given month.

Whether it is the demolition or renovation of a nearby house, or the passing of a resident that had amassed a large collection of materials not considered of use to the inheritor, a waste facility can be overloaded with waste, which limits its operational efficiency.

(Recommendation to be included in subsequent volumes of reporting)

10.5.3 Remoteness of Facilities

The Old Crow solid waste facility amplifies the challenges associated with remoteness of facilities in the Yukon. This community is only accessible by air, and cannot be incorporated into regional waste plans due to this disconnect. In order to offer the same level of services to such facilities, the costs are directly proportional to the degree of remoteness. These costs add up significantly when considering the variety of waste services required, such as recycling, staffing, user costs, etc. For such remote facilities, it is appropriate to make them as self sustaining as possible.

The cost to transport waste is considerable in the Yukon as the current waste facilities are widely spread across the territory. Remoteness cannot be considered a limiting factor; however, as regardless of how remote a facility may be, if it is necessary to handle the wastes of the surrounding communities, it must be operated as effectively as possible.

While there are, at times, large distances between waste facilities, these distances are not so unreasonable that trips would be avoided. In Alaska and the Northwest Territories, there are siting regulations in place to avoid having more than one facility within a certain distance of another. That is to say, remoteness, to some degree, is actually encouraged within these jurisdictions. And while it may increase the cost of waste hauling operations, it also limits the redundancy of waste facilities and provides for better efficiency.

(Recommendation to be included in subsequent volumes of reporting)

10.5.4 Public Involvement

Environmental Awareness

With an increasing focus on global climate change resulting from greenhouse gases, and general environmental wellbeing, the public is becoming increasingly educated and concerned about the potential effects of what is going on around them. As such, there is a growing resistance against waste management practices that are considered to be outdated, and the burning of waste, specifically, is being opposed across Canada and in the Yukon. With the Yukon Territory representing the only jurisdiction in Canada to officially permit burning, public pressure geared towards the cessation of this method of operations will only increase.

User Experience

The conditions and appearance of a waste disposal site sets an expectation in the mind of a user. If a site is not very well kept, users, in general, will tend to be less careful in the disposal of their waste. Conversely, if a site is well organized, users will tend to respect the tidiness of the facility and dispose of their waste more appropriately. The trouble, however, is that just one poor deposit can upset the site's appearance.

Furthermore, it is entirely common that when action is taken at one facility, other communities will anticipate that these steps will be undertaken in their community as well. This should be taken into consideration for all waste operation planning so as to avoid controversy. An illustration of such a scenario is the recent media attention to the disparity in funding between the Marsh Lake and Mt. Lorne facilities.

The current funding levels at each facility are limited to the total budget allotted to waste management for the entire territory annually. The budget is divided amongst the existing facilities according to the level of maintenance required at each, which is more or less proportional to the amount of waste deposited there and relates to the population of the surrounding area. Additional funding, in some cases, is granted to facilities that have acquired grants through volunteerism and separate government funding. This additional funding provides noticeable improvement to the waste facilities, which is observed by users and residents from outside the community who may not be aware of the additional funding source, which creates a perceived expectation for the same level of service elsewhere. As such, a public education program may be necessary to ensure that residents better understand why decisions are made and how funding is obtained and distributed throughout the territory.

10.5.5 Environmental Concerns, Public Safety, and Liability

Most striking about the Yukon waste operations in comparison to southern Canada are the differences in liability concerns. Scavenging, for example, while not encouraged in the Yukon, is not discouraged either. In other jurisdictions throughout Canada there are strict regulations that prohibit scavenging of any kind. By disallowing scavenging, the liability of the governing jurisdiction for injuries incurred as a result of the activity is removed.

However, a side effect of the rule is that waste separation is at times hindered, and some reusable or recyclables products are automatically considered irretrievable.

The burning vessels present another hazard where public safety and liability may become a concern. As the burning vessels are located at sites with unlimited and unsupervised access, there is the potential for injury at site due to the heat generated by the vessels, which slowly dissipates for several hours after the burning vessel is ignited (assuming that the vessel is only ignited by the appropriate contractor). While some sites post a sign indicating that the burning vessel is hot, these signs are generally afterthoughts that have been spray-painted in many cases and could go unobserved or ignored.

Also generating liability implications in the Yukon is the fact that environmental monitoring at unincorporated facilities is currently present at only three facilities (Carcross, Marsh Lake, and Upper Liard). Without environmental monitoring, there is no way to observe or be aware of the environmental implications of a waste facility, and so no action can be triggered to correct a situation that may arise.

There may arise liability concerns in the future regarding air quality as a result of waste burning practices. Air emission modelling is currently being undertaken for the territory, and the results from this modelling will give an immediate indication of the associated hazards relative to both human and environmental exposure. These results should be examined carefully and be included in the decision making processes for changes considered at each respective facility.

(Recommendation to be included in subsequent volumes of reporting)

10.5.6 Funding

Refer to Section 8.2 for information regarding funding availability and sources in the Yukon.

10.5.7 Potential Implications of Climate Change

Climate change, in loose terms, refers to the increase of temperatures throughout the globe that presents adverse effects on the natural environment, such as increased flooding and more severe weather systems. Climate change is a controversial topic at present time, and the arguments involved are largely focussed around uncertainty as to what is causing the changes (e.g., natural carbon cycles, emissions), and the effects and control of the situation.

With respect to the Yukon, increasing temperatures do have an effect on the waste stream, specifically how the environment will become more sensitive to the risks associated with wastes. The following list denotes a number of potential effects that should be taken into consideration when planning for the future of Yukon's waste management:

- Increased rate of production of methane gas from landfills as a result of increased rate of decomposition of wastes through temperature and moisture increases.

- Rising water tables, which will infiltrate landfills, particularly considering that existing landfills in the territory do not have engineered liner systems.
- Sloughing of wastes from melting permafrost.
- Wetter conditions that may affect operations

Conversely, with these potential challenges come opportunities, such as greater potential for composting, or methane gas collection from landfills, which in turn would reduce the carbon footprints associated with landfilling.

(Recommendation to be included in subsequent volumes of reporting)

10.5.8 Potential Legislation Changes

The most discussed legislation with respect to waste management in the Yukon at present and in the near future is the potential that a ban on burning could be implemented. With the Northwest Territories recently adopting such a policy, there will be additional pressure on the Yukon as the "only" province/territory still burning its waste to change its practices.

Given the expense of altering the current waste practices, a solution to the proposed change would require a change in operations. This would require additional capital and operational spending.

Potential legislation changes are difficult to anticipate, as they result from new scientific information and shifting public focus, but some potential scenarios may include:

- imposing mandatory environmental monitoring at all waste facilities;
- disallowing the establishment of any new waste facilities;
- developing hard standards for buried waste, including barrier systems for both landfills and trenches constructed for the acceptance of ash;
- imposing strict controls on the management of hazardous wastes;
- banning the use of plastic shopping bags;
- implementing emissions standards that would require air quality monitoring;
- instituting a carbon tax against emissions territory wide; and
- making it mandatory to establish e-waste or hazardous waste storage areas at all waste facilities.

