CITY OF YELLOWKNIFE

COMPOST FACILITY
OPERATIONS & MAINTENANCE MANUAL

Version 4

January 2021

DOCUMENT CONTROL

Significant changes have been made to this document, refer to the revision table below.

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1. INTRODUCTION

In 2009, the City of Yellowknife (the City), in collaboration with Ecology North, launched a compost pilot project to investigate the feasibility of municipal composting in a northern climate. Through this pilot project**,** participating local businesses and institutions were tasked with separating their organics from the regular waste stream. The City worked with a local contractor to collect the Source-Separated Organics (SSO). City staff and Ecology North employees monitored and managed the composting process. The resulting product was tested and sold to citizens of Yellowknife. Building on the success of this pilot project, Yellowknife City Council approved the implementation of a four (4) year expansion of the program in 2013. The completed expansion has the capacity to collect and process organic waste from both the residential and industrial, commercial and institutional (ICI) sectors. Construction of this facility was planned in phases and forms part of the overall landfill closure plan. Construction of the base pad began during the summer of 2014 (Phase 1) and the final phase of construction (Phase 4) was completed in 2017. In 2020, the City completely took over operations and monitoring of the Compost Facility (CF).

1.1. Purpose of Manual

The purpose of this manual is to guide City staff, more specifically the Sustainability Projects Coordinators (SPC), with the operation and maintenance of the Yellowknife Centralized CF. As there are no guidelines in the NWT for developing CF operations and maintenance manuals, this manual has been designed by consulting the following documents: Code of Practice for Compost Facilities, (Alberta Environment and Parks (AEP), 2020); Composting Facility Guidelines, (Nova Scotia Environmental (NSE), 2010); Compost Facility Requirements Guideline: How to Comply With Part 5 of the Organic Matter Recycling Regulation (Government of British Columbia Ministry of Environment (MOE), 2004); and Environment and Climate Change Canada (ECCC) Solid Waste Management for Northern and Remote Communities Planning and Technical Guidance Document (ECCC, 2017).

This manual pertains to all phases of the CF. It will be revisited and updated as necessary and as requested by the Mackenzie Valley Land and Water Board (MVLWB).

1.2. Site Information

The CF is located on decommissioned landfill cells at the west end of City's Solid Waste Facility (SWF), on land owned by the City. Access to the CF is by the service road that connects the gatehouse and landfill entryway with the CF (Figure 1 - Appendix A). The site layout is illustrated in Figure 2 (Appendix A).

The CF is designed to accommodate turned windrow composting procedures. The windrows are long trapezoidal piles of organic waste that are mechanically turned by loaders and maintained to establish specific chemical, moisture, and temperature requirements. The CF has been designed to accommodate the anticipated volume of feedstocks in accordance with the Centralized Compost Program Expansion Plan starting in 2014. The CF consists of an engineered

base pad, retention pond, wildlife fence, storage shed, garbage dumpster, runoff storage tank, and a yard waste holding pen.

1.2.1 Base Pad

The purpose of the base pad is to provide a uniform surface upon which the compost windrows can be managed by heavy equipment without mixing or introducing foreign materials into the compost. The full base pad was constructed in phases, coinciding with the four (4) year residential expansion plan approved by City Council.

The Phase 1 pad is approximately 4,100 m^2 in area. Based on the 2009 pilot project, this equates to a capacity of approximately 570 tonnes of organic waste per annum. With the additions of Phases 2 through 4, the entire area of the compost pad is approximately 15,000 m^2 with a capacity of 2,085 tonnes per annum.

The base pad was designed and constructed with a slope of 1-2% to direct any surface runoff to the retention pond located at the west end of the CF. A top surface containment berm ensures that any surface runoff is directed to the retention pond. The base pad is elevated above all surrounding areas of the landfill, which ensures that no water or leachate from the surrounding landscape or landfill can run onto the compost base pad.

The liner system used for the base pad is composed of a Transnet 220-2-8 geocomposite protective/drainage layer and a Solmax 660T-9001 60 mil Linear Low-Density Polyethylene (LLDPE) geomembrane which is an impermeable membrane. The geomembrane is utilized to prevent the infiltration of liquid into the underlying material and groundwater. As shown in Figure 1-1, the liner system is covered by a 150 mm layer of sand, followed by a 150 mm thick layer of 50 mm minus crushed gravel and topped by a 150 mm layer of 20 mm minus crushed gravel.

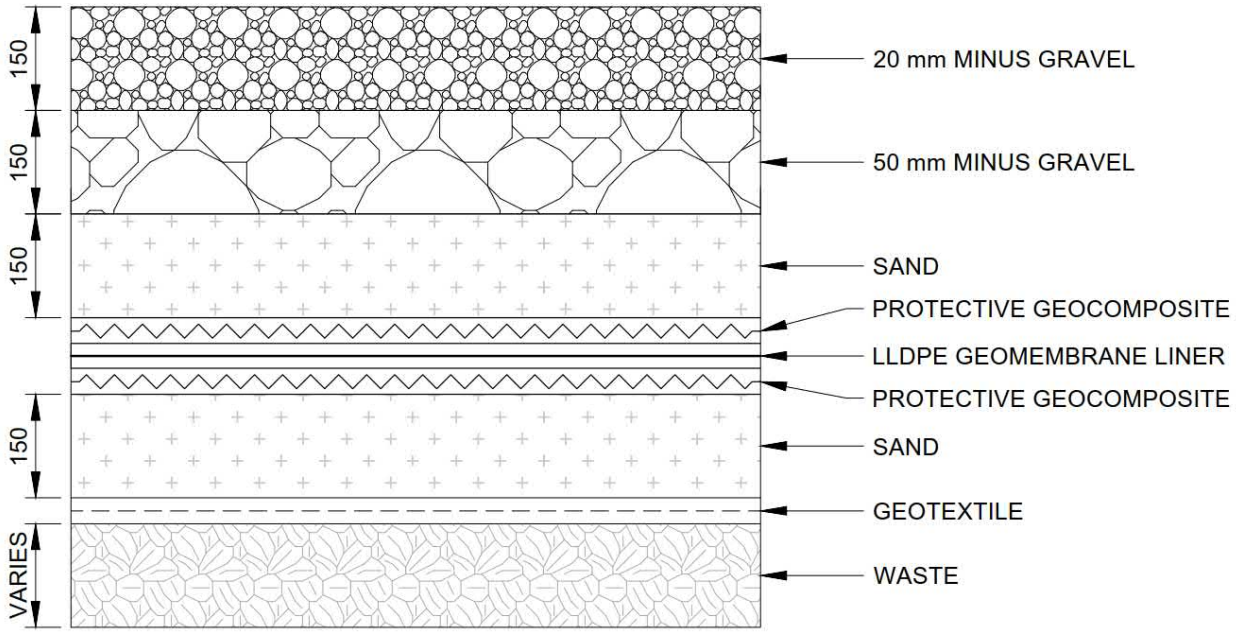

Figure 1-1: CF Base Pad Detail

1.2.2 Retention Pond

The retention pond has a volume of approximately 1,700 m^3. The liner system for the retention pond consists of a non-woven geotextile overlain by a 60 mil LLDPE geomembrane. Run-off from the CF collected in the retention pond are used to add moisture to the active windrows when necessary and appropriate, as explained in more detail in section 3.4.2. The retention pond is intended to have a freeboard of 1.0 m at all times.

1.2.3 Fence

The compost base pad is enclosed with wildlife fencing that will be electrified. Regular inspection and maintenance of the fence is completed as required. The City is working on the logistics of providing power to the fence.

1.2.4 Storage Shed

In 2009, the City replaced the existing gatehouse at the SWF with a new building. The old gatehouse was previously used at the Centralized Composting Pilot Project (CCPP) site. It is now used at the new site as a storage shed for equipment and safety gear.

1.2.5 Garbage Dumpster

One (1) garbage dumpster is located on site and is used by the CF staff for discarding non-compostable materials removed from the organics feedstocks. Once the dumpster is full, a member of the SWF staff weighs the waste material and transports it to the landfill cells for disposal. Waste from the garbage dumpsters will be compacted when it is unloaded in the landfill cell by SWF staff.

1.2.6 Yard Waste Holding Pen

A pen made of concrete barriers is located at the inner perimeter of the base pad where carbon amendments (i.e. yard waste and bales of shredded paper) are brought and stored until incorporated into the active compost pile. The mobility of the concrete barriers renders the holding pen easier to move and expand as necessary.

1.2.7 The Processing Area

A pen made of concrete barriers is located beside the Yard Waste Holding Pen. Prior to 2020, SSO was deposited in the processing area, inspected by Ecology North and CF staff, and then brought to the active pile with a loader. As of 2020, SSO is dropped off at the front end of the most active pile. The processing area is now utilized to store woodchips.

1.2.8 Compost Runoff Storage Tank

A 6,000 L (TBC) capacity storage tank is installed vertically on the compost pad near the retention pond. A pump and hose system are used to draw runoff liquid from the retention pond to the storage tank. A series of perforated pipes are placed on the active windrows and CF staff connect a hose from the storage tank to the pipes and the head pressure allows for irrigation through the pipes.

2. SITE PERSONNEL

SPC from the City lead operations at the CF with labour, equipment and support from other staff at the SWF.

The City's Senior Administrative Officer (SAO) is ultimately responsible for the operation of the CF. The overall operation of the CF is performed by the Manager – Sustainability and Solid Waste, with the SWF Supervisor responsible for the daily operation and maintenance of the facility. SPC work in concert with the SWF Supervisor to determine daily operational objectives. The SWF Supervisor assigns tasks to the SWF Attendants, who are directed onsite by the SPC.

The following sections outline the responsibilities of different personnel that are specific to the CF. For a full listing of SWF staff and their duties please refer to the City's SWF Operations & Maintenance Manual (City, 2021a).

2.1. Duties and Responsibilities

Figure 2-1 illustrates the relationship between the different CF staff. The duties of each are detailed below.

