STANDARDS FOR LANDFILLS IN ALBERTA

February 2010

Government of Alberta

TABLE OF CONTENTS

FOREWORD

Alberta Environment is updating its waste management regulatory requirements. It is anticipated that the new regulatory requirements will be in place for all landfills by 2011. The *Standards for Landfills in Alberta* (*Standards*) is one initiative in upgrading waste management regulatory requirements. The *Standards* were developed by a group of people with extensive knowledge of landfill technology from Alberta Environment and the industry. Alberta Environment acknowledges, with gratitude, the guidance and direction provided by the participants in developing this document. The members willingly participated in the process by volunteering their expertise, attend meetings and review documents.

STEERING COMMITTEE

Bob Chandler, Ph.D., P.Eng.	Alberta Environment, Environmental Assurance
Donna Chaw, Ph.D	Alberta Environment, Environmental Assurance
Rhonda Lee Curran, P. Eng, QEP	Alberta Environment, Environmental Management
John Deagle, CET	Foothills Waste Management Facility
Susan Halla, CET	Energy Resources Conservation Board
Jasna Hundal, M.Sc., P.Eng.	City of Calgary
Steve Johnson, M.Eng., P.Eng.	Waste Management of Canada Corp.
Jim Lapp, CET	City of Edmonton/SWANA-NLC
Pete Marshall, B.Sc.	Adelantar Consulting
Norm Richards, P.Eng.	NLR Consulting Ltd.
Kerry D. Robertson, B.Sc.	Energy Resources Conservation Board
Paul Ruffell, P.Eng.	EBA Engineering Consultants
Pat Sliworsky, Manager	Mackenzie Regional Waste Mgmt Commission
Mary Stewart, P. Eng	Alberta Environment, Environmental Management
Alison Walker, M.Sc.	Hazco Environmental Services

ISBN No.: 978-0-7785-8825-2 (Printed Version)

978-0-7785-8826-9 (online Version)

APPLICATION OF THE STANDARDS FOR LANDFILLS

The Alberta Standards for Landfills (*Standards*) outline the minimum requirements for development, operation, monitoring, closure and post-closure of Class I, Class II, and Class III landfills. The *Standards* are intended to provide public assurance regarding the protection of groundwater and surface water, and the appropriate management of nuisances associated with landfill development.

The *Standards* apply to disposal activities at new landfills, new cells at existing landfills, and lateral expansions at existing landfills. The *Standards* will also apply to existing registered landfills that are required to apply for an Approval due to an increase in annual waste disposal tonnage. A transition plan will be developed in consultation with landfill approval and registration holders for existing landfills operating under an Approval or Registration.

The *Standards* are intended to be a continuous improvement document. A review of the *Standards* will be conducted a minimum of every 5 years by a multi-stakeholder technical committee comprised of representatives from industry and government. The next scheduled review will be in 2015. Written requests for improvements to the *Standards* may be directed to:

Donna Chaw, Waste Policy Advisor,
Air, Land and Strategic Policy Branch
Alberta Environment
10th Floor Oxbridge Place
9820-106 Street
Edmonton, Alberta T5K 2J6

or

donna.chaw@gov.ab.ca

DEFINITIONS

All definitions as stated in the *Environmental Protection and Enhancement Act* and associated regulations shall apply to these *Standards*.

In these *Standards*,

(a) "Act" means the *Environmental Protection and Enhancement Act, R.S.A 2000, c E-12*, as amended;

(b) "action leakage rate" means the amount of leakage that would occur through the primary liner, based on two holes per hectare, each with a diameter of 2 mm;

(c) "active landfill area" means the portion of the landfill that has received or is receiving waste for disposal, where final cover has not been placed, and includes areas that are being used for interim management of waste prior to disposition;

(d) "active landfill life" means the period of operation during which waste is received for disposal at the landfill, beginning with the initial receipt of waste and ending with the start of final landfill closure activities;

(e) "adjacent" means lands that are contiguous to the landfill or would be contiguous if not for a river, stream, railway, road, or utility right of way;

(f) "APEGGA" means the Association of Professional Engineers, Geologists and Geophysicists of Alberta;

(g) "aquifer" means an aquifer as defined in the *Water Act*;

(h) "background" means the natural concentration of a substance in a particular groundwater zone in the absence of any input from anthropogenic activities or sources;

(i) "background level monitoring" means a sampling and analysis program that establishes water quality representative of pre-development conditions;

(j) "bulk liquid" means a liquid transported in a vehicle tank or body that is not contained in barrels or other such containers;

(k) "certified operator" means a person who holds a valid Certificate recognized by the Director;

(l) "clay liner" means a liner meeting the specifications in section 3.5(c);

(m) "clayey deposit" means an unconsolidated geological unit that is capable of achieving a hydraulic conductivity of 1×10^{-8} metres per second;

(n) "compliance boundary" means locations where measurements of groundwater quality for regulatory purposes are taken to assess a landfill's performance;

(o) "composite liner" means a liner meeting the specifications in section 3.5(d);

(p) "construction quality assurance" means an integrated system of management activities involving planning, implementation, documentation, assessment, reporting and quality improvement to identify the level to which the construction is in compliance with the specifications;

(q) "construction quality control" means the overall system of technical activities that measures the attributes and performance of construction to verify that the construction meets the specifications;

(r) "coulee" means a dry or intermittent stream valley or wash, especially a long steep-walled gorge representing a Pleistocene overflow channel that carried melt water from an ice sheet;

(s) "day" means any period of 24 consecutive hours unless otherwise specified;

(t) "detection level monitoring" means a monitoring program that is undertaken during the active landfill life, final landfill closure and post-closure for the purpose of detecting the migration of a contaminant constituent to the surrounding environment;

(u) "equivalent hydraulic conductivity" means and is obtained from the following calculation:

$K = d/\Sigma(d_i/K_i)$, where:

K = equivalent hydraulic conductivity
d = thickness of natural geologic material between the bottom of a landfill and the top of an exceptional underlying aquifer
d_i = thickness of each distinctly different geologic layer within the thickness of d
K_i = the hydraulic conductivity of geologic layer d_i
Σ = means the summation of all d_i/K_i values for the distinctly different geologic layers

(v) "exceptional underlying aquifer" means a hydrostratigraphic unit with a transmissivity of greater than 2.5×10^{-3} m^2/sec yielding water with a total dissolved solids (TDS) concentration not exceeding 4000 mg/L;

(w) "final cover" means a designed system, natural or man made, that is placed on the surface of a landfill or landfill cell that has reached its maximum designed waste elevation to control transmission of moisture and gas, and conforms to the end use plan;

(x) "final landfill closure" means the period of time when waste is no longer placed in the defined portion of a landfill and activities are undertaken to complete the final cover system and decommission components and facilities that are no longer required, and includes the construction of any additional components or monitoring systems that are necessary for post-closure;

(y) "fractured non-porous bedrock" means fractured bedrock with a primary porosity of less than 5 percent as measured by a helium porosimeter;

(z) “geologic materials” for the purpose of these *Standards* means one or more geologic formations;

(aa) “geomembrane” means a sheet of manufactured synthetic material designed to control migration of liquid and gas;

(bb) “geosynthetic clay liner (GCL)” means a liner that is made of a thin layer of bentonite either bonded to a geomembrane or fixed between two sheets of geotextile;

(cc) "grab sample" means an individual sample collected in less than 30 minutes and which is representative of the substance sampled;

(dd) “groundwater” means groundwater as defined in the Water Act;

(ee) “groundwater quality control limit” means a concentration of a key indicator parameter above which there is a risk that groundwater quality is impacted by landfill activity;

(ff) “gully” means a small channel with steep sides caused by erosion and cut by concentrated but intermittent flow of water usually during and immediately following heavy rains or after ice or snow melt;

(gg) “hydraulic conductivity” means the ease with which water can be transported through a material;

(hh) “hydrogeologist” means a person who is registered with APEGGA with a specialization in hydrogeology;

(ii) “hydrogeology” means the study of the relationship between water and geology with particular emphasis on the movement and chemistry of water;

(jj) “hydrostratigraphic unit” means the geological formation, or part of a geological formation, or a group of geological formations, in which the hydraulic properties are similar and allow for grouping into aquifers or aquitards;