(Recommendation to be included in subsequent volumes of reporting)

10.6 FACILITY MODEL EVALUATIONS

Refer to Section 9.0 for discussion of the waste model, which is currently under development.

10.7 SOLID WASTE STRATEGY DEVELOPMENT AND WASTE MANAGEMENT PROCEDURES AND GUIDELINES

Short- and long-term solid waste strategies are to be included in subsequent reporting volumes.

Additionally, an update to the Yukon's Solid Waste Management Procedures and Guidelines will also be prepared as part of this study in the future.

11.0 CLOSURE

This report and its contents are intended for the sole use of the Government of Yukon and their agents. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Government of Yukon, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user.

This Issued for Review report is provided solely for the purposes of client review and presents our findings and recommendations to date. Our findings and recommendations are related only through an "Issued for Use" report, which will be issued subsequent to this review. You should not rely on the interim recommendations made herein. Once our report is issued for use the "Issued for Review" report should be either returned to EBA or destroyed.

EBA will finalize and sign this document in subsequent report volumes once input from public and stakeholder meetings has been received.

Should you have any questions or comments, please direct them to Mr. Paul Moore of the Government of Yukon at solidwastestudy@gov.yk.ca.

Respectfully submitted,
EBA Engineering Consultants Ltd.

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TABLES

TABLE 1: TYPICAL ENVIRONMENTAL RISK CALCULATION SUMMARY

LOCATION: *Upper Liard*

			Burning Vessel Risk Ratings		Burn and Bury in Trench Risk Ratings		Transfer Station Risk Ratings		Incineration Risk Rating		Landfill Risk Rating	
Does the Facility Accept Domestic Waste?	yes	Waste Acceptance Risks	Low Risk	1	Low Risk	1	Low Risk	0	Low Risk	0.5	Low Risk	0.5
Does the Facility Accept Metals?	yes		Low Risk	1	Low Risk	1	Low Risk	0	Low Risk	1	Low Risk	1
Does the Facility Accept Brush & Construction Debris?	yes		Low Risk	1	Low Risk	1	Low Risk	0	Low Risk	0.5	Low Risk	0.5
Does the Facility Accept Tires?	yes		Low Risk	1	Low Risk	1	Low Risk	0	Low Risk	0.5	Low Risk	0.5
Does the Facility Accept Batteries?	yes		Moderate Risk	5	Moderate Risk	5	Moderate Risk	2.5	Moderate Risk	5	Moderate Risk	5
Does the Facility Accept Recyclables?	unknown											
Does the Facility Accept Waste Oil	yes		Moderate Risk	5	Moderate Risk	5	Moderate Risk	2.5	Moderate Risk	5	Moderate Risk	5
Does the Facility Accept Household Hazardous Wastes?	unknown		High Risk	0	High Risk	0	High Risk	0	High Risk	0	High Risk	0
Does the Facility Accept Appliances (White Goods)?	unknown		Low Risk	0	Low Risk	0	Low Risk	0	Low Risk	0	Low Risk	0
Is the Facility a Burn Operation (domestic waste only)?	yes	Operational Risks	Moderate Risk	5	Moderate Risk	5	Moderate Risk	0	Moderate Risk	2.5	Moderate Risk	0
Is the Facility a No-Burn Operation?	no		Low Risk	0	Low Risk	0	Low Risk	0	Low Risk	0	Low Risk	0
Does the Facility Have a Burning Vessel in place?	yes		Moderate Risk	5	Moderate Risk	0	Moderate Risk	0	Moderate Risk	0	Moderate Risk	0
Is there a Water Tank on-site?	yes		High Risk	0	High Risk	0	High Risk	0	High Risk	0	High Risk	0
What is the site's Geology like?	Gravel Pit		Moderate Risk	5	Moderate Risk	5	Moderate Risk	0	Moderate Risk	5	Moderate Risk	5
Groundwater Monitoring	yes		Moderate Risk	0	Moderate Risk	0	Moderate Risk	0	Moderate Risk	0	Moderate Risk	0
Air Quality Monitoring	no		Moderate Risk	5	Moderate Risk	5	Moderate Risk	0	Moderate Risk	2.5	Moderate Risk	2.5
Surface Water Monitoring	no		Moderate Risk	5	Moderate Risk	5	Moderate Risk	0	Moderate Risk	2.5	Moderate Risk	2.5
Electric Fence In Place	yes		Moderate Risk	0	Moderate Risk	0	Moderate Risk	0	Moderate Risk	0	Moderate Risk	0
Controlled Access (i.e. Gates, Operating Hours)	no		Moderate Risk	5	Moderate Risk	5	Moderate Risk	5	Moderate Risk	5	Moderate Risk	5
Does the Site Have Electricity?	no											
Distance to Nearest Water Well (km)	unknown		Auto-Calculation	0	Auto-Calculation	0	Auto-Calculation	0	Auto-Calculation	0	Auto-Calculation	0
Distance to Water Body (km)	3		Auto-Calculation	0	Auto-Calculation	0	Auto-Calculation	0	Auto-Calculation	0	Auto-Calculation	0
Distance to Closest Dwelling (km)	0.464		Auto-Calculation	7.5	Auto-Calculation	7.5	Auto-Calculation	3.75	Auto-Calculation	7.5	Auto-Calculation	7.5
Operational Costs (AVG 2003 - 2008)	$8,335.00		Risk of Illegal Dumping	0	Risk of Illegal Dumping	0	Risk of Illegal Dumping	0	Risk of Illegal Dumping	0	Risk of Illegal Dumping	0
Staff Salary Cost (YG) (AVG 2003 - 2008)	$1,368.80		Notes		Notes		Notes		Notes		Notes	
Total Cost per User	$38.82		Basis for Risk Assessments.		Basis for Risk Assessments. Windblown litter/fire hazards only difference.		Limited Waste Acceptance Risk - Leaves Site No setback concerns except noise for dwellings.		Waste Acceptance = Half Risk of Burning Vessel For Buried Wastes Monitoring Concerns halved as well		Waste Acceptance = Half Risk of Burning Clay Liner less permeable. Monitoring and Setback Risks also Halved	
Distance to Whitehorse or Other Incorporated Community (km)	15											
			Wastes Accepted - Risk Points	14	Wastes Accepted - Risk Points	14	Wastes Accepted - Risk Points	5	Wastes Accepted - Risk Points	12.5	Wastes Accepted - Risk Points	12.5
			Operational Practices - Risk Points	30	Operational Practices - Risk Points	25	Operational Practices - Risk Points	5	Operational Practices - Risk Points	17.5	Operational Practices - Risk Points	15
			Setback Risk Points	7.5	Setback Risk Points	7.5	Setback Risk Points	3.75	Setback Risk Points	7.5	Setback Risk Points	7.5
			Total Env. Risk Rating	**51.5**	**Total Env. RiskRating**	**46.5**	**Total Env. RiskRating**	**13.75**	**Total Env. RiskRating**	**37.5**	**Total Env. RiskRating**	**35**

Notes:
**Unknowns require community infrastructure input.