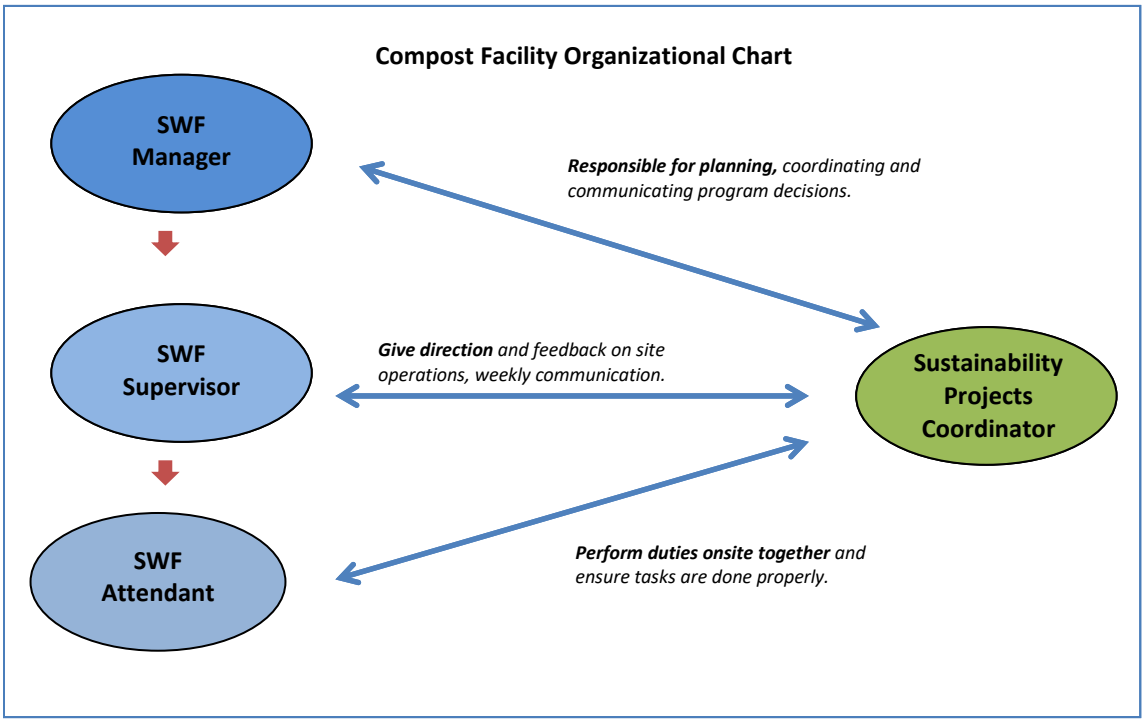

Figure 2-1: Duties and Responsibilities

Manager – Sustainability and Solid Waste Facility (SWF Manager)
The SWF Manager is responsible for the following:

- Liaison between Director of Public Works and Engineering and SWF staff.
- The SWF Manager shall:
    1. Perform operations at the facility in accordance with the CF Operations & Maintenance Manual (latest approved version), applicable Engineering Drawings, and other documentation related to the SWF including safety protocols and management plans;
    2. Ensure that only acceptable wastes, as indicated on the approved list for disposal, are permitted at the site in consultation with regulatory agencies;
    3. Communicate as required with regulatory agencies;
    4. Coordinate site visits;
    5. Maintain the environmental monitoring/sampling program;
    6. Ensure on site staff and contractors receive required training;
    7. Ensure that the site is maintained and operated in a clean and safe manner at all times, including regular collection of litter and compliance with the Northwest Territories Safety Act and Regulations; and
    8. Coordinate the preparation of landfill areas for operation and identify the requirement for the establishment of surface water control measures.

Sustainability Projects Coordinator (SPC)
The SPC is responsible for the following:

- Liaison with the SWF Supervisor and direct SWF Attendants
- The SPC shall:
    1. Provide direction by advising/coordinating with the SWF Supervisor, monitor SWF Attendants onsite when necessary and ensure operations are in accordance with the CF Operations & Maintenance Manual;
    2. Coordinate compost sampling;
    3. Maintain the monitoring, record-keeping, and reporting for: feedstock, windrow management, and compost quality;
    4. Prepare regularly scheduled reports (monthly, annually) on progress and planning at the site;
    5. Ensure that the site is maintained and operated in a clean and safe manner at all times, including regular collection of litter;
    6. Organize the marketing and use of finished compost in partnership with the City's Communications Department;
    7. Communicate with participants, waste collection contractor, and City staff:

a. Develop and disseminate educational material to the public in partnership with the City's Communication Department
b. Answer queries from residents and participants about the program in partnership with the City's Communication Department
c. Provide educational support and training when requested by the City
d. Address problems with organic bin collection including frequency of collection, location of bins, unacceptable material and illegal dumping

SWF Supervisor

The SWF Supervisor is responsible for general site operation and maintenance requirements at the SWF. The SWF Supervisor reports directly to the SWF Manager and is responsible for the following:

- Supervising full-time and part-time SWF Attendants.
- The SWF Supervisor shall:

1. Perform operations at the facility in accordance with the CF Operations & Maintenance Manual (latest approved version), applicable Engineering Drawings, and other documentation related to the SWF including safety protocols and management plans;
2. In consultation with the SWF Manager, ensure that only acceptable waste, as indicated on the approved list for disposal, are permitted at the site;
3. Provide overall direction for daily site activities;
4. Conduct work in accordance with the City's Occupational Health and Safety Program and the Northwest Territories Safety Act and Regulations;
5. Be responsible for the operations and maintenance of the site machinery;
6. Make recommendations to the SWF Manager for major and minor repair work required for site equipment;
7. Ensure that the site is maintained and operated in a clean and safe manner at all times, including regular collection of litter;
8. Coordinate snow removal and general maintenance for the access roads within the site and other areas as necessary;
9. Operate and maintain the surface water control structures and other site infrastructure;
10. Undertake site security checks, reporting any noted issues to the SWF Manager;
11. Inspect the site access road on a regular basis to recover any accumulation of waste or other debris;
12. Ensure that adequate signage and traffic control devices are in place and maintained in coordination with the SWF Manager;

13. Supervise and/or perform all duties related to the identification and recording of incoming vehicles and inspection of incoming waste;
14. Maintain adequate records for the operations, maintenance/repairs, and monitoring of the SWF;
15. Answer incoming telephone calls and requests for information, directing such requests as required; and
16. Perform such other related duties as may be assigned from time to time by the SWF Manager.

SWF Attendants

The SWF Attendants are responsible for tasks assigned to them by the SWF Supervisor. These positions typically address both ongoing and periodic general site operation and maintenance requirements. The SWF Attendants report directly to the SWF Supervisor and are responsible for the following:

- The SWF Attendants shall:
  1. Perform duties as assigned by the SWF Supervisor and as directed by the SPC;
  2. Conduct work in accordance with CF Operations & Maintenance Manual's maintenance and safety procedures;
  3. Conduct site and facility inspections as required; and
  4. Conduct work in accordance with the City's Occupational Health and Safety Program and the Northwest Territories Safety Act and Regulations.

Gatehouse Staff

The Gatehouse staff responsibilities are centered around performing cashier and data entry for the SWF. The Gatehouse staff are responsible for the following:

- The Gatehouse staff shall:
  1. Receive and record all tipping fees and inbound/outbound materials;
  2. Maintain accurate clientele information database;
  3. Direct users to proper disposal areas;
  4. Complete hazardous waste manifests as required; and
  5. Handle inquires and concerns of residents.

2.2. Personnel Training

The City is responsible for the training of all SWF staff. Staff working at the CF are trained to perform their job in a safe and environmentally responsible manner, in accordance with applicable regulations.

The SPC must report any safety issues to the SWF Supervisor. The SWF Supervisor must brief the SPC of any relevant safety information prior to conducting work at the CF.

A review of this Operations & Maintenance Manual, and related documentation, will be a prerequisite for any employee before being declared eligible for work at the CF. Additional documentation to be reviewed includes, but is not limited to, the following:

- Wildlife Management Plan;
- Landfill Fire Control and Risk Reduction Plan;
- Safe Work Practices, Policies and Procedures; and
- SWF Operations & Maintenance Manual (City, 2021a).

Any new City staff working on-site must review all the safety documentation prior to visiting the CF. As of 2020, staff must complete a Personal Field Level Hazard Assessment (FLHA) in their assigned FLHA tracking book prior to arriving at site.

The SWF Manager and SPCs are required to comply with all laws and regulations affecting the execution of the work at the site. This includes all applicable Federal, Territorial and Municipal laws and regulations pertaining to socio-economic and environmental matters. The NWT does not yet have territorial guidelines or standards for compost facility design and operation. SPCs follow recommendations from the *Alberta Code of Practice for Compost Facilities* when planning the design and operation of the Yellowknife CF.

Except where otherwise specified, the CF staff, including the SPC, SWF Attendant, SWF Supervisor, or other SWF staff working at the compost facility will herein be collectively referred to as “CF staff’.

3. OPERATIONS

The purpose of the CF is to process SSO from the Yellowknife waste stream in order to reduce the amount of material entering the landfill, reduce greenhouse gas emissions, and produce a useable resource by recycling organic matter. Compost is a product that increases soil organic matter and nutrients, eliminates and suppresses pathogens, and stabilizes chemicals that may otherwise be released into the environment, thus it is a resource that has many applications for agriculture, site remediation, and erosion control (Paul & Geesing, 2009).

The following sections describe the basics of composting, feedstocks, collection method, managing the composting process, tracking, and monitoring practices.

3.1. Basics of Centralized Composting

Centralized composting is a managed process through which organic substrates biodegrade in an aerobic and thermophilic environment. 'Aerobic' means 'in the presence of oxygen', and 'thermophilic' describes the range of temperature that is required to kill pathogens (approximately 40°C to 70°C).

3.1.1 Compost Microchemistry

Composting is a biological process carried out by microorganisms such as bacteria, fungi and actinomycetes, as well as macro-organisms such as nematodes, flatworms, rotifers, and mites. The goal of centralized composting is to maintain conditions that encourage a healthy microbial community. Monitoring and manipulating six (6) main process parameters help achieve this goal, namely:

1. Oxygen
2. Nutrients
3. Temperature
4. Particle size, porosity and structure
5. Moisture
6. pH.

While the SPC is primarily responsible for on-site monitoring and windrow maintenance, the CF staff must work collaboratively to ensure that the composting process is as safe and efficient as possible. For more details on optimal parameter levels and the importance of maintaining these levels, see Figure 3 (Appendix A). Table 1 below provides a summary of Figure 2.

Table 1: Controlling Main Process Parameters

Parameter	Importance	Optimal Levels	Control methods
Oxygen	Keep aerobic (less offensive odours)	Optimal Pile Oxygen Percent: ~16-18.5%	Passive aeration: chimney effect – free airspace in material for air to travel through Mechanical aeration: windrow turner.
Nutrients	Need: carbon (C), nitrogen (N), phosphorus (P) and potassium (K)	Target is a C:N Ratio of 25:1 to 30:1	Mixing various feedstocks and bulking agents to get the desired result, and accurately tracking amendments help control the C:N ratio.
Temperature	Ensure proper levels are achieved to destroy pathogens, optimize microbial activity, and to watch for fire safety	Material shall attain a temperature of 55°C or greater for at least 15 days during the composting period and must be turned at least 5 times in that period.	Temperatures must be monitored at least once a week and be recorded. If hot spots are found, they are to be turned. If temperatures begin to decline, the compost may be entering the curing stage or there may be a porosity problem. CPC to refer to data tracking to help gauge best course of action.
Particle Size, Porosity, & Structure	Proper airflow, limit compaction, increases rates of decomposition	Best initial pile porosity: ~50-60%, best final porosity: ~35% Particle size requirements fall within range of 1/8" – 2"	These parameters are adjusted primarily during the initial feedstock mixing step and are enhanced by adding bulking agents
Moisture	Necessary for chemical reactions, fire suppression	Moisture content should range from 40-60%	Add water with hose, remove water by aeration (turning the pile), evaporative cooling, or let it leach out
pH	Important for the decomposer organisms.	Target range is 6.5 – 7.5	Adjusted by mixing feedstocks and bulking agents at the outset of process. If pH drops to 5 add oxygen (turn pile), drywall/lime, and/or cut back on contamination.

(Compost Council of Canada, 2012)

For more information on managing the composting process, see section 3.4.

3.1.2 Composting Timeline

The composting process involves two (2) distinct stages: active composting and curing. The time requirements for these are dependent on the ability of the microorganisms to complete the two (2) stages, and so minimum time requirements (outlined below) must be respected. The completion of both stages is required to produce a pathogen-free, stable, and high-quality product.

Active Composting

The first stage of composting is characterized by the following events:

- Mesophilic, or moderate-temperature (around 45°C), phase may last for one (1) day or more. Easily degradable compounds, such as sugars, organic acids and amino acids, are decomposed.
- Thermophilic, or high-temperature (55-75°C), phase can last from a few days to several weeks. High temperatures accelerate the breakdown of proteins, fats and complex carbohydrates.

