Brandon Landfill

Environmental Assessment

Community Resource Management Facility (Landfill)

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1.0 Introduction

Project Title: Brandon Community Resource Management Facility.

Proponent: City of Brandon

Location: Brandon, MB.

Project Type: Expansion of the existing Landfill to accommodate and process different waste types.

The City of Brandon, Manitoba is growing and this has led to more waste being generated by the populace. The city has directed planners to prepare a plan for the expansion of its existing landfill that was to be upgraded into a comprehensive waste management facility. This new facility will be similar to the waste management facilities used in bigger cities such as Winnipeg and will have greater resource recovery, an upgrade from the regular dump and bury system of the landfill. The proposed facility is set to have several new features like a resource recovery center, green research park, composting facility and landfill gas capture area. The facility will also be able to carry out recycling and composting. It will also be able to accept the disposal of scrap metal, used tires, propane tanks and appliances.

2.0 Scoping

The RM of Cornwallis has decided that the existing landfill needs to be expanded upon, as it is nearing its maximum capacity. To offer more to support the population of Brandon, the city wants to include a diversion of yard waste, recycling, composting, scrap metal, batteries, used tires,

propane tanks, and appliances. The expansion of this project will be adjacent to the existing site on the southeast side, with the surrounding area consists of the prairie landscape.

To get this project started, actions and information need to be obtained, including if the proposed expansion from 200 meters by 150 meters to 250 meters by 200 meters is feasible. Audits will also have to be conducted to determine the costs of the project activities, and of the various new components. How much waste can be accepted will need to be determined by way of a waste audit. (Fenco & Angus, 1996). New transportation routes and infrastructure costs will need to be determined, as well as an energy audit for the construction and running of the facilities. The costs of hiring laborers during the construction phases and costs of the workers who will be running the operations will need to be determined. Environmental studies will also need to be completed in order to determine impacts on air quality, wildlife, water quality, vegetation and soil quality. Some of the special features of the site are the inclusion of 6 cells and 4 lagoons, as well as a proposed Resource Recovery Centre, a Green Research Business Park, and a Composting Facility. The landfill is expected to last up to 2048 at a minimum. The existing Brandon landfill site was evaluated and is estimated to have an estimated closure date of 2041. (City of Brandon, 2016).

The first step towards getting the project started will be working with the City of Brandon and the Rm of Cornwallis to create a blueprint outlining the location, proposed size, costs and the approximate timeline of the project. The hope is the project will be done the planning and design phase by 2019 and the construction will begin in 2021 and finish by 2023. The design and planning phase will involve consulting a GIS expert to show GIS maps and aerial surveys of the area, looking at wildlife information, as well as a specialist to conduct soil studies to determine the various soil types and vegetation of the region, ground and surface water information, and health information. (Esri, ND) Aboriginal groups around the area will also be consulted to ensure that they will not be directly affected by the project. A public hearing will take place to present the new proposal to the public, gain feedback, and share the proposed timelines. The construction of the project will begin by obtaining approval and licensing from the Government of Manitoba. (Environment Act, 2018) If the proposed project is approved, the construction will include land clearing, excavating, grading, water removal, infilling and the installation of the various infrastructure. The construction phase of the project will also involve building pollution barriers

such as the site drainage ditches and pumps to move wastewater to lagoons. (Arabi & Lugowski, 2015)

Upon project completion, the public and businesses in Brandon will be notified to let them know about what waste types will be accepted and what new components are located on the site. Waste audits will take place periodically to ensure that the site and facilities are being run properly as well as to determine the amount of waste that is being processed by each section of the landfill. The audits will also help ensure that the environmental impacts are minimal and that there are continued ecosystem monitoring and cost auditing.

Mitigation measures will take place in the case of emergency. Possible emergencies that could be associated with the landfill include; spills, fires, and explosions, the release of toxins into the air, groundwater contamination and soil contamination. (PLP Regional Landfill, 2018, p. 27, 28) Continuing waste audits will help to determine whether the upgrades and expansion will help keep up with the increasing waste amounts and the environmental damage and degradation associated with expansion.

2.1 Scoping of the Project

2.1.1 Scoping of Geographic area

The area involved in the scoping of the project includes any region or ecosystem that will be affected by the various project activities, including the construction and continued operation phases of the site and facilities. The scope of this project will include the southeast part of the city of Brandon as the facilities' upgrade pushes them further into open field and possible farmland, which has effects on both wildlife, land use, and groundwater. (PLP Regional Landfill, 2018, p. 27)

2.1.2 Scoping of Temporal Boundaries

The estimated temporal boundary for this project, consisting of the time from the planning and design phase up to the possible decommission of the project if there is no longer a need for such a large operation. The timeline for the project has been estimated to start with the planning and design phases in 2019, with construction beginning in 2021 and the site opening in 2023.

1. Planning and Design of the project: January 2019-December 2019
2. Site Preparation and approval: January 2020- December 2020
3. Facility Development and Construction: January 2021- Summer 2023
4. Commissioning of the site: July 2023 and ongoing
5. Upgrades or Decommissioning: Depends on a variety of different factors. The landfill is hopeful to operate until at least 2048. (Cornerstone, 2018)

2.1.3 Scoping of Value Ecosystem Components

By upgrading and expanding the current Brandon Landfill, there will be effects on the ecosystems and surrounding areas, impacting many ecosystem components that will need to be assessed and considered. Such valued ecosystem components are to be focused on include:

- Air Quality- Endangerment/conservation status (GoC Air Pollution, 2012), public visibility/appeal.
- Water Quality- Contamination, economic importance, visibility/appeal.
- Soil Quality- Leaching, erosion, PH changes, conservation status (PLA Regional Landfill, 2017)
- Vegetation- Loss of vegetation (PLA Regional Landfill, 2017), endangerment/conservation status
- Wildlife- Protected status, umbrella species (Boston University, 2018), rarity, endangerment/conservation status

(CNSC, 2018)

- Socioeconomic-Job creation, housing market, ecosystem services, visibility/appeal (Danthurebandara, et al., 2012)

2.1.4 Public Concerns

With any proposed project there is bound to be an assortment of public concerns. There will be concerns about everything from construction to the day to day operations, to how it will affect the citizens of Brandon and the surrounding area. The main areas of public concern that were identified are the following:

- Landfill Gases- Release of toxic chemicals that could be potentially carcinogenic (PLP Regional Landfill, 2017, p. 28)
- Air Quality- Emissions and odors from the site.(Danthurebandara, et al., 2012, p. 41)
- Soil Quality-Contamination of surrounding soils from leaching (Danthurebandara, et al., 2012, p. 42)
- Hazardous Material Disposal- Toxins could become airborne or leach into the ground (PLP Regional Landfill, 2017, p. 27)
- Water Quality - Toxins could leach into the water table or other water systems, possibly affecting agriculture (Danthurebandara, et al., 2012, p. 46) and consumption (PLP Regional Landfill, 2017)
- Noise- A larger landfill would increase traffic and construction, which could disrupt nearby residents and wildlife.(Danthurebandara, et al., 2012, p. 40)
- Pest increases- There could be an increase in pests and undesired animal species in the surrounding area. (Manitoba CWS, 2015)

3.0 Project Description

The City of Brandon requested plans for the expansion of the Brandon Landfill located inside the community to be developed. This new landfill is supposed to handle resource recovery and focus on a better strategy of waste disposal as the old landfill is nearing capacity. The landfill is planned to be increased from about 2 kilometers in width to 10 kilometers in the South-East corner of the landfill. The upgraded landfill will include facilities for the diversion of yard waste, recycling, composting, scrap metal, used tires, propane tanks, appliances, landfill gas capture, research and Business Park, site drainage, ponds, and leachate. The landfill is considered a class 1 waste disposal ground because it serves over 5000 people and is currently composed of 6 cells and 4 lagoons, and would also be expanded (City of Brandon, 2016).

3.1 Location

The Brandon Landfill is located in the Cornwallis Municipality due east on Victoria Ave, then traveling south of the 33rd street east. It comprises about 1000 m of the south-east section of the city.

3.2 Need of the Project

The Eastview Landfill is close to full capacity and serves the city of Brandon as well as the Rural Municipality of Cornwallis. The upgraded landfill will consider alternatives to reduce costs and find more sustainable and effective means for waste disposal. With the growing population of people using the landfill, the upgrade is required because the city of Brandon had a 6.1% increase in population between 2011 and 2016 from 46,061 to 48,859, with an even higher rate of growth from the 2006 population of 41,511 to 2011's population. (Population Statistics, 2016). Importantly, the landfill will handle toxic materials safely and efficiently.

3.3 Alternatives to the Project

The three alternatives to the project considered are waste to energy incineration, composting, and anaerobic digestion. Waste to energy incineration converts waste to electricity helping to reduce the electricity costs, but the downfalls are the release of pollutants and non-renewable energy. (Patil, et. al., 2014) Composting returns valuable nutrients to the soil, but releases CO2 and other compounds contributing to the problem of greenhouse gases. Anaerobic digestion captures methane and allows us to use it in a beneficial way, but the contribution of methane to the greenhouse effect is a drawback. (Hogg, 2016)(Cassie, et. al, 2010, p.4) The preferred alternative chosen was waste to energy incineration because the process involves less waste going into the landfill due to the fact that such waste is hastily destroyed.

3.3.2 Alternative Means

The three-alternative means to the project considered were building an additional facility north of the present landfill across Victoria Avenue East for hazardous materials, building collection depots for the residents in the city of Brandon, and building an entirely new landfill in a new location.

The proposed location for the additional facility for the treatment of hazardous materials was eliminated as an alternative as it was too close to the Assiniboine River and the risk of contaminating the river was high. Building a new landfill and a collection depot was not feasible because of construction costs. In addition, a new landfill will be further away from those already in Cornwallis Municipality.

3.4 Land Needs for the Project

The landfill is being expanded to the South East area from where it is currently located. This area was a former farmland and is not heavily vegetated and is comprised of shrubs and grasses which need to be cleared for the project to start. The clearing of this grassland is will lead to a loss of habitat for native wildlife and loss of the native plant species. (PLA Regional Landfill, 2017)

3.5 Project Phases

The project phases include planning, designing, construction, operation, and decommissioning. In planning, an environmental assessment will be conducted to determine boundaries, identify stakeholders, and estimate cost. Design involves creating a plan and a blueprint for the for the expansion process. (Cornerstone, 2018) The construction phase has several stages including but not limited to land clearing, excavating, grading, dewatering, infilling and installing structures (EPA, 2000). Operation is the active lifespan of the landfill when it is in use which is about 25 years. Decommissioning is the closing of the landfill and its facilities after the landfill reaches maximum capacity. Refer to Table 1 for the project timetable.

4.0 Environmental Descriptions

The landfill is located in the Cornwallis Rural Municipality and is overseen by the Brandon Area Planning District (BAPD) and in covered by Zoning Bylaw 6642 and the BAPD development plan (MMM Group Ltd., 2013). The landfill is classified as an industrial heavy zone under this bylaw. Such a designation provides for the highest range of uses, including industrial operations. (Zoning Bylaw 6642, 2001) The landfill is planned to be increased in width from 2 kilometers to around 10 kilometers. The soils in this location are typically well drained and loamy textured.

(Canada Manitoba Soil Survey, 1976) The site was used as a farmland prior to construction of the landfill and cleared of all native vegetation and habitat. There no longer exists a landscape of trembling aspen. The sites' drainage is managed by on-site retention ponds, a perimeter ditch, land surface with a stable engineered foundation, and a weeping tile. (SNC Lavalin, 2014, p. ii, 45) Regarding land use rights, it should be noted the Sioux Valley Dakota Nation is a First Nations community present in this area.

4.1 Air quality

In Manitoba, the air quality is generally good, and in Brandon, the air quality in is “low risk” which is ideal air quality for outdoor activities (Environment Canada, 2018). Over time there will be an expected increase in the emissions of methane, other greenhouse gases, and volatile substances. There could also be an increase in particulate concentration. (PLP Regional Landfill, 2017, p. 19, 20)

4.2 Water Quality

The leaching of toxins and contamination of the water system from wastes being dumped at the landfill a significant threat if not mitigated properly (PLP Regional Landfill, 2017).

4.2.1 Groundwater quality

Infiltration of toxic leachate is also a concern. (PLP Regional Landfill, 2017, p. 17)

4.3 Soil quality

Toxins from the soil could get into the air through evaporation, the soil could get contaminated from leaching of toxins into the soils, and the soil could acidify if proper mitigation measures are not taken. (Portage La Prairie Regional Landfill 2017).

4.4 Vegetation

The current site may eventually be surrounded by eroded soils and lost native vegetation if mitigation measures are not undertaken. (PLP Regional Landfill, 2017).

4.5 Wildlife

Some endangered species in Southern Manitoba include the tree wallows, elks, pronghorn, coyote, red fox, and continental rabbits (PLP Regional Landfill, 2017)

5.0 Aboriginal Engagement

Sioux Valley First Nation (Sioux Valley Dakota First Nation, 2016) is a First Nation reservation established in 1875, four years after the signing of Treaty 2. (Minnesota Historical Society, N.D.) (Belanger, 2005) A self-governing legal entity by virtue of the Sioux Valley Dakota Nation Governance Agreement and Tripartite Governance Agreement, which though not a treaty, does not abrogate the treaty rights of its members under S. 35(1) of the Constitution Act, 1982 (13.02) or take a position regarding Aboriginal title to land. (SVDN Governance Agreement, 2013) If the City of Brandon's expansion breaches the Nation's hunting and fishing rights, even if the project is not within reserve boundaries. There exists a fiduciary duty to consult Sioux Valley on the possibility of the project infringing on those rights.(Mikisew FN v. Canada, 2005) Even if no treaty was signed, if a band can establish a substantial connection between the Aboriginal people group and the land such that the land's use is integral to the band's society, and there is a continued occupancy between pre- and post-Canadian sovereignty, then Aboriginal title to the land is valid, even if a treaty was not signed with the Crown. Title proved by sovereignty must be proven by an exclusive occupation of the land or exclusive occupancy by joint title through shared exclusivity. Even if exclusivity cannot be established, shared non-exclusive land use rights can be recognized by Canadian Courts by virtue of them being tied to the land. The continuous settlement is not an absolute requirement to establish title. (Delgamuukw v. BC, 1997)

6.0 Public Consultation

The following are the stakeholders with interests that are or may be affected by the Brandon Landfill expansion:

6.1 Identification of stakeholders and interested parties

For this project to be carried out smoothly, stakeholders and interested parties had to be identified. The following are the stakeholders with interests that are or may be affected by the Brandon Landfill expansion:

Sioux Valley (First Nations): They are the only First Nations community in the proximity of the Landfill and they are located about half an hour away from the landfill. They might be interested in the land for hunting and farming purposes. (SVDN, 2016)

The government of Canada (Canada Environmental Assessment Agency): They will be concerned with the safety of endangered species, migratory birds, and increased emissions. (CEAA 2012, 2018)

The government of Manitoba (Sustainable Development): They will be concerned with the compliance of the project with environmental laws. (DSD, 2016)

Rural Municipality of Brandon/City of Brandon. (RM of Cornwallis, 2013)

Brandon Environment Committee. (Brandon Environment Committee, 2018)

Citizens of Brandon, Landowners and local farmers: They will be concerned about their property values, quality of life and aesthetic of the surrounding environment.

Ducks Unlimited: They have interested in the functionality of wetland habitats and the water table. (Ducks Unlimited, 2018)

6.2 Consultation Strategies

Identification of the stakeholders is far from enough for the completion of the project. The stakeholders have to be consulted and kept in the loop. These stakeholders cannot all be reached at once so we need to have different methods of communication to ensure all channels are open and all stakeholders are considered.

Advertising: This is the most widespread method we will use. The project will be advertised via social media with flyers, in newspapers and online publications. This is will also be the method by which meetings are scheduled. These online publications will also allow for public comments which are another method of acquiring the public opinion. (NL Office of Public Engagement, 2018, p. 14)

Meetings: Meetings will be held for the community members and any interested party willing to attend. They will outline the project details, effects, and mitigation strategies so the project is transparent and understandable. Public participation is important is important for the process so questions are encouraged during these meetings to ensure the project is properly understood. These meetings can also be used as a method to consult the First Nations Groups. (PLP Regional Landfill, 2018, p. 31)

Survey: Surveys will also be conducted to all stakeholders especially the citizens to get their opinions and concerns and find out how much backing the project can get. (NL Office of Public Engagement, 2018, p. 14)

Expert Panel hearings: These hearings will consist of individuals who are experts in the various fields and understand extensively the effects of this project on the environment. These experts will be able to outline any effect that has not already been identified and contribute to mitigation strategies for these effects. They can also provide alternative methods for the project to be carried out. (CEPA, 2017)

Decision Hearing: This is the final hearing before the commencement of the project. This will ensure that the final verdict is passed across to the public. The hearing will highlight the environmental assessment process, decision and the conditions for which the project is allowed to continue. (CEAA 2012, 2018)

7.0 Evaluation of Environmental Effects

With every project, there are environmental effects and these effects need to be addressed and measured to ensure they are not too adverse to the environment. We have identified the potential effects of this project to be: CO_2 emissions, soil toxicity, loss of vegetation and habitat disruption.

7.1 Air Quality

The project will lead to a contamination of air quality, and unfortunately, there is no way to completely avoid this. During construction, a large amount of particulate matter will be released into the air. Equipment will release CO_2, a greenhouse gas, throughout the construction process. Landfill gases contribute a roughly even ratio of methane and carbon dioxide, both greenhouse gases. (PLP Regional Landfill, 2017, p. 19)

7.2 Water Quality

The landfill is not located in the vicinity of any surface water bodies, so the only potential effects will act on ground and surface water. The waste dumped in the landfill will begin to decompose and chemicals will leach into the soil and contaminate the groundwater. If the groundwater is contaminated, it can spread and affect local wells in the area. (PLP Regional Landfill, 2017, 25-26)

7.3 Soil Quality

The soil is affected by the chemicals being leached into it. These chemicals will lead to a higher metal concentration in the soil and increased acid sensitivity which make the soil toxic. The soil on the landfill is not necessary for use during the lifespan of the landfill, but after the landfill is decommissioned, the soil will be toxic and may not be able to support life. (Mulligan, et al., 2000)(European Commission, 2013, p. 7)

7.4 Vegetation Quality

The vegetation is affected at the beginning of the project during the preparation stage. The vegetative cover will be cleared for the construction phase. The removal of native grassland could potentially trigger the arrival of invasive species. This effect's frequency is really low because the vegetation is only removed once. It should also be noted that the effects of vegetation clearance are residual in nature. (PLP Regional Landfill, 2017)

7.5 Wildlife Quality

The area is not known for having too much wildlife. The expansion of the landfill will mostly affect the habitat of insects and birds that frequent the area. Though the wildlife population is not massive, disrupting their habitat could have potential effects on the ecosystem. The magnitude of this effect is small because the population is small and it is not frequent as the land is only cleared once.

7.6 Noise

Throughout the construction, there will be a noise from the construction equipment like tractors and trucks. The landfill is not located too close to any residential areas or commercial structures so the noise is not likely to affect anybody. Noise will occur frequently over the lifespan of the landfill but the effect is relatively small.

8.0 Mitigation and Environmental Effect

The site will allow for an operator to develop and implement a monitoring and reporting program. (Department of Sustainable Development, 2016).The certified operator will also supervise the landfill and will detect and report the release of pollutants from the facility. (Department of Sustainable Development, 2016). The operator will ensure that project activities and the facilities are being conducted in an appropriate manner, with consistent maintenance and inspections to minimize human and environmental health risks. All mitigation will be administered in such a way to meet the regulatory requirements in The Environment Act. (The Environment Act, 2018).

8.1 Monitoring

The monitoring and reporting program for the landfill will be adapted and utilized for detection and reporting of pollutants from the landfill. Sampling, monitoring, reporting and consistent updates to the plans will be conducted for gas emissions, soil leachate, plus ground and surface water for the entire lifespan of the landfill. (Department of Sustainable Development, 2016). There will be additional monitoring provided for wildlife and vegetation in the area to ensure the effects are as minimal as possible. All concentration levels will be prepared by a qualified professional to ensure the results comply with the guidelines published by the CCME (Canadian Environmental Quality Guidelines). (Department of Sustainable Development, 2016). Sampling at the landfill will be done by a contractor and will be analyzed at an accredited laboratory. (Department of Sustainable Development, 2016).

8.2 Air Quality

For air quality mitigation, introducing an engineered gas recovery system in the new infrastructure, as well as ensuring there is proper ventilation in the new buildings for human safety. Existing buildings on site will also be examined to ensure they are up to an acceptable standard. There will be consistent monitoring of outdoor air quality, from the gases produced by waste, to maintain environmental protection. Gases from the waste will be captured and treated in a new

facility. Vegetation will be planted around the landfill to help further capture any extra gases that are not captured by the facility.

8.3 Soil Quality

Soils will be treated using nitrogen-fixing bacteria to introduce nitrogen into the soil. A Leachate Monitoring Program will also be implemented. The most effective way to control leachate is to prevent it from ever being generated, when possible. (Department of Sustainable Development, 2016). To make this possible, surface and stormwater flow need to be controlled as well using proper cover materials to prevent infiltration, and by preventing high liquid content materials from entering the landfill. (Department of Sustainable Development, 2016). If the prevention and management prove to be insufficient, then liner systems, removal systems, and operational practices can also be added. (Department of Sustainable Development, 2016). To minimize possible dust build ups from wind erosion, the soils can be sprayed by either water or an approved dust control agent. (Department of Sustainable Development, 2016). Using barriers and vegetation will also help to prevent and minimize soil erosion impacts and any leaching that is not caught within the Leachate Management System.

8.4 Water Quality

Leaching of materials will also affect ground and surface water quality. So the Leachate Monitoring Program will also pertain to water quality. Any of the infrastructures that contain hazardous materials will have impermeable flooring, absorbent pads and emergency spill kits to clean and contain any potential spills. Like the soil quality mitigation, water quality will have liner systems, removal systems, and operational practices to ensure environmental protection. (Department of Sustainable Development, 2016). Any nearby wells and surface water will be monitored to make sure no contaminants have entered water systems on and off-site.

8.5 Vegetation Quality

Any vegetation that is lost during the construction and commissioning phases of the project will be replanted and strategically placed to give the best chance of survival. Extra vegetation will

be added on top of what is being replaced in an attempt to absorb any extra gases that are not captured by the gas capturing facility. The additional vegetation will also help in preventing soil erosion and leaching impacts.

8.6 Odor and Noise

To control odor, waste will be covered with soil and wood chips, or any other approved cover material. (Department of Sustainable Development, 2016). The existing Brandon landfill also buries materials and reports that they have not had any complaints with respect to noise or odor, as indicated in their 2016 report. (City of Brandon, 2016). Also keeping segregated materials in a clean, organized area and implementing a landfill gas control system, will help in reducing odors. (Department of Sustainable Development, 2016). During construction, wind direction will be taken into consideration when carrying out project activities. For noise, hours of operation will be taken into consideration to try and ensure as little human and wildlife disruption as possible.

8.7 Wildlife Effects

As mentioned in the Odor and noise section, operation times will be taken into consideration to try and limit wildlife disruption as much as possible. Low traffic speeds and signs will also be implemented on the site, and any animal and vehicle collisions will be monitored and reported. Workers and site visitors will be encouraged to report any animal sightings and the data will be assessed, monitored and reported on a consistent basis. For pest and scavenger management barriers and approved pest management practices will be utilized. Regular inspection of the perimeter area of the landfill operations will be carried out by staff to limit interaction with large-bodied mammals such as white-tailed deer. (Pohl, 2017).

8.8 Contingency and Emergency Response Plan

The contingency and emergency plan will be posted on site for all staff to be trained on and to use. The plan will be posted at every building on site and will include the following:

- Hazard identification;
- Fire suppression plan and resources;

• Emergency personnel list;
• Outside contacts;
• Evacuation plans;
• Emergency response procedures;
• Equipment listing;
• Maps/drawings
• Hazardous materials list. (Department of Sustainable Development, 2016).

9.0 Residual Effects

With mitigation strategies put in place, the residual effects of this project should be relatively low as there is already a landfill on site and the project will just expand on the current landfill. The expansion will not generate any new effects but can increase the magnitude of the effects already present. The major residual effects will be emissions and soil erosion because there is no way to completely avoid these effects and they occur the most frequent and will last as long as the lifespan of the landfill.

10.0 Follow up

Follow up will be done during and after the decommissioning of the project to check for potential adverse effects by following the set regulations and mitigation measures properly. The follow up will be required to:

- Monitor the CO2 and methane emissions from point and nonpoint sources to ensure that the greenhouse emissions does not exceed what is acceptable for a landfill of its size.
- Measure pH and metal concentration in the soil on a bi-weekly to monthly basis.
- Monitor soil for other major toxins such as dissolved organic matter and halogenated organics.
- Ensure that the natural vegetation and ecosystem around the landfill is still healthy and not affected by the landfill.

- Monitor species health and diversity as well as abiotic indicators such as the presence of woody debris and nitrogen/phosphorus concentration.
- Monitor for hazardous materials, contamination, and accidental discharge.
- Examine animals systems for harmful microorganisms and toxins. Studies on nearby residents should also be conducted to see if there are any effects due to these toxins and microorganisms.
- Ensure that the restorative ecosystem replicates a natural one and that the water bank is strong enough to avoid flooding and water contamination.
- Locate any species deemed threatened and endangered under provincial and federal guidelines and monitor for any disruption or loss of wellbeing.
- Ensure that migratory birds habitats are not disturbed

11.0 Cumulative Effects

Cumulative environmental effects that will result from the Brandon Landfill in combination with other activities carried out, past or future is sure to arise. Using the guidelines set in the Cumulative Assessment Practitioners Guide (CEAA 1999), an assessment of the cumulative effects will be carried out using the five-step assessment framework.

Five cumulative effects were highlighted by this environmental assessment, they include;

- Air quality;
- Emission of CO2 and Methane
- Soil and Groundwater;
- Loss of vegetation and;
- Loss of vegetation

11.1 Air Quality

The landfill fill will influence the ambient air quality, which can also most likely become a more regional problem (Portage La Prairie, 2017). The production of landfill gas, as well as the

release of particulate matter from exposed surfaces, characterizes the consequence (Portage La Prairie, 2017).

11.2 Emission of CO2 and Methane

With the landfill, there will be the emission of greenhouse gas (GHG) within the region where the landfill is located. This GHG emission arising from the landfill will be accumulated with other local emission sources like urban and rural activities, agricultural, industrial and transportation activities. Coupled to this, landfill gas is generated during the natural process of bacterial decomposition involving organic material which contains good percentages of methane and carbon dioxide, with trace amounts of oxygen, hydrogen, and nitrogen (Portage La Prairie, 2017).

Methane gas from a landfill can be very potent to the atmosphere because methane has a very high trapping capacity, it has far more trapping capacity than carbon dioxide (Portage La Prairie, 2017). It is reported that anthropogenic methane emissions from municipal solid waste landfills are the largest in the world and responsible for a huge portion of methane emissions in North America (Portage La Prairie, 2017).

11.3 Soil and Groundwater

The presence of the landfill will have a potential effect on the soil and groundwater (Portage La Prairie, 2017). Such contamination involves a substance called leachate, which is generated from precipitation that percolates through solid waste (Portage La Prairie, 2017). Once the groundwater encounters decomposing solid waste, the water becomes contaminated. Such water is called leachate when it flows out of the waste material (Portage La Prairie, 2017).

11.4 Loss of Vegetation

The vegetation on the landfill prior to construction will be cleared out, all native

vegetation will be lost. Even though natural vegetative re-colonization will eventually occur in the area, mainly around waste piles, and the property boundary, the majority of this re-colonization will be from invasive species (Portage La Prairie, 2017).

11.5 Habitat/ Wildlife Disruption

The Brandon Landfill was used as a former farmland prior to construction. It was cleared of all native wildlife habitat on the active cells. Its presence will destroy species like the tree wallows (which is endangered), Elks, Pronghorn, Coyote, Red fox, and continental rabbits. However, some wildlife still exists on-site.

Coupled with this, some disturbance or mortality of small mammals is expected due to standard facility operations involving soil removal, grading, excavation and other construction and equipment activities (Portage La Prairie, 2017). Also, because of the loss of Wetland and Grassland, there has been an impact on the species and wildlife in this area as animals that feed by grazing and need trees for cover are displaced.

12.0 Significance

There are a many potentially significant adverse environmental effects that could occur due to the expansion of the landfill. The environmental effects that have the greatest significance are the following:

- Leaching of Chemicals
    - If there is a chemical spill from hazardous materials or any sort of leak, chemicals can leach into the ground and soils, as well as into ground and surface water in the area. Any chemicals that leach into water tables could affect anyone in the area who uses well water. Any waters that are affected in the area could have further effects on soils and farming in the area. Any leaks or spills from hazardous materials could result in soil erosion at the landfill location as well as in the surrounding area.

- Loss of Vegetation
    - The development of the landfill will involve removing native vegetation species. Even if the vegetation is replaced there is no guarantee it will grow back in the same way and this leaves room for invasive plant species to take over.
- Habitat Disruption and Losses
    - Removal of vegetation during the construction phase will lead to certain wildlife species being displaced. Certain Species at Risk could be disrupted and possibly put in danger. The displacement could also possibly disrupt predator-prey interactions.
- Emissions
    - When bacteria in waste breaks down it creates organic waste and emits gases such as CO_2 and CH_4 into the environment. Emissions will be produced constantly at a landfill, both natural and human-induced. Anytime waste is burned at the landfill this will cause emissions that could pose health effects for humans due to air quality issues.
- Soil Erosion
    - The leaching of chemicals from the waste and hazardous materials could cause increased acid sensitivity and metal concentration in soils. Removing vegetation could also increase soil erosion in the surrounding area. This can increase potential runoff and the amount of size of sediments entering water bodies.
- Odor and Noise Increases
    - Constructing and commissioning phases of the landfill will result in an increase of noise in the area that could potentially disrupt citizens and wildlife. When the landfill in expanded and in operation, increases in odor will be noticeable. Proper waste segregation and site operations should keep odor and noise levels to a reasonable level.
- Human and Wildlife Interactions
    - By expanding the current landfill onto new land, this could increase interactions between humans and wildlife. There will be more traffic on the roads in and around the landfill as well as an increase of pests that come with the additional waste. There

will also be more staff working at the site, so this could pose a danger to human safety as well as to wildlife safety.

All of the environmental effects above are the most significant adverse effects that could result from this proposed project. Some are more likely to occur than others. Environmental effects like emissions are all but guaranteed to have an adverse effect but something such as human and wildlife interaction is possible but less likely to occur. Emissions, chemical Leaching, water quality issues and erosion are most likely to have lasting significant adverse environmental effects, whereas odor and noise increases, habitat disruption, human and wildlife interaction and vegetation loss were thought to be less significant because they are easier to maintain with proper mitigation strategies.

This environmental report identified that significant adverse effects and the resulting mitigation measures required to decrease the environmental effects of this project. Since there is a lack of data at this stage the environmental effects of this project still need to further evaluated. Additional monitoring reports will allow for identification of proper mitigation measures for the environmental effects that are most important. Before this project begins additional studies need to be conducted on:

- Components to be Monitored:
    - Air Quality
    - Water Quality (Ground and Surface)
    - Soil Quality
    - Wildlife Habitat
    - Vegetation
- Studies may also need to be conducted to determine environmental effects of the following:
    - Emissions
    - Noise
    - Odor
    - Pests and Scavengers

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14.0 Tables and Figures

Table 1. Proposed project phases and the time period for the Brandon landfill.

Project Phases	**Start Date to End Date**
Planning	January 2019- December 2019
Design	January 2019- December 2019
Construction	January 2021- Summer 2023
Operation	January 2023 – 2048?
Decommissioning	Possibly 2048 but could vary.

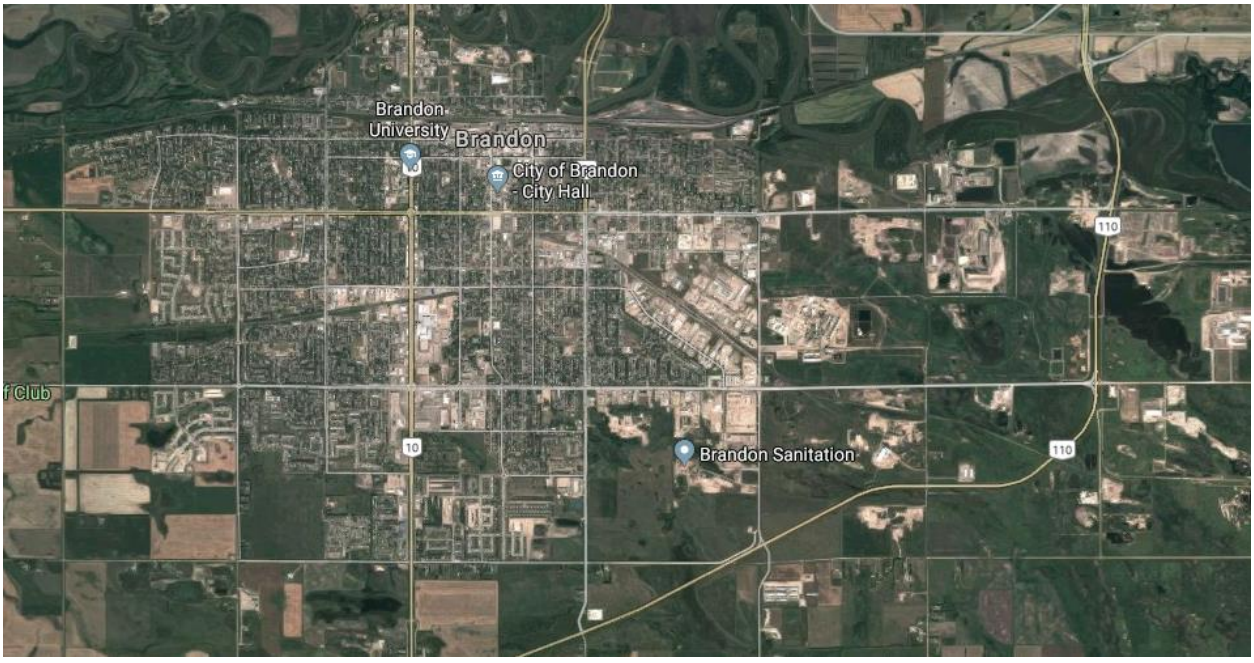

Figure 1. Map showing the location of the Brandon landfill in reference to the Brandon. (Retrieved from Google Maps, 2018).

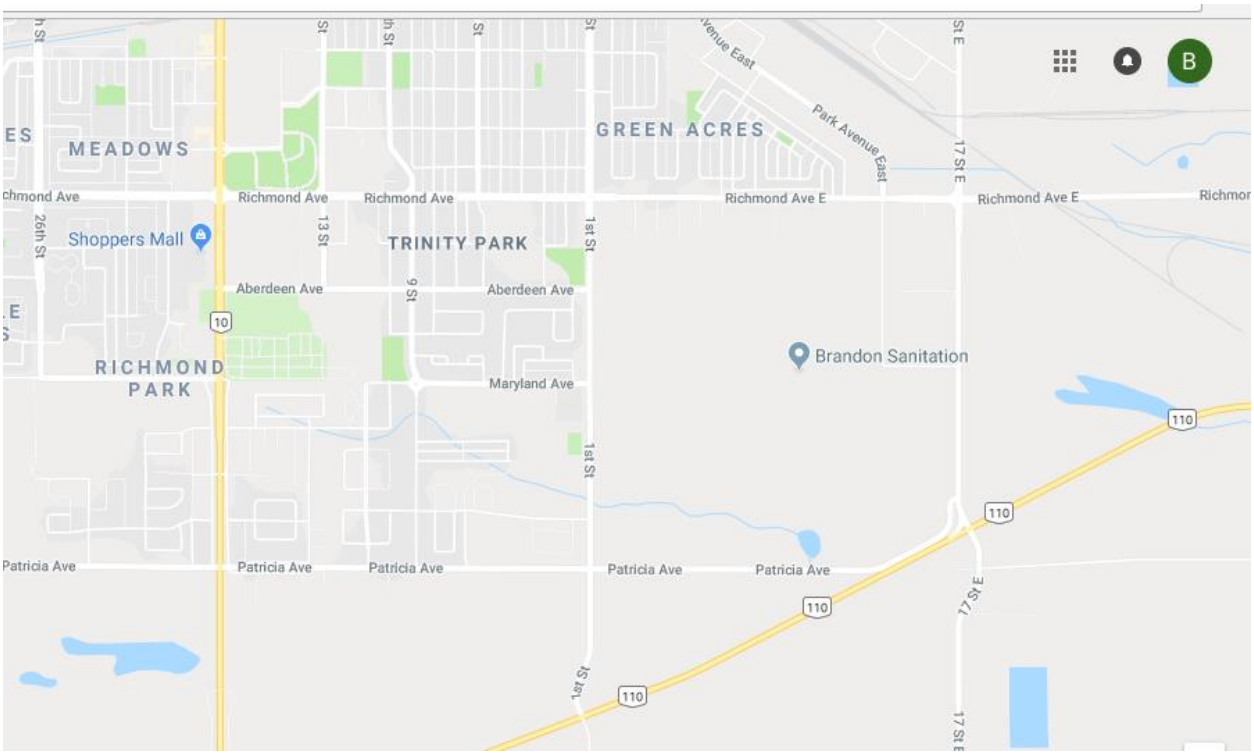

Figure 2. Map showing the location of the landfill in the southeast corner of the City of Brandon and highlights the amount of open space around the landfill. (Retrieved from Google Maps, 2018).

Figure 3. A closer look at the landfill and the surrounding area. (Retrieved from Google Maps, 2018).

Figure 4. This map highlights the area to the south of the project. (Retrieved from Google Maps, 2018).

15.0 Appendices

Criteria and Rating Schemes

	Numeric	Alphabetic
Ecological Extent	0 = no VEC affect 10 = affect to VEC	N = no effect L = low effect M = moderate effect H = high effect
Geographic Extent	1 = single point 3 = localized 5 = regional or greater	N = no effect L = low effect M = moderate effect H = high effect
Magnitude	1 = not measurable 3 = measurable -no loss of function 5= measurable-loss of function	N = no effect L = low effect M = moderate effect H = high effect
Frequency	1 = rarely 3 = sporadically 5= continuous/frequent	N = no effect L = low effect M = moderate effect H = high effect
Duration	1 = short term 3 = moderate term 5 = long term	N = no effect L = low effect M = moderate effect H = high effect
Reversibility	1 = less than 1 year 3 = between 1 and 25 years 5 = more than 25 years	N = no effect L = low effect M = moderate effect H = high effect

Environmental Effect	Ecological Context	Geographic Extent	Magnitude	Frequency	Duration	Reversibility	Total
	0 to 10 H M L	0 to 5 H M L	0 to 5 H M L	0 to 5 H M L	0 to 5 H M L	0 to 5 H M L	Out of 35
Air Quality	7 M	4 H	4 H	4 H	5 H	5 H	29
Water Quality	9 H	5 H	5 H	3 H	3 H	3 H	28
Soil Quality	8 H	3 M	4 H	3 M	4 H	4 H	26
Wildlife Disruption	7 M	3 M	3 M	3 M	3 M	3 M	21
Vegetation losses	7 M	3 M	3 M	3 M	4 H	3 M	23
Odor and Noise	7 M	3 M	2 L	3 M	3 M	2 L	20