TABLE 2: TYPICAL CARBON FOOTPRINT CALCULATION SUMMARY					
CARBON FOOTPRINT CALCUALTIONS (ANNUAL)	Burn and Bury in Trench	Burn in a Burning Facility and Bury in Trench	Sanitary Landfill Operations	Transfer Station and Regional Solid Waste Disposal Site	Incineration
Waste Acceptance (tonnes eCO_2)	18.4	18.4	141.8	141.8	18.4
Energy Use (tonnes eCO_2)	0.0	0.0	0.1	0.0	0.1
Waste Collection and Transportation (tonnes eCO_2) - (assumed diesel 7 mpg)	0.3	0.3	0.0	0.7	0.3
Landfill Heavy Equipment (tonnes eCO_2)	0.0	0.0	0.9	0.0	0.0
Average User Travel Distance (tonnes eCO_2) - (assumed gasoline 14 mpg)	19.5	19.5	39.0	19.5	19.5
TOTAL CARBON FOOTPRINT (tonnes eCO_2)	**38.2**	**38.2**	**181.9**	**162.0**	**38.4**

Notes:
Carbon footprint calculations consider nearest landfill as end of the line for carbon emissions (i.e., waste shipped from landfill sites to other locations for recycling is not considered).

YUKON WASTE COMPOSITION			
Source: City of Whitehorse Residential (Urban and Rural Combined) SWAP Data		Waste Tonnage	Handling Practice
Newsprint	**5.2%**	**11.2**	Burn/Bury
Cardboard	**1.8%**	**3.9**	Burn/Bury
Other Paper	**20.7%**	**44.5**	Burn/Bury
Aluminum	**0.9%**	**1.9**	Recycled
Steel	**3.0%**	**6.5**	Recycled
Copper Wire	**0.5%**	**1.1**	Recycled
Glass	**5.4%**	**11.6**	Recycled
HDPE	**1.1%**	**2.4**	Burn/Bury
PET	**0.5%**	**1.1**	Burn/Bury
Other Plastic	**7.1%**	**15.3**	Burn/Bury
Food Scraps	**27.8%**	**59.8**	Burn/Bury
Yard Trimmings	**10.2%**	**21.9**	Burn/Bury
White Goods	**0.1%**	**0.2**	Recycled
Personal Computers (Estimated - No Data Available)	**0.1%**	**0.2**	Recycled
Televisions (Estimated - No Data Available)	**0.1%**	**0.2**	Recycled
Microwaves (Estimated - No Data Available)	**0.1%**	**0.2**	Recycled
VCRs (Estimated - No Data Available)	**0.1%**	**0.2**	Recycled
Tires (Estimated - No Data Available)	**0.5%**	**1.1**	Recycled

Plastics assumed burned to account for non-organic input.

EMISSION FACTORS				
WASTE TYPE	Net Recycling Emissions (tonnes eCO_2/tonne of waste)	Net Composting Emissions (tonnes eCO_2/tonne of waste)	Landfill Without Landfill Gas Collection (tonnes eCO_2/tonne of waste)	Net Combustion Emissions (tonnes eCO_2/tonne of waste)
Newsprint	-0.3	0	0.32	-0.05
Fine Paper	-0.36	0	1.88	-0.04
Cardboard	-0.21	0	1.66	-0.04
Other Paper	-0.25	0	1.7	-0.04
Aluminum	-6.49	0	0.01	0.01
Steel	-1.18	0	0.01	-1.03
Copper Wire	-4.1	0	0.01	0.01
Glass	-0.1	0	0.01	0.01
HDPE	-2.27	0	0.01	2.89
PET	-3.63	0	0.01	2.17
Other Plastic	-1.8	0	0.01	2.67
Food Scraps	0	0.02	1.23	0.02
Yard Trimmings	0	0.02	0.59	0.01
White Goods	-1.46	0	0.01	-0.26
Personal Computers	-1.6	0	0.01	0.41
Televisions	-0.23	0	0.01	0.75
Microwaves	-1.27	0	0.01	-0.55
VCRs	-0.95	0	0.01	0.15
Tires	-3.29	0	0.01	-0.49

TABLE 2A: EFFECT OF WASTE DIVERSION ON CARBON FOOTPRINT CALCULATIONS

MT LORNE SUMMARY

CARBON FOOTPRINT CALCULATIONS (ANNUAL)	Burn and Bury in Trench	Burn in a Burning Facility and Bury in Trench	Sanitary Landfill Operations	Transfer Station and Regional Solid Waste Disposal Site	Incineration	Burning Facility (Increased Diversion)	Transfer Station (Increased Diversion)
Waste Acceptance (tonnes eCO_2)	12.0	12.0	92.4	92.4	12.0	-26.8	5.4
Energy Use (tonnes eCO_2)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Waste Collection and Transportation (tonnes eCO_2 - assumed diesel 7 mpg)	0.8	0.8	0.0	1.6	0.8	0.8	1.6
Landfill Heavy Equipment (tonnes eCO_2)	0.0	0.0	0.6	0.0	0.0	0.0	0.0
Average User Travel Distance (tonnes eCO_2 - assumed gasoline 14 mpg)	71.2	71.2	142.3	71.2	71.2	71.2	71.2
TOTAL CARBON FOOTPRINT (tonnes eCO_2)	84.0	84.0	235.4	165.2	84.0	45.2	78.2

Notes:
Burn-based operation carbon footprints demonstrative of theoretical values if facility were not presently a transfer station. It is no way suggested that operations be changed based on carbon footprint values.

MT LORNE BREAKDOWN

YUKON WASTE COMPOSITION	Percentage of Waste Stream	Waste Tonnage	Diverted Tonnage	Residual Tonnage	Notes
Newsprint	**5.2%**	**7.3**	4.4	2.9	Burn/Bury
Fine Paper	**0.0%**	**0.0**	0.0	0.0	Burn/Bury
Cardboard	**1.8%**	**2.5**	1.5	1.0	Burn/Bury
Other Paper	**20.7%**	**29.0**	17.4	11.6	Burn/Bury
Aluminum	**0.9%**	**1.3**	0.8	0.5	Recycled
Steel	**3.0%**	**4.2**		4.2	Recycled
Copper Wire	**0.5%**	**0.7**		0.7	Recycled
Glass	**5.4%**	**7.6**	4.5	3.0	Recycled
HDPE	**1.1%**	**1.5**	0.9	0.6	Burn/Bury
PET	**0.5%**	**0.7**	0.4	0.3	Burn/Bury
Other Plastic	**7.1%**	**9.9**	6.0	4.0	Burn/Bury
Food Scraps	**27.8%**	**38.9**	23.4	15.6	Burn/Bury
Yard Trimmings	**10.2%**	**14.3**	8.6	5.7	Burn/Bury
White Goods	**0.1%**	**0.1**		0.1	Recycled
Personal Computers (Estimated - No Data Available)	**0.1%**	**0.1**		0.1	Recycled
Televisions (Estimated - No Data Available)	**0.1%**	**0.1**		0.1	Recycled
Microwaves (Estimated - No Data Available)	**0.1%**	**0.1**		0.1	Recycled
VCRs (Estimated - No Data Available)	**0.1%**	**0.1**		0.1	Recycled
Tires (Estimated - No Data Available)	**0.5%**	**0.7**		0.7	Recycled