The active composting stage may last four (4) or more weeks (Paul and Greeley 2009).

Curing Stage

Once the supply of high-energy compounds is consumed, the compost mass will gradually decrease to mesophilic temperatures. The process will shift to the decomposition of more complex organic molecules, but also to the formation of biologically stable humic substances, or biological polymers. Fungi and actinomycetes dominate as they consume more complex organic matter such as lignin, chitin, and cellulose. The curing stage may last for several months. Curing is a critical stage for the compost to become stable and safe for use. The recommended minimum curing time is one (1) month at 40% moisture. Compost must be tested at an International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 170125 accredited laboratory after the curing stage, prior to use, to ensure that it is safe (i.e. pathogen-free).

3.2. Feedstock

The term ‘feedstock’ refers to the starting organic materials for the composting process. There are two (2) main categories that make up the feedstock: composting substrates, and bulking agents.

3.2.1 Source-Separated Organics

Source-Separated Organics (SSO) refers to a subsection of organic waste and is mainly composed of food waste and small amounts of leaf and yard waste, that has been separated by residents or businesses (i.e., at source). SSO are sources of nitrogen, which is required for successful composting. Furthermore, such organic material accounts for 38% of Yellowknife’s total waste (AET Group Inc., 2017); therefore, it is one of the most significant aspects to a successful composting and waste management program for diversion of organics from the landfill.

Local contractors collect SSO from residents participating in the green cart program on a bi-weekly basis and from participating businesses on a weekly or bi-weekly basis. More information on the collection methods can be found in section 3.3. Composting Substrates are listed in Table 2.

Table 2: Composting Substrates

Food waste	Yard waste	Paper products
• Fruits & vegetables • Meat, fish, bones • Dairy products • Bread, pasta, rice, cereal, flour • Coffee grounds, filters, tea bags	• Leaves • Grass trimmings • Plant trimmings	• Wet or food soiled boxboard and paper • Napkins, facial tissues • Wax-coated cardboard and boxboard • Certified compostable cutlery, food-soiled paper plates

3.2.2 Bulking Agents

Bulking agents are feedstock that take relatively longer to decompose and are usually carbon-rich. They are added to control aeration in the windrows by improving porosity, while offering structural stability, and balancing moisture content. Bulking agents are listed in Table 3.

Table 3: Bulking Agents

Wood waste	Paper products
• Woodchips • Sawdust	• Shredded office paper • Food soiled cardboard and boxboard

3.2.3 Prohibited Items

Items that are not appropriate for composting and are not accepted at the CF include, but are not limited to, the following listed in Table 4.

Table 4: Prohibited Items

• Plastic (excluding certified compostable items) • Tetra paks • Clothing/textiles • Tin cans/metal/glass • Aluminium foil • Cigarette butts and ashes • Dead animals and carcasses	• Rubber products • Pet feces/cat litter • Styrofoam • Honey buckets • Personal hygiene products diapers, bandages • Batteries • Lightbulbs

3.3. Feedstock Recovery (Collection Method)

SSO are collected by a local waste contractor from single-family homes through the green cart program and from businesses, institutions and multi-family dwellings through centralized drop-off specified organics dumpsters (marked "ORGANIC MATERIALS ONLY"). The SSO are then brought to the CF, inspected by staff for contamination, and deposited on the face of the active windrow.

Green Cart Program

As of 2017, all single-unit residences in Yellowknife serviced by regular waste collection, were provided with a green cart to collect SSO. Green carts are collected on a biweekly schedule. In addition to green carts, all single-unit residences have black carts for waste pickup, processing and disposal in the landfill at the SWF.

Organics Dumpsters

Different locations have different frequencies of collection based on the volume of material being produced. Depending on need, collection frequency ranges from once a week, to once every two (2) weeks. The appropriate frequency of collection is determined by the waste generator (i.e.: the business or resident) and then relayed to the waste contractors.

3.3.1 Bulking Agents

There are three (3) holding pens that contain bulking agents. The holding pens are segregated by yard waste, shredded paper, and woodchips. Bulking agents are required when there is a need to control and improve the following composting parameters: moisture content, aeration, C/N ratio, and nitrogen content. The addition of bulking agents occurs at the active piles.

Yard Waste

Yard waste is stockpiled at the SWF and brought to the CF as required. Once on site, yard waste is stored in the yard waste holding pen demarcated by concrete barriers. Yard waste is used as a bulking agent and carbon amendment. Brush (e.g. twigs, branches, etc.) greater than 25 mm in diameter must be removed and processed into woodchips before being incorporated into the windrow.

Shredded Paper

When the SPC deem necessary, shredded paper from the holding pen is incorporated into the active windrow. Shredded paper must not be left loose on top of the pile as it can cause a litter problem. Concrete barriers have been installed to mitigate litter. SWF staff regularly checks to ensure that litter is under control.

Woodchips

Logs, branches, and clean waste wood greater than 25 mm in diameter, are chipped and brought to the CF and used as a bulking agent when deemed necessary by the SPC based on visual inspection of the organic material and availability of bulking agents.

3.4. Waste Inspection

CF staff visually inspect the feedstock before combining materials at the active windrow face. If CF staff notice a large amount of contaminated material, they must remove it and place it in the garbage dumpster at the CF before integrating the acceptable load. Generally, a certain amount of contamination of non-acceptable material is expected. It is the responsibility of the CF staff to remove as much of this material whenever they can. Any remnants will later be screened out in the final stages of the composting process. As a general guideline, if more than half of the compost is contaminated, it is best to discard it as waste.

If the waste contractor or members of the public notices misuse of the drop-off locations around the city, they should inform the SPC (swfinfo@yellowknife.ca) so that they can troubleshoot and mitigate the source of contamination.

3.5. Handling Unacceptable Waste

Unacceptable waste must be manually removed from the CF and placed in the onsite dumpsters. If any hazardous waste is found, such as car batteries, it is to be kept separate and brought to the SWF gatehouse for proper disposal. Proper handling procedures for unacceptable waste and hazardous waste should be utilized in accordance with the SWF Operations & Maintenance Manual (City, 2021a), Hazardous Waste Management Plan (City, 2021b), applicable regulatory guidelines, WHMIS, and Safety Data Sheets (SDS). Once the CF dumpsters are full, they are incorporated into the rest of the landfill as household waste. A list of unacceptable wastes is found in section 3.2.3.

If an unacceptable load is continuously brought in from the same source, the SPC must be notified to troubleshoot the situation. The SPC will provide more training or education to the participants who are responsible, and/or secure the SWF site to prohibit illegal dumping.

3.6. Site Management

The CF operates as an outdoor turned-windrow composting program. The average time for processing materials is one (1) summer season for active composting and one (1) summer season for curing.

The CF is designed with a sloped base pad to allow any run-off to drain to the retention pond. To avoid cross-contamination of windrows, the most active windrows are to be placed closest to the retention pond. Also, the windrow should not be perpendicular to the main slope and should be place in an orientation that optimizes drainage. See Figures 1 and 2 in Appendix A for the site layout.

The job of the CF staff is to manage the process parameters as discussed in section 3.1.1 to create the optimal environment for microbial activity. The following sections describe the optimal management practices used at the CF to accomplish this.

3.6.1 Integrating Feedstocks

The hauling contractor deposits the SSO at the active face pf the windrow. Here, CF staff investigate the feedstock and safely remove prohibited items listed in section 3.2.3 and dispose of the items at the appropriate location. CF staff then use a loader to combine material with an appropriate amount of carbon amendment and bulking agent (i.e., shredded paper, leaf and yard waste, or woodchips.). It is mandatory for the new material to be incorporated into the active windrow the within 48 hours of when it is dropped off to minimize nuisances such as odours and wildlife hazards.

Feedstock preparation and volume mixes are determined by the CF staff, namely the SPC, based on this manual, Compost Mixture Calculation Spreadsheet (Cornell University, 2014), and the Compost Facility Operator Manual (Paul and Geesing, 2009). Upon inspection of the incoming feedstock, final adjustments may be made by the SPC in order to achieve the ideal Carbon: Nitrogen (C:N) and moisture ratios and other process parameters as outlined in Table 1.

An appropriate size for a windrow on the current base pad is approximately 4-6 m wide, 2.5-3.7 m tall, and 35 m long. It is possible that the exact dimensions of the windrows change; however, windrows shouldn't be much taller or wider than this in order to ensure proper aeration. Typical spacing of windrow piles is a minimum of 3-4 m.

3.6.2 Active Windrow Summer Management

Between mid-May and mid-October, active windrows are turned with a loader once to twice per week.

Turning Operations

The loader operator turns the windrows by lifting the materials on one side of the windrow with the loader bucket, and letting the materials slowly fall back to the ground. This is repeated for the entire length of the windrow, and then repeated on the other side of the windrow. The purpose is to increase airflow into the materials to maintain proper oxygen levels for aerobic decomposition.

When turning the piles, loader operators must ensure the bucket does not scrape the base pad and collect any gravel. When gravel from the base pad is disturbed and turned into the windrow it will negatively affect the end quality of the compost. Gravel is very difficult to screen out of

finished compost and because of this, care must be taken when turning material nearest to the base pad.

Watering Operations

The purpose of watering the windrow is to maintain moisture levels of 40-60%. The moisture level in the windrow can be measured by a hand squeeze test, explained in section 5.3, or as observed by the loader operator (if the material has too much moisture it will be difficult to lift and turn). It is up to the SPC to dictate when watering is necessary. Windrow watering is most effective when carried out at the same time as windrow turning, as it increases absorption and distribution throughout the windrow. The SPC is responsible for gauging how much water per week to irrigate onto the windrows. If there is not enough water in the retention pond to water active windrows, water from an outside source (e.g., water truck) will be used.

Prior to reaching an average temperature of 55°C for 15 days, the active windrow piles may be watered using liquid from the retention pond with a water pump and fire hose on site. The end of the pump must be fully submerged in the retention pond in order for the pump to work properly. Extra care must be taken when handling the pump and hose in the retention pond as not to damage the retention pond liner.

Once an active windrow has reached an average temperature of 55°C, which it will maintain for 15 days or more, it should be watered with clean water only for the remainder of the composting process, as described in section 3.4.5. Clean water is important at this stage of the composting process to ensure that no new pathogens are introduced, to prevent contamination, and to help with the maturation and stabilization process. The SPC will determine, based on temperature measurements, when liquid from the retention pond can no longer be used and clean water must be used to add moisture to the windrows. At this point, the windrow will also be relocated further away from the retention pond, as necessary, to prevent cross-contamination from other windrows. Clean water will be obtained from the water truck on site, which will be filled on an "as-needed" basis (currently once a week) from an approved water source.

3.6.3 Troubleshooting Operational Problems

Throughout active composting, process parameters discussed in section 3.1.1 must be managed. Process parameters are interconnected and changes in one area can initiate changes to another. Ideal conditions seldom exist – managing the composting process involves using scientific equations to determine the best course of action, but also juggling the parameters and making compromises as required. The composting process is somewhat slow to react to changes; therefore, when problems occur it is important to implement and record small changes. It is also critical to monitor changes over a duration of time, as there is typically an indication within a week as to whether changes are successful. Additional changes can be implemented until the desired result is achieved.

The On-Farm Composting Guide (Rynk, 1992) is an excellent resource for troubleshooting problems. For a sample that outlines temperature, odour, runoff liquid and vector problems, see Figure 4 (Appendix A).

