



Mackenzie Valley Land and Water Board
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October 8, 2015

File: MV2009L3-0007

Mr. Mike Auge
Municipal Works Engineer
City of Yellowknife
PO Box 580, 4807-52 Street
YELLOWKNIFE NT X1A 2N4

Email: mauge@yellowknife.ca

Dear Mr. Auge:

Surveillance Network Program (SNP) Request Approval

The Mackenzie Valley Land and Water Board (MVLWB or the Board) met on October 8, 2015 to review the proposal from the City of Yellowknife (City) to add two Surveillance Network Program (SNP) stations at Fault Lake and Vicinity Lake #3. The Board hereby accepts the City's proposal.

The Board also reviewed the request from Environment and Natural Resources to add three parameters to the sampling requirements for SNP stations monitoring landfill runoff. The Board has approved the request as submitted.

Please note the SNP has been updated to include stations 0032-20 (Fault Lake) and 0032-21 (Vicinity Lake #3) to monitor the impact of the Solid Waste Disposal Facility (SWDF) on surface water. Water quality sampling for these stations shall occur twice each year during the months of June and September. Sampling parameters have been revised in section B.3 of the SNP to include Total Phosphorus, Ortho-Phosphorus, and Dissolved Organic Carbon for all SNP stations monitoring water draining from the SWDF: stations 0032-13A, 0032-14, 0032-15A, 0032-16, 0032-20, and 0032-21.

Upon submission of the Groundwater Monitoring Plan, the Board will review and potentially revise the parameters at the SNP stations related to water quality monitoring of the SWDF.

The full cooperation of the City of Yellowknife is anticipated and appreciated. If you have any questions or concerns, please contact Miki Ehrlich at (867) 766-7469 or email mehrlich@mvlwb.com.

Yours sincerely,

A handwritten signature in black ink, appearing to read "Willard Hagen".

Willard Hagen
MVLWB Chair

Copied to: Distribution List

Attachment: Water Licence MV2009L3-0007 with revised SNP



**Mackenzie Valley Land and Water Board
Water Licence**

Pursuant to the *Mackenzie Valley Resource Management Act* and Regulations, the Mackenzie Valley Land and Water Board, hereinafter referred to as the Board, hereby grants to:

City of Yellowknife
(Licensee)

of P.O. Box 580 Yellowknife, NT X1A 2N4
(mailing address)

hereinafter called the Licensee, the right to alter, divert or otherwise use water subject to the restrictions and conditions contained in the *Northwest Territories Waters Act* and Regulations made thereunder and subject to and in accordance with the conditions specified in this Licence.

Licence number: MV2009L3-0007

Licence type: A

Water management area: Northwest Territories 01

Location: 62° 28' N; 114° 26' W

Purpose: Use of water and disposal of waste

Description: Municipal purposes

Quantity of water **not to be exceeded**: 3, 600, 000 cubic metres annually

Effective date of licence: May 31, 2010

Expiry date of licence: May 30, 2022

This Licence issued and recorded at Yellowknife includes and is subject to the annexed conditions.

Mackenzie Valley Land and Water Board


Chair


Witness

Approved by

Original signed by the Minister
Minister of Indian Affairs and Northern
Development

Part A: Scope and Definitions

Scope

This Licence entitles the City of Yellowknife to use Water and dispose of Waste for municipal purposes at the City of Yellowknife, Northwest Territories, located at: 62°28' N; 114°26' W.

Definitions

In this Licence, **MV2009L3-0007**:

“**Act**” means the *Northwest Territories Waters Act*.

“**Analyst**” means an Analyst designated by the Minister under subsection 35(1) of the Act.

“**Average Concentration**” means the discrete average of four consecutive analytical results, or if less than four analytical results, the discrete average of the analytical results collected during a batch decant, and as submitted to the Board in accordance with the sampling and analysis requirements specified in the Surveillance Network Program.

“**Average Concentration for Faecal Coliforms**” means the running geometric mean of any four consecutive analytical results submitted to the Board in accordance with the sampling and analysis requirements specified in the Surveillance Network Program.

“**Bagged Toilet Waste Disposal Facilities**” comprises the area and associated structures designed to contain bagged Toilet Wastes (honey bags) as described in Water Licence Renewal Application - Supplementary Report, Section 5.1.3 Bagged Sewage and figure titled “Map #4 Fiddlers Lake Drainage Area”, and dated March 24, 2009.

“**Biotreatment Pad**” comprises the area and associated engineered infrastructure designed to contain and treat hydrocarbon contaminated soils, as described in *Addendum to the City of Yellowknife Water Licence Modification to the Conditions of the Soil Treatment Facility Operations*, Final Version, May 2007, Figure 1 titled “Yellowknife Soil Treatment Facility Addendum to License N1L3-0032 Solid Waste Facility Yellowknife As-Built Drawing” and dated September 27, 2006.

“**Board**” means the Mackenzie Valley Land and Water Board established under Part 4 of the *Mackenzie Valley Resource Management Act*.

“**Coarse-grained Soil**” means coarse-textured soil having a median grain size of $>75 \mu\text{m}$ as defined by the American Society for Testing and Materials D422-63 (2007) “Standard Test Methods for Particle-Size Analysis of Soils”, or subsequent edition.

“**Engineer**” means a professional Engineer registered to practice in the Northwest Territories in accordance with the *Engineering and Geoscience Professions Act*, S.N.W.T. 2006, c.16.

“**Fine-grained Soil**” means fine-textured soil having a median grain size of $<75 \mu\text{m}$ as defined by the American Society for Testing and Materials D422-63 (2007) “Standard Test Methods for Particle-Size Analysis of Soils”, or subsequent edition.

“Freeboard” means the vertical distance between the water line and the lowest elevation of the effective water containment crest on a dam or dyke’s upstream slope.

“Greywater” means all liquid Wastes from showers, baths, sinks, kitchens, and domestic washing facilities but does not include Toilet Wastes.

“Inspector” means an Inspector designated by the Minister under subsection 35(1) of the Act.

“Licensee” means the holder of this Licence.

“Minister” means the Minister of Indian Affairs and Northern Development.

“Modification” means an alteration to a physical work that introduces a new structure or eliminates an existing structure and does not alter the purpose or function of the work but does not include an expansion.

“Pumpout Sewage” means all Toilet Wastes and/or Greywater collected by means of a vacuum truck for disposal at the Sewage Disposal Facilities.