MARSH LAKE SUMMARY

CARBON FOOTPRINT CALCUALTIONS (ANNUAL)	Burn and Bury in Trench	Burn in a Burning Facility and Bury in Trench	Sanitary Landfill Operations	Transfer Station and Regional Solid Waste Disposal Site	Incineration	Burning Facility (Increased Diversion)	Transfer Station (Increased Diversion)
Waste Acceptance (tonnes eCO_2)	34.2	34.2	263.9	263.9	34.2	-76.6	15.3
Energy Use (tonnes eCO_2)	0.0	0.0	0.2	0.0	0.3	0.0	0.0
Waste Collection and Transportation (tonnes eCO_2 - assumed diesel 7 mpg)	1.2	1.2	0.0	2.4	1.2	1.2	2.4
Landfill Heavy Equipment (tonnes eCO_2)	0.0	0.0	1.6	0.0	0.0	0.0	0.0
Average User Travel Distance (tonnes eCO_2 . assumed gasoline 14 mpg)	249.7	249.7	561.9	249.7	249.7	249.7	249.7
TOTAL CARBON FOOTPRINT (tonnes eCO_2)	285.1	285.1	827.6	516.0	285.4	174.3	267.4

Notes:
Burn-based operation carbon footprints demonstrative of theoretical values if facility were not presently a transfer station. It is no way suggested that operations be changed based on carbon footprint values.

MARSH LAKE BREAKDOWN

YUKON WASTE COMPOSITION	Percentage of Waste Stream	Waste Tonnage	Diverted Tonnage	Residual Tonnage	Notes
Newsprint	**5.2%**	**20.8**	12.5	8.3	Burn/Bury
Fine Paper	**0.0%**	**0.0**	0.0	0.0	Burn/Bury
Cardboard	**1.8%**	**7.2**	4.3	2.9	Burn/Bury
Other Paper	**20.7%**	**82.8**	49.7	33.1	Burn/Bury
Aluminum	**0.9%**	**3.6**	2.2	1.4	Recycled
Steel	**3.0%**	**12.0**		12.0	Recycled
Copper Wire	**0.5%**	**2.0**		2.0	Recycled
Glass	**5.4%**	**21.6**	13.0	8.6	Recycled
HDPE	**1.1%**	**4.4**	2.6	1.8	Burn/Bury
PET	**0.5%**	**2.0**	1.2	0.8	Burn/Bury
Other Plastic	**7.1%**	**28.4**	17.0	11.4	Burn/Bury
Food Scraps	**27.8%**	**111.2**	66.7	44.5	Burn/Bury
Yard Trimmings	**10.2%**	**40.8**	24.5	16.3	Burn/Bury
White Goods	**0.1%**	**0.4**		0.4	Recycled
Personal Computers (Estimated - No Data Available)	**0.1%**	**0.4**		0.4	Recycled
Televisions (Estimated - No Data Available)	**0.1%**	**0.4**		0.4	Recycled
Microwaves (Estimated - No Data Available)	**0.1%**	**0.4**		0.4	Recycled
VCRs (Estimated - No Data Available)	**0.1%**	**0.4**		0.4	Recycled
Tires (Estimated - No Data Available)	**0.5%**	**2.0**		2.0	Recycled

TABLE 3: 2008 ANNUAL CONTRACTS FOR UNICORPORATED WASTE FACILITIES								
Fiscal Year	Area	Area by Name	Expenditures	Unallocated Portion	Total Expenditures	% Expenditures	Staff Salary Costs	Area Totals
2007/08	24	Champagne	$40,870.76	$209.94	$41,080.70	7%	$6,711.94	$47,792.63
	25	Beaver Creek	$10,341.95	$53.12	$10,395.07	2%	$1,698.39	$12,093.46
	27	Burwash Landing	$19,740.00	$101.40	$19,841.40	3%	$3,241.77	$23,083.17
	28	Canyon	$35,846.00	$184.13	$36,030.13	6%	$5,886.75	$41,916.88
	29	Cacross	$39,299.61	$201.87	$39,501.48	6%	$6,453.92	$45,955.39
	30	Mt. Lorne	$51,667.96	$265.40	$51,933.36	8%	$8,485.09	$60,418.45
	35	Destruction Bay	$9,916.00	$50.94	$9,966.94	2%	$1,628.44	$11,595.37
	51	Keno City	$3,626.00	$18.63	$3,644.63	1%	$595.47	$4,240.10
	57	Marsh Lake	$118,994.21	$611.23	$119,605.44	20%	$19,541.63	$139,147.08
	63	Old Crow	$12,897.50	$66.25	$12,963.75	2%	$2,118.07	$15,081.82
	65	Pelly Crossing	$49,851.14	$256.07	$50,107.21	8%	$8,186.72	$58,293.93
	67	Ross River	$27,842.64	$143.02	$27,985.66	5%	$4,572.41	$32,558.07
	71	Tagish	$31,432.84	$161.46	$31,594.30	5%	$5,162.01	$36,756.31
	75	Upper Liard	$8,335.00	$42.81	$8,377.81	1%	$1,368.80	$9,746.62
	88	Deep Creek	$101,743.63	$522.62	$102,266.25	17%	$16,708.69	$118,974.94
	99	Territory Wide	$46,521.36	$238.96	$46,760.32	8%	$7,639.90	$54,400.22
			$608,926.60	**$3,127.85**	**$612,054.45**		**$100,000.00**	**$712,054.45**