3.6.4 Winter Management

During the Fall, the site must be prepared for the inactive winter season. No watering is necessary from September to May. The following things must be done prior to winter:

- The water levels in the retention pond need to be managed to minimize chances of overflow in the spring.
- The SPC can decide to add an insulating layer of woodchips, yard waste, and/or snow to spread over the actively composting windrows. This may help maintain above-freezing temperatures and will reduce the time required for the piles to regain ideal temperatures in the spring.
- If space is available, finished and screened compost can be stored inside to prevent freezing and to ensure that it is ready for use in early May. If there isn't adequate space available inside, finished compost can be stored in small piles, so that when it freezes during the winter it can be thawed quickly in early spring.

During the winter season food waste/feedstock will continue to be dumped at the site. The same steps must be taken as outlined in section 3.4.1**.**

3.6.5 Curing Pile

Once the active process is completed, CF staff will move the organic material to a curing area (called the curing bay). Moving windrows is possible after one (1) summer season in the active composting position, when temperatures decrease to 45**°**C, and the odour has become soil-like. Organic material is not to be moved to the curing pile unless directed by the SPC. Curing windrows require less water than active windrows. However, the ideal moisture content during the curing phase is 40% for stabilization and maturation purposes. The curing stage is equally as important as the active stage. Curing piles are to be watered with clean water only.

When the curing pile is turned, it must be it must be done with a clean loader bucket. The loader operator must ensure that the curing pile is turned first before turning the active piles. This is to ensure no pathogens are transferred to the curing pile.

3.6.6 Shoulder Season Management

Windrows (curing and active) are turned starting in April to speed the thaw cycle. This is particularly important for curing windrows, which have the potential to be sampled, screened, and used in the spring at the discretion of the City for various onsite/off site uses. It is also relevant for windrows as they heat up and become very active. In the fall season, watering of windrows is typically suspended in September for the colder fall/winter months. Windrows are turned for a number of weeks or a couple months longer than they are watered due to the fact

the water will freeze and the most active windrows continue to heat up necessitating continued temperature and oxygen management.

3.7. Processing Finished Compost

Curing should take place for at least four (4) weeks. The time period for curing may be longer if turning frequency is lower or there is limited aeration; at some facilities, compost is cured for six (6) months (Paul and Geesing, 2009). Once curing has been completed, and prior to screening, finished compost must be tested at an ISO/IEC 170125 accredited laboratory. Details regarding testing and sampling are in section 5.4.

The operators screen finished compost to remove unwanted material such as rocks, wood, and to remove bulking agents such as woodchips. The City's Pro-Screen shaker (deck) with a 4' x 8' screen is used with a 1/2" screen size. If possible, a coarse screen (greater than 1/2") should be used to carry out a preliminary screening. A skid steer is used to pour the finished compost onto the screen. The 'overs' can be screened a second time to recover as much of the useable finished compost as possible. The remaining refuse must be removed from the CF site and brought to the main landfill for disposal. Section 3.3 of the Canadian Council of Ministers of the Environment (CCME) guidelines states that there should be less than 1% of foreign matter that is 25mm or larger for compost designated for public distribution.

Once the finished compost is properly screened, it is to be piled onto a clean geotextile pad so that it is ready for sale or for use by the City. ONLY clean loaders and/or skid steers should handle finished compost.

4. MAINTENANCE PROCEDURES

As the CF is situated within the SWF, all maintenance is done in accordance with the City's Service Standards. Once a month, the entire SWF site is inspected as part of the City's Safety program. The details on this program are available in the City of Yellowknife SWF Operations and Maintenance Manual (City, 2021a). The following sections outline maintenance activities specific to the CF.

4.1. Collection Maintenance

A private contractor is responsible for the collection of SSO for both the single-family residences and ICI sector. Single-family green carts and ICI SSO dumpsters are covered at all times to discourage wildlife and prevent wind-blown debris. SWF staff conduct periodic inspections of the green carts and complete maintenance/repairs as required. If the green cart is in very poor condition, the green cart is replaced by SWF staff. ICI SSO dumpsters are the responsibility of the private contractor. Private contractors are responsible for maintaining their dumpsters and collection vehicles in accordance with their maintenance program.

4.2. Site Maintenance

Monitoring of the drop-off areas is the responsibility of the CF staff while working around the CF. Before leaving the site, the SPC will make a daily tour of the entire CF to do maintenance and cleaning of the various designated areas as required. The SPC may enlist the help of other CF staff, such as loader operators. During the daily tour, different aspects of the CF are inspected to determine if any maintenance and/or repairs are required. Records of any issues observed are kept as well as remedial measures. Loader operators are required to keep the material on the base pad level and neat to ensure no pooling of runoff liquid occurs; they may need to back-drag across the pad in order to do so.

4.2.1 Storage Maintenance

At the CF, the yard waste holding pen holds leaf and yard waste (e.g. grass, small twigs, etc) that is ready to integrate into the compost pile. This pen must be kept tidy and material must not be piled higher or pushed beyond the confines of the stacked concrete barriers.

If finished compost is also stored onsite it must be on a clean geotextile base, separating it from the base pad, and covered with clean geotextile.

4.2.2 Equipment Maintenance

Regular maintenance is to be performed on all City-owned equipment as per the City's Service Standards located in the gatehouse. Specific equipment used at the CF includes ladder, screener, skid steer, water pump and fire hose. After use, the SPC must empty the fire hose, and then cover both the hose and pump with geotextile to avoid degradation from the sun.

4.2.3 Retention Pond Maintenance

Runoff liquid is effluent from, or water that may have been in contact with, managed organic matter at the CF. Potentially contaminated runoff liquid results if feedstock or composting material is saturated with water and/or if water (from rain or snowmelt) comes in contact with the material without being absorbed. Runoff liquid has the potential for elevated levels of Biochemical Oxygen Demand (BOD), which means it can deplete groundwater and surface water of oxygen and contaminate it with excess nitrogen, trace elements, water-soluble nutrients, pesticide residue, and potentially toxic compounds. For these reasons, it is important to properly maintain the retention pond and ensure proper reuse and disposal of runoff liquid as detailed in the following descriptions.

While the retention pond will be monitored on an ongoing basis, more detailed inspections will occur during pond cleaning. It is important to train CF staff in proper operational procedures around the retention pond that reduce the potential to damage the pond liner system. Placement of equipment on the pond liner system should be limited to the pump and fire hose and extra caution should be used when placing the pump and fire hose as not to damage the liner system. If the integrity of the liner system is observed to be compromised, a qualified geosynthetic installation contractor should be utilized to complete repairs/remedial measures for the liner system as necessary.

Pond Cleaning

Garbage blown in from the CF accumulates in the retention pond regularly, so the pond should be cleared of debris at least once per season.

Runoff Liquid Disposal

Runoff liquid is used to irrigate the composting piles prior to a certain point in the composting process. If runoff liquid in the retention pond approaches an elevation 1.5 m below the top of the pond and there is a possibility that it may exceed the freeboard limit, the City must test the runoff liquid for a variety of parameters outlined in the City's Water Licence prior to off-site disposal. If off-site disposal is required, a vac truck will be utilized to dispose of the runoff liquid at an appropriate disposal facility approved to process the runoff liquid. Prior to disposal of the runoff liquid, it will be sampled and sent to an ISO/IEC 170125 accredited laboratory for analysis. Section 5 of the City's SWF Operations & Maintenance Manual (City, 2021a) contains details of the SWF's sampling and monitoring program, including runoff liquid sampling parameters. Please see Appendix B for more information on runoff liquid disposal requirements. The City is considering the use of a mobile tank to collect and redistribute the runoff liquid.

4.2.4 Base Pad Maintenance

As described in section 3.4.2, care must be taken when turning the compost piles to ensure the base pad gravel is not scraped. CF staff will conduct ongoing inspections to ensure that any unwanted ruts or depressions are fixed promptly to prevent pooling of runoff liquid. It is also important to maintain the gravel structure of the base pad to ensure the liner system is not damaged during operations. If it is observed that the liner system is exposed, an inspection of the liner system should be completed immediately. Remedial measures required should be

completed by a qualified geosynthetics installation contractor and the gravel structure should be reconstructed to the original design.

A 2015 Landfill Gas (LFG) study recommended a passive system to allow for LFG to be released in a controlled manner. Plans to install extraction wells will be considered when the entire landfill is capped. This may impact the CF and needs to be monitored accordingly. For additional information regarding landfill gas, refer to the Interim Closure and Reclamation Plan (City, 2021d).

4.3. Access Road Maintenance

Basic road maintenance is conducted as follows:

- On a regular basis, the road is to be maintained (potholes filled in, surface levelled) so as to provide a reasonably smooth surface for vehicles;
- At least twice per year, the road is graded smooth and the surface reshaped; and
- During the winter, snow is removed to ensure unrestricted access to the site for vehicles.

4.4. Nuisance Control

The CF has a number of items that, if not managed properly, can become a nuisance to operations, a source of public complaints, or a hindrance to complying with regulations. These items include odours, dust, litter and wildlife. Control methods for these items are described in the following sections. If the nuisance persists, further investigation into alternative control measures will be undertaken.

4.4.1 Odour Control

Managing odour emissions is a priority at the CF as foul odour is the most common cause for closure of compost facilities (Paul and Geesing 2009). Site personnel should take odour prevention seriously. Implementing the following odour management procedures during the initial feedstock input stage and active composting stage, as well as conducting runoff liquid monitoring/treatment as detailed below, assists in controlling odours at the facility.

Feedstock Receiving/Mixing Areas

Unprocessed feedstock, particularly on a hot day, emits strong and pungent smells. Therefore, fresh feedstock must be processed and covered with leaf and yard waste and/or woodchips on the same day as it is received.

Active Composting

Good management of the active composting process will ensure the least amount of odour problems. This includes:

- Maintaining proper pile heights as passive aeration only works when pile height, porosity and mixture are balanced;

- Using proper bulking agents to give good structure, which will help optimize free air space to avoid saturated pore space that can lead to anaerobic conditions and excess runoff liquid;
- Maintaining the proper C:N ratio, through means described in section 3.1.1. Excess nitrogen can cause strong and unpleasant odours;
- Temperatures must be recorded twice a week (material should reach 55°C or higher within four (4) days and stay between 55°C and 70°C for at least three (3) days); and
- Turning frequency must be optimized (less frequent turning is required at the end of the process) and turning should be avoided under adverse wind conditions or high ambient air temperatures.

Runoff Liquid Storage/Treatment

Lanes between piles and in the mixing area of the base pad must be smoothly graded to reduce runoff liquid ponding and ensure drainage to the retention pond. Fix ruts and depressions, grade the site if necessary, and keep ditches and swales clear of debris.

If odour from the composting process occurs, the odour characteristics may assist in identifying the cause and provide solutions for remediation. The following table describes a few different types of odour, their characteristics, and possible causes.

Table 5: Types of Odour and Characteristics

Odour: Description	Possible Chemical Compounds	Possible Causes
Foul, rotten, fishy: rotten eggs, rancid, urine, sewage	Hydrogen sulphide, Trimethylamine, Ammonia, Indoles	Anaerobic conditions; low porosity; high water content
Fruity: sweet, citrus	Esters, Limonene Pinene	Bulking agent with high resin content
Chemical: pungent cleaning solution, alcohol, swimming pool, gasoline, plastic/rubber	Terpines, Chlorine, Butanol, Ammonia	High available N, and low available C; high pH
Soil, grass, mushrooms: earthy, musty, mouldy	Geosmin, 2,4,6-Tricholoroanisole	Actinomycetes, natural compost smell

Adapted from Paul and Geesing 2009.

