
CITY OF KELOWNA
MEMORANDUM

Date: June 6, 2001
File No.: 5360-03

To: City Manager

From: Drainage/Solid Waste Manager

Subject: **Glenmore Landfill Site Development Plan**

RECOMMENDATION

THAT Council receive the “draft” Landfill Site Development Plan as information;

AND THAT staff be directed to bring forward the “final” plan for adoption as the landfill’s guiding document once public and stakeholder feedback has been obtained.

BACKGROUND

The Glenmore Landfill began receiving waste in 1966. Since then, significant changes have occurred in the community and at the landfill. The Regional Solid Waste Management Plan (1992) identified the Glenmore Landfill as the long-term regional waste disposal site and recommended the purchase of the property. The purchase of 435 acres was completed in 2000. Guiding documents for the operation of the Landfill are the Landfill Criteria for Municipal Solid Waste (MoE) and the Operational Certificate. These documents identify requirements for gas management, leachate and drainage control, daily, intermediate and final cover and lining and containment systems among many others.

Subsequent to the purchase of the properties, the comprehensive site development plan was completed based on the regulatory requirements. This document, when adopted, will form the framework of capital improvements and operational strategies at the Glenmore Landfill. The Executive Summary of the report (attachment 1) highlights the findings of the study.

The document will be brought back to Council for adoption once feedback has been gathered from the public.

There will be a presentation by staff and consultants during the Council Meeting

Alan Newcombe, P.Eng.

John Vos, P.Eng.
Director of Works & Utilities

AN/ms

Encl.

Executive Summary

Purpose

The purpose of this Comprehensive Site Development Plan (CSDP) is to present the details of proposed future development at the Glenmore Landfill. The Glenmore Landfill was identified in the 1992 Regional District of Central Okanagan (RDCO) Solid Waste Management Plan as the best long-term residual disposal site in the entire District. The landfill is to be developed in accordance with the City's "*Vision Statement*" and "*Guiding Principles*."

The CSDP describes the general intent of landfill development, provides guidance to landfill designers and operators for future development and operation of the landfill, and incorporates regulatory requirements and best available technologies into site-specific plans and criteria. The CSDP has been developed based on review of available reports and from discussion of City staff familiar with site and with landfill operations. Additional studies are recommended to supplement the data and to verify assumptions used in the development of the various design concepts and recommendations presented.

Site Description and Current Landfill Operations

Site Description

The Glenmore Landfill is located on Glenmore Road approximately 1.5 km east of Lake Okanagan and 9 km northeast of the Kelowna city centre. It is situated in a narrow, flat-bottomed valley that is bordered on the west and east by tree-covered ridges and on the north and south by agricultural lands. The ridge northeast of the active filling area is known locally as Bredin Hill, while the southeast ridge is known as Tutt Mountain.

The Glenmore Landfill is located in a bowl-like drainage basin that has no surface water outlet. The landfill is located at the low point in the drainage basin and is the receiving point for surface runoff generated within the basin. There are no perennial streams in the basin, but there are roadside ditches and natural drainage courses.

Based on historical groundwater levels measured in on-site monitoring wells, the lateral component of groundwater flow is inward from the valley sides toward the centre of the landfill area. A strong upward groundwater gradient has been measured in the centre of the valley. Regionally, the predominant groundwater flow direction within the Glenmore Valley is from north to south.

Available geological data suggest that the silt/clay layer beneath the landfill acts as a natural, low-permeability liner and inhibits the downward percolation of leachate from the landfill to the aquifer. Conversely, this layer also impedes the upward movement of groundwater from the aquifer into the landfill. Due to this upward gradient, this site makes an excellent location for a landfill because of its natural abilities to contain leachate. Since the hydraulic heads measured within the aquifer have not been increasing over time, groundwater must discharge from the aquifer via an alternative pathway. Two potential pathways are a groundwater flow channel at the southern end of the site, or percolation to bedrock along the east or west sides of the valley. At present, there is insufficient hydrogeological information to confirm or refute either of these possibilities.

Landfill Operations

The land on which the Glenmore Landfill is located was originally leased from two local farmers. The southern portion of the landfill, previously known as the Tutt Lease, comprises approximately 30 ha. The northern portion of the landfill was known as the Bredin Lease and is approximately 50 ha in area. The City recently purchased both of these lease areas, along with a much larger area, from these property owners.

The Glenmore Landfill began operations in late 1966 by infilling the slough (i.e., the Tutt Lease property) at the south end of the site. Landfill cells were constructed at the bottom of the slough area by excavating trenches approximately 4.5 m deep which were then filled with waste. Standing water now covers most of the buried waste.

The City is presently landfilling in the northern portion of the site (i.e., the Bredin Lease property) using above-grade landfill cells constructed on the existing land or waste surface. Most of this area has been filled to approximately 9 m in depth.

Regulatory Requirements for Landfill Development

The umbrella statute governing waste management in British Columbia is the provincial *Waste Management Act*, under which specific regulations, guidelines and standards have been issued. Under the provisions of the Act, the British Columbia Ministry of Environment, Lands & Parks (BCMELP) has issued an Operating Certificate (O.C. MR12218) to the City of Kelowna which authorizes the City to manage recyclable materials and to discharge refuse to the ground at the Glenmore Landfill.

BCMELP's *Landfill Criteria for Municipal Solid Waste ("Criteria")* establishes criteria for all new landfills and for expansions, both lateral and vertical, at existing landfills. The *Criteria* provide specific requirements for siting, leachate control, landfill gas management, site operations, and closure and post closure requirements.

Proposed Filling Plan

The City evaluated several filling options for the Glenmore Landfill and is currently proposing to landfill primarily within a footprint that encloses the wastes that have been previously buried on the site. This includes the slough area in which the American Avocet, a shorebird, has chosen to nest. A Conservation Plan that addressed avocet conservation and mitigation issues at the landfill recommended nesting platforms at nearby Robert Lake to encourage the birds to nest at that location.

Based on the anticipated waste generation volumes and the proposed filling plan, the landfill is expected to be operational until approximately 2050. Landfilling on the site will take place in a general north-to-south direction.

Proposed Site Development Components

Figure 1 shows the components of the proposed site development including water management, lining and containment, leachate control, gas management, site infrastructure, and access.

Water Management and Drainage

The proposed water management strategy is continued use of Bredin Pond; doubling the size of Tutt Pond; and constructing a new storage pond at the northeast corner of the landfill between Tutt Mountain and Bredin Hill. This arrangement provides a total storage capacity of 155,000 m³. Excess water would be pumped to Brandts Creek in emergency situations. The advantages of the proposed strategy is that it provides a greater reserve storage volume; it allows reduced peak pumping rates to Brandts Creek (if and when required); and it provides greater flexibility in managing on-site water.

Lining and Containment

The proposed footprint for the Glenmore Landfill site includes lands on which solid wastes have been deposited for many years as well as new areas (expansion areas) where no refuse has been deposited. The latter includes the area at the north end of the property (referred to as the North Expansion Area), and parts of the Slough Area, primarily along its perimeter.

A composite liner consisting of a geomembrane and a soil layer is proposed for the North Expansion Area and it is anticipated that a similar liner system would be used for the expansion areas along the perimeter of the slough. However, additional engineering studies will be required to determine the most appropriate liner system for the latter area. Since landfilling in the Slough area will not take place for perhaps 15 to 20 years, there is adequate time available to conduct the necessary studies.

The City proposes to continue to fill over the areas on which wastes have been deposited. Previous geologic and hydrogeologic studies of the Glenmore Landfill site indicate that this area is generally underlain by several metres of *in situ* clay having a very low hydraulic conductivity. Therefore the soils beneath the existing fill areas form a natural control liner system as defined by the *Criteria*.

It is noted that in the preparation of this report, two localized areas within the existing fill area were determined to have less than 2 m of *in situ* clay. In one area, there is approximately 1 m of soil (clayey silt) over the sand and gravel layer that underlies the entire site. In the second area, there is approximately 5 m of soil (clayey silt) over the sand and gravel layer. The hydraulic conductivity of the native soils in these specific, localized areas was not determined in the original studies.

The first area referenced above (with approximately 1m of soil over sand and gravel) will be relatively accessible during the construction of the North Expansion Area liner. It is recommended that, at that time, the City excavate the refuse in this area and install a composite liner at this location.

The second area referenced above (with approximately 5m of soil over sand and gravel) is not readily accessible. It is recommended that the City investigate this area by installing borings to determine more accurately the extent of the area with less than 2 m of *in situ* clay soil. At least one of the borings should be completed as a monitoring well that will enable leachate level monitoring and possible installation of a vertical leachate pumping well if required.

Leachate Control and Collection

Preventing clean surface water and shallow groundwater from entering the landfill is an important step in minimising the amount of leachate generated at the Glenmore Landfill. The proposed approach involves installation of a diversion ditch at the north end of the property to intercept surface runoff and shallow ground water. A continuous low-permeability diversion berm and cut-off trench would be installed around the perimeter of the balance of the site. On the outside of the berm and trench, a shallow perforated drainage pipe and a surface water ditch system would be installed to collect and convey clean water from around the perimeter of the landfill to the storage ponds described previously. Water collected in the ponds would be used for irrigation purposes.

The proposed leachate collection system for the North Expansion Area consists of strip drains embedded in a layer of drainage sand placed on top of the bottom (composite)

liner. The strip drains would drain to perforated leachate collector pipes installed in a shallow trench in the bottom liner system. The perforated leachate collectors would be connected to a single, solid leachate transmission pipe that would connect into the existing leachate collection system near the leachate pumphouse.

The proposed leachate collection system in the South Slough area would be similar to the system proposed for the North Expansion Area. The proposed leachate collection system would consist of strip drains embedded in a layer of drain sand or gravel over the landfill base in this area. The mounds of existing fill and buried waste would be excavated to a depth necessary to maintain the leachate head below an elevation of 437 masl.

Within the existing fill area, a perforated leachate collector pipe would be installed to collect leachate on the landfill-side of the berm and trench, described above. The leachate collector would connect to intermediate, leachate pumping stations that in turn would discharge to a perimeter force-main header system that would convey the leachate to the existing leachate pumping facility at the north end of the Bredin irrigation pond. The intermediate pump stations would be installed, as determined by engineering study, at several points along the perimeter collector to keep leachate near the perimeter of the landfill below an elevation 437 masl.

Landfill Gas Management

As discussed previously, landfill operations at the Glenmore Landfill started in 1966. Because the previously filled areas have already spent much of their gas generating potential, the vast majority of gas emissions are expected in the active and future filling areas. Further, the configuration of the waste as it exists today makes installation of an effective landfill gas collection system difficult. Because the refuse has been deposited over a large area and relatively thin layer, the path of least resistance for gas to exit the landfill will likely be toward the open landfill surface rather than a vent or gas collector trench.

It is recommended that gas collectors should be placed in areas where active filling is occurring, or will soon occur, and will result in a refuse thickness of greater than 6 m. This will surround the collectors with waste and allow them to function effectively without drawing in air when placed under vacuum. As the fill height is increased, additional collectors would be placed at vertical intervals of approximately 10 m. Each successive layer of collectors would be offset laterally from those in the layer below it so that individual collectors would not be aligned vertically with collectors in layers above or below.

It is recommended that the first set of landfill gas collectors be placed in the northern portion of the landfill where filling is currently underway. Additional gas collectors would be added, in stages, as landfill operations moved southward. The gas collectors in each area would be connected to a header pipe network that would carry the gas to a central blower/flare facility that would be located south of Bredin Pond where the landfill gas would be burned.

Options for beneficial use of the landfill gas including direct use of the gas for heating fuel for buildings, boiler fuel for industrial processes, in kilns, and fuel for electric power production may be considered at a later date when adequate volumes of landfill gas are available. However, consideration of potential projects would include, among other issues, a survey of potential users, competing energy prices, comparison of the user's demands to the available gas production *over time*, and cost to process landfill gas and provide it to the end user.

Site Infrastructure and Access

As part of the landfill development plan, the City plans to upgrade, expand, and relocate many of the existing site service facilities. The site service facilities such as the weigh scales and office trailers will be relocated to the northeast side of the landfill. This will be done following the construction of McKinley Road along the northern boundary of the landfill. Access to the relocated facilities will be from McKinley Road.

Improvements to be incorporated at the time of the relocation include provision of a truck queuing lane (to eliminate trucks backing up onto the public roadways during peak traffic times) and upgrading the site weigh scales. The City also proposes to relocate the "Ogogrow" biosolids composting facility from the present site in Winfield to the north east corner of the Glenmore Landfill site, north of Tutt Mountain, east of Bredin Hill

Liaison with BCMELP and Public

The City of Kelowna is committed to keeping stakeholders informed about the landfill development process. To achieve this goal, the City will develop a public consultation program that may include the distribution of information circulars, public meetings, and open house presentations.

Implementation Plan

The total estimated cost for the various CSDP components described above is approximately \$24 million. However, the final costs of the project will depend on actual site conditions, final project scope and schedule, and other variable factors.

It is proposed that implementation of the various components proceed in a staged manner. Reasons for this are two-fold. First, the capital costs for the various components will need to be distributed over a reasonable timeframe. Second, certain components of the CSDP have definite prerequisites and require the completion of preceding components. For example, a liner must be installed before a leachate collection system can be installed, and both of these components must precede waste filling activities.

Two, five-year stages are proposed for implementing the main requirements of the development plan. Most of the capital works required to develop the site and meet the technical, environmental, and regulatory requirements will be completed within this 10-year timeframe. Only the items that are specific to the later filling phases would be postponed for implementation after the first 10 years.

Conclusions and Recommendations

Conclusions

1. The location and existing site conditions of the Glenmore Landfill present significant challenges to designing a state-of-the-art landfill operation. The landfill has been in operation since 1966 and much of the waste has been deposited in a relatively thin layer over much of the site. Presently, standing water now covers most of the waste buried at the south end of the site (i.e., the slough).
2. Based on the projected waste volumes and the proposed filling plan, the landfill is expected to be operational until approximately 2050.

3. The proposed footprint of the landfill includes the slough area in which the American Avocet, a shorebird, has chosen to nest. A Conservation Plan that addressed avocet conservation and mitigation issues at the landfill recommended nesting platforms at nearby Robert Lake to encourage the birds to nest at that location.
4. Significant improvements to landfill design and operations are necessary to bring the landfill into compliance with BCMELP guidelines and in line with state-of-art practise for landfills in North America. These improvements are mainly in the following areas:
 - Surface water management
 - Construction of an engineered liner system in the northern part of the landfill
 - Improved leachate collection system
 - Design of a gas collection system and installation of components as required as landfilling proceeds

Recommendations

1. The City should present the details and conclusions from this report to all stakeholders, including regulatory bodies, to solicit their input for future development activities.
2. The City should formulate a detailed 10-year program to develop the landfill. Over that 10-year period the landfill should be brought into compliance with all BCMELP *Criteria*, and become a state-of-the-art solid waste management facility.
3. Over the next five years, the City should concentrate efforts and funding on the following:
 - Design and construction of the liner system at the north end of the site
 - Design and construction of the water management facilities.
 - Design of the overall leachate collection system, and construction in phases as required by landfilling operations
 - Design of the overall gas management system, and construction in phases as required by landfilling operations.
 - Relocation of the Ogogrow composting facilities
4. After 5 years, the City should reassess the development plans and make adjustments as appropriate.
5. The City should recognize the potential value in controlling the emission of landfill gas (greenhouse gases) in the landfill and investigate further how this value can be realized to the benefit of the City.