LEGEND

Burn Facility
Manned Transfer Station
Unmanned Transfer Station

TABLE 4: NEW REGIONAL LANDFILL COST ESTIMATE

LANDFILL CELL SIZE (m^3)	15,000
CELL DEPTH (m)	4.5
CELL LENGTH	58.0
CELL WIDTH	58.0

Task	Description	Assumption/Comment	Unit	Amount	Unit Rate	Cost Per Unit	Total Cost
Site preparation							
Mobilization/Demobilization		Depends on contractors fleet location and availability		1	$ 50,000.00	$ 50,000.00	$ 50,000.00
					Sub Total		**$ 50,000**
Earthworks							
Stripping and Clearing	Labour only	Assumed 300 mm over the footprint area, plus 5 m perimeter	m^3	1,190.70	$ 3.50	$ 4,167.45	$ 8,334.90
Cut and Fill Requirements	Supply and labour	Excavation, Transport, and Placement of Soil (10% extra volume to cell size)	m^3	16,500.00	$ 9.00	$ 148,500.00	$ 148,500.00
Installation of Compacted Soil Liner	Labour only	Volume of soil from within footprint area (1 m thick)	m^3	3,969.00	$ 13.50	$ 53,581.50	$ 53,581.50
					Sub Total		**$ 210,416**
Geomaterials							
Excavation of leakage drainage	Labour only		m	58.00	$ 20.00	$ 1,160.00	$ 2,320.00
Geotextile wrapping for leakage pipes	Supply and labour	6 oz. geotextile	m^2	232.00	$ 2.00	$ 464.00	$ 928.00
Pipe 150mm (w/ end caps)	Material only		m	58.00	$ 5.00	$ 580.00	$ 1,160.00
Pipe 375mm (w/ end caps)	Material only		m	58.00	$ 5.00	$ 580.00	$ 1,160.00
Backfill leakage drainage	Supply and labour		m	58.00	$ 22.00	$ 1,276.00	$ 2,552.00
Anchor Trench excavation and backfill	Labour only	Perimeter of cell plus 2 m on each side	m	240.00	$ 50.00	$ 12,000.00	$ 12,000.00
Supply and Installation of geo-composite	Supply and labour	1 sided, composed of geonet and geotextile	m^2	3,969.00	$ 7.00	$ 27,783.00	$ 27,783.00
Supply and Installation of geo-membrane	Supply and labour	60 mil HDPE	m^2	3,969.00	$ 10.00	$ 39,690.00	$ 39,690.00
Supply and installation of geotextile	Supply and labout	6 oz. Geotextile	m^2	3,969.00	$ 2.00	$ 7,938.00	$ 7,938.00
Sandbags (filling and supplying sand)		for liner ballasting	lump	1.00	$ 6,000.00	$ 6,000.00	$ 6,000.00
					Sub Total		**$ 101,531**
Surface improvements							
Drainage Improvements	Labour only	Assumed as perimeter of landfill cell plus internal roads	m	348	$ 25.00	$ 8,700.00	$ 8,700.00
					Subtotal		**$ 8,700**
MISCELLANEOUS							
Site Investigation and Approval Preparation		Sititng, drilling, results analysis, approval prep. and regulatory liason	lump	1	$ 150,000.00	$ 150,000.00	$ 150,000.00
Engineering Fees		Engineering Design	lump	1	$ 50,000.00	$ 50,000.00	$ 50,000.00
Groundwater Monitoring Wells	Labour and material	Assumed 8 required	unit	8	$ 3,000.00	$ 24,000.00	$ 24,000.00
Surface Water Pond	Labour and material	Assumed 35% of cell capacity	m^3	5,250	$ 13.50	$ 70,875.00	$ 70,875.00
Fencing	Labour and material	Assumed perimeter of cell x 8	m	1,856	$ 21.00	$ 38,976.00	$ 38,976.00
Road Construction	Labour and material	Assumed perimeter of landfill cell x 2.	m	116	$ 45.00	$ 5,220.00	$ 5,220.00
Weigh Scales	Supply and install	70 ft truck scale	lump	1	$ 75,000.00	$ 75,000.00	$ 75,000.00
Scalehouse	Supply and install	100 sqft	lump	1	$ 10,000.00	$ 10,000.00	$ 10,000.00
Office Building	Supply and install	1000 sqft	lump	1	$ 100,000.00	$ 100,000.00	$ 100,000.00
Maintenance Building	Supply and install	2500 sqft	lump	1	$ 180,000.00	$ 180,000.00	$ 180,000.00
Signage	Material		lump sum	1.00	$ 2,500.00	$ 2,500.00	$ 2,500.00
Lighting	Power supply and lighting		lump sum	$1.00	$ 35,000.00	$ 35,000.00	$ 35,000.00
Line location	Labour	1 day assumed	lump	1	$ 2,000.00	$ 2,000.00	$ 2,000.00
As -Built Survey	Labour	As built survey and construction surveying	lump	1	$ 2,500.00	$ 2,500.00	$ 2,500.00
						Subtotal	**$ 746,071**
						SUBTOTAL	**$ 1,116,718**
						Contingency (20%)	**$ 223,344**
						TOTAL COST	**$ 1,340,062**

TABLE 5: NEW LANDFILL CELL CONSTRUCTION COST ESTIMATE

LANDFILL CELL SIZE (m^3)	8,000
CELL DEPTH (m)	4.5
CELL LENGTH	43.0
CELL WIDTH	43.0

Task	Description	Assumption/Comment	Unit	Amount	Unit Rate	Cost per unit	Total cost
Site preparation							
Mobilization/Demobilization		Depends on contractors fleet location and availability		1	$ 50,000.00	$ 50,000.00	$ 50,000.00
					Sub Total		**$ 50,000**
Earthworks							
Stripping and Clearing	Labour only	Assumed 300 mm over the footprint area, plus 5 m perimeter	m^3	691.20	$ 3.50	$ 2,419.20	$ 4,838.40
Cut and Fill Requirements	Supply + labour	Excavation, Transport, and Placement of Soil (10% extra volume to cell size)	m^3	8,800.00	$ 9.00	$ 79,200.00	$ 79,200.00
Installation of Compacted Soil Liner	Labour only	Volume of soil from within footprint area (1 m thick)	m^3	2,304.00	$ 13.50	$ 31,104.00	$ 31,104.00
Closure of Previous Cell	Labour only	Assumed same size as current cell, 1 m cap of fill	m^2	2,304.00	$ 7.50	$ 17,280.00	$ 17,280.00
Topsoil for Capped Cell	Supply + labour	Assumed 150 mm on surface	m^2	345.60	$ 2.50	$ 864.00	
Vegetation of Capped Cell	Supply + labour	Hydroseeding	m^2	2,304.00	$ 0.45	$ 1,036.80	$ 1,036.80
					Sub Total		**$ 133,459**
Surface improvements							
Drainage Improvements	Labour only	Assumed as perimeter of landfill cell	m	172	$ 25.00	$ 4,300.00	$ 4,300.00
					Subtotal		**$ 4,300**
MISCELLANEOUS							
Engineering Fees		Cell design	lump	1	$ 20,000.00	$ 20,000.00	$ 20,000.00
Additonal Expansion Factor		Includes fencing alterations, road expansion, monitoring well reclamation and re-drilling, etc. (Assumed 15% of earthworks, surface improvements, mobilization)	lump	1	$ 28,163.88	$ 28,163.88	$ 28,163.88
As -Built Survey		As built survey and construction surveying	lump	1	$ 2,500.00	$ 2,500	$ 2,500.00
						Subtotal	**$ 50,664**
						SUBTOTAL	**$ 238,423**
						Contingency (20%)	**$ 47,685**
						TOTAL COST	**$ 286,108**