Dealing with Odour Complaints

CF staff should take odour complaints seriously; complaints must be recorded and dealt with in a timely and professional manner. If an odour complaint is received, an Odour Incident Report (Appendix C) must be filled out. The date and time must be recorded and the receiver should probe the complainant to describe the characteristics of the odour. A helpful tool for identifying odour characteristics is the Compost Odour Wheel, in Appendix C (Forgie, Sasser, and Neger 2004). Any odour complaints must be reported to the SPC and the SWF Supervisor. The

complaint will be investigated and remedial measures undertaken. All information related to the complaint, investigation, and remedial measures shall be recorded and retained at the SWF.

4.4.2 Dust and Bio-Aerosol Control

Dust can be a problem during dry seasons. Dust is generated from dry, uncontained organic material, especially during screening and turning operations, or vehicle traffic. Dust can also carry bio-aerosols, tiny biological particles that include fungi (like *Aspergillus fumigatus*), bacteria, mycotoxins and viruses. Yard waste from landscape or agricultural/horticultural operations may contain Volatile Organic Compounds (VOCs) that can be hazardous to human health. Bio-aerosols and VOCs are typically carried on dust particles. This makes dust control measures particularly important to control worker exposure and reduce the risk of disease. To minimize dust generation at the facility:

- Keep compost, feedstocks, and bulking agents moist or covered.
- Apply water to roadways (or construct with asphalt in future).
- Time composting processes with care; there is usually less wind during early morning and evening hours. Ideally, mixing, turning or screening compost should not take place on extremely windy days.
- Keep machinery and surfaces clean of dust.

4.4.3 Litter Control

Litter from the site (that is transported in with yard waste or compost substrate) can make its way to the surface and be blown about the entrance road and the surrounding environment. Litter may also potentially be blown to the CF from the landfill area of the SWF. A clean, litter-free appearance will be maintained at the site at all times, not only for public relations, but also for efficient operation of the landfill and environmental protection. Poor litter control attracts unwanted scavengers and contributes to surface drainage problems by blocking ditches and culverts. Litter control measures include:

- Litter collection fencing located around the CF area to catch blowing litter;
- Installation of concrete barriers;
- A litter collection schedule as directed by the SWF Supervisor; and
- Monitoring and regular collection of litter on fencing, on site roadways, in ditches and adjacent properties.

4.4.4 Wildlife Control

Compost facilities attract wildlife due to the availability of food. Bird control is especially important as the CF is within the airport buffer zone. In order to limit the availability of food to attract birds, the following precautions are to be considered:

- Feedstock material must be incorporated into the compost pile the same day it is dropped off; and
- Any fresh material still on the surface, after carbon amendment has been mixed in and the pile has been turned, must be covered by yard waste prior to leaving the site.

4.5. Fire Control

There is no burning of waste at any time at the CF. Please refer to the Landfill Fire Control and Risk Reduction Plan (Landfill Fire Control Inc., 2007) for details on fire prevention measures. Refer to section 7.4 for further information regarding fire hazards specific to the CF.

5. MONITORING PROCEDURES AND QUALITY TESTING

The SPC is primarily responsible for monitoring procedures and quality testing. The Gatehouse staff tracks weights of incoming residential and ICI SSO information. Furthermore, CF staff and other interested individuals have access to any monitoring data upon request.

5.1. Windrow Temperatures and Turning

According to the CCME guidelines for Compost Quality, when turned windrows are used to produce compost from feedstocks that include food waste, materials in the windrows must attain a temperature of 55°C for at least 15 days during the composting period, and during this period the windrow must be turned at least five (5) times (CCME 2005).

Active windrows at the CF should be turned and watered two (2) to three (3) times per week from June to September. Using the sheet in Appendix D, the SPC track and record when windrows are turned and watered, and how much carbon amendment is added.

Throughout the period of active windrow management, the SPC records the temperatures of the active composting and curing windrows two (2) to three (3) times a week. Temperatures must be taken before the piles are turned and watered for accurate readings. A minimum of five (5) measurements may be taken from within each windrow, at random locations throughout the windrow, using a ReoTemp compost thermometer with a 914 mm **(**36”**)** stem. Temperatures are taken at 300 mm and 1 m depths to increase the likelihood of discovering a “hot spot” (where temperatures are above 70°C). Please see section 7.4 for more information regarding fire prevention. Temperatures are recorded on the sheet in Appendix D. All such records, from the beginning of the program to present, are kept at the SWF.

5.2. Input Feedstocks and Compost Produced

As specified in the City’s Water License, CF staff are required to monitor and record all materials that are accepted at and transported away from the CF. This includes tracking the following parameters:

- Quantity (weight in kilograms) of all input feedstocks including SSO, yard waste, wood chips, shredded paper, and boxboard.
- Quantity (weight in kilograms) of finished compost produced.
- Quantity (weight in kilograms) of waste removed from the compost site.

Typically, SSO are weighed at the SWF gatehouse before being delivered to the CF. In instances where material has not been weighed, an estimate of the mass may be made, based on the average weight data for the material being estimated. Feedstock inputs, material outputs, and compost produced are recorded using the appropriate sheet in Appendix D.

5.3. Other Process Monitoring

The SPC monitors moisture two (2) times per week, while collecting other pertinent data, such as temperatures, etc. Monitoring moisture is an important aspect to understanding overall

windrow “health” and can be particularly useful when troubleshooting. In addition to monitoring moisture, bulk density monitoring should be done at least once a season on a sample of the finished compost. When this type of process monitoring is done, it is to be recorded on the operations sheet in Appendix D in the comments or notes field.

5.3.1 Moisture Monitoring

The compost pile should have the moisture of a wrung-out sponge, which can be determined by a simple ‘hand squeeze test’. CF staff is encouraged to familiarize themselves with how different moisture levels feel so they can quickly assess the pile and respond to problems.

- **Over-saturated:** water will leak when the sample is compressed and the sample will feel dense and heavy. Another way to assess this is if it takes force to push a temperature probe into the pile.
- **Good moisture:** compost will be moist but excess water won’t be dispelled, sample will have some springiness and will feel like a wrung-out sponge. The temperature probe will slide in easily.
- **Dry:** sample will be dusty and will not hold together well.

5.3.2 Bulk Density & Porosity

The SPC should measure bulk density prior to distributing compost for use, and to calculate the total amount of compost for end of year reports, PR, etc. In order to measure bulk density and porosity in a simple way, a ‘bucket test’ may be performed. This is achieved through the following steps:

1. Weigh an empty five (5) gallon pail, measure the exact volume by filling it with water (Volume (V)).
2. Fill the empty pail one-third full of material and drop the pail once from a height of 150 mm onto a firm, flat surface to compact the material.
3. Add more material until the pail is two-thirds full. Drop the pail ten (10) more times from a height of 150 mm.
4. Fill the pail to the top. Drop the pail ten (10) more times from a height of 150 mm.
5. Fill the pail to the brim, do not drop to compact the material.
6. Weigh the pail and sample. Subtract the Weight (W) of the pail to calculate the W of material.
7. Calculate the bulk density of the material: Bulk density (Density) = W / V.

5.4. Compost Quality

Previously, compost quality was determined by the SPC. As of 2020, compost quality is determined by the Compost Quality Alliance, which is overseen by the Compost Council of Canada. The Compost Quality Alliance provides a detailed lab analysis of the compost sample and various recommendations and limitations for use of compost based on the lab results to the SPC. Based on this information, the SPC finalizes the recommendation for the finished compost. Finished compost will be used at the discretion of the SWF Manager based on the

recommendations from the SPC. Finished compost is graded according to the CCME *Guidelines for Compost Quality* (2005) to ensure the product is consistent, high quality, and safe for its intended use. Category 'A' compost has unrestricted use and Category 'B' compost has restricted use because of the presence of sharp foreign matter and/or trace elements. In order to determine the category of compost, samples must be sent to an ISO/IEC 170125 accredited laboratory for analysis. Samples must be collected according to the directions of that lab. AS part of the City commitment to the Compost Quality Alliance, four (4) samples of finished (or cured) compost must be taken annually and all four (4) samples must be sent to A&L Laboratories Inc. in London, Ontario. The category designations are made based upon the following four criteria: pathogens, trace elements, foreign matter and maturity. Compost is also tested by emergence trials to ensure plants will grow in it. The following sections outline the testing parameters. Where compost exceeds guidelines for unrestricted use and/or where there is a need to use compost for internal operations such as cover, landscaping, or erosion control, the SWF Manager will decide on the product's final use.

5.4.1 Pathogens

A pathogen is a bacterium, virus or other microorganism that can cause disease. Pathogens that must be tested for include: *Salmonella sp.* and Fecal coliforms. CCME stipulates that compost that has been produced from feedstocks other than only yard waste must satisfy the following criteria:

1. Passively aerated windrow composting methods require that the decomposing material attain a temperature of 55°C ≤ 60°C for at least 15 days during the active composting period. Also, during the high temperature period, the windrow must be turned and watered at least five (5) times with fresh water. Please note that while 55°C is ideal, temperatures above 70°C for an extended period of time will kill good bacteria and can be a risk for spontaneous combustion. (Please see section 7.4 for more information regarding fire safety.)
2. Organism content in the finished compost must meet the following:
    a. Fecal coliform numbers must be < 1000/g of total solids calculated on a dry weight basis using the Most Probable Number (MPN) microbiological technique; or
    b. No Salmonella sp. species can be present, with a detection level < 3 MPN/4g total solids calculated on a dry weight basis.

5.4.2 Trace Elements

Trace elements could cause adverse effects on human health or the environment over the long term if present in quantities above the allowable level. CCME (CCME, 2005) recommendations regarding appropriate levels of trace elements are detailed in Table 6.

Table 6: CCME Trace Element Criteria

Element	CCME Category A (mg/kg)	CCME Category B (mg/kg)	Maximum 45 Year Cumulative Loading (kg/ha)
Arsenic (As)	13	75	15
Cadmium (Cd)	3	20	4
Cobalt (CO)	34	150	30
Chromium (Cr)	210	1060*	210*
Copper (Cu)	400	757*	150*
Mercury (Hg)	0.8	5	1
Molybdenum (Mo)	5	20	4
Nickel (Ni)	62	180	36
Lead (Pb)	150	500	100
Selenium (Se)	2	14	2.8
Zinc (Zn)	700	1850	370

*From CFIA T-4-93

5.4.3 Foreign Matter

Foreign matter includes pieces of plastic, rubber, glass, and gravel. CCME Category 'A' compost must satisfy the following specifications with respect to foreign matter and sharp foreign matter:

- **Foreign matter:** compost shall contain no more than one piece of foreign matter greater than 25 mm in any dimension per 500 mL.
- **Sharp foreign matter:** the compost must not contain any sharp foreign matter of dimension greater than 3 mm per 500 mL sample.

If compost is Category 'B' due to the presence of sharp foreign matter, it "cannot be used in pastures, parks, or for residential purposes" (CCME, 2005).

5.4.4 Stability and Maturity

Stability is a *stage* in the decomposition of organic matter (i.e.: measures biological activity) whereas maturity is a *chemical condition* of the compost (i.e.: measures the extent that pathogens that can harm plants). These parameters are measured by the respiration rate of microorganisms in compost and the self-heating (capacity for compost to increase in temperature due to microbial activity). Category 'A' and 'B' compost "shall be mature and stable at the time of sale and distribution" (CCME, 2005). To be mature and stable, the compost must be cured for a minimum of 21 days AND meet one of the following three requirements:

- O_2 respiration rate is less than or equal to 400 mg O_2/kg OM per hour.
- CO_2 evolution rate is less than or equal to 4 mg CO_2/kg OM per day.
- Temperature rise is less than or equal to 8°C (Dewar Flask).