“Record Drawings” means as-built drawings that have been verified by an Engineer.

“Regulations” means Regulations proclaimed pursuant to Section 33 of the Act.

“Sewage” means all Toilet Wastes and Greywater.

“Sewage Disposal Facilities” comprises the area and engineered structures designed to contain and treat Sewage, as shown in Water Licence Renewal Application - Supplementary Report, figure titled “Map #4 Fiddlers Lake Drainage Area”, and dated March 24, 2009, as well as the adjacent wetland area.

“Solid Waste Disposal Facilities” comprises the area and associated structures designed to contain solid Wastes, as shown in Water Licence Renewal Application - Supplementary Report, figure titled “Map #7 Solid Waste Facility Layout”, and dated June 29, 2009.

“Surveillance Network Program” means a monitoring program established to define environmental sampling and analysis requirements, to collect data on surface water and groundwater quality, and to assess discharge quality and licence compliance, and the potential for impacts to the environment.

“Toilet Wastes” means all human excreta and associated products but does not include Greywater.

“Waste(s)” means Waste as defined by Section 2 of the Act.

“Waste Disposal Facilities” mean all facilities designated for the disposal of Waste, and includes the Solid Waste Disposal Facilities, Sewage Disposal Facilities, and Bagged Toilet Wastes Disposal Facilities.

“Water(s)” mean any Waters as defined by Section 2 of the Act.

“Water Supply Facilities” comprises the area and associated intake infrastructure, as identified in Water Licence Renewal Application - Supplementary Report, figure titled “Map #2 Piped Water System”, and dated March 24, 2009.

Part B: General Conditions

- B.1 This Licence is issued subject to the conditions contained herein with respect to the taking of Water and the depositing of Waste of any type in any Waters or in any place under any conditions where such Waste or any other Waste that results from the deposition of such Waste may enter any Waters. Whenever new Regulations are made or existing Regulations are amended by the Governor in Council under the *Northwest Territories Waters Act*, or other statutes imposing more stringent conditions relating to the quantity or type of Waste that may be so deposited or under which any such Waste may be so deposited, this Licence shall be deemed, upon promulgation of such Regulations, to be automatically amended to conform with such Regulations.
- B.2 Compliance with the terms and conditions of this Licence does not absolve the Licensee from the responsibility for compliance with the requirements of all applicable federal, territorial, and municipal legislation.
- B.3 The Licensee shall file an annual report with the Board not later than March 31 of the year following the calendar year reported which shall contain the information as set out in Schedule 1, Item 1, included in this Licence.
- B.4 The Licensee shall comply with the Surveillance Network Program annexed to this Licence, and with any amendment(s) to the said Surveillance Network Program, as approved by the Board.
- B.5 The Licensee shall comply with the Schedules annexed to this Licence, and any amendment to the said Schedules, as approved by the Board.
- B.6 The Surveillance Network Program, Schedules, and compliance dates specified in the Licence may be modified at the discretion of the Board.
- B.7 Meters, devices, or other such methods used for measuring the volumes of Waters used and Waste discharged shall be installed, operated, and maintained by the Licensee to the satisfaction of an Inspector.
- B.8 The Licensee shall maintain, to the satisfaction of an Inspector, the necessary signs to identify the stations of the Surveillance Network Program.

- B.9 The Licensee shall relocate Surveillance Network Program sites 0032-13 and 0032-15, by September 1, 2010 to the satisfaction of an Inspector. The new locations for the Surveillance Network Program monitoring stations shall be designated as SNP 0032-13A and SNP 0032-15A. The Licensee shall notify the Board of the relocation and provide GPS coordinates of these stations.
- B.10 The Licensee shall maintain all signs posted to inform the public of Water Supply and Waste Disposal Facilities and shall post any additional signage, as required, to the satisfaction of an Inspector.
- B.11 The Licensee shall ensure a copy of this Licence is maintained at the City of Yellowknife office(s), the Solid Waste Disposal Facilities, and the Water Supply Facility office, at all times.

Part C: Conditions Applying to Water Use

- C.1 The Licensee shall obtain all Waters from the Yellowknife River using the Water Supply Facilities for municipal undertakings as described in the Water Licence Application received by the Board on July 10, 2009 or as otherwise approved by the Board.
- C.2 The total amount of Water obtained from the Yellowknife River for municipal purposes shall not exceed 3,600,000 cubic metres per year.
- C.3 The maximum amount of Water obtained shall not exceed 575,000 cubic metres per month.
- C.4 The Water intake pipe used on the Water pumps shall be equipped with a screen with a mesh size and screen design sufficient to ensure no entrainment or impingement of fish, as outlined in “Fisheries and Oceans Canada Freshwater Intake End-of-Pipe Fish Screen Guideline (1995)” or subsequent approved editions.

Part D: Conditions Applying to Waste Disposal

- D.1 The Licensee shall direct all piped and Pumpout Sewage to the Sewage Disposal Facilities or as otherwise approved by the Board.
- D.2 All sewage effluent discharged from the Sewage Disposal Facilities at Surveillance Network Program Station Number 0032-F3 shall meet the following effluent quality requirements:

Parameter	Maximum Average Concentration	Maximum Grab Sample
Faecal Coliform (FC)	200 FC per 100 ml	400 FC per 100 ml
BOD ₅	20 mg/L	30 mg/L
Total Suspended Solids	20 mg/L	40 mg/L
Oil and Grease	No visible sheen	

Acute Toxicity-Rainbow Trout: static pass/fail bioassay test whereby 70 percent survival is considered a pass.

Acute Toxicity-*Daphnia magna*: static pass/fail bioassay test whereby 70 percent survival is considered a pass.

The Waste discharged shall have a pH between 6 and 9.

- D.3 The Licensee shall advise an Inspector and notify the Board at least ten days prior to initiating decant of the sewage lagoon.
- D.4 The Licensee shall maintain the Sewage Disposal Facilities to the satisfaction of an Inspector.
- D.5 A Freeboard limit of 1 meter shall be maintained at all times at all constructed berms, dykes, and dams within the Sewage Disposal Facilities or as recommended by an Engineer and approved by the Inspector.
- D.6 All bagged Toilet Wastes shall be disposed of at the Bagged Toilet Waste Disposal Facilities to the satisfaction of an Inspector.
- D.7 The Licensee shall dispose of all solid Wastes at the Solid Waste Disposal Facilities or as otherwise approved by the Board.
- D.8 The Licensee shall ensure all treated soil from the Biotreatment Pad that will be used for capping material of landfill cells will meet the following criteria prior to incorporation:

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

As outlined for Industrial undertakings in the GNWT “Guideline for Contaminated Site Remediation” or subsequent approved editions, total petroleum hydrocarbons shall meet the following criteria prior to incorporation:

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

If testing for particle size is not completed by the Licensee to determine if soil is Coarse or Fine-grained, soil must be treated to achieve the Coarse-grained soil criteria.