TABLE 6: ANNUAL OPERATIONS AND MAINTENANCE COST ESTIMATE FOR A REGIONAL LANDFILL

EXISTING INCORPORATED LANDFILL OPERATION AND MAINTENANCE COSTS

LOCATION:	Site Location	Land Zoning	Legal Survey	Maintained by Municipal Staff	Maintained by Contractor	Areas/Communities Serviced	Approx. No. of Regular Users	Quantity of Solid Waste (A) (tonnes/yr)	Environmental Monitoring of land,air,water	Electric Fence In Place	Annual O&M Budget	Budget per User	Budget per Tonne
Carmacks	1.2 km southwest of Village, east side of highway.	Solid Waste Site		ü		Carmacks and surrounding area.	490	343	no	no	$10,000	$20.41	$29.15
Dawson City	A few km south of Town, west side of Klondike Hwy.	YTG Reserve No. MI - Industrial Business		ü		Dawson City, Klondike Valley and surrounding area.	3,000	2,550	yes	yes	$80,000	$3.33	$3.92
Faro		Lot 1027		ü		Faro and surrounding area.	400	350	no	yes		$25.00	$28.57
Haines Junction	Near km 1630 Alaska Hwy. East side.	YTG Reserve No. 023 PD - community use		ü		Haines Junction and surrounding area.	200	140	no	yes	$25,450	$50.00	$71.23
Mayo	km 49.6 Silver Trail	Federal Reserve 105M12/38 NOZ (no zoning)		ü		Mayo and surrounding area.	600	365	no	yes	$2,500	$16.67	$27.40
Teslin	1 km south east of Nisutlin River Bridge	Federal Reserve 105C02/29		ü		Teslin and surrounding area.	600	510	no	yes	$10,000	$16.67	$19.61
Watson Lake	Near km 1022 Alaska Hwy north side (Auburn Drive)	Federal Reserve 105A02/42		ü		Watson Lake and surrounding area.	1,800	1,600	no	no	$45,000	$5.56	$6.25
Whitehorse	North on Alaska Hwy, first left after Fish Lake Road	Lot 1166 105D/11 Public Utility zoning			ü	City of Whitehorse	21,000	22,500	yes	yes	$590,000	$0.48	$0.44

Notes:

(A) As provided by municipalities in Solid Waste Permit Applications and converted using 135 kg/m^3. Or, where unknown, based on a generation rate of 0.85 tonnes per person per year (E&DB Internal Report on Ban on Burning, May 1997).

Solid Waste Permits are pending - applications were submitted in April 2000.

(B) Includes landfilling, transfer station, recycling, gatehouse staff.

			AVG TONNES/YR	AVERAGE COST/YR	
AVG.	$25.75	$35.19	341.68	$12,024.14	YEAR 2000
	$31.00	$42.37	341.68	$14,477.06	YEAR 2008

COMPARTIVE ESTIMATE

Source: Appendix a - Guidelines for Establishing Transfer Stations for Municapl Solid Waste, Government of BC, Ministry of Envrionment.
February 1996, Updated 2005

1,000TPY Engineered Landfill	**1996**	**2008**			
Staffing and Equipment	$ 34,300.00 /yr	$ 44,538.55 /yr	Assumed to be equal to O&M cost highlighted in table above	------->	$44,538.55 / 1000 tonnes
Assumes compaction equipment at $90/hr, one hour per day, 3 days per week.					$ 44.54
Inspection and maintenance six hours per week at $20/hr.					This cost is used for estimating within the model.
					Considering additional costs, this amount totals:
ADDITIONAL LANDFILL COSTS (FOR AN ENGINEERED LANDFILL)					$ 69.27
Cover Materials	$ 2,200.00 /yr	$ 2,856.70 /yr		PLUS	$ 60,000.00 Year-round staffing for scalehouse.
Environmental Monitoring Program	$ 4,000.00 /yr	$ 5,194.00 /yr			
Annual Report	$ 5,000.00 /yr	$ 6,492.50 /yr			
Litter Control Fencing	$ 300.00 /yr	$ 389.55 /yr			
Closure Fund	$ 4,500.00 /yr	$ 5,843.25 /yr			
Post Closure Fund	$ 900.00 /yr	$ 1,168.65 /yr			
General Site Maintenance	$ 600.00 /yr	$ 779.10 /yr			
TOTAL	$ 53,796.00 /yr	$ 69,270.30 /yr			
MISSING COST - SCALE OPERATOR/SITE SUPERVISOR		$ 60,000.00 /yr	Assumed salaried cost. Fixed for all landfills.		
TOTAL O+M		**$ 129,270.30** /yr	Per Regional Landfill, Assuming 1,000 tonnes per year.		

Annual Operating Costs
$ 69.27 /tonne plus $ 60,000.00 /yr salary

TABLE 7: NEW TRANSFER STATION COST ESTIMATE

ESTIMATE NUMBER 1

Open Top Container

Site Development at Existing Site		
Site Grading	$	2,500.00
Access Road	$	5,500.00
Fencing	$	-
Retaining Structure (2-40yd bin system)		
Granular Base	$	7,300.00
Concrete Slabs	$	10,000.00
Concrete Footings	$	4,700.00
Concrete Retaining Wall	$	20,000.00
Supply and Place Fill	$	13,500.00
Safety Railings	$	2,000.00
Utilities		
110 v Power Supply (accessible from road)	$	7,300.00
Site Finishes		
Perimeter Fence	$	-
Landscaping	$	2,000.00
Signs	$	500.00

Operation and Maintenance

Haul Costs		
Hours per Week		2
Number of Weeks		52
Haul Cost	$	90.00
Total	$	9,360.00
Maintenance		
Hours per Week		1
Number of Weeks		52
Labour Cost	$	25.00
Total	$	1,300.00

	2001 Cost	2008 Cost
TOTAL CAPITAL	$ 75,300.00	$ 88,357.02
TOTAL O&M	$ 10,660.00	$ 12,508.44

Source: Solid Waste Strategy, Gartner Lee Limited, September 2001

ESTIMATE NUMBER 2

February 1996 -- Update to 2008 With Bank of Canada Inflation Calculator
100 TPY Rolloff Station

Capital			**1996**		**2008**
Site Preparation		$	5,000.00	$	6,492.50
Access Road and Ramp		$	3,600.00	$	4,674.60
Retaining Wall		$	7,000.00	$	9,089.50
Concrete Pad		$	5,600.00	$	7,271.60
Rolloff Bins (Two 50 yd3)		$	11,000.00	$	14,283.50
Rolloff Bin Covers		$	10,200.00	$	13,244.70
Purchase Effort + Taxes		$	16,000.00	$	20,776.00
Signs		$	200.00	$	259.70
Subtotal		**$**	**58,600.00**	**$**	**76,092.10**
Contingency	10%	$	5,860.00	$	7,609.21
Engineering	15%	$	9,669.00	$	12,555.20
TOTAL		**$**	**68,269.00**	**$**	**88,647.30**
			2001 Cost		2008 Cost