5.4.5 Other Compost Quality Characteristics

There are several additional important factors to determine the quality of the compost and to inform what proportion of compost should be mixed with soil for varying applications. These include pH, Electrical Conductivity (EC), maximum moisture content, Sodium Adsorption Ratio (SAR), minimum organic matter content, and C:N ratio. Soil sampling and laboratory testing will determine these results.

5.4.6 Emergence Trials

The SPC is responsible for emergence trials, which are a requirement of the Canadian Food Inspection Agency (CFIA) and need to be conducted with every lot of finished compost. An emergence trial is important to perform to report, with confidence, that the compost will support plant growth. Furthermore, CFIA requires that there is demonstrable correlation between the finished compost and plant growth for the compost to be considered a "soil amendment". For more information, consult section T-4-120 under the Fertilizer Act on the CFIA website.

To perform an emergence trial the following steps must be taken:

1. Collect samples of the finished compost and screen with 1/2", if not already done.
2. Plant eight (8) seeds of radish and eight (8) seeds of tomato in each of the following mixes:
    a. 1/2 compost, 1/2 potting soil
    b. 1/3 compost, 2/3 potting soil
    c. 2/3 compost, 1/3 potting soil
    d. all compost
    e. all potting soil.
3. Place in sun and water all mixes equally, record when plants 'emerge' and track growth for two (2) weeks after emergence.
4. Keep photo and data records for quality insurance evidence. These records are kept at the SWF and are available to the public upon request.

5.5. Retention Pond Sampling

If liquid in the retention pond reaches an elevation 1.5 m below the top of the pond, samples of the liquid will be collected and submitted for testing in accordance with the City's Water Licence requirements. There are two (2) Surveillance Network Program (SNP) stations to monitor runoff liquid composition from the CF. Table 7 describes each of the stations and the frequency of sampling. Sampling results will be included in the annual report. A freeboard of 1.0 m should be maintained in the retention pond at all times. Refer to Section 4.2.3 for additional information regarding liquid disposal.

Table 7: SNP Station Information

SNP Station ID	Description	Sampling Frequency
0032-18	Effluent/drainage water collected from the compost facility	Before discharge of water from the compost facility
0032-18A	Effluent/drainage water collected from the expanded centralized compost facility	Before discharge of water from the compost facility

6. SITE RECORDS

Copies of records pertaining to operation and maintenance of the CF are kept at the SWF. Information in these records includes:

- Estimated volume of waste collected and the generator of the waste (e.g. Residential) both monthly and annually;
- Details of any maintenance, repairs, or remedial measures undertaken at site;
- Record sheets and data regarding turning, watering, and added amendments;
- Records of any runoff liquid analysis and quantities disposed off-site.
- Records of any complaints and corresponding investigation and remedial measures;
- Safety records;
- Visits by regulatory authorities;
- Copy of the City's Water Licence;
- Copies of all manuals pertaining to the operation and maintenance of the CF including, but not limited to: the Yellowknife Centralized Composting Pilot Project Final Report, CF Operation & Maintenance Manual, Hazardous Waste Management Plan (City, 2021b), Landfill Fire Control and Risk Reduction Plan, Wildlife Management Plan, Bio-treatment Pad Operation and Maintenance Manual, Safe Work Practices, Service Standards, and Spill Contingency Plan (City, 2021c); and
- Copies of spill reports and related regulations.

Copies of the documents listed above are also kept at City Hall, along with the following:

- Copies of sampling and analysis reports of the groundwater monitoring wells, runoff from the SWF, and runoff liquid; and
- Copies of annual reports submitted to the MVLWB.

7. HEALTH AND SAFETY PROCEDURES

This section supplements the Public Works and Engineering document titled "Safe Work Practices, Policies and Procedures – 3rd Edition" and the Safety Procedures outlined in the City's SWF Operations & Maintenance Manual. The following safety procedures exist to minimize health risks to personnel working in and around the SWF, property, and the environment. Therefore, CF staff are expected to up-hold the following standards:

- Equipment must be kept clean;
- Wear, at a minimum, Personal Protective Equipment (PPE) such as gloves, safety glasses, dust mask or respirator, and CSA certified steel-toed boots;
- Appropriate coveralls or a safety vest with a reflective X on the back must be worn at all times;
- Follow applicable safety policies, procedures, regulations, WHMIS, SDS, and the Hazardous Waste Management Plan (City, 2021b) for the handling of compost, waste materials, and hazardous wastes encountered;
- If CF staff members are not wearing coveralls, they need to wear pants;
- Wash hands frequently, as a minimum before eating and after work; and
- Personnel shall receive appropriate vaccinations and ensure they are kept up to date. Please contact the Department of Health for a list of the appropriate vaccinations.

Specific hazards at the CF include vehicles and mobile equipment safety, noise, dust and bio-aerosols, spontaneous combustion, fires, runoff liquid, and hazardous materials. In order to minimize risks, all CF Staff must read through this manual, as well as associated plans and manuals, and understand their responsibilities. If there is an incident, it must be reported to the SWF Supervisor. The following sections detail health and safety hazards at the CF and procedures to minimize risk.

7.1. Vehicles and Mobile Equipment

CF staff often work with people on the ground, as well as people operating heavy machinery. Site staff must never assume operators know they are there or have seen them and need to stay within sight of the operator whenever possible. Understand where the blind spots are on equipment (remember: if you can't see the operator, they can't see you). Make eye contact with the operator and have radio communication prior to moving around equipment. Additionally, caution must be exercised when operating the screener, as projectiles may be thrown from the screener, which could cause injury. CF staff must comply with all safety regulations that come with any of the machinery.

7.2. Noise

CF staff must wear ear protection whenever working with loud machinery such as the water pump, screener, and loaders. CF staff must take extra precautions to be aware of what is going on around them when wearing ear protection.

7.3. Dust and Bio-Aerosols

Workers on the site shall wear dust masks or respirators with an HEPA filter to prevent exposure to fungal spores (N95, N99, and N100) especially under dry and dusty conditions and when compost is being turned or screened. Respirators shall be either cleaned thoroughly after each use or kept for use by only one individual. Filters shall be changed with regularity to ensure adequate functionality. To isolate themselves from spore-dispersing components during mechanical turning, CF staff in front-end loaders/tractors shall keep their cabs closed. In the gatehouse storage area, practice good housekeeping and keep surfaces clean and organized.

7.4. Fires and Spontaneous Combustion

The risk of fires occurring at composting facilities is a significant safety concern. The three (3) inputs required to start a fire are oxygen, fuel, and heat. Composting materials can present oxygen and fuel such as amendment stockpiles (woodchips, paper), dry compost, fine compost that accumulates around screeners, dust accumulation, methane pockets, and potentially gasoline or oil leaked from equipment. Keep ignition sources away from flammable and combustible materials. Sources of ignition can be engine manifolds and exhausts, cigarettes, lightning, electrical arcs, short circuits, and wildfires. Reduce risky practices that could introduce a source of ignition near composting materials. NO SMOKING!

Spontaneous combustion is combustion in the absence of 'forced ignition' and instead results from a series of heat-generating processes, each of which sets the next process off:

Biological (50-80°C) ➡ Chemical oxidation (100°C – H_2O evaporates) ➡ Slow pyrolysis (150°C)

Reaction rates double with each 10°C rise in temperature. Typical composting materials ignite at 150-200°C. Dry materials (20-40% moisture), large piles that are self-insulating, or piles with poor porosity create ideal conditions for spontaneous combustion. Spontaneous combustion occurs more commonly in feedstock or product storage piles than active composting. Materials burn by smoldering if oxygen is limited, but more oxygen could cause glowing fire and then open flames. Opening up a pile or otherwise introducing oxygen can allow a smoldering fire to quickly turn into open flame. Smoldering fires can persist for long periods of time (months).

7.4.1 Fire Prevention

The following procedures shall be followed to minimize fire hazards and associated risks:

- Fire department to have a tour of site and be aware of hazards, work through procedures in advance so they are familiar.
- Maintain proper aisles between piles to allow for equipment and firefighter access.
- Limit pile height to 3.7 m (12 feet).
- Maintain moisture content in stockpiles (feedstocks) >40%.
- Reduce dust accumulation on machinery and throughout site.
- Monitor stockpiles for fissures of steam or wet spots on the surface that might indicate a subsurface hotspot. Always use temperature probes; if there is a smoldering fire you could fall into ember pockets if you are walking on the pile.

7.4.2 In Case of Fire

Internal or smolder fires are difficult to extinguish because it is hard to tell exactly where and exactly how big they are. These fires must be dug out and smothered. Here are some steps to follow in case of a smoldering fire:

1. Call the fire department (867-873-2222) and/or 9-1-1. The CF staff shall meet the fire department at the SWF's entrance and guide them to the site.
2. Do NOT walk on the smoldering pile, as ember pockets could be present.
3. Plan how you will extinguish the fire and make sure everyone understands their role. Make adequate space available for the next steps.
4. The stockpile containing the fire must be broken down with mobile equipment, and the hot material spread out and cooled or wet. Material from the exterior of the pile should be moved away first instead of digging into the heart of the pile.
5. Use spotters who are in radio communication with the equipment operator.
6. Have hoses ready to wet down any open flames.

7.5. Runoff Liquid

Compost runoff liquid is potentially toxic. CF staff to avoid contact with runoff liquid if possible. If handling material that has been in contact with runoff lquid, such as the pump and fire hose, ensure that proper PPE is worn.

7.6. Hazardous Material

There is the potential for CF staff to encounter hazardous material in incoming feedstock. Refer to the Hazardous Waste Management Plan (City, 2021b) and applicable regulatory guidelines and SDS for the handling and management of hazardous material.

8. SITE ACCESS CONTROL

Access to the CF is restricted to CF staff unless an organized tour or public open house has been arranged in advance and approved by the SWF Manager.

8.1. Contact Numbers

Contacts of those responsible for overseeing the operation and maintenance of the CF are as follows:

SWF Manager:.....(867) 669-3404
SWF Supervisor: .....(867) 669-3451
Sustainability Projects Coordinator: ..(867) 920-5657
Gatehouse.....(867) 669-3406

Other useful contacts:

Kavanaugh Bros Ltd. Office (hauling):(867) 873-2811
WB Water Services (water):.....(867) 873-8277
JMS Landscaping (screening): .....(867) 445-2854
BearWise (wildlife fence):.....(867) 766-4847
Ecology North Office (support):.....(867) 873-6019

9. EMERGENCY RESPONSE

The City must be able to respond efficiently and effectively to all possible emergencies that may occur at the City's facilities. These include, but are not limited to fuel, chemical and wastewater spills, as well as fires. Due to the nature of the City's facilities, burning or spillage of unknown or hazardous materials may occur. Only personnel who are properly trained to deal with these situations should respond to such emergencies.

Personnel must familiarize themselves with the emergency preparedness plans before a potential accident or emergency occurs. Copies of these plans are kept in all common work areas. The following sections list contact numbers and outline procedures to follow in the event of an emergency.

9.1. Emergency Contact Numbers

The following is a list of contact numbers in the case of an emergency:

Emergency Assistance: ……9-1-1

Fire Department:.....(867) 873-2222

RCMP Detachment: .....(867) 669-1111

24-Hour Spill Response Line: .....(867) 920-8130

9.2. Spill Contingency Plan

A Spill Contingency Plan (City, 2021c) has been created for activities associated with City operations including the water treatment plant, Fiddler's Lake Treatment System, SWF and storage and handling of hazardous materials. A copy of the Spill Contingency Plan (City, 2021c**)** may be found at the MVLWB water licence registry page and the SWF office. City personnel must familiarize themselves with the plan to respond quickly and effectively in the event of a spill.