- D.9 The Licensee shall maintain all dams, berms, dykes, and control structures associated with the Waste Disposal Facilities and Water Supply Facilities to the satisfaction of an Engineer. An inspection of all dams, berms, dykes, and control structures shall be completed once every two years by an Engineer. The Engineer's report shall be submitted to the Board within 60 days of the inspection and include a cover letter from the Licensee outlining an implementation plan to respond to any recommendations made by the Engineer and a summary of any actions taken by the Licensee to satisfy the previous review recommendations made by the Engineer.
- D.10 The Licensee shall, within 15 months of the issuance of this licence, submit to the Board for approval a stormwater management plan which shall contain the information as set in Schedule 2, item 1, included in this Licence.
- D.11 The Licensee shall, at least 90 days prior to construction of a new landfill cell at the Solid Waste Disposal Facilities, submit to the Board for approval, a design report that is signed and stamped by an Engineer that shall include, but not be limited to:
- a) Final design drawings signed and stamped by an Engineer which note "issued for construction" or similar phrase clearly shown;
 - b) Construction and materials specifications; and
 - c) Construction Quality Assurance and Quality Control program.
- D.12 The Licensee shall, within 60 days prior to operation of a new landfill cell at the Solid Waste Disposal Facilities, submit to the Board for approval, an updated operations and maintenance manual.
- D.13 The Licensee shall within six months of completion of construction of a new landfill cell at the Solid Waste Disposal Facilities, submit to the Board for approval, as-built plans and Record Drawings, signed and stamped by an Engineer.
- D.14 The Licensee shall, within 18 months of issuance of this licence, submit to the Board for approval, a revised solid waste disposal facilities drainage study that includes, but is not limited to, the information as set in Schedule 2, item 2, included in this Licence.
- D.15 The Licensee shall by March 31, 2012, submit to the Board for approval, a revised Fiddlers Lake treatment system plan that shall include, but is not limited to, the information as set in Schedule 2, item 3, included in this Licence.
- D.16 The Licensee shall within 60 days prior to any upgrading the Sewage Disposal Facilities, submit to the Board for approval, a design report that is signed and stamped by an Engineer that shall include, but not be limited to, for-construction drawings signed and stamped by an Engineer and construction and materials specification including the Licensee's Construction Quality Assurance and Quality Control Program.
- D.17 The Licensee shall, within 90 days of completion of any upgrades to the Sewage Disposal Facilities, submit to the Board for approval, as-built plans and Record Drawings, signed and stamped by an Engineer, of the upgrades completed on the Sewage Disposal Facilities.

- D.18 The Licensee shall, within six months of issuance of this Licence, submit to the Board for approval, current Record Drawings of the Sewage Disposal Facilities.
- D.19 The Licensee shall, within 18 months of issuance of this Licence, submit to the Board for approval, a report that includes, but is not limited to:
- a) Occurrence and generation of algal blooms within the Sewage Disposal Facilities;
 - b) The associated impacts of seasonal changes in pH;
 - c) Evaluation of mitigative measures to achieve water quality compliance at SNP 0032-F3; and
 - d) An implementation plan and schedule for mitigative practices, if required.
- D.20 The Licensee shall complete a one year-long characterization study of Sewage effluent in accordance with the "Canadian Council of Ministers of Environment's 2009 Strategy for Treatment of Municipal Wastewater Effluent". The Licensee shall submit to the Board for approval, a report of the Sewage effluent study by March 31, 2012.
- D.21 The Licensee shall complete monitoring of wastewater effluent quality for carbonaceous biological oxygen demand (CBOD) and biological oxygen demand (BOD) for a minimum of three years. The study findings, including a trend analysis, shall be submitted to the Board for approval before August 31, 2014.
- D.22 The Licensee shall, by March 31, 2012, complete and submit to the Board for approval, a study on the capabilities of the effluent discharge area for the Biotreatment Pad of the Solid Waste Disposal Facilities to absorb Water. This study and report shall consider discharge volume and seasonal timing for discharge.
- D.23 The Licensee shall, by March 31, 2013, complete and submit to the Board for approval, a study to understand metal concentrations in surface Water in the vicinity of the Solid Waste Disposal Facilities. The study should include recommendations for mitigation measures should the metal concentrations be linked to a solid Waste source.

Part E: Conditions Applying to Modifications

- E.1 The Licensee may, without written approval from the Board, carry out Modifications to the Water Supply Facilities and Waste Disposal Facilities provided that such Modifications are consistent with the terms of this Licence and the following requirements are met:
- a) The Licensee has notified the Board in writing of such proposed Modifications at least 60 days prior to beginning the Modifications;
 - b) Such Modifications do not place the Licensee in contravention of either the Licence or the Act;
 - c) The Board has not, during the 60 days following notification of the proposed Modifications, informed the Licensee that review of the proposal will require more than 60 days; and
 - d) The Board has not rejected the proposed Modifications.

- E.2 Modifications for which all of the conditions referred to in Part E, item 1 have not been met, can be carried out only with written approval from the Board.
- E.3 The Licensee shall provide to the Board as-built plans and Record Drawings, signed and stamped by an Engineer, of Modifications referred to in Part E within 90 days of completion of the Modifications.

Part F: Conditions Applying to Closure and Reclamation

- F.1 The Licensee shall submit to the Board for approval an interim Closure and Reclamation plan for the Solid Waste Disposal Facilities at least 6 months prior to closure of the current solid waste disposal cell. The Plan shall include, but not be limited to, the information as set in Schedule 3, Item 1, included in this Licence.
- F.2 The Licensee shall submit to the Board for approval a closure and reclamation plan at least six months prior to abandoning any Waste Disposal Facilities. The plan shall include, but not be limited to, the information as set in Schedule 3, Item 1, included in this Licence.
- F.3 The Licensee shall implement the Plan specified in Part F, Items 1 and 2 as and when approved by the Board.

Part G: Conditions Applying to Construction

- G.1 Prior to construction of any dams, dykes, or control structures intended to contain, withhold, divert, or retain Waters or Wastes, the Licensee shall submit to the Board, at least 60 days prior to construction, final design drawings stamped and signed by an Engineer, which notes “issued for construction” or similar phrase.
- G.2 Construction of designed structures shall be carried out as approved by the Board.
- G.3 The Licensee shall provide to the Board as-built plans and Record Drawings, signed and stamped by an Engineer, of the constructed facilities referred to in Part G, Item 1 within 90 days of completion.

Part H: Conditions Applying to Operation and Maintenance

- H.1 The Licensee shall, within the timelines as listed in Schedule 4, item 1, submit to the Board for approval updated plans for the operation and maintenance of the Waste Disposal Facilities. These plans shall include, but not be limited to, the information as set in Schedule 4, Item 1, included in this Licence.
- H.2 The Licensee shall implement the updated plans specified in Part H, Item 1 as and when approved by the Board.
- H.3 The Licensee shall annually review the updated operations and maintenance plans in Schedule 4, item 1 and shall modify these plans to identify changes in operations, technology, and results from research and other studies. All proposed updates or revisions to the plan shall be submitted to the Board for approval and included as an update in the Annual Report.

Part I: Conditions Applying to Spill Contingency Planning

- I.1 The Licensee shall, within six months of the issuance of this Licence, submit to the Board for approval a spill contingency plan in accordance with “Indian and Northern Affairs Canada’s 2007 Guidelines for Spill Contingency Planning”. The Spill Contingency Plan shall apply to the Waste Disposal Facilities and Water Supply Facilities. The Spill Contingency Plan shall include, but not be limited to, an action plan to mitigate effects from leaks or spills.
- I.2 The Licensee shall review the Spill Contingency Plan annually and modify the plan as necessary to reflect changes in operation, technology and staffing. All proposed updates or revisions shall be submitted to the Board for approval.
- I.3 The Licensee shall immediately report to the 24-Hour Spill Report Line (867-920-8130) any spills of Waste, as outlined in “Indian and Northern Affairs Canada’s 2007 Guidelines for Spill Contingency Planning”, which are reported to or observed by the Licensee, within the City of Yellowknife boundaries or in the areas of the Water Supply Facilities or Waste Disposal Facilities.
- I.4 If, during the period of this Licence, an unauthorized discharge of Waste occurs, or if such a discharge is foreseeable, the Licensee shall:
 - a) Employ the Spill Contingency Plan;
 - b) Report the incident immediately via the 24 Hour Spill Report Line at (867) 920-8130; and
 - c) Submit to an Inspector a detailed report on each occurrence not later than 30 days after initially reporting the event.

Signed on behalf of Mackenzie Valley Land and Water Board



Chair



Witness

Schedule 1 – General Conditions

1. The Annual Report referred to in Part B, item 3 shall include, but not necessarily be limited to, the following:
 - a) The monthly and annual quantities in cubic metres of fresh Water obtained from all sources;
 - b) The monthly and annual quantities in cubic metres of each and all Waste discharged to the Waste Disposal Facilities;
 - c) The monthly and annual quantities of Waste removed from the Waste Disposal Facilities;
 - d) A summary of modifications and/or major maintenance work carried out on the Water Supply and Waste Disposal Facilities, including all associated structures;
 - e) Tabular summaries of all data generated under the Surveillance Network Program;
 - f) A summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year;
 - g) A summary of any studies requested by the Board that relate to Waste disposal, Water use or reclamation, and a brief description of any future studies planned;
 - h) A list of unauthorized discharges;
 - i) Comparison of Waste volumes accepted to the remaining storage volume at the Waste Disposal Facilities;
 - j) The monthly and annual quantities of organics received and quantity of compost produced and/or distributed from the compost facility;
 - k) Record of Biotreatment Pad containment pond liner inspections;
 - l) Updates or revisions to the approved Stormwater Management Plan;
 - m) Updates or revisions to the approved Sewage Disposal Facilities Operation and Maintenance Plan;
 - n) Updates or revisions to the approved Spill Contingency Plan;
 - o) Updates or revisions to the approved Solid Waste Disposal Facilities Operation and Maintenance Plan;
 - p) Updates or revisions to the approved Biotreatment Pad Operation and Maintenance Plan;
 - q) Updates or revisions to the approved Hazardous Waste Management Plan;
 - r) Tabular summaries of all data generated from the Stormwater Effluent Monitoring Program;
 - s) At each of the seven sampling locations for stormwater, provide trends of biological and heavy metal data collected in the Stormwater Effluent Monitoring Program (short term) and Surveillance Network Program monitoring station (long term);
 - t) Comparison of the Surveillance Network Program data to Water Licence regulated limits and sampling and analysis requirements;
 - u) The inclusion of all formal written correspondence between the Inspector and Licensee;
 - v) A summary of efforts to monitor, manage, treat and dispose of sewage sludge at the Sewage Disposal Facilities; and
 - w) Any other details on Water use or Waste disposal requested by the Board by November 1 of the year being reported.

Schedule 2 – Conditions Applying to Waste Disposal

1. The Stormwater Management Plan, referred to in Part D, item 13, shall include, but not be limited to, the following:
 - a) Best management practices in order to address any potential issues reflected through the Stormwater Effluent Monitoring Program;
 - b) Commitment to long-term monitoring through the addition of strategic sampling locations within the Surveillance Network Program;
 - c) The continuation of monitoring for hydrocarbons as performed during the 2009 sampling program;
 - d) Commitment to analyze and report on best management practices for stormwater management which the Licensee intends to adopt along with any expansion to the Yellowknife stormwater system;
 - e) General discussion regarding back-up power to all lift stations and their implementation; and
 - f) Discussion on snow disposal outlining areas currently used or to be used for snow disposal, and the methods for managing drainage Water from the snow disposal area(s).

2. The Solid Waste Disposal Facilities Drainage Study shall include, but not be limited to, the following:
 - a) Conceptual model of leachate generation, surface Water flow, and groundwater flow;
 - b) Validation of the conceptual model of leachate generation, surface Water flow, and groundwater flow;
 - c) Recommended subsurface monitoring locations;
 - d) To the extent of being reasonably feasible, characterize the bedrock integrity, which includes the identification of permeability and/or fracturing;
 - e) Determine applicability of existing surveillance network program stations, and recommend new stations if the study determines existing stations are not adequately placed to monitor quality and quantity of all surface Water out points;
 - f) Determine a Water inflow and outflow budget to characterize the quantity and quality of leachate generated; and
 - g) To the extent of being reasonably feasible, determine the native ground elevations at the base of the Solid Waste Facilities.

3. The revised Fiddlers Lake Treatment System Plan shall include, but not be limited to the following:
 - a) Discussion on the triggers and thresholds that will be employed to determine when an upgrade to the Fiddler's Lake treatment system is required, which shall include, but not be limited to: consideration to influent loadings (volume and concentration); effluent water quality; effluent loadings to receiving water bodies; treatment time within the system, and time requirements to complete any studies or design that supports the upgrade;

- b) Discussion of how ammonia and phosphorous treatment will be completed to meet the following discharge objectives: average concentration for ammonia of 5 mg/L (maximum of 10 mg/L), average concentration for phosphorous of 1 mg/L (maximum of 2 mg/L);
- c) Details, analysis of results, and recommendations from any wastewater treatment study, may include, but not limited to, a wetland performance study during cold weather and a lagoon pre-treatment study; and
- d) Details of a phosphorous study into the loadings into receiving water bodies and associated potential impacts.

Schedule 3 – Conditions Applying to Closure and Reclamation

1. The Closure and Reclamation Plan shall include, but not be limited, to the following:
 - a) Contaminated site remediation;
 - b) Leachate prevention;
 - c) An implementation schedule;
 - d) Maps delineating all disturbed areas, borrow material locations, and site facilities;
 - e) Consideration of altered drainage patterns;
 - f) Type and source of cover materials;
 - g) Future area use;
 - h) Hazardous Wastes;
 - i) Reclamation of the existing Solid Waste Disposal Facilities cell;
 - j) Preliminary/conceptual information for the new Solid Waste Disposal Facilities cell;
 - k) Details of how leachate, surface, and subsurface runoff will be monitored and modeled during and after closure;
 - l) Leachate Modeling and Monitoring Plan and annual reporting details;
 - m) Landfill Gas Monitoring Plan; and
 - n) Annual reporting of the findings of the Landfill Gas Monitoring Plan.

Schedule 4 – Conditions Applying to Operation and Maintenance

1. The updated Operations and Maintenance Plan for the Sewage Disposal Facilities shall include, but not be limited to, the following:
 - a) Frequency of inspection of dams, dykes, and drainage courses;
 - b) Removal of floating materials for the Sewage Disposal Facilities;
 - c) Optimizing effluent discharge quality;
 - d) Runoff and drainage control within and around the facilities, and restoration of erosion;
 - e) A sludge management plan that includes a description of how sludge is monitored, managed, treated, and disposed of. The plan should include the types of sludge produced in the lagoon, received from the water treatment plant and any other sludge sources being disposed of in the lagoon; and
 - f) Be submitted to the Board within 24 months of issuance of this Licence.

2. The updated Operations and Maintenance Plan for the Solid Waste Disposal Facilities shall include, but not be limited to, the following:
 - a) Treatment of contaminated drainage;
 - b) Prevention of windblown debris;
 - c) Segregation of domestic, metal, and recyclable waste materials;
 - d) Method and frequency of site maintenance, including burning where permitted;
 - e) Water and leachate management and monitoring;
 - f) Liner maintenance and inspection; and
 - g) Be submitted to the Board within 24 months of issuance of this Licence.

3. A plan for hazardous Waste management at the Solid Waste Disposal Facilities shall be completed in general accordance with Government of Northwest Territories, Department of Environment and Natural Resources 2009 document titled Developing a Community Hazardous Waste Management Plan and submitted to the Board within 12 months of issuance of this Licence.

4. The Operations and Maintenance Plan for the Biotreatment Pad shall include, but not be limited to, the following:
 - a) Management of future increases in soil volume;
 - b) Frequency and spatial details for soil sampling during treatment;
 - c) How leachate will be tested and analyzed;
 - d) How results will be reported;
 - e) How leachate will be discharged and stored; and
 - f) Be submitted to the Board within 12 months of issuance of this Licence.



**MACKENZIE VALLEY LAND AND WATER BOARD
SURVEILLANCE NETWORK PROGRAM**

Licensee: City of Yellowknife

License Number: MV2009L3-0007

Effective Date of Licence: May 31, 2010

Effective Date of Surveillance Network Program (SNP): May 31, 2010
(Revised September 1, 2011)
(Revised February 16, 2012)
(Revised March 16, 2012)
(Revised February 27, 2014)
(Revised January 21, 2015)
(Revised October 8, 2015)

A. Location and Description of Surveillance Network Stations

Station Number	Description	Sampling Frequency
0032-1	Raw Water valve on Yellowknife River Water supply line in City Pumphouse #1. Sampling required. Rationale: To determine the quantity of Yellowknife River Water for use as a municipal potable Water supply source.	No Water quality sampling required. Daily quantity of Water use to be monitored.
0032-2	Wet well Water intake in City Pumphouse #1 on Yellowknife Bay. Sampling required. Rationale: To determine the quantity of the Yellowknife Bay Water for use as an emergency municipal potable Water supply source.	No Water quality sampling required.
0032-FI	Marker downstream of Lake FI along the Fiddler's Lake Sewage Disposal System, approximately 1.5 kilometers upstream of Great Slave Lake (62°24'49" N. and 114°	Monthly Water quality sampling except during decant period.

	<p>44' 11.9" W).</p> <p>Rationale: To monitor Water quality of Lake F1 and effectiveness of the Fiddler's Lake sewage disposal system.</p>	<p>During decant sampled weekly and for four weeks following decant.</p>
0032-F3	<p>Marker upstream of the outflow from Lake F3 of the Fiddler's Lake Sewage Disposal System (62°25' 24.8" N. and 114°39' 10" W). Sampling required.</p> <p>Rationale: Site of compliance. To monitor Water quality of lake F3 and to determine the effectiveness of the Fiddler's Lake Sewage Disposal System.</p>	<p>Monthly Water quality sampling except during decant period. During decant sampled weekly and for four weeks following decant. Sampled at spring break up and before freeze-up in fall for bioassay tests.</p>
0032-10	<p>Sewage effluent at the control structure located at lake F6.</p> <p>Rationale: To determine Sewage effluent quality prior to discharge to Fiddler's Lake sewage disposal system.</p>	<p>Monitoring Site. No Water quality sampling required for this Water Licence.</p>
0032-12	<p>Raw Water valve in City Pumphouse #2 on the Yellowknife River.</p> <p>Rationale: To determine the Water quality of the Yellowknife River prior to being pumped into the submarine line to Pumphouse #1.</p>	<p>Monitoring Site. No Water quality sampling required for this Water Licence.</p>
0032-13	<p>A point approximately 400 metres northwest of the Solid Waste Disposal Facilities above the confluence of an unnamed feeder creek.</p> <p>Rationale: To monitor Water quality associated with runoff and seepage from the Solid Waste Disposal Facility.</p>	<p>Active until replaced with 0032-13A.</p> <p>Water quality sampling twice each year during the months of June and September.</p>
0032-13A	<p>A point approximately 400 metres northwest of the Solid Waste Disposal Facilities that captures the drainage from the facility and drainage from the snow disposal area. SNP 0032-13A replaces</p>	<p>Water quality sampling twice each year during the months of June and September.</p>

	<p>SNP 0032-13.</p> <p>Rationale: To monitor Water quality associated with runoff and seepage from the Solid Waste Disposal Facility and snow disposal area.</p>	
0032-14	<p>Upstream of culvert located on Hwy #4, upstream of fault and downstream of confluence of unnamed feeder creek.</p> <p>Rationale: To monitor Water quality associated with runoff and seepage from the Solid Waste Disposal Facility.</p>	<p>Water quality sampling twice each year during the months of June and September.</p>
0032-15	<p>Upstream of culvert on Ski Club access road, opposite the biathlon shooting range.</p> <p>Rationale: To monitor Water quality associated with runoff and seepage from the Solid Waste Disposal Facility.</p>	<p>Active until replaced with 0032-15A.</p> <p>Water quality sampling twice each year during the months of June and September.</p>
0032-15A	<p>West side of Hwy #4, across from SNP 0032-15. SNP0032-15A replaces SNP 0032-15.</p> <p>Rationale: To monitor Water quality associated with runoff and seepage from the Solid Waste Disposal Facility.</p>	<p>Water quality sampling twice each year during the months of June and September.</p>
0032-16	<p>Upstream of culvert on Hwy #3, opposite Jackfish Lake.</p> <p>Rationale: To monitor Water quality associated with runoff and seepage from the Solid Waste Disposal Facility.</p>	<p>Water quality sampling twice each year during the months of June and September.</p>
0032-17	<p>Effluent or drainage Water discharged from the Biotreatment Pad.</p> <p>Rationale: To monitor final effluent quality before discharge.</p>	<p>Water quality sampling required prior to and during discharge.</p>
0032-18	<p>Effluent/drainage Water collected from the compost facility.</p> <p>Rationale: To monitor final effluent quality before discharge.</p>	<p>Before discharge of Water from the compost facility.</p>

0032-18A	Effluent/drainage Water collected from the expanded centralized compost facility. Rationale: To monitor final effluent quality before discharge.	Before discharge of Water from the compost facility.
0032-19	Effluent/drainage Water collected from the new landfill cell opened in 2011-12 (Cell A). Rationale: To monitor final effluent quality before discharge.	Before discharge of Water from Cell A.
0032-20	At the south end of Fault Lake where the run-off enters the lake. Approximate coordinates: 62°28'38.6"N, 114°21'52.5" W. Rationale: To monitor Water quality associated with runoff and seepage from the Solid Waste Disposal Facility.	Water quality sampling twice each year during the months of June and September.
0032-21	At Vicinity Lake #3 within the boundaries of the Solid Waste Disposal Facility. Approximate coordinates: 62°28'28.5"N, 114°23'11.4" W. Rationale: To monitor Water quality associated with runoff and seepage from the Solid Waste Disposal Facility.	Water quality sampling twice each year during the months of June and September.

B. Sampling and Analysis Requirements

- Station Numbers 0032-F1 and 0032-F3 shall be sampled once monthly except during a decant. Water at Station Numbers 0032-F1 and 0032-F3 shall be sampled weekly during each decant and for a period of four weeks following each decant. All samples collected at Station Numbers 0032-F1 and 0032-F3 shall be analyzed for the following parameters:

³ Nutrients	⁴ Major ions
Faecal Coliform	Faecal Streptococci
Suspended Solids	Oil and Grease
² Field parameters	BOD ₅
CBOD	

2. Station Number 0032-F3 shall be sampled two times yearly at spring break-up and before freeze-up in the fall. The samples will be provided to an accredited laboratory for the purpose of performing a static pass/fail bioassay for both rainbow trout and *Daphnia magna* (per Environment Canada's Environmental Protection Series Biological Test Methods). If greater than 30 percent mortality occurs, the samples should be collected for LC₅₀ bioassay testing.
3. Water related to the Solid Waste Disposal Facility drainage basin at Station Numbers 0032-13A, 0032-14, 0032-15A, 0032-16, 0032-20, and 0032-21 shall be sampled twice each year during the months of June and September and analyzed for the following parameters:

Total Ammonia	Nitrate and Nitrite
Faecal Coliform	BOD ₅
Total Phosphorus	Ortho-Phosphorus
Dissolved Organic Carbon	Total Phenols
Total Mercury	Oil and Grease
² Field parameters	¹ ICP-MS Metal Scan (Total)
methyl <i>tert</i> -butyl ether	⁴ Major Ions
Toluene	Benzene
Xylene	Ethylbenzene
Total Petroleum Hydrocarbons - Fraction 1 (C6-C10) + Fraction 2 (>C10-C16) + Fraction 3 (>C16-C34) + Fraction 4 (>34)	

4. Station Number 0032-17 shall be sampled prior to and during discharge and analyzed for the following parameters:

¹ ICP-MS Metal Scan (Total)
² Field parameters
Benzene
Toluene
Ethylbenzene
Xylene
Total Petroleum Hydrocarbons - Fraction 1 (C6-C10) + Fraction 2 (>C10-C16) + Fraction 3 (>C16-C34) + Fraction 4 (>34)

5. Water related to the compost facilities at Station Numbers 0032-18, 0032-18A, and 0032-19 shall be sampled before discharge from the facilities and analyzed for the following parameters:

Total Ammonia	Nitrate and Nitrite
Faecal Coliform	BOD ₅
Total Phenols	Oil and Grease
Total Mercury	¹ ICP-MS Metal Scan (Total)

² Field parameters	⁴ Major Ions
methyl <i>tert</i> -butyl ether	Benzene
Toluene	Ethylbenzene
Xylene	
Total Petroleum Hydrocarbons - Fraction 1 (C6-C10) + Fraction 2 (>C10-C16) + Fraction 3 (>C16-C34) + Fraction 4 (>34)	

6. All sampling, sample preservation, and analyses shall be conducted in accordance with methods prescribed in the current edition of Standard Methods for the Examination of Water and Wastewater or by such other methods approved by the Analyst.
7. All analyses shall be performed in a laboratory approved by the Analyst.

Notes:

¹ICP-MS Metal Scan (Total) shall include at a minimum, the following parameters:

Aluminium	Arsenic
Beryllium	Boron
Cadmium	Chromium
Cobalt	Copper
Iron	Lead
Manganese	Mercury
Molybdenum	Nickel
Selenium	Silver
Strontium	Vanadium
Zinc	

²Field parameters include the following measurements:

pH	Temperature
Conductivity	Dissolved Oxygen

³Nutrients include the following parameters:

Total Ammonia	Total Phosphorus
Nitrate-Nitrogen	Ortho Phosphorus
Total Dissolved Phosphorus	Total Organic Carbon
Total Kjeldahl Nitrogen	

⁴Major ions include the following parameters:

Calcium	Magnesium
Chloride	Sodium
Alkalinity	Fluoride

Total Dissolved Solids	Potassium
Sulphate	Total Hardness

C. Flow and Volume Measurement Requirements

1. The Licensee shall measure and record the following:
 - a) The daily quantity of Water pumped from the Yellowknife River at Station Number 0032-1;
 - b) The daily quantity of Water pumped from Yellowknife Bay at Station Number 0032-2 in cubic metres;
 - c) The weekly flow of Sewage effluent discharged from the control structure at Station Number 32-10;
 - d) The monthly quantity of Waste discharged from Lift Station Numbers 5 and 6; and
 - e) The lagoon elevations and design elevation for dams.

D. Dam and Dyke Monitoring

1. The dams and dykes of the Sewage Disposal Facilities shall be inspected once every two years during the summer season by an Engineer to determine the stability of the structures.
2. The dykes constructed to divert the drainage flow from Lake F9 and Unnamed Lake into the Grace Lake system shall be inspected every four years by an Engineer, at a time of high water level, to determine the stability of the structures.
3. Within 60 days of completion of the geotechnical inspection, the Licensee shall submit a cover letter outlining an implementation schedule for the Engineer's recommendations.

E. Reports

1. The Licensee shall submit quarterly reports for January through March, April through June, July through September, and October through December. These quarterly reports shall contain all of the information generated by Parts A, B, C, and D of the Surveillance Network Program and shall be submitted within 30 days of the end of the quarter being reported.

Signed on behalf of the Mackenzie Valley Land and Water Board



Chair



Witness

Annex A Schedule

Supplemental information to be submitted by Licensee as required through Licence Conditions

Licence Condition	Report Title/Require Action	Timeline for Submission
B.3 (Schedule 1, item 1)	Annual Report	March 31 each year
B.8	Identify SNP Station(s) with signage	At all times
B.9	Re-locate SNP 0032-13 and 0032-15 and provide coordinates to the Board	By September 1, 2010
B.10	Identify Water Supply and Waste Disposal Facilities with signage	At all times
B.11	Copies of Water Licence in City of Yellowknife office(s), the Solid Waste Disposal Facilities, and the Water Supply Facility	At all times
D.3	Advise Inspector and notify the Board prior to decant of Sewage Disposal Facility	At least 10 days before decant begins
D.9	Inspection of constructed berms, dykes, and dams within the Waste Disposal Facilities and Water Supply Facilities	Once every 2 years with a report to be submitted to the Board within 60 days of the inspection
D.10 (Schedule 2, Item 1)	Stormwater Management Plan	Within 15 months of issuance of this Water Licence

D.11	Design Report	90 days prior to the construction of a new cell at the Solid Waste Disposal Facility
D.12	Operations and Maintenance Manual	60 days prior to operation of a new landfill cell
D.13	As built plans and Record Drawings	90 days of completion of construction
D.14 (Schedule 2, Item 2)	Solid Waste Disposal Facility Drainage Study	Within 18 months of issuance of Water Licence
D.15 (Schedule 2, Item 3)	Revised Fiddlers Lake Treatment System Plan	March 31, 2012
D.16	Sewage Disposal Facility Design Report	60 days prior to any upgrading
D.17	As built plans and Record Drawings for Sewage Disposal Facilities	Within 90 days of completion of any upgrades
D.18	Current Record Drawings of the Sewage Disposal Facilities	Within 6 months of issuance of this Water Licence
D.19	Sewage Disposal Facility reporting	Within 18 months of issuance of Water Licence
D.20	Year long study of sewage effluent and Report	March 31, 2012
D.21	BOD and CBOD Study	August 31, 2014

D.22	Study on the capabilities of the effluent discharge area	March 31, 2012
D.23	Metal concentrations in surface water for Solid Waste Disposal Facility Study	March 31, 2013
PART E	Modifications to Water Supply Facilities and Waste Disposal Facilities	Various – refer to Water Licence
F.1 (Schedule 3, Item 1)	Interim closure and reclamation plan for the Solid Waste Disposal Facility	6 months prior to closure of the current Solid Waste Facility Disposal cell
F.2 (Schedule 3, Item 1)	Closure and Reclamation Plan	At least six (6) months prior to abandoning any Waste Disposal Facilities
G.1	Construction of any dams, dykes or control structures	Prior to construction
G.3	As-built plans and Record Drawings	Within 90 days of completion
H.1 (Schedule 4)	Updated plans for the Operation and Maintenance of the Waste Disposal Facilities	Various – refer to Schedule 4
I.1	Spill Contingency Plan in accordance with “Indian and Northern Affairs Canada’s 2007 Guidelines for Spill Contingency Planning”	Within 6 months of issuance of Water Licence
I.2	Review of Spill Contingency Plan and submission of updates/revision	Annually – Annual Reporting Requirement

Annex B Revisions to Water Licence MV2009L3-0007

List of changes that have been made to the Water Licence since issuance

Date	Location of change	What has changed
September 1, 2011	Surveillance Network Program, section A	SNP station 0032-F1 longitude coordinate changed to 114° 44' 11.9" W.
February 16, 2012	Surveillance Network Program, section A and B	Sampling frequency for station 0032-18 revised to require sampling to occur prior to discharge.
March 16, 2012	Surveillance Network Program, section A and B	Sampling frequency for station 0032-17 revised to require sampling to occur prior to and during discharge.
September 24, 2013	Schedule 1, item (e) revised	1(e) A sludge management plan that includes a description of how sludge is monitored, managed, treated, and disposed of. The plan should include the types of sludge produced in the lagoon, received from the water treatment plant and any other sludge sources being disposed of in the lagoon.
	Schedule 4, new item	A summary of efforts to monitor, manage, treat and dispose of sewage sludge at the Sewage Disposal Facilities.
February 27, 2014	Surveillance Network Program, section A and B	SNP station 0032-18A added to test leachate at the expanded centralized compost facility.
January 21, 2015	Surveillance Network Program, section A and B	SNP station 0032-19 added to test leachate at the new landfill cell opened in 2011-12 (Cell A).
October 8, 2015	Surveillance Network Program, section A and B	SNP stations 0032-20 and 0032-21 added to monitor Water quality associated with runoff and seepage from the Solid Waste Disposal

		Facility. Total Phosphorus, Ortho-Phosphorus, and Dissolved Organic Carbon added to testing parameters for stations listed in section B.3 of the SNP.
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Reasons for Decision

Issued pursuant to section 54 of the *Waters Act*

Type A Water Licence Application	
Preliminary Screener	MVLWB
Reference/File Number	MV2009L3-0007
Applicant	City of Yellowknife
Project	Surveillance Network Program

Decision from Mackenzie Valley Land and Water Board Meeting of

October 8, 2015

With respect to this revision, notice was given in accordance with sections 63 and 64 of the *Mackenzie Valley Resource Management Act* (MVRMA) and section 43 of the *Waters Act*. There was no public hearing held in association with this revision.

Background

The Mackenzie Valley Land and Water Board (MVLWB) received a letter from the Water Resources Officer (WRO) to add three parameters to the current analyses of Water Licence MV2009L3-0007 at SNP locations 0032-13A, 0032-14, 0032-15A, 0032-16, 0032-19 and 0032-20, all of which are intended to monitor surface water as it leaves the Solid Waste Facility (SWF) and reports downstream. The request from the WRO stems from changes that have been observed in the aquatic ecosystem and water quality of Jackfish Lake, which is downstream of the City's SWF. Testing for these parameters may help determine whether runoff from the landfill is contributing to the high phosphorus levels in Jackfish Lake that have led to algal blooms for the past two springs.

Decision

The Board is satisfied that:

- the project has been screened pursuant to the MVRMA;
- any potential adverse environmental effects are insignificant or mitigable with known technology; and
- the project is not likely to be a source of public concern.

After reviewing the submission of the Applicant, the written comments received by the Board and the Staff report prepared for the Board, the Board, having due regard to the facts and circumstances, the merits of the submissions made to it, and to the purpose, scope, and intent of the MVRMA and the *Waters Act* and Regulations made thereunder, has determined that:

.../2


Water Licence MV2009L3-0007 be revised. The Board's reasons for this decision are as follows:

- The Board is satisfied that adequate consultation has been conducted and that advice has been sought and considered in accordance with sections 63 and 64 of the MVRMA.
- No significant or unmitigable public concern was made known to the Board.
- It is the opinion of the Board that the conditions attached to MV2009L3-0007, pursuant to the *Waters Act*, will significantly reduce the potential environmental impacts resulting from water use and/or deposit of waste.
- The use of water and/or deposit of waste proposed by the Applicant is of a nature contemplated by the MVRMA and the *Waters Act*.
- The Board has notified the Applicant, through a statement included in the scope of this Licence, that compliance with the terms and conditions of this Licence does not absolve the Licensee from responsibility for compliance with the requirements of any other legislation.
- The Board has reviewed the information contained in the September 29, 2015 Staff Report regarding environmental impacts and/or public concerns.
- According to CCME's document, *Phosphorus: Canadian Guidance Framework for the Management of Freshwater Systems*¹, "in the majority of lakes, phosphorus is normally the limited nutrient for algal growth." Also, the document provides a description of the different forms of phosphorus and uptake in aquatic systems: "Phosphorus in aquatic systems occurs in three forms: inorganic phosphorus, particulate organic phosphorus, and dissolved (soluble) organic phosphorus. Aquatic plants require inorganic phosphate for nutrition, typically in the form of orthophosphate ions (PO₄³⁻). This is the most significant form of inorganic phosphorus, and is the only form of soluble inorganic phosphorus directly utilized by aquatic biota."
- The parameters requested for analysis at the SNP stations related to water quality leaving the SWF are common components of landfill leachate, as found in the *Standards for Landfills in Alberta*² and British Columbia's *Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills*³.

Water Licence MV2009L3-0007 contains provisions that the Board feels necessary to ensure and monitor compliance with the MVRMA and the *Waters Act* and the Regulations made thereunder and to provide appropriate safeguards in respect of the Applicant's use of the waters and/or deposit of waste affected by the Licence. The Board will provide additional referenced material or documents if requested in writing to do so.

SIGNATURE

Mackenzie Valley Land and Water Board



Chair

October 8, 2015

Date

¹ Canadian Council for Ministers of the Environment, Canadian Environmental Quality Guidelines (2004). Canadian Water Quality Guidelines for the Protection of Aquatic Life, Phosphorus: Canadian Guidance Framework for the Management of Freshwater Systems. Retrieved from: <http://cegg-rcqe.ccmec.ca/download/en/205>

² Government of Alberta. (2010, February). Standards for Landfills in Alberta. Retrieved from Alberta Environment and Sustainable Resource Development: <http://environment.gov.ab.ca/info/library/7316.pdf>

³ BC Ministry of Environment. (n.d.). Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills. Retrieved from http://www2.gov.bc.ca/gov/DownloadAsset?assetId=DDDE9224A6354A90B951A7BB73581EF4&filename=guidelines_environmental_monitoring_municipal_solid_waste_landfills.pdf