Source: Appendix B - Guidelines for Establishing Transfer Stations for Municapl Solid Waste, Government of BC, Ministry of Envrionment.
February 1996, Updated 2005

TABLE 8: INCINERATOR FACILITY COST ESTIMATE

ESTIMATE NUMBER 1

Source: Burning Garbage and Land Disposal in Rural Alaska, Alaska Energy Authority, May 2004

Incineration System	
BOS Fabrication and Freight	$207,400.00
Metal Building, complete	$325,400.00
Fire Supression System	$41,000.00
Water, Sewer, and Fuel Storage	$20,700.00
Converyor System	$18,700.00
Operator Training	$1,500.00
TOTAL CAPITAL	**$614,700.00**
Other Solid Waste System Items	
Landfill Engineering and Permitting	$60,000.00
Landfill Site Control	$81,300.00
Landfill Construction	$75,000.00
Dump Closure and ash Monofill	$34,400.00
Waste Collection Equipment	$55,400.00
Waste Oil Burner	$12,700.00

Operation and Maintenance	
Fuel	
Burns per Year	140.00
Gallons per Burn	34.00
Cost per Gallon	$1.35
Total	$6,426.00
Labour	
Burns per Year	140.00
Hours per Burn	5.00
Dollars per Hour	$25.00
Total	$17,500.00
Electricity	$2,500.00
Materials and Supplies	$3,000.00
Training	$500.00
TOTAL O&M	**$29,926.00**

ESTIMATE NUMBER 2

Quote from Eco Waste Solutions (October 20, 2008): **$457,300.00**

Additional Comments: 100 gallons diesel required per burn.
Alternatively, 24 kwH per burn electricity required.

ADJUSTED COST ESTIMATE BASED ON BLEND OF ABOVE SOURCES

Incineration System	
Unit Cost	$536,000.00
TOTAL CAPITAL	**$536,000.00**

Operation and Maintenance	
Fuel	
Burns per Year	91.98
Gallons per Burn	100.00
Cost per Gallon	$3.37
Total	$30,984.84
Labour	
Burns per Year	91.98
Hours per Burn	5.00
Dollars per Hour	$25.00
Total	$11,497.50
Training	$500.00
TOTAL O&M	**$42,982.34**

TABLE 9: FUTURE COST PROJECTIONS FOR CURRENT FACILITIES

	Annual	2008 to 2013	2008 to 2018	2008 to 2023	2008 to 2028
Stats Canada IPPI	*0.021*	*0.11*	*0.231*	*0.366*	*0.515*
Burning Vessel/Trench Model	**2008**	**2013**	**2018**	**2023**	**2028**
Average Total Cost (Based on 12 sites)	$ 28,259.48	$ 31,368.02	$ 34,787.42	$ 38,602.45	$ 42,813.11
Cost Per User		$ 13.32	$ 14.18	$ 15.12	$ 16.19
Cost Per Tonne		$ 11.99	$ 12.76	$ 13.61	$ 14.57
Manned Transfer Station Model	**2008**	**2013**	**2018**	**2023**	**2028**
Average Total Cost (Based on Marsh Lake and Mt. Lorne)	$ 99,782.76	$ 110,758.87	$ 122,832.58	$ 136,303.25	$ 151,170.89
Cost Per User		$ 81.77	$ 87.03	$ 92.83	$ 99.37
Cost Per Tonne		$ 73.60	$ 78.33	$ 83.55	$ 89.44
Unmanned Transfer Station Model	**2008**	**2013**	**2018**	**2023**	**2028**
Average Total Cost (Based on Deep Creek)	$ 118,974.94	$ 132,062.18	$ 146,458.15	$ 162,519.77	$ 180,247.03
Cost Per User		$ 336.38	$ 358.00	$ 381.85	$ 408.78
Cost Per Tonne		$ 302.74	$ 322.20	$ 343.67	$ 367.91

Notes:

Information based on existing contracts for unincorporated waste facilities (Community Infrastructure Branch 2008).

TABLE 10: FUTURE COST PROJECTIONS FOR WASTE FACILITY ALTERNATIVES

	Annual	2008 to 2013	2008 to 2018	2008 to 2023	2008 to 2028
Stats Canada IPPI	*0.021*	*0.11*	*0.231*	*0.366*	*0.515*
Landfill Cell Construction (8,000 m^3)	**2008**	**2013**	**2018**	**2023**	**2028**
Capital Cost	$ 286,107.70	$ 317,579.54	$ 352,198.57	$ 390,823.11	$ 433,453.16
Annual O&M (Based on Haines Junction Budget)	$ 25,450.00	$ 28,249.50	$ 31,328.95	$ 34,764.70	$ 38,556.75
Incinerator Facility	**2008**	**2013**	**2018**	**2023**	**2028**
Capital Cost	$ 536,000.00	$ 594,960.00	$ 659,816.00	$ 732,176.00	$ 812,040.00
Annual O&M	$ 42,358.78	$ 47,018.25	$ 52,143.66	$ 57,862.10	$ 64,173.56
New Transfer Station Establishment	**2008**	**2013**	**2018**	**2023**	**2028**
Capital Cost	$ 88,647.30	$ 98,398.50	$ 109,124.82	$ 121,092.21	$ 134,300.65
Annual O&M	$ 99,782.76	$ 110,758.87	$ 122,832.58	$ 136,303.25	$ 151,170.89

Notes:
Information based on Class C cost estimates prepared by EBA Engineering, 2008

APPENDIX A

APPENDIX A FUNDING PROGRAMS AVAILABLE IN THE YUKON

EXISTING FUNDING PROGRAMS IN THE YUKON

1.0 GAS TAX FUND (GTF)

The Gas Tax Fund (GTF), a key component of the Building Canada infrastructure plan, is helping to build Canada's communities by providing predictable and long-term funding in support of municipal infrastructure that contributes to cleaner air, cleaner water, and reduced greenhouse gas emissions.

The GTF supports environmentally sustainable municipal infrastructure, such as:

- public transit;
- drinking water;
- wastewater infrastructure;
- green energy;
- solid waste management; and
- local roads and bridges.

In addition, it benefits communities by providing funding to increase the capacity of communities to undertake long-term planning.

Municipalities can pool, bank, and borrow against this funding, providing significant additional financial flexibility. To ensure accountability to Canadians, communities report on their use of the funds on an annual basis.

Investment: The Building Canada plan is delivering $8 billion ($2 billion per year) in new predictable funding for sustainable infrastructure in our cities and communities. From 2007 to 2008 to 2013 to 2014, municipalities will receive a total of $11.8 billion in gas tax funding.