9.3. Fire Response Plan

The City has developed a Landfill Fire Control and Risk Reduction Plan that outlines the appropriate response to any occurrence of fire at the landfill. Please refer to this plan for detailed information.

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APPENDIX A

Figures

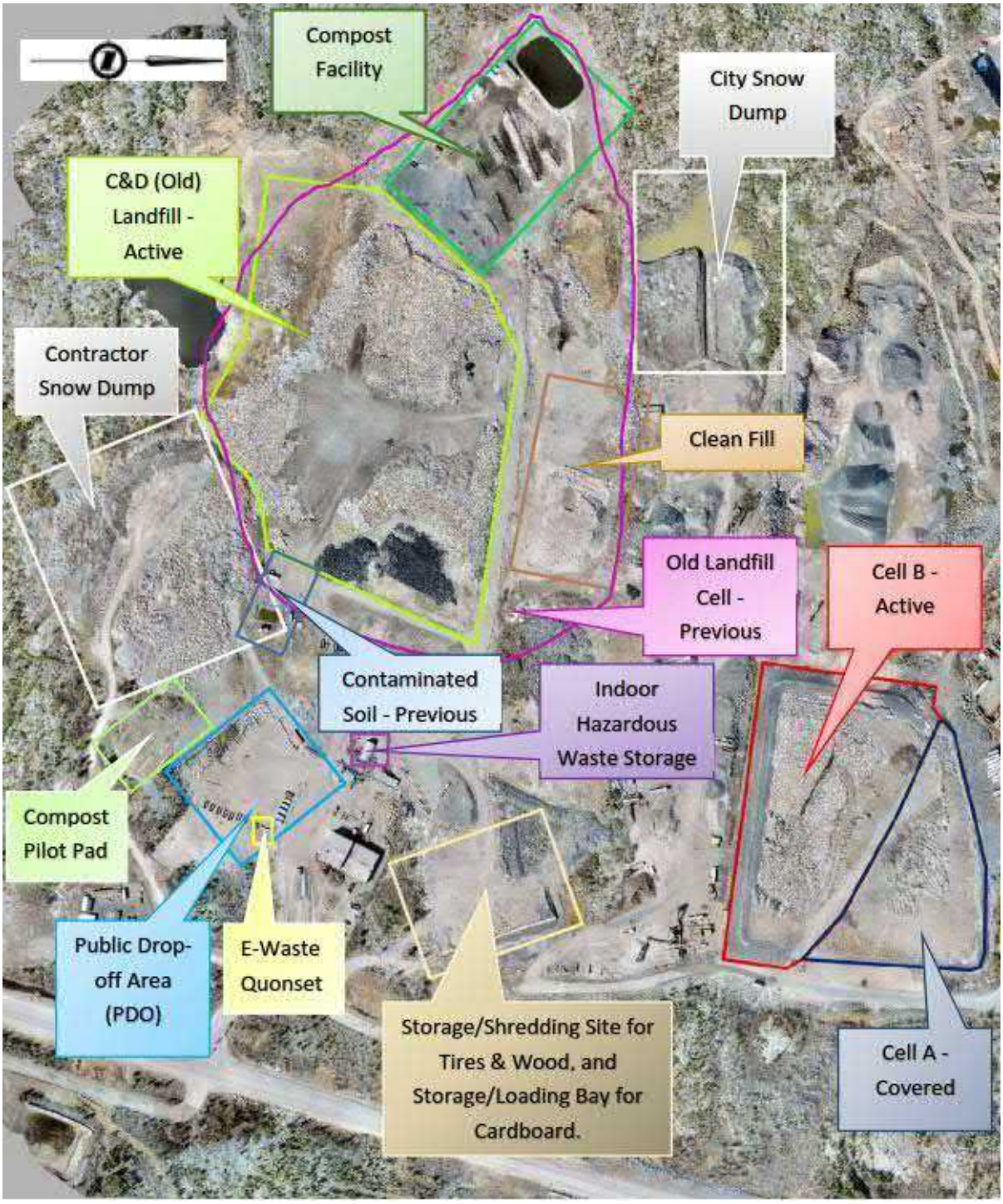


Figure 1: Solid Waste Facility Site Layout


Figure 2: Compost Facility Site Layout
Retention Pond
Runoff Storage Tank
Processing Area
Storage Shed
Yard Waste Holding Shed
Garbage Dumpster

Figure 3: Controlling Main Process Parameters
Source for information: Bill Carney, LSU

Parameter	Importance	Levels	Control methods
Oxygen	Microbes that operate in aerobic conditions **release less offensive** odour compounds and **decompose organic material 10 to 20 times faster** than anaerobic microbes.	• Optimal Pile Oxygen Percent: ~16-18.5% • H2S & VOC odour threshold at levels under ~16% • Odour saturation at ~6% • Over ~18.5% and temperatures won't be able to rise, pile will dry out	Ensure adequate 'interstitial' or 'pore space' oxygen level in materials. This is done by: 1. **Passive aeration:** chimney effect – free airspace in material for air to travel through (can be achieved with good porosity) 2. **Mechanical aeration:** windrow turner
Nutrients	Primary nutrients needed by microorganisms are: • Carbon (C) and nitrogen (N) for energy, protein synthesis and reproduction; • Phosphorus (P) and potassium (K) for reproduction and metabolism • Also need small amounts of trace elements	• Target is a C:N Ratio of 25:1 or 30:1 • Feedstocks with **high C:N Ratios** degrade slowly, • Feedstocks with **low C:N Ratios** degrade quickly but can quickly consume oxygen leading to **anaerobic conditions** and give off excess nitrogen as ammonia	C:N Ratio is controlled by mixing various **feedstocks** and **bulking agents** to get the desired result. **Nitrogen high:** grass, food waste, manure **Carbon high:** Paper, woodchips, sawdust
Temperature	Microbial activity **releases significant amounts of heat**; temperature must be monitored to ensure proper levels are achieved to: • Destroy pathogens • Optimize microbial activity • To watch for fire safety	Material shall attain a temperature **of 55'C or greater for at least 15 days** during the composting period **and must be turned at least 5 times in that period.** • **Lower** temperatures will not kill off pathogens • **Excessive** temperatures can limit microbial activity and can lead to spontaneous combustion	Temperatures must be monitored **at least once a week and be recorded**. • If hot spots are found they are to be turned • If temperatures begin to decline, the compost may be entering the curing stage
Parameter	**Importance**	**Levels**	**Control Methods**
Particle Size, Porosity & Structure	**Porosity** is a measure of free air space and determines resistance to airflow. **Structure** refers to the strength or rigidity of particles and their resistance to compaction and degradation. **Particle size** affects the rate of decomposition due to available surface.	• **Best initial** pile porosity: ~50-60%, **best final** porosity: ~35% (porosity needs decrease over time) • Particle size requirements fall within range of 1/8" – 2"	These parameters are adjusted primarily during the initial feedstock mixing step and are enhanced by adding bulking agents. Pile porosity can be measured with by determining bulk density with a bucket test.
Moisture	• **Microbes** require water to assimilate nutrients, metabolize new cells, and reproduce. • Water provides medium for **chemical reactions** • Water **transports substances** within composting mass	• Moisture content should range from 40-60% • **Below 40%,** microbial activity slows • **Above 60%,** anaerobic conditions dominate due to low free airspace	• **Add water** by irrigating pile from LCP • **Remove water** by aeration (turning the pile), evaporative cooling, or let it leach out
pH	A correct pH is important for the decomposer organisms: • Bacteria prefer pH of 6-7.5 • Fungi can survive with a pH of 5.5 – 8	**Target range is 6.5 – 7.5** • If pH is greater than 9, nitrogen is converted to ammonia and slows process • If pH is below 5.5, microbes will die and some heavy metals may become 'mobile' and affect chemical quality of finished compost	Adjusted by mixing feedstocks and bulking agents at the outset of process. If pH drops to 5 you can: • Add oxygen (turn pile) • Add lime • Cut back on pollution

Figure 4: On-Farm Composting Troubleshooting Guide (Rynk, 1992)

PROBLEM	POSSIBLE CAUSE	SOLUTION
Temperature does not rise	Insufficient aeration resulting from poor pile structure.	Add bulking agent to increase pore space. Remix and reform windrows. Adjust particle size of materials in future windrows.
	Materials are too dry.	Increase moisture by adding water or wet materials. Reshape windrows to collect precipitation (i.e. flat or convex top).
	Insufficient nitrogen (C:N Ratio too high).	Balance C:N ratio by adding nitrogen containing materials (e.g. grass, manure). Remix and reform windrows. Re-evaluate recipe for future windrows.
	Windrows are too small causing excessive heat loss.	Increase cross-sectional size of windrows
	Materials are too wet (i.e. moisture content greater than 60%).	Add dry amendments (be careful not to upset the C:N balance). Remix and reform windrow.
	Low pH (i.e. less than 5.5).	Add lime or wood ash to adjust pH. Remix and reform windrow.
	Composting process is complete.	
Temperature gradually falls over several days	Low oxygen.	Turn windrows.
	Low moisture content.	Increase moisture by adding water. Reshape windrow to collect precipitation (i.e. flat or convex top).
Windrows do not reheat after turning	Low moisture	Increase moisture by adding water. Reshape windrow to collect precipitation (i.e. flat or convex top).
	Process nearing completion	
Uneven temperatures	Poorly mixed materials.	Remix and reform windrows.
	Uneven aeration.	Turn windrow.
Curing pile is overheating	Materials are not fully composted.	Return material to composting area for completion.
	Piles are too large.	Reduce pile size.
Windrows are overheating	Aeration is insufficient for heat removal (characterized by moist materials).	Increase turning frequency.
	Insufficient evaporation cooling (characterized by low moisture content).	Adjust and monitor moisture content.
	Windrow is too large.	Decrease windrow cross-sectional area. Be careful not to make windrow so small that it cannot retain heat.

PROBLEM	POSSIBLE CAUSE	SOLUTION
	Too much nitrogen.	Adjust C:N Ratio. Increase turning frequency.
Ammonia odours	Excess nitrogen (i.e. C:N Ratio too low).	Add carbon material, or decrease the
	Carbon materials not breaking down.	Increase amount of carbon materials, or decrease the particle size of the carbon material. Switch to another carbon material.
	pH of materials is too high	Add low pH materials to windrows, remix and reform.
Rotten odours and low windrow temperatures	Anaerobic conditions caused by insufficient aeration.	Turn windrow. Increase turning frequency.
	Anaerobic conditions caused by too much moisture.	Add dry amendment.
	Anaerobic conditions caused by pore structure.	Add porous bulking agent Remix and reform windrow.
Rotten odours and high windrow pile temperatures	Pile too large.	Reduce windrow dimensions.
	Uneven aeration within windrow	Check porosity in windrows. Remix and reform as required.
Odours during turning	Odourous raw materials.	Use an odour-absorbing bulking agent. Increase turning frequency. Increase windrow porosity.
	Anaerobic pockets.	Increase turning frequency. Increase turning efficiency to break up clumps of material. Improve mixing methods to prevent clumping of materials.
Excessive runoff liquid from piles	Materials are too wet (i.e. moisture content greater than 60%).	Add dry amendments (be careful not to upset C:N balance). Remix and reform windrows.
	Excessive precipitation.	Reshape windrows to shed water (i.e. concave top). Cover windrows with tarp.
Flies and mosquitoes	Raw material attracting pests.	Remove offending materials. Incorporate raw materials into windrows as soon as possible.
	Windrows attracting pests	Increase turning frequency to expos all material to high temperature and kill fly larvae. Cover windrows with layer of finished compost.