(kk) “inert waste” means a solid waste that, when disposed of in a landfill or re-used, is not reasonably expected to undergo physical, chemical or biological changes to such an extent as to produce substances that may cause an adverse effect and includes without limitation, demolition debris, concrete, asphalt, glass, ceramic materials, scrap metal and dry timber or wood that has not been chemically treated;

(ll) “industrial solid waste” means solid waste resulting from or incidental to any process of industry;

(mm) "ISO 17025" means the international standard, developed and published by International Organization for Standardization (ISO), specifying management and technical requirements for laboratories;

(nn) “key operating personnel” mean all staff that are in responsible charge of daily operations of a landfill;

(oo) “landfill cell” means a designed or designated area of a landfill comprised of an excavation or earthen structure in which waste is enclosed;

(pp) “landfill gas” means a mixture of gases generated by the microbial decomposition of and chemical reactions between wastes in a landfill;

(qq) “laterally expanding landfill” means a landfill that is being expanded beyond the previously approved waste footprint;

(rr) “leachate” means a liquid that has been in contact with waste in the landfill cell and has undergone chemical or physical changes;

(ss) “leachate collection system” means a system that gathers leachate so that it may be removed from a landfill;

(tt) “leachate pond” means a pond that is designed for temporary storage of leachate;

(uu) “liner” means a continuous layer placed beneath and at the sides of a landfill cell that is compatible with the waste and restricts the migration of leachate, or landfill gas or both;

(vv) “lower explosive limit (LEL)” means the lowest percentage, by volume, of an explosive vapour or gas that must be present in air to ignite;

(ww) “maximum acceptable leachate head” means the maximum depth of leachate above the primary liner, not including the sumps or leachate pipe trenches;

(xx) “monitoring system” means all equipment used for sampling, analyzing or recording data in respect of any parameter;

(yy) “monitoring well” means a well drilled at a site to measure groundwater levels and collect groundwater samples for the purpose of physical, chemical, or biological analysis to determine the concentration of groundwater constituents;

(zz) “municipal solid waste” means solid waste resulting from or incidental to municipal, community, commercial, institutional and recreational activities, and includes garbage, rubbish, ashes, street cleanings, abandoned automobiles, and all other solid wastes except hazardous waste, industrial solid waste, oilfield waste and biomedical wastes;

(aaa) “post-closure” means the period of time after completion of the final landfill closure;

(bbb) “primary liner” means the uppermost liner;

(ccc) "primary porosity" means the pore space in the rock matrix excluding pore space created by processes such as dissolution or fracturing;

(ddd) "prohibited waste" means a waste that may not be accepted for disposal at a landfill because of the classification of the landfill as defined in the *Waste Control Regulation,* as amended, or that is otherwise prohibited by the Province of Alberta;

(eee) "ravine" means a small stream channel, narrow, steep-sided, and commonly V-shaped in cross-section, and larger than a gully;

(fff) "recycle" means to do anything that results in providing a use for a thing that otherwise would be disposed of or dealt with as waste, including collecting, transporting, handling, storing, sorting, separating and processing the thing, but does not include the application of waste to land or the use of a thermal destruction process;

(ggg) "response level monitoring" means a monitoring program that is undertaken following detection of contaminant constituents above specified limits or performance standards and is continued until corrective measures have mitigated the contaminant constituents to below the specified limits or meets performance standards;

(hhh) "run-off" means any rainwater or melt water that drains as surface flow from the active landfill area, excluding leachate;

(iii) "run-on" means any rainwater or melt water that may drain as surface flow onto the active landfill area;

(jjj) "secondary leachate collection system" means a system that gathers liquids between a primary liner and a secondary liner system;

(kkk) "secondary liner" means the lowermost liner of a double liner system;

(lll) "site specific conditions" means all conditions related to the landfill site that may influence its design or operation including climate and quantity and nature of the waste received or proposed to be received at the landfill;

(mmm) "siting" means the process of identifying, investigating, evaluating and selecting locations for solid waste management and disposal facilities;

(nnn) "soil" means mineral or organic earthen materials that can, have, or are being altered by weathering, biological processes or human activity;

(ooo) "structural components" means liners, leachate collection systems, final cover systems, run-on and run-off systems and any other landfill components that are necessary for the protection of human health and the environment;

(ppp) "subsoil" means the layer of soil directly below the topsoil, to a maximum depth of 1.2 metres below the topsoil surface, that consists of the B and C horizons as defined in *The System of Soil Classification for Canada, Agriculture and Agri-Food Canada, 1998, Publication 1643, 3rd Edition*, as amended or replaced from time to time;

(qqq) "topsoil" means the uppermost layers of soil that consist of the L, F, H, O, and A horizons as defined in *The System of Soil Classification for Canada, Agriculture and Agri-Food Canada, 1998, Publication 1643, 3rd Edition*, as amended or replaced from time to time;

(rrr) "unstable area" means land which may be subject to differential settling due to soil conditions, geologic and geomorphic features or man-made features;

(sss) "uppermost formation" means a continuous water-saturated geological stratum or strata, including but not limited to sand lenses and aquifers, that is projected to be the most probable pathway or pathways for lateral transport of leachate;

(ttt) "waste footprint" means the areas within a landfill where waste has been disposed of and is proposed to be disposed of, but does not include those areas used for purposes other than disposal such as surface water storage, recycling facilities, buffer zones and buildings; and

(uuu) "year" means calendar year, unless otherwise specified.

SECTION 1: REGULATORY DISCLOSURE PROCESS FOR A NEW OR LATERALLY EXPANDING LANDFILL

1.1 Disclosure Plan

(a) Prior to submitting an application for a landfill approval or registration, the person responsible for a proposed new or laterally expanding landfill shall submit a written Disclosure Plan to the Director.

(b) The Disclosure Plan shall include, at a minimum, all of the following:
- (i) the proposed process for public consultation;
- (ii) a proposed process for responding to concerns identified during the public consultation process; and
- (iii) the proposed process for technical investigation of the site.

(c) The person responsible for a proposed new or laterally expanding landfill shall implement the Disclosure Plan as authorized in writing by the Director.

1.2 Application Submission

(a) In addition to any information required by the Director under the *Approvals and Registration Procedure Regulation* (AR 113/93), an application for approval or registration of a new or laterally expanding landfill shall be submitted to the Director prior to commencing construction of the landfill.

(b) The application for a new or laterally expanding landfill shall contain at a minimum, all the following documents:
- (i) documentation that demonstrates conformance with the Disclosure Plan;
- (ii) detailed Technical Investigation Program Report as per section 2.4;
- (iii) financial security or environmental reserve fund documentation for closure and post-closure activities;
- (iv) Landfill Design Plan and Specifications as per section 3.1;
- (v) Operations Plan as per section 4.3; and
- (vi) Landfill Monitoring Plan as per section 5.1.

SECTION 2: LANDFILL DEVELOPMENT AND SITING

2.1 Natural Environment Separation

(a) The person responsible for a new landfill shall comply with setbacks as provided in Table 2.1.

Table 2.1
Standards for Environmental Separation

Setting	Distance from waste footprint
Land subject to slope failure	*100 meters*
A natural area that permanently contains water such as a lake, river or creek.	*300 meters, unless otherwise authorized in writing by the Director*
A man-made surface feature that permanently contains water such as an irrigation canal, drainage ditch, but not a road-side ditch, or dugout.	*300 meters, unless otherwise authorized in writing by the Director*

(b) The person responsible for a laterally expanding landfill shall comply with setbacks as provided in Table 2.1 unless:
- (i) the landfill existed prior to September 1st,1996; or
- (ii) the Director accepts evidence in writing from the person responsible that surface water and groundwater will not be impacted.

(c) A new landfill or the new waste footprint of a laterally expanding landfill shall not be situated at a location where there exists one or more of the following conditions:
- (i) the area is situated within a ravine, coulee or gully;
- (ii) there is less than 30 metres of geologic materials with an equivalent hydraulic conductivity greater than 1×10^{-8} metres/second between the bottom of the liner, or where no liner is required, immediately beneath where waste will be deposited, excluding sumps or leachate pipe trenches, and an exceptional underlying aquifer; or
- (iii) the geologic materials within 10 metres below the bottom of the liner, excluding sumps or leachate pipe trenches, include fractured non-porous bedrock or karst features.

(d) A new landfill, or the new waste footprint of a laterally expanding landfill, shall only be situated at a location where:
   (i) there is a 5 metre thick layer of a clayey deposit having an equivalent hydraulic conductivity less than 1×10^{-8} metres per second immediately beneath the lowest part of the liner, or where no liner is required, immediately beneath where waste will be deposited, excluding sumps or leachate pipe trenches; and
   (ii) the geologic materials immediately beneath the clayey deposit required in 2.1(d)(i) or 2.1(d)(ii) consist of at least 3 metres of material providing equivalent or better protection to the requirements in 2.1(d)(i).

(e) The clayey deposit in 2.1(d) may include one or more layers of a material with a hydraulic conductivity greater than 1×10^{-6} metres per second provided that:
   (i) the accumulated thickness of the layers are less than 0.5 metres; and
   (ii) any such layers do not extend beyond the compliance boundary.

(f) The thickness of the clayey deposit required in 2.1(d) may be attained by reconstruction of compacted earthen materials to an equivalent hydraulic conductivity less than 1×10^{-8} metres per second.

(g) Sections 2.1(c) to 2.1(d) do not apply to the new waste footprint of a laterally expanding landfill if the Director accepts written evidence from the person responsible that the groundwater quality will not exceed groundwater performance standards as per section 5.3 at the compliance boundary.

(h) Section 2.1(g) only applies to landfills which were in existence prior to January 1, 2010.

2.2 Requirements for a Technical Investigation Program

(a) Prior to the design of a new or laterally expanding landfill, the person responsible shall complete a Technical Investigation Program specific to the landfill site and its surrounding area.

(b) The person responsible shall ensure that the components of the Technical Investigation Program are prepared by APEGGA registered professionals with expertise in the subject area.

(c) The Technical Investigation Program shall include characterization of the geologic, hydrologic, hydrogeologic and geotechnical settings expressed on regional and local scales.

(d) The Technical Investigation Program shall identify the geologic, hydrologic, hydrogeologic and geotechnical characteristics of the site including, at a minimum, all of the following:
   (i) the groundwater and surface water regimes associated with the new or laterally expanding landfill;
   (ii) the potential contaminant flow paths from the landfill into the receiving environment;

(iii) for a laterally expanding landfill, the potential impacts on groundwater and surface water regimes relative to the existing landfill;
(iv) characterization of the variability, depth, and engineering properties of onsite soils; and
(v) a site stability assessment.

(e) The boreholes completed for the Technical Investigation Program shall be distributed at:
(i) an evenly distributed spacing of not more than 200 metres; or
(ii) a minimum of five evenly distributed locations for landfills with a waste footprint smaller than 5 hectares.

(f) The minimum depth of the hydrogeologic characterization component of the Technical Investigation Program shall be deeper than 30 metres below the proposed base of the new or laterally expanding landfill.

(g) The Director may require additional boreholes for hydrogeologic characterization required in 2.2(e) and 2.2(f) to adequately delineate geologic formations.

(h) A topographic survey shall be conducted for the area of the new or laterally expanding landfill as part of the Technical Investigation Program.

2.3 Groundwater Monitoring Wells

(a) The drilling, construction, maintenance and reclamation of boreholes and monitoring wells for the purposes of conducting the Technical Investigation Program shall be done in accordance with all applicable requirements described in Part 7 of the *Water (Ministerial) Regulation (AR 205/98)*, as amended.

2.4 Detailed Technical Investigation Program Report

(a) The person responsible for a new or laterally expanding landfill shall ensure that APEGGA registered professionals with expertise in the subject area prepares components of the Detailed Technical Investigation Program Report.

(b) The Detailed Technical Investigation Program Report shall include, at a minimum, all of the following information:
(i) a description of the topography, surface drainage patterns, geology, hydrogeology, existing and surrounding land use within 800 metres of the proposed site;
(ii) a drawing showing the proposed site in relation to:
a. adjacent development and infrastructure;
b. natural and constructed physical features such as streams, rivers, water bodies, canals and drainage controls;
c. domestic, municipal and other licensed water well locations within 5 km of the proposed site; and
d. municipal wellhead protection zones;
(iii) a detailed site plan showing:
a. surface topography; and
b. locations and surface elevations of all boreholes and monitoring wells;

(iv) the profile and depths of the topsoil and subsoil;
(v) detailed borehole records showing the geologic and hydrogeologic conditions encountered and the depth of all major stratigraphic features;
(vi) site stability;
(vii) cross-sections showing:
  a. an interpretation of the geologic stratigraphy to the depth of the hydrogeologic characterization component;
  b. directions of groundwater flow; and
  c. hydraulic conductivities of the geologic strata that influence or control groundwater movement;
(viii) a detailed written interpretation of the hydrologic, hydrogeologic and geotechnical conditions on a regional and local scale;
(ix) a statement that the site is suitable for landfill development in accordance with applicable regulatory requirements in Alberta; and
(x) recommendations for:
  a. the area suitable for landfilling;
  b. the landfill design based on the hydrologic and hydrogeologic conditions; and
  c. dealing with the implications of the conditions in section 2.4(b)(viii) on possible landfill development.

SECTION 3: DESIGN AND CONSTRUCTION

3.1 Landfill Design Plan and Specifications

(a) The person responsible shall ensure that APEGGA registered professionals with expertise in the subject area prepares the Landfill Design Plan and Specifications for a new or laterally expanding landfill.

(b) The Landfill Design Plan and Specifications for a new or laterally expanding landfill shall include, at a minimum, all of the following information:

(i) an engineering design report that provides:

a. a description of the type and quantity of waste that is anticipated to be accepted at the landfill;

b. a description of the design intent and a summary of the components included in the design to achieve the design intent;

c. an evaluation of the potential for leachate generation and leachate composition based on site specific conditions;

d. an evaluation of the potential for landfill gas generation and gas composition based on the type of waste accepted, climate, the landfill design, or other site specific conditions;

e. a description of monitoring systems;

f. a preliminary landfill closure plan that includes at a minimum:

i a staging plan for closure of the landfill or portions of the landfill;

ii a plan to manage surface water infiltration or moisture additions according to the design intent of the landfill cells;

iii a proposed design for the final landfill cover system;

iv general information of the final elevation and slopes;

v a re-vegetation plan of completed areas of the landfill; and

vi a description of the potential end-use of the landfill after final landfill closure; and

(ii) engineering design maps and plans that provide:

a. topographic maps showing the overall proposed site development and setbacks;

b. a site plan that shows the proposed landfill footprint and the location of the compliance boundary;

c. a minimum 30 metre separation between the waste footprint and the landfill property line;

d. cross-sections showing the proposed surface elevations, base elevations and grades for the landfill development;

e. drawings for structural components of the landfill including, but not limited to, liner systems and leachate collection and removal systems;

f. a run-on control system to prevent flow onto the active landfill area for events up to at least the peak discharge from a 1 in 25 year – 24 hour duration rainfall event;

g. a run-off control system for the active landfill area to collect and control at least the run-off water volume resulting from a 1 in 25 year – 24 hour duration rainfall event; and

h. a groundwater monitoring system as per the minimum requirements in section 5.6.

(c) If a new or laterally expanding landfill accepts segregated material for the purpose of waste minimization, sorting, recovery, processing, or storage then the Landfill Design Plan and Specifications shall include specific areas to be used for these activities.

(d) Any deviations to the Landfill Design Plan and Specifications must be authorized in writing by the Director prior to implementation.

3.2 Design of a Class II Landfill

(a) In addition to the requirements in section 3.1, the Landfill Design Plan and Specifications for the construction of a new or laterally expanding Class II Landfill shall include, at a minimum, all of the following:
- (i) a liner; and
- (ii) a leachate collection system capable of maintaining the maximum acceptable leachate head.

3.3 Design of a Class III Landfill

(a) In addition to the requirements as described in section 3.1, the Landfill Design Plan and Specifications for construction of a new or laterally expanding Class III landfill shall provide for the containment of inert wastes.

3.4 Design of a Leachate Pond

(a) The Design Plan and Specifications for the construction of a leachate pond shall include, at a minimum, all of the following:
- (i) a primary geomembrane liner;
- (ii) a secondary geomembrane liner; and
- (iii) a secondary leachate collection system.

(b) The liner system in 3.4(a) shall be constructed over a prepared clay sub-grade suitable to protect the integrity of the liner system.

3.5 Construction

(a) The person responsible shall construct a new or laterally expanding landfill or landfill cell in accordance with the Landfill Design Plan and Specifications authorized in an Approval or Registration.

(b) Detailed Construction Plans and Specifications, prepared in accordance with the Landfill Design Plan and Specifications, shall be submitted to the Director prior to each major stage of construction, including but not restricted to cell construction and closure.

(c) If the new landfill, laterally expanding landfill or landfill cell is to be constructed with a clay liner, the clay liner shall be constructed by compacting earthen material:
   (i) that has a hydraulic conductivity of less than 1×10^{-9} metres/second to a thickness of not less than 1 metre, measured perpendicular to the slope, or
   (ii) that has a hydraulic conductivity greater than 1×10^{-9} metres/second to a thickness greater than 1 metre that will achieve an equivalent advective performance to 3.5(c)(i).

(d) If the new landfill, laterally expanding landfill or landfill cell is to be constructed with a composite liner, the composite liner shall be constructed with a geomembrane placed directly on the surface of:
   (i) a liner that is comprised of earthen material with a hydraulic conductivity of less than 1×10^{-9} metres/second compacted to a thickness of not less than 0.6 metres, measured perpendicular to the slope, or
   (ii) a liner that is comprised of earthen materials with a hydraulic conductivity greater than 1×10^{-9} metres/second compacted to a thickness greater than 0.6 metres that will achieve an equivalent advective performance to 3.5(d)(i), or
   (iii) a liner that is comprised of a geosynthetic clay liner and earthen material compacted to a thickness of not less than 0.6 metres, measured perpendicular to the slope, that will achieve a combined equivalent advective performance to 3.5(d)(i).

3.6 Construction Quality Assurance and Control

(a) Prior to the construction of a new landfill, laterally expanding landfill or landfill cell, the person responsible shall submit to the Director a Construction Quality Assurance Plan and a Construction Quality Control Plan.

(b) The person responsible shall construct a new landfill, new landfill cell, laterally expanding landfill or landfill cell according to the Construction Quality Assurance Plan and the Construction Quality Control Plan as authorized in writing by the Director.

(c) Any deviations to the Construction Quality Assurance or Construction Quality Control Plan or the Detailed Construction Plans and Specifications, must be authorized in writing by the Director prior to implementation.

(d) Section 3.6 (c) does not apply to deviations where:
   (i) the deviation results in a minor adjustment to the Detailed Construction Plan and Specifications to suit field conditions encountered; and
   (ii) the deviation will not result in a change in the design performance of the landfill or landfill cell.

(e) Prior to commencing operation of a new or laterally expanding landfill or landfill cell, the person responsible shall submit a report detailing the Construction Quality Assurance Results to the Director confirming that the landfill has been constructed according to the Construction Quality Assurance Plan, Construction Quality Control Plan, and the Landfill Design Plan and Specifications.

(f) If the construction of the new or laterally expanding landfill or landfill cell has not been carried out according to some or all of the Construction Quality Assurance Plan, the Construction Quality Control Plan or the Landfill Design Plans and Specifications, the person responsible shall provide a report to the Director that explains the deviation(s) and includes a description of any potential impacts that may result from the deviation(s).

SECTION 4: LANDFILL OPERATION

4.1 Operator Certification

(a) The person responsible for a landfill shall ensure that during active landfill life and until final landfill closure all key operating personnel hold a valid basic landfill operator certificate after 18 months of employment at the facility.

(b) To qualify for basic certification, the operator must:
- (i) be at least 18 years of age; and
- (ii) have one year of full time operational experience at a landfill which is current to within the last 3 years from the date of application.

(c) The following landfill operator certificates are recognized by the Director:
- (i) Alberta Environment Certificate of Qualification issued under the Municipal Waste Facility Operator Certification Guideline; and
- (ii) Alberta Basic Landfill Operator Certificate issued by the Solid Waste Association of North America-Northern Lights Chapter.

(d) The person responsible for the facility shall ensure that the facility has operators with the required certification endorsements as per the *Alberta Landfill and Composting Facility Operator Certification Guidelines*, published by Alberta Environment.

(e) The person responsible for the landfill shall notify the Director in writing of the names of all the key operating personnel, the required facility endorsements, and any change in any of the key operating personnel or facility endorsements within 30 days of the change.

4.2 Topsoil and Subsoil Salvaging and Storage

(a) During the construction and operation of a landfill, the person responsible shall separately recover and stockpile all topsoil and subsoil such that all topsoil and subsoil stockpiles:
- (i) shall be constructed in a manner that allows for maximum recovery of the topsoil and subsoil;
- (ii) shall be contoured, stabilized and seeded to protect against soil loss by erosion; and
- (iii) shall only be used for reclamation at the landfill site.

4.3 Operations Plan

(a) The person responsible for a landfill shall
- (i) develop;
- (ii) maintain; and
- (iii) implement

an Operations Plan that is consistent with the Landfill Design Plan and Specifications and these *Standards*.

(b) The Operations Plan shall include, at a minimum, all of the following information:
- (i) waste acceptance policies and procedures as per section 4.4;
- (ii) polices and procedures for wastes requiring special handing, if accepted;
- (iii) operating procedures for nuisance management as per section 4.5;
- (iv) a Wildlife Management Plan as per section 4.6;
- (v) procedures for covering the waste including a description of proposed materials and the frequency of cover applications;
- (vi) a plan for the protection of liners;
- (vii) an emergency response plan;
- (viii) a site safety plan;
- (ix) a plan for the detection and management of subsurface landfill gas, if applicable;
- (x) a plan for the management of leachate including its collection, removal, treatment and disposal;
- (xi) a plan for leachate pond management, if applicable;
- (xii) a plan for the management of surface water run-off and run-on control systems;
- (xiii) the Landfill Monitoring Plan in accordance with section 5.1; and
- (xiv) a plan for other operations where they are included at the landfill site such as the storage, processing, recycling or composting of segregated waste or feedstocks.

4.4 Waste Acceptance Policies and Procedures

(a) The waste acceptance policies and procedures in the Operations Plan shall be consistent with the requirements as described in the *Waste Control Regulation* (AR 192/96), as amended, or as specified in writing by the Director.

(b) The waste acceptance policies and procedures shall include a program to detect a prohibited waste so that it is prevented from being disposed of in a landfill cell.

4.5 Nuisance Management

(a) The person responsible for a landfill shall take all necessary measures to control nuisances such as litter, fires, disease vectors, odours and dust, including but not limited to:
- (i) erecting artificial barriers, utilizing natural barriers, or other effective measures to control access to the site;
- (ii) covering solid waste that is disposed in the landfill with soil or other cover material at a frequency specified in the Operations Plan;
- (iii) maintaining areas for storage, processing or recycling of segregated waste in a clean and orderly manner;
- (iv) establishing and maintaining litter controls to minimize the escape of waste from the landfill site;
- (v) retrieval of litter that accumulates on the landfill site; and
- (vi) retrieval of litter that is washed, blown, or transported onto adjacent properties, provided the consent of the owner of the adjacent property is first obtained.

4.6 Wildlife Management

(a) The person responsible for a landfill shall restrict wildlife from the landfill in accordance with both of the following:
   (i) *Waste Management Facilities and Wildlife*, Alberta Sustainable Resource Development, as amended; and
   (ii) *The Landfill Guidelines,* Alberta Environment, as amended.

(b) Where wildlife problems are not resolved, the person responsible must develop a wildlife management plan acceptable to local Fish and Wildlife officials.

4.7 Controlled Burning

(a) No person shall conduct opening burning or permit open burning at a landfill unless:
   (i) the open burning is conducted in accordance with the *Substance Release Regulation (AR 124/93*); and
   (ii) the open burning is done in an area that is:
      a. constructed with a fire break consisting of barren mineral soil;
      b. located so that is separated from disposal operations, storage compounds and buildings; and
      c. supervised at the time of burning.

(b) At least 7 days prior to the date of the burning, the person responsible for the landfill shall notify all of the following:
   (i) the local authorities;
   (ii) all adjacent property owners; and
   (iii) the local fire department.

   informing them of the proposed burning and the date on which the proposed burning is to take place.

4.8 Liquid Waste Restriction

(a) No liquid waste shall be disposed in a Class III landfill cell.

(b) No oilfield waste that is liquid shall be disposed in any landfill cell.

(c) No hazardous waste that is liquid shall be disposed in any landfill cell.

(d) A containerized liquid, that is waste, greater than 5 litres shall not be disposed in any landfill cell.

(e) A bulk liquid, that is waste, greater than 5 litres shall not be disposed in a Class II landfill unless the landfill cell is designed with a liner and leachate collection system and acceptable liquid addition limits are as described in the Landfill Design and Specifications Plan authorized in writing by the Director.

(f) Section 4.8(e) includes wastewater sewage from a community that is not served by a wastewater treatment plant.

4.9 Signage

(a) The person responsible shall erect and maintain signs at the landfill entrance providing, at a minimum, all of the following information:
- (i) the name of the approval or registration holder;
- (ii) the landfill class;
- (iii) any waste restrictions; and
- (iv) the telephone numbers for:
  - a. the person responsible;
  - b. the local fire department; and
  - c. Alberta Environment (1-800-222-6514).

4.10 Leachate Management

(a) Section 4.10 applies to all landfills with leachate collection systems.

(b) During active landfill life, final landfill closure and post-closure the maximum acceptable leachate head in landfill cells constructed after July 1, 2009 shall not exceed 300 mm.

(c) During active landfill life, final landfill closure and post-closure the maximum acceptable leachate head for landfill cells constructed prior to July 1, 2009 shall not exceed the maximum acceptable leachate head as authorized in writing by the Director.

(d) The person responsible for a landfill shall remove leachate from the cell at a frequency that maintains the level of leachate at or below the maximum acceptable leachate head.

(e) Notwithstanding the requirements in 4.10(b), 4.10(c) and 4.10(d), upon detection of any exceedances of the maximum acceptable leachate head, the person responsible shall reduce the leachate head level to below the maximum acceptable leachate head level within a maximum of 14 calendar days subsequent to the detection.

(f) Landfills or landfill cells that have been approved by the Director to include an alternative design for liner and leachate collection systems shall manage leachate as authorized in writing by the Director.

SECTION 5: MONITORING, ANALYSIS AND CORRECTIVE ACTION

5.1 Landfill Monitoring Plan

(a) The person responsible for a landfill shall
   (i) develop;
   (ii) maintain; and
   (iii) implement

   a Landfill Monitoring Plan.

(b) The Landfill Monitoring Plan shall include, at a minimum, all of the following:
   (i) a Groundwater Monitoring Program; and
   (ii) a Surface Water Monitoring Program.

(c) In addition to the requirements in section 5.1(b) the person responsible for a landfill that is designed and constructed with a leachate collection system shall develop a Leachate Monitoring Program as part of the Landfill Monitoring Plan.

(d) In addition to the requirements in section 5.1(b), the person responsible for a landfill that accepts organic waste that is reasonably expected to undergo microbial decomposition shall develop a Subsurface Landfill Gas Monitoring Program as part of the Landfill Monitoring Plan.

(e) The person responsible shall ensure that APEGGA registered professionals with expertise in the subject area prepares the Landfill Monitoring Plan.

(f) If the Director finds the Landfill Monitoring Plan to be deficient, the person responsible shall correct all deficiencies as outlined by the Director in writing.

(g) The person responsible shall implement the Landfill Monitoring Plan as authorized in writing by the Director.

(h) The person responsible shall implement the Landfill Monitoring Plan from the beginning of the active landfill life until the end of post-closure, unless otherwise authorized in writing by the Director.

5.2 Groundwater Monitoring Program

(a) The person responsible for a landfill shall develop the Groundwater Monitoring Program to include, at a minimum, all of the following:
   (i) background groundwater quality for each monitoring well;
      a. existing landfills or landfill cells may establish background levels after the start of landfill operations by:
         i using historical data; or
         ii obtaining groundwater samples from monitoring wells established in nearby areas not affected by landfill activity;
   (ii) establish groundwater quality control limits for each naturally occurring parameter;

(iii) a detailed program for groundwater sample collection frequency and analysis, that includes, at a minimum, all of the following:
  a. retrieval of representative samples from the groundwater monitoring system at a frequency set out in Table 5.1, or as otherwise authorized in writing by the Director; and
  b. laboratory analysis of the samples for parameters as described in Table 5.2; and

(iv) a Groundwater Contingency Plan

(b) The Groundwater Monitoring Program for a Class II landfill that receives wastes other than municipal solid wastes shall include additional parameters than those specified in Table 5.2 as specified in writing by the Director and based on site-specific conditions.

(c) Response level monitoring parameters and frequency shall be as authorized in writing by the Director.

(d) The groundwater monitoring data shall be presented using control charts and interpreted by a professional registered with APEGGA, or other professional authorized in writing by the Director, to determine any groundwater quality impacts as a result of the landfill operations.

Table 5.1
Frequency for Groundwater Sampling and Analysis

Landfill	Background Monitoring	Detection Level
Class II and III Landfills with liner and leachate collection systems	• Twice[1] per year for the first four (4) years of operations. • Once per year every 3rd year after background levels have been established.	Twice per year[2]
Class II and III Landfills without liner and leachate collection systems	• Twice per year for the first four (4) years of operations. • Once per year after background levels have been established.	Once per year

[1] The two sampling events should be considerate of seasonal variations.
[2] The frequency is reduced to 1 time per year during the year when the background parameters are done.

Table 5.2
Groundwater Parameters for Background Level and Detection Level Monitoring Parameters

Parameter	Background	Detection level
General and Inorganic Parameters		
pH, Total Dissolved Solids, Alkalinity, Ammonia, Total Kjeldahl Nitrogen, Electrical Conductivity, Hardness (CaCO3)	√	√
Major Ions		
Chloride, Calcium, Magnesium, Sodium, Potassium, Sulphate, Nitrate-N, Nitrite - N	√	√
Dissolved Metals		
Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Iron, Lead, Lithium, Manganese, Molybdenum, Mercury, Nickel, Phosphorus, Silicon, Silver, Strontium, Thallium, Tin, Vanadium, Uranium, and Zinc	√	
Iron and Manganese	√	√
Other Organics		
Dissolved Organic Carbon (DOC)	√	√
Volatile Organic Compounds[3]		
Benzene, Toluene, Ethylbenzene, Xylene, F1, F2, Phenols	√	
Methylene Chloride, Vinyl Chloride, Trichloroethylene (TCE), Tetrachlorethylene (PCE).	√	

5.3 Groundwater Performance Standards

(a) Throughout the active landfill life, final landfill closure, and post-closure of the landfill, the groundwater quality within the compliance boundary shall meet the all of the following groundwater performance standards:
- (i) groundwater quality of one or more parameters shall not display an increasing trend;
- (ii) groundwater parameters shall not exceed the corresponding groundwater quality control limit; and
- (iii) any parameters not naturally present in groundwater is not detected in three consecutive sampling events.

5.4 Implementation of Groundwater Contingency Plan

(a) The person responsible shall immediately notify the Director and shall implement the Groundwater Contingency Plan developed in accordance with section 5.2(a)(iv), if at any time until the end of post-closure the groundwater fails to meet the groundwater performance standards within the compliance boundary.

[3] Parameters not naturally present in groundwater

5.5 Compliance Boundary

(a) The person responsible shall establish the compliance boundary at locations that are:
  (i) at least 20 metres inside the property boundary of the landfill; and
  (ii) at least 10 metres, but not more than 60 metres from the waste footprint.

5.6 Groundwater Monitoring Wells

(a) The person responsible for a new or laterally expanding landfill shall construct groundwater monitoring wells that are:
  (i) no more than 200 metres from the nearest groundwater monitoring well as measured along the compliance boundary;
  (ii) at locations that provide an accurate representation of upgradient and downgradient groundwater quality.

(b) The person responsible shall ensure that each groundwater monitoring location along the compliance boundary includes at least one well designed to allow for the collection of groundwater samples from the uppermost formation.

(c) All groundwater monitoring wells shall be protected from damage and shall be locked, except when being sampled, unless otherwise authorized in writing by the Director.

(d) If a groundwater sample cannot be collected because the monitoring well is damaged or is no longer capable of producing a representative sample:
  (i) the groundwater monitoring well shall be cleaned, repaired or replaced; and
  (ii) a representative groundwater sample shall be collected prior to the next scheduled sampling date unless otherwise authorized in writing by the Director.

5.7 Surface Water Monitoring Program

(a) The Surface Water Monitoring Program shall include, at a minimum, all of the following:
  (i) a detailed program for surface water sample collection and analysis, that includes, at a minimum, all of the following:
    a. retrieval of representative samples from the run-off control system at a frequency as described in Table 5.3, or as otherwise authorized in writing by the Director;
    b. laboratory analysis of the samples for parameters as described in Table 5.3;
    c. surface water quality of the receiving water body; and
    d. upstream and downstream surface water quality of any run-off water receiving stream, if applicable.
  (ii) identification of potential sources of contamination, spills and leaks at the landfill;
  (iii) release procedures for run-off that meets release limits in Table 5.3;
  (iv) management of run-off that exceeds the release limits in Table 5.3; and

(v) a Surface Water Contingency Plan for response and assessment in the event that:
   a. the run-off containment is contaminated from spills or leaks;
   b. there is an accidental release to the surrounding watershed; or
   c. there is an unauthorized release to the surrounding watershed.

(b) Releases from the run-off control system shall comply with the limits for the parameters specified in Table 5.3.

(c) Notwithstanding 5.7(b), the person responsible may use alternate run-off control system release limits, if the Director accepts written justification for the use of the proposed run-off control system release limits.

(d) The Surface Water Monitoring Program for a Class II landfill that receives wastes other than municipal solid wastes shall include additional parameters additional to those specified in Table 5.3, as specified in writing by the Director and based on site-specific conditions.

(e) The person responsible shall not release any substances from the run-off control system to the surrounding watershed, except in accordance with the Surface Water Monitoring Program, as approved in writing by the Director.

(f) The surface water monitoring data shall be interpreted by a professional registered with APEGGA, or other professional authorized in writing by the Director, to determine any surface water quality impacts as a result of the landfill operation.

Table 5.3
Surface Water Monitoring and Release Limits

Parameter	Frequency	Sample Type	Sample Location	Release Limit Maximum Concentration or Range (in mg/L unless otherwise specified)
pH	a) prior to each release; and b) during any unanticipated release from the runoff control system	Representative grab sample	Each runoff Control System Pond from which a release: (a) is to occur, or (b) is occurring	6.0 – 9.5 pH units
Total Dissolved Solids				2500
Total Suspended Solids				25
Ammonia (Total)				5.0
Chloride				250
Sodium				200
Sulphate				500
Chemical Oxygen Demand				50
Oil and Grease				No visible sheen
Volume	When released	When released	Discharge Point	When released

5.8 Implementation of the Surface Water Contingency Plan

(a) If at any time until the end of post-closure, there are accidental or unauthorized releases from the run-off control system to the receiving watershed, the person responsible shall immediately notify the Director and shall implement the Surface Water Contingency Plan developed in accordance with section 5.7(a)(v).

5.9 Leachate Monitoring Program

(a) The Leachate Monitoring Program shall include, at a minimum, all of the following:
   (i) a detailed program for leachate collection system sample collection and analysis, that includes, at a minimum, all of the following:
      a. a program to measure the depth of leachate head in the cells;
      b. retrieval of representative samples at a frequency as described in Table 5.4, or as otherwise authorized in writing by the Director; and
      c. laboratory analysis of the leachate samples for parameters as described in Table 5.4;
   (ii) if applicable, a detailed program for leachate pond sample collection and analysis, that includes, at a minimum, all of the following:
      a. retrieval of representative samples at a frequency as described in Table 5.4, or as otherwise authorized in writing by the Director; and
      b. laboratory analysis of the leachate pond content for parameters as described in Table 5.4;
   (iii) an Action Leakage Rate shall be developed for the sump(s) associated with the leachate pond leak detection system, as applicable, as per the *Action Leakage Rate Guideline* published by Alberta Environment.
   (iv) a Leak Detection Response Action Plan shall be developed, in accordance with section 6.2 of the *Action Leakage Rate Guideline*, for response and action if the Action Leakage Rate is exceeded.

(b) The Leachate Monitoring Program shall be implemented during the active landfill life, final landfill closure and post-closure for the landfill.

Table 5.4
Landfill Leachate Sampling and Analysis

Monitoring Activity	Monitoring		
	Minimum Frequency	Method	Sampling Location
Leachate level monitoring in cells	April to October - weekly November to March - Monthly	Measurement	At each leachate manhole and sump
Volume of leachate removed from cells	As removed	Measurement	At each leachate manhole and sump
Volume of leak detection liquid removed from the secondary leachate collection system	Monthly or as removed	Measurement or calculated	At secondary leachate collection system sump(s)
Leachate parameters:			
pH, Total Dissolved Solids, Total Suspended Solids Ammonia (total), Total Kjeldahl Nitrogen, Chloride, Sodium, Sulphate, COD. Metals BTEX, F1, F2, Phenols	Annually	(a) grab sample (b) representative grab	(a) at each leachate manhole and sump; and (b) at the leachate pond, if applicable

5.10 Implementation of the Leak Detection Response Action Plan

(a) Throughout the active landfill life, closure, and post-closure of the landfill, the total flow per month at the leachate pond leak detection system shall not be greater than the Action Leakage Rate, or as otherwise authorized in writing by the Director.

(b) If at any time until the end of post-closure, the total flow per month at the leachate pond leak detection system is greater than the Action Leakage Rate, then the person responsible shall immediately notify the Director and shall implement the Leak Detection Response Action Plan developed in accordance with section 5.9(a)(iv).

5.11 Subsurface Landfill Gas Monitoring Program

(a) The Subsurface Landfill Gas Monitoring Program shall include, at a minimum, the all of the following:
   (i) a description of the subsurface landfill gas monitoring sites and their locations;
   (ii) the methods to be used for measurement and detection of the lateral migration of subsurface landfill gas;
   (iii) the frequency for measurement of subsurface landfill gas; and
   (iv) a Subsurface Landfill Gas Contingency Plan for the mitigation of subsurface landfill gas migration.

(b) The subsurface landfill gas monitoring data shall be interpreted by a professional registered with APEGGA, or other professional authorized in writing by the Director, to determine the potential impacts from the subsurface migration of landfill gas.

5.12 Implementation of the Subsurface Landfill Gas Contingency Plan

(a) Throughout the active landfill life, final landfill closure, and post-closure the subsurface landfill gas shall not exceed the landfill gas explosive limits as described in Table 5.5.

(b) If at any time until the end of the post-closure, the explosive gas limits as described in Table 5.5 are exceeded, the person responsible shall immediately notify the Director and shall implement the Subsurface Landfill Gas Contingency Plan developed in accordance with section 5.11(a)(iv).

Table 5.5
Subsurface Landfill Gas Explosive Limits

Sampling Location	Explosive Gas Limits
In the subsurface at the property boundary	50% LEL
In an on-site building or enclosed structure or in the area immediately outside the foundation of the building or structure	20% LEL
In an off-site building or enclosed structure or in the area immediately outside the foundation of the building or structure	1% LEL

5.13 Methods for Water, Leachate and Solid Waste Analysis

(a) With respect to any sample required to be taken, the person responsible shall ensure that:
(i) collection;
(ii) preservation;
(iii) storage;
(iv) handling; and
(v) analysis;

shall be conducted in accordance with the following, or as otherwise specified in writing by the Director:

(vi) For air monitoring:
a. The *Methods Manual for Chemical Analysis of Atmospheric Pollutants*, Alberta Environment, as amended; and
b. The *Air Monitoring Directive*, Alberta Environment, as amended;

(vii) For surface water, leachate and groundwater monitoring:
a. the Standard Methods for the Examination of Water and Wastewater, American Public Health Association, American Water Works Association and the Water Environmental Federation, as amended; and
b. the Methods Manual for Chemical Analysis of Water and Wastes, Alberta Environment Centre, Vegreville, Alberta, October 1987,AEC V96-M1, as amended.

(viii) For whole effluent toxicity tests:
a. the *Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout*, Environment Canada, Environmental Protection Series I/RM/13, July 1990, as amended;
b. the *Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Daphnia Magna*, Environment Canada, Environmental Protection Series, I/RM/14, July 1990, as amended;
c. the *Biological Test Method: Growth Inhibition Test Using the Freshwater Alga Selenastrum capricornutum*, Environment Canada, Environmental Protection Series, November 1992, as amended;
d. the *Biological Test Method: Test of Reproduction and Survival Using the Cladoceran Ceriodaphnia dubia*, Environment Canada, Environmental Protection Series 1/RM/21, February 1992, as amended;
e. the *Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnows*, Environment Canada, Environmental Protection Series 1/RM/22, February 1992, as amended; and
f. the *Biological Test Method: Toxicity Test Using Luminescent Bacteria (Photobacterium phosphoreum),* Environment Canada, Environmental Protection Series,1/RM/24, November 1992, as amended.

(ix) For soil samples:

a. *Manual on Soil Sampling and Methods Analysis*, Lewis Publishers, 1993, as amended;
b. The *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, USEPA, SW-846; September 1986, as amended;
c. The *Soil Quality Criteria Relative to Disturbance and Reclamation*,Alberta Agriculture, March 1987, as amended;
d. the Guidance Manual on Sampling, Analysis and Data Management for Contaminated Sites – Volume I: Main Report, CCME EPC-NCS62E, 1993, as amended; and
e. the Guidance Manual on Sampling, Analysis and Data Management for Contaminated Sites – Volume II: Analytical Method Summaries, CCME EPC-NCS66E, 1993, as amended.

(x) For waste analysis

a. the*Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods, USEPA, SW-846*, September 1986, as amended;
b. the *Methods Manual for Chemical Analysis of Water and Wastes, Alberta Environmental Centre*, Vegreville, Alberta, 1996, AECV96-M1 as amended;
c. the *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association, American Water Works Association, and the Water Environment Federation, as amended;
d. the *Interim Compilation of Test Methods and Methods of Dangerous Goods Regulations*, Environment Canada, as amended; or
e. the *Toxicity Characteristic Leaching Procedure (TCLP), USEPA Regulation 40 CFR261, Appendix II,* Method No. 1311, as amended.

.

(b) The person responsible shall analyze all samples that are required to be obtained by this approval in a laboratory accredited pursuant to ISO 17025, as amended, for the specific parameter(s) to be analyzed, unless otherwise authorized in writing by the Director.

SECTION 6: FINAL LANDFILL CLOSURE AND POST-CLOSURE

6.1 Detailed Final Landfill Closure Plan

(a) The person responsible for a landfill shall submit a Detailed Final Landfill Closure Plan and notify the Director in writing of the intent to close the landfill at least 180 calendar days prior to implementing final landfill closure.

(b) The Detailed Final Landfill Closure Plan shall include, at a minimum, all of the following:
- (i) a schedule for completion of the final landfill closure;
- (ii) a plan for design and completion of final cover;
- (iii) a design plan for erosion control;
- (iv) a design plan for restoration of surface water drainage;
- (v) design plans for changes to the groundwater and landfill gas monitoring systems, including, but not limited to the addition or reclamation of monitoring wells;
- (vi) design plans for changes to the leachate collection and landfill gas control systems, including but not limited to the addition or deletion of components of those systems;
- (vii) a schedule for decommissioning and removal of buildings, storage areas, processing areas or any other operations or facilities that are on the landfill property that will no longer be required; and
- (viii) a Post-Closure Plan.

(c) The design plan of the final cover shall include as a minimum, all of the following:
- (i) a drawing that shows the proposed geometry of the final cover, which shall have a slope at a minimum of 5 percent and a maximum of 30 percent;
- (ii) a final cover system consisting of three layers constructed in the following order from bottom to top:
  - a. 0.60 metres barrier layer with a maximum hydraulic conductivity of 1×10^{-7} metres per second;
  - b. subsoil; and
  - c. 0.20 metres of topsoil.
- (iii) subsoil depth in 6.1(c)(ii)b. shall be:
  - a. 0.35 metres for pasture or recreational uses; or
  - b. 0.80 metres for cultivated land use or forestry;
- (iv) vegetation establishment as per the intended land use;
- (v) alternative final cover systems may be authorized by the Director.

(d) The person responsible shall ensure that APEGGA registered professionals with expertise in the subject area prepares components of the Detailed Final Landfill Closure Plan.

(e) If the Director finds the Detailed Final Landfill Closure Plan to be deficient, the person responsible shall correct the deficiencies as outlined by the Director in writing prior to completion of the final landfill closure.

(f) The person responsible shall complete the final landfill closure in accordance with the Detailed Final Landfill Closure Plan as authorized in writing by the Director.

6.2 Post-Closure Plan

(a) The Post-Closure Plan shall include, at a minimum, all of the following:
- (i) a plan for maintaining the integrity of the final cover;
- (ii) a plan for remediation of areas affected by subsidence and differential settlement;
- (iii) a plan for maintaining surface water drainage systems; and
- (iv) a plan for maintaining and operating the following components where they are part of the landfill design:
  - a. groundwater monitoring systems;
  - b. leachate collection and removal systems; and
  - c. landfill gas control systems.

(b) If the Director finds the Post-Closure Plan to be deficient, the person responsible shall correct the deficiencies as specified in writing by the Director within 120 calendar days of the date of the deficiency letter.

6.3 Post-Closure

(a) Post-Closure shall be a minimum period of 25 years following the final landfill closure.

(b) Post-Closure will begin 30 days following submission of the Final Landfill Closure Report, unless otherwise authorized in writing by the Director.

(c) In addition to 6.3(a), Post-Closure shall continue until the following circumstances occur:
- (i) groundwater quality performance standards for each parameter are met within the compliance boundary;
- (ii) subsurface landfill gas concentrations are below explosive limits as described in Table 5.5 at subsurface gas monitoring locations;
- (iii) the leachate constituents are:
  - a. below the upper groundwater quality control limits established for each parameter; and
  - b. parameters not naturally present in groundwater is not detected in three consecutive sampling events; and
- (iv) the accumulated volume of leachate is equal to or less than the previous years accumulated volume of leachate for five consecutive years.

(d) During Post-Closure, the person responsible, at a minimum, shall:
- (i) protect and maintain the integrity of the final cover and surface water drainage systems;
- (ii) make repairs to the cover system as necessary to correct the effects of settling, subsidence, erosion, leachate break-out or other such events within one year of discovery of any problem; and
- (iii) protect, maintain, operate and monitor the following components where they are part of the landfill design:

a. groundwater monitoring system;
b. leachate collection system; and
c. landfill gas control system.

(e) During Post-Closure, the person responsible shall inspect the final cover a minimum of two times per year.

SECTION 7: RECORD KEEPING AND REPORTING

7.1 Reporting of Contraventions

(a) In addition to any other reporting required pursuant to the Act or the regulations, any person carrying out a landfill operation shall immediately report any contravention of these *Standards* to:
- (i) the person responsible; and
- (ii) the Director:
  - a. by telephone at (780) 422-4505; or
  - b. by any other method authorized in writing by the Director.

(b) In addition to any other reporting required pursuant to the Act or the regulations, where a contravention is reported under section 7.1(a), the person responsible shall provide a report to the Director:
- (i) in writing; or
- (ii) by any other method authorized in writing by the Director

within 7 calendar days of the reporting of the contravention, or within any other time period specified in writing by the Director.

(c) The report required in section 7.1(b) shall contain, at a minimum, all of the following:
- (i) a description of the contravention;
- (ii) the date of the contravention;
- (iii) an explanation as to why the contravention occurred;
- (iv) the legal land description of the location of the contravention;
- (v) the name of the registered owner or owners of the parcel of land on which the contravention occurred;
- (vi) a summary of all preventative measures and actions that were taken prior to the contravention;
- (vii) a summary of all measures and actions that were taken to mitigate any effects of the contravention;
- (viii) the measures that will be taken to address any remaining potential effects related to the contravention;
- (ix) the Approval number or Registration number provided by the Director for the landfill site, and the name of the person who held the Approval or Registration number at the time when the contravention occurred;
- (x) the names, addresses, telephone numbers and responsibilities of all persons operating the site at the time that the contravention occurred;
- (xi) the names, addresses and telephone numbers of all persons who had charge, management or control of the site at the time that the contravention occurred;
- (xii) a summary of proposed measures that will prevent future contraventions including a schedule of implementation for those measures;
- (xiii) any information that was maintained or recorded under these *Standards*, as a result of the contravention; and
- (xiv) any other information required by the Director in writing.

7.2 Report Requested by the Director or Representative of the Director

(a) The person responsible shall provide within 7 calendar days, or any other time period specified in writing by the Director, any records, reports, documents, or data required to be created by these *Standards* to the Director, or a representative of the Director, upon request.

7.3 Operating Record

(a) The person responsible for a landfill shall establish and maintain an Operating Record for a landfill until the end of Post-Closure.

(b) The person responsible shall provide the Operating Record to the Director upon a request in writing.

(c) The Operating Record shall contain, at a minimum, all of the following information:
- (i) the Approval or Registration number;
- (ii) as-built records for the landfill showing the location and development of excavations, fill areas, final grades and structural components;
- (iii) annual topographic survey records and plans showing the areas where waste has been disposed in the previous year of operation;
- (iv) the most recent version of the design and operating plan for the landfill;
- (v) records of handing of any wastes accepted at the landfill including the amounts accepted and the disposal locations within the landfill;
- (vi) all Annual Reports for the landfill as described in section 7.5;
- (vii) nuisance records;
- (viii) the Final Landfill Closure Report as described in section 7.6; and
- (ix) all Post-Closure Annual Reports for the landfill as described in section 7.7.

7.4 Tonnage Records

(a) The person responsible shall submit annual tonnage records though Alberta Environment's online Waste Measurement System for wastes accepted by March 31 of the year following the year in which the waste was accepted.

7.5 Annual Report

(a) For each year of the active landfill life, the person responsible shall prepare an Annual Report for the landfill covering the calendar year reported on.

(b) The person responsible shall submit the Annual Report to the Director by March 31 of the year following the year on which the report is based.

(c) The Annual Report shall contain, at a minimum, all of the following information:
- (i) a report from Alberta Environment's online Waste Measurement System including the types and quantities of wastes disposed at the landfill;
- (ii) the deposition location of wastes requiring special handling;

(iii) all of the following environmental monitoring records and their interpretations:
  a. groundwater monitoring;
  b. leachate monitoring, if applicable;
  c. landfill gas monitoring, if applicable;
  d. records on the quality and quantity of leachate removed from each landfill cell for treatment or disposal;
  e. records on the quality and quantity of leachate removed from each leachate pond for treatment or disposal, if applicable; and
  f. records on the quality and quantity of impounded surface water released to the environment;

(iv) a statement of compliance

(v) a site development plan showing the status of landfill operations at the end of the operating year, including but not limited to:
  a. contour mapping;
  b. the location of active and inactive disposal areas;
  c. areas where a final cover has been placed; and
  d. the location of cells constructed;

(vi) any remedial action taken;

(vii) any complaints received and the action or actions taken as a result of a complaint; and

(viii) adjustments to financial security or the environmental reserve fund necessary for final landfill closure and post-closure activities.

7.6 Final Landfill Closure Report

(a) The person responsible shall ensure that APEGGA registered professionals with expertise in the subject area prepares components of the Final Landfill Closure Report.

(b) The person responsible shall submit a copy of the Final Landfill Closure Report to the Director within 60 calendar days of completion of the final landfill closure.

(c) The person responsible shall file a copy of the Final Landfill Closure Report in the operating record for the landfill within 60 calendar days of completion of the Final Landfill Closure Report.

(d) The Final Landfill Closure Report shall include, at a minimum, all of the following:
  (i) the date of completion of the final landfill closure;
  (ii) a statement including supporting evidence that the Final Landfill Closure has been completed in accordance with the Final Landfill Closure Plan;
  (iii) a description of any deviations to the Final Landfill Closure Plan and the reasons for the deviations;
  (iv) a description of the final cover system and the installation methods and procedures used;
  (v) an estimate of the total quantity of waste placed on the site over the active landfill life; and
  (vi) a description of how all of the following elements have been, or will be dealt with:
    a. the final use of the closed areas;
    b. drainage restoration;

c. soil replacement;
d. final cover slopes;
e. erosion control;
f. re-vegetation and conditioning of the site; and
g. subsidence and differential settlement remediation.

7.7 Post-Closure Annual Report

(a) During each year of post-closure, the person responsible shall prepare a Post-Closure Annual Report for the landfill covering the calendar year reported on.

(b) The person responsible shall place the Post-Closure Annual Report in the Operating Record by March 31 of the year following the year on which the report is based.

(c) During the Post-Closure the person responsible shall compile all of the following information, unless otherwise authorized in writing by the Director:
(i) the annual groundwater monitoring report;
(ii) the annual surface water monitoring report;
(iii) a report on the operation of the leachate collection and removal systems, if required in section 5.1(c);
(iv) the leachate monitoring report if required in section 5.1(c);
(v) the annual landfill gas monitoring report if required in section 5.1(d);
(vi) a report on the operation of the landfill gas control systems, if required in section 5.1(d);
(vii) a record of any maintenance and repairs carried out; and
(viii) a report of any remedial or corrective action taken.

7.8 End of Post-Closure Report

(a) The person responsible for the landfill shall notify the Director of the end of the Post-Closure by submitting an End of Post-Closure Report within 60 days following the end of post-closure.

(b) The End of Post-Closure Report shall include, at a minimum, all of the following:
(i) a summary of Post-Closure activities;
(ii) a summary of Post-Closure monitoring data; and
(iii) supporting evidence that the requirements as described in 6.3(c) have been achieved.

APPENDIX A:

Document Submission Checklist

Disclosure Process

Document	Timing of Submission	Reference
Written Disclosure Plan	Prior to application submission.	1.1(a)

Landfill Application (prior to construction)

Document	Timing of Submission	Reference
Landfill Application Form	Upon submission of application and completion of Disclosure Plan	*Approvals and Registrations Procedure Regulation*
Report that the Disclosure Process was carried out as planned.	Upon submission of application and completion of Disclosure Plan	1.2(b)
Detailed Technical Investigation Program Report	Upon submission of application and completion of Technical Investigation Program	1.2(b)
Landfill Design Plan and Specifications	Upon submission of application	1.2(b)
Operations Plan	Upon submission of application	1.2(b)
Financial Security or environmental reserve fund	Upon submission of application	1.2(b)
Landfill Monitoring Plan	Upon submission of application	1.2(b)

Construction Documents

Document	Timing of Submission	Reference
Detailed construction plans and specifications	Prior to each major stage of construction (e.g. new cells and final landfill closure)	3.5(b)
Construction QA Plan and Construction QC Plan	Prior to construction of a new or laterally expanding landfill	3.6(a)
Deviations in Construction QA Plan and Construction QC Plan	These must be authorized prior to implementation.	3.6(c)
Construction Quality Assurance Results	Prior to operations and each major stage after construction	3.6(e)
Report that details any environmental impacts that may result from deviations to the construction QA Plan, construction QC plan, and Landfill Design and Specifications Plan.	Prior to operations and each major stage after construction	3.6(f)

Operations

Document	Timing of Submission	Reference
Certified Operators	Within 30 days of any change	4.1(e)
Contraventions	7 calendar days after the reporting of the contravention to the Director	7.1(b)
Online Tonnage Reports	On or before March 31	7.4 (a)
Annual Reports	On or before March 31	7.5 (b)

Closure and Post-Closure

Document	Timing of Submission	Reference
Detailed Final Landfill Closure Plan	180 days prior to implementation	6.1(a)
Post-Closure Plan	To be submitted as part of the Detailed Final Landfill Closure Plan	6.1(b)
Final Landfill Closure Report	Within 60 days upon completion of Final Landfill Closure Plan	7.6(b)
End of Post-Closure Report	Within 60 days of End of Post-Closure date.	7.8(a)