In response to ongoing requests for stable, long-term funding, Budget 2008 announced that the GTF will be extended at $2 billion per year beyond 2013 to 2014 and become a permanent measure. This will allow all municipalities, both large and small, to better plan and finance their long-term infrastructure needs.

2.0 THE GREEN MUNICIPAL FUND

Federation of Canadian Municipalities' (FCM's) Green Municipal Fund (GMF) provides loans and grants, builds capacity, and shares knowledge to support municipal governments and their partners in developing communities that are more environmentally, socially, and economically sustainable.

The Government of Canada endowed FCM with $550 million to establish GMF to provide a long-term, sustainable source of financing for municipal governments and their partners. To ensure the greatest possible impact, FCM uses GMF to invest in plans, studies, and projects that provide the best examples of municipal leadership in sustainable development and that can be replicated in other communities. FCM develops case studies and other tools to support municipal governments that are prepared to follow these examples.

FCM offers low-interest GMF loans or low-interest loans combined with grants to implement leading examples of sustainable development projects. GMF can offer financing for up to 80% of the eligible costs of some capital projects. GMF interest rates for municipal governments are Government of Canada bond rate for the equivalent term minus 1.5%.

Potential applicants can apply at any time for low interest loans to support brownfield remediation, beginning in July 2008.

Potential applicants can apply only in response to specific targeted calls for applications in four sectors: energy, transportation, waste, and water. Specific prerequisites and criteria are set through each call for applications. In most cases, applicants must have already completed a feasibility study or field test.

3.0 INFRASTRUCTURE CANADA PROGRAM

The Infrastructure Canada Program (ICP) has been helping to renew and build infrastructure in rural and urban municipalities across Canada.

The ICP has focussed on green municipal infrastructure – projects that improve the quality of our environment and contribute to clean air and water.

Program Details

The goal of the ICP has been to enhance municipal infrastructure in urban and rural communities across the country, and improve Canadians' quality of life through investments that protect our environment and support long-term economic growth.

Green municipal infrastructure has been the program's first priority. Examples of eligible projects included:

- water and wastewater systems;
- water management;
- solid waste management and recycling; and
- capital expenditures to retrofit or improve the energy efficiency of buildings and facilities owned by local governments.

4.0 FIRST NATION INFRASTRUCTURE FUND (FNIF)

The objective of the First Nations Infrastructure Fund (FNIF) is to improve the quality of life and the environment for First Nation communities by assisting First Nations in the provinces to improve and increase public infrastructure on reserves, Crown Land, land set aside for the use and benefit of a First Nation, or off-reserve in the case of cost-shared projects with non-First Nation partners, such as neighbouring municipalities.

Four categories of projects are eligible for funding under the program, each with several subcategories. All projects must fall within one or more of the eligible subcategories:

- Planning and skills development:
  - Comprehensive community planning.
  - Capital/infrastructure planning.
  - Community infrastructure awareness and maintenance capacity.
  - Training related to supporting community infrastructure.
- Solid waste management:
  - Waste disposal site construction.
  - Waste diversion projects.
  - Transfer stations.
  - Recycling.
- Roads and bridges:
  - Local roads.
  - Access roads.
  - Cost sharing with provincial/municipal roads projects.
  - Bridges.
- Energy systems:
  - Grid hook-up projects.
  - Sustainable energy systems for facilities – solar walls, ground-source heat pumps, wind power, etc.

APPENDIX B

EXISTING WASTE PROGRAMS IN THE YUKON

1.0 BEVERAGE CONTAINER RECYCLING PROGRAM

1.1 SUMMARY OF INITIATIVE

The program began in 1992 and is administered through the provincial government. The Department of Environment supports regulations, administers refund payments, pays depots handling fees, and is responsible for promotional/educational initiatives. Depots are operated by non-profit organizations or private businesses. The consumers bring in their used beverage containers and other recyclables to one of approximately 24 depots.

1.2 OBJECTIVES

The purpose of the expanded deposit return program is to divert waste material away from landfills and reduce roadside litter. Besides this, generating a stable and sustainable recycling fund is an ongoing goal.

1.3 DESIGNATED PRODUCTS

Schedule A under the Regulation outlines the following designated products: Beverage containers intended to contain any non-dairy, non-liquor beverage with a capacity of 1,000 mL or less a refundable deposit of $0.05, and a recycling fund fee $0.05; with a capacity of greater than 1,000 mL a refundable deposit of $0.25 and a recycling fund fee of $0.10. For beverage containers intended to contain liquor, aluminium cans have a refundable deposit of $0.05 and a recycling fund fee of $0.05; refillable glass containers have a refundable deposit of $0.10 and no recycling fund fee; non-refillable containers with a capacity of 200 mL to 499 mL have a refundable deposit of $0.10 and a recycling fund fee of $0.05; non-refillable containers with a capacity of 500 mL or greater have a refundable deposit of $0.25 and a recycling fund fee of $0.10.

1.4 END-OF-LIFE PRODUCT ISSUES

The waste management concerns associated with this product relate to the volume of waste generated at local dumps or landfills.

2.0 USED TIRE MANAGEMENT PROGRAM

2.1 SUMMARY OF INITIATIVE

The Designated Materials Regulation establishes an advance disposal surcharge to be paid by consumers at the time of acquisition of specific new tires. It also establishes retailer permits governing the sale of new tires and depot permits for the handling of used tires.

Retailers who supply new tires within the Yukon are required to collect this surcharge from consumers, and remit it to the government.

2.2 OBJECTIVES

The primary goal of the regulation is to create a self-sustaining management program for all used tires in the territory.

2.3 DESIGNATED PRODUCTS

All new tires with an inner diameter of 24.5 inches (622.3 mm) or less that will be used on a motorized vehicle or a conveyance powered by a motorized vehicle, and that have not been retreaded or used.

2.4 END-OF-LIFE PRODUCT ISSUES

Used tires present a significant disposal challenge. They do not break down in the natural environment and will accumulate indefinitely unless they are processed in some way. They take up valuable landfill space when stored in piles above ground, provide a perfect breeding ground for mosquitoes, and pose a fire hazard.

3.0 HOUSEHOLD HAZARDOUS WASTE COLLECTION

The Monitoring and Inspections section of the Yukon Government's Department of Environment assists communities or interested groups in conducting household hazardous waste collections.

The section provides limited funding to offset some of the costs of the event: technical assistance; a safety orientation for event volunteers; and disposal of all wastes collected. The hazardous waste collection days usually run over two days and are scheduled separately in each community.

4.0 SPECIAL WASTE COLLECTION

Since 1993, Environment Yukon has administered an annual collection of "special wastes" from Yukon industries and ships them out of the Yukon for recycling or disposal. Special wastes include used oil, antifreeze, solvents, vehicle batteries, and other wastes with hazardous properties.

The department pays for all transportation and administration costs. Industry members pay the cost of treatment only. An average of 45,000 kg of special wastes are collected annually.