PROBLEM	POSSIBLE CAUSE	SOLUTION
	Standing water is attracting pests.	Divert run-off. Re-grade areas.
Birds	Attracted by putrescible materials (e.g. food).	Incorporate the putrescible materials into windrows as soon as possible. Eliminate putrescible materials from program. Implement bird deterrent practices (e.g. noise makers, nets or guy-wires above site).

APPENDIX B

Runoff Liquid Testing Parameters

MVLWB Water Licence: MV2009L3-0007

- CF Run-Off Sampling Parameters

5. Water related to the compost facilities at Station Numbers 0032-18 and 0032-18A shall be sampled before discharge from the facilities and analyzed for the following parameters:

Total Ammonia	Nitrate and Nitrite
Faecal Coliform	BOD_5
Total Phenols	Oil and Grease
Total Mercury	[1]ICP-MS Metal Scan (Total)
[2]Field parameters	[4]Major Ions
methyl *tert*-butyl ether	Benzene
Toluene	Ethylbenzene
Xylene	
Total Petroleum Hydrocarbons - Fraction 1 (C6-C10) + Fraction 2 (>C10-C16) + Fraction 3 (>C16-C34) + Fraction 4 (>34)	

-

Parameter	Maximum Grab Sample
pH	6–8
Benzene	5.0 mg/kg
EthylBenzene	20 mg/kg
Toluene	0.8 mg/kg
Xylene	20 mg/kg

-

Parameter	Maximum Average Concentration	Maximum Grab Sample
Faecal Coliform (FC)	200 FC per 100 ml	400 FC per 100 ml
BOD_5	20 mg/L	30 mg/L
Total Suspended Solids	20 mg/L	40 mg/L
Oil and Grease	No visible sheen	

-

Total Petroleum Hydrocarbons	Fine Grained Soils	Coarse Grained Soils
Fraction 1 (C6-C10)	660 mg/kg	310 mg/kg
Fraction 2 (>C10-C16)	1500 mg/kg	760 mg/kg
Fraction 3 (>C16-C34)	2500 mg/kg	1700 mg/kg
Fraction 4 (>C34)	6600 mg/kg	3300 mg/kg

-

APPENDIX C

Odour Complaint Reporting

Odour Incident Report

In order to facilitate the review of odour incidents, this odour incident report will become part of the public record and a copy of it, including your contact information and comments, will be provided to other parties including other persons, agencies, governments and the

During the odour incident, please call:
SWF Supervisor…… (867) 445-1044
Sustainability Projects Coordinator …… (867) 920-5657

source(s) of the odour.

Contact Information:

Name ……
Address ……..
Telephone ……..

Odour incident start: Date …… Time ……

Odour incident end: Date …… Time ……

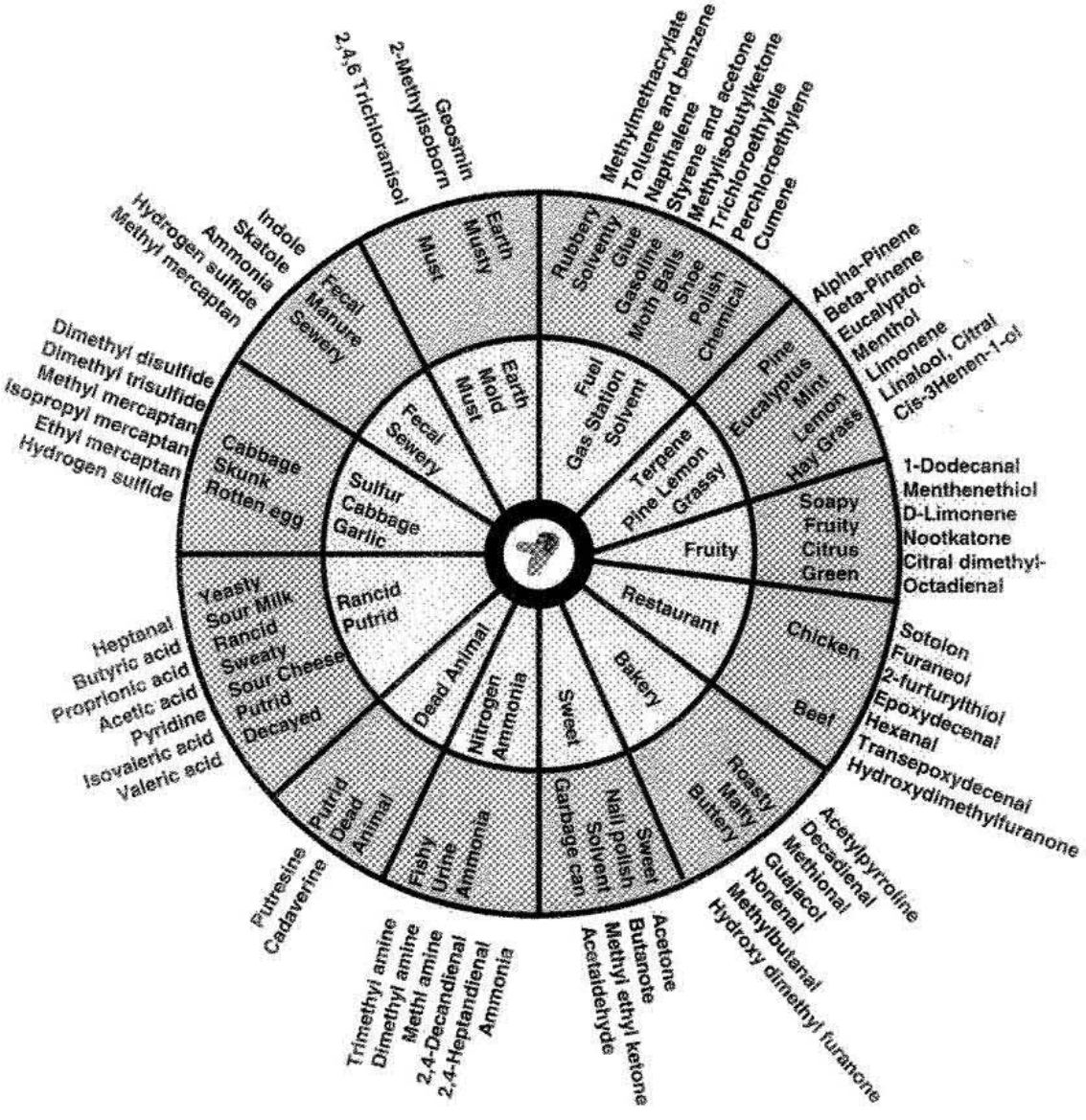
Location where the odour was smelled:

Description of odour (use Compost Odour Wheel on back):

Weather Conditions (check applicable descriptors):

Sunny		**Foggy**		**Strong Wind**		**Wind direction:**
Partly Cloudy		**Raining**		**Medium Wind**		**From N From S**
Cloudy		**Snowing**		**Light/No Wind**		**From E From W**

Compost Odour Wheel



APPENDIX D

Windrow Management Tracking

Appendix D.1

Windrow Tracking

It is important to keep track of windrow details in order to know what material went in to each one and when active and curing times are. This is also important for testing. Soil sampling must be done on each batch of finished compost (referred to as "Product – P#"). Soil sampling gauges the quality and content of the finished compost. The Sustainability Projects Coordinator (SPC) is in charge of operations and maintenance and needs to be able to track what materials went into each windrow in the event that a windrow does not have a high enough quality or meets the CCME standards.

New Windrow Names

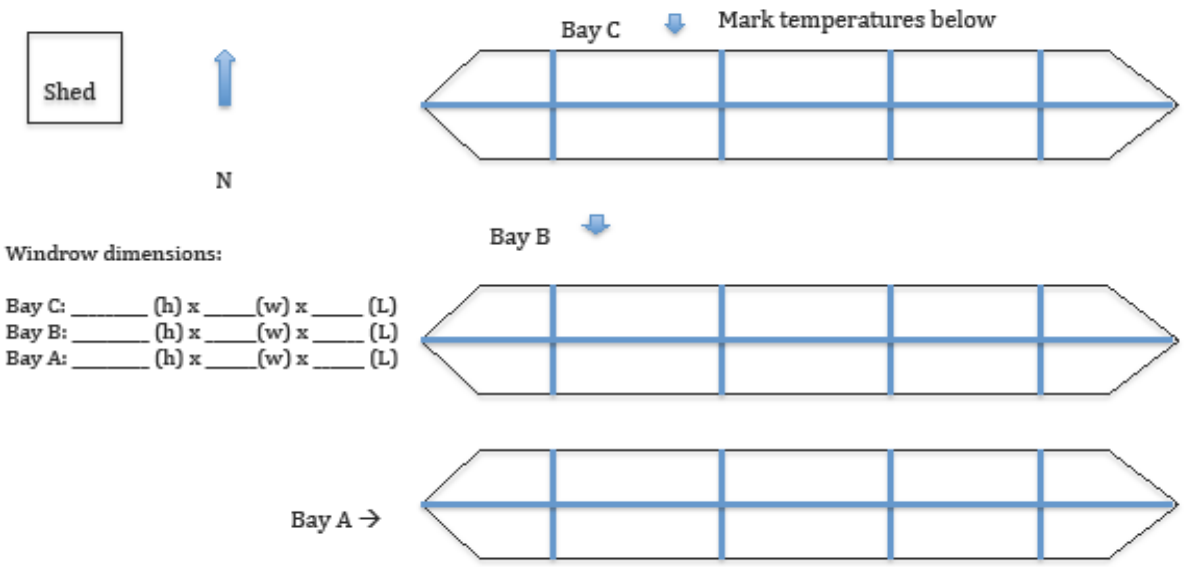
Each windrow will be named with the year and Windrow Tracking Number (2013 – 001). The Bays will stay the same (Bay A, Bay B, Bay C). This can be thought of as an "address" and the windrow is the "tenant". Once one windrow is combined with another, it must be renamed with a new number. Once a windrow is finished compost, it will be renamed with a P for 'Product' with the year it was combined/set to cure (2013 – P1).

The compost coordinators will keep track of what windrow is in what bay and the history of that windrow (when it was started, what feedstocks went into it, how often it was turned, watered, temperatures and what other windrows were mixed with it).

For more information regarding windrow tracking and data management, or to see records from previous years, please contact the Sustainability Projects Coordinator.

Tel: **(867) 920-5657**
E-mail: **sustainability@yellowknife.ca**

Compost – Field Monitoring Guide



Windrow dimensions:

Bay C: _____ (h) x _____(w) x _____ (L)
Bay B: _____ (h) x _____(w) x _____ (L)
Bay A: _____ (h) x _____(w) x _____ (L)

Date: _____ Name: _____

Operator (name): _____
Weight of organics: _____ kg
Carbon amendments: _____ buckets
Water amendments: _____ gallons
Removed garbage: _____ cans

Legend: (increases by a .5 scale)
Smell: 0 = no odour → 5 = strong odour
Moisture: 0 = dry → 5 = very wet

Bay	Windrow Tracking	Moisture	Odour #	Smells like...	Noteworthy (i.e. plants, garbage, steam)	Turned	Watered
Bay C – North							
Bay C- South							
Bay B – North							
Bay B- South							
Bay A – North							
Bay A - South							

Notes and next steps: