Application for a Development Permit
Regional Landfill - SW31-35-21-W2M
RM of LeRoy, Saskatchewan

REACT

WM372.2 30 July 2015

WaterMark
CONSULTING LTD.

TABLE OF CONTENTS

List of Figures

List of Tables

Supporting Documents

1.0 INTRODUCTION

The REACT Waste Management District requires a new regional landfill. The existing REACT landfill, located south of Humboldt, is nearing capacity and is subject to flooding. Therefore a siting study for development of a new landfill location was recommended in January 2013.

The Waste Management District covers 17 rural municipalities extending over 16,000 km^2 in East Central Saskatchewan. Supporting Document I provides background on estimated quantities of waste generated in the REACT waste management district.

REACT wishes to develop the new landfill within the RM of Leroy on SW31-35-21 W2M. An agreement for the conditional sale of the property has been executed with the owners Glenn Mueller and Sandra Engele. Figure 1.1 shows the location of the site relative to Humboldt, Saskatchewan.

2.0 PRESENT LAND USE

The land being proposed for development (SW31-35-21 W2M) is currently agricultural. A canola crop is presently on the land. The land is Hummocky with numerous small potholes that hold water in the spring. This quarter and a few of the adjacent quarters have been modified in an attempt to enhance drainage however there is no local or regional drainage courses that pass through the site. The western boundary of the site is marked by a north-south developed grid road and north-south ditch adjacent to the site. A small dugout about 10 m x 40 m is present approximately 200 m southeast of the northwest corner of the quarter. There is no other development on the site. Figure 2.1 shows the site plan with topographic contours. It also shows the locations of soil and groundwater test holes completed across the site since 2013.

3.0 PROPOSED USE

REACT is proposing to construct a modern, state of the art, regional landfill that is compliant with the "draft" Landfill Chapter of the new Saskatchewan Environmental Code and has capacity for between 50 and 100 years of municipal waste. The landfill will be

designed as a number of individual cells, each with their own engineered containment and leachate collection system. A description of the design features of the landfill is provided in Section 6.0 below. A description of the operations features and procedures is provided in Section 7.0. Monitoring, reclamation and decommissioning of the landfill will be progressive processes throughout the life of the landfill and these aspects are described in Sections 8.0 and 10.0 of the application.

4.0 REGULATORY SETTING

The Saskatchewan Ministry of Environment developed a comprehensive set of "draft" guidelines in the "draft" Landfill Chapter of the Saskatchewan Environmental Code. The Environmental Code as a framework for environmental assessment and protection was passed into law in 2014 however the Landfill Chapter has not yet been included in the legislation. Although the Landfill Chapter is not legislated Ministry personnel suggest that the "draft" Landfill Chapter should by used as a guideline for best practises. The Municipal Refuse Management Regulations of Chapter E-10.2 of the Saskatchewan Environmental Management and Protection Act are the current legislated regulations pertaining to municipal landfills. These are viewed as limited in scope and out of date by the Ministry. Alberta Standards for Landfills and Code of Practise for Landfills are also recommended as useful "best practises" references for legislated Standards and Codes of Practise.

5.0 LANDFILL SITING STUDY

A comprehensive siting study was completed in June 2013 to identify potential parcels of land that generally fit a set of criteria based on topography, drainage, occupied residences, surficial soils, geology and mapped aquifers. The siting study criteria and parameters are outlined in Supporting Document II. The study area and the REACT collection area are outlined in Figure 5.1. Figure 5.2 shows the available parcels identified in the southern half of the study area after the final constraint mapping study. There were no areas considered suitable in the RM's of Humboldt and St. Peter, primarily because the higher population density and density of drainage courses were higher in these RM's. Figure 5.3

shows the nearest occupied residences and water wells surrounding the selected site (SW31-35-21 W2M). Table 5.1 lists the water well records within 3.2 km of the site.

Table 5.1
Private Wells Within 3.2 km of Landfill

Name	Land Location	Use	Depth to (ft) Water	Tip	Year Installed	WWDR No.	Aquifer
Jaeb	NW21-35-21	domestic	80	193	1959	21125	Interglacial
Jaeb	NW21-35-21	domestic	78	238	1997	107958	Interglacial
Ward	NW21-35-21	domestic	6	41	2012	228950	seepage
Harder	SE30-35-21	domestic	80	168	1961	21126	Sktn Intra
Harder	SE30-35-21	domestic	40	242	1976	47782	Interglacial
Zimmer	NE7-36-21	domestic	50	104	1961	21129	Sktn Intra
Wolfe	NE24-35-22	domestic	80	240	1961	21269	Interglacial
Rath	NW24-35-22	domestic	55	198	1969?	21270	Interglacial
Rath	NW24-35-22	domestic	61	220	1998	109129	Interglacial
Jaeb	SE25-35-22	domestic	69	350	1961	21271	Suth. Intra.
Sterl	NW26-35-22	domestic	-	207	1961	21273	Sktn Intra
Steil	SW26-35-22	domestic	80	352	1961	21274	Suth Intra
Wiegers	NE35-35-22	domestic	50	70	1962	21278	Sktn Intra
Kihnlen	NE2-36-22	domestic	50	97	1961	21279	Sktn Intra
Kihnlen	NE2-36-22	domestic	70	243	1984	76851	Interglacial
Kihnlen	NW2-36-22	domestic	68	243	1984	79197	Interglacial
Flory	NW19-35-21	domestic	72	265	1981	69810	Interglacial

Note: all legal land locations West of the 2nd Meridian

There are records of 17 wells within the 3.2 km radius of the site, several of which are apparently replacement wells on the original farm yards. There is only one well at an occupied residence within 2 km of the site (SE30-35-21 W2M). This well is completed in the Interglacial aquifer at a depth of approximately 74 m.

The completion of a siting study using a scientific basis, rather than the historic practise of developing the nearest parcel of poor land (which often meant gravelly or swampy land), results in selection of potential parcels that meet the environmental protection criteria and avoid constraints. This process identifies parcels with desirable properties for containment, located away from physical and environmental constraints. It facilitates a “Risk Based Approach” toward landfill development. Utilizing the natural containment attributes of the

site allows the development to minimize the engineering required to develop a site with a high degree of environmental protection with considerable cost savings.

Constraints used as follows:

- Population Buffers - Outside of a 3.2 km radius of any town or village and outside of a 1,000 m radius from any occupied single family dwelling. The guidelines recommend a minimum setback of 450 m therefore the 1,000 m radius was considered conservative.
- Environmental Buffers – Outside the recommended 300 m setback from any major streams, rivers, creeks or lakes. Not located on 1:500 year floodplain and preferably located high in the watershed and away from regional drainages.
- Hydrogeological Buffers – Not sited overlying any sandy surficial soils and shallow surficial aquifers up to 30 m deep. Avoid deeper aquifers also if possible to reduce long term risks.

Plotting all constraints and attributes on a map of the region resulted in identification of approximately 80 parcels of land that met the criteria as shown on Figure 5.2. Land availability is key and finding parcels that meet the technical criteria and also may be available for purchase was an important criteria. The knowledge of the local REACT board members was invaluable in reducing the number of parcels down to 20 and eventually only 5 parcels were considered further. Two of the five sites were negotiated for the right to conduct subsurface soils investigations with the option to purchase should the soils investigations prove potential. SW31-35-21 W2M was selected after preliminary test drilling investigations and land availability was negotiated. Figure 5.2 shows occupied residences within a 3 km radius of the site. The regulated 450 m setback and 1000 m limit used in the siting study are also shown.

6.0 DESIGN FEATURES

6.1 Site Suitability

Four deep rotary test holes with piezometers have been completed on the site. Three of the piezometers are installed into the deep aquifer identified to occur at approximately 75 m

depth beneath the site and one rotary test hole and piezometer was intended to test the deep glacial till. Six auger bore holes (three with piezometers) were completed to define the preliminary shallow stratigraphy and groundwater conditions. These bore holes also indicated significant thicknesses of low permeability till. A further seventeen (17) augered bore holes (seven with piezometers) were then completed on an evenly spaced grid across the site to confirm subsurface conditions in detail. Locations of all rotary test holes (prefixed TH) and augered bore holes (prefixed BH) are shown on Figure 2.1 presented earlier. All studies have indicated more than adequate thicknesses of very low permeability glacial tills capable of providing excellent environmental containment of the site over the long term. Details of these investigations are being provided in the Application to Construct and Operate a Regional Landfill which is currently being prepared for submission to Ministry of Environment for technical approval of the site.

6.2 Landfill Concept

Preliminary and detailed landfill design studies have subsequently been initiated based on the positive results of all the subsurface investigations. The regional landfill concept is based on the development of approximately 31 landfill cells across the ¼ section. The preliminary design indicates over 60 years of capacity will exist at the site. The site has been divided into four quadrants resulting from the positioning of the internal access roads. Figure 6.1 shows the general layout of the landfill cells and other features associated with the development. The main features of each quadrant are described below.

- Quadrant 1 is the northwestern quadrant of the quarter section. It will contain the office, scales, equipment building and equipment storage areas, a burn pit, temporary stockpile areas and Runoff Collection Pond A. It will also contain landfill cells 1 to 6 with a total capacity of approximately 12 years.
- Quadrant 2 is the northeastern quarter of the quarter. It will contain the leachate evaporation ponds, topsoil stockpile area and runoff collection pond B. It will also contain landfill cells 7 to 13 with capacity for approximately 14 years.
- Quadrant 3 is the southwestern quarter of the quarter section. It will contain runoff collection pond C and a construction waste stockpile as well as landfill cells 14 to 23. This quadrant has capacity for approximately 22 years.

- Quardrant 4 is the southeastern quarter of the quarter. It will contain the clean soil stockpile area and runoff retention pond D. This quadrant included landfill cells 24 to 31 and has capacity for approximately 17 years of waste placement.

6.3 Wastes Accepted and Rejected

The landfill will not accept any liquid waste other than liquid that is normally contained in household waste. No petroleum, petroleum remains or by-products will be accepted. Low concentration hydrocarbon contaminated soils may be accepted in the temporary stockpile area as long as volumes are small and they are kept separate from accepted wastes. A plan for landfarming small volumes of contaminated soil will be developed. If hydrocarbon contaminated soils are within guideline low level concentrations they may be used as landfill daily cover material. No pesticide or herbicide liquids or unwashed containers will be accepted at the landfill. No materials designated as Hazardous Waste Dangerous Goods and no liquid domestic sewage will be accepted. No refuse or by-product of slaughter house operation will be accepted. Large objects such as automobiles will not be accepted.

Leachate generated by the landfill may be irrigated over landfilled wastes if necessary. This would only be considered if the evaporation ponds are filled to capacity and there is a need to dispose of leachate by other means.

6.4 Anticipated Waste Quantities

No scales are in place at the existing REACT landfill so an accurate measurement of current waste generation rates is not available. The Bridging Strategy and Operating Plan report prepared by WaterMark in 2013 provides the basis for estimating waste volumes and tonnages from historic records, population statistics and load counts. This report is provided as Supporting Document I. A projected waste volume of 28,000 m^3/yr was projected in Supporting Document I by 2017, this included a population growth factor of 3% and a contingency of 20%. Beyond 2017 it is difficult to continue the same growth projections over the next 60 years. A volume of 28,000 m^3/yr has been used in the design for estimating the life of the landfill site. This will undoubtedly be refined over the years as operation provide real data from scaled volumes. Improved in-place compaction with the new landfill may increase the efficiency of the waste placement

6.5 Upstream Drainage Diversion

A primary feature for environmental protection will be diversion of all upstream drainage around the site. The site location is such that there are no significant drainage channels in the vicinity of the site. There are no naturally occurring drainage channels leading on or off the site. The site has some man-modified drainage that connects sloughs but these are not connected to the regional drainage system. The regional drainage area will be reduced by ¼ section since the landfill area will be internally drained toward four runoff ponds that will be developed. The upstream diversion ditches will redirect regional runoff westward along the north ditch, southward and westward along the east and south ditches. Figure 6.1 shows the location of the upstream diversion ditches and the blue arrows around the perimeter indicate the directions that runoff will be directed. Ditch bottoms will be 3 m wide and have backslopes varying from 3:1 to 2.5:1.

Any upstream runoff will eventually enter the RM road east ditch as it currently does minus any runoff from the developed quarter section which will be contained on site. Culverts will be established where necessary for approaches. No changes to existing regional runoff are expected other than a slight reduction resulting from elimination of any contributions from the ¼ section.

6.6 Perimeter Visual Barrier and Fenced Area

A treed perimeter will provide a visual barrier around the entire site. These will be planted around the entire perimeter in the first year of the development as shown in Figure 6.1. The active areas will be fenced off throughout operations. Initially the Storage and Processing area, Cells 1 and 2, Runoff Pond A and the Leachate Collection Ponds will be fenced. As the landfill grows the fenced area will be shifted around according to active areas. The fencing will be 2.5 m to 3.5 m high and designed to capture wind blown litter as well as keep the site secure.

6.7 Perimeter Road and Internal Roads

The perimeter road will be constructed during the initial construction period since the perimeter road and the upstream runoff diversion ditch are related. The road will provide a

safety berm around the perimeter in addition to the upstream diversion works. Everything inside the road will drain internally to designated runoff ponds. The perimeter road will have a road top width of 6.4 m. The inside ditch of the perimeter road will be constructed with slopes varying from 4:1 to 2:1. The outside ditch of the perimeter road will be the upstream diversion works ditch so the toe of the road will be sloped through the tree planting and fence areas toward the diversion ditch proper.

Informal internal roads will be used initially but once Quadrant 1 is completed the designed internal roads will be built. These roads will have a road top width of 6.0 m and 3:1 ditches that will be tied in with the overall grading plan.

6.8 Internal Drainage Containment and Runoff Ponds

The total area inside the perimeter road totals 52 ha. The development has been divided into 4 quadrants with each quadrant approximately 13 ha. Runoff ponds capable of handling a 1:100 year 24 hour rainfall extreme event are being designed. This is equivalent to 127 mm (5") of rainfall in 24 hrs or a runoff volume of 16,700 m^3 per 13 ha quadrant. Runoff pond capacity of this volume below FSL will be required for each quadrant. The site grading will direct drainage around the landfill cells and into the runoff ponds A to D as shown by the pink arrows on Figure 6.1.

6.9 Landfill Cells

Approximately thirty one (31) landfill cells have been laid out across the site. Each cell will be constructed with a compacted clay liner sloped to a central collection trench with perforated pipe and surrounded by crushed rock drain material that is in turn sloped toward the end of the cell where a manhole receives the leachate and it can be pumped or suctioned out of the manhole and disposed of in the evaporation pond described in the next section.

Risk based analysis of the hydrogeological information has proven that this site is well suited for landfill development and that highly engineered (i.e. HDPE or LDPE liners) containment systems are <u>not</u> necessary because of the low permeability of the soil (natural containment) and lack of shallow aquifers.

Each cell will have 450 mm of engineered, compacted clay liner overlain by the drainage trench and a layer of drainage sand. This simple leachate collection system will enable the leachate head to be controlled during operations until the cell is mounded to above grade elevations and a compacted clay cover is completed over each cell. The cover will minimize long term infiltration through the cell. Cells will have 4:1 subgrade slopes and a depth below grade of 4 m. Each cell will be mounded to a compacted waste height of 4 m above grade and a 1 m thick compacted clay cover would be constructed progressively as the compacted waste height reaches final grade.

Technical analysis confirming the favourable hydrogeologic and contaminant transport conditions are being provided in the application being prepared for the Ministry Environment for a license to construct and operate the regional landfill.

There are two cell sizes one with an outside dimension of 170 m x 60 m and the other is 170 m x 50 m, these contain 55,200 m^3 and 41,200 m^3 of storage capacity respectively. Where two cells are adjacent to one another there is further waste capacity in the gap between the two mounds that will be filled during construction. Each gap provides an additional approximate 10,000 m^3 of capacity. Figure 6.2 shows typical landfill cell plans, cross sections and details.

6.10 Engineered Cover and Landfill Gas Collection

Methane gas and carbon dioxide are produced through the biodegradation of the waste. Toxic hydrogen sulphide (H_2S) gas or other volatile organic compounds (VOC's) can also be produced, although not commonly. A passive landfill venting system will be constructed to ensure that there is no gas build-up, particularly of harmful gases such as H_2S and VOC's. As the final grades are reached on the above ground portion of each cell a 150 mm vent layer of permeable sand and gravel will be placed. The vent layer will be covered with a 1000 mm thick compacted clay cover. This clay cover is intended to limit infiltration from precipitation so that leachate generation is minimized. The cover can also trap landfill gases. The vent layer serves a dual purpose as it also provides a capillary break beneath the clay cover to further limit infiltration.

Vents will be placed into the high points along the crest of the compacted clay cover. These vents will allow passive venting of the completed landfill cells.

6.11 Leachate Evaporation Ponds

Approximately 5,600 m^3/yr of leachate is estimated to be pumped from the landfill at peak leachate production. This volume is estimated assuming two open or partially covered cells that have infiltration rates of 50% of the annual average precipitation and four recently completed covered cells that are producing leachate equivalent to 10% of the annual average precipation. These amounts of annual leachate require a total evaporation pond area of 12,600 m^2 (112 m x 112 m) to effectively evaporate all leachate produced. Time required to fill the ponds will be dependant upon climatic conditions. In order to manage the leachate and preserve the integrity of the engineering clay liner the pond will be constructed in four evaporation cells with the first cell providing sufficient surface area for 3 to 4 years operation and the second and subsequent evaporation cells being constructed as required once there are more landfill cells constructed. Figure 6.1 shows the location and general layout of the leachate evaporation ponds in the northeast corner of the quarter.

It is expected that all leachate can be managed through evaporation however if excess leachate is generated options for recirculating leachate by irrigating closed landfill cells are also available.

7.0 OPERATIONS

7.1 Year 1 Construction Operations

In the first year the following features will be constructed.

- Upstream diversion ditches
- Perimeter road
- Site grading for entrance, scales, office, temporary stockpiles and equipment storage building area.
- Topsoil and clean soil stockpile areas
- Internal Runoff Pond A

- Landfill Cell 1
- Leachate Evaporation Pond – Cell 1
- Fencing
- Tree Planting

7.1.1 Upstream Diversion Ditching & Perimeter Road

The upstream diversion ditch is the outside perimeter road ditch. The earthworks quantitities are linked (i.e. cut from the ditches will be used as fill in the roads). The upstream diversion works must be completed in the first year prior to operation of the landfill therefore the perimeter road will also be finished on the northern half and at least rough graded over the south half. Approximately 11,500 m^3 of topsoil strippings from the perimeter road and the diversion ditching is expected. The perimeter road and diversion ditch will be a balanced earth design, most clean soil from cuts in the ditches will be used as fill in the roads. Finishing the south half of the perimeter road may not need to occur until beyond 10 years. The south half of the perimeter road will however be rough graded because the diversion ditch will be need to be completed around the entire quarter.

The diversion ditching has incorporated the east ditch of the RM of Leroy grid road that runs north-south along the west side of the property. Detailed plans for this ditching are provided in Figure 7.1. Detailed design of the diversion ditching and perimeter roads is underway. Proposed plan for the RM road – east ditch, includes some deepening to improve the grade of the existing RM ditch to accommodate flow from the north interceptor ditch which will be directed down the RM ditch. Currently runoff backs up in the ditch and into a slough/dugout area in the northwest of the quarter.

7.1.2 Process Area - Scale, Equipment Storage and Temporary Stockpiles

The main entrance to the landfill and the scale, office, equipment storage and temporary stockpile areas will be stripped and graded in the first year of operation. A topsoil volume of approximately 12,000 m^3 will be stripped from this area prior to grading. Figure 7.2 shows the layout of features in the process area. Runoff from the process area will be directed toward a culvert that will convey the runoff into Runoff Pond A. The grading plan will be a balanced earth design.

The office will be an ATCO trailer sized building (12 m x 6 m) located adjacent to the weigh scales at the landfill entrance. Scales will be sized to handle typical waste collection trucks used by REACT. The equipment storage building will be a quanset building (approximately 30 m x 15 m in size) capable of storing one dozer, one compactor and one waste collection truck. It will be located in the southwest corner of the process area.

The process area will have space for metals, plastic grain bags and other recyclables near the north west corner of the process area. A compost stockpile and active compost process area is included in the northeast part of the process area. A construction waste stockpile is included in the southeast corner of the process area.

7.1.3 Topsoil and Clean Soil Stockpiles

An area designated for the initial topsoil stockpile and the initial clean soil stockpile will be located around the leachate pond area as shown on Figure 7.3. The topsoil stockpile will receive strippings from the perimeter road and diversion ditches, process area, runoff pond A, landfill cell 1 and the leachate evaporation cell 1. The clean soil stockpile area will receive the cut from runoff pond A and approximately half of the excavated soil from landfill cell 1. The other half of the excavated soil from landfill cell 1 will be placed along the east side of the process area where it will be used as daily cover material and final cover material for cell 1. Portions of the soil stockpiles will eventually be converted to landfill cells over time. The clean soil and topsoil will be used for landfill cell cover construction and general reclamation around the site.

7.1.4 Internal Runoff Pond A

Internal runoff pond A will be constructed in year one. All the storage volume for the runoff ponds is below existing ground level so that runoff from the entire Phase 1 quadrant can be directed into the pond (i.e. no dyking required). This will require excavation of approximately 27,000 m^3 to create a pond with sufficient capacity for a 1:100 flood event plus 0.6 m freeboard above FSL. The topsoil and clean soil will be stockpiled in the northeast quadrant surrounding the leachate evaporation pond area. Initially approximately 4,500 m^3 of topsoil will be stripped from this area and moved to the topsoil stockpile area.

7.1.5 Landfill Cell 1

Landfill cell 1 will be constructed in year one following the design described in Section 6.8. Approximately 3,100 m^3 of topsoil will be stripped from this area and moved to the topsoil stockpile area. Approximately 27,500 m^3 of clean soil will be excavated from Cell 1. Approximately 6,200 m^3 of this soil will be placed back into the cell and compacted to constructed the engineered clay liner. As stated in the previous section approximately half of the excavated soil will be placed along the east side of the process area for later use as daily cover and final cover material, the remainder will be moved to the main clean soil stockpile.

7.1.6 Initial Leachate Evaporation Pond

All leachate generated by the landfill will be managed on site by evaporation. The design requires that an evaporative surface area of about 1.3 ha be provided to ultimately evaporate the projected maximum leachate volume, however this requirement will not be necessary in the early years of development. A four celled leachate evaporation pond system is being designed. Multiple cells are required to maintain the integrity of the compacted clay liner from freeze/thaw and wetting/drying processes. Construction of a single cell will also reduce construction costs in the first year. Each subsequent cell would be constructed before the existing cell(s) reach capacity. Each cell will have a maximum of 1.4 m depth to maintain an FSL of 0.61 m below the top of dyke. The second cell may not be required until more landfill cells are developed and more leachate is generated. The timing for construction of subsequent cells will depend upon whether climatic conditions are wet, dry or average, however we anticipate the second cell will be necessary by year 3 or 4.

7.1.7 Fencing

Fencing will be completed around the north half of the quarter section in year 1. The fencing will be post and netting type with internal return at the top to catch litter that travels up the fence with the wind.

7.1.8 Tree Planting

A tree shelter belt will be planted around the entire quarter section in year 1. The planting will be outside the fencing on three sides of the quarter. The planting will be on the inside of the fence on west side so as not to encroach on the RM road. The tree planting is intended to provide a visual barrier and wind barrier as well as a second line to catch wind blown litter.

7.2 Routine Operations

7.2.1 Anticipated Traffic Volumes and Types of Vehicles

Most of the waste will be transported into the site by REACT waste transfer trucks. REACT currently operates a fleet of 6 vehicles bringing waste to the existing landfill. A total of 20-30 frontload trucks per week, are anticipated.

The main routes from the north will be directly south from Muenster (approximately 16 km of RM of Leroy and RM of St. Peters and south on Highway 20 from Humboldt to Burr and then east 10 km to the site through the RMs of Wolverine and Leroy. Traffic from the south will be primarily through Lanigan on grid roads in the RM of Wolverine and Leroy. Grid roads through the Town of Leroy will be the primary routes from the east. The grid east of Meacham will be a primary access from the west.

7.2.2 Scale Operations and Record Keeping

A weigh bridge scale capable of handling tandem axled waste transfer trucks and dump trucks will be installed at the entrance to the site. A computerized waste reception record will automatically log vehicle gross weight. Waste category, ID of the carrier, waste source and other special features will be recorded at the waste reception stage. Wastes that are segregated and/or recycled will be recorded separately. These may include metals, plastic grain bags, clean wood/trees etc.

Weight based tracking will allow development of realistic costs that can be applied to either the waste generators or the haulers as appropriate. Private light truck and trailer

traffic will also be weighed and recorded. Gate and scale records will provide the most accurate and cost effective means of tracking quantities of waste that will be received at the site and this will in turn provide valuable information for long term planning. After 1 or 2 years worth of data is available the average tonnage and volumes can be accurately estimated and the data will ultimately be used to determine the anticipated life of the landfill more accurately.

7.2.3 Waste Placement

Each landfill cell will be constructed in lifts from the bottom up. Figure 7.4 shows the development sequence from first layer to final cover. The first layer will consist of uncompacted waste 500 mm to 1000 mm thick. This layer will be started around the leachate manhole and moved progressively away from the manhole toward the other end of the cell. Placement of the first layer is important to protect the clay liner and the leachate collection system from direct traffic, frost and desiccation. This layer will be completed prior to initiating a second lift and it will have a minimum 150 mm cover soil placed over it. These two layers will provide the running surface for equipment traffic and protect the liner and leachate collection system.

Progressive compacted waste lifts from 400 mm to 500 mm thick will follow. Each new lift will start around the leachate manhole and work back toward the other end of the cell. Each new lift becomes progressively larger in area as the cell is filled to ground level. Waste compaction and daily soil covering practises are discussed in Sections 7.2.4 and 7.2.5.

Once the cell is filled to ground level the waste placement lifts become progressively smaller in surface area as the final slope of 6:1 is achieved. As final elevations and slopes are achieved the final cover (consisting of a 150 mm thick sand and gravel vent layer and a 1000 mm thick compacted clay cover) is progressively constructed over the cell. See Section 7.2.8 for information on landfill gas venting.

7.2.4 Waste Compaction

Waste compaction is an important aspect of waste placement, effective compaction has a range of benefits, as follows:

- Consumes less airspace and therefore helps to maximize waste capacity per cell.
- Provides a stable surface for vehicles to move on,
- Birds and rodents find it more difficult to dig into for food,
- Helps prevent litter from escaping,
- Inhibits odour release and reduces fire risk,
- Displaces air and increases rate of onset of anaerobic conditions,
- Aids in stormwater runoff and provides a good base for applying cover soil,

Waste will be placed and compacted in lifts. Compacted thickness of each lift will be between 300 mm and 500 mm. Compaction will be done with either a dozer or a specialized loader/compactor. Compaction will be done upslope (typically at 3H:1V slopes) to maximize compactive effort of the machine.

7.2.5 Daily Soil Covering

A cover soil layer will be applied daily, whenever possible, to cover compacted waste lifts in the active area. Only the working face will be left open. The cover soil will be 100 mm to 200 mm thick. Daily soil covering aids in reducing wind blown litter, odour, birds, vermin, and flies. It is also more aesthically pleasing and provides better surface water drainage conditions. A cover soil stockpile will be placed beside each cell during initial construction. This will minimize distance required in hauling cover soil.

7.2.6 Burning

A separate designated area is provided in the process area for burning. Only clean wood such as trees, brush, demolition lumber will be allowed into the clean wood pit. Burning would be completed when necessary and only when the winds are below speeds prescribed by the burning permit.

7.2.7 Special Wastes

Recyclable metals, plastic grain bags and other large recyclables will be stockpiled separately. A compost area may also be provided in the process area. Small amounts of hydrocarbon contaminated soil may be stored temporarily on site. If below Saskatchewan

Environment contaminated soil limits this soil will be incorporated into the daily soil cover program.

7.2.8 Landfill Gas Venting

A passive venting system will be employed to provide conduits for landfill gases to escape. A 150 mm thick vent layer consisting of permeable sand and gravel will be placed over the finished grades of the landfill cell prior to placing the compacted clay cover material. Rule of thumb is 1 vent for every 7,500 m^3 of waste in a cell. With typical cell capacity in the 50,000 m^3 range, about 7 vent pipes will be evenly spaced along the crests on each cell. These will be 127 mm diameter slotted PVC pipes. The vent pipes would extend through the vent layer of sand and gravel and terminate approximately 2 m below ground. Each vent would be slotted on the lower meter of pipe and each vent would be completed with a "candy cane" vent on top to reduce potential for plugging with debris etc.

Monitoring of vent gas concentrations during operations will determine whether fewer or greater numbers of vents are required. The clayey nature of the glacial soils in the area suggest that lateral migration into undisturbed soils will not likely occur however four shallow gas monitoring wells will be established on the corners of the first cell to confirm conditions. Gas analysis for methane, carbon dioxide, nitrogen and hydrogen sulphide and VOC's will be completed to characterize the typical emmissions from both the vents and the lateral monitoring wells.

7.2.9 Road Maintenance

The roads leading to the site will see higher traffic volumes and may require increased maintenance by the RM's of Leroy, Wolverine, Humboldt and St. Peters.

7.2.10 Buffer Zone

Active landfilling operations will occur at a minimum, 40 m inside all property boundaries.

7.2.11 Hours of Operation

Hours of operation will be determined as per previous operations.

7.2.12 Signage

Signs will be placed at the landfill entrance that will, at a minimum, provide the following:

- Name of the Approval, name of landfill, registration number
- Any waste restrictions
- Hours of operation
- Telephone numbers for the landfill operator, local fire department and Saskatchewan Ministry of Environment.

Directional signs will be posted off site along major routes leading to the site.

7.2.13 Record Keeping and Reporting

A detailed groundwater, surface water, landfill gas and leachate monitoring program will be developed. It may involve monthly and quarterly sampling for various chemical and physical parameters and maintenance of a database that will be used to generate annual reports to Saskatchewan Ministry of the Environment to demonstrate compliance with all regulated parameters.

8.0 DECOMMISSIONING & RECLAMATION

8.1 Initial Reclamation

Sideslopes of roads and ditches will be seeded with pasture grass, alfalpha and clover mix in the year of or the year following construction to limit erosion on these slopes.

8.2 Progressive Reclamation of Landfill Cells

As the compacted clay cover is progressively completed on each landfill cell the slopes will be reclaimed by spreading 150 mm of topsoil evenly across the cover and seeding with a pasture mix to establish a vegetative cover.

8.3 Closure Monitoring

All groundwater monitoring points adjacent to landfill cells will be monitored for a period after a cell is completed. The leachate levels in the manhole will also continue to be

monitored. Leachate will be extracted as necessary to maintain leachate levels at less than 60 cm above the base of drainage layer. Once stable leachate generation levels and groundwater conditions have been achieved and leachate quality meets guidelines for a few consecutive years the monitoring will cease and a given cell will be considered closed and decommissioned. Once landfill gas generation is stabilized. Venting and leachate pump out ports will be decommissioned at that time.

8.4 Decommissioning Runoff Ponds

The runoff ponds will remain in place upon decommissioning as they provide a long term, passive means of controlling runoff long after the landfill is decommissioned. A vegetative cover will be established in each pond soon after construction as these ponds may be mainly dry throughout long periods of time depending upon climate conditions.

9.0 SOCIO-ECONOMIC IMPACT

9.1 Local Impact

REACT currently employs 20 fulltime and 17 part time employees. The new landfill will probably employ 2 or 3 more people initially.

9.2 Region Impact

The proposed landfill will provide a safe, environmentally sound and modern state of the art landfill for the region. It will serve over 25,000 people for the next sixty years provide an integral service for the community as a whole. The selected site has an excellent natural geologic containment character with little risk of regional impact.

9.3 Public Consultation

A public meeting will be held for the RM of Leroy and the RM of Wolverine in conjunction with this permit application. An open house format is anticipated that will provide poster boards showing plans and sections of the site conditions and proposed design of the new landfill.

10.0 ENVIRONMENTAL IMPACT ASSESSMENT

10.1 Potential Impacts

An extensive siting study was carried out to identify a secure landfill location with respect to population density, surface water groundwater and groundwater attributes. Detailed site specific studies have also confirmed the site is an excellent site for long term containment. The potential impacts are expected to be few and of minor impact levels. The removal of a ¼ section of land from the agricultural base is the main impact. Occasional odour issues in down wind locations and increased dusting from increased road traffic are likely to be the only physical impacts arising from the development of the site.

10.2 Mitigation and Contingency Plans

Minimizing groundwater and surface water issues was considered in the siting and design of the site. No aquifers are present within 70 m below the base of the proposed development and estimates of contaminant migration indicate that it would take tens of thousands of years before any leachate could migrate through the thick layer of clay till. Mitigation of surface water issues is provided in both the siting of the site at a high elevation in a poorly defined basin and away from any permanent water body or water course. Further mitigation is in the design of the site which includes diversion of any upstream surface water around the site and containment of surface water generated internally within runoff ponds with capacity to hold greater than 1 in 100 year extreme rainfall events.

Mitigation of odour issues will be provided by the daily cover and diligent plans for managing landfill cell construction. If road dust issues arise these would be dealt with accordingly by either road watering onsite or chemical suppression of dust on problematic sections of off site access roads.

10.3 Monitoring

A comprehensive program of groundwater and surface water monitoring and leachate management will be carried out. These monitoring programs will be completed to meet or

exceed current best practises for landfill monitoring as they may apply to this specific site. Detailed plans for the monitoring network will be provided in the Application for Permit to Construct and Operate a regional landfill.

11.0 SUMMARY STATEMENT

A large scale, regional landfill is being proposed for development at SW31-21-35 W2M in the RM of Leroy. A siting study was completed in the early stages of the project to identify areas where the natural attributes of the physical environment would provide a high degree of environmental protection and population and infrastructure constraints could be avoided. Detailed site characterization follow up studies have confirmed a very low potential for environmental impacts and the general suitability of the site. Preliminary design work has been completed. The engineering design further provides protection of surface water and groundwater. A detailed design incorporating engineering best practises and state of the art design and operating procedures is being completed. It is intended that, upon approval by the RM of Leroy and subsequent approval by Saskatchewan Ministry of the Environment, that construction could begin in late 2016.

A public open house is being planned to allow input from the ratepayers of the RM of Leroy. Any issues or concerns raised by the public will be addressed in the detailed design stages. Additional public meetings may be required to satisfy the Saskatchewan Ministry of the Environment conditions for approval to construct and operate a regional landfill.

12.0 CLOSURE

This document was prepared on behalf of REACT for the RM of LeRoy in order to convey the plans for the project and aid the RM of Leroy in assessment of the project. It is the primary information document appended to the application for a development permit.

WATERMARK CONSULTING LTD.

William A. Jealous, P.Eng., P.Geo.

David J. Tratch, P.Eng.

Association of Professional
Engineers and Geoscientists of Saskatchewan
Certificate of Authorization No. C1203
C1203