

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Friday, April 26, 2013 2:02 PM
To: Danyluk, Carol ENV:EX; Bourgeois, Jason ENV:EX
Cc: Stroich, Chris ENV:EX; Love, Mark P ENV:EX; Sundher, Avtar S ENV:EX; McCammon, Alan W ENV:EX
Subject: Application of TG6 - Cache Creek Landfill

Not Responsive

Anyway, given Wastech's outstanding proposal to install a pump and treat system at the Cache Creek landfill, you may want to have them go through the exercise of water use determination following TG6. This would establish the necessity of making the pump and treat system a regulatory requirement. Of course this path obligates the SDM (Jason or Cassandra) to make a decision on the standard and point of compliance. Alternately, with respect to Wastech's pump and treat proposal, you could just approve their plan without going through this exercise of determining the appropriate standard.

(Mark, Chris, Alan...if I have misunderstood how we are proceeding, please let me know.)

Larry

Not Responsive

Pages 2 through 3 redacted for the following reasons:

Not responsive

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Thursday, April 18, 2013 5:03 PM
To: Janet Tecklenborg
Cc: Danyluk, Carol ENV:EX
Subject: Closure Period Plan

Follow Up Flag: Follow up
Flag Status: Completed

Doc1.doc

As discussed, this is very draft...well, more half-baked concept really. I haven't even shared this internally (Carol is getting a copy via this e-mail). Essentially, I am attempting to take the "criteria" out of the Closure Period Plan, confirm what we have accepted, and highlight the pieces where we need to do a little more work. I would propose that we attach such a table in formalizing approval of what you already submitted.

Anyway, I just thought I would throw it at you for any initial thoughts. I plan to finalize it on Monday.

Thanks,

Larry

	Expected Completion	Criteria for Completion	Additional Information/Comments	Approval Status
Final Cover	Within 3 months of last load of refuse	• final cap completed; • seed applied and irrigation set up; • QP report submitted and approved by MOE; • Windblown litter cleaned up to the satisfaction of the majority of Landfill Advisory Committee Members	Closure Plan to be submitted in accordance with Section ??? providing specification details, QAQC 12 months in advance of closure.	Approved
Revegetation	Minimum of 3 years after closure??	• Self-sustaining vegetation without irrigation. • Determined min. 1 year (??, 2 growing seasons?) post irrigation. • Determined by QP assessment.	Provide additional details in consideration of: • Potentially individual grid areas may be approved as completed at different times. • Establish guiding criteria for QP. Possibly describe percent cover and diversity on a scale (e.g. 1 to 10) and pick a passing grade. • Once the standard is met, what is the timeframe that demonstrates self-sustainability?	Not Approved
Irrigation	Min. of 3 years??	After revegetation of entire site is approved.		Approved
Landfill Gas Monitoring (on site and off-site emissions)				

Landfill Gas Collection and Utilization				
Condensate Management				
Leachate Control				
Groundwater Management				
Groundwater Monitoring				
Surface Water Management				
Other features Land tenure Fencing security				

Donchi, Erin CSNR:EX

From: Haley, Megan ENV:EX
Sent: Wednesday, April 24, 2013 10:54 AM
To: Danyluk, Carol ENV:EX
Subject: Closure Period plan review
Attachments: Closure Period Plan Concerns reviewed.docx

I can't remember if this was sent to you.

Anyhoo, you might finds some useful tidbits!

Megan Haley, C.I.T.
Environmental Protection Officer
1259 Dalhousie Drive
Kamloops, BC V2C 5Z5
Phone: (250) 371-6283
Fax: (25)371-40000
Megan.Haley@gov.bc.ca

Considering Closure of the Cache Creek Landfill

The Cache Creek Landfill (CCLF) is scheduled to close in 2016. When the site was originally authorized in 1987, a post-closure fund was established for the monitoring, maintenance and repair of the landfill. The value of the fund, as of January 2012, was approximately \$12.7 million held in an internal trust managed by government. The fund is to be administered by the Director for the benefit of the Village of Cache Creek.

Essentially, on closure of the site, the Ministry of Environment becomes the contract manager for the site and the Director shall disperse funds for all post-closure activities. MOE remains as the regulator, but also becomes the financier and pays the owner/operator for all post-closure activities. Any residual from the fund, will ultimately be released to the Village of Cache Creek.

This arrangement sets up some unique challenges:

- The current thinking is that Wastech will submit an annual budget which will be approved by the Director. Administration of monthly disbursement will be carried out the Village of Cache Creek. A third party monitor, paid for by the fund, will provide oversight on disbursement of the fund and will report directly to the Ministry. Additional considerations are:
 - Currently Wastech's contract with Metro, sets a fixed profit at 12%. However, there is no contract in place with the Ministry, and as Wastech and the Village are site owners and Wastech is the operator, Wastech will be the sole source of all work. There is really nothing that prevents them from increasing their profit margin.
 - The way the trust has been set up, really removes any motive on the part of Wastech from preserving the value of the trust.
 - If the trust is depleted, through contractual arrangements, Metro indemnifies Wastech and the Village for 25 years post closure. Beyond 25 years, liability provisions of the contaminated sites regulation kick in.
- At what point does the Closure Fund start to pay for activities?
 - For example:
 - environmental monitoring will likely be paid from the fund the last day garbage is received;
 - cap maintenance: a couple of months within the time when the last load of waste has been deposited, the final cap is completed;
 - vegetation: likely a few years after closure once viable vegetation has been demonstrated to be established. What is the criterion for defining adequate re-vegetation? (Adequate re-vegetation is determined by a professional and based on percent cover and species composition) Is there a potential need for on-going irrigation? What is the water source?

- LFG Management: the fund does not pay for LFG utilization but does pay for managing off-site migration. This area of responsibility and cost has potential for conflict;
 - Do Wastech's fees include administration and management costs? To what extent within their organization?
 - All of these pose challenges for apportionment of costs and are likely to be the subject of on-going negotiations. As Metro and the Village will have continued financial interests in the project, no doubt they will want to be part of the negotiations;
 - Wastech has recently submitted a "closure period plan" which starts to form criteria and timelines for the above.
- Leachate Control - Wastech was advised last year of their obligation to give notice of off-site migration. Considerations include:
 - o 6 offsite wells appear to be influenced by the landfill above background and exceed CSR in varying amounts (e.g. drinking, aquatic, irrigation and livestock); 1 for sulphate and chloride, 4 for sulphate only, and one for fluoride. Levels are nothing to get excited about, the leachate is being attenuated and there are no receptors being impacted.
 - o Wastech is concerned about additional regulatory burden, the perception of pollution that might be created through "notice of offsite migration" and that after a lot of additional assessment work they will end up having to actively collect and treat leachate regardless. Based on advice from LRM, Wastech was asked to hold off giving notice.
 - o Wastech has responded proposing a groundwater pump and treat system (**only the irrigation option proposes to treat the water**) in the order of 100 m³/day. Options for disposal of the groundwater include: 1) 10 hectares of evaporation ponds, 2) evaporation using waste heat from internal combustion engines at the electrical generation plant, 3) 6 hectares of spray evaporation ponds, or 4) on-site spray irrigation. Although costs have not yet been estimated, it will surely be in the multi-millions of dollars.
 - o Questions around how long a pump and treat system would be necessary, where would ponds be located, any ancillary impacts to the groundwater regime, have not yet been considered.
 - o The pump and treat system is likely unnecessary for environmental protection and but appears to be a response to anticipated controversy in giving notice of off-site migration. Note that under the terms of the contract with Metro, Metro would like finance the capital and the closure fund would finance long term operations.

- Is there enough money in the fund?
 - Intuitively, yes. Cost estimates have not been projected for the above. Sorting out the details for post-closure of the site has just started. Cost estimates will be developed over the next couple of years.
 - If cost estimates predicts surplus in the fund, it is anticipated that the Village will request release of the residual. If the costs predict the fund it inadequate, there is really not an obvious solution for increasing the value of the fund. The initial focus would be on minimizing disbursements.

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Monday, January 23, 2012 2:10 PM
To: 'Peter Wishart'; 'Harvey Choy'; 'Peter Hughes'; 'Don May'
Cc: Files KAM ENV:EX; 'Janet Tecklenborg'; 'lloyd@cachecreek.info'
Subject: FW: Proposed Revisions - MR 7577 Operational Certificate

Importance: High

Hi all,

Please see the proposed revisions highlighted in yellow to the Cache Creek Landfill Operational Certificate. If you have any questions or comments, I would be very pleased to discuss them with you. I have already discussed the revisions with the authorized party (Wastech and the Village).

It is my intention to place a notice advising of the revisions in the local newspaper by their publishing deadline on noon Thursday. The publication notice advises of the proposed amendment and that a decision will not be made before 14 days following publishing.

Larry Gardner, AScT, Eng.L
Head, Environmental Management
Thompson Region
Kamloops, BC
250-371-6226
Larry.Gardner@gov.bc.ca

BC Pollution Free



MR 7577 (5) Oper
Certificate 2...

OPERATIONAL CERTIFICATE

MR-7577

FOR THE CACHE CREEK LANDFILL

*Under the Provisions of the Environmental Management Act
and in accordance with the
Thompson-Nicola Regional District Solid Waste Management Plan*

**THE VILLAGE OF CACHE CREEK
Box 7
Cache Creek BC V0K 1H0**

**WASTECH SERVICES LTD.
1200 United Boulevard
Coquitlam BC V3T 6T4**

are authorized to manage municipal solid waste at a sanitary landfill facility located in Cache Creek, British Columbia, subject to the conditions listed herein. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

This Operational Certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority shall rest with the Operational Certificate Holder. This Operational Certificate is issued pursuant to the provisions of Section 28 of the *Environmental Management Act*. It is the responsibility of the Operational Certificate Holders to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

This Operational Certificate supersedes all previous versions of the Permit PR-07577 or Operational Certificate MR-07577 issued under the *Waste Management Act* or the *Environmental Management Act*.

For the purposes of the administration of this Operational Certificate, "Regional Manager" means the Regional Environmental Protection Manager of the Ministry of Environment, Kamloops office.

Date Issued: June 27, 1996
Date Amended: August 31, 2009

Larry Gardner, ASCT, Eng.L
For Director, *Environmental Management Act*
Thompson and Cariboo Regions
OPERATIONAL CERTIFICATE NO.: MR-07577

1. LOCATION OF AUTHORIZED FACILITY

The location of the sanitary landfill facility for the management of municipal solid waste to which this Operational Certificate is applicable is described as:

- Pre-Annex boundaries of the Landfill as detailed in the September 24, 2005 Modification of the Lease from the Province to the Village of Cache Creek: Block A, Section 13, Township 21, Range 25 and Blocks C, D, E and F, Section 18, Township 21, Range 24, all West of the Sixth Meridian, Kamloops Division of Yale District and containing 49.636 hectares, plus
- Annex A added to the west side of the existing landfill footprint on February 16, 2009: Block B, Section 13 together with that part of Section 13 all of Township 21, Range 25, West of the 6th Meridian, Kamloops Division, Yale District, containing 6.70 hectares, more or less.

2. RECYCLABLE MATERIALS MANAGEMENT

Municipal solid waste that has value for the purposes of reuse or reprocessing shall be considered recyclable material. Recyclable materials may be diverted from disposal and temporarily stored at the landfill facility prior to removal from the site. The nature of the recyclable material authorized for storage at the landfill facility shall be to the satisfaction of the Regional Manager.

3. MUNICIPAL SOLID WASTE MANAGEMENT

3.1 Disposal to Landfill

- 3.1.1** The works authorized are a sanitary landfill and related appurtenances located approximately as shown on the attached Site Plan. The landfill shall be operated to meet or surpass the requirements for a sanitary landfill as described in the *BC Landfill Criteria for Municipal Solid Waste (1993)*.
- 3.1.2** The discharged waste shall originate from within the province of British Columbia, subject to the following:
- (a) Waste discharged to this landfill shall satisfy the requirements of the Thompson-Nicola Regional District Solid Waste Management Plan.
 - (b) Waste discharged to this landfill shall not contravene the Regional Solid Waste Management Plan of the Regional District from which the waste originated.
- 3.1.3** All waste to be discharged at this site shall be inspected by a suitably trained Wastech Services Ltd. employee prior to receipt or shall be tipped, spread and inspected by a suitably trained Wastech Services Ltd. employee prior to being

placed into the working face for compliance with the terms and conditions of the Operational Certificate.

3.1.4 The maximum authorized rate of waste discharge is 500,000 tonnes annually.

3.1.5 The characteristics of the waste discharged to the landfill are those of municipal solid waste as defined in the *Environmental Management Act*.

3.1.6 The following types of wastes shall not be discharged:

- (1) Hazardous wastes, other than those specifically approved for disposal to authorized landfills, as defined in the *Hazardous Waste Regulation* under the *Environmental Management Act*.
- (2) Anatomical, pathological, and untreated biomedical wastes as defined in the *Guidelines for the Management of Biomedical Wastes in Canada* (Canadian Council of Ministers of the Environment, February 1992).
- (3) Bulk liquids and semi-solid wastes, which contain free liquids, as determined by US EPA Method 9095A Paint Filter Liquids Test, Test Methods for Evaluating Solid Wastes-Physical/Chemical Methods (EPA Publication No. Sw-846).
- (4) Hog fuel, log yard debris and chipped wood waste.
- (5) Recyclable materials as directed by the Director.

3.1.7 Notwithstanding the requirements of section 3.1.6(1), the disposal of waste asbestos in compliance with the requirements of Section 40 of the *Hazardous Waste Regulation* under the *Environmental Management Act* is hereby authorized.

3.2 Recovery of Energy Potential From Landfill Gas (LFG)

3.2.1 On or before June 30, 2013, energy potential from the landfill gas shall be recovered in accordance with the plan approved under section 3.2.2.

3.2.2 On or before [dated 14 days from signing], a plan referred to as the "LFG Utilization Plan" shall be submitted for approval of the Director. The plan shall include at least the following:

- Description of the process to recover the energy potential from the waste;
- Projected energy recovery expressed in joules;

- Expected efficiency of energy recovery; and,
- A critical path to achieve recovery by June 30, 2013.

3.2.3 On or before the first day of each quarter, until project completion, a project progress report relative to the critical path shall be submitted to the Director.

3.2.4 The Post-Closure Fund described in Section 8.0 shall not be applied to recovering the energy potential from the landfill gas. For certainty, the post-closure fund shall not be applied to operation, maintenance, monitoring, capital upgrades or investigation related to energy recovery from the landfill gas.

4. OPERATING REQUIREMENTS

4.1 Design, Operating and Closure Plans

4.1.1 The following design, operating and closure plans are approved:

- (1) Cache Creek Sanitary Landfill, Volume 1 - Design, Operation and Closure, Volume 2 - Supporting Technical Documents dated December, 1988, prepared by Golder Associates Ltd. Consulting Engineers.
- (2) Cache Creek Sanitary Landfill Operations and Closure Plan 1995 dated April 12, 1995, and appendix 11 Internal Storm Water Management Plan, dated September 28, 1995, prepared by Golder Associates Ltd.,
- (3) Stage 4, Cache Creek Sanitary Landfill, Volume 1 - Design Features and Closure dated June 30, 1995, and Stage 4, Cache Creek Sanitary Landfill, Volume 2, Technical Analyses dated September 26, 1995, prepared by Golder Associates Ltd.
- (4) Landfill Gas Management Program, Cache Creek Landfill, Cache Creek, B.C., dated July 15, 1996, prepared by Golder Associates Ltd.
- (5) The Cache Creek Sanitary Landfill Operations and Closure Plan 2000, dated June 15, 2000, prepared by Golder Associates Ltd.
- (6) The Cache Creek Sanitary Landfill Operations and Closure Plan 2005, dated April 25, 2007, prepared by Golder Associates Ltd.

4.1.2 The design, operating and closure plans shall be reviewed every 5 years throughout the operating life of the landfill and updated to encompass the next

10 years of landfill operation and/or post-closure activities. The updated landfill design, operating and closure plans shall be prepared by a professional engineer or geoscientist licensed to practice in the province of British Columbia and knowledgeable in such matters. The updated plans shall be submitted to the Director for approval and shall include any information relevant to the design, operation, closure and post-closure care of the landfill.

4.1.3 Pursuant to Section 4.1.5 of this Operational Certificate, an updated design, operating and closure plan shall be submitted to the Director for approval by October 16, 2009. As a minimum, the updated plan shall address the following topics to the satisfaction of the Director:

- Design specifications for the blanket drainage system for leachate collection
- Quality assurance/quality control (QA/QC) protocol for the installation of the composite liner system and leachate drainage collection system
- Design specifications for the fly ash monofill
- Procedure for disposal of fly ash
- Procedure for washing fly ash trailers and the recycling of the wash water
- Program and schedule for establishment of self-sustaining vegetation on the final cover
- Leachate handling and disposal procedures, both during active landfill operations and during the post-closure period
- Site security and vector control provisions for less than 24 hour per day operations, particularly how bears, coyotes, birds, etc. will be prevented from accessing the active face during the non-active periods.
- Bird control program reviewed by Transport Canada as it relates to the adjacent airport.
- Updated site plan showing location of new groundwater monitoring wells
- Changes to groundwater monitoring program with respect to AMEC recommendations in June 2009 report
- Upgrades to the landfill gas collection system to improve gas collection efficiency
- Consideration of a baseline environmental monitoring program for the Bonaparte River.
- Re-evaluation of the final cap design and performance.
- Monitoring Committee Terms of Reference in accordance with section 5.2

4.1.4 A landfill post-closure plan shall be submitted not less than 12 months prior to the estimated site closure date. The post-closure plan shall be reviewed every 5

years following closure and updated to encompass the next 10 years of post-closure activities. The post-closure plan and subsequent updates shall be prepared by a professional engineer or geoscientist licensed to practise in the province of British Columbia and knowledgeable in such matters. The post-closure plan and subsequent updates shall be submitted to the Director for approval and shall include at least the following:

- (1) a complete review and assessment report of the overall integrity of the landfill,
- (2) a detailed timetable for closure and/or post-closure procedures and correction of any deficiency identified in the review and assessment report, and
- (3) a detailed schedule of inspection, monitoring and maintenance to be carried out for a minimum post-closure period of 25 years.
- (4) a process for the administration of the post-closure security fund required under section 8 of this Operational Certificate.

4.1.5 The landfill facility shall be constructed and maintained in accordance with the plans approved under sections 3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4 and 9 subject to the conditions set herein. A knowledgeable representative from the engineering design firm shall carry out field reviews of the landfill construction and installation of works. As-constructed drawings of the landfill and all works, including elevations relative to a common datum, shall be submitted to the Director. The as-constructed drawings shall be sealed by a professional engineer or geoscientist representing the engineering design firm who is licensed to practise in the province of British Columbia and knowledgeable in the appropriate field of study.

4.1.6 Written authorization from the Director shall be obtained prior to implementing any changes to the approved plans. Based on any information obtained in connection with this facility, the Director may require revision of, or addition to, the design, operating and closure plans.

4.2 Landfill Site Development

4.2.1 Discharge of waste into water is prohibited. Surface water diversions and groundwater drainage works shall be installed to prevent surface water run-off and groundwater seepage from entering the waste discharge area. The effect of sediment transport from areas upgradient and within the landfill site shall be considered when designing, installing and maintaining the surface water diversion system. Diversion and drainage structures shall be maintained by the Operational Certificate Holders on a regular basis to the satisfaction of the Director.

- 4.2.2** A berm of suitable material shall be constructed to preclude visibility of the active waste discharge area and any exposed wastes from travellers using the Trans Canada Highway.
- 4.2.3** Waste shall not be deposited at this site beyond the landfill stages 1, 2, 3, 4 and the area referred to in Section 1 as Annex A, as specified in the approved plans.

4.3 Waste Compaction and Coverage

- 4.3.1** Discharged wastes shall be compacted and cover material applied as outlined in section 4.3.2. Wastes shall be compacted and covered on a continuous basis. However, if operations are reduced to less than 24 hours per day, then provisions such as security, fencing, and/or other measures approved by the Director shall be deployed to prevent wildlife access. All wastes shall be covered within 24 hours of discharge to the landfill.
- 4.3.2** The area of the active landfill working face shall be minimized as much as possible. Wastes shall be spread in thin layers of 60 centimetres, or less, on the working face and compacted. A compacted layer of at least 15 centimetres of suitable soils, or a functionally equivalent depth of other cover material acceptable to the Director, shall be placed on all exposed compacted waste.
- 4.3.3** An intermediate cover of at least 30 centimetres of compacted soils, or a functionally equivalent depth of other cover material acceptable to the Director, shall be applied on any areas of the active landfill site to which waste will not be discharged for a period of 30 days or more.
- 4.3.4** Final cover shall be installed within 30 days of completion of the landfill to the final elevations as specified in the approved plans. Completed portions of the landfill shall progressively receive final cover during the active life of the landfill. Final cover shall consist of at least 1 metre of low permeability compacted mineral soil, overlain by at least 15 centimetres of topsoil capable of supporting indigenous vegetation. With the written approval of the Director, the topsoil used for this final covering may be mixed with conditioning agents such as sludge (biosolids), compost and the like to add organics and improve the moisture holding capacity and nutrient value of the soil. Final cover shall be constructed and maintained with adequate drainage and erosion controls and seeded with suitable grasses.
- 4.3.5** The Director may vary the frequency of covering when freezing conditions adversely affect normal operation.

4.4 Landfill Management

- 4.4.1** The landfill shall be supervised to the satisfaction of the Regional Manager. Landfill supervisors shall be trained in landfill operation pertaining to the conditions of this Operational Certificate and the approved design, operating and closure plans.
- 4.4.2** Access to the site shall be controlled and supervised. All access points shall have locking gates and shall be locked during periods when supervision is not available.
- 4.4.3** Public scavenging and salvaging of waste at the landfill site is prohibited.
- 4.4.4** Designated areas shall be maintained for the storage of recyclable materials. These designated area(s) shall be separate from the active landfill area and shall be maintained free of litter. Storage of recyclable materials at the landfill site shall be limited to a reasonable length of time subject to the approval of the Director.
- 4.4.5** Litter and wind strewn waste shall be controlled by limiting the area of the working face, installing a wind blown litter collection fence in a location which is in the anticipated prevailing downwind direction of the landfill working face, instituting a regular litter pickup, general good site maintenance practises or any other measures required by the Director.
- 4.4.6** Dust and odour created within the landfill property shall be controlled using methods and materials acceptable to the Regional Manager.
- 4.4.7** Open burning of waste is prohibited.
- 4.4.8** The landfill shall be operated so as to minimize the attraction of nuisance wildlife and disease vectors such as birds and rodents by applying adequate cover to the waste and by maintaining the site free of litter. Additional control measures may be specified by the Director if wildlife and/or vector attraction to the site becomes a public safety hazard.
- 4.4.9** The landfill works shall be inspected on a regular basis by the landfill supervisor. In the event of an emergency or any condition, which prevents continuing operation of the approved method of landfill operation and control, or results in non-compliance with the terms and conditions of this Operational Certificate, the Regional Manager shall be notified immediately and appropriate remedial action taken.

- 4.4.10** The Director may require future upgrading of the landfill control works to protect the environment during the operating life of the landfill and for a minimum post-closure period of 25 years.
- 4.4.11** Upon closure, the boundaries of the landfilled area shall be legally surveyed. A covenant that the property was used for the purpose of waste disposal shall be registered against the land title as provided for under Section 215.1 of the Land Title Act.

5. MONITORING

5.1 Environmental Protection Monitoring

Monitoring of ground and surface water, leachate collection sump fluids and landfill gas shall be carried out in accordance with the monitoring program approved in the design, operating and closure plans. The monitoring program shall be reviewed in the annual report required under section 7.2. Based on the information submitted in the annual report, or any other information obtained in connection with this site, the Director may vary the frequency, location and analyses of ground and surface water, leachate collection sump fluid and landfill gas sampling.

5.2 Monitoring Committee

A Monitoring Committee shall be established with representatives from the community including Secwepemc and N'lakapamux Nations. Details of the site development, operations, closure, post-closure and on-going environmental monitoring and interpretation shall be shared with the committee. The purpose of the Monitoring Committee is to promote environmentally sound operations and effective monitoring.

6. LEACHATE CONTROL AND TREATMENT

6.1 Management of Leachate Collection System Fluid

Leachate collection sump fluid levels shall be monitored and fluid removed from the leachate collection system as specified in the approved design, operating and closure plans. A sample of fluid from each of the leachate collection sumps shall be collected on a quarterly basis and laboratory analyses obtained for the leachate indicator parameters identified in the monitoring program. The Director may vary the location and frequency of sampling and analyses of leachate collection system fluid should conditions warrant. Fluid recovered from the leachate collection system may be used within the landfill footprint for irrigation, dust suppression and/or re-circulated within the buried waste

unless otherwise directed by the Director. Other methods of treatment and/or disposal of the leachate collection sump fluids must have the prior approval of the Director.

6.2 Groundwater Contamination by Leachate

Should it be determined that leachate is being generated and carried in the groundwater or surface water and, in the opinion of the Director, requires interception and treatment, appropriate remedial measures as approved by the Director shall be implemented.

7. REPORTING

7.1 Interim Reporting and Record Keeping

The leachate collection sump fluid level readings, groundwater elevation and combustible gas monitoring data, and the sump fluid, groundwater and gas sampling analyses results shall be available for inspection at the Wastech Cache Creek Landfill office. Data from monitoring and sample analysis shall be submitted to the Regional Manager with the annual report in accordance with section 7.2. Between annual reporting events, the Regional Manager and Monitoring Committee (ref. section 5.2) shall be promptly informed of any significant changes from long term trends observed in the parameters that are monitored.

7.2 Annual Report

An annual report shall be submitted by March 31 of each year for the previous calendar year of landfill operation or post-closure activities. The annual report shall review and interpret the analytical data from monitoring of leachate collection sump fluids, groundwater and landfill gas for the preceding calendar year. Proposed changes to the monitoring program shall be identified in the annual report. The annual report shall summarize the findings of the landfill supervisor's routine inspections, and identify any proposed changes from the approved plans. For reporting of calendar years prior to landfill closure, the annual report shall include an estimate of the solid waste landfilled in the preceding calendar year in both tonnes and compacted in-situ cubic metres and review the remaining site capacity. The annual report shall include documentation of the method used to quantify the volume of waste discharged and the tonnage estimates shall be broken down into the estimated tonnes discharged from each regional district or other specific areas of origin to the satisfaction of the Director. Copies of the annual report shall be provided to the public libraries in Ashcroft and Cache Creek and posted on the Operational Certificate holder's web sites.

8. POST-CLOSURE SECURITY REQUIREMENTS

A post-closure monitoring, maintenance and repair fund shall be established and administered by the Director for the benefit of the Village of Cache Creek. Within 30 (thirty) days of the end of each quarter, Wastech Services Ltd. shall contribute money into this trust fund for wastes discharged to the landfill originating from outside the local area of the Village of Cache Creek. The amount of money contributed shall be determined according to the following schedule:

- \$0.75 per tonne of waste discharged during the first 8 (eight) years of waste transfer from the regional district or jurisdiction which is the source of the waste
- \$0.60 per tonne of waste discharged during the next 12 (twelve) years of waste transfer from the regional district or jurisdiction which is the source of the waste
- \$0.35 per tonne of waste discharged during each following year until landfill closure.

The Director shall have the sole authority to access and direct the use of monies from the trust fund for post-closure monitoring, maintenance and repair of the landfill site. The Director shall make monies available immediately upon closure of the landfill for the purposes of monitoring, maintenance and repair.

The trust fund shall remain in force for at least 10 (ten) years after closure of the landfill site. Thereafter, the need for the trust fund shall be reviewed by the Director once every 5 (five) years. The Director shall have the sole authority to reduce the size of the trust fund or eliminate the fund if, in the opinion of the Director, such action is warranted. In the event the trust fund is reduced or eliminated, the funds shall be released to the Village of Cache Creek to be used at the discretion of the Council of the Village of Cache Creek for municipal purposes.

9. CLOSURE PERIOD PLAN

The "Closure Period" is the indeterminate timeline commencing before cessation of landfilling activities and lasting until completion of discrete closure activities such as placement of final cap, establishing sustainable vegetation, etc. The Post-Closure Fund described in Section 8.0 will be applied to each discrete closure activity after the Director is satisfied closure has been met for that individual activity.

On or before August 31, 2012, a plan referred to as the "Closure Period Plan" shall be submitted for approval of the Director. The plan shall include at least the following:

- A list and description of discrete closure activities to be undertaken during the Closure Period;
- A projected timeline for each discrete closure activity from initiation to completion; and,
- Where appropriate, criteria for determining when the closure activity is complete.

The Closure Period Plan shall align with the Closure Plan as set out in Sections 4.1.2 and 4.1.4.

Donchi, Erin CSNR:EX

From: Danyluk, Carol ENV:EX
Sent: Wednesday, July 24, 2013 2:24 PM
To: Danyluk, Carol ENV:EX
Subject: FW: Cache Creek Landfill Closure Period Plan
Attachments: Closure Period Plan response letter.doc; Closure Period Plan Table final.doc; MR 7577 CCLF OC.doc; Closure Period Plan Concerns reviewed.docx

Importance: High

Note to File MR 7577

This is the latest draft response, which is comprised of the first two attachments, a letter and a table. I have also attached a copy of the Operational Certificate for reference and a memo that goes over some of the concerns and considerations.

Carol Danyluk, P.Eng.,

Senior Environmental Protection Officer
Thompson Cariboo Region
Ministry of Environment
1259 Dalhousie Drive, Kamloops BC V2C 5Z5.
Telephone: (250) 371-6229
carol.danyluk@gov.bc.ca



File: MR-7577

May 16, 2013

Wastech Services Ltd.
1200 United Boulevard
Coquitlam, BC V3K 6T4

Attention: Janet Tecklenborg
General Manager

Dear Janet Tecklenborg;

Thank you for meeting with Regional Environmental Protection representatives here on April 5, 2013, to discuss the Closure Period Plan submitted for the Cache Creek Landfill, and for your follow up correspondence of April 18, 2013, outlining the discussions we had on April 5, 2013. We have reviewed the Closure Period Plan and the requirements of the Operational Certificate 7577, and have identified some outstanding issues to be addressed or discussed further.

For clarity, I believe it is worthwhile to review the separate but related requirements of the Operational Certificate MR-7577 pertaining to planning for closure and post-closure activities at the landfill.

Design, Operating and Closure Plan

Section 4.1.2 of the Operational Certificate requires that design, operating and closure plans shall be reviewed every 5 years throughout the operating life of the landfill and updated to encompass the next 10 years of landfill operation and/or post-closure activities. The design, operating and closure plans include any information relevant to the design, operation, closure, and post-closure care of the landfill. The latest approved version of this plan, the Cache Creek Landfill Operations and Closure Plan 2009, October 16, 2009, would therefore require updating in 2014.

Post-Closure Plan

Section 4.1.4 of the Operational Certificate requires that a post-closure plan be prepared by a Qualified Professional and be submitted for the Directors approval at least 12 months prior to the estimated site closure date. This plan is to provide:

- a complete review and assessment report of the overall integrity of the landfill
- a detailed timetable for closure and/or post-closure procedures and correction of any deficiency identified in the review and assessment report, and
- a detailed schedule of inspection, monitoring and maintenance to be carried out for a minimum post-closure period of 25 years

- a process for the administration of the post-closure security fund required under section 8 of the Operational Certificate

Although not specified in section 4.1.4. of the Operational Certificate, once the Director has approved the plans for specific activities or measures required to close the landfill, an estimate of the anticipated costs for the post-closure monitoring and maintenance of the landfill site and associated works, along with reasonable contingencies, will be required for the fiscal management of the post-closure security fund.

Given that it is anticipated that the site will reach capacity and disposal of refuse will end sometime in 2016, the post-closure plan should be submitted in 2015 a minimum of 12 months prior to the completion of landfill. It was questioned during our meeting on April 5, 2013, whether it would be necessary to update the operations and closure plan in 2014 given the post-closure plan will be submitted the following year. In review of the requirements of the post-closure plan, it is clear that this plan will compliment but not necessarily replace the function of the design, operating and closure plan. The requirements of both sections 4.1.2 and 4.1.4. of the Operational Certificate must each be met.

Post-Closure Security Fund

Section 8 of the Operational Certificate provides specifications for the post-closure trust fund which is to be administered by the Director, who will have authority to access and direct the use of monies from the trust fund specifically for the purpose of post-closure monitoring, maintenance and repair of the landfill site.

Closure Period Plan

Section 9 of the Operational Certificate requires the closure period plan. The “closure period” is defined as “the indeterminate timeline commencing before cessation of landfilling activities and lasting until completion of discrete closure activities such as placement of final cap, establishing sustainable vegetation, etc.” The closure period plan is to provide:

- A list and description of discrete closure activities to be undertaken during the Closure Period;
- A projected timeline for each discrete closure activity from initiation to completion; and,
- Where appropriate, criteria for determining when the closure activity is complete.

The closure period plan will align with and support the closure and post-closure plans mandated in sections 4.1.2 and 4.1.4 of the Operational Certificate. The post-closure fund described in section 8 will be applied to monitoring, maintenance and repair of the closed landfill site after the Director is satisfied closure has been met for the relevant discrete closure activities as described in the closure period plan. The landfill post-closure plan that will be submitted a year prior to closure may also identify refined criteria for closure and post-closure activities based on the qualified professional assessment provided at that time.

For example, the post-closure fund will finance the cost of most monitoring activities associated with the landfill site immediately following the completion of the landfill. However, monitoring activities associated with the off-site migration of landfill gas will not be funded by the post-closure fund until it has been demonstrated that the current off-site migration of landfill gas is controlled in accordance with the specifications in the approved closure period plan. Monitoring activities that are dictated by the Environmental Assessment Certificate for the Cache Creek Landfill Expansion, such as the baseline monitoring program required for the Bonaparte River, will not be funded by this post-closure trust fund.

Attached you will find a table outlining the six different categories of closure period activities, these categories were also cited in your letter of April 18, 2013.

- Final Cover
- Re-vegetation
- Landfill Gas Management
- Leachate Management
- Groundwater Management
- Storm water Management

The table provides a brief summary of the criteria for completion, additional comments and an indication of the discrete closure activities and criteria for completion that are approved and the elements that will require further details and specification prior to approval. The following provides some elaboration and direction on the elements of the closure period plan which are not yet approved and the information still required.

Re-vegetation

The criteria for defining completion are agreeable in principle but very conceptual in nature and further detail is necessary. The proposed test plots at representative locations may provide a useful tool for gauging success of the re-vegetation program. However, how will it be confirmed that the test plots are actually representative of similar outcomes in the areas of the landfill that are intended to be represented by the individual test plots? Once a defined standard measure of successful re-vegetation is met, what will be the timeframe that demonstrates self-sustainability? How will the program be adapted as different areas of the landfill become self sustainable at different rates and times?

An overall assessment could be developed where the closed landfill is divided into a grid that can be rationalized based on physical and temporal attributes (location on landfill and completion of final cover, seeding, or history of re-vegetation attempts. Within the grid areas the rate of vegetation cover and diversity can be rated on a scale with a pre- defined standard or range of pass or fail. Completed sections of the landfill with individual grid areas that have all achieved the standard may be approved as complete at different times.

Landfill Gas Management

The criteria for the completion of the landfill gas extraction facilities are agreeable. However, once the criteria for completion are satisfied post-closure, there remains potential that additional extraction wells or other controls may become necessary in the future to address any further landfill gas migration that may occur. Under these circumstances the landfill gas utilization efficiency may be impacted. The closure period plan suggests a need for a strategy to balance the regulatory need to prevent landfill gas emissions and/or offsite migration with the Operational Certificate standard of greater than 75% utilization efficiency. This issue must be addressed in post-closure plan to be submitted in accordance with Section 4.1.4

As specified in section 3.2.4 of the Operational Certificate, the Post-Closure Fund will not be applied to the recovery of energy from landfill gas. Landfill gas utilization will remain the financial responsibility of Wastech Services post-closure. At our meeting on April 5, 2013, there was some discussion of whether condensate collection from the landfill gas extraction facilities and conveyance to the evaporation ponds for treatment should also remain the responsibility of Wastech Services. I invite you to provide me with a rational for further

consideration of how the cost of condensate collection and treatment should be apportioned post-closure.

Groundwater Management

The Closure Period Plan proposes the installation of groundwater recovery wells. In further considering this proposal it is appropriate to first determine the applicable water quality standards for the site and the point of compliance at which the standards will apply. The guidance for this determination is provided by *Technical Guidance 6 on Contaminated Sites*, (<http://www.env.gov.bc.ca/epd/remediation/guidance/technical/pdf/tg06.pdf>) . You are required to retain the appropriated qualified professionals to provide a recommendation and rational in this regard. Following receipt of the above information, I will make the determination of the applicable water quality standards and point of compliance. This will establish whether groundwater collection and treatment, or alternatively risk assessment, is a regulatory requirement.

I trust that the foregoing is clear, however please do not hesitate to request further clarification where necessary. Please contact Carol Danyluk at 250-371-6229 to discuss any outstanding concerns or questions.

Sincerely,

Jason Bourgeois,
For the Director, Environmental Management Act

Attachment: Closure Period Plan Review Table

Closure Period Plan Review

Final Cover			
Anticipated Completion	Criteria for Completion	Additional Information /Comments	Approval Status
Within 3 months of last load of refuse	- Final cover is completed in accordance with approved Design, Operations and Closure Plan and/or Post-Closure Plan. - Re-vegetation seed applied and irrigation set up. - Windblown litter cleaned up to the satisfaction of the majority of Landfill Advisory Committee Members	Post- Closure Plan may provide additional specification for closure post-closure activities, QAQC, based on QP assessment made at least 12 months prior to closure.	Approved
Within 1 year of last load of refuse.		Post Closure Security Fund will cover the cost of the land lease from the invoice period beginning after completion of the final cover	Approved
Re-Vegetation			
Anticipated Completion	Criteria for Completion	Additional Information /Comments	Approval Status
Minimum of 3 years after closure	- Self-sustaining vegetation without irrigation. - Determined by QP assessment.	Provide additional details in consideration of: - Potentially individual grid areas may be approved as completed at different times. - Establish guiding criteria for QP. Possibly describe percent cover and diversity on a scale (e.g. 1 to 10) and pick a passing grade. Describe measurement/observation criteria. - Once the standard is met, what is the timeframe that demonstrates self-sustainability?	Additional information and specifications required.
Minimum of 3 years.	Irrigation systems, fencing and site security maintained until after re-vegetation of specified areas approved.		Approved

Closure Period Plan Review

Landfill Gas Management			
Anticipated Completion	Criteria for Completion	Additional Information /Comments	Approval Status
Minimum of 2 years after closure.	Landfill Gas Extraction Facilities • QP submits report confirming all LFG facilities are in place and operational. • <2.5% methane off-property in monitoring/groundwater wells and <5% LEL at off-site locations/ structures for a minimum three consecutive years starting 2015. • LFG collection is >75% efficiency as determined by two consecutive measurements over 2 different seasons in 2016 and 2017.	Once criteria for completion are satisfied, the post-closure fund will be responsible for subsequent on-site and off-site emission monitoring. Once criteria for completion of LFG extraction facilities are satisfied, the post-closure fund will be responsible for extraction wells or other controls necessary to address any further LFG migration.	Approved
	LFG utilization strategy • Balance the requirement to prevent landfill gas emissions and/or offsite migration with the Operational Certificate standard of greater than 75% utilization efficiency.	LFG utilization efficiency may be impacted by measures to control offsite migration. It will be at Wastech's discretion to flare or utilize low quality gas while maintaining overall >75% collection efficiency.	Detailed specifications to be provided in post-closure plan in accordance with Section 4.1.4
	LFG Condensate Management • No specific criteria for completion have been established	Condensate collection and management are required as a function of landfill gas collection and utilization. LFG condensate is conveyed to the evaporation ponds or alternate disposal as approved by the Director. Rational is required to support apportionment of the cost of condensate management, given that the cost of energy recovery from landfill gas is not to be borne by the post-closure fund.	Additional information is required Detailed specifications to be provided in post-closure plan in accordance with Section 4.1.4

Closure Period Plan Review

Leachate Control			
Anticipated Completion	Criteria for Completion	Additional Information /Comments	Approval Status
Minimum One year following last load of refuse.	- QP submits report confirming evaporation ponds are complete. - No above-ground or at-ground surface off-site discharge of leachate for one year following last load of refuse.	Detailed specifications and QA/QC to be provided in post-closure plan to be submitted in accordance with Section 4.1.4	Approved
Groundwater Management			
Anticipated Completion	Criteria for Completion	Additional Information /Comments	Approval Status
Within 3 months of the last load of refuse.	- Final cap completion - Groundwater & Surface Water Monitoring	Post-closure security fund is responsible for cost of environmental monitoring following completion of landfill cap; not including monitoring associated with the Extension (i.e. Bonaparte River baseline study as per EA Certificate)	Approved
Within 3 months of the last load of refuse.	- Groundwater recovery wells are installed along with selected groundwater disposal opinion. - Groundwater monitoring to confirm performance of recovery wells	A determination of the appropriate water quality criteria and point of compliance must be made with reference to the Contaminated Sites Technical Guidance #6 –Water Use Determination. Exceedence of the criteria once determined would trigger remediation or risk assessment. Disposal option to be selected. Long term costs and implication to post-closure fund to be projected.	Additional information and specifications required.

Closure Period Plan Review

Surface Water Management			
Anticipated Completion	Criteria for Completion	Additional Information /Comments	Approval Status
Within 6 months of last load of refuse.	Completion of drainage work upgrades as outlined in Appendix D.	Include Appendix D in Post-Closure Plan	Approved



March 27, 2012

Tracking Number: 244931

Authorization Number: 7577

REGISTERED MAIL

Wastech Services Ltd. and the Village of Cache Creek
1200 United BLVD
Coquitlam, BC V3K 6T4

Dear Operational Certificate Holder:

Enclosed is Amended Operational Certificate 7577 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the operational certificate. **The following sections have been revised: addition of Section 3.2; revision to Section 4.1.5; and, addition of Section 9.0.** An annual fee will be determined according to the Permit Fees Regulation.

This operational certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority rests with the operational certificate holder. It is also the responsibility of the operational certificate holder to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

This decision may be appealed to the Environmental Appeal Board in accordance with Part 8 of the *Environmental Management Act*. An appeal must be delivered within 30 days from the date that notice of this decision is given. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

Administration of this operational certificate will be carried out by staff from the Southern Interior Region - Thompson. Plans, data and reports pertinent to the operational certificate are to be submitted to the Regional Manager, Environmental Protection, at Ministry of Environment, Regional Operations, Southern Interior Region - Thompson, 1259 Dalhousie Dr., Kamloops BC V2C 5Z5.

Yours truly,

Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*

Ministry of Environment

Environmental Protection
Division

1259 Dalhousie Dr.
Kamloops BC V2C 5Z5

Southern Interior Region -
Thompson
Telephone: (250) 371-6200
Facsimile: (250) 828-4000

Southern Interior Region - Thompson

Enclosure

cc: Environment Canada



MINISTRY OF
ENVIRONMENT

OPERATIONAL CERTIFICATE

7577

FOR THE CACHE CREEK LANDFILL

*Under the Provisions of the Environmental Management Act
and in accordance with the
Thompson-Nicola Regional District Solid Waste Management Plan*

**The Village of Cache Creek
Box 7
Cache Creek BC V0K 1H0**

**Wastech Services Ltd.
1200 United BLVD
Coquitlam, BC V3K 6T4**

are authorized to manage municipal solid waste at a sanitary landfill facility located in Cache Creek, British Columbia, subject to the conditions listed herein. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

This Operational Certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority shall rest with the Operational Certificate Holder. This Operational Certificate is issued pursuant to the provisions of Section 28 of the *Environmental Management Act*. It is the responsibility of the Operational Certificate Holders to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

This Operational Certificate supersedes all previous versions of the Permit PR-07577 or Operational Certificate MR-07577 issued under the *Waste Management Act* or the *Environmental Management Act*.

For the purposes of the administration of this Operational Certificate, "Regional Manager" means the Regional Environmental Protection Manager of the Ministry of Environment, Kamloops office.

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)

Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

1. LOCATION OF AUTHORIZED FACILITY

The location of the sanitary landfill facility for the management of municipal solid waste to which this Operational Certificate is applicable is described as:

- Pre-Annex boundaries of the Landfill as detailed in the September 24, 2005 Modification of the Lease from the Province to the Village of Cache Creek: Block A, Section 13, Township 21, Range 25 and Blocks C, D, E and F, Section 18, Township 21, Range 24, all West of the Sixth Meridian, Kamloops Division of Yale District and containing 49.636 hectares, plus
- Annex A added to the west side of the existing landfill footprint on February 16, 2009: Block B, Section 13 together with that part of Section 13 all of Township 21, Range 25, West of the 6th Meridian, Kamloops Division, Yale District, containing 6.70 hectares, more or less.

2. RECYCLABLE MATERIALS MANAGEMENT

Municipal solid waste that has value for the purposes of reuse or reprocessing shall be considered recyclable material. Recyclable materials may be diverted from disposal and temporarily stored at the landfill facility prior to removal from the site. The nature of the recyclable material authorized for storage at the landfill facility shall be to the satisfaction of the Regional Manager.

3. MUNICIPAL SOLID WASTE MANAGEMENT

3.1 Disposal to Landfill

3.1.1 The works authorized are a sanitary landfill and related appurtenances located approximately as shown on the attached Site Plan. The landfill shall be operated to meet or surpass the requirements for a sanitary landfill as described in the *BC Landfill Criteria for Municipal Solid Waste (1993)*.

3.1.2 The discharged waste shall originate from within the province of British Columbia, subject to the following:

- (a) Waste discharged to this landfill shall satisfy the requirements of the Thompson-Nicola Regional District Solid Waste Management Plan.

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

- (b) Waste discharged to this landfill shall not contravene the Regional Solid Waste Management Plan of the Regional District from which the waste originated.
- 3.1.3** All waste to be discharged at this site shall be inspected by a suitably trained Wastech Services Ltd. employee prior to receipt or shall be tipped, spread and inspected by a suitably trained Wastech Services Ltd. employee prior to being placed into the working face for compliance with the terms and conditions of the Operational Certificate.
- 3.1.4** The maximum authorized rate of waste discharge is 500,000 tonnes annually.
- 3.1.5** The characteristics of the waste discharged to the landfill are those of municipal solid waste as defined in the *Environmental Management Act*.
- 3.1.6** The following types of wastes shall not be discharged:
- (1) Hazardous wastes, other than those specifically approved for disposal to authorized landfills, as defined in the *Hazardous Waste Regulation* under the *Environmental Management Act*.
 - (2) Anatomical, pathological, and untreated biomedical wastes as defined in the *Guidelines for the Management of Biomedical Wastes in Canada* (Canadian Council of Ministers of the Environment, February 1992).
 - (3) Bulk liquids and semi-solid wastes, which contain free liquids, as determined by US EPA Method 9095A Paint Filter Liquids Test, Test Methods for Evaluating Solid Wastes-Physical/Chemical Methods (EPA Publication No. Sw-846).
 - (4) Hog fuel, log yard debris and chipped wood waste.
 - (5) Recyclable materials as directed by the Director.
- 3.1.7** Notwithstanding the requirements of section 3.1.6(1), the disposal of waste asbestos in compliance with the requirements of Section 40 of the *Hazardous Waste Regulation* under the *Environmental Management Act* is hereby authorized.

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

3.2 Recovery of Energy Potential From Landfill Gas (LFG)

- 3.2.1 On or before June 30, 2013, energy potential from the landfill gas shall be recovered in accordance with the plan approved under section 3.2.2.
- 3.2.2 On or before April 13, 2012, a plan referred to as the "LFG Utilization Plan" shall be submitted for approval of the Director. The plan shall include at least the following:
- Description of the process to recover the energy potential from the waste;
 - Projected energy recovery expressed in joules;
 - Expected efficiency of energy recovery; and,
 - A critical path to achieve recovery by June 30, 2013.
- 3.2.3 On or before the first day of each quarter, until project completion, a project progress report relative to the critical path shall be submitted to the Director.
- 3.2.4 The Post-Closure Fund described in Section 8.0 shall not be applied to recovering the energy potential from the landfill gas. For certainty, the post-closure fund shall not be applied to operation, maintenance, monitoring, capital upgrades or investigation related to energy recovery from the landfill gas.

4. OPERATING REQUIREMENTS

4.1 Design, Operating and Closure Plans

4.1.1 The following design, operating and closure plans are approved:

- (1) Cache Creek Sanitary Landfill, Volume 1 - Design, Operation and Closure, Volume 2 - Supporting Technical Documents dated December, 1988, prepared by Golder Associates Ltd. Consulting Engineers.
- (2) Cache Creek Sanitary Landfill Operations and Closure Plan 1995 dated April 12, 1995, and appendix 11 Internal Storm Water Management Plan, dated September 28, 1995, prepared by Golder Associates Ltd.,

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

- (3) Stage 4, Cache Creek Sanitary Landfill, Volume 1 - Design Features and Closure dated June 30, 1995, and Stage 4, Cache Creek Sanitary Landfill, Volume 2, Technical Analyses dated September 26, 1995, prepared by Golder Associates Ltd.
- (4) Landfill Gas Management Program, Cache Creek Landfill, Cache Creek, B.C., dated July 15, 1996, prepared by Golder Associates Ltd.
- (5) The Cache Creek Sanitary Landfill Operations and Closure Plan 2000, dated June 15, 2000, prepared by Golder Associates Ltd.
- (6) The Cache Creek Sanitary Landfill Operations and Closure Plan 2005, dated April 25, 2007, prepared by Golder Associates Ltd.

4.1.2 The design, operating and closure plans shall be reviewed every 5 years throughout the operating life of the landfill and updated to encompass the next 10 years of landfill operation and/or post-closure activities. The updated landfill design, operating and closure plans shall be prepared by a professional engineer or geoscientist licensed to practice in the province of British Columbia and knowledgeable in such matters. The updated plans shall be submitted to the Director for approval and shall include any information relevant to the design, operation, closure and post-closure care of the landfill.

4.1.3 Pursuant to Section 4.1.5 of this Operational Certificate, an updated design, operating and closure plan shall be submitted to the Director for approval by October 16, 2009. As a minimum, the updated plan shall address the following topics to the satisfaction of the Director:

- Design specifications for the blanket drainage system for leachate collection
- Quality assurance/quality control (QA/QC) protocol for the installation of the composite liner system and leachate drainage collection system
- Design specifications for the fly ash monofill
- Procedure for disposal of fly ash

Date issued:
Date amended:
(most recent)

March 18, 1987
March 27, 2012



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

- Procedure for washing fly ash trailers and the recycling of the wash water
- Program and schedule for establishment of self-sustaining vegetation on the final cover
- Leachate handling and disposal procedures, both during active landfill operations and during the post-closure period
- Site security and vector control provisions for less than 24 hour per day operations, particularly how bears, coyotes, birds, etc. will be prevented from accessing the active face during the non-active periods.
- Bird control program reviewed by Transport Canada as it relates to the adjacent airport.
- Updated site plan showing location of new groundwater monitoring wells
- Changes to groundwater monitoring program with respect to AMEC recommendations in June 2009 report
- Upgrades to the landfill gas collection system to improve gas collection efficiency
- Consideration of a baseline environmental monitoring program for the Bonaparte River.
- Re-evaluation of the final cap design and performance.
- Monitoring Committee Terms of Reference in accordance with section 5.2

4.1.4 A landfill post-closure plan shall be submitted not less than 12 months prior to the estimated site closure date. The post-closure plan shall be reviewed every 5 years following closure and updated to encompass the next 10 years of post-closure activities. The post-closure plan and subsequent updates shall be prepared by a professional engineer or geoscientist licensed to practise in the province of British Columbia and

Date issued:
Date amended:
(most recent)

March 18, 1987
March 27, 2012



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

knowledgeable in such matters. The post-closure plan and subsequent updates shall be submitted to the Director for approval and shall include at least the following:

- (1) a complete review and assessment report of the overall integrity of the landfill,
- (2) a detailed timetable for closure and/or post-closure procedures and correction of any deficiency identified in the review and assessment report, and
- (3) a detailed schedule of inspection, monitoring and maintenance to be carried out for a minimum post-closure period of 25 years.
- (4) a process for the administration of the post-closure security fund required under section 8 of this Operational Certificate.

4.1.5 The landfill facility shall be constructed and maintained in accordance with the plans approved under sections 3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4 and 9 subject to the conditions set herein. A knowledgeable representative from the engineering design firm shall carry out field reviews of the landfill construction and installation of works. As-constructed drawings of the landfill and all works, including elevations relative to a common datum, shall be submitted to the Director. The as-constructed drawings shall be sealed by a professional engineer or geoscientist representing the engineering design firm who is licensed to practise in the province of British Columbia and knowledgeable in the appropriate field of study.

4.1.6 Written authorization from the Director shall be obtained prior to implementing any changes to the approved plans. Based on any information obtained in connection with this facility, the Director may require revision of, or addition to, the design, operating and closure plans.

4.2 Landfill Site Development

4.2.1 Discharge of waste into water is prohibited. Surface water diversions and groundwater drainage works shall be installed to prevent surface water run-off and groundwater seepage from entering the waste discharge area. The effect of sediment transport from areas upgradient and within the landfill site shall be considered when designing, installing and maintaining the surface water diversion system. Diversion and drainage structures shall be maintained by the Operational Certificate

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

Holders on a regular basis to the satisfaction of the Director.

- 4.2.2** A berm of suitable material shall be constructed to preclude visibility of the active waste discharge area and any exposed wastes from travellers using the Trans Canada Highway.
- 4.2.3** Waste shall not be deposited at this site beyond the landfill stages 1, 2, 3, 4 and the area referred to in Section 1 as Annex A, as specified in the approved plans.

4.3 Waste Compaction and Coverage

- 4.3.1** Discharged wastes shall be compacted and cover material applied as outlined in section 4.3.2. Wastes shall be compacted and covered on a continuous basis. However, if operations are reduced to less than 24 hours per day, then provisions such as security, fencing, and/or other measures approved by the Director shall be deployed to prevent wildlife access. All wastes shall be covered within 24 hours of discharge to the landfill.
- 4.3.2** The area of the active landfill working face shall be minimized as much as possible. Wastes shall be spread in thin layers of 60 centimetres, or less, on the working face and compacted. A compacted layer of at least 15 centimetres of suitable soils, or a functionally equivalent depth of other cover material acceptable to the Director, shall be placed on all exposed compacted waste.
- 4.3.3** An intermediate cover of at least 30 centimetres of compacted soils, or a functionally equivalent depth of other cover material acceptable to the Director, shall be applied on any areas of the active landfill site to which waste will not be discharged for a period of 30 days or more.
- 4.3.4** Final cover shall be installed within 30 days of completion of the landfill to the final elevations as specified in the approved plans. Completed portions of the landfill shall progressively receive final cover during the active life of the landfill. Final cover shall consist of at least 1 metre of low permeability compacted mineral soil, overlain by at least 15 centimetres of topsoil capable of supporting indigenous vegetation. With the written approval of the Director, the topsoil used for this final covering may be mixed with conditioning agents such as sludge

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

(biosolids), compost and the like to add organics and improve the moisture holding capacity and nutrient value of the soil. Final cover shall be constructed and maintained with adequate drainage and erosion controls and seeded with suitable grasses.

- 4.3.5 The Director may vary the frequency of covering when freezing conditions adversely affect normal operation.

4.4 Landfill Management

- 4.4.1 The landfill shall be supervised to the satisfaction of the Regional Manager. Landfill supervisors shall be trained in landfill operation pertaining to the conditions of this Operational Certificate and the approved design, operating and closure plans.
- 4.4.2 Access to the site shall be controlled and supervised. All access points shall have locking gates and shall be locked during periods when supervision is not available.
- 4.4.3 Public scavenging and salvaging of waste at the landfill site is prohibited.
- 4.4.4 Designated areas shall be maintained for the storage of recyclable materials. These designated area(s) shall be separate from the active landfill area and shall be maintained free of litter. Storage of recyclable materials at the landfill site shall be limited to a reasonable length of time subject to the approval of the Director.
- 4.4.5 Litter and wind strewn waste shall be controlled by limiting the area of the working face, installing a wind blown litter collection fence in a location which is in the anticipated prevailing downwind direction of the landfill working face, instituting a regular litter pickup, general good site maintenance practises or any other measures required by the Director.
- 4.4.6 Dust and odour created within the landfill property shall be controlled using methods and materials acceptable to the Regional Manager.
- 4.4.7 Open burning of waste is prohibited.
- 4.4.8 The landfill shall be operated so as to minimize the attraction of

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

nuisance wildlife and disease vectors such as birds and rodents by applying adequate cover to the waste and by maintaining the site free of litter. Additional control measures may be specified by the Director if wildlife and/or vector attraction to the site becomes a public safety hazard.

- 4.4.9** The landfill works shall be inspected on a regular basis by the landfill supervisor. In the event of an emergency or any condition, which prevents continuing operation of the approved method of landfill operation and control, or results in non-compliance with the terms and conditions of this Operational Certificate, the Regional Manager shall be notified immediately and appropriate remedial action taken.
- 4.4.10** The Director may require future upgrading of the landfill control works to protect the environment during the operating life of the landfill and for a minimum post-closure period of 25 years.
- 4.4.11** Upon closure, the boundaries of the landfilled area shall be legally surveyed. A covenant that the property was used for the purpose of waste disposal shall be registered against the land title as provided for under Section 215.1 of the Land Title Act.

5. MONITORING

5.1 Environmental Protection Monitoring

Monitoring of ground and surface water, leachate collection sump fluids and landfill gas shall be carried out in accordance with the monitoring program approved in the design, operating and closure plans. The monitoring program shall be reviewed in the annual report required under section 7.2. Based on the information submitted in the annual report, or any other information obtained in connection with this site, the Director may vary the frequency, location and analyses of ground and surface water, leachate collection sump fluid and landfill gas sampling.

5.2 Monitoring Committee

A Monitoring Committee shall be established with representatives from the community including Secwepemc and N'lakapamux Nations. Details of the site development, operations, closure, post-closure and on-going environmental

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

monitoring and interpretation shall be shared with the committee. The purpose of the Monitoring Committee is to promote environmentally sound operations and effective monitoring.

6. LEACHATE CONTROL AND TREATMENT

6.1 Management of Leachate Collection System Fluid

Leachate collection sump fluid levels shall be monitored and fluid removed from the leachate collection system as specified in the approved design, operating and closure plans. A sample of fluid from each of the leachate collection sumps shall be collected on a quarterly basis and laboratory analyses obtained for the leachate indicator parameters identified in the monitoring program. The Director may vary the location and frequency of sampling and analyses of leachate collection system fluid should conditions warrant. Fluid recovered from the leachate collection system may be used within the landfill footprint for irrigation, dust suppression and/or re-circulated within the buried waste unless otherwise directed by the Director. Other methods of treatment and/or disposal of the leachate collection sump fluids must have the prior approval of the Director.

6.2 Groundwater Contamination by Leachate

Should it be determined that leachate is being generated and carried in the groundwater or surface water and, in the opinion of the Director, requires interception and treatment, appropriate remedial measures as approved by the Director shall be implemented.

7. REPORTING

7.1 Interim Reporting and Record Keeping

The leachate collection sump fluid level readings, groundwater elevation and combustible gas monitoring data, and the sump fluid, groundwater and gas sampling analyses results shall be available for inspection at the Wastech Cache Creek Landfill office. Data from monitoring and sample analysis shall be submitted to the Regional Manager with the annual report in accordance with section 7.2. Between annual reporting events, the Regional Manager and Monitoring Committee (ref. section 5.2) shall be promptly informed of any significant changes from long term trends observed in the parameters that are

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

monitored.

7.2 Annual Report

An annual report shall be submitted by March 31 of each year for the previous calendar year of landfill operation or post-closure activities. The annual report shall review and interpret the analytical data from monitoring of leachate collection sump fluids, groundwater and landfill gas for the preceding calendar year. Proposed changes to the monitoring program shall be identified in the annual report. The annual report shall summarize the findings of the landfill supervisor's routine inspections, and identify any proposed changes from the approved plans. For reporting of calendar years prior to landfill closure, the annual report shall include an estimate of the solid waste landfilled in the preceding calendar year in both tonnes and compacted in-situ cubic metres and review the remaining site capacity. The annual report shall include documentation of the method used to quantify the volume of waste discharged and the tonnage estimates shall be broken down into the estimated tonnes discharged from each regional district or other specific areas of origin to the satisfaction of the Director. Copies of the annual report shall be provided to the public libraries in Ashcroft and Cache Creek and posted on the Operational Certificate holder's web sites.

8. POST-CLOSURE SECURITY REQUIREMENTS

A post-closure monitoring, maintenance and repair fund shall be established and administered by the Director for the benefit of the Village of Cache Creek. Within 30 (thirty) days of the end of each quarter, Wastech Services Ltd. shall contribute money into this trust fund for wastes discharged to the landfill originating from outside the local area of the Village of Cache Creek. The amount of money contributed shall be determined according to the following schedule:

- \$0.75 per tonne of waste discharged during the first 8 (eight) years of waste transfer from the regional district or jurisdiction which is the source of the waste
- \$0.60 per tonne of waste discharged during the next 12 (twelve) years of waste transfer from the regional district or jurisdiction which is the source of the waste
- \$0.35 per tonne of waste discharged during each following year until landfill closure.

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

The Director shall have the sole authority to access and direct the use of monies from the trust fund for post-closure monitoring, maintenance and repair of the landfill site. The Director shall make monies available immediately upon closure of the landfill for the purposes of monitoring, maintenance and repair.

The trust fund shall remain in force for at least 10 (ten) years after closure of the landfill site. Thereafter, the need for the trust fund shall be reviewed by the Director once every 5 (five) years. The Director shall have the sole authority to reduce the size of the trust fund or eliminate the fund if, in the opinion of the Director, such action is warranted. In the event the trust fund is reduced or eliminated, the funds shall be released to the Village of Cache Creek to be used at the discretion of the Council of the Village of Cache Creek for municipal purposes.

9. CLOSURE PERIOD PLAN

The “Closure Period” is the indeterminate timeline commencing before cessation of landfilling activities and lasting until completion of discrete closure activities such as placement of final cap, establishing sustainable vegetation, etc. The Post-Closure Fund described in Section 8.0 will be applied to each discrete closure activity following cessation of landfilling at the site and after the Director is satisfied closure has been met for that individual activity.

On or before August 31, 2012, a plan referred to as the “Closure Period Plan” shall be submitted for approval of the Director. The plan shall include at least the following:

- A list and description of discrete closure activities to be undertaken during the Closure Period;
- A projected timeline for each discrete closure activity from initiation to completion; and,
- Where appropriate, criteria for determining when the closure activity is complete.

The Closure Period Plan shall align with the Closure Plan as set out in Sections 4.1.2 and 4.1.4.

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

Considering Closure of the Cache Creek Landfill

The Cache Creek Landfill (CCLF) is scheduled to close in 2016. When the site was originally authorized in 1987, a post-closure fund was established for the monitoring, maintenance and repair of the landfill. The value of the fund, as of January 2012, was approximately \$12.7 million held in an internal trust managed by government. The fund is to be administered by the Director for the benefit of the Village of Cache Creek.

Essentially, on closure of the site, the Ministry of Environment becomes the contract manager for the site and the Director shall disperse funds for all post-closure activities. MOE remains as the regulator, but also becomes the financer and pays the owner/operator for all post-closure activities. Any residual from the fund, will ultimately be released to the Village of Cache Creek.

This arrangement sets up some unique challenges:

- The current thinking is that Wastech will submit an annual budget which will be approved by the Director. Administration of monthly disbursement will be carried out the Village of Cache Creek. A third party monitor, paid for by the fund, will provide oversight on disbursement of the fund and will report directly to the Ministry. Additional considerations are:
 - Currently Wastech's contract with Metro, sets a fixed profit at 12%. However, there is no contract in place with the Ministry, and as Wastech and the Village are site owners and Wastech is the operator, Wastech will be the sole source of all work. There is really nothing that prevents them from increasing their profit margin.
 - The way the trust has been set up, really removes any motive on the part of Wastech from preserving the value of the trust.
 - If the trust is depleted, through contractual arrangements, Metro indemnifies Wastech and the Village for 20 years post closure. Beyond 20 years, liability provisions of the contaminated sites regulation kick in.
- At what point does the Closure Fund start to pay for activities?
 - For example:
 - environmental monitoring will likely be paid from the fund the last day garbage is received;
 - cap maintenance: a couple of months within the time when the last load of waste has been deposited, the final cap is completed;
 - vegetation: likely a few years after closure once viable vegetation has been demonstrated to be established. What is the criterion for defining adequate re-vegetation? (Adequate re-vegetation is determined by a professional and based on percent cover and species composition) Is there a potential need for on-going irrigation? What is the water source?

- LFG Management: the fund does not pay for LFG utilization but does pay for managing off-site migration. This area of responsibility and cost has potential for conflict;
 - Do Wastech's fees include administration and management costs? To what extent within their organization?
 - All of these pose challenges for apportionment of costs and are likely to be the subject of on-going negotiations. As Metro and the Village will have continued financial interests in the project, no doubt they will want to be part of the negotiations;
 - Wastech has recently submitted a "closure period plan" which starts to form criteria and timelines for the above.
- Leachate Control - Wastech was advised last year of their obligation to give notice of off-site migration. Considerations include:
 - o 6 offsite wells appear to be influenced by the landfill above background and exceed CSR in varying amounts (e.g. drinking, aquatic, irrigation and livestock); 1 for sulphate and chloride, 4 for sulphate only, and one for fluoride. Levels are nothing to get excited about, the leachate is being attenuated and there are no receptors being impacted.
 - o Wastech is concerned about additional regulatory burden, the perception of pollution that might be created through "notice of offsite migration" and that after a lot of additional assessment work they will end up having to actively collect and treat leachate regardless. Based on advice from LRM, Wastech was asked to hold off giving notice.
 - o Wastech has responded proposing a groundwater pump and treat system (**only the irrigation option proposes to treat the water**) in the order of 100 m³/day. Options for disposal of the groundwater include: 1) 10 hectares of evaporation ponds, 2) evaporation using waste heat from internal combustion engines at the electrical generation plant, 3) 6 hectares of spray evaporation ponds, or 4) on-site spray irrigation. Although costs have not yet been estimated, it will surely be in the multi-millions of dollars.
 - o Questions around how long a pump and treat system would be necessary, where would ponds be located, any ancillary impacts to the groundwater regime, have not yet been considered.
 - o The pump and treat system is likely unnecessary for environmental protection and but appears to be a response to anticipated controversy in giving notice of off-site migration. Note that under the terms of the contract with Metro, Metro would like finance the capital and the closure fund would finance long term operations.

- Is there enough money in the fund?
 - Intuitively, yes. Cost estimates have not been projected for the above. Sorting out the details for post-closure of the site has just started. Cost estimates will be developed over the next couple of years.
 - If cost estimates predicts surplus in the fund, it is anticipated that the Village will request release of the residual. If the costs predict the fund it inadequate, there is really not an obvious solution for increasing the value of the fund. The initial focus would be on minimizing disbursements.

Donchi, Erin CSNR:EX

From: Danyluk, Carol ENV:EX
Sent: Wednesday, July 24, 2013 1:28 PM
To: Gardner, Larry ENV:EX
Cc: Bourgeois, Jason ENV:EX
Subject: FW: Files regarding the Closure Period Plan

Importance: High

Can you call me about this?

Not Responsive

However, Janet is also interested in seeing any internal communications that are routinely releasable with regards to the Closure Period Plan.

Carol

From: Janet Tecklenborg [<mailto:jtecklenborg@wastech.ca>]
Sent: Wednesday, July 24, 2013 10:53 AM
To: Bourgeois, Jason ENV:EX
Cc: Danyluk, Carol ENV:EX
Subject: Files regarding the Closure Period Plan

Jason,

As discussed this morning, is it possible to come up to Kamloops tomorrow or Friday to review the Cache Creek Landfill Closure Period Plan? Please let me know if this works for you.

Best regards,

Janet

Janet Tecklenborg, P.Eng.
General Manager
Wastech Services Ltd.
o - 604-517-6572
m - 604-314-2389

From: Haley, Megan ENV:EX
Sent: Wednesday, May 29, 2013 7:54 AM
To: Danyluk, Carol ENV:EX
Subject: Off-site CCL

Not sure if this will be of any use to you, but I found it and thought I would send it your way! Larry's comments are in red!

- The water in the area is not currently used for drinking water. **Any idea where the nearest well is and any information on why or why not it would be influenced by CCLF? I know the AMEC report discusses this. If you don't know where to access the information off hand, don't worry about it at this point.**
- The measured total dissolved solids in the area were reported to have a mean of 4100 mg/L, with a range of 1380-8660 mg/l, these measurements were prior to construction of landfill (Source: CCL Volume II Supporting Technical Documents December 1988, Table 3-1, pg 11)
 - Technical Guidance 6 states that groundwater containing a total of dissolved solids concentration of 4000 mg/l or greater is considered to be unsuitable to be used for drinking water.
- The Bonaparte River is located approximately 500 m away from the landfill (Closure Period Plan, pg 2, C-1) (this is the direct distance not necessarily the groundwater flow path of the first entry point of the groundwater flow in to the Bonaparte).
 - Technical Guidance 6 states that aquatic life water use applies to all groundwater located within 500 m of a surface water body containing aquatic life.
- The hydraulic conductivity at the base of the landfill (on the east side of the trans Canada hwy) is approximately $3 \times 10^{-5} - 1 \times 10^{-5}$ m/s (Source: CCL Volume II Supporting Technical Documents December 1988, Table 2.1, pg 7)
 - The closet aquifer to the landfill defined by BC Water Resources Atlas, is located adjacent to the Bonaparte River valley, north of the landfill, it is comprised of alluvial, glacial, and fluvial sediments (Closure Period Plan, pg 3)
 - Technical Guidance 6 states that if there is an aquifer below the site with a hydraulic conductivity greater than 1×10^{-6} m/s and a yield greater than or equal to 1.3 l/min **then what?**
- Currently no irrigation is taking place on adjacent properties. Further investigation is required to confirm if irrigation wells exist in the area and have the potential to be used

Megan Haley, BSc, C.I.T.
Environmental Protection Officer
1259 Dalhousie Drive
Kamloops, BC V2C 5Z5
Phone: (250) 371-6283
Fax: (250) 371-40000
Megan.Haley@gov.bc.ca

Donchi, Erin CSNR:EX

From: Danyluk, Carol ENV:EX
Sent: Monday, July 8, 2013 12:38 PM
To: Counce, Cassandra ENV:EX
Subject: RE: Cache Creek update

Cache Creek Landfill

- The site is operated by Wastech Services Ltd. and the majority of the waste deposited there is imported from Metro Vancouver. Closure of this landfill site is currently anticipated for sometime in 2016. A 'Closure Period' Plan has been submitted as required by the Operational Certificate to plan for the transition period from the last load of refuse and the closure works that must be completed prior to the post-closure administration of the landfill. This is significant as the post closure maintenance of the site is to be managed by the Ministry and funded out of the \$13 million plus landfill post-closure trust fund. Post-closure activities include the management of landfill gas and leachate, and the maintenance of final cover and vegetation.
- The Ministry is currently reviewing the Closure Period Plan. Wastech is proposing that, based on trends in groundwater monitoring data, local groundwater may require treatment. Additional information will be required to establish the appropriate water quality standards and points of compliance for this landfill site and the surrounding receiving environment. Background water quality is marginal in the vicinity.
- Wastech has been required by an amendment to the Operational Certificate to make beneficial use of the energy from landfill gas generated at this landfill site. The LFG Utilization Plan was approved last year, and proposes the use of reciprocating engines to produce electricity. Wastech and the Ministry are working with BC Hydro to facilitate the upgrade of the Ashcroft Power Station that will enable the substation capacity to handle the additional power.
- Stabilized Fly Ash from the Metro Van Burnaby Incinerator has been deposited to the Cache Creek Landfill since approximately 2001 without issue. In 2012 fly ash test results for two months failed to meet the standard required by the Hazardous Waste Regulation for leachable cadmium. The importation of fly ash from Metro Van to the Cache Creek landfill has been discontinued since October 2012. Investigation remains inconclusive at this time as to whether the stabilization process was incomplete or alternatively, is there issues with the reliability of the testing procedure and the results reported. An independent Study is underway to determine the reliability of the stabilization process and process controls, the suitability and reliability of the analytical testing procedure, and potentially, the cause of the high results reported last year. The study will also make recommendations for a management protocol for the fly ash that was imported during the period last year when the exceedences were reported.

Carol

From: Counce, Cassandra ENV:EX
Sent: Monday, July 8, 2013 10:09 AM
To: Danyluk, Carol ENV:EX
Subject: Cache Creek update
Importance: High

Hi Carol,

Can you give me a quick 3-4 sentence summary on what is happening with Cache Creek please? It's for the ROB highlights which is due today.

Thanks,

Cassandra Counce
Regional Director, Environmental Protection
Thompson & Cariboo Regions

Ministry of Environment

1259 Dalhousie Drive

Kamloops, BC V2C 5Z5

(direct) 250.371-6225 • (fax) 250.828-4000 • (reception) 250.371-6200

www.gov.bc.ca/env

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Monday, April 22, 2013 4:49 PM
To: 'Janet Tecklenborg'
Cc: Danyluk, Carol ENV:EX
Subject: RE: Closure Period Plan

Ok...will touch base with you tomorrow....I essentially completed it and provided it to Carol. I just wanted to get your first impressions before putting in a bunch of time. We'll clean it up and get you something more robust. My suggestion to Carol as that she provide you a draft copy that maybe it is easy to answer some of the basic questions before sending it to you formally.

Larry

From: Janet Tecklenborg [<mailto:jtecklenborg@wastech.ca>]
Sent: Monday, April 22, 2013 4:38 PM
To: Gardner, Larry ENV:EX
Cc: Danyluk, Carol ENV:EX; David Thompson
Subject: RE: Closure Period Plan

Larry,

I received the very preliminary attached draft table. There is not enough information for me to comment on the format or the preliminary data that was included.

Thanks

Janet

From: Gardner, Larry ENV:EX [<mailto:Larry.Gardner@gov.bc.ca>]
Sent: April-18-13 5:03 PM
To: Janet Tecklenborg
Cc: Danyluk, Carol ENV:EX
Subject: Closure Period Plan

As discussed, this is very draft...well, more half-baked concept really. I haven't even shared this internally (Carol is getting a copy via this e-mail). Essentially, I am attempting to take the "criteria" out of the Closure Period Plan, confirm what we have accepted, and highlight the pieces where we need to do a little more work. I would propose that we attach such a table in formalizing approval of what you already submitted.

Anyway, I just thought I would throw it at you for any initial thoughts. I plan to finalize it on Monday.

Thanks,

Larry

Donchi, Erin CSNR:EX

From: Danyluk, Carol ENV:EX
Sent: Thursday, July 25, 2013 11:58 AM
To: Gardner, Larry ENV:EX
Subject: RE: Closure Period Plan e-mails

Thanks. I have put all of these records to the paper file.
I will also copy these records to the authorization file on lanshare.

Unless you prefer otherwise, I will delete the folder below once I have completed this?

Cheers.

Carol

From: Gardner, Larry ENV:EX
Sent: Wednesday, July 24, 2013 3:18 PM
To: Danyluk, Carol ENV:EX
Subject: Closure Period Plan e-mails

Placed them here...was pretty thorough and figures this covers it.

[\\Avenger\S40066\WANSWARE\EPD\EPD_SHARED\Cache](#) Creek Landfill\Closure-Period Plan

Donchi, Erin CSNR:EX

From: Bourgeois, Jason ENV:EX
Sent: Thursday, June 13, 2013 6:29 PM
To: Danyluk, Carol ENV:EX
Cc: Gardner, Larry ENV:EX
Subject: Re: Notice of Likely or Actual Offsite Migration, CCLF

I just skimmed this. If LRS knows what we intend to do and are not screaming "you cannot do that", then I am good with this.

I will talk to you in greater detail about this when Carol gets a chance.

From: Danyluk, Carol ENV:EX
Sent: Thursday, June 13, 2013 04:56 PM
To: Bourgeois, Jason ENV:EX
Cc: Gardner, Larry ENV:EX
Subject: FW: Notice of Likely or Actual Offsite Migration, CCLF

Jason, when you and I discussed this earlier this week, we were both of the impression that the ROM director that Larry referenced below would be Jennifer McGuire. I had a chance to discuss this with Larry today, and he clarified that the he meant the Regional EP decision maker, you or Cassandra (whoever might sign the Operational Certificate or make any decision under that authorization).

Larry and I discussed whether the approach suggested below would be confirmed or established as policy endorsed by our executive. The group cc'd below is not currently tasked with bringing forward a policy for the approval of our executive. I understand it is more of an adhoc committee of Section Heads that have expressed concern at resolving this and other issues related to CSR and landfill authorizations.

Larry suggested that you might be comfortable with proceeding on the basis of the consensus of this committee, or you might decide to flag it to Cassandra for further direction from our executive. The committee did consider your reservations of doing indirectly what you cannot do directly, but did not see this as the case.

I can proceed with crafting a response to Wastech to the proposed groundwater collection and treatment scenario which will provide technical direction on the information we will require to make a decision on the appropriate water quality standards and point of compliance. The advice to Wastech will reference the CSR technical guidance (TG6) as the appropriate methodology to follow, but will not suggest that the CSR process for decision making should kick in at this time.

However, once we have received the additional information that I will be requesting, someone will need to make a decision in fairly short order so that the detailed design and installation of works can proceed well in advance of the closure of this landfill in 2016.

As I see it, if you make a decision now in good faith based on the CSR TG6, which is a clear and reasonably precise technical procedure, you are acting in a the collective best interest of all concerned. You would be basing your decision on a set of scientific principles that, to the best of our current knowledge, will be used in the future when and if the CSR kicks in.

Another way of looking at it - If you make a decision now under the OC, this should not impede or impair any delegated director from making a decision as required in the future by the CSR or otherwise, if there is good reason to do so.

I think this is common sense but I know that this does not always prevail even when we want it to. Or I may be entirely missing the point or, as usual, a little naive.

Thanks for your consideration Jason.

Carol

From: Gardner, Larry ENV:EX
Sent: Monday, June 10, 2013 3:51 PM
To: Danyluk, Carol ENV:EX
Cc: McCammon, Alan W ENV:EX; Sundher, Avtar S ENV:EX; Love, Mark P ENV:EX; Stroich, Chris ENV:EX
Subject: RE: Notice of Likely or Actual Offsite Migration, CCLF

Hi Carol,

You asked: "who will make the determination of the appropriate water quality standards and point of compliance related to the landfill?". Consensus from our committee at this point is that it would be the ROM SDM. Such a determination would be on the basis of Permit/OC conditions and not be under CSR Sec. 12. However the decision would be informed by an assessment following TG6.

The possible implication of fees for the determination is going to take further discussion to sort out. For the interim, I would suggest directing Wastech to undertake an assessment following TG6 and that the assessment will be used as the basis for the ROM director to set the applicable standard and point of compliance. Don't have them complete a *Contaminated Sites Fee for Service Application Form*; this may inadvertently direct them down the fee path (although this could be a future direction we take).

I hope this helps with your communications with Wastech. If it would help to vet a letter by this committee for comment, I would be pleased to coordinate that.

I've appended the e-mail correspondence on this matter for your information.

Larry

From: Stroich, Chris ENV:EX
Sent: Friday, June 7, 2013 10:54 AM
To: Gardner, Larry ENV:EX
Cc: McCammon, Alan W ENV:EX; Sundher, Avtar S ENV:EX; Love, Mark P ENV:EX
Subject: RE: Notice of Likely or Actual Offsite Migration

Hi Larry,

As we discussed yesterday here's my 2 cents...

Your first bullet ... *The closer we align the process of determining standards using CSR guidance and process, the more it appears we are trying to "indirectly" make a determination that we don't have authority for*

- I am not so sure about that. We use other agencies standards, principles, best practices all the time to inform decisions that essentially 'prevent pollution'.

Fees..... I think we should be charging fees for any application that is non-standard. For example if the proponent wants to exceed BC WQG at the property boundary, there should be a fee for the extra review. We have a long way to go with this, like getting standardized assessment procedures and standardized risk determination procedures.

Chris Stroich, M.Sc., P.Ag.
Section Head, Environmental Management
British Columbia Ministry of Environment
#401-333 Victoria Street

Nelson, B.C., V1L 4K3
Tel: 250-354-6387
Cell: 250-551-2255
Fax: 250-354-6332
Email: Chris.Stroich@gov.bc.ca

From: Gardner, Larry ENV:EX
Sent: Tuesday, June 4, 2013 9:58 AM
To: Stroich, Chris ENV:EX
Cc: McCammon, Alan W ENV:EX; Sundher, Avtar S ENV:EX; Love, Mark P ENV:EX
Subject: RE: Notice of Likely or Actual Offsite Migration

Chris, so sorry I missed you on my original post!
much appreciate any thoughts you have on the discussion below.

S22

Still, I would very

There is some really good discussion here and I guess we are due for another call. I'll see if I can set something up in the next week or two.

As for providing Carol advice, there are two questions that I believe Alan and I are in agreement on...Mark, Chris, Avtar...would you care to way in?

- Regulatory oversight of authorized discharges rests with ROM to the max extent possible until such time and there is a change in land use. So it should be a ROM SDM setting the appropriate standard and point of compliance. *[I agree with Alan that ROM SDMs have a lot of authority without being delegated under CSR S.12. My concern is the principal in law that "what you can't do directly, you can't do indirectly". The closer we align the process of determining standards using CSR guidance and process, the more it appears we are trying to "indirectly" make a determination that we don't have authority for. If no one else see this as a concern, we can just leave it alone. Alternately, I can seek advice from Dennis Doyle or we can just recommend to the Director that delegation authority of CSR S.12 be extended...thoughts?]*
- Fees...a determination of the appropriate groundwater use under CSR incurs fees. At this point we are suggesting that a determination by ROM would not trigger fees as it would be done under a similar but different process. *[Alan, is this something you want to run by Mike McFarlane before we pass on advice to Carol? At best, Mike would be prepared to make a call on this. Alternately we could prepare a Decision Note for DEC or Steering Committee. I think many of the principals that Alan highlights in his message would form the rational for a Decision Note. To quantify the costs would take a little more thought but could range from: 1) number of landfills x \$fee; to 2) (number of landfills + mines + major industrial sites) x \$fee]*

I believe it would be safe for Carol to start down the path of a determination with CCLF. She just needs to be aware that we need to confirm the SDM subject to the above and confirm whether fees will be imposed. If you are in agreement, I'll communicate this last paragraph to Carol.

Larry

From: McCammon, Alan W ENV:EX
Sent: Monday, June 3, 2013 11:05 AM
To: Danyluk, Carol ENV:EX; Gardner, Larry ENV:EX
Cc: Kukleva, Natalia ENV:EX; Evans, Peggy L ENV:EX; Haley, Megan ENV:EX; Love, Mark P ENV:EX; Sundher, Avtar S ENV:EX
Subject: RE: Notice of Likely or Actual Offsite Migration

Sorry for delay... here are a few comments from me regarding the most recent emails from Carol and Larry; comments are noted and underlined within Larry's most recent email, below.

Generally, I would agree with Carol and Larry that it would be desirable for ROB to continue its oversight of CCLF as it carries out remedial actions but remains fundamentally a landfill operation (assuming this is the case).

More broadly, here are my current thoughts (fellow Committee members, in particular, feel free to pipe up if there's any substantive disagreement with these):

- I think we need to continue to strive for simplicity in our interpretation and implementation of the applicable regulatory provisions in the landfill context... for the benefit of our EP team as well as our clients.
- I think it's appropriate that regulatory oversight of landfills remain, to the max extent possible, in the hands of ROB at least until such time as a landfill owner wishes to actively prepare for and implement a new land use during or after landfill closure. I understand this is consistent with the MOU on roles/responsibilities as between ROB and LRS. See next bullet for challenge.
- I think there remains a need for some further discussion and establishment of a common position within EP as to when the various concurrent legal requirements of EMA Part 4 (e.g., Notification of commencement/completion of independent remediation; Notification of offsite migration; Duty to submit a site profile due to "decommissioning") are triggered or not triggered. The fact is that Part 2 and Part 4 of EMA co-exist and operate simultaneously; it's up to us to see what interpretive flexibilities may exist to make the regulatory framework appropriately effective for us (the regulator) and appropriately streamlined and predictable for clients. It's important for all to appreciate that the above notification triggers, for example, only apply in the context of "independent remediation" including "site investigation". It sounds like the present CCLF example might put us in that place where both parts of EMA are operating... i.e., remediation underway or planned to be? But in other situations this may not be the case.
- I think what our Committee has noticed is that there can be a gap between the expectations of ROB and LRS for environmental protection at landfill sites under permit/OC and under remediation, respectively. This isn't surprising in my view given the different histories (genesis and application of regulatory approaches). Recent discussions of the Committee suggest there is value in seeking to narrow this gap (seek greater consistency in EP expectations across the Division) and it is recognized that one of the biggest challenges relates to the legacy portfolio of authorized landfill sites, a portfolio that the Division is not well resourced to address but which could be addressed over time when applications are made to amend these authorizations or during closure.
- I'm an advocate for ROB leveraging, as much as possible, the existing remediation regulatory framework (e.g., CSR s. 12, TG6, TG15 etc. regarding specification of applicable standards, point of compliance etc.; TG4 and TG8 regarding vapour and groundwater characterization, again where these represent appropriate technical guidance) because I think this has the potential to assist with fostering greater consistency in EP. The Committee looking at the EMA Part 2 and Part 4 interplay will be discussing some recent thoughts Larry has put together regarding the potential applicability of TG8 (the groundwater characterization one) in the landfill context, for example.
- Finally, no matter where we work in the EP Division we are striving for the same thing: effective and meaningful environmental and human health protection. And since we're trying to protect the same environment and the same people, it would seem appropriate to harmonize our expectations and approaches to the extent we can.

I know I may not have specifically answered all the questions posed by Carol and Larry, but maybe some of this higher level stuff can help us get there.

Also, if you see some value, I'm certainly open to chatting on the phone regarding the current CCLF situation.

Regards,

Alan
604.582.5280

From: Evans, Peggy L ENV:EX
Sent: Monday, May 27, 2013 9:29 AM

To: Gardner, Larry ENV:EX; Danyluk, Carol ENV:EX; Kukleva, Natalia ENV:EX; McCammon, Alan W ENV:EX
Cc: Haley, Megan ENV:EX; Sundher, Avtar S ENV:EX; Love, Mark P ENV:EX
Subject: RE: Notice of Likely or Actual Offsite Migration

Hi All

A small point of clarification on my advice to Larry at the bottom of his email.

While Fe/Mn standards for drinking water have been dropped in Schedule 6, CSR for the majority of land uses, it does not mean that they do not represent a health risk, or aesthetic annoyance as in the case of Fe. Increasingly, Mn is found to have toxic effects at low concentrations. The WHO limit for Mn is 400 ug/L. Health Canada Guidelines are aesthetic based at Fe - 300 ug/L and Mn - 50 ug/L. The CSR DW standard (tox based) is Fe – 6,500 ug/L and Mn - 550 ug/L. The application of the standards for most industrial activities were dropped in a recent CSR amendment because dissolved Mn, and to lesser extent Fe, are commonly found above the CSR standards in shallow groundwater, either from natural causes or from any number of human activities, including landfills. There was extensive debate around the amendment but in the end we went forward with it because Fe/Mn had become the focus of, and an impediment to, the remediation of a large number of contaminated sites.

My comment

“So, municipal landfills, composting operations or hydrocarbon contaminated sites no longer have to investigate Fe/Mn in groundwater where DW use applies”

should have read

“While CSR Fe/Mn standards no longer apply to municipal landfills, it would still be prudent to include Fe/Mn in compliance monitoring programs due to the aesthetic and health effects of these substances and Health Canada DW guidelines (and CSR tox-based standards that apply elsewhere). However, the presence of Fe/Mn above CSR DW standards in groundwater migrating onto a neighbouring property would no longer invoke a legal obligation to send a Notification of Contaminant Migration to the neighbour, although they could still be triggers for response within an Operational Certificate.”

Peggy

From: Gardner, Larry ENV:EX
Sent: Friday, May 24, 2013 4:53 PM
To: Danyluk, Carol ENV:EX; Evans, Peggy L ENV:EX; Kukleva, Natalia ENV:EX; McCammon, Alan W ENV:EX
Cc: Haley, Megan ENV:EX; Sundher, Avtar S ENV:EX; Love, Mark P ENV:EX
Subject: FW: Notice of Likely or Actual Offsite Migration

Hi Carol, I had attempted to capture the latest perspective on this matter from the group working on *EMA waste discharge authorizations and the alignment to EMA Part 4 (Contaminated Site Remediation)* in the attached e-mail. It seems there are still a couple of key points outstanding before starting down this path as follows:

- There seems to be consensus at this point regarding potential contamination from authorized facilities and having the proponent apply TDG6 in requesting the SDM set the appropriate groundwater standard and point of compliance.
- I would advocate that the SDM would be the person responsible for oversight of the site...so in the case of the CCLF it would be the Regional Director or Section Head. **However, SHs don't have the authority under CSR S.12** (I don't believe RDs do either but didn't have a delegation letter to check). There is a possible debate on whether CRS S.12 would be invoked under this type of determination...we could seek legal advice. Likely the easiest would be to expand regional SDM's delegation authority to include S.12. Alternately, determination would have to go to land remediation. (Thoughts on this Alan?) My feeling is that perhaps CSR s. 12 and supporting guidance like TG6 and TG 15 can be utilized by the landfill owner and ROB decision maker in determining performance targets outside of the legal context of EMA Part 4 legal decisions (i.e., no need for additional delegated authority)... recall that the ROB SDM has a lot of authority under Part 2 and I wouldn't see why he/she couldn't draw upon whatever is helpful to set down requirements in the primary authorization or any associated negotiations with the permit holder.
- If the decision rests with the regional SDM, no doubt the land remediation folk can provide us advice on this. For many cases TDG6 will likely provide sufficient guidance. But for some, following TDG6 none of the

standards will apply. What then? For existing sites, it may not make sense to use the property boundary as the point of compliance. Where should it be then? We realize that further guidance on these kinds of points will help with consistency of application. In the interim, we should be able to take advantage of land remediation's experience to help us with this. Is the "Landfill Criteria" document helpful with respect to this? For example it speaks to points of compliance being 150 m away from the landfill footprint I think? Perhaps TG15 could be concurrently applied and appropriate points of compliance established? As for absence of applicable standards in the EMA Part 4 framework, the "Landfill Criteria" appear to list several potential references for performance standards and maybe those will help in these circumstances?

- At some point down the road, should the responsibility for oversight transfer, the new SDM may determine that some change in the standard or point of compliance is necessary for protection of the environment. Obviously such a change would need to consider previous decisions. This is akin to what we do with permit amendments. This is why the current discussions will be very helpful... so that we take advantage early to see if we can have more consistent environmental protection targets and so there will be less of a gap for those landfill sites (perhaps the minority) that will be put to a new future use, post-closure.
- Another matter is fees. Would the proponent be subject to fees? (Alan, I think regionally we would jump to not imposing fees, however, if you see different maybe this point warrants further discussion?) If the ongoing "separation" of our regulatory oversight (to the extent we can do it up until new landfill site uses are contemplated) is possible, then I don't see EMA Part 4 fees kicking in unless clients make specific applications to Land Remediation for review or other services.

Once the standard and point of compliance is established, the next question is: "Is there an exceedance?"

If not, all is good. If there is an exceedance, I believe "notice of off-site migration" would be triggered and subsequently "risk classification" (Peggy? Alan?...this may be a detail that we still need to work out). Nevertheless, risk assessment and/or mitigation would be triggered. No doubt, the Land Remediation folk could guide us through the risk assessment process. At this time, I don't know that we could just adopt the existing guidance documents for risk assessment outright...I'm guessing that would be likely. If the risk assessment determined acceptable risk, all is good. If not, we are back to mitigation. Regarding the duty to submit notice of offsite migration (NOM), it only applies in the context of independent remediation or site investigation (see additional explanation of this in my bullets above). So, the duty may arise when the permit holder moves into those categories of work but presumably the ROB permit will have required some sort of notification to MoE already due to the performance fail and can provide any necessary direction regarding notifications beyond that point while remediating the fail.

If anyone has a contrary understanding of where we landed, please jump in. **I see we still need to sort out who the SDM is and the matter of fees to answer Carol's question.**

By the way, I understand from Peggy that...*"DW standards for Fe and Mn have been dropped for all but a limited number of industrial/commercial activities (CSR, Schedule 2 uses). You'll have to check Schedule 6 of the CSR (water standards) where there is a footnote indicating which uses (mostly metal mining, smelting, working, waste-disposal, etc) would still have Fe/Mn DW standards apply. So, municipal landfills, composting operations or hydrocarbon contaminated sites no longer have to investigate Fe/Mn in groundwater where DW use applies"*.

Larry

From: Danyluk, Carol ENV:EX
Sent: Friday, May 24, 2013 11:56 AM
To: Gardner, Larry ENV:EX; Evans, Peggy L ENV:EX; Kukleva, Natalia ENV:EX; McCammon, Alan W ENV:EX
Cc: Haley, Megan ENV:EX
Subject: RE: Notice of Likely or Actual Offsite Migration

Hi all, I am preparing a response to Wastech related to the groundwater pump and treat proposal that has been forwarded as part of the closure plans for the Cache Creek Landfill. I am wondering if perhaps there was any subsequent response or discussion on this email that I was not copied on?

Key to my response is who will make the determination of the appropriate water quality standards and point of compliance related to the landfill? I would like to recommend that our regional Director make the determination so that we can clearly identify the basis for the remedial actions required of Wastech prior to closure (2016). The determination would be based on the criteria in CSR TG6 and the landfill criteria which I see as not conflicting.

I would like to confirm that I have not missed anything essential to this recommendation?

Thanks for your consideration.

Carol Danyluk, P.Eng.,

Senior Environmental Protection Officer
Thompson Cariboo Region
Ministry of Environment
1259 Dalhousie Drive, Kamloops BC V2C 5Z5.
Telephone: (250) 371-6229
Fax: (250) 828-4000
carol.danyluk@gov.bc.ca

Our Plan For The Future- BC Pollution Free



Please consider the environment before printing this email.

From: Gardner, Larry ENV:EX
Sent: Wednesday, June 6, 2012 4:58 PM
To: Evans, Peggy L ENV:EX
Cc: Kukleva, Natalia ENV:EX; Rhebergen, Frank ENV:EX; Perkins, Megan ENV:EX; Danyluk, Carol ENV:EX
Subject: FW: Notice of Likely or Actual Offsite Migration

Hi Peggy, further to our discussion regarding “notice of offsite migration” for the Cache Creek Landfill, I thought it would be good to record my understanding of the issue. I think this helps with common messaging as we move forward. I am aware that the Natalia is trying to mesh our regulatory processes (Permits/OCs and the CSR) with the updated landfill criteria. Also, I had a meeting with Wastech this morning and a number of points came up with respect to these two separate regulatory processes. At any rate, here is my understanding of the issues and processes:

Background on Cache Creek Landfill:

- There are about 30 wells at the site and 3 background wells (307, 309, TH1). The landfill has developed over two prior background wells. The two attachments provide some further detail on the wells and contaminants.
- Background Wells: 307 & 309 exceed CSR water standards for sulphate and manganese; TH1 exceeds CSR for sulphate and boron; (would need to confirm that none of these are influenced by LFG which would make them unsuitable for background).
- 6 offsite wells appear to be influenced by the landfill above background and exceed CSR in varying amounts (e.g. drinking, aquatic, irrigation and livestock); 1 for sulphate and chloride, 4 for sulphate only, and one for fluoride.
- Levels are nothing to get excited about and the leachate is being attenuated.
- Wastech is concerned about additional regulatory burden, the perception of pollution that might be created through “notice of offsite migration” and that after a lot of additional assessment work they will end up having to actively collect and treat leachate regardless.
- To my surprise, they are considering proposing a multi-million dollar pump and treat system...basically jump right to the solution. They would also like to do this under the terms of the closure plan and not be dragged into the CSR process. They see this as unnecessary if they are going right to the solution. I don’t know if this is possible or how the CSR might apply.
- I am satisfied that an active treatment system is not necessary. So what is the downside if the proponent wants to do it? There are a couple of considerations here: 1) essentially Metro Vancouver finances it; I can’t really see them being thrilled about the idea and think there could be grounds for them to appeal my approval of the closure plan arguing that the collection/treatment is unnecessary; 2) what might be the

implication to the trust fund that finances the site post-closure? These issues are not pertinent to the landfill/CRS discussion but sometimes it helps to be aware of the motivators.

Is notification triggered?

- Wastech questioned whether notification of offsite migration is triggered. I responded that it is by “investigation” or “remediation”. I understand past LRB conversations landed on monitoring as a condition of permit is “investigation” and , therefore if a CSR level is exceeded then notification is required. It seems they would like a definitive answer to this question...are you the correct person to direct them to?

Background levels already exceed CSR:

- Under Protocol 9, Wastech can request a determination that would set background levels. Presumably, they have enough information on hand to support such an application. I believe this would cost \$3K in CSR fees. However, as down gradient wells appear to be slightly higher than the background, it is likely notification of offsite migration would be required anyway.
- How do you determine the applicable criteria for the site? Peggy, you mentioned that DW is the default. Can they request that the director specify the criteria under Section 12 where the director takes in to account the site specifics? Is there a fee for this? Could the director conclude none of the water uses (drinking, aquatic, irrigation livestock) apply? (For certainty, I do not have delegated authority for this section of the legislation.) It seems Technical Guidance, Water Use Determination, which I provided them, supports this approach.

What happens after they give notification?

- It appears by Fact Sheet #34, that if Notice of Offsite is required, it triggers Risk Classification as per Protocol 12. I think there is a reasonable probability that the risk classification will result in this being a high risk site. I don't understand the consequence should this be the outcome...could you provide further explanation?
- Then what? In the event there is applicable water criteria that is exceeded, would the next step be to either remediate or risk assess the contaminant? Would this involve delineating all possible contaminants of concern? For an active landfill, this could be quite onerous. Or would the conclusion be to leave it to the Director responsible for oversight in consideration of the of the following clause within the Operational Certificate?

Groundwater Contamination by Leachate

Should it be determined that leachate is being generated and carried in the groundwater or surface water and, in the opinion of the Director, requires interception and treatment, appropriate remedial measures as approved by the Director shall be implemented.

- It is worth pointing out that the following clause is common to landfill permits (not in Cache Creeks).

Groundwater Impacts

Groundwater at the property boundary (or as otherwise specified by the Director) shall not be impacted by leachate beyond levels specified in a separate letter from the Director.

It begs the question....which Director (CSR or Regional...or either/both?)

In light of the above, do you have advice on how Wastech should proceed? As I noted above, they would prefer to continue down the path of being regulated by their OC and not trigger any CSR obligations. Is there something I missed to misrepresented? I have a hard time negotiating the regulatory maze we have created with our overlapping processes.

This issue is also related to the points Ben Van Nostrand raised below. I suspect it applies to pretty much all the landfills in the province and the CSR requirements are largely being ignored as they apply to landfills. If I had my druthers, we would separate landfills from the CSR in a similar fashion to what we have done for oil, gas and mines. I don't believe we achieve any greater level of environmental protection through the additional regulatory burden.

Thanks,

Larry

From: Rhebergen, Frank ENV:EX
Sent: Thursday, March 15, 2012 1:44 PM
To: Danyluk, Carol ENV:EX; Gardner, Larry ENV:EX
Subject: FW: Notice of Likely or Actual Offsite Migration

FYI

*Frank Rhebergen, P.Eng.
Senior Environmental Protection Officer
Ministry of Environment
1259 Dalhousie Drive, Kamloops BC V2C 5Z5
Phone: 250 371-6207 / Fax: 250 828-4000*

From: Kukleva, Natalia ENV:EX
Sent: Thursday, March 15, 2012 12:51 PM
To: Leuschen, Allan ENV:EX; Rhebergen, Frank ENV:EX
Subject: FW: Notice of Likely or Actual Offsite Migration

FYI. It's really relevant to the discussion we had around appropriate water quality criteria to be used at property boundary. Not sure how to address the issue if there is an issue with current OCs.

From: Evans, Peggy L ENV:EX
Sent: Thursday, March 15, 2012 12:01 PM
To: Kukleva, Natalia ENV:EX; Wilson, Jennifer A ENV:EX
Cc: McCammon, Alan W ENV:EX; Hanemayer, Vincent C ENV:EX; Macfarlane, Mike ENV:EX; Fox, Glyn ENV:EX; Walton, Doug ENV:EX; Ward, John ENV:EX
Subject: FW: Notice of Likely or Actual Offsite Migration

Hi All

I'm bringing a recent inquiry to your attention as it is likely to come up at your meeting next week on landfill criteria. Unfortunately, your meeting coincides with our weekly management meeting where we will be discussing this issue. I'm not sure who from LRS can attend your meeting S22 and Alan and I would normally be at our management meeting. We'll sort this out separately.

The issue at hand relates to performance criteria during landfill operation but would also apply at closure. It stems from overlap with CSR stds and requirements. I don't recall it coming up in a big way at the meeting I attended early in the year on landfill criteria.

Issue:

- The ministry has imposed more stringent procedures for protecting groundwater under the CSR (effective Feb 1, 2011). In short, drinking water is assigned as the default water use at a site unless there is a demonstrated lack of a groundwater resource below the site (per Tech Guidance). Previously, water use under the CSR was determined based on a current DW user within 1.5 km or a site, or alternative assessments could be done to prove DW shouldn't apply;
- The DW standards are more stringent generally than the AW standards of the CSR, sometimes considerably more stringent;
- Fe, Mn standards exist for DW use. There are no Fe, Mn stds for AW use. These are of course common contaminants at landfill sites due to the abundance of carbon and consequent O2 consumption and dissolution of Fe, Mn from native soils. There could be others constituents that would pop up as a problem where DW stds vs Aw stds apply (Cl, As);

- The CSR has provisions for Notification of Contaminant Migration (NOM) onto neighbouring properties. These provisions kick in where contamination is “known or likely to be occurring onto neighbouring properties” during “investigation (Sct 60.1) or remediation (Sct 57)”.
- At the Columbia-Shuswap RD landfill (see Ben Van Nostrand’s email below), the Op Cert requires monitoring at the property boundary to show compliance with AW stds. Their consultant reviewing groundwater monitoring results along the property boundary advised that the DW stds now apply under the CSR, concentrations of Fe, Mn and As exceed DW stds and a NOM is triggered.

Next Steps

- I let Ben know that LRS is currently reviewing the Fe, Mn DW stds and that process may result in changes to how the stds apply over the next 2-3 months.
- I advised that LRS would discuss monitoring as a trigger for NOMs under the Part 4, EMA.
- This latter point is where there is overlap with compliance measures used in Operational Certificates. I don’t know how these are set (maybe previous CSR guidance) but it sounds from Ben’s email that there may be a lot of OCs that use AW stds as the compliance measure and potentially a lot of landfills with Fe, Mn exceedances at the property boundaries. This is important context and would be good to have more details from those dealing with landfills.
- I don’t know what the draft landfill criteria propose in this regard but now is as good a time as any to raise the issue.
- The conclusion of our reg review of Fe, Mn DW stds will take awhile but we are well aware of the problem with landfills.
- I can let you know where we ended up in our LRS mgmt. mtg on monitoring and NOMs and you can hopefully share your groups thoughts in this regard after next week.
- In the meanwhile, I’ve recommended Ben wait until the ministry gets back to him before making any decisions on his site.

Hope this is helpful in framing the issue and don’t hesitate to stop by if you have any questions.

Peggy

From: Evans, Peggy L ENV:EX
Sent: Thursday, March 15, 2012 10:27 AM
To: 'Ben Van Nostrand'
Cc: Gardner, Larry ENV:EX; Mickel, Tamara ENV:EX; Rhebergen, Frank ENV:EX
Subject: RE: Notice of Likely or Actual Offsite Migration

Thanks Ben

Yes, you’re inquiry was timely indeed. There’s a few people that need to be brought into the discussion. Might be a week before I can get back to you on this.

Cheers
Peggy

From: Ben Van Nostrand []
Sent: Thursday, March 15, 2012 9:49 AM
To: Evans, Peggy L ENV:EX
Cc: Gardner, Larry ENV:EX; Mickel, Tamara ENV:EX; Rhebergen, Frank ENV:EX
Subject: RE: Notice of Likely or Actual Offsite Migration

Hi Peggy, thanks again for taking the time to get back to me yesterday and discuss how the CSR DW Standards impact municipal landfill monitoring programs. It is my understanding that you are going to discuss the issue further with your counterparts and potentially regional offices, after which you will be getting back to me to provide an update.

In the meantime I will work with our groundwater monitoring contractor to hold off on finalizing the reports and the subsequent recommendations which will trigger the CSRD having to notify our downstream neighbours. I am fully prepared to comply with the CSR however, I want to ensure that this is indeed the intent of the legislation, as it will likely affect the majority of landfills around the province.

My other questions for the Regional offices is whether or not the existing Operational Certificates need to be amended to include a reference to the CSR standards and potentially wording around CSR triggers for offsite notices of contamination.....or should it be left as is.

Sincerely,

Ben Van Nostrand B.Sc., P.Ag., ASCT.
Waste Management Co-ordinator, Environmental & Engineering Services
COLUMBIA SHUSWAP REGIONAL DISTRICT
direct (250) 833 5940
fax (250) 832 1083
cell (250) 517 7271

www.csr.bc.ca

From: Evans, Peggy L ENV:EX [<mailto:Peggy.Evans@gov.bc.ca>]
Sent: Tuesday, March 13, 2012 5:02 PM
To: Ben Van Nostrand
Subject: RE: Notice of Likely or Actual Offsite Migration

Hi Ben

Sorry not to have called back. I've been very busy this week. I'm in tomorrow afternoon. Can you let me know a good time to call?

Regards

Peggy Evans, M.Sc., P.Geo.
Manager, Risk Assessment and Remediation
Land Remediation Section
BC Ministry of Environment
Phone: 250-356-8386
Peggy.Evans@gov.bc.ca

From: Ben Van Nostrand [<mailto:bvannostrand@csrd.bc.ca>]
Sent: Monday, March 12, 2012 3:58 PM
To: Evans, Peggy L ENV:EX
Subject: Notice of Likely or Actual Offsite Migration

Hi Peggy, I have some questions regarding the landfill I manage and the applicable Contaminated Sites Regulation (Section 6).

If you could call me when you have a moment I'd appreciate it.

Cheers,

Ben Van Nostrand B.Sc., P.Ag., ASCT.
Waste Management Co-ordinator, Environmental & Engineering Services
COLUMBIA SHUSWAP REGIONAL DISTRICT
direct (250) 833 5940
fax (250) 832 1083

cell (250) 517 7271

www.csr.bc.ca

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Monday, August 20, 2012 4:20 PM
To: Gardner, Larry ENV:EX
Subject: CC Landfill Study (5).doc



CC Landfill Study
(5).doc



File: MR-07577

March 31, 2009

Conestoga-Rovers & Associates
Frederick (Rick) Mosher
rmosher@CRAworld.com

AMEC
Dean Wall
dean.wall@amec.com

SLR Consulting
John Wiens
jwiens@slrconsulting.com

Stantec/Jacques Whitford
Lesley Reid
Lesley.reid@jacqueswhitford.com

Dear Sirs and Madam,

Re: Study of Cache Creek Landfill Environmental Monitoring

The intention of this letter to advise you of a study being commissioned by the Ministry of Environment to review and assess existing designs and environmental monitoring related to the Cache Creek Landfill (CCLF). The conclusions and recommendations from this 3rd party review will serve as guidance to the Ministry for future decisions regarding design, operations, monitoring, closure and possible expansion planning for the CCLF. The study is to be undertaken by experts in landfill design, hydrogeology, contaminant transport, geochemistry and toxicology. The project is expected to commence immediately with completion eight weeks from initiation.

You are invited to respond by April 7, 2009 advising of your interest in undertaking this study. I ask that you include the following information in your response:

- The team you would propose to assemble for the study complete with:

- o Team member's role and an estimate in percentage of time of their involvement in the study (e.g. Project Manager/Reviewer @ 40% of the project). Contributors with less than 5% anticipated time need not be identified.
 - o Curriculum Vitae for each of the team members.
 - o Confirmation of each team member's immediate availability for the project. (On commencement of the project, team members shall not be replaced without written approval.)
- List any projects your firm or individual team members have undertaken in the past two years related to interior British Columbia landfills, British Columbia waste to energy projects, Metro Vancouver projects or Wastech Services Ltd. projects. The purpose of this request is to avoid any perception of bias with those with past involvement with this facility, facility proponents or related activities.

The preferred consultant will be selected based on the demonstrated expertise of the team and in the absence of past work related to this facility. A *Terms of Reference* and fee for the study will be negotiated with the preferred consultant the week of April 7, 2009 with project commencement on or before April 14, 2009. The project is expected to be completed by the first week of June, 2009.

The conclusions and recommendations from this 3rd party review will serve as guidance to the Ministry for future decisions regarding design, operations, monitoring, closure and expansion of the CCLF.

The following provides further background on the project:

Wastech Services Ltd. of Coquitlam, BC, has been operating the CCLF since it opened in 1989 on provincial crown land leased to the Village of Cache Creek and sublet to Wastech. The CCLF is currently authorized to receive up to 500,000 tonnes per year (tpy) of municipal solid waste (MSW) from Metro Vancouver with a relatively small fraction coming from Powell River, Cowichan Valley and Thompson Nicola Regional Districts. Included in the 500,000 tpy total is typically 10 to 15,000 tpy of stabilized incinerator flyash from the MSW incinerator in Burnaby. A total of 8.3 million tonnes of MSW has been disposed of at CCLF to date and the current landfill area will reach capacity in the last quarter of 2010. An application by Wastech for an amendment to their Operational Certificate requests authorization for expanding the horizontal footprint of the landfill by 6.9 hectares, thereby increasing the capacity by about 750,000 tonnes. A further application is in the provincial Environmental Assessment review process for adding 15 million tonnes capacity on land directly adjacent to (above) the existing LF operation.

Since inception of the CCLF, Golder Associates has been the primary consultant for landfill design, operations and closure planning, landfill gas and leachate collection systems, and receiving environment monitoring (groundwater and off-site migration of gas). Golder produces annual operations and monitoring reports which outline design and/or operational changes on site, compile the monitoring data and provide an interpretive analysis. Gartner Lee is contracted by the Village of Cache Creek to annually review the Golder submissions.

The CCLF is constructed on a hillside in the dry southern interior of BC (avg annual precipitation of 230 mm) and has a 1 m thick compacted clay liner at the base of the entire landfill area. Finger drains, constructed at the base of each of the 4 stages are sloped towards leachate collection sumps which are automatically pumped to leachate holding tanks which are periodically emptied by a tanker truck for discharge on the working level of the landfill. The leachate collection finger drains and sumps have an additional 40 mil HDPE liner on top of the clay liner. A network of 18 groundwater monitoring wells exists around the landfill and monitoring data goes back to 1988, prior to MSW disposal at the site. A landfill gas collection system includes 63 vertical wells, a dual flare system and associated interconnection works.

Findings of a Health Canada-funded study, recently done for a first-nation tribal council (NNTC) and released to media on March 19, raised a number of red flags about the CCLF. Among the report's key findings was an apparent contamination of groundwater draining into the Bonaparte River and private wells, with leachate reaching within two kilometres of the Ashcroft Indian Band's main well. In addition, tests performed on the livers of a couple of dead coyotes (road kill) found significantly elevated levels of dioxins and furans which is speculated to be sourced from the landfill gas flare system and/or the incinerator flyash. The report is critical of the landfill's design, particularly with respect to the liners and leachate collection system. The study entitled An Investigation of Landfill Emissions in Assessing the Potential for Health Impacts on Bands within the Nlaka'pamux Nation, was prepared by Dr. Michael Easton, PhD, of International EcoGen Inc. An accompanying report entitled Hydrogeological Assessment: Boston Flats Area, Cache Creek, B.C. was prepared by Summit Environmental Consultants Ltd. (Copies of both reports are attached.)

This most recent work presents differences in opinion on environmental impact from the CCLF and is the impetus for this study.

It is not envisioned that further site investigation will be carried out and that this study will rely on existing information. It is believed that most, if not all, of this information is available electronically and includes but is not limited to:

- o Landfill designs and operations plan;*
- o Annual operations and monitoring reports;*
- o Existing 3rd parties reviews of environmental monitoring;*
- o Landfill gas assessment;*
- o Information on the WES-fixed flyash from the Burnaby WTE facility;*
- o The referenced EcoGen and Summit reports; and,*
- o Ministry and other agency reviews of the above information.*

I would appreciate if you would immediately reply by e-mail and advise whether or not you will be responding to this request. I thank you advance for considering this project.

Sincerely,

Larry Gardner, ASCT, Eng.L
Head, Municipal Section
Environmental Management

Attachments

Donchi, Erin CSNR:EX

From: Perkins, Megan ENV:EX
Sent: Friday, December 21, 2012 10:15 AM
To: Gardner, Larry ENV:EX
Subject: CCL Period Closure notes
Attachments: Closure Plan notes.docx

Review of CCL Period Closure Plan

Defining Final Cover Design Completion

- Adequate soil cover thickness - 1 m thick barrier soil with hydraulic conductivity of 6×10^{-5} cm/sec or less
- 0.2 m thickness of top soil
- Adequate surface drainage works to allow quick runoff away from cover
- Landfill slopes - Landfill slopes are 2.6:1 between benches, and an overall slope of 3:1 including benches
- Compaction of waste and complete coverage with intermediate cover before the application of the final cover
- Installation of all required leachate and water lines, insuring at least 1.2 m of soil cover for winter frost purposes
- Windblown litter collection – litter from the landfill, North Borrow property, and a distance of 300 m beyond the Landfill property – based on the majority of the opinion of the members of the landfill advisory committee

Defining Revegetation Completion

- On average vegetation equal to or equivalent to the vegetation on the landfill prior to the landfill development – 60% cover, species composition to be determined over a period of several years – preferred native species include: Rabbit brush, Bluebunch wheatgrass, Rough fescue, Sandberg's bluegrass, Prairie sagewort, Brittle prickly-pear cactus, Umber pussytoes, Yarrow, Long-leaved daisy, acceptable non-native species: Crested wheatgrass, Hard fescue, Tall wheatgrass, Idaho fescue (weeds are not included in percent cover)
- Application of a growing medium of top soil, organic matter, and other amendments to create a friable and fertile bed
- Corrective reclamation measures (adding growing medium, reseeding, planting seed plugs)
- The percent vegetation cover and species composition will be determined by a competent Professional Biologist or Agrologist, Registered in BC

Defining Irrigation Completion

- Target condition is a combination of drought tolerant grasses, herbs, and forbs that will survive without ongoing watering and with minimal maintenance.
- Will the site require continued irrigation?
- Will current water supply be effect for future water demands?

Defining Landfill Gas Management Completion

- The qualified professional for the Landfill Gas Management Facilities Design Plan confirms that all of the required LFG management facilities are in place and operational.
- No off-property gas or groundwater monitoring wells exceed 2.5 % methane by volume, over 12 consecutive monitoring rounds starting at the beginning of 2015
- No off-property ambient air measurements exceed 5% of the lower explosive limit for methane (0.25% methane by volume), for 12 consecutive monitoring rounds starting at the beginning of 2015. Sampling locations: current Wastech office, Wastech shop, truck wash, crawl space of the trailer on the Coast Range Concrete property, and in the corner of the former chip plant property.
- The LFG collection efficiency is 75% is greater as defined by the Landfill Gas Management Facilities Design Guidelines, or at Wastech's option, as determined by two methane emission discharge rate measurement rounds during two different season in 2016 and/or 2017, which indicate that methane emissions are 27% or less than the methane collection rate averaged over the 30 days leading up to including the day of the measurements.

Defining Leachate Control Completion

- Adequate management of leachate means that the maximum annual volume of leachate can be managed by evaporation in the proposed evaporation ponds, infiltration into the refuse of Stage 5 via the leachate recirculation system, or both.
- No above-ground or at-ground off-site discharge of Landfill leachate to the environment occurs within one year if the final MSW placement at the landfill

Defining Surface Water Management Completion

- All road/bench ditches to be lined with filter cloth and rip-rap
- Ensure correct construction of channel side slopes
- Sediment traps at culvert inlets are clean, and have appropriate side slopes, and have ponding depths of at least 0.3 m.
- Do necessary culvert slope improvements, repair damaged culvert inlets or outlets
- Filter cloth and rip-rap berm areas

Notifications and Survey

- Press release eight months prior, bulletin one year prior, posting sign at the landfill one year prior.
- Complete survey of the Landfill
- A post-closure maintenance manual should be prepared which includes: safety considerations, a plan identifying each facility that would need to be maintained, a summary of the design of the landfill, and a timeline of significant events.

Groundwater Flow Notes

- FEFLOW (three- dimensional numerical groundwater flow model) predicts the travel time for groundwater to flow from the Landfill to the Bonaparte River to be between 70 and 165 years
- Based on hydrogeological data from previous site investigations and available regional information.
- Use groundwater extraction wells, to manage migration of groundwater from beneath and around the landfill
- Determined that 8 to 12 pumping wells would be required to account for pumping inefficiencies and heterogeneities
- Wells would have a collective pumping rate of 100 m³/day
- Options for Groundwater disposal:
 - Evaporation ponds – 10 hectares would be required
 - Utilization of waste heat from internal combustion engines – predicted 5000 to 8000 m³/year of water could be evaporated by utilizing the waste heat from the internal combustion engines
 - Spray evaporation ponds – 6 to 8 hectares of evaporation ponds with spray evaporators. Goal is to provide 20 to 30% volume reduction
 - On-site treatment plant – disposed water could be treated in a modular treatment plant. 85% would be suitable for reuse (irrigation) or discharge to surface water. The remainder of the 15% would require 1.5 hectares of evaporation ponds and spray evaporation.

Defining Groundwater Management Completion

- Groundwater recovery wells are installed along with selected groundwater disposal option
- Groundwater monitoring to confirm performance of recovery wells

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Monday, April 22, 2013 4:44 PM
To: Danyluk, Carol ENV:EX
Subject: Closure Period Plan Table.doc

Closure Period
Plan Table.doc

Still needs a little work...but close.

	Task	Expected Completion	Criteria for Completion	Additional Information/Comments	Approval Status
1	Final Cover	Within 3 months of last load of refuse	• final cap completed. • seed applied and irrigation set up. • QP report submitted and approved by MOE. • Windblown litter cleaned up to the satisfaction of the majority of Landfill Advisory Committee Members	Closure Plan to be submitted in accordance with Section ??? providing specification details, QAQC 12 months in advance of closure.	Approved
2	Re-vegetation	Minimum of 3 years after closure??	• Self-sustaining vegetation without irrigation. • Determined min. 1 year (??, 2 growing seasons?) post irrigation. • Determined by QP assessment.	Provide additional details in consideration of: • Potentially individual grid areas may be approved as completed at different times. • Establish guiding criteria for QP. Possibly describe percent cover and diversity on a scale (e.g. 1 to 10) and pick a passing grade. Describe measurement/observation criteria. • Once the standard is met, what is the timeframe that demonstrates self-sustainability?	Not Approved. Subject to further discussion.
3	Irrigation	Min. of 3 years??	• After re-vegetation of entire site is approved.		Approved
4	Landfill Gas Monitoring (on-site and off-site)	Minimum of 3 years after closure.	• QP submits report confirming all LFG facilities are in place and operational. • 12 consecutive seasonal monitoring	Once criteria for completion is satisfied, the PCF will be responsible for subsequent on-site	Approved

	emissions)		rounds following cap installation showing <2.5% methane off-property in monitoring/groundwater wells. • 12 consecutive seasonal monitoring rounds following cap installation showing <5% LEL at off-site locations/structures. • LFG collection is at minimum >75% efficiency determined by two consecutive measurements over 2 seasons showing methane <27% or less than the methane collection rate averaged over the 30 days in advance of the measurement (??).	and off-site emission monitoring.	
5	Landfill Gas Migration	Minimum 3 years after closure.	• Same as #4, LFG Monitoring	Once criteria for completion is satisfied, the PCF will be responsible for installation or replacement of on or off-site extraction wells or other controls necessary to address LFG migration. Connection of any extraction well to the LFG recovery system will be the responsibility of Wastech. Note that this will be regardless of the quality of the gas. It will be at Wastech's discretion to flare or utilize low quality gas.	Not Approved. Subject to Further Discussion
6	Landfill Gas Collection and Utilization	Ongoing responsibility of Wastech	N/A	Except for extraction wells as per item #5, LFG collection and utilization remains the responsibility of Wastech.	Not Approved. Subject to further discussion.

7	Condensate Management	Within 6 months of last load of refuse.	QP submits report confirming evaporation ponds are complete.	Condensate collection and conveyance to the evaporation ponds remains the responsibility of Wastech. Once the condensate is conveyed to the evaporation ponds or alternate disposal method as determined by the Director, the condensate becomes the responsibility of the PCF. Detailed specifications and QA/QC to be provided in Closure Plan to be submitted in accordance with Section ???.	Not Approved. Subject to further discussion.
8	Leachate Control	One year following last load of refuse.	- QP submits report confirming evaporation ponds are complete. - No above-ground or at-ground surface off-site discharge of leachate for one year following last load of refuse.	Detailed specifications and QA/QC to be provided in Closure Plan to be submitted in accordance with Section ???.	Approved
9	Groundwater & Surface Water Monitoring	Within 3 months of the last load of refuse.	Final cap completion as per Item #1.	PCF is responsible for environmental monitoring following completion of landfill cap and not including monitoring associated with the Extension (i.e. Bonaparte River baseline study as per EA Certificate)	Approved
10	Groundwater Management	Within 3 months of the last load of	- Final cap completion as per Item #1. - Groundwater recovery wells are	Disposal option to be selected. Long term costs and implication to	Not Approved.

		refuse.	installed along with selected groundwater disposal opinion. Groundwater monitoring to confirm performance of recovery wells,	post-closure fund to be projected. Detailed specifications and QA/QC to be provided in Closure Plan to be submitted in accordance with Section ???. <i>[Consider setting land use criteria subject to discussions with Land Remediation...I will have a better idea on Wednesday.]</i>	Subject to further discussion.
11	Surface Water Management	Within 6 months of last load of refuse.	Completion of drainage work upgrades as outlined in Appendix D.	Include Appendix D in Closure Plan to be submitted in accordance with Section???	Approved
12	Land Lease	Within 1 year of last load of refuse.	PCF is responsible for the invoice period beginning after completion of the landfill cap as per #1.		Approved
13	Fencing	Minimum of 3 years.	Until re-vegetation is established as per Item #2.		Approved
14	Site Security	Minimum of 3 years.	Until re-vegetation is established as per Item #2.		Approved

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Tuesday, February 7, 2012 1:21 PM
To: Files KAM ENV:EX
Subject: FW: Amendment ad - MR-7577
Attachments: ENV12-004_Amendment_5.81x7.25in_BF.pdf

From: Fehr, Bob GCPE:EX
Sent: Tuesday, February 7, 2012 11:43 AM
To: Meier, Kristi GCPE:EX; Gardner, Larry ENV:EX
Subject: Amendment ad

Correx done

Thanks

Bob

Environmental Protection Notice

Notice of Intent to Issue an Amendment to an Operational Certificate MR-7577 Under the Provisions of the Environmental Management Act

Take notice that the Director intends, a minimum of 14 days after the date of this publication, to issue an amendment to Operational Certificate MR-7577 in the name of the Village of Creek and Wastech Services Ltd. for the existing sanitary landfill located at Cache Creek.

The amendment will impose the following new conditions:

- Require utilization of the collected landfill gas by June 30, 2013.
- Require submission of a "Closure Period Plan" by August 31, 2012, which describes the timelines for undertaking discrete closure activities following which the Post-Closure Fund will pay for monitoring, repair and maintenance of the landfill.

A copy of the draft amended Operational Certificate may be viewed on-line at <http://www.env.gov.bc.ca/epd/> under the **Publication Notifications** banner. A copy may also be viewed at the Ministry of Environment Office at 1259 Dalhousie Drive, Kamloops, B.C. V2C 5Z5 during normal business hours.

Any comments regarding the draft Operational Certificate must be sent to the Regional Manager, Environmental Protection, Ministry of Environment, within 14 days of the date of this publication at the address above or on-line at <https://extranet.gov.bc.ca/forms/gov/contact/index.html> (Please start your comment with "Attn: EP Manager, Kamloops").

A copy of any comments should also be sent to Wastech Services Ltd at jtecklenborg@wastech.ca or 1200 United Boulevard, Coquitlam B.C. V3K 6T4

Dated at Kamloops, B.C. on February 9, 2012.



Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Thursday, September 6, 2012 4:59 PM
To: Perkins, Megan ENV:EX
Subject: FW: Anything you want ot add?
Attachments: WASTECH meeting Sept 6.docx

Good job...I made a few edits which hopefully make sense.

From: Perkins, Megan ENV:EX
Sent: Thursday, September 6, 2012 4:22 PM
To: Gardner, Larry ENV:EX
Subject: Anything you want ot add?

Megan Perkins, C.I.T.
Environmental Protection Officer
1259 Dalhousie Drive
Kamloops, BC V2C 5Z5
Phone: (250) 371-6283
Fax: (25)371-40000
Megan.Perkins@gov.bc.ca

MEETING DISCUSSION NOTES

Meeting at the Ministry of Environment building: September 6, 2012

Present at meeting:

- David Thompson – Wastech
- Janet Tecklenborg – Wastech
- Larry Gardner – MoE
- Megan Perkins – MoE

Landfill Gas Utilization Plan – Update

- Determined that Fortis could not handle the quantity of gas generated from the landfill (i.e. insufficient pipe capacity). There were also unresolved liability concerns (i.e. gas quality)
- Opting for the electricity route, reciprocating engines (provided by CAT).
- Equipment delivery is typically projected to take up to 11 months; this may will increase the required time landfill gas utilization to begin.
- Wastech suggested has asked for an they may need an extension for the utilization this deadline. Deadline request was turned down by Larry, unless Wastech would need to provide a compelling argument why it is not possible to speed up equipment delivery. can provided documentation proving difficult or impossible circumstances to comply with the deadline of Jun 30, 2013, listed in Section 3.2.1 in the Operational certificate.
- Wastech doing pre-engineering for the purpose of expediting the project.
- The revised spread sheet is serving as the addendum for the Plan.
- 7 wells currently installed, plans for 6 more (October).
- On approving the utilization plan, the MoE letter will state is to provide a letter to Wastech stating that 75% collection is ‘expected’ to be achieved by 2013 when utilization begins; this would be a compliance target. The letter will also state the obligation to maximize utilization. is letter is for the purpose of supplying Metro an explanation as to why 75% collection goal is being implemented.

Closure Period Plan

- The Plan was just reviewed by Metro Van and also the Village of Cache Creek
- The village reportedly expressed concerns regarding groundwater contamination; Wastech and Golder have added a plan to pump and evaporate groundwater from the landfill.
 - This topic has not yet been approved by Metro Van.
 - Concerns about the cost of pumping and evaporating, who would cover the costs?

- o What would be the implications of the closure fund if this system was implemented?
- The Plan will be submitted to the MoE office tomorrow.

Gully Drains

- Will get Golder to put together a response on this topic.

Alternative Daily Cover

- Wastech has begun using the ADC.
- Wastech has agreed to provide the MoE with an engineers approval of the use of ADC.

Donchi, Erin CSNR:EX

From: Bourgeois, Jason ENV:EX
Sent: Friday, July 26, 2013 4:35 PM
To: Gardner, Larry ENV:EX
Cc: Danyluk, Carol ENV:EX
Subject: FW: Cache Creek Landfill Closure Period Plan
Attachments: Letter re CCLF Closure Period Plan.pdf

I need to pick your brain again on your take of pro, con, risk with regard to approval of CPP.

From: Bourgeois, Jason ENV:EX
Sent: Friday, July 26, 2013 4:30 PM
To: 'Janet Tecklenborg'
Cc: Danyluk, Carol ENV:EX
Subject: FW: Cache Creek Landfill Closure Period Plan

Janet, further to our telephone discussion today, I propose that Carol and I meet with Wastech to discuss any outstanding issues that may remain with the Cache Creek Landfill Closure Plan (CPP). By the CPP, I refer to the original document provided on September 7, 2012 and the supplemental materials provided in May of 2013.

I understand from conversations with Carol that, on several occasions, she has offered to share with Wastech, our draft response to the current draft of the CPP. I understand further that you informed us that that would not be necessary and it was not urgent for Wastech to receive our comments, in draft, or otherwise. However, I think in order to facilitate our upcoming discussion, and focus our attention on any truly outstanding issues, it would be best that our draft response is shared in advance. Unfortunately, with the holiday season upon us, we will not be in a position to do that until August 13, at the earliest.

With regard to possible dates for a face to face meeting, I tentatively propose August 27-30, Sept 3-5, Sept 9, Sept 11 pm, Sept 12 pm, or Sept 13 for now. Once Carol and I can discuss additional possible dates on August 13th, we can provide you with an update at that time.

Regards,
Jason

From: Sharlyne Jay [<mailto:sjay@wastech.ca>]
Sent: Thursday, April 18, 2013 10:07 AM
To: Bourgeois, Jason ENV:EX
Cc: Caunce, Cassandra ENV:EX; Gardner, Larry ENV:EX; Danyluk, Carol ENV:EX; Ted Rattray; David Thompson; Janet Tecklenborg
Subject: Cache Creek Landfill Closure Period Plan

Please see attached letter from Janet Tecklenborg. Hard copies will be sent by mail.

Regards,
Sharlyne

Sharlyne Jay
Executive Assistant
604-517-6558

April 18, 2013

Jason Bourgeois, Section Head Environmental Management
Ministry of Environment
1259 Dalhousie Drive
Kamloops, BC V2C 5Z5

Dear Jason Bourgeois,

**RE: Cache Creek Landfill Closure Period Plan (CPP)
April 5, 2013 meeting between Ministry of Environment (MOE) and Wastech**

The purpose of this letter is to record the points discussed at the April 5, 2013 meeting between the MOE in Kamloops and Wastech regarding the September 7, 2012 CPP for the Cache Creek Landfill.

It was agreed that Closure will occur across a period of time, encompassing specific closure activities following the last placement of municipal solid waste in the landfill sometime in 2016. The CPP is currently composed of six different activities:

- Groundwater Management
- Leachate Management
- Storm water Management
- Final Cover
- Revegetation
- Landfill Gas Collection

It was noted that the September 7, 2012 CPP does not, at present, include any special management of the fly ash mono cell should this be determined as necessary.

The purpose of the Post Closure Trust Fund (PCTF) was reviewed as outlined in the 1987 Environmental Hearing Board Decision. Referring to that purpose, the following points were emphasized

- The PCTF is meant for the on-going maintenance and "unforeseen calamitous event(s)".
- Closure costs are clearly not to be drawn from the PCTF.

It was agreed that the PCTF will be applied following completion of the closure activities across the closure period. It is recognized that certain of the closure activities, such as landfill gas (LFG) management, which is a current activity, will continue after the final placement of MSW in the landfill into the post closure period for many years.

It was agreed that MOE, Wastech and the Village of Cache Creek (VCCCK) will formulate a process for the administration, oversight and management of the PCTF. The process needs to include the division of financing and operating responsibilities as between the CPP and the PCTF plan.



WASTECH SERVICES LTD.

ISO 14001

1200 United Boulevard, Coquitlam, B.C. V3K 6T4 Telephone 604-521-1715 FAX 604-521-0763

MOE-2013-00197

Page 88

100% post-consumer paper

The MOE noted that the PCTF was to remain in existence for as long as MOE determines it is necessary. It was noted that Metro Vancouver (MV) have an agreement with the VCKK to indemnify the financial capacity of the PCTF for not less than 20 years following closure of the landfill. MOE noted that MV would indefinitely be required to indemnify the landfill liabilities beyond closure.

Wastech identified the need to be proactive, particularly with the groundwater collection and treatment system required by the CPP, given, among other things:

- The need to be prudent and responsible so as to prevent there being a groundwater problem in light of the trend in chloride concentrations downstream of the landfill, suspected by Golder of being related to the high levels of chloride in the fly ash co-disposed with the municipal solid waste since the early 2000's,
- The expert evidence that the Wes-Phix process does not permanently stabilize the fly ash unless the alkalinity is maintained, which cannot be done for fly ash that is mixed with MSW. (NUS Corporation for EPA CORRE, Characterization of Municipal Waste Combustion Ash, Ash Extracts and Leachates. Coalition on Resource Recovery and the Environment. 530-SW-90-029A., 1990)
- The commitments made at the 1987 Environmental Hearing Board to deal with the collection of downstream groundwater that might emanate from in and around the landfill should that be necessary, and
- The Operational Certificate is meant to proactively protect the environment during operation of the landfill.

The MOE expects to respond to the current draft of the CPP by mid May 2013, to enable Wastech to include appropriate capital requirements beginning in the 2014 calendar year.

It was agreed that Wastech is to submit to the MOE a detailed schedule of closure activities 12 months prior to the 2016 end of the landfill activity.

Please let me know if you have any changes to the summary of the items discussed at the April 5, 2013 meeting.

Best regards,



Jan / Janet Tecklenborg
General Manager

cc: Ted Rattray, Wastech
Larry Gardner, Ministry of Environment
Cassandra Counce, Ministry of Environment
Carol Danyluk, Ministry of Environment

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Thursday, April 4, 2013 9:29 AM
To: Caunce, Cassandra ENV:EX; Bourgeois, Jason ENV:EX
Subject: FW: CCLF - Closure Period Plan
Attachments: 1214470228-002-R-Rev0 Closure Period Plan 07SEP_12.pdf

From: David Thompson [<mailto:dthompson@wastech.ca>]
Sent: Thursday, April 4, 2013 9:22 AM
To: Gardner, Larry ENV:EX
Subject: CCLF - Closure Period Plan

Hi Larry,

Attached is a copy of the Closure Period Plan for Cache Creek.

Please let me know if you receive this successfully.

Thanks,

David Thompson, MBA, P.Eng.

Manager, Engineering Services

Wastech Services Ltd.

(p) 604-517-6557

(c) 604-328-2555

dthompson@wastech.ca

September 7, 2012

REPORT ON

Closure Period Plan, Cache Creek Landfill

Submitted to:
Wastech Services Ltd.
1200 United Boulevard
Coquitlam, BC
V3K 6T4

REPORT

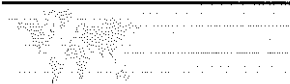


Report Number: 1214470228-002-R-Rev0

Distribution:

1 Copy - Ministry of Environment, Kamloops, BC
1 Copy - Metro Vancouver, Burnaby, BC
1 Copy - Village of Cache Creek, BC
3 Copies - Wastech Services Ltd., Coquitlam, BC
3 Copies - Golder Associates Ltd., Burnaby, BC





CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

Table of Contents

1.0 INTRODUCTION.....	1
1.1 Purpose	1
1.2 Background	1
1.3 Closure Status as of June 2012.....	3
2.0 FINAL COVER DESIGN	4
2.1 Description of Final Cover Design	4
2.2 Site Preparation	5
2.3 Measures to Repair Damage.....	5
2.4 Criteria for Defining Completion.....	6
3.0 REVEGETATION.....	7
3.1 Existing Conditions	7
3.2 Revegetation Measures.....	8
3.3 Irrigation.....	9
3.3.1 Existing Conditions.....	9
3.3.2 Estimated Watering Needs	9
3.3.3 Recommendations	10
3.4 Criteria for Defining Completion.....	11
4.0 LANDFILL GAS MANAGEMENT	12
4.1 Landfill Gas Management Facilities Design Plan.....	12
4.2 Landfill Gas Monitoring	14
4.3 Criteria for Defining Completion.....	14
5.0 LEACHATE CONTROL	15
5.1 Leachate Management Plan.....	15
5.2 Leachate Evaporation System.....	15
5.3 Leachate Recirculation System	16
5.4 Contingency Plan.....	16
5.5 Criteria for Defining Completion.....	17
6.0 GROUNDWATER MANAGEMENT	18

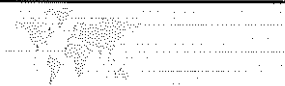


CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

6.1	Constituent Transport Analysis	18
6.2	Monitoring Well Optimization	18
6.2.1	Monitoring Well Locations	18
6.2.2	Analytical Constituents	19
6.3	Preliminary Mitigation Options	21
6.3.1	Groundwater Recovery	21
6.3.2	Disposal of Collected Water	22
6.4	Criteria for Defining Completion	23
7.0	FILLING PLAN DURING CLOSURE	24
8.0	SURFACE WATER MANAGEMENT	25
8.1	Surface Water Facilities Design	25
8.2	Criteria for Defining Completion	25
9.0	SOIL MATERIAL SOURCES	27
10.0	NOTIFICATIONS AND SURVEY	28
11.0	ESTIMATED TIMELINE OF ACTIVITIES	29
12.0	CLOSING COMMENTS	30

TABLES

Table 1:	Liner Types	2
Table 2:	Approximate Final Cover Treatment Areas (as of June 27, 2012)	3
Table 3:	Matching Water Need to Water Supply	10
Table 4:	Existing Landfill Gas Facilities (as of December 2011)	12
Table 5:	Proposed Scope of Post-closure Gas Monitoring Locations	14
Table 6:	Estimated Annual Leachate Collection	15
Table 7:	Proposed Scope of Post-closure Groundwater Monitoring Program	19
Table 8:	Estimated Concentrations of Constituents in Groundwater Requiring Treatment	22
Table 9:	Screening of Groundwater Disposal Options	22
Table 10:	Approximate Airspace of Projected Filling Sequence	24
Table 11:	Soil Materials for Closure	27
Table 12:	Estimated Timeline of Landfill Closure Activities	29



CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

FIGURES

- Figure 1: Key Plan
- Figure 2: Approximate Areas of Existing Final Cover Treatment (as of June 27, 2012)
- Figure 3: Conceptual Closure Topography
- Figure 4: Conceptual Leachate Recirculation System Design
- Figure 5: Mitigation Concept for Small Leachate Outbreaks
- Figure 6: 2012 Filling Sequence (Start of 1st Quarter 2012)
- Figure 7: 2012 Filling Sequence (Start of 2nd Quarter 2012)
- Figure 8: 2012 Filling Sequence (End of 3rd Quarter 2012)
- Figure 9: 2013 Filling Sequence (Middle of 2nd Quarter 2013)
- Figure 10: 2013 Filling Sequence (Middle of 4th Quarter 2013)
- Figure 11: 2014 Filling Sequence (Middle of 2nd Quarter 2014)
- Figure 12: 2014 Filling Sequence (End of 3rd Quarter 2014)

APPENDICES

APPENDIX A

Operational Certificate OC-7577 Dated March 27, 2012

APPENDIX B

Summary of Landfill Gas Extraction Well Installation

APPENDIX C

Numerical Groundwater Flow Model

APPENDIX D

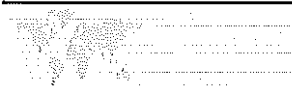
Recommendations for Drainage Work Upgrades

APPENDIX E

Cache Creek Landfill Closure Period Plan – Revegetation

APPENDIX F

Irrigation Constraints and Requirements



1.0 INTRODUCTION

1.1 Purpose

The Cache Creek Landfill (Landfill) is a landfill authorized by Operational Certificate 7577 (OC-7577) for the disposal of municipal solid waste (MSW). This Closure Period Plan (Plan) has been prepared in accordance with Section 9 of OC-7577 amended on March 27, 2012. This Plan describes the discrete closure activities to be undertaken during the closure period, including a projected timeline for each discrete closure activity, from its initiation to completion, and, where appropriate, the criteria for determining when the closure activity is complete.

The Plan is a more detailed description of closure activities than what was provided in the closure plan that is part of the Landfill's *2009 Operations and Closure Plan* (project no. 09-1411-0028/3000, dated December 18, 2009).

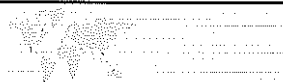
The "closure period" is defined by OC-7577 as the indeterminate timeline commencing before cessation of landfilling activities, and lasting until completion of discrete closure activities, such as placement of final cover or establishment of sustainable vegetation.

1.2 Background

The Landfill is located in the southwestern corner of the Village of Cache Creek on Crown land (see Figure 1). The legal description of the property within which the Landfill is located is as follows:

- Pre-Annex boundaries of the Landfill as detailed in the September 24, 2005 Modification of the Lease from the Province to the Village of Cache Creek: Block A, Section 13, Township 21, Range 25 and Blocks C, D, E and F, Section 18, Township 21, Range 24, all West of the Sixth Meridian, Kamloops Division of Yale District and containing 49.636 hectares; plus
- Annex A added to the west side of the original Landfill (Stages 1 to 4) footprint on February 16, 2009: Block B, Section 13 together with that part of Section 13 all of Township 21, Range 25, West of the 6th Meridian, Kamloops Division, Yale District, containing 6.70 hectares, more or less.

The original operating permit for the original Landfill, Waste Management Permit No. PR-7577, was issued on March 18, 1987, and was upheld by the British Columbia Environmental Appeal Board on September 21, 1987. The permittees include the Village of Cache Creek, who leases the Landfill site from the Ministry of Crown Lands, and Wastech Services Ltd. (Wastech), who sublets the site and operates the Landfill. Subsequently, on June 27, 1996, OC-7577 was issued under the provisions of the *Waste Management Act* and in accordance with the Thompson-Nicola Regional District (TNRD) *Solid Waste Management Plan*. OC-7577 was upheld on January 6, 1997 by the Deputy Director of Waste Management. On December 18, 1997, the Environmental Appeal Board (Appeal No. 97-WAS-01) confirmed the OC, requested clarification of the definition of "lifts," stipulated additional sampling and monitoring, and requested further investigation of landfill gas (LFG) properties. The OC was amended to MR-7577 on November 14, 2003, primarily to include construction of the south berm, which provided for an estimated increase of 618,000 m³ in Landfill capacity. The OC was amended on October 22, 2007 to allow the placement of an additional 85,000 tonnes of MSW at the Landfill due to the labour dispute between the City of Vancouver and its work



CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

force, and the associated reduced disposal rate at the Vancouver Landfill in 2007. An August 31, 2009 amendment to the OC included Stage 5 (the Annex). The most recent amendment to OC-7577 is dated March 27, 2012, and specifies recovery of energy from LFG and provision for a Closure Period Plan. A copy of the OC, dated March 27, 2012, is provided in APPENDIX A.

Supporting documents for the OC are as follows:

- *Cache Creek Sanitary Landfill, Volumes I and II* dated January 27, 1989, prepared by Golder Associates Ltd. (project no. 882-1023);
- *Stage 4, Cache Creek Landfill, Volumes I and II* dated June 30, 1995, prepared by Golder Associates Ltd. (project no. 942-1897A); and
- *Technical Assessment, Annex to Cache Creek Landfill, Cache Creek, BC* dated December 10, 2007, prepared by Golder Associates Ltd. (project no. 07-1411-0028/8000).

The available area for placing waste totals approximately 40.3 hectares. Of this area, Table 1 summarizes the liner types for the Landfill.

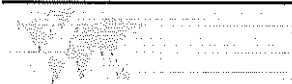
Table 1: Liner Types

Liner Type	Location	Approximate Area (m ²)	Approximate Sump Storage Capacity (m ³)
Soil	Stages 1 to 4	319,000	N/A
HDPE geomembrane (1 mm thickness)	Stage 1	4,750	99
HDPE geomembrane (1 mm thickness)	Stage 2	3,650	61
HDPE geomembrane (1 mm thickness)	Stage 3	7,500	133
HDPE geomembrane (1 mm thickness)	Stage 4	7,500	162
HDPE/GCL composite liner (1.5 mm thickness HDPE geomembrane)	Stage 5 (fly ash mono-fill)	5,200	20
HDPE /GCL composite liner (1.5 mm thickness HDPE geomembrane)	Stage 5 (non-ash MSW)	55,450	300

Note: "HDPE" and "GCL" represent high-density polyethylene and geosynthetic clay liner, respectively.

The Landfill is currently permitted to receive a maximum of 500,000 tonnes of MSW per year. The total design volume, including refuse and cover soil volumes, for the Landfill is estimated to be 12.3 million cubic metres. The maximum thickness of waste is anticipated to be 60 m.

The largest annual volume of leachate that has been collected at the Landfill to date was in 2008, when 1,047 m³ of leachate was collected from Sumps 1 to 4, of which 868 m³ was collected from Sump 4 alone.



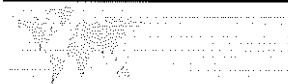
CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

1.3 Closure Status as of June 2012

As of December 2011, 39.6 hectares or 98% of the available waste disposal area has been covered with waste. Figure 2 shows the approximate areas of final cover treatment as of June 27, 2012.

Table 2: Approximate Final Cover Treatment Areas (as of June 27, 2012)

Treatment	Area (ha)	Untreated Remaining Area (ha)
Final cover material (1 m or thicker) only, with no top soil or growth medium	3.2	13.3
Top soil or growth medium, underlain by final cover material	23.8	16.5
Seeded recently or in the past	17.1	23.2
Covered by irrigation system	15.2	25.1



2.0 FINAL COVER DESIGN

2.1 Description of Final Cover Design

The final cover design for the Landfill consists of the following:

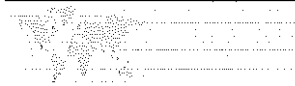
- Vegetation compatible with the Landfill design and local climatic conditions for erosion protection, as per original permit design data (the vegetation for the final cover is discussed further in Section 3.0);
- 0.2 m thickness of top soil as a growing medium (the top soil for the final cover is discussed further in Section 3.0);
- 1 m thickness of barrier soil having a hydraulic conductivity of 6×10^{-5} cm/sec or less (characteristics of the barrier soil are discussed further in Section 2.4); and
- Surface drainage works designed to allow runoff to quickly flow away from the cover in a controlled manner, and to accommodate post-construction settlements (surface drainage works are discussed further in Section 8.0).

The Landfill final cover design is consistent with an evapotranspiration type of landfill final cover. Evapotranspiration landfill cover systems typically rely on water storage, rather than low permeability, to reduce leachate generation, and generally have the following elements:

- Fine-grained soils to retain water – The above specification of the final cover soil having a hydraulic conductivity of 6×10^{-5} cm/sec or less is consistent with that of a fine-grained soil. For example, the Hydrologic Evaluation of Landfill Performance model (1994, version 3.07) default soil characteristics table shows a clay of low plasticity having a saturated hydraulic conductivity of 6.4×10^{-5} cm/sec; and
- Vegetative cover for transpiration of moisture (this is addressed further in Section 3.0).

The minimum final Landfill slope has been reduced from 4% (in the previous versions of the Operations and Closure Plan) to approximately 2% for the top platform. This change has been implemented to better accommodate the proposed leachate evaporation ponds, and because the design of the top platform (Figure 3) is anticipated to result in an increase in slope with time due to Landfill settlement (*i.e.*, the 2% initial slope is anticipated to generally increase in the future). The design area of the top platform of the Landfill will be approximately 3.1 hectares.

In general, for the post-closure period, the design Landfill slopes are 2.6 horizontal to 1 vertical (2.6H:1V) between benches, and an overall Landfill slope of 3H:1V including benches. Slopes that are at or flatter than these slope angles are stable, from a geotechnical engineering perspective, provided that leachate levels within the waste remain low. Available information on leachate levels within the Landfill indicates that leachate levels within the waste of the Landfill are low. The low leachate levels within the Landfill are attributed to the dry climate and the low volumes of leachate that has been recirculated in the past.



CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

During active landfilling, the constructed Landfill slopes are generally anticipated to become slightly flatter with time, due to post-construction settlement of the underlying waste. As such, and as part of the existing Operations and Closure Plan, the as-constructed slopes between benches may be steeper than 2.6H:1V.

Slopes between benches that are locally flatter than 2H:1V are considered to have low potential for deep-seated slope instability and to be generally stable, provided that leachate levels within the waste remain low (*i.e.*, no leachate breakout occurs on the slopes). The slopes that are steeper than 2.6H:1V may require more attention to maintain (*e.g.*, final cover regrading, repair, revegetation) during the post-closure period. Slopes between 2.6H:1V and 2H:1V are considered to be generally stable, from a deep-seated slope stability perspective and provided that leachate levels within the waste remain low, although the surface of these areas may need more attention to maintain during the post-closure period.

2.2 Site Preparation

To prepare the Landfill to receive final cover, the following general actions should be undertaken:

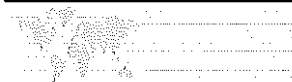
- 1) The Landfill area to receive final cover should be graded to achieve the design closure slopes shown in Figure 3. Exposed waste should be compacted and covered with intermediate cover material; and
- 2) Any leachate lines (*e.g.*, a leachate recirculation pipeline) should be installed. Water or leachate lines that operate through the winter should have at least 1.2 m of soil cover for frost protection purposes.

Landfill gas header piping should be installed soon after placement of barrier soil and prior to placement of top soil.

2.3 Measures to Repair Damage

Potential damage to the Landfill final cover includes cracks due to differential settlement, erosion gullies caused by flow of surface runoff on the final cover, and holes by burrowing animals. To repair damage of these types, the following general actions should be undertaken:

- 1) Cracks and holes should be filled with silty soil or top soil. The surface should then be seeded immediately by hand. If necessary, the surface should be hydroseeded or drill-seeded in early spring or in the fall; and
- 2) Erosion gullies should be repaired by filling to within 0.2 m of the ground surface with a silty soil and nominally compacting this material, and then filling to ground surface with top soil. The top soil should then be seeded in early spring or in the fall. Alternatively, gullies less than 0.5 m deep may be completely filled with top soil. In conjunction with the repairs, the cause of the erosion should be assessed and addressed as appropriate.



2.4 Criteria for Defining Completion

The following are the criteria for defining completion of final cover installation:

- 1) The thickness (t) of barrier soil shall be determined based on one thickness measurement per hectare of final cover. The following equation shall be used: $t = H \times \cos(\phi)$, where ϕ is the local slope angle in degrees, and H is the vertical distance in a drilled or excavated hole between the top of refuse and the top of barrier soil. The average thickness determined from all measurements shall be 1.05 m or more. Of the thickness measurements, one in every 10 may be between 0.85 and 0.95 m. The locations with measured barrier soil thicknesses of less than 1.05 m shall be recorded on a plan;
- 2) For criteria defining suitability of the top soil layer, see Section 3.4;
- 3) The barrier soil shall have a hydraulic conductivity of 6×10^{-5} cm/sec or less, based on either *in situ* or laboratory measurements of hydraulic conductivity, or sampling and testing of the amount of fines (passing the 0.074 mm sieve size). If the latter criterion is used, the average fines content (i.e., the percent of material by weight passing the 0.074 mm sieve size) of the tested samples shall be 30% or greater. All of the tested samples shall have a minimum fines content of 17%;
- 4) Final overall Landfill slopes on the top platform of the Landfill are not less than 2%, based on the results of an air survey;
- 5) Final overall Landfill slopes between benches are at 50% or flatter, based on the results of an air survey;
- 6) Final overall Landfill slope, as measured between the 510 bench and the edge of the top platform of the Landfill, or from the toe of the north side of Stage 5 to the top platform, is 34% or less, based on the results of an air survey; and
- 7) Windblown litter from the Landfill has been collected from the Landfill, the North Borrow property, and a distance of up to 300 m beyond the Landfill property, based on the majority opinion of members of the Landfill Advisory Committee.



3.0 REVEGETATION

Placement of final cover and surface application of top soil on the cover have been conducted at the Landfill on an ongoing basis during its construction. APPENDIX E summarizes the conditions of vegetation at the Landfill as of the end of 2011, and outlines the recommended revegetation measures to prepare the Landfill for its closure in 2016. This section provides a summary of APPENDIX E.

3.1 Existing Conditions

Placement of Landfill final cover (barrier) soil, and surface application of top soil on the barrier soil have been conducted on an ongoing basis as the Landfill has been constructed. After top soil was applied, grass/legumes were seeded, generally by broadcast methods and hydroseeding. Areas with poor vegetation establishment have been reseeded in subsequent years, often more than once. Fertilizer was generally applied, and in recent years, irrigation was also installed. As of the end of 2011, revegetation has been very sporadic. Vegetation establishment is not adequate for closure over approximately 30% of 510¹ Bench slope, as well as over essentially all of 530 and 520 Bench slopes. The 570 and 590 Bench slopes are in the early stages of reclamation and seeding, and cannot yet be evaluated.

In 2011, the lower, relatively flat part of the 510 Bench slope had acceptable vegetation establishment, with more than 80% cover over 80 to 90% of the area. On the upper 510 Bench slope, vegetation establishment was unsatisfactory as weeds and bare areas dominated, and bunchgrass was sparse. Vegetative cover was 40 to 50% over about 40% of the slope, and was negligible to about 20% over 60% of the area.

The 530 Bench slope had generally unsatisfactory vegetation establishment with bunchgrass, weeds, and bare areas. The subsoils were generally compact, or very compact. Plant root penetration was severely or totally restricted at depths of 8 to 10 cm. Some areas had applied top soil less than 20 cm thick.

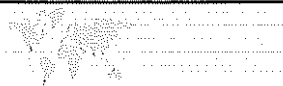
The 550 Bench slope had unsatisfactory vegetation establishment. About half of the Bench slope was dominantly weeds with little or no bunchgrass, and the other half consisted of bunchgrass, weeds, and bare areas. Again, the subsoils were generally compact, or very compact. Plant root penetration was severely or totally restricted at depths of 8 to 10 cm. Some areas had applied top soil less than 20 cm thick.

The 570 Bench slope has been hydroseeded (October 26, 2011). The seed and mulch application appeared very uniform with complete coverage.

On the 590 Bench slope, the 1 m application of Landfill barrier soil had been placed. Applied top soil had been placed over the approximately south half of the 590 Bench slope. This slope had not been seeded, and irrigation was not installed (October 26, 2011).

On the 610 Bench slope, the 1 m application of Landfill barrier soil had been placed. No applied top soil had been placed. This Bench slope had not been seeded, and irrigation was not installed. Weeds have established on small parts of the slope (October 26, 2011).

¹ A Bench slope is the area between the indicated Bench and the next higher Bench.



CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

Golder visited the Landfill in June 2012 to assess vegetation on the Bench slopes, and is preparing a report to summarize the results of this assessment. The observations in our June 2012 site visit support the recommended revegetation measures outlined in the next section.

3.2 Revegetation Measures

Closure of the Landfill will require establishment of vegetation on all Bench slopes that meets the closure criteria for revegetation. The Bench roadways will remain in their existing condition.

Top soil will be applied, and seeding and/or planting will be done on the upper Bench slopes not yet top soiled, and on the final Bench slopes yet to be completed as Landfill capacity is reached. Remedial activity will also be undertaken on the Bench slopes that have been seeded, but with unsatisfactory revegetation success (*i.e.*, the closure criteria have not been achieved).

Bench Slopes not yet Top Soiled

For Bench slopes not yet top soiled, a minimum 200 mm depth of prepared growing medium (used here interchangeably with top soil) will be placed above the 1 m thick barrier soil. Quality control on the growing medium is important for its success. Growing medium is a combination of top soil, organic matter, and other amendments to create a friable and fertile bed for revegetation. Addition of organic matter, well mixed in throughout the top soil, is critical to the success of revegetation, as this material reduces the tendency for crusting, and increases nutrient and water-holding capability, both of which are important to plant establishment.

Seeded Bench Slopes

For Bench slopes that have been seeded or areas where vegetation establishment is not successful (*i.e.*, does not meet the closure criteria), corrective reclamation measures (*e.g.*, possible addition of good quality growth medium, reseeding, possibly planting of seedling plugs) will be identified.

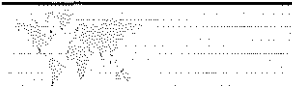
Seeding and Planting

Seed and seedlings on the soil surface will be more subject to rapid desiccation than those that are buried in the growing medium. Seeding methods that provide cover for the seed and seedlings will be more effective. Drilling of seed into the soil is ideal. The next best option is hydroseeding with good mulch cover. Surface broadcast of seed is unlikely to be successful in the Cache Creek climate.

Seeding must be done in the early spring or late fall. Hydroseeding can be done at the time of spring snow melt. Irrigation watering should also begin as soon as freezing nights pass (late April/early May), and should extend through the growing season, into October before hard freeze.

For patching of pre-seeded areas with inadequate vegetation, the use of "blown-in" seed/compost mixes is recommended for trial. "Terra-seeding" is a trade name for this process; it uses blower trucks, controlled compost/soil mixes, and injected seed and fertilizer to place a mix of 25 to 50 mm deep.

Revegetation species mix for seeding should be as recommended previously, plus minor additions of legumes and forb seed, as well as plugs of Rabbit brush.



3.3 Irrigation

Golder has assessed the irrigation needs for this Plan. The details of our assessment are in APPENDIX F. This section provides a summary of this appendix.

3.3.1 Existing Conditions

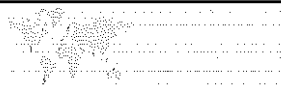
The water used in the Landfill Irrigation system is obtained from a Village of Cache Creek water main along the Trans-Canada Highway. Water is supplied from a reservoir that services the industrial area of Cache Creek. The Valley water main could provide a flow rate varying from 184 US gallons per minute (gpm), to possibly 240 US gpm with a pump upgrade. Water is conveyed from the water main to the Landfill by a pump station near the Landfill main entrance. From the pump station, a 100 mm diameter HDPE pipe conveys the water to the central area of the Landfill. At about 660 m elevation, two existing tanks, with a combined capacity of 20,000 US gallons, receive water supply from the irrigation main. From these two tanks, a second 100 mm diameter irrigation supply line runs downhill to provide water to irrigation laterals and heads on the lower Landfill benches.

Irrigation heads (RainBird Eagle 900 [full circle] and 950 [part circle]) are currently used between the 550 and 610 Benches. These heads are operated in short bursts (about six minutes per burst) to reduce the potential for surface erosion of the Landfill surface. One run of the entire irrigation system (single cycle) distributes 36,000 US gallons onto the Landfill between the 550 and 610 Benches. In July, three cycles of six-minute bursts are programmed for each day, leading to an operating time per zone per day of 18 minutes (0.3 hours).

3.3.2 Estimated Watering Needs

Irrigation systems are typically designed to sufficiently provide water for plant growth and to replace water lost through evapotranspiration, to meet the plant management objectives of a site. For the Landfill, the objective is for plant establishment and plant survival. Golder used the Irrigation Industry of BC Sprinkler Irrigation Scheduling Calculator to estimate the watering needs for the Landfill, and considered the use of two irrigation heads (RainBird Eagle 900 as currently used at the Landfill, and a low-flow agricultural system RainBird LF 2400), and the following irrigation scheduling stages:

- Stage 1 – This stage has an objective for seed germination and initial root establishment to about 25 mm depth, would typically occur from mid April to mid May, and would require daily irrigation;
- Stage 2 – This stage has an objective for root establishment to about 10 cm depth, would typically occur from mid May to mid June (or potentially longer), and would require irrigation in about two days per week;
- Stage 3 – This stage has an objective for root establishment to about 20 cm depth, would typically occur from mid June to mid July (or potentially longer), and would require irrigation in about one day per week; and
- Stages 4A and 4B – This stage has an objective for expanding root mass, ensuring seed set and maturation, and allowing plants to adjust to no irrigation and to go dormant for winter. It would typically occur from mid August, through the end of September or winterization. This stage would require irrigation once per day, but with reduced run times and cycles.



CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

The results of the assessment are summarized in Table 3.

Table 3: Matching Water Need to Water Supply

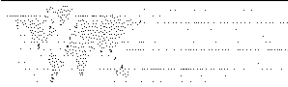
Factor	Quantity	Unit
Irrigation system current coverage area	15.2	ha
Irrigation system upcoming coverage area	25.1	ha
Potential total irrigation system coverage area need	40.3	ha
Potential coverage concept, RainBird Eagle 900 system area (July)	19.57	ha
Potential coverage concept, RainBird LF 2400 system area (July)	17.23	ha
Potential total irrigation system coverage supply area	36.8	ha
Potential coverage concept, RainBird Eagle 900 system flow	96	US gpm
Potential coverage concept, RainBird LF 2400 system flow	97.2	US gpm
Potential total irrigation system coverage flow need	193.2	US gpm
Village water supply available without pump upgrade	184	US gpm
Village water supply available with pump upgrade	240	US gpm
Village water supply for other purposes (with pump upgrade)	46.8	US gpm

3.3.3 Recommendations

To allow for successful revegetation of the Landfill to a self-sustaining restored ecosystem, the following key recommended actions should be considered (additional recommendations are included in APPENDIX F):

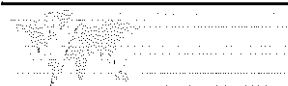
- Additional water supply from the Village water main to the upper areas of the Landfill should be considered. Alternatively, the potential for supplying groundwater from nearby areas could be assessed;
- The pump system should be upgraded to provide adequate ongoing flows to the Landfill in the growing season;
- For the higher elevations of the Landfill, consideration should be given to an irrigation system with lower flow and lower precipitation rate;
- Two irrigation zones should be operated concurrently to promote Landfill revegetation. The second irrigation supply line should be sized for a flow rate of approximately 100 US gpm, and should have a second booster pump to provide a minimum irrigation operation pressure of 240 kPa (35 psi) to irrigate the highest and furthest point of the Landfill; and
- A comprehensive irrigation plan, with a detailed watering schedule, should be prepared.

The recommendations listed above and in APPENDIX F are intended to provide guidance as an experimental program. They do not negate the need for field review and judgment on irrigation scheduling in relation to plant root performance and changing weather conditions. The recommendations should be reviewed based on performance through a growing season.



3.4 Criteria for Defining Completion

The criterion for defining completion of revegetation of the Landfill surface is to achieve, on average, a vegetation target equivalent to the vegetation on the Landfill footprint prior to its development. The percent cover and species composition may be specified as a range, rather than a specific number. The percent vegetative cover and species composition will be determined over a period of several years, as required, at permanently marked plot locations at representative sites on the various benches. These determinations will be conducted according to specific, accepted observation methods by a competent Professional Biologist or Agrologist, Registered in British Columbia.



4.0 LANDFILL GAS MANAGEMENT

4.1 Landfill Gas Management Facilities Design Plan

Golder has prepared a *Landfill Gas Management Facilities Design Plan* (dated December 23, 2011) for the Landfill. Table 4 summarizes the existing LFG facilities at the Landfill as of December 2011.

Table 4: Existing Landfill Gas Facilities (as of December 2011)

Description	Quantity
Vertical LFG extraction wells	100
Horizontal LFG collectors	3
Landfill gas extraction plants, each with a flare capacity of 800 ft ³ /minute	2

APPENDIX B contains a summary of LFG extraction well installation.

The *Landfill Gas Management Facilities Design Plan* anticipates the installation of approximately 81 vertical extraction wells and horizontal collectors on two filling platforms between 2012 and 2016.

The *Landfill Gas Management Facilities Design Plan* proposes the following LFG management system improvements:

- Upgrade of the LFG extraction plant – A new LFG extraction plant, complete with an enclosed flare and analyzers for methane and oxygen, is proposed for installation in 2012 or 2013;
- Control of off-site LFG flow – The available LFG collection infrastructure will be optimized by adjusting valve settings and maintaining existing infrastructure. Additional LFG extraction wells will also be installed as required. The *Landfill Gas Management Facilities Design Plan* provides a series of steps summarized as follows to control off-site LFG flow that could occur between 2012 and 2016:
 - a) Replacement LFG wells and supplemental extraction wells installed in 2011 on the east side of the Landfill have been connected to subheader piping;
 - b) The LFG management system will be monitored and adjusted to optimize off-site LFG control for at least six months;
 - c) In July 2012, Wastech installed seven vertical LFG wells (four new wells, and three replacement wells) to enhance the existing network of LFG extraction wells for control of off-site LFG flow. Installation of a new LFG extraction plant and up to 14 more LFG extraction wells is also planned. The exact number, locations and depths of the new LFG wells will be subject to the results of Steps a and b;
 - d) The LFG management system will be monitored and adjusted to optimize off-site LFG control for at least six months;
 - e) If off-site LFG flow continues to be unacceptable, then the LFG management system will be expanded further by adding new LFG extraction wells in 2013. Tentatively, this expansion would consist of seven vertical extraction wells along the 590 bench road, and the associated connections to header or subheader piping. The exact number, locations and depths of these wells will be subject to the results of Step d;



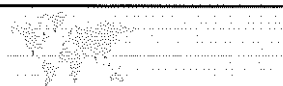
CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

- f) The LFG management system will be monitored and adjusted to optimize off-site LFG control for at least six months;
 - g) If off-site LFG flow continues to be unacceptable, then the LFG management system will be expanded further by adding new LFG extraction wells in 2014. Tentatively, this expansion would consist of nine vertical extraction wells along the 610 bench road, and the associated connections to header or subheader piping. The exact number, locations and depths of these wells will be subject to the results of Step f;
 - h) In 2014 or 2015, emissions from the Landfill will be measured and mapped to identify areas requiring improved LFG collection; and
 - i) Additional vertical LFG extraction wells will be installed in 2015 and 2016, if needed, based on the results of Step h.
- Achievement of 75% LFG collection efficiency – An additional 11 horizontal collectors and 37 vertical wells in Stage 5 are planned in areas having no LFG collection infrastructure at present. Increased header capacity is to be installed on the south side of the Landfill, between the existing LFG extraction plant and the west side of the Landfill, to reduce head loss and increase collection capacity.

After the *Landfill Gas Management Facilities Design Plan* was issued in December 2011, OC-7577 was amended on March 27, 2012. The amended OC requires the energy potential from the LFG be recovered on or before June 30, 2013. Although the LFG utilization technology has not yet been selected, most utilization technologies are more efficient when the methane content is elevated, typically at or above 50% methane by volume, and the oxygen and balance gas content is minimized. In contrast, desirable operational parameters for the control of off-site LFG flow may include elevated balance gas content at about 15 to 20% by volume, and a methane content below 50% by volume. Thus, it is possible that the regulatory need to control off-site LFG flow may conflict with the desire to optimize LFG utilization efficiency. It is also possible that the regulatory need to reduce emissions may also conflict, at some extraction well locations, with the desire to optimize LFG utilization efficiency. Should one of these conflict-of-priorities occur in the year prior to final MSW placement, it may be necessary to carry out one of the following:

- Operating the utilization system on LFG that is not optimal; or
- Constructing a separate header system connected to the LFG extraction plant to separate LFG extraction wells with good quality LFG for utilization, from wells with low methane content due to aggressive control of LFG that is migrating off-site.

In any case, the LFG collection field should be operated in accordance with best practice, avoiding excessive overdrawing on wells.



CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

4.2 Landfill Gas Monitoring

Wastech will need to continue to carry out LFG monitoring to allow proper operation of the LFG management system. This monitoring program consists of quarterly monitoring of methane, oxygen, carbon dioxide, hydrogen sulphide, and organic vapours at the locations outlined in Table 5.

Table 5: Proposed Scope of Post-closure Gas Monitoring Locations

North of Landfill	South of Landfill	On-site, East of Landfill	Off-site, East of Landfill	Off-site, South of Landfill
TH6 Well	TH1A GP	OW1 GP1*	MW97-2 GP1*	OW2 GP1
MW09-3 GP	TH1A Well	OW1 GP2*	MW97-2 GP2*	OW2 GP2
MW97-1 GP*	TH5 Well	OW3 GP	MW97-2 GP3*	OW4 GP
MW97-1 Well*	MW09-2 GP	OW3 Well	MW10-2 GP*	OW4 Well
MW10-1 GP	MW09-4 GP	MW07-1 GP*	Wastech office	MW03-GP
MW10-4 GP			Wastech shop	MW09-1 GP*
			Truck Wash	MW09-1 B Well*
			Buildings on Casadio property*	MW10-3 GP
				Buildings on Roadhouse Towing and Mechanical Repair property

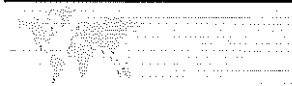
Note: * These locations are monitored by Wastech for LFG as part of the operational monitoring of the LFG management system.

4.3 Criteria for Defining Completion

The following are the criteria for defining that the LFG management system facilities are adequate:

- 1) The qualified professional for the *Landfill Gas Management Facilities Design Plan* confirms in writing that all of the required LFG management facilities are in place and operational;
- 2) None of the off-property gas monitoring wells or groundwater monitoring wells has a methane concentration exceeding 2.5% methane by volume due to the Landfill, based on at least one monitoring round per season over 12 consecutive monitoring rounds starting at the beginning of 2015;
- 3) None of the off-property ambient air measurements exceed 5% of the lower explosive limit for methane (0.25% methane by volume), based on at least one monitoring round per season over 12 consecutive monitoring rounds starting at the beginning of 2015. These air measurements are to be conducted at the current Wastech office, Wastech shop, truck wash, the crawl space of the trailer on the Coast Range Concrete (formerly Casadio) property, and in a corner of the office on the former chip plant property; and
- 4) The LFG collection efficiency is 75% or greater as defined by the *Landfill Gas Management Facilities Design Guidelines*, or, at Wastech's option, as determined by two methane emission discharge rate measurement rounds during two different seasons in 2016 and/or 2017, which indicate that methane emissions are 27% or less than the methane collection rate averaged over the 30 days leading up to and including the day of the measurements.

The above criteria for defining completion do not negate the need for continued proper operation and maintenance of the LFG management system, until the requirements of Section 11, or Sections 19 and 20 of the *Landfill Gas Management Regulation* are met. The post-closure operations and maintenance phase includes the installation of replacement LFG extraction wells as required.



5.0 LEACHATE CONTROL

5.1 Leachate Management Plan

Table 6 summarizes the estimated quantities of leachate that is predicted to be collected by the leachate collection system of the Landfill.

Table 6: Estimated Annual Leachate Collection

Sump	Estimated Quantity (m³)
Total 1 to 4	520
5 (fly ash)	160
6	1,670
Total (All Sumps)	2,350

The leachate collection rate is anticipated to decline within a few years after Landfill closure.

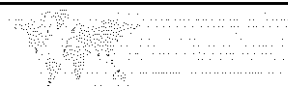
The primary method of leachate disposal will be leachate evaporation in the leachate evaporation ponds to be constructed on the top platform of the Landfill at about elevation 677 m. The leachate evaporation system will be designed to evaporate all of the predicted amount of leachate. In addition, a leachate recirculation system is to be installed prior to Landfill closure. Although the leachate recirculation system may not be used for leachate management immediately after construction, in the interim, it could be part of the LFG management system (as a horizontal collector) until it is used for leachate management.

5.2 Leachate Evaporation System

The leachate evaporation system will consist of approximately three or four ponds having a total lined area of approximately 6,000 m². Multiple ponds are more desirable over the long term than a single pond due to their ability to accommodate differential settlement while maintaining their evaporative capacity. The ponds should be designed to accommodate long-term settlement.

The ponds have been designed for net evaporation for an "average" year. Years with less evapotranspiration could result in leachate being retained in the ponds for more than one year.

The evaporation ponds should be lined with an exposed geomembrane. If a significant amount of sludge collects in the ponds, the sludge should be cleaned out and disposed of at a suitable facility. Extreme care should be exercised when cleaning the ponds to avoid damage to the geomembrane.



5.3 Leachate Recirculation System

The leachate recirculation system will consist of two or more infiltration lines located within Stage 5. Figure 4 provides a conceptual design of the leachate recirculation system. The lines are proposed to be one of the following:

- Dedicated recirculation lines, with the potential to also extract LFG – Two leachate recirculation lines, aligned in a west-east direction, will be constructed from the west edge of Stage 5 into the waste. The lines will consist of non-perforated HDPE pipes extending east into the refuse in Stage 5. The HDPE pipes will then be perforated and turn north for about 140 to 150 m. One of the pipes will generally follow the deepest section of the waste in Stage 5. The other pipe will be near the eastern property line of Stage 5. The perforated sections will be bedded with gravel to serve as an infiltration gallery for leachate. The width of the gravel trench will be a minimum of 3 m; and
- Horizontal LFG collectors with features to allow leachate recirculation – The upper level of proposed horizontal collectors would be designed both to allow for leachate infiltration and to collect LFG.

To prolong the life of the leachate recirculation system and reduce maintenance effort, a treatment system is to be installed to precipitate and remove suspended solids.

5.4 Contingency Plan

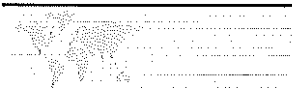
The estimate of annual leachate collection has some uncertainty, and Golder's proposed approach is to use the "total all sumps" estimated quantity (2,350 m³; see Table 6) for the design. If actual quantities exceed the estimated quantities, then one of the following can be undertaken:

- Leachate can be stored for more than one year in the leachate evaporation ponds;
- An additional leachate evaporation pond can be constructed; or
- Leachate can be recirculated through Stage 5.

Leachate breakouts have the potential to occur in the area with leachate recirculation if the leachate recirculation system becomes overloaded. If leachate breakouts occur, the potential contingency action is to reduce the flow rate of leachate to the leachate recirculation system, and discharge the excess leachate to a leachate evaporation pond.

Due to the dry climate, leachate breakouts are unlikely to occur in Landfill areas without a leachate recirculation system. In the unlikely event that a leachate breakout occurs where there is no leachate recirculation system, the leachate could be treated by one of the following:

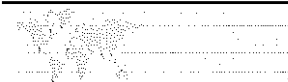
- Collecting the leachate, and discharging it to a leachate evaporation pond or the leachate recirculation system; or
- Covering the leachate with gravel until it seeps into the Landfill surface or the ground surface. This concept is shown in Figure 5.



5.5 Criteria for Defining Completion

The following are the criteria for defining that the leachate management system facilities are adequate:

- 1) All planned leachate management facilities are in place and adequately sized to manage leachate, based on the maximum annual leachate collection rate recorded. The maximum annual leachate collection rate is defined as the maximum volume of leachate collected in one year, up to three full calendar years after completion of waste placement at the Landfill. Adequate management of leachate means that the maximum annual volume of leachate can be managed by evaporation in the proposed evaporation ponds, infiltration into the refuse of Stage 5 via the leachate recirculation system, or both; and
- 2) No above-ground or at-ground surface off-site discharge of Landfill leachate to the environment occurs within one year of final MSW placement at the Landfill.



6.0 GROUNDWATER MANAGEMENT

6.1 Constituent Transport Analysis

A three-dimensional FEFLOW numerical groundwater flow model was developed for the Landfill to provide information for use in the optimization of the post-closure monitoring program and the management of off-site groundwater migration, if required. The numerical model was constructed based on hydrogeological data from previous site investigations and available regional information. A description of the conceptual model used in the numerical model construction, the structure of the numerical model (including modelling assumptions), and the results of the numerical modelling, are presented in APPENDIX C.

The general pattern of groundwater flow simulated by the numerical model agrees reasonably well with the conceptual model and the hydraulic heads measured in monitoring wells. The predicted groundwater flow direction on the regional hillslope surrounding and including the Landfill is towards the east to the infilled valley. Flow from the infilled valley is directed along its trajectory towards the southeast. Flow from the infilled valley and surrounding area ultimately discharges to the Bonaparte River. A small component of groundwater flow from the area next to the northeast side of the Landfill flows to the northeast. As such, a groundwater flow divide exists within the infilled valley near the north side of the Landfill, such that flow north of the divide is towards the northeast and flow south of the divide is towards the southeast.

The particle tracking solution in FEFLOW was used to evaluate the potential path-lines from beneath and around the Landfill for a conservative groundwater constituent, based on the processes of advection and dispersion. This involved the application of imaginary particles to the approximate water table below the Landfill footprint within the model. The particles were numerically tracked to represent groundwater path-lines from these locations. The path-line results indicate that saturated groundwater flow from below the Landfill is predicted to reach the infilled valley and then flow towards the southeast and discharge to the Bonaparte River southeast of the Landfill. The shortest travel time for groundwater flow from the Landfill to the Bonaparte River was estimated to range between 70 and 165 years.

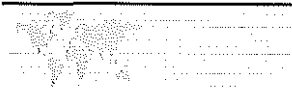
6.2 Monitoring Well Optimization

6.2.1 Monitoring Well Locations

The results of the numerical modelling and particle tracking analysis were used to assess the effectiveness of the existing monitoring well network. The results indicate that the locations of the existing monitoring wells are well-suited for monitoring of groundwater levels and groundwater chemistry following Landfill closure.

Southeast of Landfill

The particle tracking analysis shows that, as expected, path-lines from beneath and around the Landfill flow towards the southeast along the infilled valley. In accordance with the regional flow pattern, the particles ultimately discharge to the Bonaparte River. While the particle tracking shows the dispersion of particles in a fan-like pattern towards the east, the quickest travel time to the Bonaparte River is predicted to be along the southeast-most portion of the particle paths.



CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

For planning purposes, consideration could be given to the installation of one additional groundwater monitoring well along the southeast portion of the particle path-lines, where groundwater flow is the quickest. In the event that elevated constituents related to the Landfill are identified at that location, a second monitoring well would be placed further downgradient to serve as a sentinel well above the Bonaparte River. A third monitoring well could be placed above the Bonaparte River Valley to serve as a sentinel well in the inferred centre of the predicted particle path-lines.

North of Landfill

Geophysical analysis and surface water sampling conducted to date indicate that elevated chloride concentrations measured north of the Landfill at monitoring well MW10-1B may be related to an alternative source, such as the sedimentation pond, rather than a direct pathway from the Landfill itself. Ongoing investigations are being conducted north of the Landfill to investigate groundwater conditions in this area.

Monitoring Well Completions

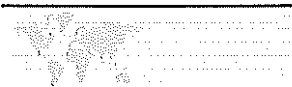
For each of the proposed monitoring well locations, it is assumed that separate monitoring wells would be completed in the surficial sediments and weathered bedrock, and that gas probes would be placed in the unsaturated zone to allow monitoring for LFG.

6.2.2 Analytical Constituents

Based on existing information, the analytical constituents and sampling frequency comprising the current groundwater monitoring program appear to be appropriate for the monitoring of potential groundwater quality impacts following Landfill closure. A summary of this monitoring program is presented below.

Table 7: Proposed Scope of Post-closure Groundwater Monitoring Program

Well	Inorganic and Physical Parameters	VOCs	Tritium	Dissolved Methane	Rationale
Upgradient					
MW307	Semi-annual	Annual	Annual	Annual	Limited variability in upgradient conditions expected
MW309	Semi-annual	Annual	Annual	Annual	Limited variability in upgradient conditions expected
Cross-gradient (north)					
MW97-1	Quarterly	Annual	Annual	Annual	Rising chloride observed
MW09-3A	-	-	-	-	Bedrock conditions already represented by MW09-3B
MW09-3B	Semi-annual	Annual	Annual	Annual	Bedrock well
MW10-1A	Quarterly	Annual	Annual	Annual	Continue bedrock monitoring until source of chloride in overburden identified
MW10-1B	Quarterly	Annual	Annual	Annual	Elevated chloride observed
MW10-4	Quarterly	Annual	Annual	Annual	Sentinel well north of Annex



CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

Well	Inorganic and Physical Parameters	VOCs	Tritium	Dissolved Methane	Rationale
Cross-gradient (south)					
TH1A	Quarterly	Annual	Annual	Annual	Sentinel well south of Annex
MW09-4A	Annual	Annual	Annual	Annual	Bedrock well
MW09-4B	Quarterly	Annual	Annual	Annual	Overburden well
MW09-4D	-	-	-	-	Deep bedrock well for water level monitoring
Downgradient (on-site)					
TH6	Quarterly	Annual	Annual	Annual	Well completed at overburden/bedrock interface
OW1	Quarterly	Annual	Annual	Annual	Overburden well
OW3	Annual	Annual	Annual	Annual	Replaced by MW07-1A/B; annual sampling to assess relative to historical trends
MW07-1A	Semi-annual	Annual	Annual	Annual	Bedrock well, but chemistry variable
MW07-1B	Quarterly	Annual	Annual	Annual	Overburden well
MW09-2A	Annual	Annual	Annual	Annual	Bedrock well
MW09-2B	Quarterly	Annual	Annual	Annual	Overburden well
Downgradient (off-site)					
TH9A	Annual	Annual	Annual	Annual	Replaced by MW10-2A; annual sampling until conditions at new well are established
TH9B	Annual	Annual	Annual	Annual	Replaced by MW10-2B; continue annual sampling since TH-9B represents a shallower flow zone
OW2	Quarterly	Annual	Annual	Annual	Overburden well
OW4	Quarterly	Annual	Annual	Annual	Overburden well
MW03-2A	Annual	Annual	Annual	Annual	Bedrock well
MW03-2B	-	-	-	-	Dry
MW09-1A	Annual	Annual	Annual	Annual	Bedrock well
MW09-1B	Quarterly	Annual	Annual	Annual	Overburden well
MW10-2A	Annual	Annual	Annual	Annual	Bedrock well
MW10-2B	Quarterly	Annual	Annual	Annual	Overburden well
MW10-2D	Annual	-	-	-	Deep bedrock well for water level monitoring; sample annually
MW10-3A	Annual	Annual	Annual	Annual	Bedrock well
MW10-3B	-	-	-	-	Dry
MW10-3D	Annual	-	-	-	Deep bedrock well for water level monitoring; sample annually

Note: "VOCs" represents volatile organic compounds.



CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

Should the proposed monitoring wells be installed, it is assumed that the overburden wells would be sampled on a quarterly basis and the bedrock wells would be sampled on an annual basis.

A comprehensive characterization of leachate from the Landfill sumps was conducted in 2008 to determine whether any constituents of concern were present in Landfill leachate that were not part of the groundwater monitoring program (Golder, 2009)². No constituents were identified from the study that would warrant changes to the scope of the analytical program. Considering recent literature on emerging contaminants at landfill sites (Andrews et. al., 2012)³, together with the continued evolution of the waste stream, consideration could be given to conducting an updated characterization of the Landfill leachate to determine whether additional constituents should be added to the post-closure groundwater monitoring program; however, a recent study by AMEC (2012)⁴ on emerging contaminants concluded that it is unlikely that these compounds would be present in groundwater in concentrations that exceed current regulatory standards in BC.

6.3 Preliminary Mitigation Options

6.3.1 Groundwater Recovery

The calibrated numerical groundwater flow model was used to simulate recovery wells to mitigate the off-site migration of groundwater constituents. The results from the numerical model were used to estimate the number, locations, and pumping rates for these wells, and the total pumping rate for the well field as a whole.

A simulation using the calibrated model was conducted that involved migration control by groundwater pumping. The simulation included well boundary conditions to represent the operation of pumping well centres. Several model runs were completed, where the number and locations of the pumping well centres and the pumping rate for each of the centres were varied in an attempt to mitigate losses to the surrounding environment (*i.e.*, the capture of groundwater from beneath and around the Landfill) at the approximate minimum total pumping rate. The particle tracking solution in FEFLOW was used to determine when all path-lines were captured by the pumping wells.

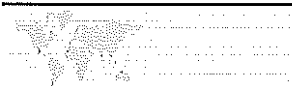
The resultant analysis determined that for the base case, a total of four pumping well centres located east of the Landfill, each pumping at a rate of 4 US gpm, would be required to mitigate the off-site migration of groundwater. This would result in a combined recovery rate for the well field of 16 US gpm (approximately 90 m³/day).

To account for well pumping inefficiencies and heterogeneities associated with the local groundwater flow regime, it is assumed, for the purpose of planning, that on the order of 8 to 12 pumping wells, with a collective pumping rate on the order of 100 m³/day, would be required to capture groundwater originating from beneath the Landfill. For preliminary costing purposes, it is assumed that the wells would be completed with 200 mm (8 inch) diameter casings. Typically, the presence of one observation well for every two recovery wells is required to assess the effectiveness of groundwater recovery. It is assumed that these observation wells would be completed with 100 mm (4 inch) diameter casings.

² Golder Associates Ltd., April, 2009. 2008 Annual Report, Cache Creek landfill, Cache Creek, BC.

³ Andrews, W. J., J. Masoner and I.M. Cozzarelli, 2012. Emerging Contaminants at a Closed and an Operating Landfill in Oklahoma. Groundwater Monitoring and Remediation 32, No. 1, Winter 2012, pages 120-130.

⁴ AMEC Environment & Infrastructure, July 2012. Review of Potential Long Term Issues Related to Operation, Closure and Post Closure of the Cache Creek Landfill, Cache Creek, BC.



CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

One or two pumping wells, together with an observation well, will initially be installed, and a 48-hour pilot pumping test, followed by 24 hours of recovery, will be conducted to assess efficiency of the recovery wells. This information will be used to refine the numerical modelling, which will in turn be used to finalize the well field design.

6.3.2 Disposal of Collected Water

The quantity of groundwater that would be collected by a groundwater pumping system is estimated to be on the order of 100 m³/day. The table below provides estimated concentrations of certain constituents in the groundwater that would be collected.

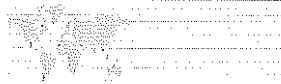
Table 8: Estimated Concentrations of Constituents in Groundwater Requiring Treatment

Constituent	Estimated Concentration (Location)
Magnesium	835 mg/L (OW1, OW4)
Manganese	0.556 mg/L (OW2)
Selenium	0.026 mg/L (OW4)
Sodium	789 mg/L (MW97-1)
Uranium	0.033 mg/L (OW4)
Chloride	154 mg/L (OW2)
Sulphate	2,970 mg/L (OW2, OW4)

The following groundwater disposal options were screened for applicability:

Table 9: Screening of Groundwater Disposal Options

Option	Description
Evaporation ponds	Approximately 10 hectares of ponds would be required.
Utilization of waste heat from internal combustion engines	If the utilization technology is electricity generation by internal combustion engines, on the order of 5,000 to 8,000 m ³ /year of the water could be evaporated by utilizing the waste heat from the internal combustion engines assuming a 4-MW electricity generation plant. Further assessment is required to properly quantify the amount of water that could be evaporated.
Spray evaporation ponds	This would consist of 6 to 8 hectares of evaporation ponds, with spray evaporators. Although sprayers can be designed to evaporate at least 80% of the feed flow in hot, dry weather, the goal of the design is to provide a 20 to 30% volume reduction, while avoiding the production of dry aerosol salts that can be carried beyond the property.
On-site treatment plant	The disposed water could be treated in a modular treatment plant. Of the water entering the treatment plant, approximately 85% would be suitable for reuse (such as for irrigation) or discharge to surface water, with the remaining 15% would be as a concentrate of brackish waste water (brine). The waste water would require disposal. A disposal option could be 1.5 hectares of evaporation ponds and spray evaporation.



6.4 Criteria for Defining Completion

The following are the criteria for defining that impacts to groundwater are adequately controlled:

- Groundwater recovery wells are installed along with a selected groundwater disposal option; and
- Groundwater monitoring to confirm performance of recovery wells.

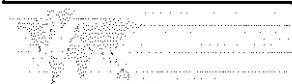


7.0 FILLING PLAN DURING CLOSURE

Figures 6 to 12 show the projected filling sequence for 2012 and up to the third quarter of 2014. This filling sequence assumes that, in 2012 and thereafter, the Landfill will accept 200,000 tonnes of MSW annually, plus approximately 11,000 tonnes of fly ash. Table 10 summarizes the approximate airspace available in each of the projected platforms shown in Figures 6 to 12. These airspace estimates include the volumes of MSW, fly ash, intermediate and final covers, and the lock-block wall separating fly ash from MSW.

Table 10: Approximate Airspace of Projected Filling Sequence

Figure	Approximate Platform Elevation (m)	Approximate Airspace Consumed (m ³)
6	Stage 4: 655 to 660	—
	Stage 5: 651 to 654	—
7	652	59,924
8	655	125,886
9	658	178,579
10	661	131,264
11	664	141,813
12	667	120,164



8.0 SURFACE WATER MANAGEMENT

8.1 Surface Water Facilities Design

The surface water facilities design is contained in APPENDIX D. A summary is provided below:

- The forestry access road ditches will be lined with filter cloth and rip-rap;
- A few damaged inlets or outlets of culverts, and a few culverts will be cleared of sediment build-up;
- Where a berm is present on the downhill side of a Ministry of Forests road, aprons lined with filter cloth and Class 25 rip-rap will be constructed to the toe of the road fill at any break in the berm where flows are directed off the road;
- All of the culvert inlets located adjacent to sediment traps will have slope improvements, as well as placement of filter cloth and Class 25 rip-rap. The other sediment traps will be lined with filter cloth and rip-rap, except for the Creek A Trap #3, the D Creek Sediment Trap, the sediment trap adjacent to the 590 Bench Road access, and sediment traps located adjacent to the North Borrow Pit; and
- The ditch to the north of the sediment trap on the west side of the forestry access road, to the east of the airport access road, will be extended to the south to receive flows from the sediment trap.

8.2 Criteria for Defining Completion

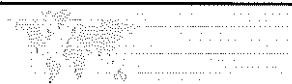
The criteria for defining that the surface water diversion works are adequate are contained in APPENDIX D. A summary is provided in this section.

Drainage Channels

- Drainage channels have side slopes that are flatter than 1.5H:1V, have V-shaped cross-sections, and have available depths (including freeboard) of 1.25 m.

Culverts/Road Crossings

- Culvert inlets and outlets are free of sediment and debris;
- Culvert slopes are greater than 1%; and
- Where culvert discharges onto fill material, the area receiving runoff is lined with filter cloth and Class 25 rip-rap.

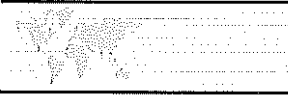


Roads

- Ministry of Forests roads have surfaces graded to adequately shed runoff off the roads. These roads have ditches that are lined with filter cloth and Class 25 rip-rap, and have side slopes no steeper than 1.5H:1V; and
- Landfill bench roads have drainage ditches on their uphill sides, and are graded with at least 2% cross fall towards the ditches. The ditches are lined with filter cloth and Class 25 rip-rap at their low ends and/or where gradients are more than 2%.

Sediment Traps

- Sedimentation traps at culvert inlets are clean, at the time of the designated site inspection, and have side slopes of 2H:1V with well-compacted native material, or of 1.5H:1V with rip-rap armouring. If a 1.5H:1V rip-rap-lined culvert inlet slope is not possible at a particular location due to short culvert inlet length, the culvert inlet is extended and the roadside fill is regraded to reclaim the recommended slope. Alternatively, retaining walls are installed at the location to achieve slope stability; and
- Sediment traps have ponding depths of at least 0.3 m.



CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

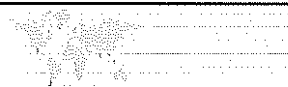
9.0 SOIL MATERIAL SOURCES

Table 11 provides an estimate of the types and quantities of soil materials required to complete closure, the use of such materials, as well as the identification of a potential source as provided by Wastech. The quantities are those required as of July 2012 until Landfill closure, and do not include materials already brought to the Landfill.

Table 11: Soil Materials for Closure

Material	Use	Estimated Quantity (m ³)	Potential Source
Till	Final cover	133,000	North Borrow
Top soil	Vegetation growth layer of final cover	25,000	Local excavations
Clear gravel	Landfill gas wells, horizontal collectors, and leachate recirculation system	6,000	Coast Range Concrete (Cache Creek)
Sand and gravel	Benches	10,000	Woodburn Property
Organic amendments (for top soil)	Top soil amendment	14,000	Local ranches
Rip-rap	Watercourses	4,000	North Borrow

Note: The "Material" description may include all of the different types or gradations of the material.



10.0 NOTIFICATIONS AND SURVEY

The public will be notified of the Landfill closure and alternative waste disposal facilities by the following:

- Issuing a press release both eight months and one month prior to the anticipated closure date;
- Issuing an information bulletin to the TNRD for posting on its website approximately one year prior to the anticipated closure date; and
- Posting a sign at the Landfill entrance approximately one year prior to the anticipated closure date. The sign will remain posted, and will be updated and maintained for at least one year after the closure date.

The above press release and sign will indicate the anticipated Landfill closure date and the location of alternative waste disposal facilities.

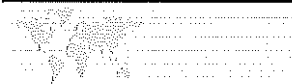
Maintenance of the water diversion structures is required to ensure stability and performance of the Landfill. In particular, construction or diversion works upstream of the Landfill by logging, agriculture, or any other activities could impact the performance and integrity of the water diversion structures (e.g., increased sediment and debris loading in the channels could plug the culverts and create erosion at the Landfill). For these reasons, the Water Stewardship Division of the Ministry of Environment will be contacted prior to Landfill closure to ensure that all future activities in or around the streams that are diverted around the Landfill are undertaken with due consideration and protection of the downstream works.

A lease tenure has been registered against the original Landfill property that the property is being used for waste disposal. A lease tenure against Stage 5 for its use for waste disposal commenced on October 1, 2009.

Once all of the closure works have been substantially completed, a survey of the Landfill should be carried out, and a plan should be prepared showing the following:

- Topography with 2 m contour intervals;
- All at-ground or above-ground structures and facilities, including a label as to what the structure or facility is. This would include buildings, equipment (mechanical, electrical or irrigation), above-ground piping, wells, LFG facilities, culverts (with diameters identified), roads, watercourses, powerpoles, manholes;
- All below-ground linear services, such as buried electrical lines, LFG piping, leachate lines; and
- Property lines and easements, including the legal description of each parcel.

Prior to closure, a post-closure maintenance manual should be prepared. This manual would describe the detailed procedures and safety considerations for all post-closure maintenance activities, as well as a plan identifying each facility that would need to be maintained. The manual will also include a summary of the design and construction of the Landfill (including a plan drawing), and a timeline of significant events (e.g., construction of each phase).



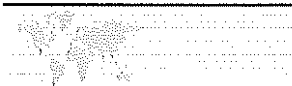
CACHE CREEK LANDFILL CLOSURE PERIOD PLAN

11.0 ESTIMATED TIMELINE OF ACTIVITIES

The estimated timeline of Landfill closure activities shown below assumes that Landfill closure will occur on December 31, 2016, meaning that waste placement and final cover soil placement is complete. It is expected that most of the implementation times will be within one year (± 1 year) of the indicated time. Most of the closure activities will be completed by the end of 2016. Some of the tasks will be partially completed by the end of 2016, and will be fully completed in 2017, after the post-closure survey is carried out.

Table 12: Estimated Timeline of Landfill Closure Activities

Activity	Implementation Time
Final cover placement	2012 to 2016
Revegetation of final cover	2012 fall; spring and fall of each of 2013 to 2016; and spring 2017
Installation of LFG management facilities	2012 to 2017
Decommissioning of existing evaporation ponds	2015
Construction of new evaporation ponds	2015
Construction of leachate recirculation system	2014
Monitoring well installation	2013 to 2014
Groundwater recovery well installation	2014 to 2015
Surface water drainage work	2013 to 2016
Public notification of Landfill closure	2016
Post-closure Landfill survey	2017
Preparation of a post-closure maintenance manual	2016 to 2017



12.0 CLOSING COMMENTS

The Closure Period Plan is anticipated to allow closure to be achieved. However, it must be recognized that, even if all of the recommendations of the Plan are followed, there may still be situations where the criteria to measure completion are not met. For example, although our recommendations include guidance for top soil, irrigation, and seed mix for revegetation success, we cannot test for all parameters or sample all of the soil, nor can we thoroughly inspect all of the construction works. Thus, it is possible that, in some areas, the vegetation may not establish permanently or weeds may overtake the vegetation. While there is an element of risk associated with all of the tasks, in Golder's opinion, the highest risk of not meeting the closure criteria on the initial work phase would be for the revegetation, remedial groundwater collection, and LFG collection aspects.

The services performed by Golder were in a manner consistent with that level of care and skill ordinarily exercised by other landfill professionals currently practicing under similar conditions in the southern interior region of British Columbia, subject to the time limits, and financial, physical or other constraints applicable to the services. No warranty, express or implied, is made.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

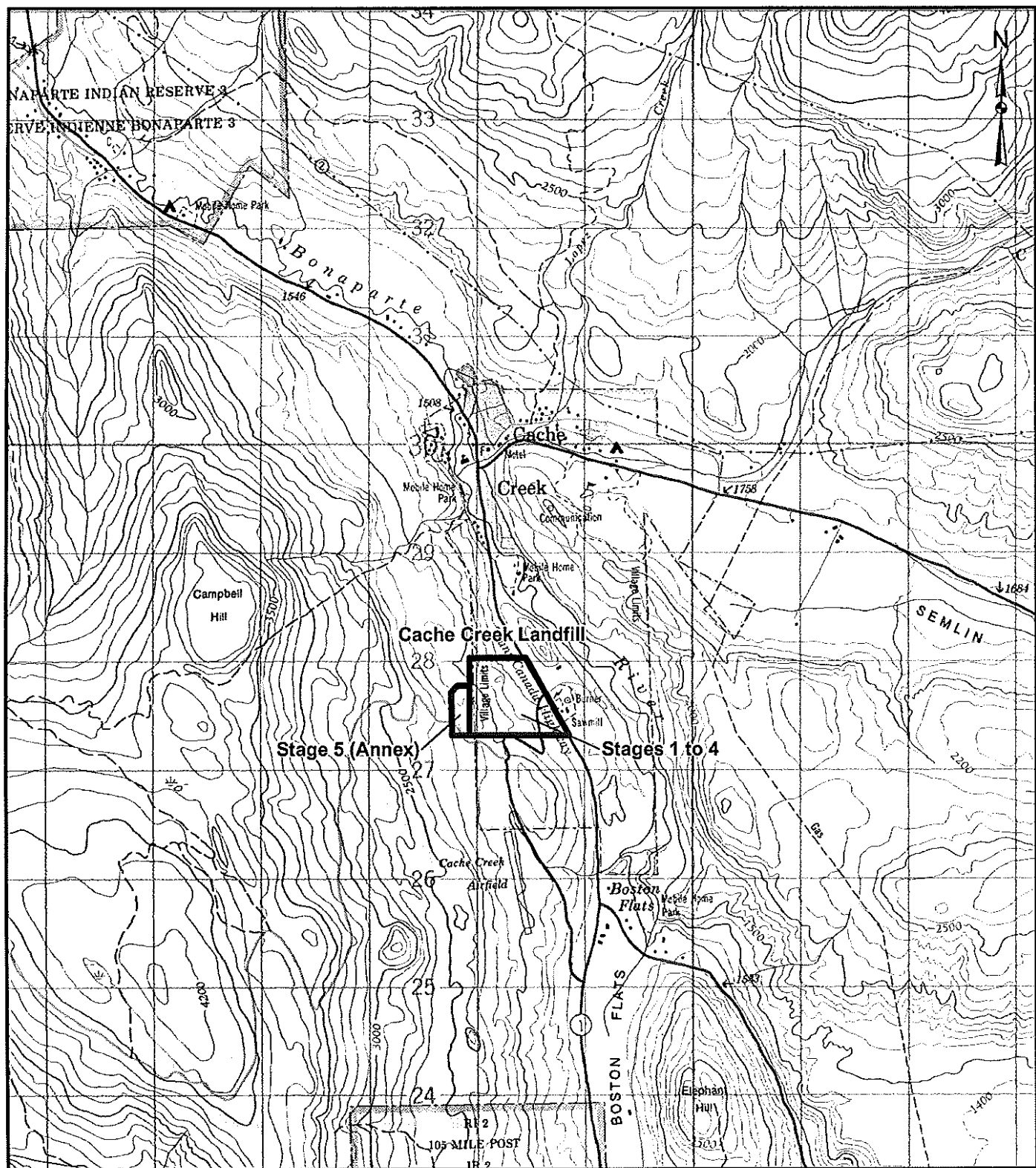
Keith C. K. Lam, P.Eng.
Project Manager

KCKL/CLYW/syd

ORIGINAL SIGNED

Colin L. Y. Wong, P.Eng.
Principal

o:\final\2012\1447\12-1447-0228\1214470228-002-r-rev0-components\1214470228-002-r-rev0 closure period plan 07sep_12.docx



LEGEND

 Cache Creek Landfill

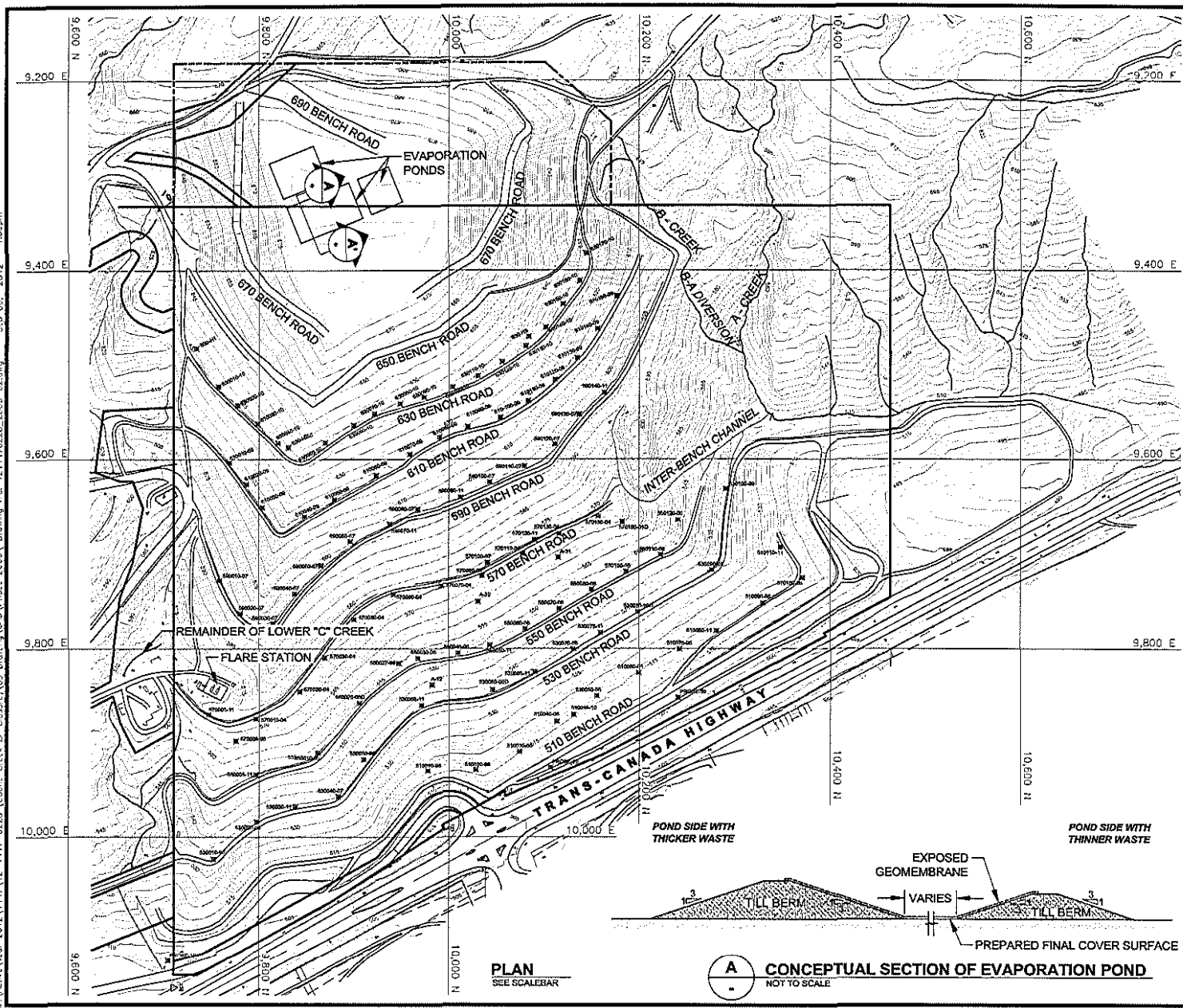
1,000 0 1,000
SCALE 1:50,000 METRES

REFERENCE

NTS Mapsheet 92I/14 provided by CanMatrix.
Datum: NAD 83 Projection: UTM Zone 10

PROJECT		WESTECH SERVICES LIMITED CACHE CREEK LANDFILL CACHE CREEK, B.C.			
TITLE		KEY PLAN			
 Golder Associates Greater Vancouver Office, B.C.		PROJECT No. 11-1447-0028		SCALE AS SHOWN	REV. 0
		DESIGN	KL	12DEC11	FIGURE 1
		GIS	MM	12DEC11	
		CHECK			
		REVIEW	MOE-2013-00197		

W:\Projects\2012\1447\12-1447-0223 (Cache Creek LF Closure)\09 Drafting\CAD\Phase 2000\Drawing File 1214470223_2000-02.dwg, Sep 06, 2012 - 1:35pm



LEGEND

- PROPERTY LINE OF STAGES 1 TO 4
- PROPERTY LINE OF STAGE 5
- ✕ LANDFILL GAS EXTRACTION WELL
- ✕ UNPRODUCTIVE WELL (FROM WASTECH)
- ✕ CAPPED LANDFILL GAS PROBE

NOTES

1. THIS FIGURE IS IN A LOCAL CO-ORDINATE SYSTEM.
2. LOCATIONS OF LANDFILL GAS WELLS AND PROBES WERE PROVIDED BY WASTECH ON DECEMBER 21, 2011.
3. UNPRODUCTIVE WELLS WERE PROVIDED BY WASTECH IN NOVEMBER 2009.
4. LOCATIONS OF EVAPORATION PONDS SHOWN ARE CONCEPTUAL AND SUBJECT TO REVISION.

REFERENCES

1. TRUE CONSULTING GROUP, CAD FILE: sv-305-000-legal.dwg, DATE RECEIVED: JANUARY 13, 2012.
2. TRUE CONSULTING GROUP, CAD FILE: TRUE - EAGLE MAPPING DEM 2011 YEAR END.dwg, SURVEYED ON DECEMBER 15, 2011.
3. EAGLE MAPPING, CAD FILE: Landfill2011-Pln.dwg, SURVEYED ON OCTOBER 13, 2011.



DATE	06/07/12	BY	K.C.K.	ISSUED WITH FINAL REPORT	J.S.B.	REV.	01
DATE	06/22/12	BY	K.C.K.	DRAFT - ISSUED FOR CLIENT REVIEW	J.S.B.	REV.	02
DATE	07/17/12	BY	K.C.K.	DRAFT - ISSUED FOR CLIENT REVIEW	J.S.B.	REV.	03
PROJECT	WASTECH SERVICES LIMITED CACHE CREEK LANDFILL CACHE CREEK, B.C.						
TITLE	CONCEPTUAL CLOSURE TOPOGRAPHY						
PROJECT NO.	12-1447-0223	PHASE	2000	DATE			
DESIGN	K.C.K.	JUL-10-12	FILE	1214470223_2000-02			
CADD	J.S.B.	JUL-10-12	SCALE	AS SHOWN REV.			
CHECK	K.C.K.	SEP-07-12					
REVIEW	C.L.V.	SEP-07-12					

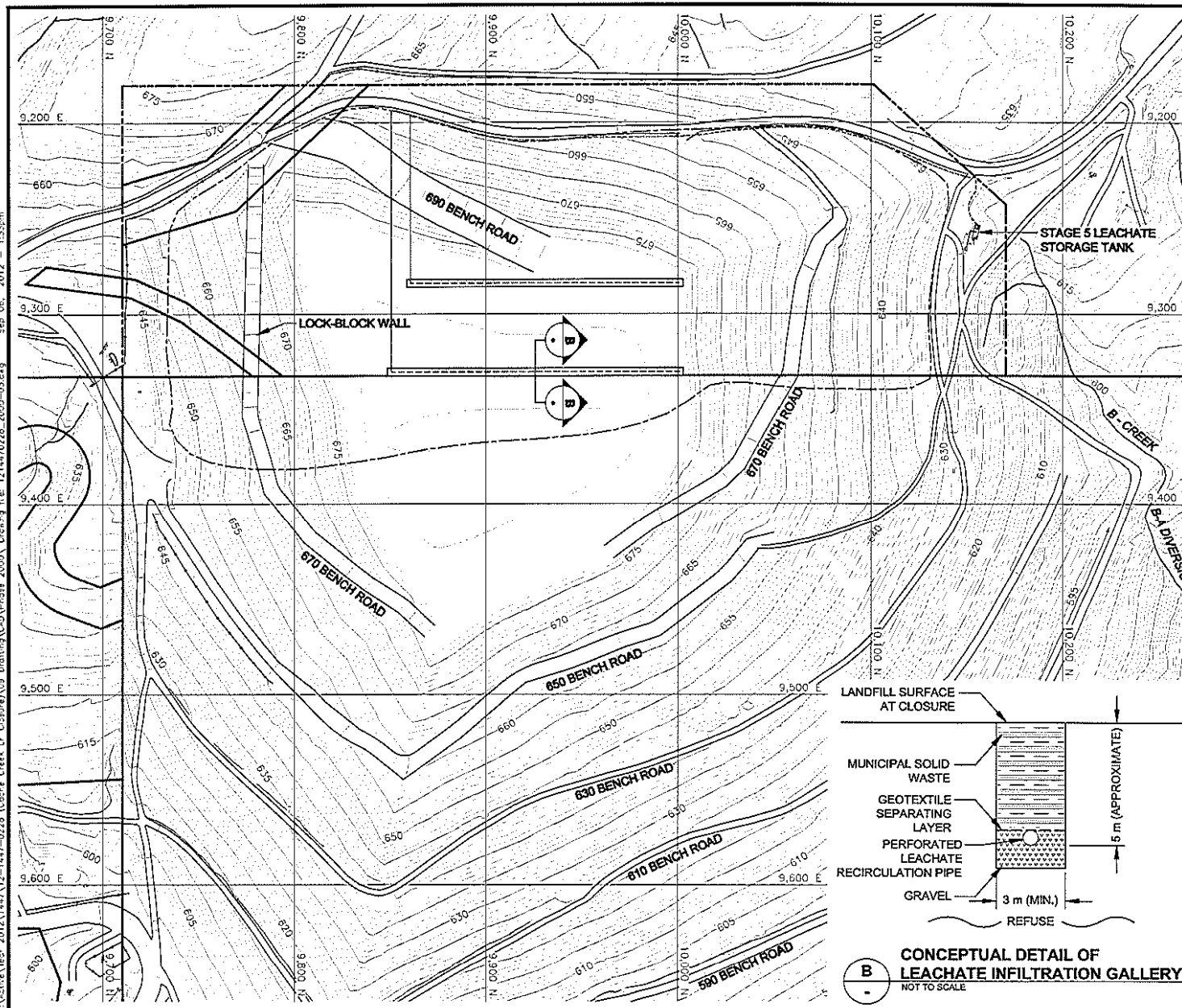


Golden
Associates

FIGURE 3



FIGURE 3



LEGEND

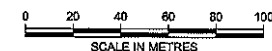
- PROPERTY LINE OF STAGES 1 TO 4
- PROPERTY LINE OF STAGE 5
- LEACHATE INFILTRATION GALLERY
- NON-PERFORATED LEACHATE RECIRCULATION PIPE
- PERFORATED LEACHATE RECIRCULATION PIPE
- LIMIT OF STAGE 5 COMPOSITE LINER (JUNE 2010)
- LEACHATE FORCEMAIN

NOTE

1. THIS FIGURE IS IN A LOCAL CO-ORDINATE SYSTEM.

REFERENCES

1. TRUE CONSULTING GROUP, CAD FILE: sv-305-000-legal.dwg, DATE RECEIVED: JANUARY 13, 2012.
2. TRUE CONSULTING GROUP, CAD FILE: TRUE - EAGLE MAPPING DEM 2011 YEAR END.dwg, SURVEYED ON DECEMBER 15, 2011.
3. EAGLE MAPPING, CAD FILE: Landfill2011-P.in.dwg, SURVEYED ON OCTOBER 13, 2011.
4. TRUE CONSULTING GROUP, CAD FILE: TRUE-EAGLE YR END DEC 2010.dwg, SURVEYED ON DECEMBER 23, 2010.
5. TRUE CONSULTING GROUP, CAD FILE: 305-18.dwg, DATED: JUNE 9, 2010.



Δ 01/07/12/K.C.L.	ISSUED WITH FINAL REPORT	J.S.D.	-	-
Δ 04/22/12/K.C.L.	DRAWN - FOR CLIENT REVIEW	J.S.D.	-	-
Δ 07/26/12/K.C.L.	DRAWN - FOR CLIENT REVIEW	J.S.D.	-	-

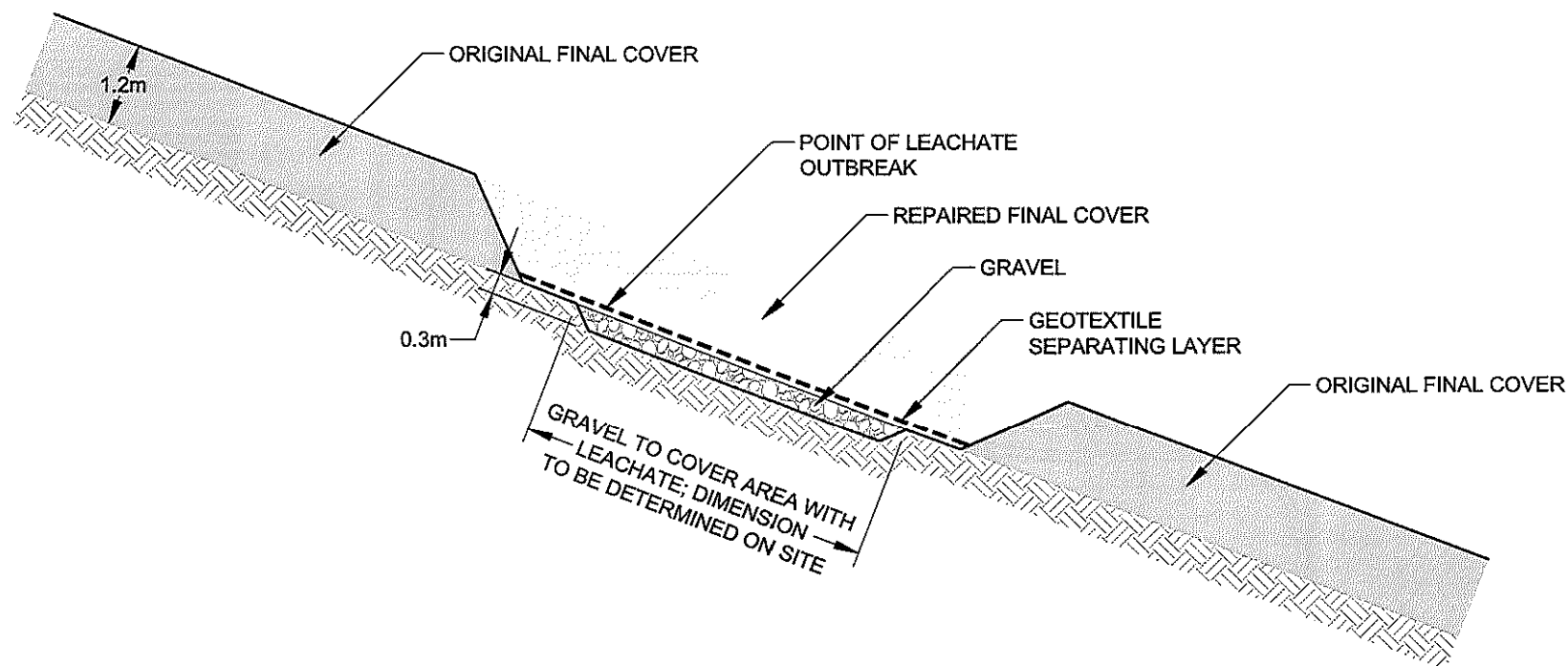
PROJECT
WASTECH SERVICES LIMITED
CACHE CREEK LANDFILL
CACHE CREEK, B.C.

CONCEPTUAL LEACHATE RECIRCULATION SYSTEM DESIGN

PROJECT No. 12-1447-0228	PHASE 2000 TASK
DESIGN K.C.L. JUL-26-12	FILE No. 1214470228-2000-03
CADD J.S.D. JUL-26-12	SCALE: AS SHOWN REV. C
CHECK K.C.L. SEP-07-12	
REVIEW C.L.V. SEP-07-12	

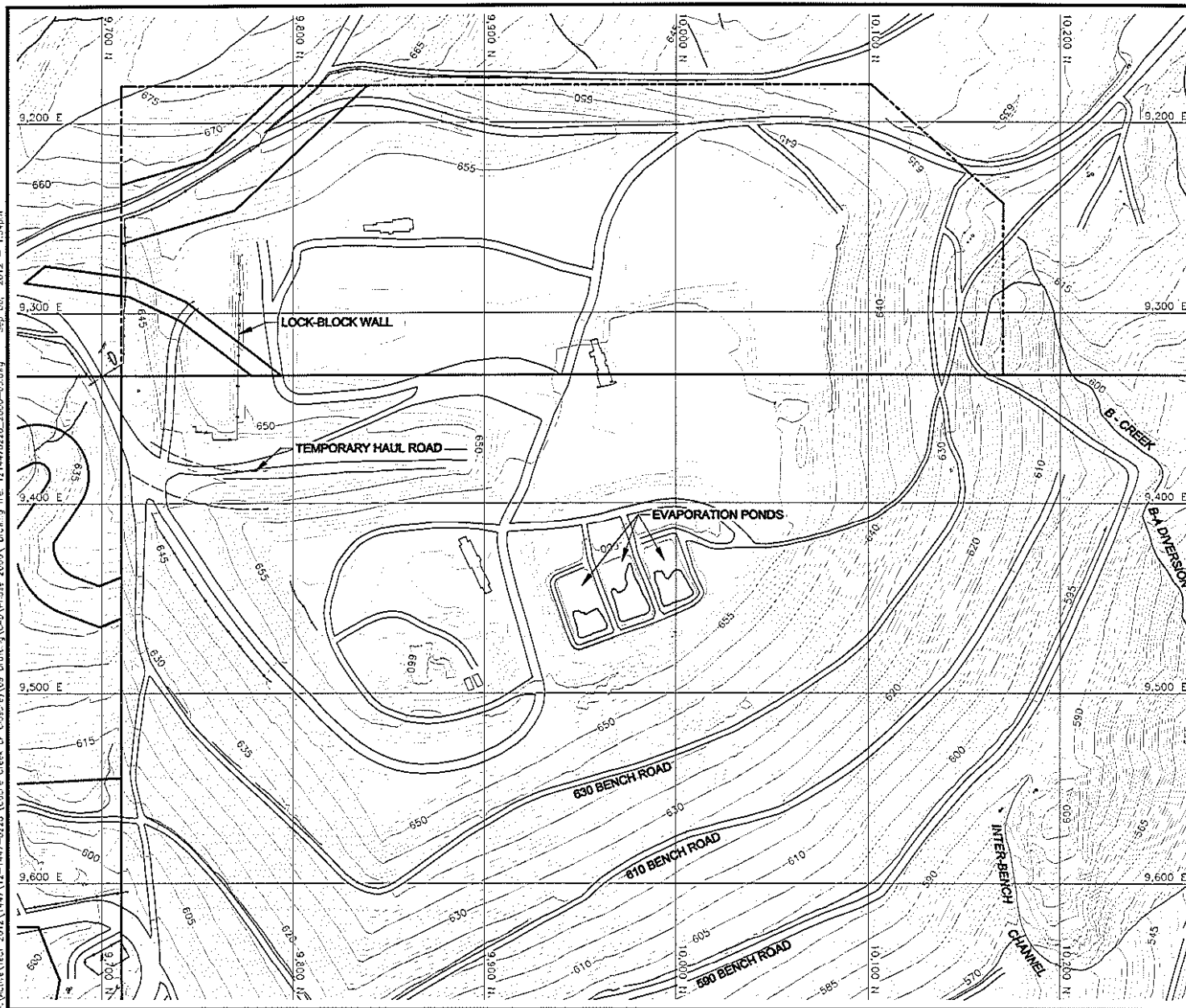


FIGURE 4



SCHEMATIC ONLY
NOT TO SCALE

08/07/12	K.C.K.L.	ISSUED WITH FINAL REPORT	J.S.D.	--	--
06/22/12	K.C.K.L.	DRAFT - ISSUED FOR CLIENT REVIEW	J.S.D.	--	--
07/26/12	K.C.K.L.	DRAFT - ISSUED FOR CLIENT REVIEW	J.S.D.	--	--
PROJECT WASTECH SERVICES LIMITED CACHE CREEK LANDFILL CACHE CREEK, B.C.					
TITLE MITIGATION CONCEPT FOR SMALL LEACHATE OUTBREAKS					
		PROJECT No. 12-1447-0228	PHASE 2000	TASK	
		DESIGN K.C.K.L.	JULY-19-12	FILE No1214470228_2000-04	
		CADD J.S.D.	JULY-19-12	SCALE AS SHOWN	REV. C
		CHECK K.C.K.L.	SEP-07-12		
		REVIEW C.L.Y.W.	SEP-07-12		
FIGURE 5					



LEGEND

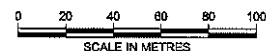
- PROPERTY LINE OF STAGES 1 TO 4
- PROPERTY LINE OF STAGE 5

NOTE

1. THIS FIGURE IS IN A LOCAL CO-ORDINATE SYSTEM.

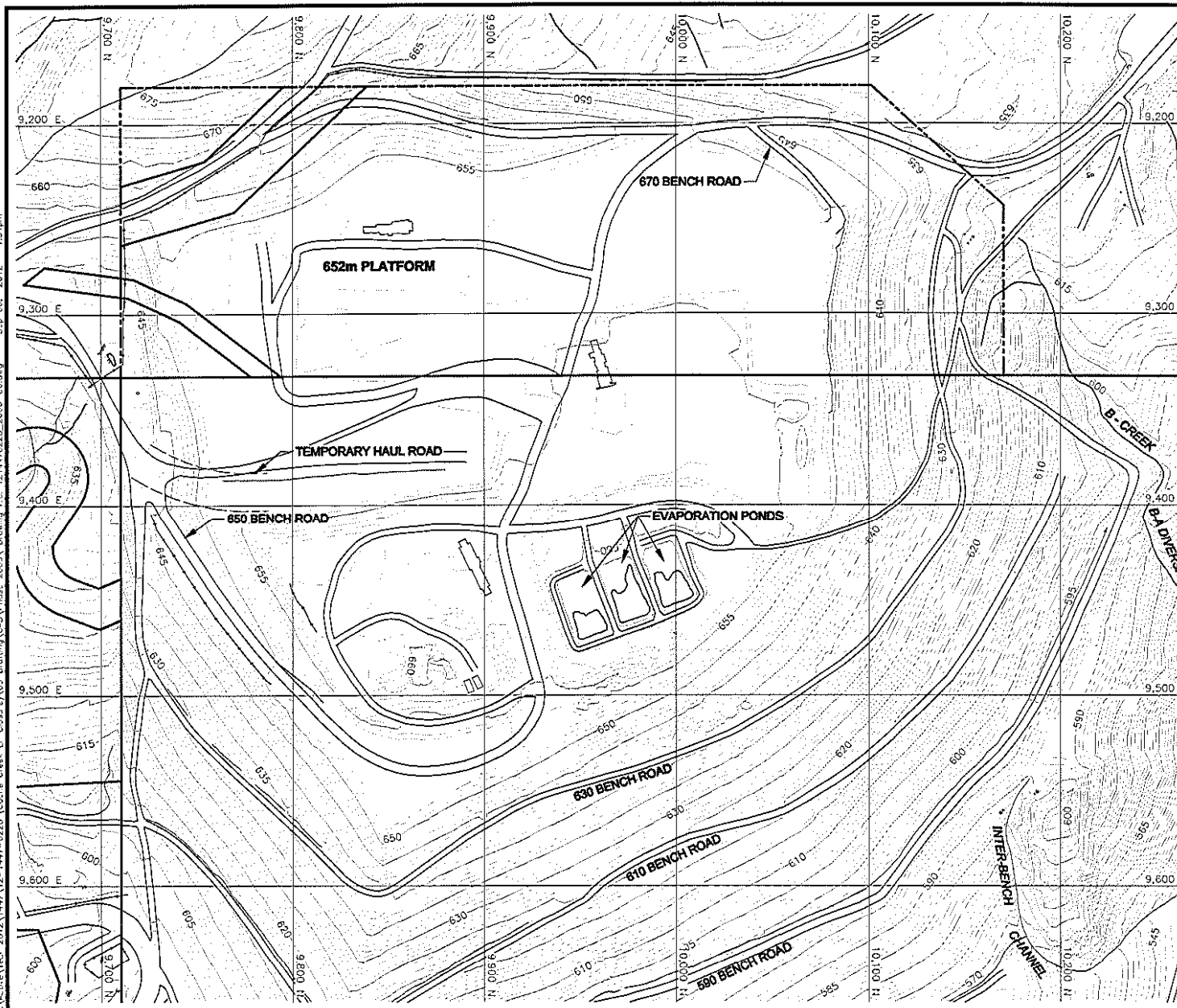
REFERENCES

1. TRUE CONSULTING GROUP, CAD FILE: sv-305-000-legal.dwg, DATE RECEIVED: JANUARY 13, 2012.
2. TRUE CONSULTING GROUP, CAD FILE: TRUE - EAGLE MAPPING DEM 2011 YEAR END.dwg, SURVEYED ON DECEMBER 15, 2011.
3. EAGLE MAPPING, CAD FILE: Landfill2011-Pln.dwg, SURVEYED ON OCTOBER 13, 2011.



09/07/12	N.C.K.L.	ISSUED WITH FINAL REPORT	J.S.D.	-	-
06/29/12	N.C.K.L.	DRAFT - ISSUED FOR CLIENT REVIEW	J.S.D.	-	-
07/26/12	N.C.K.L.	DRAFT - ISSUED FOR CLIENT REVIEW	J.S.D.	-	-
PROJECT: WASTECH SERVICES LIMITED CACHE CREEK LANDFILL CACHE CREEK, B.C.					
TITLE: 2012 FILLING SEQUENCE (START OF 1ST QUARTER 2012)					
		PROJECT No. 12-1447-0228	SCALE	2000	TASK
		DESIGN N.C.K.L.	09-26-12	FILE No. 12-1447-0228-3000-05	
		CADD J.S.D.	09-26-12	TITLE AC SHOWN	REV. E
		CHECK N.C.K.L.	SEP-07-12		
NOVEMBER		CLIENT: 12P-07-12			
FIGURE 6					

m:\Active\Year 2012\1447\12-1447-0228 (Cache Creek LF Closure)\09 Drafting\CAD\Phase 2009\ Drawing File: 1214470228_2009-06.dwg Sep 06, 2012 - 1:34pm



LEGEND

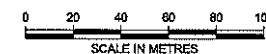
- PROPERTY LINE OF STAGES 1 TO 4
- PROPERTY LINE OF STAGE 5

NOTES

1. THIS FIGURE IS IN A LOCAL CO-ORDINATE SYSTEM.
2. ALIGNMENT OF THE TEMPORARY HAUL ROAD TO BE DETERMINED DURING FILLING.

REFERENCES

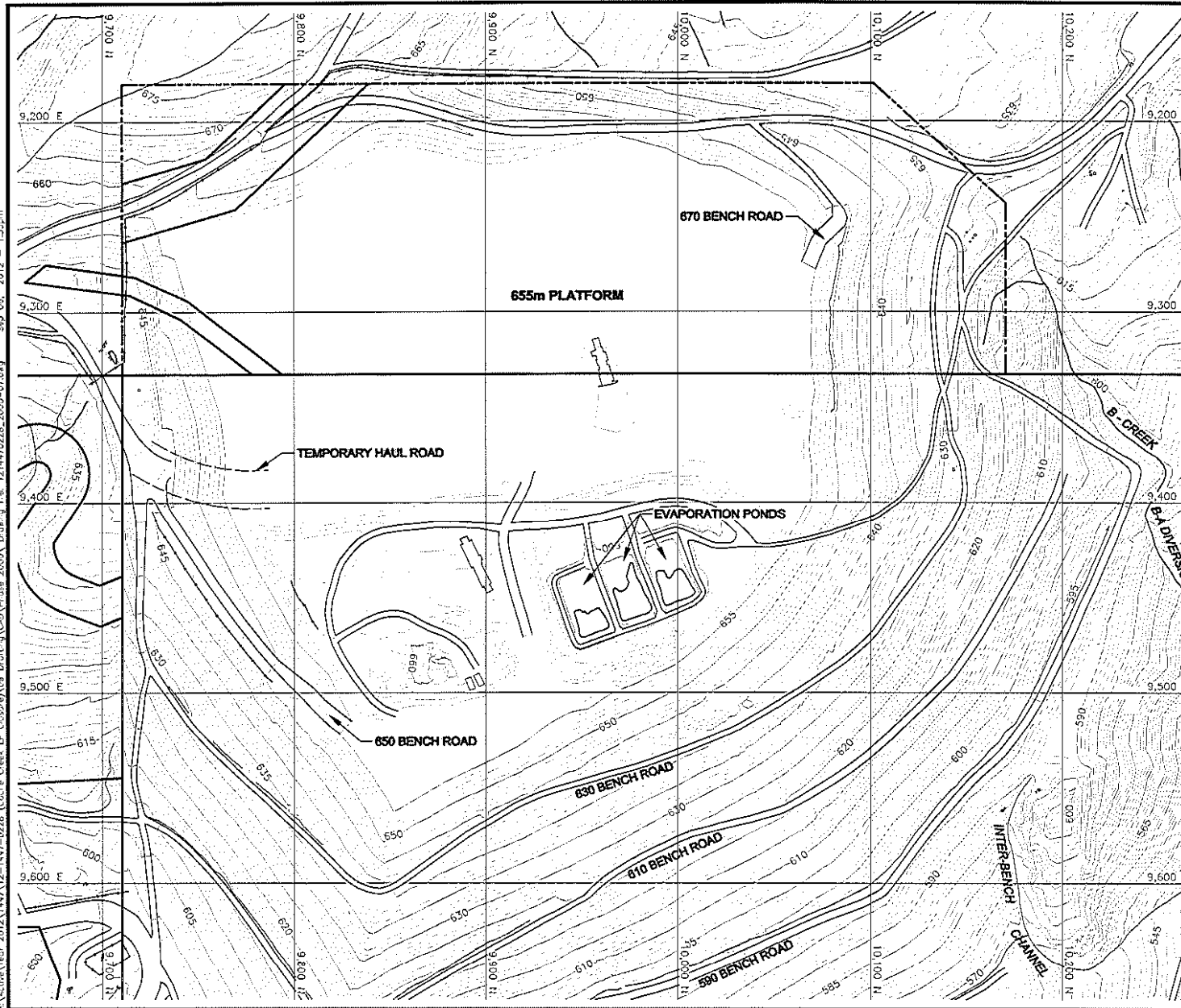
1. TRUE CONSULTING GROUP, CAD FILE: sv-305-000-legal.dwg, DATE RECEIVED: JANUARY 13, 2012.
2. TRUE CONSULTING GROUP, CAD FILE: TRUE - EAGLE MAPPING DEM 2011 YEAR END.dwg, SURVEYED ON DECEMBER 15, 2011.
3. EAGLE MAPPING, CAD FILE: Landfill2011-P.in.dwg, SURVEYED ON OCTOBER 13, 2011.



09/07/10 K.K.L.	ISSUED WITH FINAL REPORT	J.S.D.	-	-
06/02/10 K.K.L.	DRAFT - ISSUED FOR CLIENT REVIEW	J.S.D.	-	-
07/07/10 K.K.L.	DRAFT - ISSUED FOR CLIENT REVIEW	J.S.D.	-	-
PROJECT: WASTECH SERVICES LIMITED CACHE CREEK LANDFILL CACHE CREEK, B.C.				
TITLE: 2012 FILLING SEQUENCE (START OF 2ND QUARTER 2012)				
		PROJECT No. 12-1447-0228	PRICE: 2000	TASK:
		DESIGN: K.K.L.	JUL-26-12	FILE: 1214470228_2009-06
		CADD: J.S.D.	JUL-26-12	SCALE: AS SHOWN
		CHECK: K.K.L.	SEP-07-12	REV: C
		REVIEW: C.L.Y.W.	SEP-07-12	

FIGURE 7

M:\Active\Year 2012\1447-12-1447-0228 (Cache Creek LF Closure)\09 Drafting\CAD\Drawings\2000-07-dwg.dwg, 12/14/2012, 1:35pm



LEGEND

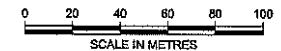
- PROPERTY LINE OF STAGES 1 TO 4
- - - - - PROPERTY LINE OF STAGE 5

NOTES

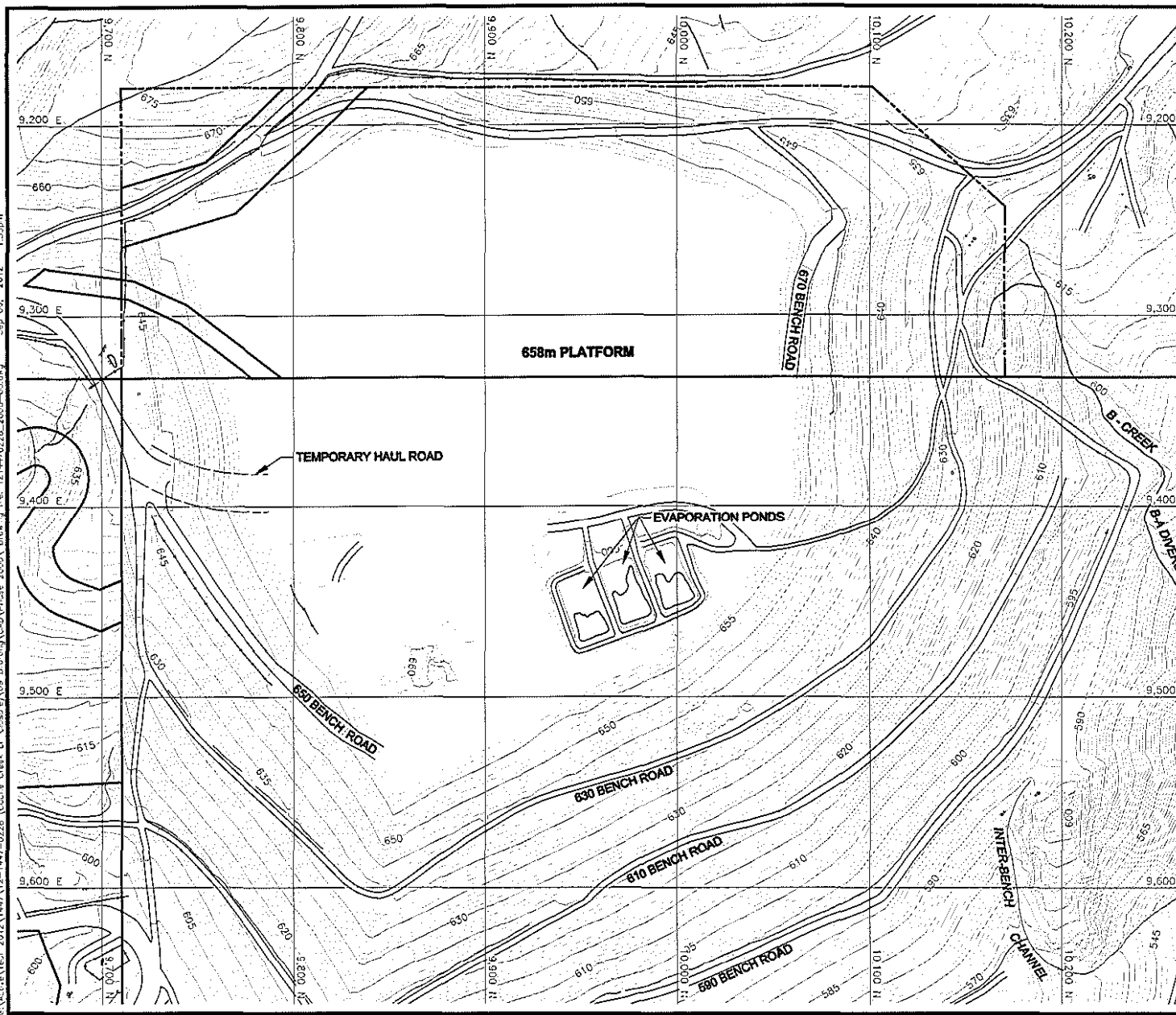
1. THIS FIGURE IS IN A LOCAL CO-ORDINATE SYSTEM.
2. ALIGNMENT OF THE TEMPORARY HAUL ROAD TO BE DETERMINED DURING FILLING.

REFERENCES

1. TRUE CONSULTING GROUP, CAD FILE: sv-305-000-legal.dwg, DATE RECEIVED: JANUARY 13, 2012.
2. TRUE CONSULTING GROUP, CAD FILE: TRUE - EAGLE MAPPING DEM 2011 YEAR END.dwg, SURVEYED ON DECEMBER 15, 2011.
3. EAGLE MAPPING, CAD FILE: Landfill2011-Pln.dwg, SURVEYED ON OCTOBER 13, 2011.



DATE	BY	CHKD	ISSUED WITH FINAL REPORT	J.S.D.	-	-
DATE	BY	CHKD	DRAFT - ISSUED FOR CLIENT REVIEW	J.S.D.	-	-
DATE	BY	CHKD	DRAFT - ISSUED FOR CLIENT REVIEW	J.S.D.	-	-
WASTECH SERVICES LIMITED CACHE CREEK LANDFILL CACHE CREEK, B.C.						
2012 FILLING SEQUENCE (END OF 3RD QUARTER 2012)						
			PROJECT NO.	12-1447-0228	PRICE	7000 TACR
			DESIGN	K.C.K.L.	JUL-20-12	FILE NO. 214470228-2000-07
			CADD	J.S.D.	JUL-20-12	SCALE: AS SHOWN REV. C
			CHECK	K.C.K.L.	SEP-07-12	
			REVIEW	G.L.Y.W.	SEP-07-12	
FIGURE 8						



LEGEND

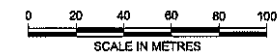
- PROPERTY LINE OF STAGES 1 TO 4
- - - PROPERTY LINE OF STAGE 5

NOTES

1. THIS FIGURE IS IN A LOCAL CO-ORDINATE SYSTEM.
2. ALIGNMENT OF THE TEMPORARY HAUL ROAD TO BE DETERMINED DURING FILLING.

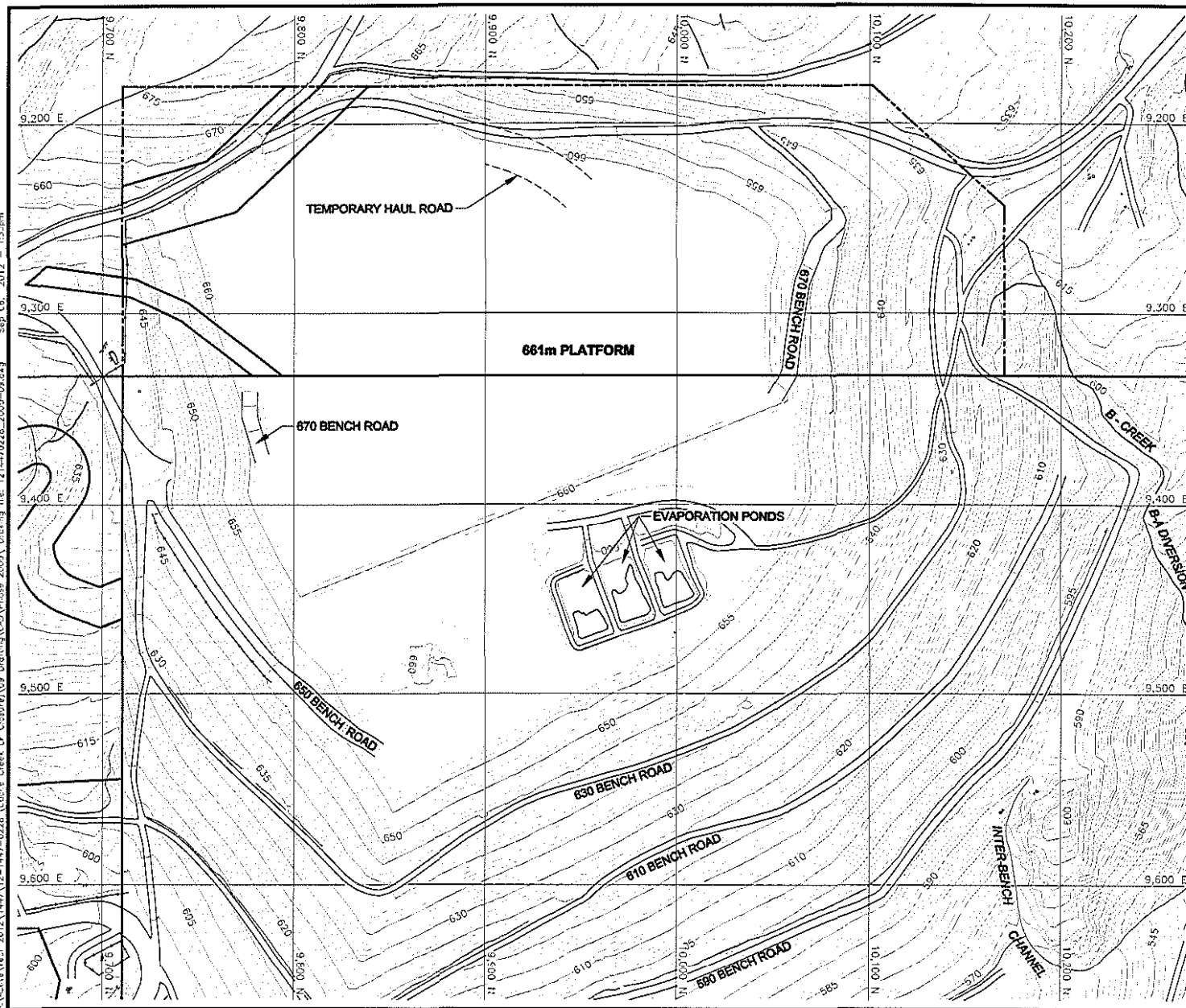
REFERENCES

1. TRUE CONSULTING GROUP, CAD FILE: sv-305-000-legal.dwg, DATE RECEIVED: JANUARY 13, 2012.
2. TRUE CONSULTING GROUP, CAD FILE: TRUE - EAGLE MAPPING DEM 2011 YEAR END.dwg, SURVEYED ON DECEMBER 15, 2011.
3. EAGLE MAPPING, CAD FILE: Landfill2011-Pln.dwg, SURVEYED ON OCTOBER 13, 2011.



DATE	24/07/12	SCALE	DATE	24/07/12	SCALE
BY	J.G.D.	BY	J.G.D.	BY	J.G.D.
CHECKED	J.G.D.	CHECKED	J.G.D.	CHECKED	J.G.D.
REVIEWED	J.G.D.	REVIEWED	J.G.D.	REVIEWED	J.G.D.
PROJECT					
WASTECH SERVICES LIMITED					
CACHE CREEK LANDFILL					
CACHE CREEK, B.C.					
TITLE					
2013 FILLING SEQUENCE					
(MIDDLE OF 2ND QUARTER 2013)					
PROJECT No. 12-1447-0228 PHASE 2000 TASK					
DESIGN	K.G.L.	JUL-20-12	FILE	No1214470228_2000-08	
CADD	J.G.D.	JUL-20-12	SCALE	AS SHOWN	REV. 0
CHECK	K.G.L.	SEP-07-12			
REVIEW	C.L.Y.	SEP-07-12			
Goldier Associates					FIGURE 9

M:\Technical\2012\1447\12-1447-0228 (Cache Creek LF Closure)\09 Drafting\CAD\Draws 2009\Drawing File: 1214470228 2009-09.dwg Sep 06, 2012 - 1:35pm



LEGEND

- PROPERTY LINE OF STAGES 1 TO 4
- - - PROPERTY LINE OF STAGE 5

NOTES

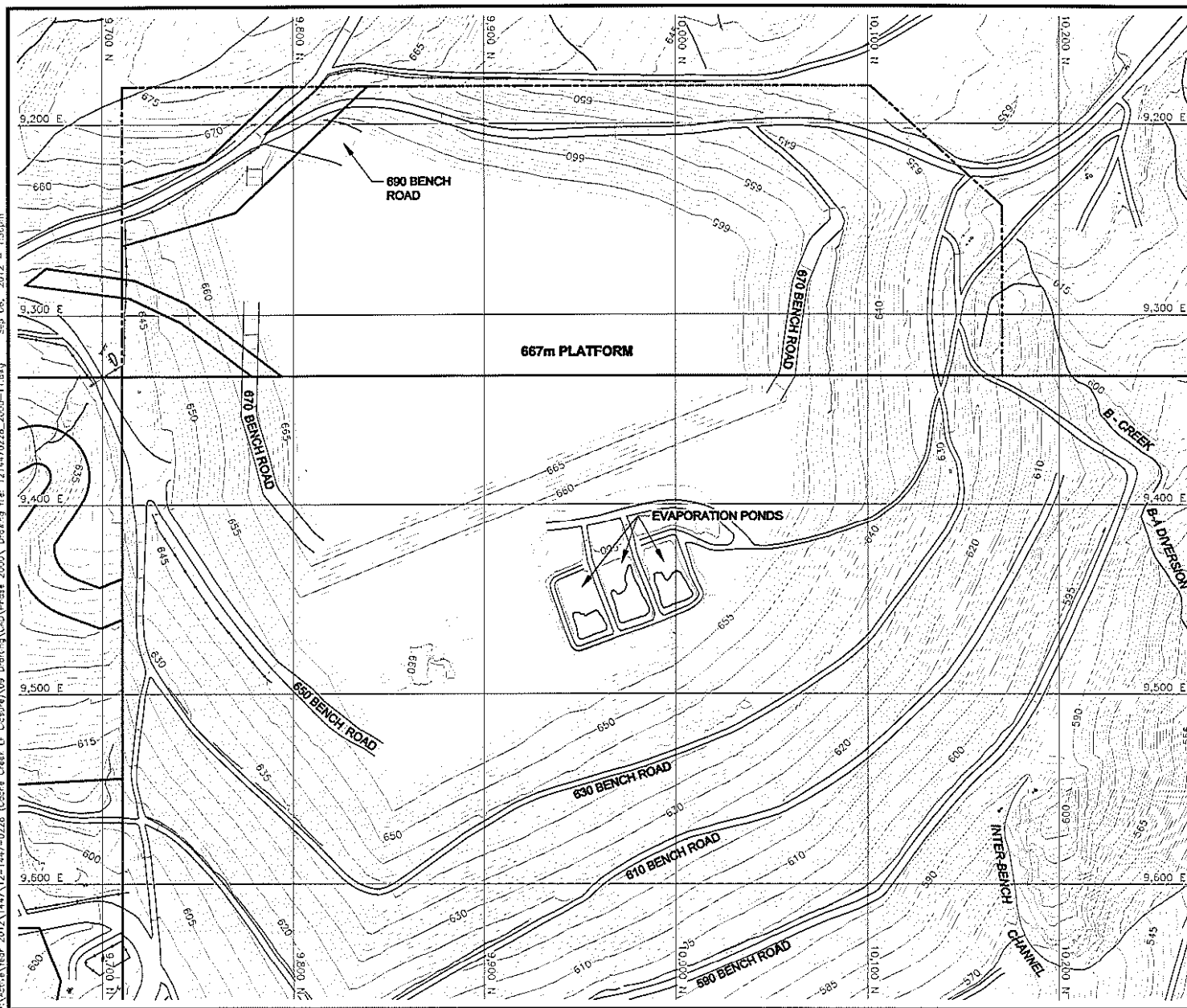
1. THIS FIGURE IS IN A LOCAL CO-ORDINATE SYSTEM.
2. ALIGNMENT OF THE TEMPORARY HAUL ROAD TO BE DETERMINED DURING FILLING.

REFERENCES

1. TRUE CONSULTING GROUP, CAD FILE: sv-305-000-legal.dwg, DATE RECEIVED: JANUARY 13, 2012.
2. TRUE CONSULTING GROUP, CAD FILE: TRUE - EAGLE MAPPING DEM 2011 YEAR END.dwg, SURVEYED ON DECEMBER 15, 2011.
3. EAGLE MAPPING, CAD FILE: Landfill2011-Pln.dwg, SURVEYED ON OCTOBER 13, 2011.



PROJECT	AA 08/07/12/K.C.N.L.	DRAFT - ISSUED FOR CLIENT REVIEW	J.S.D.	-
	07/26/12/K.C.N.L.	DRAFT - ISSUED FOR CLIENT REVIEW	J.S.D.	-
WASTECH SERVICES LIMITED CACHE CREEK LANDFILL CACHE CREEK, B.C.				
2013 FILLING SEQUENCE (MIDDLE OF 4TH QUARTER 2013)				
	PROJECT No.	12-1447-0228	PHASE	2000 - TACK
	DESIGN	K.C.N.L.	REV	26-12
	CADD	J.S.D.	REV	26-12
	CHECK	K.C.N.L.	DATE	07-12
	REVIEW	K.L.Y.W.	DATE	07-12
				FIGURE 10



LEGEND

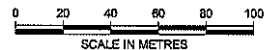
- PROPERTY LINE OF STAGES 1 TO 4
- PROPERTY LINE OF STAGE 5

NOTE

1. THIS FIGURE IS IN A LOCAL CO-ORDINATE SYSTEM.

REFERENCES

1. TRUE CONSULTING GROUP, CAD FILE: sv-305-000-legal.dwg, DATE RECEIVED: JANUARY 13, 2012.
2. TRUE CONSULTING GROUP, CAD FILE: TRUE - EAGLE MAPPING DEM 2011 YEAR END.dwg, SURVEYED ON DECEMBER 15, 2011.
3. EAGLE MAPPING, CAD FILE: Landfill2011-Pln.dwg, SURVEYED ON OCTOBER 13, 2011.



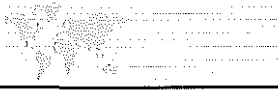
DATE	06/07/12	BY	K.C.L.	ISSUED FOR CLIENT REVIEW	45.0	-	-
DATE	07/26/12	BY	K.C.L.	ISSUED FOR CLIENT REVIEW	45.0	-	-

PROJECT
WASTECH SERVICES LIMITED
CACHE CREEK LANDFILL
CACHE CREEK, B.C.

TITLE
**2014 FILLING SEQUENCE
(END OF 3RD QUARTER 2014)**

	PROJECT No.	12-1447-0228	PHASE	2000	TASK	
	DESIGN	K.C.L.	JUL-20-12	FILE No.	1214470228_2000-11	
	CAD	J.S.D.	JUL-20-12	SCALE	AS SHOWN	REV. 0
	CHECK	K.C.L.	SEP-07-12			
	REVIEW	CLY.W.	SEP-07-12			

FIGURE 12



APPENDIX A

Operational Certificate OC-7577 Dated March 27, 2012



March 27, 2012

Tracking Number: 244931

Authorization Number: 7577

REGISTERED MAIL

Wastech Services Ltd. and the Village of Cache Creek
1200 United BLVD
Coquitlam, BC V3K 6T4

Dear Operational Certificate Holder:

Enclosed is Amended Operational Certificate 7577 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the operational certificate. **The following sections have been revised: addition of Section 3.2; revision to Section 4.1.5; and, addition of Section 9.0.** An annual fee will be determined according to the Permit Fees Regulation.

This operational certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority rests with the operational certificate holder. It is also the responsibility of the operational certificate holder to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

This decision may be appealed to the Environmental Appeal Board in accordance with Part 8 of the *Environmental Management Act*. An appeal must be delivered within 30 days from the date that notice of this decision is given. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

Administration of this operational certificate will be carried out by staff from the Southern Interior Region - Thompson. Plans, data and reports pertinent to the operational certificate are to be submitted to the Regional Manager, Environmental Protection, at Ministry of Environment, Regional Operations, Southern Interior Region - Thompson, 1259 Dalhousie Dr., Kamloops BC V2C 5Z5.

Yours truly,

Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*

Ministry of Environment

Environmental Protection
Division

1259 Dalhousie Dr.
Kamloops BC V2C 5Z5

Southern Interior Region -
Thompson
Telephone: (250) 371-6200
Facsimile: (250) 828-4000

7577

page 2

Date: March 27, 2012

Southern Interior Region - Thompson

Enclosure

cc: Environment Canada



MINISTRY OF
ENVIRONMENT

OPERATIONAL CERTIFICATE

7577

FOR THE CACHE CREEK LANDFILL

*Under the Provisions of the Environmental Management Act
and in accordance with the
Thompson-Nicola Regional District Solid Waste Management Plan*

The Village of Cache Creek
Box 7
Cache Creek BC V0K 1H0

Wastech Services Ltd.
1200 United BLVD
Coquitlam, BC V3K 6T4

are authorized to manage municipal solid waste at a sanitary landfill facility located in Cache Creek, British Columbia, subject to the conditions listed herein. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

This Operational Certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority shall rest with the Operational Certificate Holder. This Operational Certificate is issued pursuant to the provisions of Section 28 of the *Environmental Management Act*. It is the responsibility of the Operational Certificate Holders to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

This Operational Certificate supersedes all previous versions of the Permit PR-07577 or Operational Certificate MR-07577 issued under the *Waste Management Act* or the *Environmental Management Act*.

For the purposes of the administration of this Operational Certificate, "Regional Manager" means the Regional Environmental Protection Manager of the Ministry of Environment, Kamloops office.

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)

Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

1. LOCATION OF AUTHORIZED FACILITY

The location of the sanitary landfill facility for the management of municipal solid waste to which this Operational Certificate is applicable is described as:

- Pre-Annex boundaries of the Landfill as detailed in the September 24, 2005 Modification of the Lease from the Province to the Village of Cache Creek: Block A, Section 13, Township 21, Range 25 and Blocks C, D, E and F, Section 18, Township 21, Range 24, all West of the Sixth Meridian, Kamloops Division of Yale District and containing 49.636 hectares, plus
- Annex A added to the west side of the existing landfill footprint on February 16, 2009: Block B, Section 13 together with that part of Section 13 all of Township 21, Range 25, West of the 6th Meridian, Kamloops Division, Yale District, containing 6.70 hectares, more or less.

2. RECYCLABLE MATERIALS MANAGEMENT

Municipal solid waste that has value for the purposes of reuse or reprocessing shall be considered recyclable material. Recyclable materials may be diverted from disposal and temporarily stored at the landfill facility prior to removal from the site. The nature of the recyclable material authorized for storage at the landfill facility shall be to the satisfaction of the Regional Manager.

3. MUNICIPAL SOLID WASTE MANAGEMENT

3.1 Disposal to Landfill

3.1.1 The works authorized are a sanitary landfill and related appurtenances located approximately as shown on the attached Site Plan. The landfill shall be operated to meet or surpass the requirements for a sanitary landfill as described in the *BC Landfill Criteria for Municipal Solid Waste (1993)*.

3.1.2 The discharged waste shall originate from within the province of British Columbia, subject to the following:

- (a) Waste discharged to this landfill shall satisfy the requirements of the Thompson-Nicola Regional District Solid Waste Management Plan.

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

- (b) Waste discharged to this landfill shall not contravene the Regional Solid Waste Management Plan of the Regional District from which the waste originated.
- 3.1.3 All waste to be discharged at this site shall be inspected by a suitably trained Wastech Services Ltd. employee prior to receipt or shall be tipped, spread and inspected by a suitably trained Wastech Services Ltd. employee prior to being placed into the working face for compliance with the terms and conditions of the Operational Certificate.
- 3.1.4 The maximum authorized rate of waste discharge is 500,000 tonnes annually.
- 3.1.5 The characteristics of the waste discharged to the landfill are those of municipal solid waste as defined in the *Environmental Management Act*.
- 3.1.6 The following types of wastes shall not be discharged:
- (1) Hazardous wastes, other than those specifically approved for disposal to authorized landfills, as defined in the *Hazardous Waste Regulation* under the *Environmental Management Act*.
 - (2) Anatomical, pathological, and untreated biomedical wastes as defined in the *Guidelines for the Management of Biomedical Wastes in Canada* (Canadian Council of Ministers of the Environment, February 1992).
 - (3) Bulk liquids and semi-solid wastes, which contain free liquids, as determined by US EPA Method 9095A Paint Filter Liquids Test, Test Methods for Evaluating Solid Wastes-Physical/Chemical Methods (EPA Publication No. Sw-846).
 - (4) Hog fuel, log yard debris and chipped wood waste.
 - (5) Recyclable materials as directed by the Director.
- 3.1.7 Notwithstanding the requirements of section 3.1.6(1), the disposal of waste asbestos in compliance with the requirements of Section 40 of the *Hazardous Waste Regulation* under the *Environmental Management Act* is hereby authorized.

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

3.2 Recovery of Energy Potential From Landfill Gas (LFG)

- 3.2.1 On or before June 30, 2013, energy potential from the landfill gas shall be recovered in accordance with the plan approved under section 3.2.2.
- 3.2.2 On or before April 13, 2012, a plan referred to as the "LFG Utilization Plan" shall be submitted for approval of the Director. The plan shall include at least the following:
- Description of the process to recover the energy potential from the waste;
 - Projected energy recovery expressed in joules;
 - Expected efficiency of energy recovery; and,
 - A critical path to achieve recovery by June 30, 2013.
- 3.2.3 On or before the first day of each quarter, until project completion, a project progress report relative to the critical path shall be submitted to the Director.
- 3.2.4 The Post-Closure Fund described in Section 8.0 shall not be applied to recovering the energy potential from the landfill gas. For certainty, the post-closure fund shall not be applied to operation, maintenance, monitoring, capital upgrades or investigation related to energy recovery from the landfill gas.

4. OPERATING REQUIREMENTS

4.1 Design, Operating and Closure Plans

4.1.1 The following design, operating and closure plans are approved:

- (1) Cache Creek Sanitary Landfill, Volume 1 - Design, Operation and Closure, Volume 2 - Supporting Technical Documents dated December, 1988, prepared by Golder Associates Ltd. Consulting Engineers.
- (2) Cache Creek Sanitary Landfill Operations and Closure Plan 1995 dated April 12, 1995, and appendix 11 Internal Storm Water Management Plan, dated September 28, 1995, prepared by Golder Associates Ltd.,

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, AScT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

- (3) Stage 4, Cache Creek Sanitary Landfill, Volume 1 - Design Features and Closure dated June 30, 1995, and Stage 4, Cache Creek Sanitary Landfill, Volume 2, Technical Analyses dated September 26, 1995, prepared by Golder Associates Ltd.
- (4) Landfill Gas Management Program, Cache Creek Landfill, Cache Creek, B.C., dated July 15, 1996, prepared by Golder Associates Ltd.
- (5) The Cache Creek Sanitary Landfill Operations and Closure Plan 2000, dated June 15, 2000, prepared by Golder Associates Ltd.
- (6) The Cache Creek Sanitary Landfill Operations and Closure Plan 2005, dated April 25, 2007, prepared by Golder Associates Ltd.

4.1.2 The design, operating and closure plans shall be reviewed every 5 years throughout the operating life of the landfill and updated to encompass the next 10 years of landfill operation and/or post-closure activities. The updated landfill design, operating and closure plans shall be prepared by a professional engineer or geoscientist licensed to practice in the province of British Columbia and knowledgeable in such matters. The updated plans shall be submitted to the Director for approval and shall include any information relevant to the design, operation, closure and post-closure care of the landfill.

4.1.3 Pursuant to Section 4.1.5 of this Operational Certificate, an updated design, operating and closure plan shall be submitted to the Director for approval by October 16, 2009. As a minimum, the updated plan shall address the following topics to the satisfaction of the Director:

- Design specifications for the blanket drainage system for leachate collection
- Quality assurance/quality control (QA/QC) protocol for the installation of the composite liner system and leachate drainage collection system
- Design specifications for the fly ash monofill
- Procedure for disposal of fly ash

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

- Procedure for washing fly ash trailers and the recycling of the wash water
- Program and schedule for establishment of self-sustaining vegetation on the final cover
- Leachate handling and disposal procedures, both during active landfill operations and during the post-closure period
- Site security and vector control provisions for less than 24 hour per day operations, particularly how bears, coyotes, birds, etc. will be prevented from accessing the active face during the non-active periods.
- Bird control program reviewed by Transport Canada as it relates to the adjacent airport.
- Updated site plan showing location of new groundwater monitoring wells
- Changes to groundwater monitoring program with respect to AMEC recommendations in June 2009 report
- Upgrades to the landfill gas collection system to improve gas collection efficiency
- Consideration of a baseline environmental monitoring program for the Bonaparte River.
- Re-evaluation of the final cap design and performance.
- Monitoring Committee Terms of Reference in accordance with section 5.2

4.1.4 A landfill post-closure plan shall be submitted not less than 12 months prior to the estimated site closure date. The post-closure plan shall be reviewed every 5 years following closure and updated to encompass the next 10 years of post-closure activities. The post-closure plan and subsequent updates shall be prepared by a professional engineer or geoscientist licensed to practise in the province of British Columbia and

Date issued:
Date amended:
(most recent)

March 18, 1987
March 27, 2012



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

knowledgeable in such matters. The post-closure plan and subsequent updates shall be submitted to the Director for approval and shall include at least the following:

- (1) a complete review and assessment report of the overall integrity of the landfill,
- (2) a detailed timetable for closure and/or post-closure procedures and correction of any deficiency identified in the review and assessment report, and
- (3) a detailed schedule of inspection, monitoring and maintenance to be carried out for a minimum post-closure period of 25 years.
- (4) a process for the administration of the post-closure security fund required under section 8 of this Operational Certificate.

4.1.5 The landfill facility shall be constructed and maintained in accordance with the plans approved under sections 3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4 and 9 subject to the conditions set herein. A knowledgeable representative from the engineering design firm shall carry out field reviews of the landfill construction and installation of works. As-constructed drawings of the landfill and all works, including elevations relative to a common datum, shall be submitted to the Director. The as-constructed drawings shall be sealed by a professional engineer or geoscientist representing the engineering design firm who is licensed to practise in the province of British Columbia and knowledgeable in the appropriate field of study.

4.1.6 Written authorization from the Director shall be obtained prior to implementing any changes to the approved plans. Based on any information obtained in connection with this facility, the Director may require revision of, or addition to, the design, operating and closure plans.

4.2 Landfill Site Development

4.2.1 Discharge of waste into water is prohibited. Surface water diversions and groundwater drainage works shall be installed to prevent surface water run-off and groundwater seepage from entering the waste discharge area. The effect of sediment transport from areas upgradient and within the landfill site shall be considered when designing, installing and maintaining the surface water diversion system. Diversion and drainage structures shall be maintained by the Operational Certificate

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L.
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

Holders on a regular basis to the satisfaction of the Director.

- 4.2.2 A berm of suitable material shall be constructed to preclude visibility of the active waste discharge area and any exposed wastes from travellers using the Trans Canada Highway.
- 4.2.3 Waste shall not be deposited at this site beyond the landfill stages 1, 2, 3, 4 and the area referred to in Section 1 as Annex A, as specified in the approved plans.

4.3 Waste Compaction and Coverage

- 4.3.1 Discharged wastes shall be compacted and cover material applied as outlined in section 4.3.2. Wastes shall be compacted and covered on a continuous basis. However, if operations are reduced to less than 24 hours per day, then provisions such as security, fencing, and/or other measures approved by the Director shall be deployed to prevent wildlife access. All wastes shall be covered within 24 hours of discharge to the landfill.
- 4.3.2 The area of the active landfill working face shall be minimized as much as possible. Wastes shall be spread in thin layers of 60 centimetres, or less, on the working face and compacted. A compacted layer of at least 15 centimetres of suitable soils, or a functionally equivalent depth of other cover material acceptable to the Director, shall be placed on all exposed compacted waste.
- 4.3.3 An intermediate cover of at least 30 centimetres of compacted soils, or a functionally equivalent depth of other cover material acceptable to the Director, shall be applied on any areas of the active landfill site to which waste will not be discharged for a period of 30 days or more.
- 4.3.4 Final cover shall be installed within 30 days of completion of the landfill to the final elevations as specified in the approved plans. Completed portions of the landfill shall progressively receive final cover during the active life of the landfill. Final cover shall consist of at least 1 metre of low permeability compacted mineral soil, overlain by at least 15 centimetres of topsoil capable of supporting indigenous vegetation. With the written approval of the Director, the topsoil used for this final covering may be mixed with conditioning agents such as sludge

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, AScT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

(biosolids), compost and the like to add organics and improve the moisture holding capacity and nutrient value of the soil. Final cover shall be constructed and maintained with adequate drainage and erosion controls and seeded with suitable grasses.

- 4.3.5 The Director may vary the frequency of covering when freezing conditions adversely affect normal operation.

4.4 Landfill Management

- 4.4.1 The landfill shall be supervised to the satisfaction of the Regional Manager. Landfill supervisors shall be trained in landfill operation pertaining to the conditions of this Operational Certificate and the approved design, operating and closure plans.
- 4.4.2 Access to the site shall be controlled and supervised. All access points shall have locking gates and shall be locked during periods when supervision is not available.
- 4.4.3 Public scavenging and salvaging of waste at the landfill site is prohibited.
- 4.4.4 Designated areas shall be maintained for the storage of recyclable materials. These designated area(s) shall be separate from the active landfill area and shall be maintained free of litter. Storage of recyclable materials at the landfill site shall be limited to a reasonable length of time subject to the approval of the Director.
- 4.4.5 Litter and wind strewn waste shall be controlled by limiting the area of the working face, installing a wind blown litter collection fence in a location which is in the anticipated prevailing downwind direction of the landfill working face, instituting a regular litter pickup, general good site maintenance practises or any other measures required by the Director.
- 4.4.6 Dust and odour created within the landfill property shall be controlled using methods and materials acceptable to the Regional Manager.
- 4.4.7 Open burning of waste is prohibited.
- 4.4.8 The landfill shall be operated so as to minimize the attraction of

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, AScT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

nuisance wildlife and disease vectors such as birds and rodents by applying adequate cover to the waste and by maintaining the site free of litter. Additional control measures may be specified by the Director if wildlife and/or vector attraction to the site becomes a public safety hazard.

- 4.4.9 The landfill works shall be inspected on a regular basis by the landfill supervisor. In the event of an emergency or any condition, which prevents continuing operation of the approved method of landfill operation and control, or results in non-compliance with the terms and conditions of this Operational Certificate, the Regional Manager shall be notified immediately and appropriate remedial action taken.
- 4.4.10 The Director may require future upgrading of the landfill control works to protect the environment during the operating life of the landfill and for a minimum post-closure period of 25 years.
- 4.4.11 Upon closure, the boundaries of the landfilled area shall be legally surveyed. A covenant that the property was used for the purpose of waste disposal shall be registered against the land title as provided for under Section 215.1 of the Land Title Act.

5. MONITORING

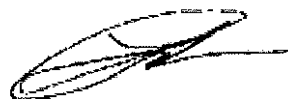
5.1 Environmental Protection Monitoring

Monitoring of ground and surface water, leachate collection sump fluids and landfill gas shall be carried out in accordance with the monitoring program approved in the design, operating and closure plans. The monitoring program shall be reviewed in the annual report required under section 7.2. Based on the information submitted in the annual report, or any other information obtained in connection with this site, the Director may vary the frequency, location and analyses of ground and surface water, leachate collection sump fluid and landfill gas sampling.

5.2 Monitoring Committee

A Monitoring Committee shall be established with representatives from the community including Secwepemc and N'lakapamux Nations. Details of the site development, operations, closure, post-closure and on-going environmental

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

monitoring and interpretation shall be shared with the committee. The purpose of the Monitoring Committee is to promote environmentally sound operations and effective monitoring.

6. LEACHATE CONTROL AND TREATMENT

6.1 Management of Leachate Collection System Fluid

Leachate collection sump fluid levels shall be monitored and fluid removed from the leachate collection system as specified in the approved design, operating and closure plans. A sample of fluid from each of the leachate collection sumps shall be collected on a quarterly basis and laboratory analyses obtained for the leachate indicator parameters identified in the monitoring program. The Director may vary the location and frequency of sampling and analyses of leachate collection system fluid should conditions warrant. Fluid recovered from the leachate collection system may be used within the landfill footprint for irrigation, dust suppression and/or re-circulated within the buried waste unless otherwise directed by the Director. Other methods of treatment and/or disposal of the leachate collection sump fluids must have the prior approval of the Director.

6.2 Groundwater Contamination by Leachate

Should it be determined that leachate is being generated and carried in the groundwater or surface water and, in the opinion of the Director, requires interception and treatment, appropriate remedial measures as approved by the Director shall be implemented.

7. REPORTING

7.1 Interim Reporting and Record Keeping

The leachate collection sump fluid level readings, groundwater elevation and combustible gas monitoring data, and the sump fluid, groundwater and gas sampling analyses results shall be available for inspection at the Wastech Cache Creek Landfill office. Data from monitoring and sample analysis shall be submitted to the Regional Manager with the annual report in accordance with section 7.2. Between annual reporting events, the Regional Manager and Monitoring Committee (ref. section 5.2) shall be promptly informed of any significant changes from long term trends observed in the parameters that are

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, AScT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

monitored.

7.2 Annual Report

An annual report shall be submitted by March 31 of each year for the previous calendar year of landfill operation or post-closure activities. The annual report shall review and interpret the analytical data from monitoring of leachate collection sump fluids, groundwater and landfill gas for the preceding calendar year. Proposed changes to the monitoring program shall be identified in the annual report. The annual report shall summarize the findings of the landfill supervisor's routine inspections, and identify any proposed changes from the approved plans. For reporting of calendar years prior to landfill closure, the annual report shall include an estimate of the solid waste landfilled in the preceding calendar year in both tonnes and compacted in-situ cubic metres and review the remaining site capacity. The annual report shall include documentation of the method used to quantify the volume of waste discharged and the tonnage estimates shall be broken down into the estimated tonnes discharged from each regional district or other specific areas of origin to the satisfaction of the Director. Copies of the annual report shall be provided to the public libraries in Ashcroft and Cache Creek and posted on the Operational Certificate holder's web sites.

8. POST-CLOSURE SECURITY REQUIREMENTS

A post-closure monitoring, maintenance and repair fund shall be established and administered by the Director for the benefit of the Village of Cache Creek. Within 30 (thirty) days of the end of each quarter, Wastech Services Ltd. shall contribute money into this trust fund for wastes discharged to the landfill originating from outside the local area of the Village of Cache Creek. The amount of money contributed shall be determined according to the following schedule:

- \$0.75 per tonne of waste discharged during the first 8 (eight) years of waste transfer from the regional district or jurisdiction which is the source of the waste
- \$0.60 per tonne of waste discharged during the next 12 (twelve) years of waste transfer from the regional district or jurisdiction which is the source of the waste
- \$0.35 per tonne of waste discharged during each following year until landfill closure.

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)



Larry Gardner, ASCT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

The Director shall have the sole authority to access and direct the use of monies from the trust fund for post-closure monitoring, maintenance and repair of the landfill site. The Director shall make monies available immediately upon closure of the landfill for the purposes of monitoring, maintenance and repair.

The trust fund shall remain in force for at least 10 (ten) years after closure of the landfill site. Thereafter, the need for the trust fund shall be reviewed by the Director once every 5 (five) years. The Director shall have the sole authority to reduce the size of the trust fund or eliminate the fund if, in the opinion of the Director, such action is warranted. In the event the trust fund is reduced or eliminated, the funds shall be released to the Village of Cache Creek to be used at the discretion of the Council of the Village of Cache Creek for municipal purposes.

9. CLOSURE PERIOD PLAN

The "Closure Period" is the indeterminate timeline commencing before cessation of landfilling activities and lasting until completion of discrete closure activities such as placement of final cap, establishing sustainable vegetation, etc. The Post-Closure Fund described in Section 8.0 will be applied to each discrete closure activity following cessation of landfilling at the site and after the Director is satisfied closure has been met for that individual activity.

On or before August 31, 2012, a plan referred to as the "Closure Period Plan" shall be submitted for approval of the Director. The plan shall include at least the following:

- A list and description of discrete closure activities to be undertaken during the Closure Period;
- A projected timeline for each discrete closure activity from initiation to completion; and,
- Where appropriate, criteria for determining when the closure activity is complete.

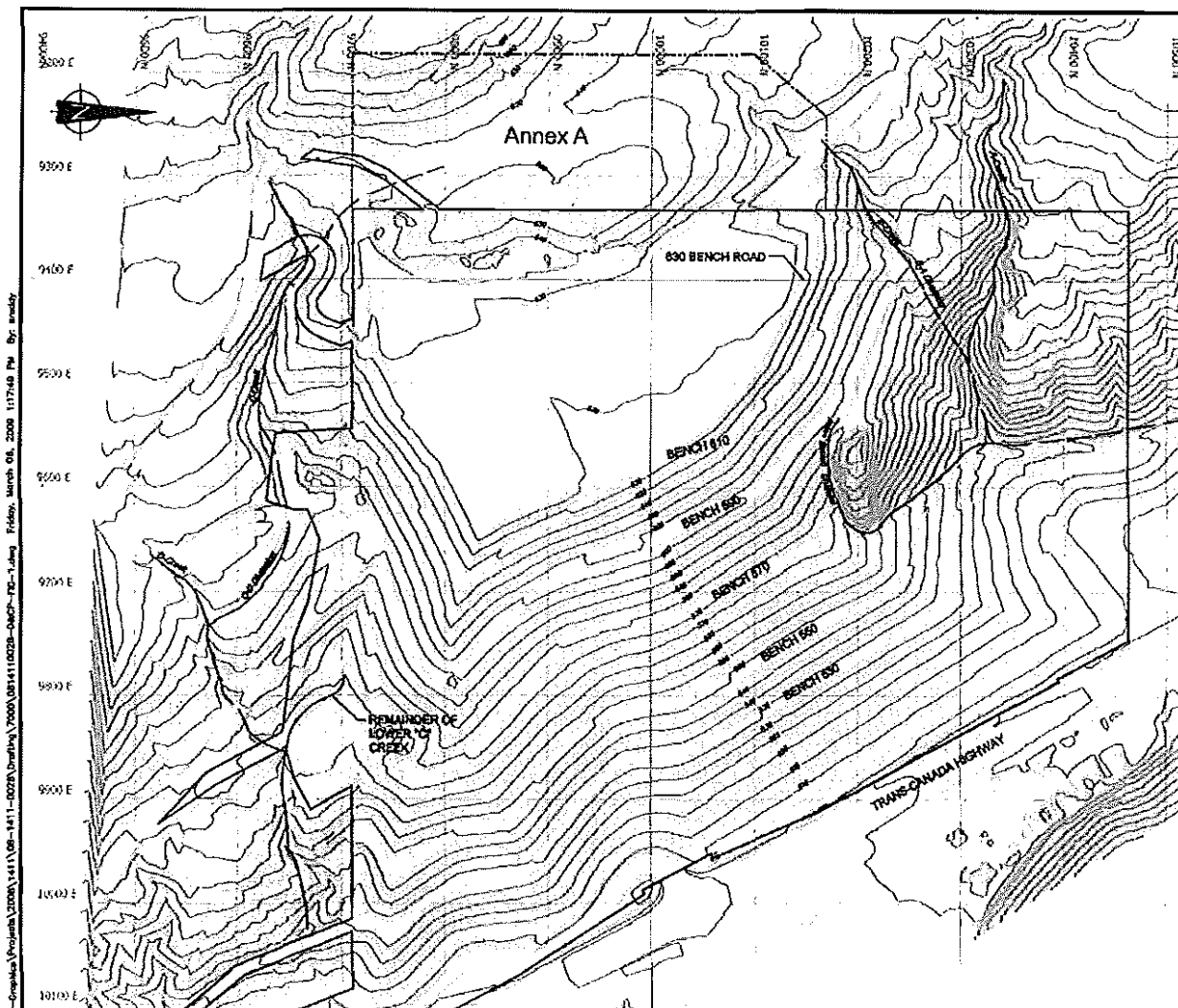
The Closure Period Plan shall align with the Closure Plan as set out in Sections 4.1.2 and 4.1.4.

Date issued: March 18, 1987
Date amended: March 27, 2012
(most recent)

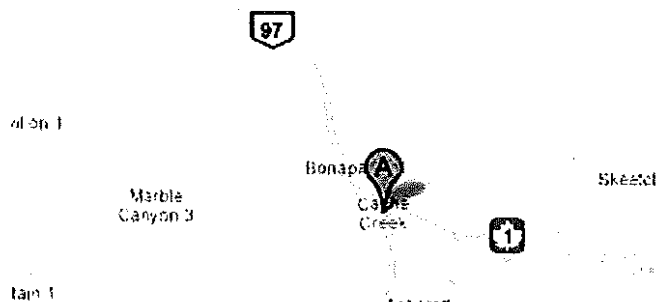


Larry Gardner, AScT, Eng.L
for Director, *Environmental Management Act*
Southern Interior Region - Thompson

SITE PLAN



Location Map



Scale: Not to Scale

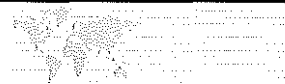
Operational Certificate MR-7577

Larry Gardner, ASCT, Eng. L
For Director, *Environmental Management Act*
Thompson and Caribou Regions



APPENDIX B

Summary of Landfill Gas Extraction Well Installation



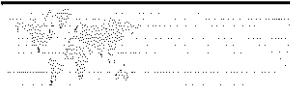
APPENDIX B

Summary of Landfill Gas Extraction Well Installation

The following table summarizes the number of operational landfill gas vertical wells and horizontal collectors since initial start-up of the landfill management system at the Cache Creek Landfill on April 21, 1997.

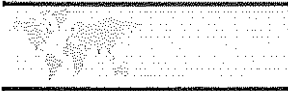
Year	No. of Operational Vertical Wells	No. of Operational Horizontal Collectors	Comments
1998	22	0	Flare Station #1 became operational on April 21, 1997.
1999	26	0	The landfill gas management system was connected to Sumps 1 to 3.
2000	29	0	
2001	32	0	
2002	32	0	
2003	32	0	
2004	40	0	
2005	41	0	
2006	48	0	The landfill gas management system was connected to Sump 4. Flare Station #2 became operational in April 2006.
2007	63	0	
2008	63	0	
2009	83	0	
2010	100	3	Horizontal collectors were connected to the landfill gas management system in September 2010.
2011	100	3	Eight replacement wells and five supplemental wells were constructed in 2011. These were connected to the landfill gas management system in 2012. Three capped probes were also installed for monitoring purposes.
2012	104	3	Three replacement wells were installed in 2012.

O:\Final\2012\1447\12-1447-0228\1214470228-002-R-Rev0-Components\Appendices\APP B LFG Installation History.docx



APPENDIX C

Numerical Groundwater Flow Model



September 7, 2012

CACHE CREEK LANDFILL

Numerical Assessment of Groundwater Flow

Submitted to:
Wastech Services Ltd.
1200 United Boulevard
Coquitlam, BC
V3K 6T4

REPORT



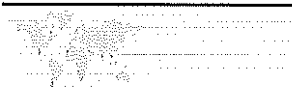
Report Number: 1214350804-500-Rev0-6000

Distribution:

2 Copies – Wastech Services Ltd.
2 Copies – Golder Associates Ltd.



MOE-2013-00197
Page 157



Executive Summary

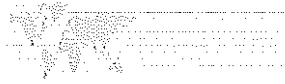
A three-dimensional numerical groundwater flow model was developed for the Cache Creek Landfill and surrounding area to provide information that can be used to optimize the post-closure monitoring program and to provide a tool that can be used in the management of groundwater migration, if required.

The groundwater model simulated current conditions and potential future conditions reflecting a Landfill closure scenario that involved potential, if required, migration control by groundwater pumping. The model inputs were primarily based on hydrogeologic data from previous investigations and annual monitoring reports prepared by Golder Associates Ltd. (Golder). The model inputs would be modified as required in future, as part of further assessment and design, should additional monitoring and subsurface testing be carried out.

The report summarizes the available hydrogeological information, describes the conceptual model for the Site, and describes the construction and calibration of the numerical groundwater flow model. This report concludes with preliminary estimates of the number and location of groundwater extraction wells and the associated range in groundwater pumping rates that may be required to manage the migration of groundwater from beneath and around the Landfill through the in-filled valley located east of the Site.

The results of the simulation to control migration by groundwater pumping determined that a total of four pumping well centres located east of the Landfill, each pumping at a rate of 4 US gallons per minute (USgpm), would be required to manage the off-site migration of groundwater through the in-filled valley. This would result in a combined recovery rate for the well field of 16 USgpm (approximately 90 m³/day).

To account for well pumping inefficiencies and heterogeneities associated with the local groundwater flow regime, it is assumed that on the order of 8 to 12 pumping wells located east of the Landfill at equally-spaced distances with a collective pumping rate on the order of 100 m³/day, would be required to capture groundwater originating from beneath the Landfill. Additional investigations north of the landfill would reduce the uncertainty in that area.



Study Limitations

This report has been prepared for the exclusive use of Wastech Services Ltd. and its agents. The factual information, descriptions, interpretations, comments, conclusions and recommendations contained herein are specific to the project described in this report and do not apply to any other project or site. Under no circumstances may this information be used for any other purposes than those specified in the scope of work unless explicitly stipulated in the text of this report or formally authorized by Golder. This report must be read in its entirety as some sections could be falsely interpreted when taken individually or out-of-context. As well, the final version of this report and its content supersedes any other text, opinion or preliminary version produced by Golder.

Plans, specifications, calculations, notes, electronic files and similar material used to construct the groundwater model and complete the simulations herein are instruments of service, not products. Golder shall not be held responsible for damages resulting from unpredictable or unknown underground conditions, from erroneous information provided by and/or obtained from sources other than Golder, and from ulterior changes in the site conditions unless Golder has been notified of any occurrence, activity, information or discovery, past or future, susceptible of modifying the underground conditions described herein, and have had the opportunity of revising its interpretations, comments and recommendations. Furthermore, Golder shall not be held responsible for damages resulting from any use of this report and its content by a third party, and/or for its use for other purposes than those intended.

Hydrogeological investigations and groundwater modelling are dynamic and inexact sciences. They are dynamic in the sense that the state of any hydrological system is changing with time, and in the sense that the science is continually developing new techniques to evaluate these systems. They are inexact in the sense that subsurface conditions are not known between the specific investigation locations, and there is invariably a lack of complete information both spatially and temporally about the geological and hydrogeological conditions. A groundwater model uses the laws of science and mathematics to draw together the available data into a mathematical or computer-based representation of the essential features of an existing hydrogeological system. While the model itself obviously lacks the detailed reality of the existing hydrogeological system, the behaviour of a valid groundwater model reasonably approximates that of the real system. The validity and accuracy of the model depends on the amount of data available relative to the degree of complexity of the geologic formations, the site hydrogeology, and on the quality and degree of accuracy of the data entered. Therefore, every groundwater model is a simplification of reality and the model described in this report is not an exception.

The professional groundwater modelling services performed as described in this report were conducted in a manner consistent with the level of care and skill normally exercised by other members of the engineering and science professions currently practising under similar conditions, subject to the quantity and quality of available data, the time limits and financial and physical constraints applicable to the services. Unless otherwise specified, the results of previous or simultaneous work provided by sources other than Golder and quoted and/or used herein are considered as having been obtained according to recognised and accepted professional rules and practices, and therefore deemed valid. This model provides a predictive scientific tool to evaluate the impacts on a real groundwater system of specified hydrological stresses and/or to compare various scenarios in a decision-making process. However, and despite the professional care taken during the construction of the model and in conducting the simulations, its accuracy is bound to the normal uncertainty associated to groundwater modelling and no warranty, expressed or implied, is made.

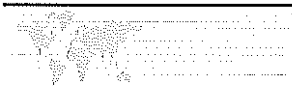


Table of Contents

1.0 INTRODUCTION.....	1
2.0 DATA SOURCES	1
3.0 CONCEPTUAL MODEL	2
3.1 Location and Climate.....	2
3.2 Geology	3
3.2.1 Bedrock Geology	3
3.2.2 Surficial Geology	3
3.3 Hydrogeology	3
3.4 Recharge and Discharge Areas.....	4
4.0 NUMERICAL MODEL DESCRIPTION	4
4.1 Numerical Code	5
4.2 Model Extent and Mesh	5
4.3 Model Boundaries.....	6
4.4 Model Input Parameters	6
4.5 Assumptions	7
4.6 Model Calibration.....	7
5.0 NUMERICAL MODEL RESULTS	8
5.1 Current Conditions.....	8
5.2 Simulation Approach for Mitigation	9
5.3 Model Limitations and Uncertainty.....	9
6.0 SUMMARY AND CONCLUSIONS	10
7.0 CLOSURE.....	11
8.0 REFERENCES.....	12



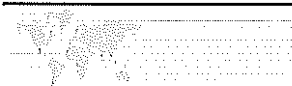
NUMERICAL ASSESSMENT OF GROUNDWATER FLOW

TABLES

Table 1:	Data Sources	1
Table C-2:	Summary of Observation Well Details	
Table C-3:	Summary of Hydraulic Conductivity Results	

FIGURES

Figure C1:	Groundwater Model Extent and Mesh
Figure C2:	Surficial Geology
Figure C3:	Bedrock Geology
Figure C4:	Known Aquifers and Water Wells
Figure C5:	Interpreted Bedrock Surface Below In-filled Valley
Figure C6:	Model Boundary Conditions
Figure C7:	Observation Wells Used in Model Calibration
Figure C8:	Hydraulic Conductivity Versus Depth Below Bedrock Surface
Figure C9:	Calibrated Hydraulic Conductivity
Figure C10:	Model Calibration Observed Versus Predicted Heads
Figure C11:	Results of Calibration Current Hydraulic Heads
Figure C12:	Predicted Groundwater Management Area With Mitigation



1.0 INTRODUCTION

A numerical hydrogeological assessment was carried out for the Cache Creek Landfill (the Site) located in Cache Creek, BC. This assessment included the development of a conceptual groundwater model for the Site and subsequent construction of a three-dimensional numerical model. The objectives of the model were two-fold: 1) to provide information that will be used to optimize the post-closure monitoring program; and 2) to provide a tool that can be used in the management of groundwater migration, if required.

The groundwater model simulated current conditions and potential future conditions reflecting a landfill closure scenario that involved potential, if required, migration control by groundwater pumping. The model inputs were primarily based on hydrogeologic data from previous investigations and annual monitoring reports prepared by Golder Associates Ltd. (Golder). The model inputs would be modified as required in future, as part of further assessment and design, should additional monitoring and subsurface testing be carried out.

This report summarizes the available hydrogeological information, describes the conceptual model for the Site, and describes the construction and calibration of the numerical groundwater flow model. This report concludes with preliminary estimates of the number and location of groundwater extraction wells and the associated range in groundwater pumping rates that may be required, should there be a need to manage the migration of groundwater from the Landfill through the in-filled valley located east of the Site.

2.0 DATA SOURCES

The following data sources were compiled in building the conceptual model and used as input for the numerical groundwater flow model:

Table 1: Data Sources

Data	Source
Topography	Digital elevation models (DEMs) for mapsheets 092I/14 and 092I/11 from Geobase Base Mapping and Geomatic Services - British Columbia Government. 1976. Victoria, B.C.
Orthophoto (georeferenced)	Imagery from BING Maps for ArcGIS published by Microsoft Corporation, Redmond, WA, May 2009.
Surficial geology	Map 92I/NW from the Geological Survey of Canada: J.M. Ryder, H.A. Thomson (1972).
Bedrock geology	B.C. Digital Geology Maps (Version 1.0, 2005) from the Ministry of Energy and Mine and Responsible for Housing.
Bedrock surface elevation below in-filled valley	Figure I.2-6 in the 2010 Annual Report, Cache Creek Landfill (Golder 2011). This map was developed from an interpolation of all available test pit, borehole, geophysical, and rock outcrop data.



NUMERICAL ASSESSMENT OF GROUNDWATER FLOW

Data	Source
Registered water well logs	Online BC Water Resource Atlas (BCWRA): http://webmaps.gov.bc.ca/imf5/imf.jsp?site=wrbc
Monitoring well details and groundwater level elevations	Appendix I from Volume II, Cache Creek Sanitary Landfill Report (Golder, 1988); Appendix VI I in the 2009 Annual Report and Appendix I in the 2011 Annual Report, Cache Creek Landfill (Golder 2010 and 2012). Tables 4 and 5 in 'Hydrogeological Characterization, Cache Creek Landfill Stage 5 Extension' (CH2M HILL, 2009)
Hydraulic conductivity results	Appendix VI in the 2009 Annual Report and Appendix I in the 2010 Annual Report for Cache Creek Landfill (Golder 2010 and 2011).
Landfill outline	TRUE CONSULTING GROUP Surveyed on: December 15, 2011.

3.0 CONCEPTUAL MODEL

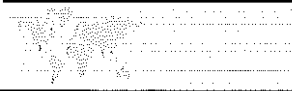
A conceptual model is a representation of the groundwater regime that organizes and simplifies the Site hydrogeology so that it can be modelled numerically. The conceptual model must retain enough complexity so that the numerical model adequately reproduces or simulates, to the degree required to meet project objectives, realistic groundwater flow behaviour. During the development of the conceptual model, the main hydrostratigraphic units are defined and characterized, and the dominant groundwater flow patterns are identified. The conceptual model is then used as a basis for the construction of a numerical model for the Site.

A description of the Site's preliminary conceptual model is presented below.

3.1 Location and Climate

The Cache Creek Landfill is located within the Bonaparte River Valley within the Interior Plateau of British Columbia. The Site is located immediately west of the Trans Canada Highway on the lower reaches of a hillside that rises to the west. Regionally, the land surface rises to an elevation of approximately 1,200 m above sea level at a distance of 4 km west of the Site and declines to an elevation of approximately 430 m above sea level at the Bonaparte River, located approximately 500 m east of the Site (Figure C-1).

The climate of Cache Creek is categorized as semi-arid, with low levels of annual precipitation, cold winters and hot summers. While climate stations have recently been established at the Landfill site, the nearest climate station for which both current and long-term climate data is available is the Kamloops climate station, which has continuous records dating back to 1916. The climate normals for this station (1971 to 2000) indicate that the average annual temperature for Kamloops is 8.9°C, with a daily average ranging from -4.2°C in January to 21°C in July. The average annual precipitation at the Kamloops station is 268 mm/yr based on a 95-year average from 1916 to 2011.



3.2 Geology

3.2.1 Bedrock Geology

The bedrock geology beneath the Site is characterized by the Melange belt of the Cache Creek Complex (Figure C-3). The dominant rock type on the Site is cherty argillite, along with argillite, meta-volcanic greenstone, limestone, chert, sericite and chlorite schists. Weathering of the meta-sedimentary bedrock is highly variable, with competent bedrock observed in some locations and a high degree of weathering observed in others. Based on drilling observations, the depth of bedrock weathering beneath the Site is estimated to be on the order of 10 m.

Bedrock outcrops are present in the upper reaches of the Site and adjacent to the Site. A large, drumlinized bedrock ridge separates the Site from the Bonaparte River Valley to the northeast and a large bedrock knob is present immediately north of Stages III and IV of the Landfill.

Bedrock is at or close to ground surface in the upper reaches of the Landfill. Towards the base of the hill slope, the depth of the bedrock below ground surface increases to form a bedrock valley that is in-filled with glacial and post-glacial sediments. The valley trends in a south-southeast direction, narrowing at the north end and widening to the south toward the Bonaparte River Valley. It is located just west of the TransCanada Highway at the north end of the Site and some 40 m east of the highway near the south boundary of the Site. The depth to the bedrock in the centre of the valley ranges from approximately 20 m at the north end to 40 m at the south end.

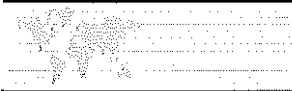
3.2.2 Surficial Geology

The surficial geology of the area is characterized by sediments related to the last (Fraser) glaciation and post-glacial processes. As illustrated in Figure C-2, the majority of the Site is underlain by glacial till and ground moraine overlying bedrock. Within the in-filled valley, the till and bedrock are overlain by ice-contact sands and gravels that thicken towards the valley axis and towards the southern end of the Site. The majority of the channel is in-filled by thick (up to 40 m) alluvial fan deposits originating at the mouths of major gullies on the western slope. The lower portion of the fans generally consist of silts and fine sands with a trace of clay, while the upper portion of the fans generally consist of sand and gravel with silt.

The BC Water Resource Atlas has characterized the surficial materials adjacent to the Bonaparte River Valley as relatively permeable Quaternary deposits (Figure C-4). The area southeast of the Site, east of the Trans Canada Highway and west of the Bonaparte River, is characterized by a sand and gravel kame deposit (Figure C-2). The area north of the kame adjacent to the Bonaparte River, which is separated from the Site by the large bedrock ridge, is mapped as alluvial plain or floodplain deposits. The closest aquifer to the Site, as defined by the BC Water Resource Atlas, is located adjacent to the Bonaparte River Valley north of the Site (Figure C-4) and is related to the Valley Floor Complex comprised of alluvial, glacial and fluvial sediments.

3.3 Hydrogeology

The highlands area 4 km west of the Site is inferred to represent a regional groundwater flow divide. Regional groundwater flow is inferred to be directed towards the east from this area towards the Bonaparte River Valley (Figure C-4).



NUMERICAL ASSESSMENT OF GROUNDWATER FLOW

Beneath the Site itself, groundwater flow on the hill slope is directed to the east-northeast, primarily along the interface between the till and underlying bedrock, under a gradient of 0.22 m/m. At the base of the hill slope, groundwater flow is predominantly southeast along the axis of the in-filled valley within the surficial sediments. Only the lower portion of the valley sediments is saturated, with saturated thicknesses of the surficial materials ranging from less than 1 m to 12 m in thickness. The horizontal gradients within the in-filled valley range from 0.03 m/m directly east of the Site to 0.002 m/m southeast of the Site.

There is a component of groundwater flow directed towards the north at the north end of the in-filled valley and north of the Landfill, under a gradient of 0.009 m/m.

Vertical hydraulic gradients indicate that along the lower portion of the hill slopes and the north-western portion of the in-filled valley, a small component of groundwater flow is generally upwards from the bedrock to the overburden. In the southeast portion of the in-filled valley downgradient of the Site, a small component of groundwater flow is downward from the overburden to the bedrock.

3.4 Recharge and Discharge Areas

Recharge to groundwater is primarily through infiltration of precipitation. The amount of precipitation percolating the Landfill and entering the groundwater was estimated using the Hydrologic Evaluation of Landfill Performance (HELP) model (version 3.07). This model requires inputs of precipitation, temperature, and solar radiation data, together with site-specific evapotranspiration information, to carry out water balance calculations. The HELP models for the Landfill were set up using precipitation and temperature data recorded at the Kamloops Airport and solar radiation data recorded at Summerland. These weather stations are the closest locations to the Landfill with long-term weather data records. The precipitation data were further scaled to match the annual precipitation recorded at Ashcroft Manor, approximately 7 km southeast of the Landfill.

The HELP model results indicate that the total recharge to groundwater is on the order of 5% of the annual precipitation, which amounts to 14 mm/yr. This recharge estimate is considered to be conservative, given the comparatively lower recharge estimates (2% of annual precipitation) employed for other studies in similar climates (Wood and Sanford, 1995) and Golder's experience at other sites in the Kamloops area.

Groundwater is inferred to discharge to the Bonaparte River Valley, southeast of the Site, through the more permeable surficial sediments in that area.

4.0 NUMERICAL MODEL DESCRIPTION

The conceptual model of groundwater conditions at the Site was used as a basis for the development of a three-dimensional numerical groundwater flow model. Following construction and calibration, this model was used to evaluate potential pathways from the Landfill base to the downgradient groundwater discharge areas. In addition, this model was used to provide preliminary estimates of mitigation controls that could be achieved, if required, through the operation of groundwater extraction wells.



4.1 Numerical Code

The numerical groundwater model was constructed using FEFLOW (Diersch, 2012). This numerical code is capable of simulating variably saturated groundwater flow and solute transport in three dimensions, and in heterogeneous porous media under a variety of hydrogeologic boundary conditions and hydraulic stresses. The finite element mesh constructed using FEFLOW allows the Site hydrostratigraphy to be adequately represented, while providing sufficient spatial resolution for reasonable predictions in areas of interest (e.g., near Landfill and potential in-filled valley extraction wells).

4.2 Model Extent and Mesh

The extent of the numerical model was based on the understanding of groundwater flow conditions near the Site, with model boundaries set sufficiently distant from the Site to allow adequate representation of conditions prior to and after Landfill closure. The extents of the model and the finite element mesh are presented in Figure C-1.

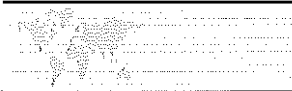
Horizontally, the model was centred on the Site and extended approximately 6,000 m in the east-west direction and 6,000 m in the north-south direction, with a planar area of about 16 km². The model extended to three small lakes located about 2,500 m to the southwest of the Site, and to the Bonaparte River located about 500 m to the east of the Site. Between these surface water features, the northwestern and southeastern model extents followed inferred groundwater flow lines.

The overall vertical extent of the model was approximately 1,200 m. The vertical extent was based on the topographic elevation, which comprised the model top, and an inferred groundwater flow line within deep, low permeability bedrock, which comprised the model base.

Horizontal and vertical mesh discretization varied from approximately 20 m in the vicinity of the Site to approximately 150 m furthest from the Site. The gradual increase in mesh discretization with proximity to the Site permitted more accurate representation of flow from beneath the Landfill towards groundwater discharge areas and allowed steep hydraulic gradients to develop in response to the hypothetical operation of groundwater extraction wells in the vicinity of the Landfill.

Vertically, the model was divided into nine numerical layers. The elevation of the model top was set to topographic elevation. The elevation of the model base (i.e., bottom of layer 9) was set as 0 masl to allow for regional groundwater flow to be represented, as shown on the schematic cross-section on Figure C-4.

Model layers one to three represented the overburden deposits as generally outlined in the surficial geology map on Figure C-2. The combined thickness of these layers was 10 m, except in the in-filled valley, where the combined thickness ranged from 10 m to approximately 60 m. The base of model layer 3 represented the surface of the weathered bedrock. The weathered bedrock surface elevation within the in-filled valley was set to the bedrock surface elevation presented on Figure C-5. The inferred bedrock surface on Figure C-5 was developed previously by Golder (2011) from an interpolation of all available test pit, borehole, geophysical, and rock outcrop data. The extrapolated bedrock surface on Figure C-5, to the north and south of the inferred surface, considered the topography and surficial geology in these areas; however field data was not available to confirm the accuracy of the extrapolation.



NUMERICAL ASSESSMENT OF GROUNDWATER FLOW

Model layers four and five represented the weathered bedrock with a combined thickness of 10 m. The lower model layers (layers six to nine) represented competent bedrock with a combined thickness ranging from 420 m below the Bonaparte River to the east, to 1,180 m below the upslope area to the west. A description of the bedrock geology is provided on Figure C-3.

4.3 Model Boundaries

Boundary conditions implemented in the numerical model provide linkage between the model domain and the hydrologic and hydrogeologic conditions that are outside of the model area. These boundaries are illustrated on Figure C-6 and are described below.

Specified-head boundaries were assigned to the top of the model at the location of surface water bodies, including the Bonaparte River to the east of the Site and the small lakes to the southwest. Specified-head boundaries constrained to only allow outflow of groundwater were applied to ephemeral creeks and to the diversion channels around the Landfill. The water elevations assigned to the surface water bodies were based on topographic elevation data.

A specified-flux boundary was assigned to the top of the model to represent groundwater recharge from precipitation. The recharge rate of 14 mm/yr, equivalent to 5% of the annual average precipitation (268 mm/yr), was applied based on the results of the water balance assessment using the HELP model.

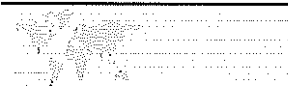
A specified-flux boundary was assigned to the west side of the model equivalent to the estimated groundwater inflow rate on the upgradient side of the modelled area. The applied inflow rate ($120 \text{ m}^3/\text{d}$) was based on 50% of the estimated recharge rate (14 mm/yr) over the upgradient recharge area ($5.88\text{E}^6 \text{ m}^2$) shown on Figure C-4. The remaining 50% of this flow was assumed to recharge the deeper bedrock below the model domain.

The northern and southern sides of the model, as well as the base of the model, were set as zero-flux (no flow) boundaries to represent groundwater flow lines based on the inferred regional groundwater flow direction towards the Bonaparte River.

4.4 Model Input Parameters

Nine hydrostratigraphic units were represented in the groundwater model as layers and/or zones, as shown on Figure C-9. Table C-3 and Figure C-8 provide a summary of the hydraulic conductivity test results for six of these hydrostratigraphic units, namely the sand till and two sand and gravel units within the in-filled valley, the ground moraine (silt till) zone to the north of the Landfill, weathered bedrock, and competent bedrock.

The remaining three units consisted of: a known aquifer comprised of alluvial, glacial and fluvial sediments (Valley Floor Complex, Figure C-2) at the northern end of the model domain, alluvial plain or floodplain sediments along the Bonaparte River, and the assumed thin silt till (Till Veneer/Blanket, Figure C-2) and weathered bedrock at ground surface over the remaining model top. The model input parameters for these units (hydraulic conductivity and vertical extent) were assumed based on their description provided on the surficial geology map referenced on Figure C-2 and typical values published in the literature.



A simplified approach was used to represent the unsaturated zone within the model domain because its regional extent precluded detailed representation of saturated/unsaturated conditions. This detailed representation was not considered necessary as the main focus of the study was assessment of potential migration in the saturated zone beneath and away from the Landfill. The approach consisted of applying a linear decrease in hydraulic conductivity to a minimum of one order of magnitude decrease at 10 m or more above the water table in all areas of the model except the in-filled valley. Because the sediments in the in-filled valley are several orders of magnitude more permeable than elsewhere in the model, the unsaturated zone within the in-filled valley was simulated using a linear decrease in hydraulic conductivity to a minimum of three orders of magnitude at 1 m or more above the water table. This simplified approach allowed a reasonable representation of saturated groundwater flow.

4.5 Assumptions

A summary of the assumptions of the numerical model constructed for the Site is outlined below:

- Initial values of model input parameters were based on the results of permeability testing and, where testing results were not available, on typical values published in the literature.
- Surface water bodies (lakes and rivers) were simulated using specified-head boundaries. It was assumed that the permeability of sediments that may line the beds of these water bodies was similar to the underlying geologic strata. Thus, no restriction of flow between the surface water and individual hydrostratigraphic units was simulated.
- Groundwater flow deeper than 0 masl was assumed to be negligible, and to have negligible influence on model predictions.
- Although the model only provides a simplified representation of actual conditions at the Site, the simplifications do not prevent the adequate reproduction of conditions to meet project objectives and provide groundwater flow behaviour.

4.6 Model Calibration

The numerical model was calibrated using the average static groundwater level elevations observed at 45 monitoring well locations shown on Figure C-7. The monitoring well details and the average groundwater level elevations are provided in Table C-2.

As part of the calibration process, the hydraulic conductivity of the hydrostratigraphic units were iteratively adjusted until the model's hydraulic head values were reasonably similar to the observed heads at the monitoring wells, and were similar to the previous inferred groundwater elevation contours presented in the 2011 Annual Report – Cache Creek Landfill (Golder 2012, Figure I.2-2). Figure C-9 presents the calibrated values of hydraulic conductivity used in the model. Although the hydraulic conductivities assigned to the units within the in-filled valley fall within the lower end of the range that was established based on the measured values, this is considered reasonable as the in-situ testing intentionally targeted more permeable intervals within these units, whereas the values assigned in the calibrated model reflect bulk properties that also include less-permeable intervals within each unit. Furthermore, it was not possible to maintain model calibration with higher values of hydraulic conductivity values assigned to the in-filled valley without unreasonable increases in the recharge rates.

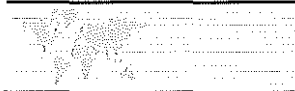


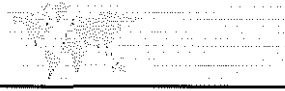
Figure C-10 provides a comparison of hydraulic heads calculated by the calibrated model and the observed average hydraulic heads under current conditions. The mean absolute error between predicted and measured values was approximately 8 m. This indicates that, on average, the model predictions were within ± 8 m from the measured values. The weighted root-mean-square error was 4.2%. Considering the scale of the model (16 km^2) and the significant topographic variation across the modelled area (up to 750 m), these calibration results were considered to be reasonable for the purposes of predicting groundwater flow conditions at the Site.

5.0 NUMERICAL MODEL RESULTS

5.1 Current Conditions

Figure C-11 presents water table contours predicted by the calibrated model for current conditions. The general pattern of groundwater flow simulated by the numerical model agrees reasonably well with the Site conceptual model and the hydraulic heads measured in monitoring wells. The predicted groundwater flow direction on the regional hillslope surrounding and including the Landfill is towards the east to the in-filled valley. Flow from the in-filled valley is directed along its trajectory towards the southeast. Flow from the in-filled valley and surrounding area ultimately discharges to the Bonaparte River. A small component of groundwater flow from the area next to the northeast side of the Landfill flows to the northeast towards the aquifer. As such, a groundwater flow divide exists within the in-filled valley near to the north side of the Landfill such that flow north of the divide is towards the northeast and flow south of the divide is towards the southeast. As shown on cross-section A-A' in Figure C-11, the calibrated model indicates lateral groundwater flow upslope of the in-filled valley and some vertically upward groundwater flow within the in-filled valley and next to the Bonaparte River. This flow is consistent with the topographically-controlled regional flow system illustrated in the cross-section in Figure C-4.

The particle tracking solution in FEFLOW was used to evaluate the potential path-lines from the Landfill. This involved the application of imaginary particles to the approximate water table below the Landfill footprint within the model. The particles were numerically tracked to represent groundwater path-lines from these locations. For this evaluation, the effective porosity of the in-filled valley sediments and other surficial material was assumed to be 0.25, with a lower and upper range of 0.15 and 0.35, respectively, based on values reported in the literature for similar materials (Maidment, 1993). The effective porosity for the weathered bedrock was assumed to be 0.05, with a lower and upper range of 0.01 and 0.1, respectively, based on values reported in the literature for similar sedimentary rock (Maidment 1993). The effective porosity of the competent bedrock was assumed to be 0.01, with a lower and upper bound range of 0.005 and 0.05, respectively, based on research by Guimera and Carrera (1999). The path-line results indicate that saturated groundwater flow from below the Landfill is predicted to reach the in-filled valley and then flow toward the southeast and discharge to the Bonaparte River southeast of the Landfill. The shortest travel time for groundwater flow from the Landfill to reach the Bonaparte River was estimated to be approximately 120 years along the southern-most pathway, with a lower and upper range of 70 years to 165 years, respectively.



5.2 Simulation Approach for Mitigation

The calibrated numerical groundwater flow model was used to simulate the extraction wells that could be required for managing migration of groundwater from the Landfill. The results from the numerical model were used to estimate the number, location, and pumping rates for these wells, and the total pumping rate for the well field as a whole.

A simulation was conducted based on the calibrated model that involved migration control by groundwater pumping. The simulation included flux boundary conditions to represent the operation of pumping well centers. Several model runs were completed where the number and locations of the pumping well centers, and the pumping rates at each of the centers were varied in an attempt to capture of groundwater flow from the Landfill. The particle tracking solution in FEFLOW was used to evaluate the potential seepage path-lines from the Landfill, and to establish when all path-lines were captured by the pumping wells.

The results of the simulation to control migration by groundwater pumping are presented for the calibrated model in Figure C-12. The simulation determined that a total of four pumping well centres located east of the Landfill, each pumping at a rate of approximately 4 US gallons per minute (USgpm), would be required to manage the off-site migration of groundwater. This would result in a combined recovery rate for the well field of 16 USgpm (approximately 90 m³/day).

To account for well pumping inefficiencies and heterogeneities associated with the local groundwater flow regime, it is assumed that on the order of 8 to 12 pumping wells located east of the Landfill at equally-spaced distances with a collective pumping rate on the order of 100 m³/day, would be required to capture groundwater originating from beneath the Landfill.

5.3 Model Limitations and Uncertainty

The accuracy of the numerical model and the uncertainty associated with the predictive results are a function of the uncertainty in the input data, the accuracy of the conceptual understanding of the Site hydrogeology, the reasonableness of the model assumptions, and the quality of the model output when compared with observed conditions. This uncertainty is inherent in any hydrogeological assessment, as it is simply not practical to install monitoring wells at dense enough spacing that would allow identification and testing of all heterogeneities, discontinuities.

The primary uncertainties of the model are related to the actual position of the groundwater divide within the in-filled valley and potential presence of continuous, higher-permeability pathways within the in-filled valley sediments. The former was established based on water level readings from the available monitoring wells which provide somewhat sparse coverage north and north east from the Site. If a higher-permeability pathway extending north or south was present within the valley in-fill, the travel times to the Bonaparte River could be shorter than the values discussed in Section 5.0.



6.0 SUMMARY AND CONCLUSIONS

The purpose of the three-dimensional numerical groundwater flow model was to simulate groundwater migration from the Landfill so that 1) the post-closure Landfill monitoring program could be optimized and 2) pumping requirements to manage the migration of groundwater from beneath and around the Landfill could be determined.

Recommendations for post-closure groundwater monitoring, based on the modelling results, are presented in the Closure Period Plan. The modelling study concluded that on the order of 8 to 12 pumping wells located east of the Landfill at equally-spaced distances with a collective pumping rate on the order of 100 m³/day, would be required to capture groundwater originating from beneath the Landfill. Additional investigations north of the landfill would reduce the uncertainty in that area.



7.0 CLOSURE

We trust that the information contained in this preliminary report is sufficient for your present needs. Should you have any additional questions regarding the project, please do not hesitate to contact the undersigned at 604-296-4200.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Connie Romano, M.Sc., P.Geo.
Associate, Hydrogeologist

ORIGINAL SIGNED

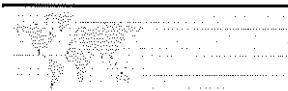
Willy Zawadzki, M.Sc., P.Geo.
Principal, Senior Hydrogeologist

ORIGINAL SIGNED

Jill Sacré, M.Sc., P.Geo.
Principal, Senior Hydrogeologist

CR/WZ/syd

o:\final\2012\1435\12-1435-0804\1214350804-500-rev0-6000\1214350804-500-rev0-6000-cache creek gw modelling 07sep_12.docx



8.0 REFERENCES

- Aquaveo. 2009. GMS (Groundwater Modeling System) v. 6.5.6. Utah, USA.
- BC Ministry of the Environment Water Resource Atlas, 2012. Web-based interactive mapping tool for viewing BC water resources information. (http://www.env.gov.bc.ca/wsd/data_searches/wrbc/index.html).
- CH2MHill, 2009. Hydrogeological Characterization, Cache Creek Landfill Stage 5 Extension, Cache Creek, BC, May 2009.
- Diersch, H.G. 2012. FEFLOW Interactive Graphics-based Finite Element Simulation Systems for Subsurface Flow and Transport Processes. v. 6.0 (p11). DHI-WASY Institute for Water Resources Planning and System Research Ltd., Berlin, Germany.
- Environment Canada, 2012. Canadian Climate Normals. Kamloops Climate Monitoring Station. (http://www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html).
- Fetter, C.W., 2001. Applied Hydrogeology. Prentice-Hall, Inc., Upper Saddle River, N.J. 07458.
- Freeze, R.A, and Cherry, J.A., 1979. Groundwater. Prentice Hall, Inc., Englewood Cliffs, N.J. 07632.
- Geological Survey of Canada Map 92I/NW. J.M. Ryder, H.A. Thomson (1972).
- Golder Associates Ltd., 2012. 2011 Annual Report, Cache Creek Landfill, Cache Creek. BC. March 2012.
- Golder Associates Ltd., 2011. 2010 Annual Report, Cache Creek Landfill, Cache Creek, BC. April 2011.
- Golder Associates Ltd., 2010. 2009 Annual Report, Cache Creek Landfill, Cache Creek, BC. April 2010.
- Golder Associates Ltd., 1988. Cache Creek Sanitary Landfill. Volume II, Supporting Technical Documents. December, 1988.
- Guimera and Carrera (1999). A comparison of hydraulic and transport parameters measured in low-permeability fractured media. *Journal of Contaminant Hydrology* 41(2000) pp 261-281.
- Maidment, D.R., 1993. "Handbook of Hydrology". R.R. McGraw-Hill Inc. USA.
- Monger, J.W.H and J.M. Journeay, 1994. Guide to the Geology and Tectonic Evolution of the Southern Coast Mountains. Geological Survey of Canada Open File 2490.
- Ryder, J.M., 1976. Terrain Inventory and Quaternary Geology, Ashcroft, British Columbia. Geological Survey of Canada Paper 74-49.
- Schroeder, P. R, Aziz, N.M., Lloyd, C.M., and Zappi, P.A. 1994. The Hydrologic Evaluation of Landfill Performance (HELP) Model: User's Guide for Version 3. EPA/600/R-94/198a, September 1994, U.S. Environmental Protection Agency Office of Research and Development, Washington, DC.
- Wood, W.W.. and Sanford. W.E. 1995. Chemical and Isotopic Methods for Quantifying Ground-Water Recharge in a Regional, Semiarid Environment. *Groundwater*, Vol. 33, No. 3 pp 458-468.

TABLE C-2
Summary of Observation Well Details

Location	Well	Local		UTM		Date Installed	Ground Elevation (masl)	TOC Elevation (masl)	Slackup	Well Bottom Elevation (masl)	Top of Bedrock Elevation (m)	Depth to Top of Bedrock (m)	Screen Midpoint Depth below Top of Bedrock (m)	Screen		Screen Interval Elevation (masl)	Screen Mid-Point Elev (masl) *	Lithology of Screen Interval	Status	Typical Water Level Elevation* (masl)	Comment
		Northing	Eastings	Northing	Eastings									depth to top from GS (m)	depth to bottom from GS (m)						
Upgradient of Landfill	TH2	9400.644	6306.472	5627227.538	6179611.583	Aug-80	637.35	638.24	0.80	603.85				-	-	-	600.85	-	Destroyed	-	
	TH3	9847.725	6387.601	5627674.183	6179773.163	Aug-80	-	643.59*						-	-	-	632.42	630.82	Inactive ²	-	
	MW305	9652.90	6242.34	5627777.803	6178293.379	Nov-04	645.61	646.58	0.945	608.01	612.11	33.50	4.8	38.9	36.0	608.711	606.011	Bedrock	Inactive ²	619.32	water level above bedrock surface; Fig VII-12 (2009 Report)
	MW306	10116.050	6142.253	5627940.231	617716.200	Jul-03	638.841	638.70	0.949	627.24	626.70	9.14	0.9	8.55	11.0	630.201	627.24	Bedrock (interface)	Active	627.40	
	MW307	9628.85	6060.697	5627648.035	617057.280	Jul-03	653.123	653.017	0.794	627.52	623.01	19.51	4.0	22.85	25.9	662.573	657.523	Bedrock	Active	671.82	
South of Landfill	MW308	10062.418	6035.297	5627650.454	617453.233	Jul-03	721.299	722.026	0.750	603.50	701.15	26.12	3.4	21.05	25	696.349	696.299	Bedrock	Active	722.53	flows very gently over casing top
	TH1A	9530.749	6307.365	5627470.938	617895.875	Aug-80	644.201	645.115	0.854	630.86	632.07	12.19	-0.3	10.35	13.4	633.911	630.861	Bedrock (interface)	Active	631.60	
	TH1B	9530.749	6307.365	5627470.938	617895.875	Aug-80	638.78	640.01	0.83	628.78	634.26	5.50	4.0	4	11	631.78	628.78	Bedrock	Active	632.64	water level below bedrock
	TH5	9483.257	6055.803	5627515.819	618245.073	Aug-80	597.96	598.58	0.02	578.88	585.40	12.50	5.1	10	19.1	581.98	578.88	Bedrock	Active	580.10	fluctuates (since 2009, min=631.38, max=634.10); water level at bedrock surface
	MW09-4A	9632.17	6076.469	5627469.515	618487.047	Nov-09	505.814	506.818	1.004	551.18	557.58	6.29	5.0	13.11	14.63	552.704	551.184	Bedrock	Active	555.78	water level at or above bedrock surface
North of Landfill	MW09-4B	9632.49	6076.23	5627470.185	618405.507	Nov-09	505.873	506.882	0.859	557.81	557.56	7.92	-0.62	9.34	8.00	553.333	557.813	Surficial sediments	Active	556.43	water level at or above bedrock surface
	MW09-4D	9637.78	6079.601	5627485.545	618408.334	Nov-09	505.757	506.582	0.825	557.39	558.44	7.32	68.5	75.32	79.37	490.437	487.387	Bedrock	Active		has never recovered, rose by 13 m in 2011, has risen by 5.8 m so far in 2012 to 512.78; water level below bedrock surface
	TH10	95162.611	6310.985	5627377.726	617889.870	Jul-88	622.64	623.22	0.58	602.84	622.04	0.00	18.50	1.6	18.8	605.84	602.84	Bedrock	Inactive ²	-015	water level below bedrock surface; Fig VII-12 (2009 report)
	MW09-7-1	10504.00	6716.40	5628341.400	618293.170	Mar-07	498.28	498.97	0.71	477.66	476.50	18.70	-0.01	15.2	18.3	483.08	477.98	Bedrock (interface)	Active	476.32	water level below bedrock surface
	MW09-5A	10445.86	6057.86	5628270.253	618225.005	Nov-09	498.51	497.242	0.532	401.07	408.42	27.89	6.0	35.12	34.04	403.10	401.07	Bedrock	Active	477.37	water level above bedrock surface
Landfill	MW09-5B	10445.81	6056.045	5628278.237	618227.519	Nov-09	460.120	497.003	0.634	408.54	408.24	27.89	0.9	28.09	26.59	404.030	406.530	Bedrock	Active	477.35	water level above bedrock surface
	MW10-1A	10054.32	6029.750	5628480.040	618165.730	Nov-10	486.02	480.714	0.794	460.82	475.07	19.35	2.2	20.05	23.1	468.87	468.82	Bedrock	Active	478.94	
	MW10-1B	10052.25	6030.957	5628484.003	618165.990	Nov-10	486.99	480.925	0.915	470.79	475.01	19.35	-1.7	18.15	19.2	473.84	470.79	Surficial sediments	Active	478.94	
	TH4	10115.397	6058.660	5627906.253	618058.231	Nov-10	620.11	630.024	0.814	608.14	618.01	3.29	7.82	10.67	10.67	612.19	608.14	Bedrock	Active	608.17	
	MW10-4	10233.37	6042.943	5628050.578	617976.845	Nov-10	508.34	508.80	0.55	470.84	474.24	34.10	2.5	35.6	37.5	472.74	470.84	Bedrock	Destroyed	-	
Downgradient Within Property Boundary	TH3	10440.390	6755.205	5628274.780	618324.504	Jun-88	495.59	490.30	0.705	471.29	474.29	21.30	1.5	21.2	24.3	474.39	471.29	Interface	Active	475.82	water level above bedrock surface
	OW1	10140.01	6009.167	5627977.059	618488.380	Oct-62	507.66	509.27	0.61	408.80	476.78	30.88	-0.3	34.3	38.8	475.364	468.904	Surficial sediments	Active	473.63	water level above bedrock surface
	OW2	9987.81	6055.3	5627820.815	618537.845	1988	506.27	500.77	0.5	479.70				-	-	-	479.70	Surficial sediments	Active	481.35	
	MW03-1A	9679.75	6082.87	5627815.577	618582.148	Oct-03	507.16	507.98	0.83	454.58	458.82	47.24				457.58	454.50	Bedrock	Inactive ²	-	
	MW03-1B	9679.75	6082.87	5627815.577	618582.148	Oct-03	507.16	507.98	0.83	460.56	458.02	47.24				463.6	460.56	Surficial sediments	Inactive ²	-	
Downgradient Outside Property Boundary - East of Landfill	MW07-1A	9681.68	6080.71	5627821.294	618591.048	Oct-07	-	507.76		458.02	463.3			50.6	52.43	455.7	454.2	Bedrock	Active	482.23	gradually rising from -480.2 in Jan 2010 to 482.05 in Apr 2012; water level above bedrock surface
	MW07-1B	9679.82	6080.82	5627821.294	618601.048	Oct-07	-	507.87		458.02	463.3			43.0	44.50	483.8	482.3	Surficial sediments	Active	481.91	gradually rising from -481.3 in Jan 2010 to 482.25 in Apr 2012; water level above bedrock surface
	MW08-2A	9655.530	10184.73	5627501.160	617971.851	Feb-09	503.451	504.238	0.757	449.04	465.05	37.80	15.0	52.0	53.51	451.5	446.9	Bedrock	Active	461.45	water level at or below bedrock surface
	MW08-2B	9654.427	10182.30	5627459.060	617878.201	Feb-09	503.091	504.586	0.890	458.28	468.20	37.45	7.2	43.9	45.41	459.8	458.3	Surficial sediments	Active	464.61	water level at or below bedrock surface
	TH6A	10205.44	6076.91	5628047.439	618554.472	Jun-88	500.45	501.21	0.757	470.85	471.45	20.00	-0.3	28	29.5	472.45	470.95	Bedrock	Active	475.08	water level above bedrock surface
Downgradient Outside Property Boundary - South of Landfill	TH6B	10205.44	6076.91	5628047.439	618554.472	Jun-88	500.45	501.21	0.757	470.85	471.45	20.00	-0.3	28	29.5	472.45	470.95	Surficial sediments	Active	474.46	water level above bedrock surface
	MW10-2A	10156.768	10006.51	5627987.241	618583.702	Nov-10	501.86	502.803	0.943	461.03	463.46	38.40	1.7	38.3	40.83	462.50	461.80	Bedrock	Active	474.57	
	MW10-2B	10155.824	10007.73	5627989.305	618585.000	Nov-10	501.93	502.738	0.808	462.03	462.40	39.47	-2.0	35.65	39	465.98	462.93	Surficial sediments	Active	474.57	
	MW10-2D	10154.725	10006.93	5627988.253	618585.231	Nov-10	501.82	502.755	0.935	462.05	461.72	40.25	-1.0	34.7	38.20	461.0	460.87	Bedrock	Active	462.75	sometimes MW10-2A is slightly higher than MW10-2B and sometimes the opposite; has never recovered, rising at a rate of ~1 m per quarter to 407.06 in Apr 2012
	OW2	9716.023	10228.54	5627501.555	618610.027	Oct-62	498.02	496.45	0.825	457.02	457.82	40.80	-0.8	38.4	41	490.253	487.023	Surficial sediments	Active	460.46	water level above bedrock surface
Downgradient Outside Property Boundary - South of Landfill	OW4	9522.11	10376.72	5627389.504	618970.513	1988	488.30	489.08	0.775	457.30	457.82	30.48	-0.5	-	-	-	458.32	Surficial sediments	Active	460.22	water level above bedrock surface
	MW03-2A	9594.76	10501.83	5627410.008	619062.333	Oct-03	485.68	486.48	0.80	458.68	462.82	22.80	4.3	25.0	26.7	460.08	458.98	Bedrock	Active	457.61	the level started to rise in 2012 by 0.25 m per quarter to 458.47 in Apr 2012; water level below bedrock surface
	MW03-2B	9594.76	10501.83	5627410.007	619062.341	Oct-03	485.68	486.48	0.80	460.43	462.82	22.80	-2.14	19.2	22.25	468.48	463.43	Surficial sediments	Active	463.63	
	MW06-1A	9734.03	10236.5	5627581.435	618821.642	Feb-09	488.336	488.05	0.714	447.88	456.33	39.01	10.7	49.0	50.48	448.4	447.9	Bedrock	Active	452.72	the levels started to rise in 2012 by 3.8 m in Jan 2012 and 1.4 m in Apr 2012 to 457.34; water level at or above bedrock surface
	MW06-1B	9730.214	10240.00	5627583.074	618820.034	Feb-09	488.309	488.134	0.825	460.11	456.30	39.01	4.0	34.7	38.20	461.0	460.87	Surficial sediments	Active	462.75	
Extension	MW10-3A	9369.254	10400.00	5627220.281	619050.190	Nov-10	485.51	486.316	0.800	449.66	450.01	34.90	2.1	35.5	38.55	450.01	448.90	Bedrock	Active	477.66	
	MW10-3B	9369.254	10400.00	5627220.281	619050.190	Nov-10	485.51	486.316	0.800	450.73	450.73	34.75	31.7	34.75	34.75	450.73	450.73	Surficial sediments	Active	450.73	dry
	MW10-3D	9369.254	10400.00	5627220.281	619050.190	Nov-10	485.51	486.316	0.800	450.73	450.73	34.75	31.7	34.75	34.75	450.73	450.73	Surficial sediments	Active	450.73	dry
	MW-310	9621.261	8767.638	5627734.253	617336.295	Jan-09	738.535	737.028	0.832	699.15	684.08	52.12	16.1	67	69.5	689.945	687.445	Bedrock	Active	688.32	has never recovered, rising at a rate of ~0.1 m per quarter to 443.27 in Apr 2012
	MW-311	9621.261	8767.638	5627734.253	617336.295	Jan-09	738.535	737.028	0.832	699.15	684.08	52.12	16.1	67	69.5	689.945	687.445	Bedrock	Active	688.32	has never recovered, rising at a rate of ~0.1 m per quarter to 443.27 in Apr 2012
Extension	MW-312a	9704.850	8697.565	5627576.640	617282.916	Jan-09	738.167	737.028	0.832	699.15	684.08	52.12	16.1	67	69.5	689.945	687.445	Bedrock	Active	688.32	dry
	MW-312b	9704.850	8697.565	5627576.640	617282.916	Jan-09	738.167	737.028	0.832	699.15	684.08	52.12	16.1	67	69.5	689.945	687.445	Bedrock	Active	688.32	dry
	MW-41B	10157.383	6079.909	5627672.038	617416.141	Aug-08	704.763	705.502	0.739	689.10	688.30	10.40	-2.4	12.6	15.0	682.014	689.514	Surficial sediments	Active	688.83	

Notes:

TABLE C-3
Summary of Hydraulic Conductivity Results

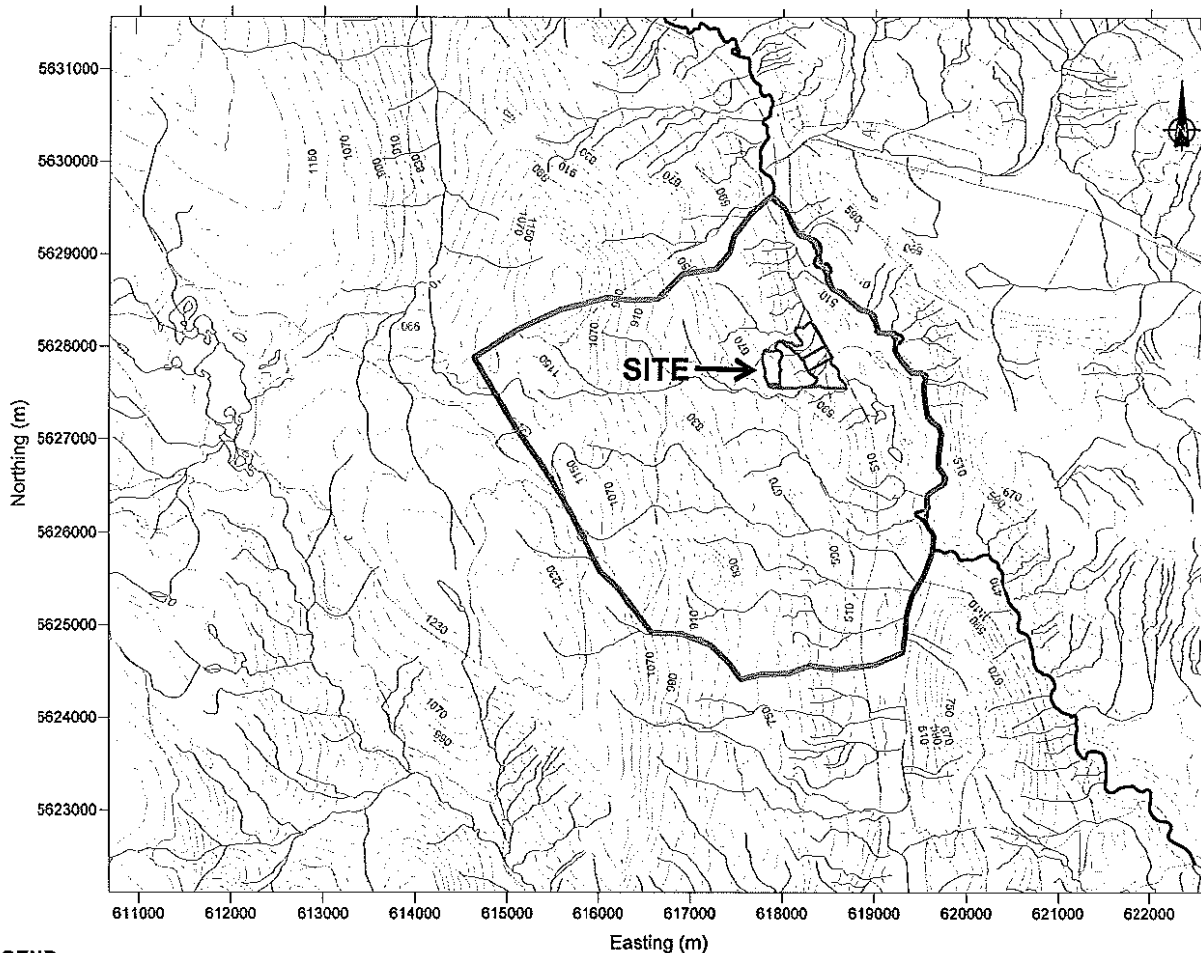
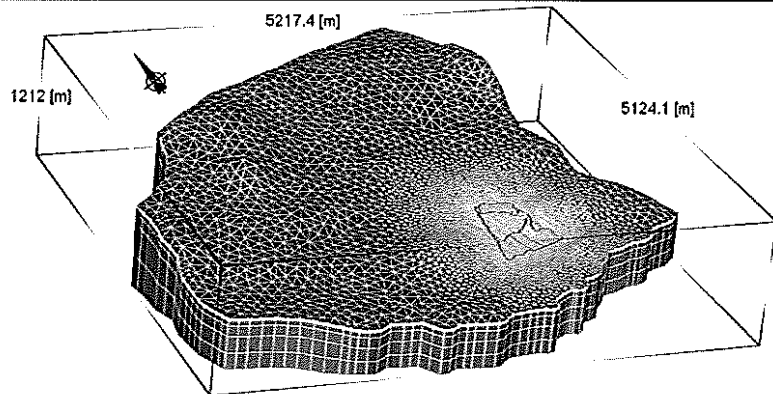
Well	Date	K (m/s)	Geometric Means	Test Method	Screen Depth		Screen Elev		Geologic Description of Screened Unit	Overburden Location	Depth to Top of Bedrock (m)	Screen Midpoint Depth below Top of Bedrock (m)
					depth to top from GS (m)	depth to bottom from GS (m)	Top (masl)	Bottom (masl)				
MW10-1B	21-Nov-10	2.0E-05	NA	slug/bail	16.15	19.20	473.84	470.79	Silt, some sand and gravel	Infilled Valley	19.35	-1.7
TH6	10-Feb-12	2E-06		slug/bail	21.20	24.30	474.39	471.29	Silty Sand and Gravel, Weathered Bedrock		21.3	1.5
OW1	9-Mar-12	9.0E-04		slug/bail	34.30	38.80	473.36	468.86	Sandy Gravel, Weathered Bedrock		36.88	-0.3
TH9B	1-Dec-88	1E-05		slug/bail	28.00	29.50	472.45	470.95	Fine Sand with some silt, Weathered Bedrock		29	-0.3
TH7B	1-Dec-88	3.0E-05		slug/bail	26.80	29.80			Sand some silt and gravel		29	-0.7
MW09-1B	9-Feb-12	4.0E-03		slug/bail	36.68	38.20	461.63	460.11	Silt & Sand to Silty Sand and Gravel		39.01	-1.6
OW2	9-Feb-12	6.0E-04		slug/bail	38.40	41.60	460.22	457.02	Sandy Gravel, Weathered Bedrock		40.8	-0.8
OW4	9-Feb-12	2.0E-04		slug/bail	-	-	-	457.30	-		30.48	-0.5
TH1B	1-Dec-88	4E-07	4.0E-07	slug/bail	5.00	6.30	634.78	633.48	Gravelly Sandy Silt, Weathered Bedrock	Slope	5.5	0.2
MW10-2B	17-Nov-10	2E-08	2E-08	slug/bail	35.95	39.00	465.98	462.93	Clayey Silt, some sand and gravel	Infilled Valley	39.47	-2.0
MW10-2A	15-Nov-10	7E-09	2E-08	slug/bail	39.30	40.83	462.56	461.03	Weathered Bedrock		38.4	1.7
MW10-3A		NA		slug/bail - poor test	35.50	38.55	450.01	446.96	Bedrock		34.9	2.1
MW10-1A	20-Nov-10	3E-08		slug/bail	20.05	23.10	469.87	466.82	Bedrock, Weathered Bedrock		19.35	2.2
TH4	1-Dec-88	5E-09		slug/bail	35.60	37.50	472.74	470.84	Bedrock		34.1	2.5
TH1A	10-Feb-12	6E-09		slug/bail	8.00	11.00	631.78	628.78	Bedrock		5.5	4.0
MW03-2A	9-Feb-12	4E-08		slug/bail	25.60	28.70	460.08	456.98	Bedrock		22.86	4.3
TH3	1-Dec-88	4E-07		slug/bail	13.30	14.90	632.42	630.82	Bedrock		9.8	4.3
TH7A	1-Dec-88	4E-09		slug/bail	33.00	35.90			Bedrock		29.9	4.6
TH5	1-Dec-88	1E-06		slug/bail	16.00	19.10	581.96	578.86	Bedrock		12.5	5.1
TH9A	1-Dec-88	2E-08		slug/bail	32.80	35.80	467.65	464.65	Bedrock		29	5.3
MW07-1A	9-Mar-12	< 1E-09		slug/bail	50.90	52.43	455.70	454.20	Bedrock		46.33	5.3
MW09-3B		NA		slug/bail - poor test	31.70	34.75	453.78	450.73	Bedrock		27.89	5.3
MW09-4A	10-Feb-12	1E-08		slug/bail	13.11	14.63	552.70	551.18	Bedrock		8.23	5.6
MW09-3A	10-Feb-12	4E-07		slug/bail	33.12	34.64	463.19	461.67	Very Weathered to Competent Bedrock		27.89	6.0
MW09-2B	9-Feb-12	3E-08		slug/bail	43.89	45.41	459.80	458.28	Weathered Bedrock		37.49	7.2
MW09-1A	9-Mar-12	< 1E-09	1.6E-10	slug/bail	48.96	50.48	449.38	447.86	Bedrock		39.01	10.7
MW10-2D		* < 3.0E-11		water level rise to static	49.95	53.00	452.00	448.95	Bedrock		40.23	11.2
MW10-3D		* < 5.0E-12		water level rise to static	47.25	50.30	438.23	435.18	Bedrock		34.9	13.9
MW09-2A		3.2E-08		slug/bail	51.99	53.51	451.46	449.94	Bedrock		37.8	15.0
MW09-4D		* 2.0E-11		water level rise to static	75.32	78.37	490.44	487.39	Bedrock		7.32	69.5

Notes

* K estimate is approximated based on an assessment of the water level rise over time.

1. Values shown as "<" are included in geometric mean as boundary values. This approach is considered conservative.

Italicized value for screen mid-point is assumed based on bedrock location and depth of well.



LEGEND

- Model Extent
- Topography Contours (masl)
- Watercourse
- Road

NOTES

1. No vertical exaggeration.
2. Topography contour interval is 40 m.
3. Coordinate System is NAD 83 UTM Zone 10.

REFERENCES

1. Obtained digital elevation models (DEMs) for map sheets 092I/14 and 092I/11 from Geobase Base Mapping and Geomatic Services - British Columbia Government. 1976. Victoria, B.C.

PROJECT

**WASTECH SERVICES LIMITED
CACHE CREEK LANDFILL
CACHE CREEK, BC**

TITLE

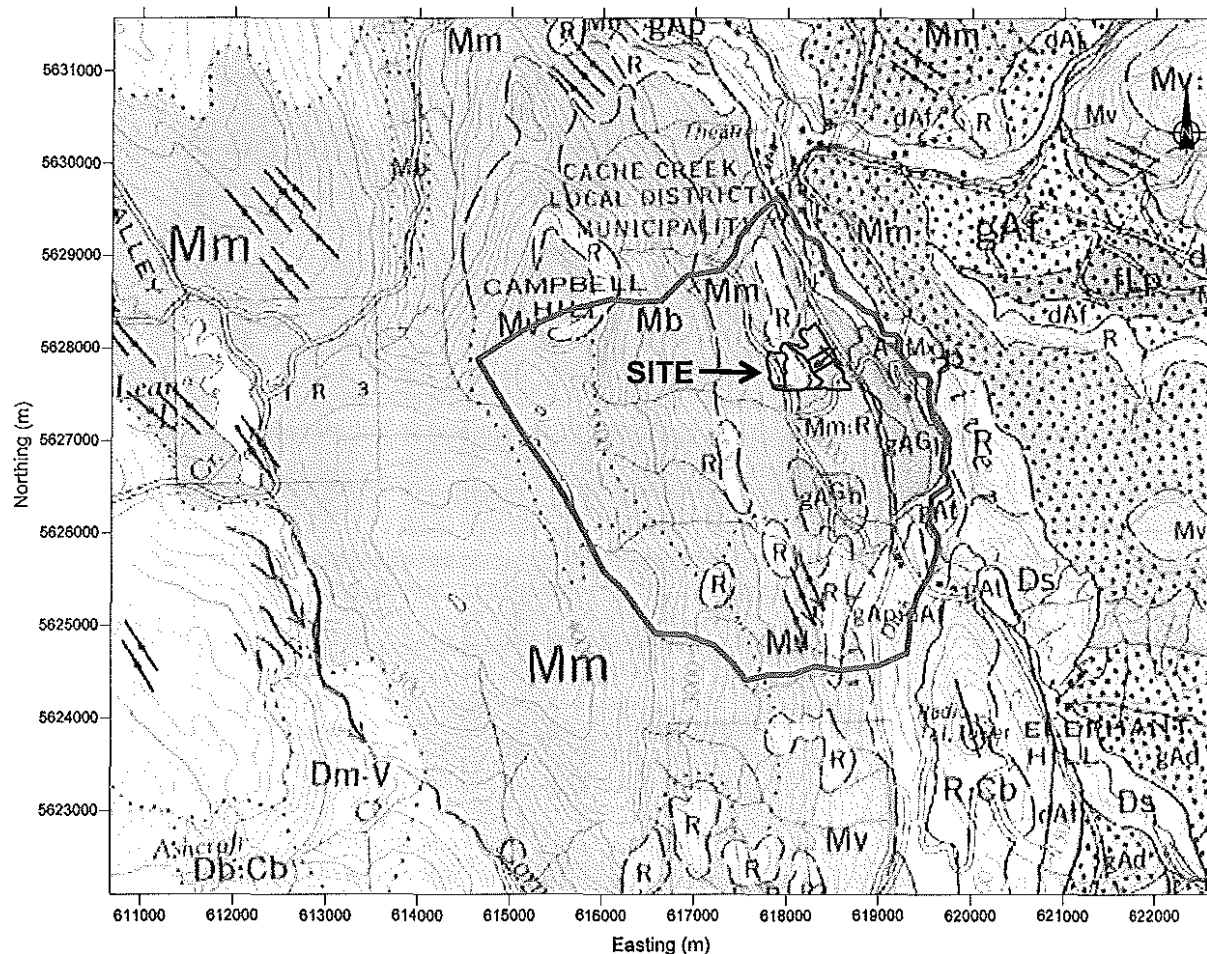
GROUNDWATER MODEL EXTENT AND MESH



**Golder
Associates**

PROJECT No.	12-1435-0804	PHASE No.	6000
DESIGN	—	20JUN12	SCALE AS SHOWN REV.
CADD	—	20JUN12	
CHECK			
REVIEW			

FIGURE C-1



LEGEND

	Model Extent		Topography Contour (masl)
Cb	Colluvial Blanket and Colluvial Veneer	Mv	Till Veneer
fLp	Lacustrine Plain	Mb	Till Blanket
gAf	Alluvial Fan (fluvial)	Dm	Drift
dAf	Alluvial Fan (mudflow)	V	Gullied
gAp	Alluvial Plain (flood plain)	Ds	Terrace Scarps and River Banks
gAd	Delta	Db	Drift Blanket
gAl	River Terraces, Alluvial Terraces	R	Rock Outcrop
gAGh	Kames (hummocky)	A+Mx	Valley Floor Complex
Mm	Ground Moraine		

NOTES

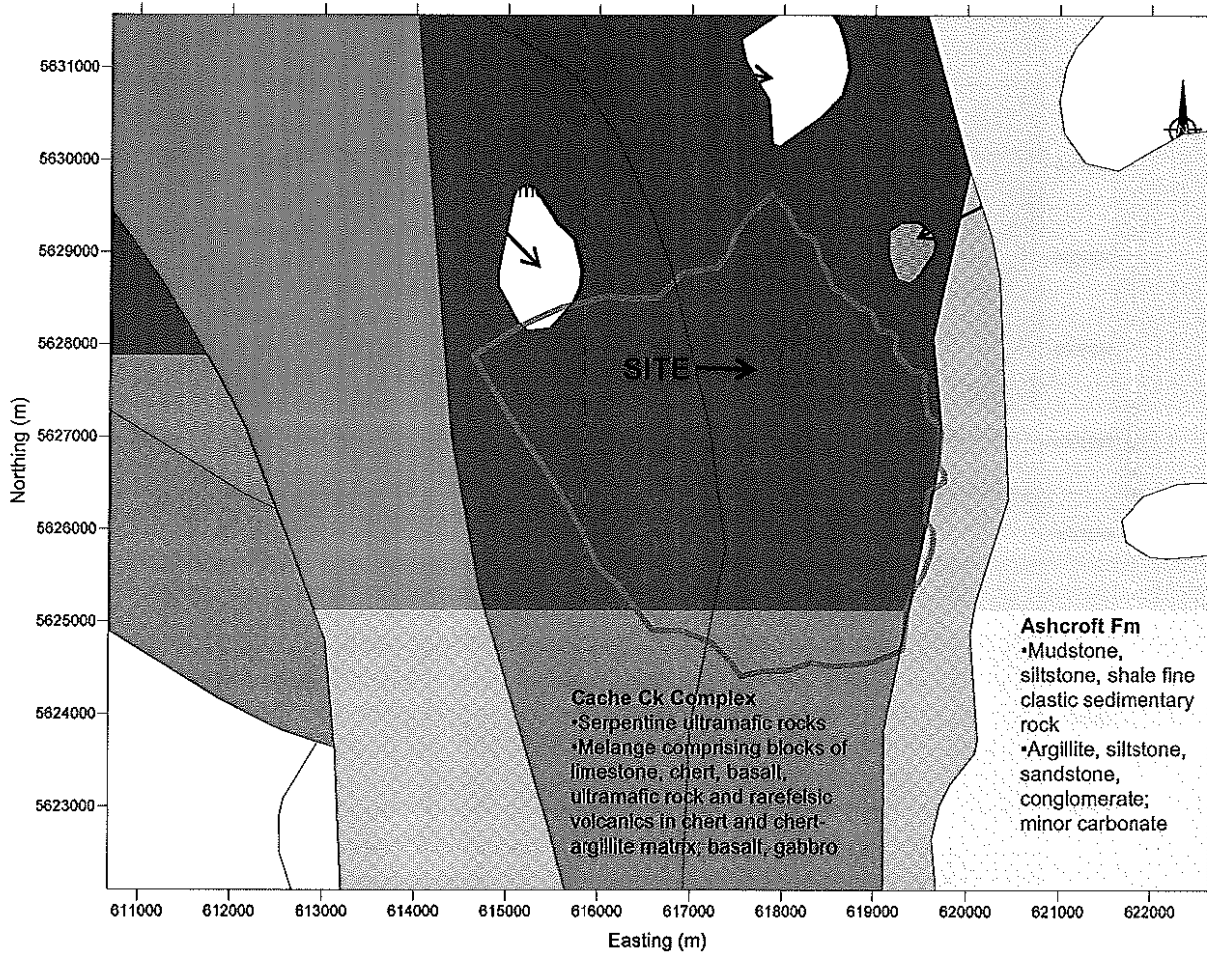
1. Topography contour interval is 100 m.
2. Coordinate System is NAD 83 UTM Zone 10.

REFERENCES

1. Map 921/NW Obtained from the Geological Survey of Canada: J.M. Ryder, H.A. Thomson (1972).

PROJECT		WASTECH SERVICES LIMITED CACHE CREEK LANDFILL CACHE CREEK, BC	
TITLE		SURFICIAL GEOLOGY	
PROJECT No. 12-1435-0804		PHASE No. 6000	
DESIGN	20JUN12	SCALE	AS SHOWN REV.
CADD	20JUN12	FIGURE C-2	
CHECK			
REVIEW			





LEGEND

— Model Extent

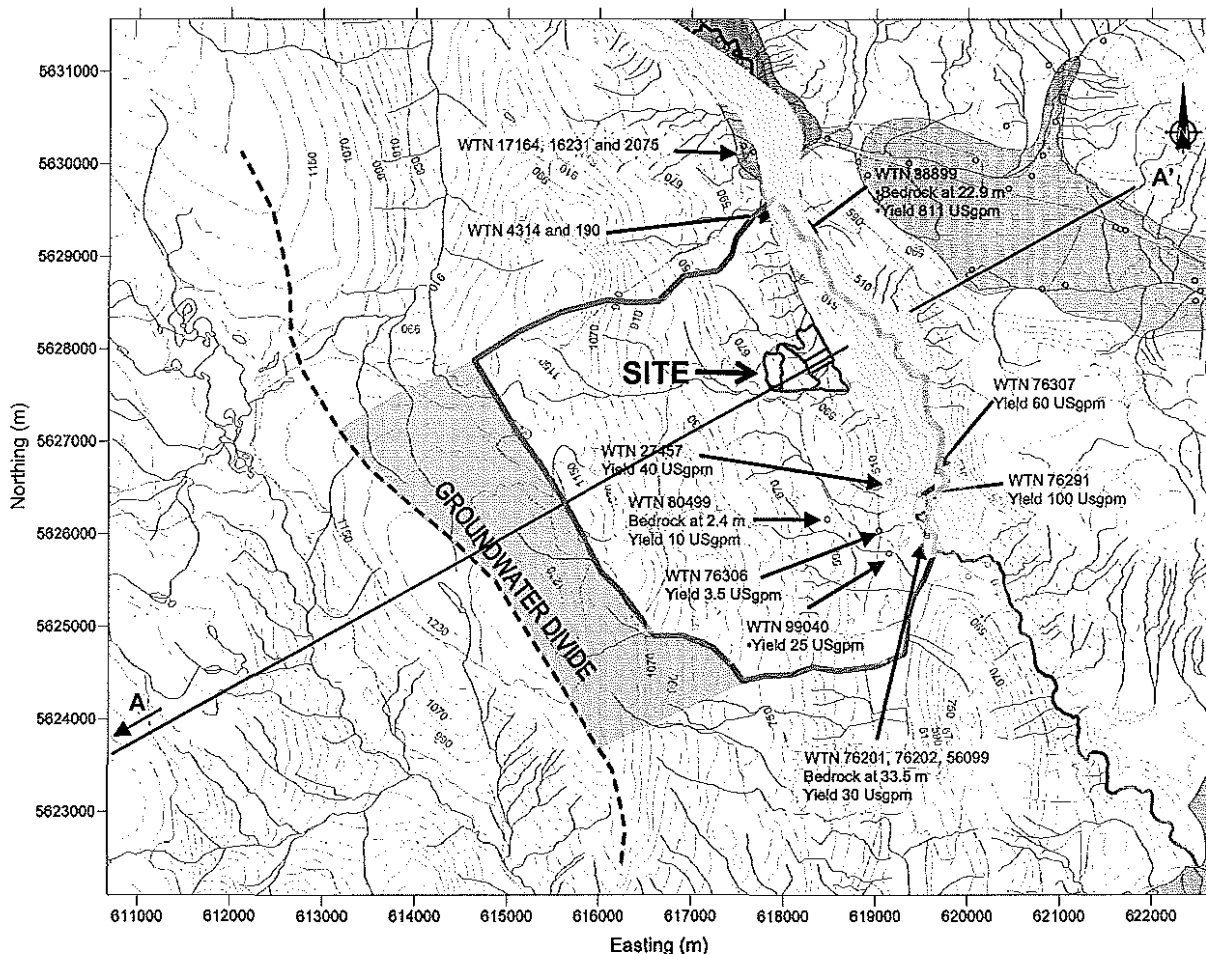
NOTES

1. Coordinate System is NAD 83 UTM Zone 10.

REFERENCES

1. B.C. Digital Geology Maps (Version 1.0 2005) obtained from the Ministry of Energy and Mine and Responsible for Housing.

PROJECT		WASTECH SERVICES LIMITED CACHE CREEK LANDFILL CACHE CREEK, BC	
TITLE		BEDROCK GEOLOGY	
 Golder Associates		PROJECT No. 12-1435-0804	PHASE No. 6000
		DESIGN	20JUN12
		CADD	20JUN12
		CHECK	
		REVIEW	
		SCALE	AS SHOWN REV.
		FIGURE C-3	



LEGEND

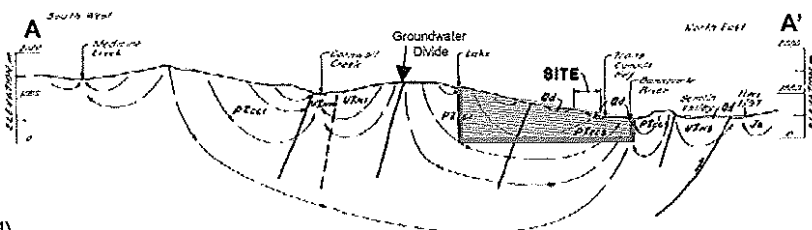
- Model Extent
- Known Aquifers
- Quaternary Deposit
- Upgradient Recharge Area
- Water Well and Well Tag Number (WTN)
- Topography Contours (masl)
- Watercourse
- Road

NOTES

1. Topography contour interval is 40 m.
2. Coordinate System is NAD 83 UTM Zone 10.

REFERENCES

1. Online BC Water Resource Atlas (BCWRA):
<http://webmaps.gov.bc.ca/imf5/imf.jsp?site=wrbc>
2. Obtained digital elevation models (DEMs) for map sheets 092I/14 and 092I/11 from Geobase Base Mapping and Geomatic Services - British Columbia Government. 1976. Victoria, B.C.
3. Regional Geological Cross Section A-A' adapted from the Golder report entitled "Cache Creek Sanitary Landfill: Volume 2 Supporting Technical Documents", dated December 1988.



PROJECT

**WASTECH SERVICES LIMITED
CACHE CREEK LANDFILL
CACHE CREEK, BC**

TITLE

KNOWN AQUIFERS AND WATER WELLS

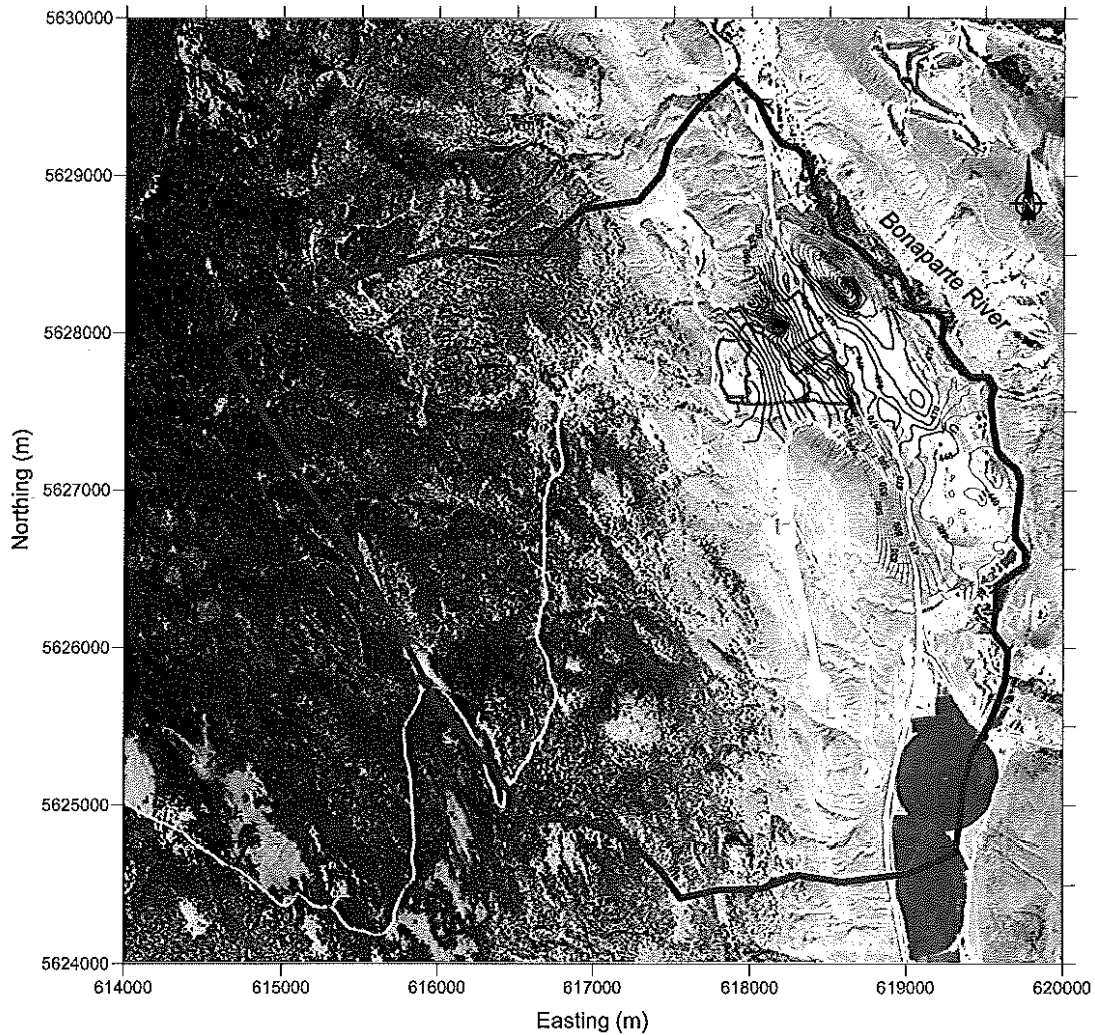


**Golder
Associates**

PROJECT No.	12-1435-0804
DESIGN	20JUN12
CADD	20JUN12
CHECK	
REVIEW	

PHASE No.	6000
SCALE	AS SHOWN REV.

FIGURE C-4



LEGEND

- Model Extent
- Landfill
- Contours Representing Inferred Bedrock Surface Elevation^{Reft} (masl)
- Contours Representing Extrapolated Bedrock Surface from the Inferred Bedrock Surface (masl)

NOTES

1. Coordinate System is NAD 83 UTM Zone 10.

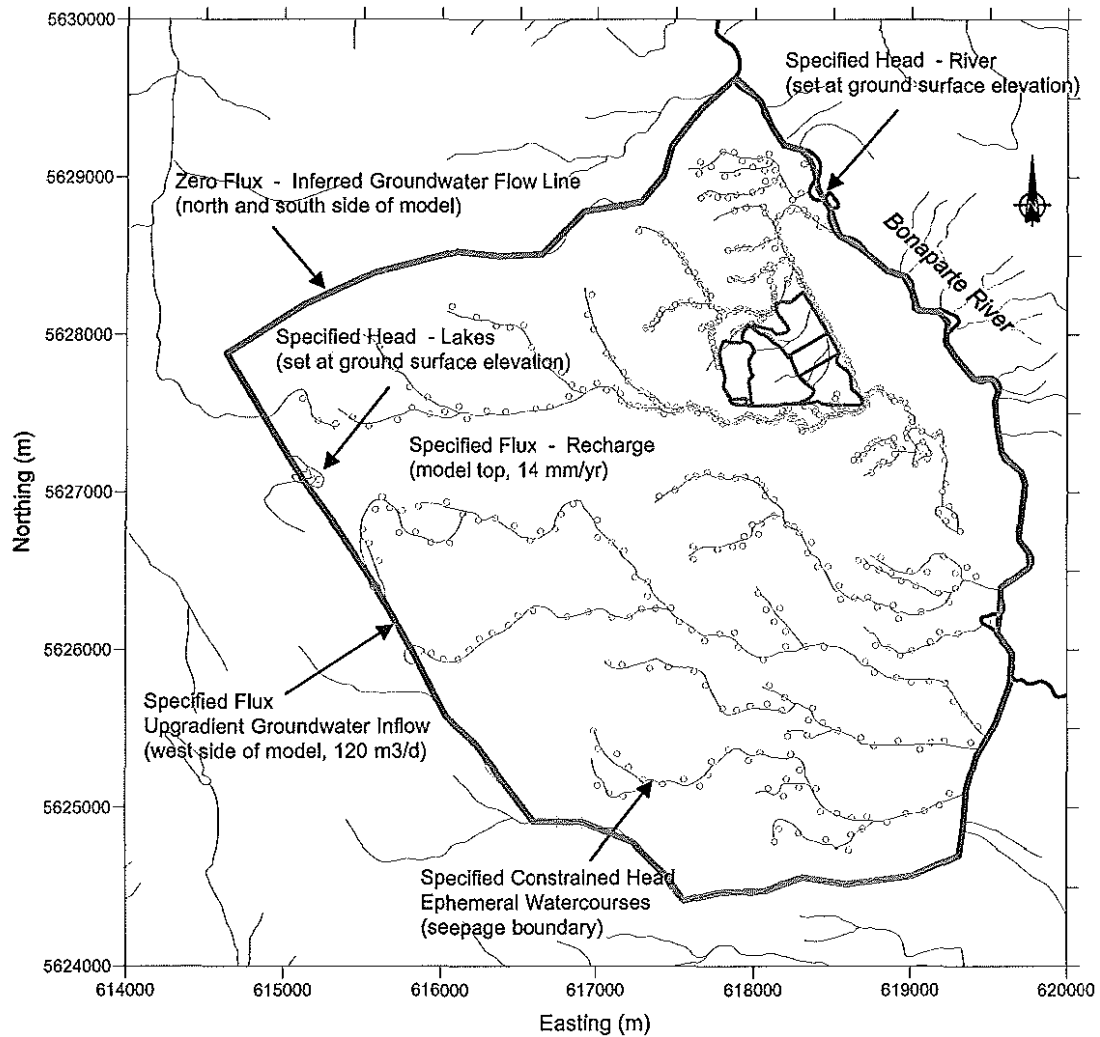
REFERENCES

1. Inferred bedrock surface elevation from Figure I.2-6 in the 2010 Annual Report, Cache Creek Landfill (Golder 2011).
2. Imagery obtained from BING Maps for ArcGIS published by Microsoft Corporation, Redmond, WA, May 2009.

PROJECT		WASTECH SERVICES LIMITED CACHE CREEK LANDFILL CACHE CREEK, BC	
TITLE		INTERPRETED BEDROCK SURFACE BELOW IN FILLED VALLEY	
PROJECT No. 12-1435-0804		PHASE No. 6000	
DESIGN	—	20JUN12	SCALE AS SHOWN REV.
CADD	—	20JUN12	
CHECK			
REVIEW			

**Golder
Associates**

FIGURE C-5



LEGEND

- Model Extent
- Landfill
- Watercourse

NOTES

1. Coordinate System is NAD 83 UTM Zone 10.

PROJECT

**WASTECH SERVICES LIMITED
CACHE CREEK LANDFILL
CACHE CREEK, BC**

TITLE

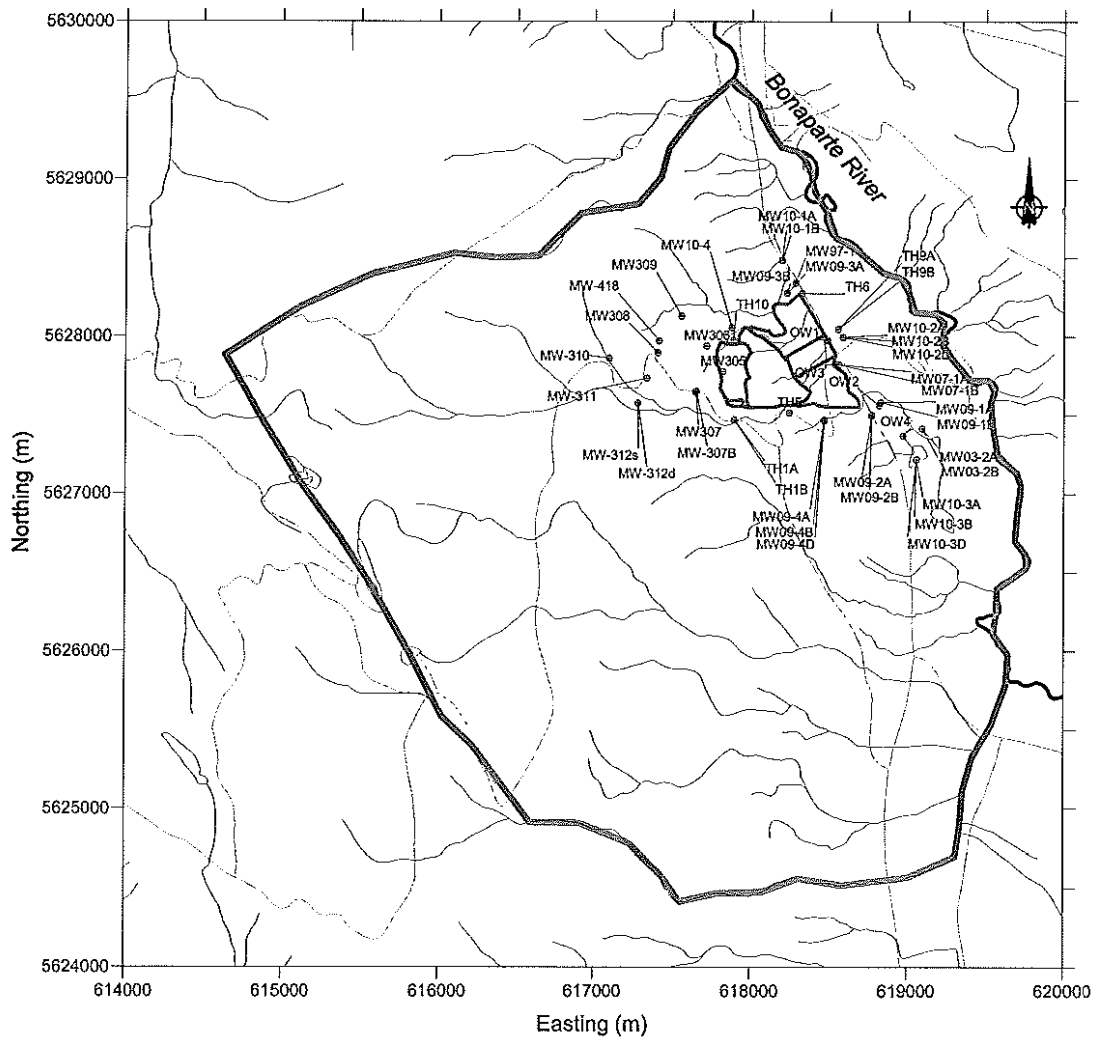
MODEL BOUNDARY CONDITIONS



**Golder
Associates**

PROJECT No.	12-1435-0804	PHASE No.	6000
DESIGN	— 20JUN12	SCALE	AS SHOWN REV.
CADD	— 20JUN12		
CHECK			
REVIEW			

FIGURE C-6



LEGEND

- Model Extent
- Landfill
- Monitoring Well
- Watercourse
- Road

NOTES

1. Coordinate System is NAD 83 UTM Zone 10.

PROJECT

**WASTECH SERVICES LIMITED
CACHE CREEK LANDFILL
CACHE CREEK, BC**

TITLE

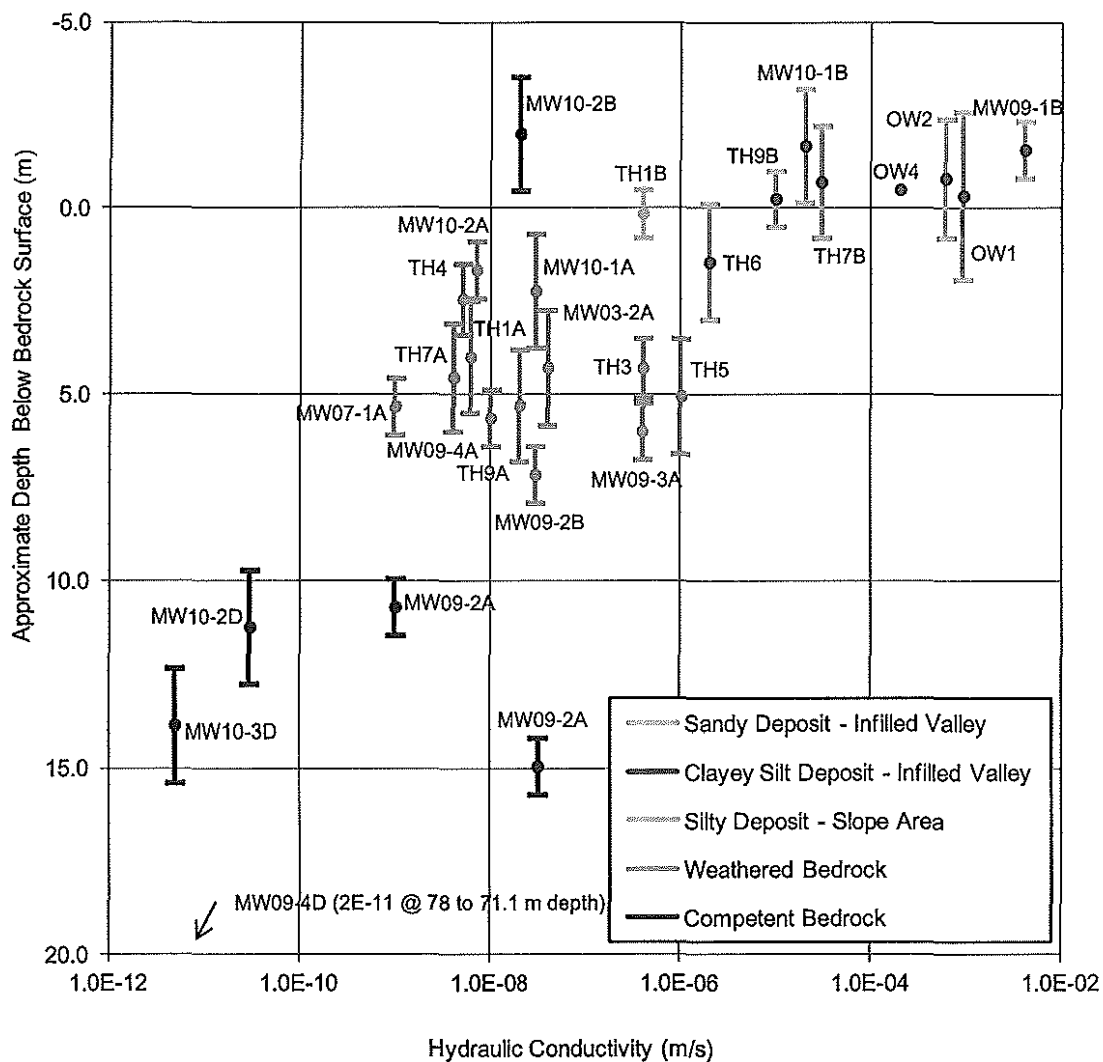
**OBSERVATION WELLS USED IN MODEL
CALIBRATION**



**Golder
Associates**

PROJECT No.	12-1435-0804	PHASE No.	6000
DESIGN	—	20JUN12	SCALE AS SHOWN REV.
CADD	—	20JUN12	
CHECK			
REVIEW			

FIGURE C-7



NOTES

1. Vertical bars represent the test interval.
2. Points represent the test interval midpoint.
3. OW4 test interval is unknown. The test midpoint value is assumed.

PROJECT

**WASTECH SERVICES LIMITED
CACHE CREEK LANDFILL
CACHE CREEK, BC**

TITLE

**HYDRAULIC CONDUCTIVITY VERSUS DEPTH
BELOW BEDROCK SURFACE**

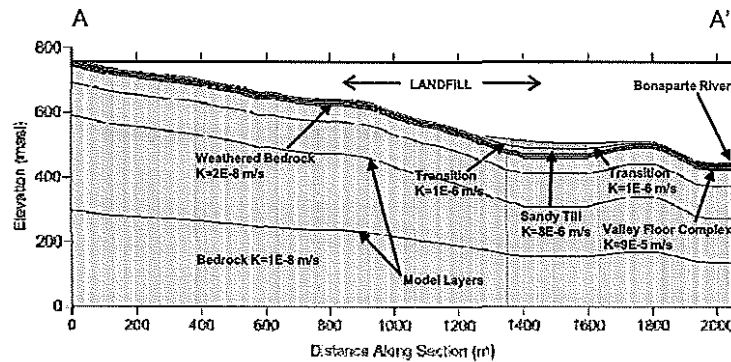
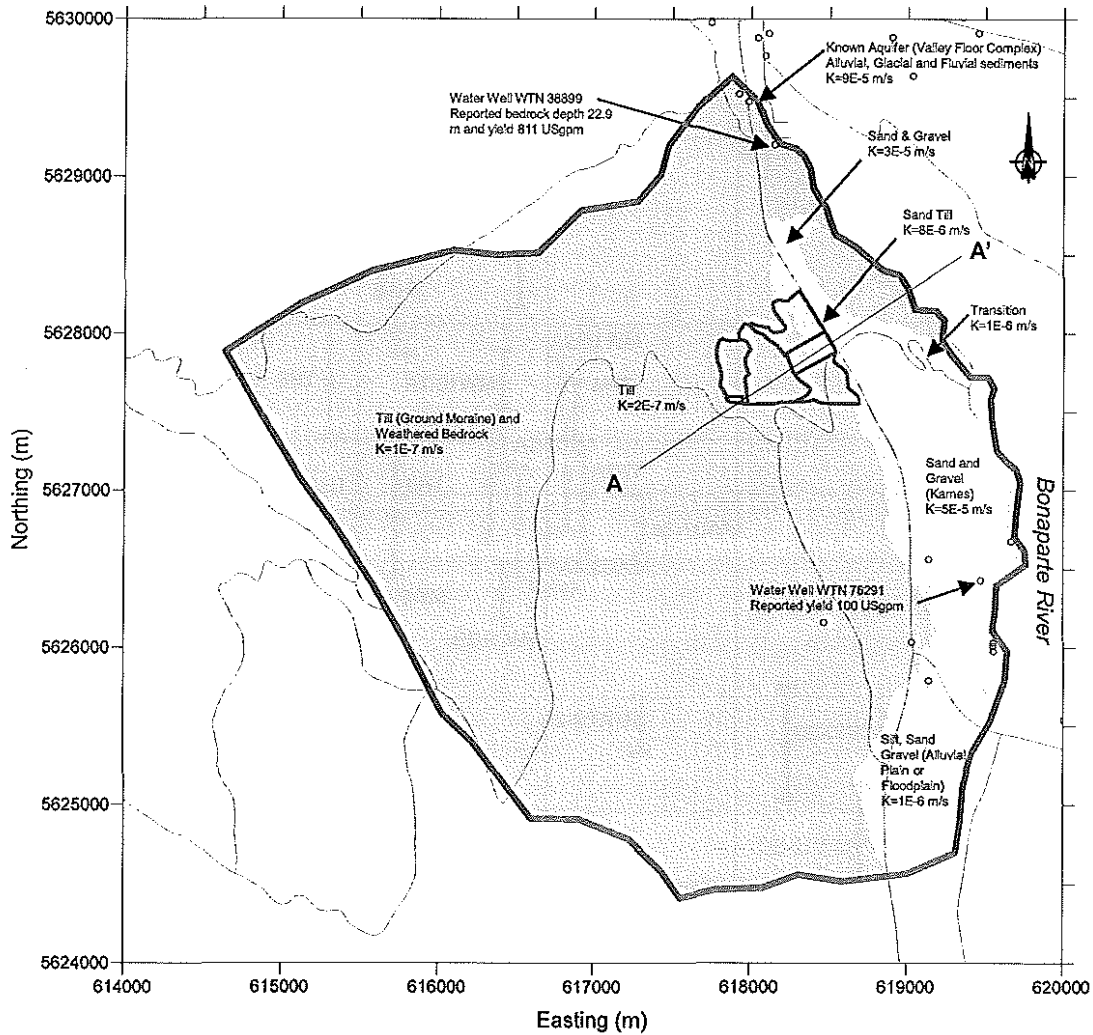


**Golder
Associates**

PROJECT No.	12-1435-0804	PHASE No.	6000
DESIGN	—	20JUN12	SCALE
CADD	—	20JUN12	REV.
CHECK	—		
REVIEW	—		

FIGURE C-8

Calibrated Hydraulic Conductivity in Model Layer One



Southwest-Northeast Cross Section

LEGEND

- Model Extent
- Landfill
- Water Well
- Section Name and Location
- Road

NOTES

1. No vertical exaggeration.
2. Coordinate System is NAD 83 UTM Zone 10.

PROJECT

**WASTECH SERVICES LIMITED
CACHE CREEK LANDFILL
CACHE CREEK, BC**

TITLE

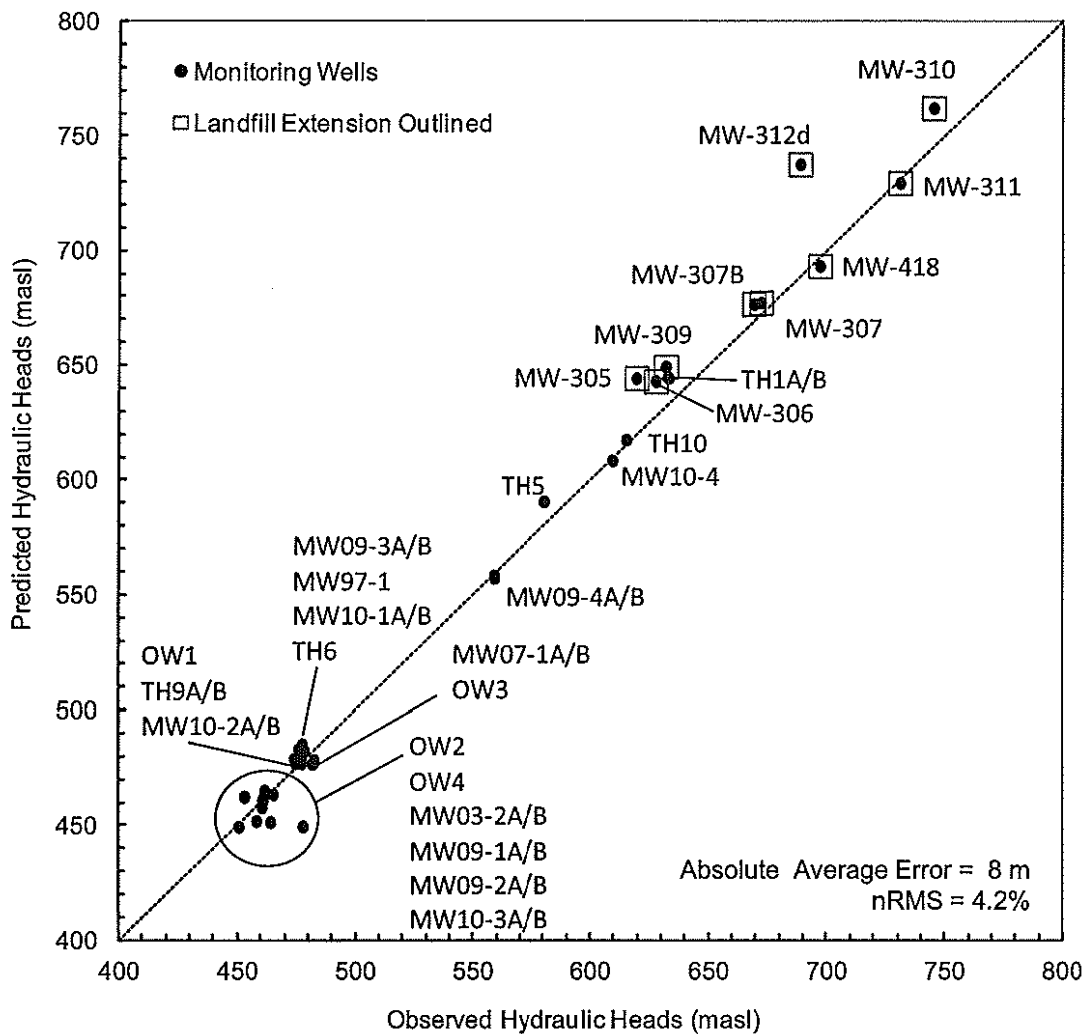
CALIBRATED HYDRAULIC CONDUCTIVITY



**Golder
Associates**

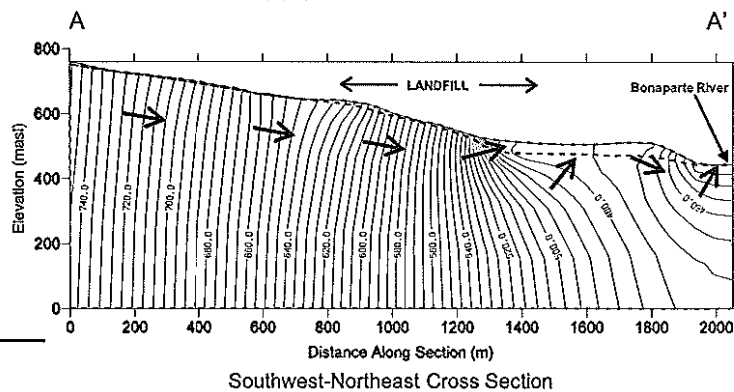
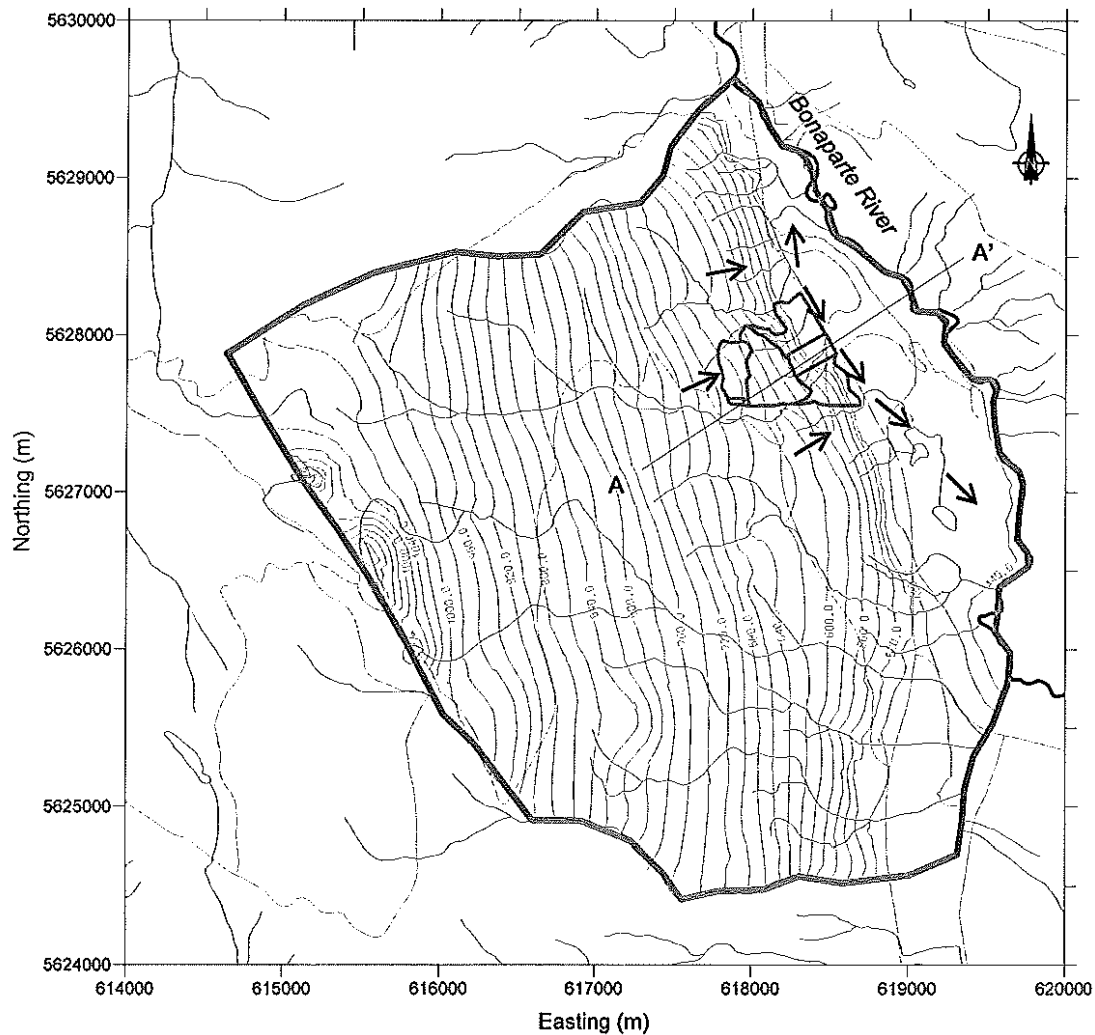
PROJECT No.	12-1435-0804	PHASE No.	6000
DESIGN	—	20JUN12	SCALE AS SHOWN REV.
CADD	—	20JUN12	
CHECK			
REVIEW			

FIGURE C-9



PROJECT		WASTECH SERVICES LIMITED CACHE CREEK LANDFILL CACHE CREEK, BC	
TITLE		MODEL CALIBRATION OBSERVED VS PREDICTED HEADS	
 Golder Associates	PROJECT No.	12-1435-0804	PHASE No. 6000
	DESIGN	20JUN12	SCALE AS SHOWN REV.
	CADD	20JUN12	
	CHECK		
	REVIEW		

FIGURE C-10



LEGEND

- Model Extent
- Landfill
- Inferred Water Table
- Predicted Hydraulic Head Contours (masl)
- ➔ Predicted Groundwater Flow Direction
- A—A' Section Name and Location
- Watercourse
- Road

NOTES

1. No vertical exaggeration.
2. Coordinate System is NAD 83 UTM Zone 10.

PROJECT

**WASTECH SERVICES LIMITED
CACHE CREEK LANDFILL
CACHE CREEK, BC**

TITLE

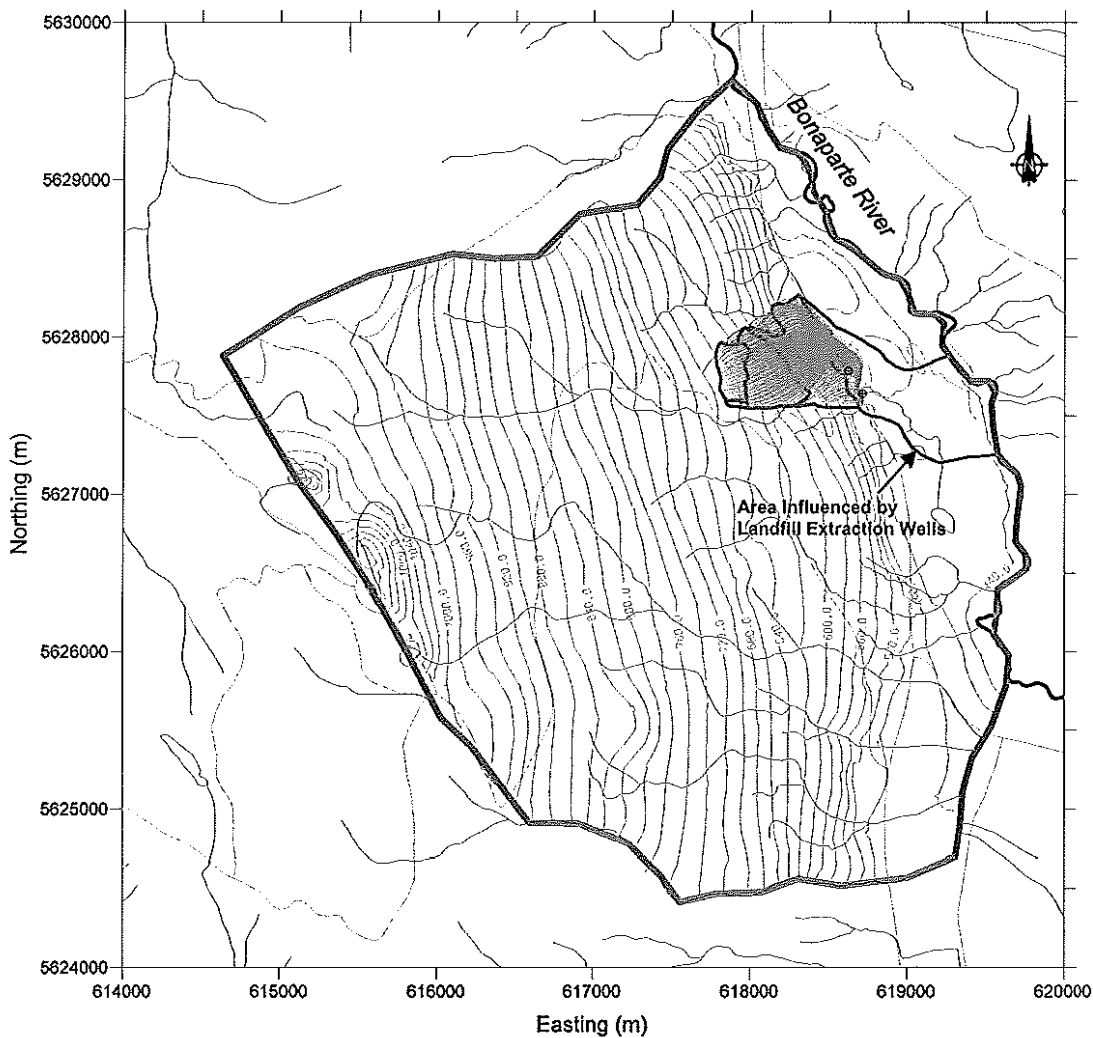
**RESULTS OF MODEL CALIBRATION
CURRENT HYDRAULIC HEADS**



**Golder
Associates**

PROJECT No.	12-1435-0804	PHASE No.	6000
DESIGN	—	20JUN12	SCALE AS SHOWN REV.
CADD	—	20JUN12	
CHECK			
REVIEW			

FIGURE C-11



LEGEND

- Model Extent
- Landfill
- Predicted Hydraulic Head Contours (masl)
- Predicted Particle Tracks
- Watercourse
- Road
- Proposed Extraction Well

NOTES

1. Predicted pumping wells (4 in total), each pumping at 4 USgpm. Combined pumping rate of 90 m³/d (16 USgpm).
2. Pumping wells screened through overburden and weathered bedrock.
3. Hydraulic head contour interval is 20 m.
4. Coordinate System is NAD 83 UTM Zone 10.

PROJECT

**WASTECH SERVICES LIMITED
CACHE CREEK LANDFILL
CACHE CREEK, BC**

TITLE

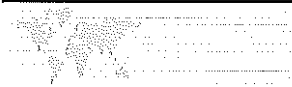
**PREDICTED GROUNDWATER MANAGEMENT
AREA WITH MITIGATION**



**Golder
Associates**

PROJECT No.	12-1435-0804	PHASE No.	6000
DESIGN	—	20JUN12	SCALE AS SHOWN REV.
CADD	—	20JUN12	
CHECK			
REVIEW			

FIGURE C-12



APPENDIX D

Recommendations for Drainage Work Upgrades

FOCUS

July 30, 2012

File No.: 061200073

Golder Associates Ltd.
500 – 4260 Still Creek Drive
Burnaby, BC V5C 6C6

Dear Colin L.Y. Wong, P.Eng.:

RE: Recommendations for Upgrading of Drainage Works Prior to Decommissioning of the Cache Creek Landfill

Focus Corporation has prepared this letter report as a summary of recommendations with respect to the existing surface runoff control works at the landfill. The objective of the recommendations is to provide drainage infrastructure that will require less periodic maintenance following the decommissioning of the landfill.

The existing works were constructed in the late 1980s following an initial report that included a geotechnical analysis of the soil conditions at and adjacent to the landfill. Upgrades and changes have also been performed subsequent to the initial construction as the performance of the initial works was observed and the landfill expanded and was altered.

Existing landfill drainage works consist of pre-existing and constructed drainage courses.

Current Conditions

The Cache Creek landfill is located on mostly sloping terrain, some of it quite steep, immediately west of the Trans-Canada Highway. A combination of pre-existing and constructed drainage courses collect surface runoff from the landfill and lands above the landfill and convey it to a 1200 mm diameter culvert under the Trans-Canada Highway near the northeast corner of the site. Refer to enclosed drawing 001.

A variety of landfill access bench roads as well as other access roads and a forestry access road traverse the site. Where drainage paths cross these roads, culverts have been installed. Based on a review of previous reports and biannual field inspections, these culverts are adequately sized. However, some of them do require maintenance and/or repair.

The bench roads mentioned above are also used to collect runoff and convey it along the contours of the roads to the appropriate receiving channels to the north and south of the landfill. These receiving channels, previously identified as A, B, C, and D Creeks, direct the flows to the culvert under the Trans-Canada Highway at the northeast side of the site as mentioned above.

Recommendations/Criteria

The recommendations below have been compiled based on the review of previous reports and geotechnical direction as well as recent site visits. The criteria will increase the site's ability to resist erosion and reduce maintenance requirements. There is no way to eliminate the requirement for future maintenance altogether and periodic review should still be performed, especially in the initial years following the decommissioning of the landfill, to verify the adequacy of these measures. It has been assumed that the forestry access road and ditches are also to be upgraded and maintained by Westech.

Drainage Channels

Following recent site visits, we have determined that all of the natural, previously existing channels are bedrock lined or have sufficient vegetation to prevent significant erosion. The constructed diversion ditches created to divert flows have been armoured as previously specified, are of low slope, and appear to have very minimal erosion. These natural and diversion channels are adequately constructed and do not require any upgrading. The forestry access road ditches are all sloped greater than 2% therefore will require lining and riprap. We recommend any ditch reconstruction follow the profile guidelines below.

- Channel side slopes shall be a maximum of 1.5H:1V
- Channels are to be constructed with V-shaped cross-sections, with an available depth including freeboard of 1.25 meters.

Culverts / Road Crossings

Existing culverts are generally in good shape with exception of a few damaged inlets or outlets and a few culverts that should be cleared of sediment buildup. Many of the culvert inlet sediment traps have very steep or vertical walls adjacent to the road. We recommend following the guidelines below when upgrading culverts:

- Culvert inlets and outlets are to be free of sediment and debris.
- Culverts that have damaged inlets or outlets are either to be replaced or are to have damaged sections removed and new extensions installed, establishing previous length, or longer, depending on whether or not inlet/outlet slopes require shallowing, see detail 2 on drawing 001.

- Culvert slopes are to be greater than 1%. Where culvert discharges onto fill material, runoff receiving area is to be lined with filter cloth and Class 25 riprap.
- Sedimentation traps at culvert inlets are to be cleaned and side slopes are to be pulled back to either 2H:1V with well-compacted native material or 1.5H:1V with riprap armouring.
- Where 1.5H:1V riprap-lined culvert inlet slopes are not possible due to a short culvert inlet length, extension of the culvert inlet and re-grading of roadside fill should be done to reclaim the recommended slope. Refer to detail 1.
- If 1.5H:1V sedimentation trap side slopes are not achievable, retaining walls may be installed to achieve slope stability. It is estimated that approximately four sedimentation traps adjacent to culvert crossings will require some sort of bank stabilization with retaining walls. The locations identified as being likely candidates for retaining walls due to the steep slopes adjacent to the road include the sedimentation traps adjacent to Culverts A, C, and D. There is also the possibility that they could be required adjacent to culverts B, F, or G, depending on how achievable the desired slopes are.
- If the depth of a sedimentation trap is more than required as shown on the Drainage Inspection summary tables, the trap can be filled to the point where the desired depth is what is noted on the summary table. This could aid in reducing the side slopes of the trap.

Roads

Ministry of Forests Road:

- Where a berm is present on the downhill side of the road, filter cloth and Class 25 riprap lined aprons are to be constructed to the toe of the road fill at any break in the berm where flows are directed off the road. See Photos 1 and 2 for examples of unarmoured and armoured drainage aprons.
- Road surfaces should be graded such that runoff is adequately shed off the road.
- Roadside ditches are to be lined with filter cloth and class 25 riprap and are to have side slopes no steeper than 1.5H:1V.

Landfill Bench Roads:

- Bench roads are to be graded with at least 2% crossfall to the uphill side and have a drainage ditch on the uphill side of the road.
- Drainage ditches are to have filter cloth and Class 25 riprap lining at their lower ends and/or where gradients are in excess of 2%.

FOCUS

- Where drainage paths are constructed to convey drainage down slopes below bench, drainage apron guidelines outlined above are to be followed.



Photo 1: Improper Roadside Drainage Apron

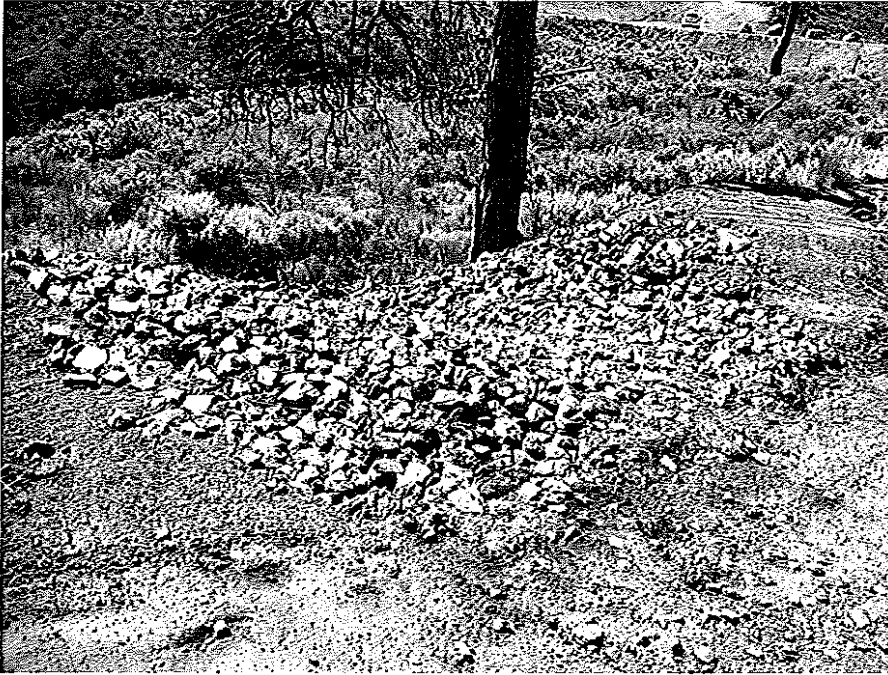


Photo 2: Proper Roadside Drainage Apron

Sediment Traps

All of the culvert inlets located adjacent to sediment traps will require slope improvements and the placement of filter cloth and Class 25 riprap. The other sediment traps will also require filter cloth and riprap with exceptions of the Creek A Trap #3, the D Creek Sediment Trap, the sediment trap adjacent to the 590 Bench Road access, and sediment traps located adjacent to the North Borrow Pit. See drawing 001. The following criteria apply to all sediment traps to be upgraded.

- Sediment traps are to adhere to the same slope requirements as drainage channels listed above.
- Sediment traps shall be constructed such that the depth of ponding is at least 0.3 meters.
- Sediment traps are one item that should initially receive at least annual maintenance. They should be observed and sediment should be removed as the trap becomes filled such that sediment is not carried into drainage channels or culverts. Following observation, a maintenance schedule may be developed.

- There is currently a sediment trap on the west side of the forestry access road to the east of the airport access road that has no defined outlet. We recommend extending the ditch located to the north of this sediment trap on the west side of the forestry access road to the south such that flows from this trap will enter the ditch.

The location of the recommended upgrades can be seen on the attached Figure 1. Any of the highlighted green ditches and sediment traps will require reshaping followed by filter cloth and riprap.

Closing

This report has been prepared by Focus Corporation and outlines recommended steps to be taken to upgrade the drainage works at the Cache Creek Landfill prior to decommissioning.

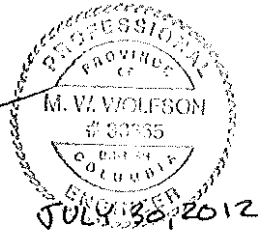
Please contact us if you require additional information.

Sincerely,

FOCUS CORPORATION

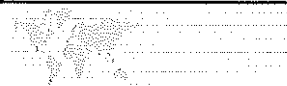


Mike Wolfson, P.Eng.



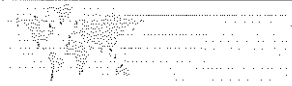
mww

FOCUS



APPENDIX E

Cache Creek Landfill Closure Period Plan – Revegetation



APPENDIX E

Cache Creek Landfill Closure Period Plan – Revegetation

1.0 INTRODUCTION

The Cache Creek Landfill (Landfill) has been operational since the late 1980's. Placement of Landfill barrier soil, and surface application of top soil on the barrier soil have been conducted on an ongoing basis as the Landfill has been constructed. The term "top soil" (two words) is used in this appendix for the 20 cm or so thickness of soil material, in some cases supplemented with organic material, which has been applied to provide root zone material for vegetation establishment and growth.

After top soil was applied, grass/legumes were seeded, generally by broadcast methods and hydroseeding. Areas with poor vegetation establishment have been reseeded in subsequent years, often more than once. Fertilizer was generally applied, and in recent years, irrigation was also installed. As of the end of 2011, revegetation has been very sporadic and unsuccessful over approximately 80% of the four Landfill Benches (510, 530, 550 and 570) that have been seeded. A Bench refers to the area between the indicated bench road and the next higher bench road. For example, the "550 Bench" refers to the area above the 550 bench road (*i.e.*, the area between the 550 and 570 bench roads).

2.0 EXISTING CONDITIONS

The existing vegetation and soil conditions described below are as of the end of 2011. A brief description is provided for Benches 510, 530, 550, 570, 590 and 610.

The 510 Bench

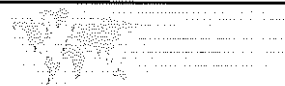
The lower, relatively flat part of the 510 Bench had good vegetation establishment, with more than 80% cover over 80 to 90% of the area. This is considered acceptable vegetation establishment, with dominantly bunchgrass with minor weeds. On the upper part of the Bench, vegetation establishment was unsatisfactory as weeds and bare areas dominated and bunchgrass was sparse. Vegetative cover was 40 to 50% over about 40% of the Bench, and was negligible to about 20% over 60% of the Bench. On the lower part of the Bench, vegetation establishment was also unsatisfactory, with patches of weeds.

The primary grass/legume vegetation is crested wheatgrass (*Agropyron cristatum*), with minor hard fescue (*Festuca pseudovina*) and occasional alfalfa, annual ryegrass, white sweetclover, and shrub rabbit brush (*Chrysothamnus nauseous*). Weeds are dominantly summer cypress (*Kochia scoparia*), and also include Russian thistle (*Salsola kali*), fragile sourweed (*Rumex acetosella*), and curly dock (*Rumex crispus*).

The 530 Bench

The 530 Bench had dominantly unsatisfactory vegetation establishment, with bunchgrass, weeds, and bare areas. There were also areas with dominantly weeds with little or no bunchgrass.

The subsoils on the 530 Bench were generally compact, or very compact. Plant root penetration was severely or totally restricted at depths of 8 to 10 cm.



APPENDIX E

Cache Creek Landfill Closure Period Plan – Revegetation

The primary grass/legume vegetation is crested wheatgrass (*Agropyron cristatum*), with minor hard fescue (*Festuca pseudovina*), and occasional alfalfa, annual ryegrass, stipa (*Stipa viridula*), and shrub rabbit brush (*Chrysothamnus nauseous*). Weeds are dominantly summer cypress (*Kochia scoparia*), and also include Russian thistle (*Salsola kali*), fragile sourweed (*Rumex acetosella*), and curly dock (*Rumex crispus*).

The 550 Bench

The 550 Bench had unsatisfactory vegetation establishment. About half of the Bench was dominantly weeds with little or no bunchgrass, and the other half consisted of bunchgrass, weeds, and bare areas.

The subsoils on the 550 Bench were generally compact, or very compact. Plant root penetration was severely or totally restricted at depths of 8 to 10 cm.

The primary grass/legume vegetation is crested wheatgrass (*Agropyron cristatum*), with minor hard fescue (*Festuca pseudovina*) and stipa (*Stipa viridula*). Weeds are almost entirely summer cypress (*Kochia scoparia*), and also include Russian thistle (*Salsola kali*).

The 570 Bench

The 570 Bench has been hydroseeded. The seed and mulch application appeared very uniform with complete coverage.

The 590 Bench

The 1 m barrier soil has been placed. As of October 26, 2011, applied top soil had been placed over the approximately south half of the 590 Bench. This Bench had not been seeded and irrigation was not installed.

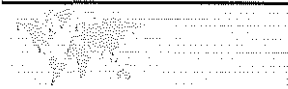
The 610 Bench

The 1 m barrier soil has been placed. No applied top soil has been placed. The 610 Bench has not been seeded and irrigation was not installed. Weeds have established on small parts of the Bench.

3.0 REVEGETATION MEASURES

Closure of the Landfill will require establishment of vegetation on all bench slopes that meets the closure criteria for revegetation as defined in Section 4.0. The bench roadways will remain in their existing condition.

Top soil will be applied, and seeding and/or planting will be done on the upper bench slopes not yet top soiled, and on the final benches yet to be completed as Landfill capacity is reached. Remedial activity will also be undertaken on the benches that have been seeded, but with unsatisfactory revegetation success (*i.e.*, the closure criteria have not been achieved).



APPENDIX E

Cache Creek Landfill Closure Period Plan – Revegetation

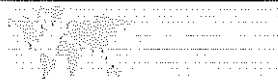
Revegetation progress has been made as the Landfill progressed, particularly on the lower benches, as summarized under Section 2.0. Completion of the growing medium and revegetation should respond to the analysis and core recommendations made in the 2009, 2010, and 2011 Golder reports. In reviewing these reports and the related field installations, the remaining revegetation phases should pay careful attention to the details outlined in the following sections for benches yet to be top soiled, and for remedial activities on seeded benches with unsatisfactory revegetation success.

3.1 Benches not yet Top Soiled

- A minimum 200 mm depth of prepared growing medium (used here interchangeably with top soil) should be supplied above the 1 m thick barrier soil. This depth is the minimum for adequate rooting depth of the revegetation. Since the barrier soil has a compacted surface, and since it is not desirable to scarify it or blend it with growing medium due to its generally higher salt content, the 200 mm depth of growing medium is an absolute minimum for new installations.
- Quality control on the growing medium is important for its success. Growing medium is a combination of top soil, organic matter, and other amendments to create a friable and fertile bed for revegetation. The top soil component would ideally be of a sandy loam to loam texture, with most gravel and cobbles screened out if present. Addition of organic matter, well mixed in throughout the top soil, is critical to success of the revegetation, as this material reduces the tendency for crusting, and increases nutrient and water-holding capability, both of which are important to plant establishment. For clarity, Table 1 summarizes the ranges of acceptable physical and chemical properties for the installed growing medium. Soil tests on proposed growing medium mixes should be completed, and recommendations for related fertilizer additives should be provided by a qualified soil science laboratory (e.g., Pacific Soil Analysis Inc.) prior to growing medium installation.
- Organic matter amendments for growing medium need to be tested by a qualified soil science laboratory prior to purchase, to ensure that they are sufficiently composted not to exceed carbon/nitrogen limits, and that they fall below the maximum salts ranges in Table 1. If manure or straw components are proposed to be used, a check of the source organic stockpile should be made to ensure that it is not weed infested.
- Seed and seedlings on the soil surface will be more subject to rapid desiccation than those that are buried in the growing medium. Seeding methods that provide cover for the seed and seedlings will be more effective. Drilling of seed into the soil is ideal. The next best option is hydroseeding with good mulch cover. Surface broadcast of seed alone is unlikely to be successful in the Cache Creek climate.

3.2 Remedial Activities on Seeded Benches

- Areas on each bench where vegetation establishment is not successful (*i.e.*, not meeting the closure criteria) should be identified. The parts of “unsuccessful” areas that are likely to improve, based on the depth and quality of top soil, and with continued irrigation and weed control, should be assessed and estimated. Top soil should be a minimum of 200 mm deep, should contain 5% organic matter and low



APPENDIX E

Cache Creek Landfill Closure Period Plan – Revegetation

salinity (electrical conductivity of less than 4 mmhos/cm), and should have less than 30% coarse fraction¹. Weed control will include annual cutting in late spring or early summer, before seed heads form. Areas identified as likely to improve should not require additional seeding, but should be fertilized based on a soil test.

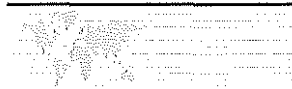
- Areas with inadequate vegetation and where improved vegetative growth is unlikely, based on the depth and quality of top soil, should be identified. Top soil quality is not adequate if depth is less than 200 mm, organic matter is less than 5%, electrical conductivity (salinity) is less than 8 mmhos/cm, or the coarse fraction is more than 30%. These areas should receive additional top soil, as defined by the criteria in Table 1. Top soil should be added so that the total depth (existing top soil and added top soil) minus the coarse fragment content is the equivalent minimum of 200 mm². Seeding should be carried out after top soil placement.

Table 1: Properties of Growing Medium for Cache Creek Landfill Benches

Growing medium type:	Reclamation growing medium suitable for root zone material or top soil
Application:	On all benches as a growing medium (or top soil)
Texture: Percent of Dry Weight of Total Growing Medium	
Coarse gravel (larger than 19 mm and smaller than 40 mm)	0 to 5%
All gravel (larger than 2 mm and smaller than 40 mm)	0 to 30%
Texture: Percent of Dry Weight of Growing Medium Excluding Gravel	
Sand (larger than 0.05 mm and smaller than 2 mm)	20 to 70%
Silt (larger than 0.002 mm and smaller than 0.05 mm)	15 to 60%
Clay (smaller than 0.002 mm)	5 to 30%
Clay and silt combined (smaller than 0.05 mm)	Maximum 70%
Additional Soil Properties	
Organic content	5 to 30%
Acidity (pH)	6.0 to 7.8
Salinity (electrical conductivity – ds/m)	0 to 8
Sodium adsorption ratio (SAR)	0 to 8
Maximum compaction	85% of standard Proctor maximum dry density
Minimum saturated hydraulic conductivity	15 mm/hour

¹ Coarse fraction is defined as stones, cobbles, gravel, and coarse sand larger than 2 mm.

² The effective rooting medium is the top soil minus the coarse fraction, which does not contribute to effective water-holding capacity or fertility. For example, if the depth is 300 mm, the coarse fragment content should be not more than 33%.



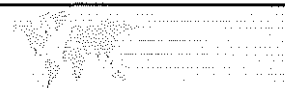
APPENDIX E

Cache Creek Landfill Closure Period Plan – Revegetation

3.3 Seeding and Planting

- Seed and seedlings on the soil surface will be more subject to rapid desiccation than those that are buried in the growing medium. Seeding methods that provide cover for the seed and seedlings will be more effective. Drilling of seed into the soil is ideal. The next best option is hydroseeding with good mulch cover. Surface broadcast of seed is unlikely to be successful in the Cache Creek climate.
- Seeding must be done in the early spring or late fall. Hydroseeding can be done at the time of spring snow melt. Snow melt will be variable across the Landfill, and hydroseeding can be done on any remaining snow banks. This places seed and moisture onto the ground as the snow melts, when moisture is present and a little before strong heat gain. This also mimics the natural “seeding” process from native bunchgrass plants. With this early spring seeding, irrigation watering should also begin as soon as freezing nights pass (late April/early May), and should extend through the growing season, into October before hard freeze³.
- Hydroseeding on snow could include use of wood fibre mulch and fertilizer with the seed. Bonded fibre matrix would not be used with this technique. The limitation of this technique is the lack of cover for the seed. However, this is balanced by the cooler and moister conditions to support germination and root growth.
- For patching of pre-seeded areas with inadequate vegetation, the use of “blown-in” seed/compost mixes is recommended for trial. “Terra-seeding” is a trade name for this process; it uses blower trucks, controlled compost/soil mixes, and injected seed and fertilizer to place a mix of 25 to 50 mm deep. Seed is embedded throughout this depth, and thus has good cover, organic matter, and fertility to encourage germination and initial root growth. To encourage root growth from this surface compost into the underlying soil, there should be scarification of the existing ground surface to a depth of about 150 mm, to remove surface crust and leave an open seedbed. The surface of this scarified area is best left rough. This terra-seeding technique, combined with irrigation described above, is a promising new technology worthy of field trials. Terra-seeding could also be considered for blowing onto the snow in spring, which would have the advantage of soil cover of the seed.
- For either hydroseeding or terra-seeding on snow, there would be a need for full preparation of the seedbed in very late fall, prior to freeze-up. Installation of growing medium with organic amendments would be required, plus scarification of the growing medium surface to eliminate surface crust. Some surface crusting during the winter may occur, depending on snow cover.
- For germination and root establishment with minimal plant losses to desiccation, it is necessary to provide for a relatively constant supply of moisture to the planting zone. The plants’ resistance to drought will increase as they are able to grow sufficient rooting mass and depth in subsequent growing seasons. The sensitivity of young seedlings to mortality by drought is one of the key limitations of the Landfill. It is also the driving reason behind the need for effective growing medium and organic matter quality, and the provision of optimum amounts of irrigation water throughout the growing season, including spring, fall and summer.

³ Recent hydroseeding in the fall of 2011 produced no visible revegetation, which is a unique situation. Physical and chemical soil variables do not appear to be at fault. It was a relatively warm winter, and it is suspected that different weather patterns played a role – allowing the seed to germinate at some point through the winter, and then freezing or drying such that the young seedlings were killed prior to spring. To reduce the risk of such “winter kill” happening again, it is recommended that future seeding be moved to very early spring.



APPENDIX E

Cache Creek Landfill Closure Period Plan – Revegetation

- In addition to seeding, an establishment of forbs is desirable to mimic the pre-development conditions. Where forbs, or native grasses, will not establish from seed, the use of rooted plugs (or small pots) will increase the chance of survival. It is recommended that establishment of vegetation cover from seed following the above guidelines be carefully monitored in the fall of 2013. Decisions should be made at that time about follow-up seed installations, and if the use of rooted plugs is required. If rooted plugs are to be installed, they need to be pre-ordered from nurseries in the fall of 2013, for installation in late fall 2014. Since plugs are rooted, fall planting should be more successful than for seed alone.
- Revegetation species mix for seeding should be as recommended before, plus minor additions of legumes and forb seed, as well as plugs of Rabbit brush.

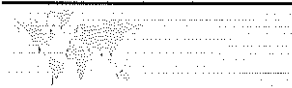
4.0 CRITERIA FOR DEFINING COMPLETION

The criterion for defining completion of revegetation of the Landfill surface is to achieve, on average, a vegetation target equivalent to the vegetation on the Landfill footprint prior to its development. The recommended vegetation target is summarized in Table 2. The total percent cover, for all species combined, should be 60%. The percent vegetative cover and species composition will be determined over a period of several years, as required, at permanently marked plot locations at representative sites on the various benches. These determinations will be conducted according to specific, accepted observation methods by a competent Professional Biologist or Agrologist, Registered in British Columbia.

Table 2: Recommendation Vegetation Targets for Landfill Closure

Plant Species Group ^a	Preferred Native Species	Acceptable Non-native Species
Shrub	Common rabbit brush	–
Grass	Bluebunch wheatgrass (<i>Agropyron spicatum</i>) Rough fescue (<i>Festuca campestris</i>) Sandberg's bluegrass (<i>Poa secunda</i>)	Crested wheatgrass (<i>Agropyron cristatum</i>) Hard fescue (<i>F. pseudovina</i>) Tall wheatgrass (<i>Thinopyrum intermedium</i>) Idaho fescue (<i>Festuca idahoensis</i>)
Forb	Prairie sagewort Brittle prickly-pear cactus Umber pussytoes Yarrow Long-leaved daisy	Alfalfa (<i>Medicago sativa</i> [Drylander cultivar])

Note: ^a Weeds are not included in percent cover. The percent cover is the average found in nearby areas outside the Landfill footprint. These percentages may be revised to show a range of acceptable percentage ground cover. Some ground cover is double counted (e.g., there may be grass under shrubs). The target for total cover, regardless of what plant species groups are present, should be 60%



APPENDIX F

Irrigation Constraints and Requirements



APPENDIX F

Irrigation Constraints and Requirements

1.0 INTRODUCTION

Golder, in consultation with Wastech, reviewed the water supply constraints at the Cache Creek Landfill (Landfill or Site). This review indicates that water supply is a significant consideration in the phasing of Landfill closure, as it is challenging to supply sufficient water from the existing municipal water service to provide adequate water to the entire closed Site during the most demanding watering time (typically July).

Irrigation equipment flow and related design is commonly rated in US gallons per minute (gpm) and inches. Hence, these units are used in this appendix. Pipe diameters in this appendix are nominal.

2.0 EXISTING IRRIGATION CONDITIONS

Based on the information provided by Wastech, irrigation water supply is from a Village of Cache Creek water main (4 inch diameter) along the Trans-Canada Highway. Static pressure at the point of connection varies from 40 to 60 psi, averaging 50 psi. The Village supply could offer a flow rate of 184 US gpm. With a pump upgrade, the Village supply could possibly offer a flow rate of 240 US gpm.

The Village supply is from a reservoir that services the industrial area of Cache Creek. Other users are estimated to demand 60,000 US gallons per day. Fire protection requires not less than 15,000 US gallons to remain in the reservoir. It may be possible for more than 240 US gpm to be supplied by the Village. However, a comprehensive well response test would have to be completed to assess this possibility. The specific volume of water available will need to be confirmed prior to finalizing irrigation planning for the Landfill closure.

From the Village main, an irrigation mainline is managed by Wastech. A pump station near the main entrance road to the Landfill (central to the Site) uses a Grundfos CR(E) 15 variable speed pump. From the pump station, a 4 inch diameter high-density polyethylene pipe runs up the central area of the Landfill. Up to the 550 bench road, the pipe is SDR6. Above this, the pipe is SDR9. Pressure loss due to elevation gain from approximately elevation 510 m to the maximum future elevation of 672 m is significant (162 m elevation gain, or 531 feet $\times$ 0.4335 = 230 psi of pressure loss due to elevation). Additional pressure losses will vary with design flow in and SDR grade of the pipe. An irrigation detailed design is required to properly estimate pressure losses related to flow for future irrigation extension to higher elevations of the Landfill.

At about elevation 660 m, two existing tanks receive water supply from the irrigation main. These tanks have a combined capacity of 20,000 US gallons. From these two tanks, a second 4 inch diameter irrigation supply line runs downhill to provide water to irrigation laterals and heads on the lower Landfill benches. A pressure-regulating valve at about bench elevation 570 m reduces the gravity-related pressure gain (about 128 psi at that point) to be suitable to run irrigation sprinkler heads. Solenoid master valves are located at the 610, 570 and 550 bench roads.

Irrigation heads currently in use between the 550 and 610 bench roads are RainBird Eagle 900 (full circle) and 950 (part circle). The RainBird Eagle series are a high quality golf course head, with the ability to handle large variations in incoming pressure (up to 150 psi), and with valve-in-head features. These heads are set to operate at 60 psi. With an orange nozzle, this would provide an irrigated radius of about 75 feet per head.



APPENDIX F

Irrigation Constraints and Requirements

The calculated precipitation rate would be about 0.55 inches per hour if these heads are properly installed with head-to-head spacing.

Although the irrigation heads are of high quality with many desirable features, the precipitation rate of 0.55 inches per hour is high for a steeply sloping site. To avoid surface erosion, the heads are operated in short bursts, with about six minutes (about two full rotations) in each burst. Three six-minute cycles are programmed for each day in July, leading to an operating time per zone per day of 18 minutes (0.3 of an hour). At the 0.55-inches-per-hour precipitation rate, this provides approximately 0.165 inches of precipitation per day.

Irrigation scheduling uses a RainBird ESP-LX Series Controller, with a two-wire Decoder Control. This sophisticated controller can handle up to 200 stations. At the time of writing, approximately 136 stations are in use. Each station opens the valves of one or two heads, and two zones are opened to supply water concurrently. Based on the drawing rate of a full circle Eagle 900 head (31.9 US gpm at 60 psi), each three-head irrigation application would create a flow demand of about 96 US gpm.

One run of the entire irrigation system (single cycle) distributes 36,000 US gallons onto the Landfill between the 550 and 610 bench roads. A cross-check calculation using this total would indicate 529 gallons per three heads (two stations) per six-minute cycle, or a flow rate of about 88 US gpm. This flow rate is slightly less than the projected flow demand of 96 gpm, likely due to the slightly lower flows from the part circle heads. The 36,000-US-gallon quantity exceeds the combined storage capacity of the holding tanks (20,000 US gallons). Thus, there is an ongoing makeup from the Village water supply to the tanks when irrigation is taking place, continuing with each repeated irrigation cycle.

The existing irrigation system has been operating successfully under these parameters.

3.0 PROJECTED WATERING NEEDS

The objective of Landfill revegetation is to return the Site to a naturally functioning vegetated state that will evolve towards a similar vegetation ecosystem that existed before Landfill development.

The target condition is a combination of drought tolerant grasses, herbs and forbs that will survive without ongoing watering and with minimal maintenance. Even with this dryland target, a fundamental question regarding successful revegetation of the Landfill is "how much water is needed for plant establishment?"

The amount of establishment watering need is variable, depending on climate (temperature, rainfall, wind, and solar radiation), soil texture, organic matter and its depth, plant leaf and rooting characteristics, and stage of plant establishment. These factors combine to create an evapotranspiration (ET) rate (*i.e.*, the total amount of water evaporated from soil and plant surfaces, plus the amount of water transpired by plants). The local ET rate varies throughout the day and seasons, but is commonly summarized daily or weekly.

Irrigation systems are typically designed to sufficiently replace water lost to ET to meet plant management objectives. In a golf course, for example, the objective is green turf. However, in Landfill revegetation, the objective is plant survival and establishment. Even though the amount of water required for Landfill revegetation is a fraction of that required for growing green turf, there is still a need for the Site to design watering with respect to ET loss.



APPENDIX F

Irrigation Constraints and Requirements

A useful tool for assessing watering needs is the Irrigation Industry Association of BC's (IIABC's) sprinkler irrigation scheduling calculator (www.irrigationbc.com). There are two calculators – one for agriculture, and the other one for landscape. The agriculture version is designed for field irrigation, and is commonly used for irrigation systems that pivot or walk across a field. The landscape version is designed for scheduling of rotors or other stationary systems, like those used at the Landfill, and therefore, it is the appropriate calculator for the Landfill. The landscape version of IIABC's calculator is referred to as the Calculator in this appendix.

For a complete guide to using the Calculator, refer to the *Landscape Sprinkler Irrigation Scheduling Calculator Users Guide*, IIABC, February 2009, available through the website calculator interface. As an introduction, irrigation scheduling calculations use the following variables:

- Local weather records and forecasts;
- Landscape type;
- Soil cross-section; and
- Irrigation system design.

The results provide a summary of the following:

- The amount of water the irrigation system needs to apply to make up the moisture deficit that has occurred (in inches per week);
- The amount of water that can be stored in soil, which is readily available to plants (reflected in how many watering days per week); and
- The amount of effective rainfall that is usable by plants (rainfall will reduce the required irrigation water or run time).

The following are the specific entries to the Calculator used to develop initial estimates of watering requirements at the Landfill:

- Weather station: Ashcroft;
- Vegetation type: ground cover;
- Vegetation water use: average (0.5) – this is lower than low-water-use turfgrass, but is higher than established drought-resistant ground cover, given that this is an establishment phase;
- Vegetation density factor: low;
- Area microclimate factor: average (could be high due to wind exposure);
- Effective rooting depth – varies as plants grow roots (see Table F-1);



APPENDIX F

Irrigation Constraints and Requirements

- Plant management factor: 1 (default) for initial establishment period, reducing to 0.7 and 0.5 in later drought-transition phases of plant establishment;
- Water availability coefficient: 50% (default);
- Soil texture: sandy loam (should be recalculated for other soil textures and depths applied to various benches);
- Soil infiltration rate: default (could be decreased due to slope);
- Soil layer depth – The design condition is one 20 cm deep layer of sandy loam (should be recalculated for other textures and depths actually applied to various benches). However, for the purposes of calculating water application during establishment, the effective depth varies as plant roots grow in (see Table F-1);
- Management allowable depletion – This is the maximum amount of plant-available water that should be removed by plants before irrigation starts again. The default 100% is suggested for the stage where roots are established in the full depth of growing medium. A 50% depletion rate is compared for seed germination. Partial root development would involve a value of 75% depletion (see Table F-1);
- A staged watering program is recommended, with greater intervals between watering times provided, as roots establish and penetrate more deeply into the growing medium. The objective is to establish deep roots as quickly as possible to increase plant resiliency against natural drought (refer to Table F-1); and
- Irrigation system design – Two irrigation heads were assessed: RainBird Eagle 900 as currently used at the Site, and an alternate low-flow agricultural system RainBird LF 2400 (see RainBird Agriculture Irrigation catalogue available online). Irrigation efficiency for rotors was assumed as the default (70%). The key characteristics for full circle rotors are summarized in Table F-2.

Table F-1: Staged Watering for Root Establishment

Stage	Effective Rooting Depth (inches)	Soil Layer Depth (inches)	Management Allowable Depletion (%)
Stage 1: Germination and initial root growth	1	1	50
Stage 2: Root growth to 100 mm depth	4	4	75
Stage 3: Root growth to 200 mm depth	8	8	100

Table F-2: Alternative Irrigation Systems

Rotor Type	Design Operating Pressure (psi)	Radius (feet)	Flow (US gpm)	Precipitation (Application) Rate (inches/hour)
RainBird Eagle 900, 31.9 US gpm, orange nozzle at 60 psi	60	75	31.9	0.55
RainBird LF 2400, 2.7 US gpm, 1/8-inch nozzle at 35 psi	35	40	2.7	0.16

APPENDIX F

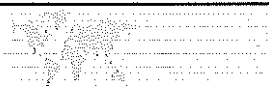
Irrigation Constraints and Requirements

Irrigation scheduling needs to be designed to respond to local climate conditions that vary by the week and through the growing season. In the case of new plant establishment, it is also necessary to alter the irrigation schedule from the germination stage, through the root establishment stage and the gradual weaning off the irrigation system, into a naturally sustaining dryland ecosystem.

To illustrate this sequence in a typical growing season starting in April, we suggest a series of irrigation scheduling stages:

- Stage 1 – The objective of this stage is for seed germination and initial root establishment to about 1 inch depth. This stage would typically occur from mid April to mid May. Irrigation in this period would be every day, with several short cycles a day, to keep the seed and surface rooting zone moist and humid. Deep irrigation is not necessary as there are no deep roots;
- Stage 2 – The objective of this stage is for root establishment to about 4 inch depth. This stage would typically occur from mid May to mid June, but could take longer. Irrigation frequency would drop to about two days a week, with fewer and slightly longer daily cycles, given surface vegetation growth to reduce erosion potential. The objective is to soak the soils to a 4 inch depth twice a week, and to allow gradual drying between watering days. This encourages roots to grow deeper into the soil. Alternatively, if the Stage 1 irrigation scheduling were continued, it only waters the soil surface and encourages shallow rooting, which is not amenable to drought resistance or plant health;
- Stage 3 – The objective of this stage is for root establishment to about 8 inch depth. This stage could typically occur from mid June to mid July, but may take longer. Climate-related irrigation needs will be highest in July. Irrigation frequency would be about one day a week. Several cycles in a day may be necessary to avoid erosion. The need is to soak the entire 8 inch depth of growing medium, but not more, because the desire is not to push water down into the Landfill cover. Plants uptake the moisture between weekly watering days, and there is a relative drying out of the soils, which again drives roots deep; and
- Stages 4A and 4B – The objective of this stage is for expanding root mass, ensuring seed set and maturation, and allowing plants to adjust to no irrigation and to go dormant for winter. This stage would typically occur from mid August, through the end of September or winterization. Irrigation would be once per day, but with reduced run times and cycles. The effect is to increase the relatively dry times in the soil profile, which will encourage roots to grow horizontally to seek more soil water volume. Surface plants will tend to set seed and then go dormant, with growth stopping and hardening off for winter. This would increase winter survival and, again, mimic the natural conditions.

The above staged irrigation schedule should create a reasonably established vegetation cover in one growing season, provided that proper growing medium texture, organics, and physical/chemical properties are provided, and good weed suppression are taking place by maintenance if required. The objective is for the initial crop to set seed, and to allow natural broadcast of this seed, which will start the natural cycle of ecosystem restoration in the following season. The amount of second-season seed that germinates and survives will depend on climatic factors at that time, and is unpredictable. It is likely that dryland bunchgrass ecosystems may go for years without much spring germination, until an exceptional wet growing season provides favourable conditions, at which time the ecosystems would establish new plants and density. Provided that the base crop is established, the plants should survive to take advantage of natural wetter years as they occur.



APPENDIX F

Irrigation Constraints and Requirements

The following seven scenarios are run in this assessment:

- RainBird Eagle 900 – Stage 1, Stage 2, and Stage 3; and
- RainBird LF 2400 – Stage 1, Stage 2, Stage 3, Stage 4A, and Stage 4B.

Table F-3 summarizes and adapts the outputs from the Calculator. This table provides a conceptual set of weekly irrigation minutes, irrigation days, cycles and minutes. It also estimates how much land area could be watered in a day or a week.

Two scenarios are considered in this assessment, one that runs only one zone at a time, and the other one that runs two zones at a time. The effect of running two zones at one time is to approximately double the flows required. Current flows being drawn from the Village water main are estimated in the range of 97 US gpm to supply one irrigation zone at a time. Running two zones at a time is estimated to draw a flow of 194 US gpm.

The question of running one zone or two zones concurrently is related to how much land area needs to be watered within the time available. Table F-3 shows the relationship between the potential total irrigation land area and the potential water supply.

Table F-3: Matching Water Need to Water Supply

Factor	Quantity	Unit
Irrigation system current coverage area	15.2	ha
Irrigation system upcoming coverage area	25.1	ha
Potential total irrigation system coverage area need	40.3	ha
Potential coverage concept, RainBird Eagle 900 system area (July)	19.57	ha
Potential coverage concept, RainBird LF 2400 system area (July)	17.23	ha
Potential total irrigation system coverage supply area	36.8	ha
Potential coverage concept, RainBird Eagle 900 system flow	96	US gpm
Potential coverage concept, RainBird LF 2400 system flow	97.2	US gpm
Potential total irrigation system coverage flow need	193.2	US gpm
Village water supply available without pump upgrade	184	US gpm
Village water supply available with pump upgrade	240	US gpm
Village water supply for other purposes (with pump upgrade)	46.8	US gpm

Note: All calculations are based on flows running 24 hours per day, 7 days per week. Recovery and maintenance times may be necessary, and will reduce this supply.



APPENDIX F

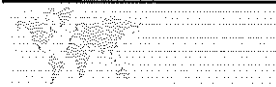
Irrigation Constraints and Requirements

4.0 RECOMMENDATIONS

To allow for successful revegetation of the Landfill to a self-sustaining restored ecosystem, a careful program of growing medium installation, spring seeding, and staged irrigation scheduling is required. To provide adequate irrigation time for the remaining revegetation areas, and for revegetation of unsatisfactory areas, it is advisable to invest in additional water supply from the Village water main to the upper areas of the Landfill, or alternatively to explore groundwater supply potential nearby.

The following lists the key recommendations:

- A review of options with the Village should be completed to upgrade the pump system to provide adequate ongoing flows to the Landfill in the growing season (up to 194 US gpm);
- The existing RainBird Eagle 900 system should be used as-is, with scheduling adjusted to the stages described above. Extension of this system to additional areas, up to about 20 ha in total, including existing coverage, could be considered as part of an overall irrigation plan, if pressures allow;
- For the higher elevations of the Landfill, consideration should be given to an irrigation system with lower flow and lower precipitation rate. The RainBird LF 2400 system is one such system, but there are others to consider as well. The LF 2400, if used, does not have built-in pressure compensation. Hence, it would need to be run approximately along contour to minimize low head drainage, and would ideally be equipped with valves central to the pipe run to reduce required pipe size and pressure loss. Up to approximately 17 ha of the upper Site could use this lower flow design;
- The existing pipes running up the hill appear adequate to run the Eagle 900 system at lower elevations. However, there is not sufficient watering time in high demand situations (July) to use these pipes to water all the land required, unless there is an extended and gradual phasing of the revegetation area each year. To promote revegetation of all Landfill areas, it is necessary to run two irrigation zones concurrently. Therefore, it is necessary to run a second irrigation supply main up the Landfill. This supply main should be sized for an approximately 100-US-gpm flow, and will require a second booster pump to provide the irrigation operation pressure of at least 35 psi to the highest and furthest point of the Landfill to be irrigated;
- To ensure all water pressure, water volume and flows, and irrigation scheduling considerations are co-ordinated, it is strongly recommended that a comprehensive irrigation plan be drawn. This plan would show all heads, pipes, valves, pressure reducers, water meters, backflow preventors, and other major fittings, their sizes, flows, and pressure losses. A companion detailed watering schedule for each zone type in each irrigation stage should also be created. Together, these will provide certainty for tendering, installation and operations;
- Changing watering schedules between Stages 1 through 4B should be based on excavated test holes and observed root development. When the rooting criteria are met, irrigation adjustments would be made to the next stage;
- If root establishment is not occurring, or if exceptional weather conditions occur, the irrigation scheduling calculator should be run for the coming week, and scheduling adjustments should be made to suit weather conditions and plant performance. As a labour saver, it is recommended that the applicability of a weather module that would adjust the clocks based on real-time weather data be reviewed. However, some manual programming related to the establishment irrigation stages would likely be required; and



APPENDIX F

Irrigation Constraints and Requirements

- Establishment watering of the seeded sites should extend throughout the growing season. The very droughty nature of the Site and soils, and the very fast spring warm-up and high summer temperatures, make seed and seedlings subject to die-off due to dessication. Irrigation needs to be started as soon as frost has passed (late April/Early May), and to be run until early frost (October), when the system would be winterized. Irrigation design, construction and operations need to follow IABC's specifications. Although surface routing of pipes is acceptable, the following recommended improvements to increase irrigation effectiveness should be considered:
 - a) Ensuring head-to-head coverage (the design water-throw radius of each rotor touches that of the adjacent head);
 - b) Running lateral lines along contour to minimize pressure differential in each lateral;
 - c) Locating zone valves, where applicable, at the centre of the zone to minimize pressure losses in lateral pipes;
 - d) Using pressure-regulating modules at valves, or in lateral lines as required, to minimize differential pressure at heads;
 - e) Choosing heads with matched precipitation rates – Precipitation rates should be relatively low (less than 0.25 inches per hour) to avoid surface erosion, and to allow longer irrigation laterals and more heads per valve on a given pipe size; and
 - f) Providing a relatively constant supply of moisture to the planting zone for germination and root establishment, with minimal plant losses to dessication. The plants' resistance to drought will increase as they are able to grow sufficient rooting mass and depth in subsequent growing seasons. The sensitivity of young seedlings to mortality by drought is one of the key limitations of the Site. It is also the driving reason behind the need for effective growing medium and organic matter quality, and the provision of optimum amounts of irrigation water throughout the growing season, including spring, fall and summer.

The above recommendations are intended to provide guidance as an experimental program. Field review and judgment on irrigation scheduling in relation to plant root performance and changing weather conditions is still necessary. These recommendations should be reviewed based on performance through a growing season. Adaptations to the timing of changes in irrigation scheduling stages may be necessary, partially dependent on qualities of the installed growing medium and timing of seeding.

Where existing areas require revegetation, the cultivation and addition of proper organic matter and growing medium, well mixed in, will be necessary prior to reseeded. Establishment irrigation run times must be adjusted to reflect the growing medium materials actually installed in various areas of the Site.

Detailed planning and scheduling of revegetation of existing unsatisfactory areas may provide efficiencies in how much irrigation area is required at one time. A phasing diagram, tied to the required irrigation water supply, is advisable to consider efficiencies in water and energy use, as well as cost savings that can be gained.

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
500 - 4260 Still Creek Drive
Burnaby, British Columbia, V5C 6C6
Canada
T: +1 (604) 296 4200



Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Tuesday, May 14, 2013 4:41 PM
To: Danyluk, Carol ENV:EX
Subject: FW: Closure Period Plan Response
Attachments: Closure Period Plan response letter.doc; Closure Period Plan Table CAD.doc; Closure Period Plan Table LAG.doc

Importance: High

See a couple of edits...

- I think we want to say the table is a draft...there are a few things we didn't agree on in the meeting (e.g. condensate)
- I had sent you a follow up message I think about they buy assets and pay depreciation....did you want to include that point or leave it?
- Determining a standard using TG6 isn't really a policy...yet. Although nothing prevents us from using it.
- I think we want to know the cost of treatment or at least put in on the table

Really good job on this!

Larry Gardner
Environmental Management Section Head
Kamloops, BC
250-371-6226
Larry.Gardner@gov.bc.ca

BC Pollution Free

From: Danyluk, Carol ENV:EX
Sent: Monday, May 13, 2013 5:26 PM
To: Gardner, Larry ENV:EX
Subject: Closure Period Plan Response
Importance: High

Hi Larry, I sure hope you have time to look at this tomorrow. I have reworked your table but I think it hits on everything you had in the original, I included your version so that you could make the comparison.

I would like to give this to Jason ASAP as we are at Mid May which is when I had committed to responding.

Cheers!

Carol Danyluk, P.Eng.,

Senior Environmental Protection Officer
Thompson Cariboo Region
Ministry of Environment
1259 Dalhousie Drive, Kamloops BC V2C 5Z5.
Telephone: (250) 371-6229
carol.danyluk@gov.bc.ca

File: MR-7577

May 10, 2013

Wastech Services Ltd.
1200 United Boulevard
Coquitlam, BC V3K 6T4

Attention: Janet Tecklenborg
General Manager

Dear Janet Tecklenborg;

Thank you for meeting with Regional Environmental Protection representatives here on April 5, 2013, to discuss the Closure Period Plan submitted for the Cache Creek Landfill, and for your follow up correspondence of April 18, 2013, outlining the discussions we had on April 5, 2013. We have reviewed the Closure Period Plan and the requirements of the Operational Certificate 7577, and have the identified some outstanding issues to be addressed or discussed further.

For clarity, I believe it is worthwhile to review the separate but related requirements of the Operational Certificate MR-7577 pertaining to planning for closure and post-closure activities at the landfill.

Design, Operating and Closure Plan

Section 4.1.2 of the Operational Certificate requires that design, operating and closure plans shall be reviewed every 5 years throughout the operating life of the landfill and updated to encompass the next 10 years of landfill operation and/or post-closure activities. The design, operating and closure plans include any information relevant to the design, operation, closure, and post-closure care of the landfill. The latest approved version of this plan, the Cache Creek Landfill Operations and Closure Plan 2009, October 16, 2009, would therefore require updating in 2014.

Post-Closure Plan

Section 4.1.4 of the Operational Certificate requires that a post-closure plan be prepared by a Qualified Professional and be submitted at least 12 months prior to the estimated site closure date. This plan is to provide:

- a complete review and assessment report of the overall integrity of the landfill
- a detailed timetable for closure and/or post-closure procedures and correction of any deficiency identified in the review and assessment report, and
- a detailed schedule of inspection, monitoring and maintenance to be carried out for a minimum post-closure period of 25 years
- a process for the administration of the post-closure security fund required under section 8 of the

Operational Certificate

Given that it is anticipated that the site will reach capacity and disposal of refuse will end sometime in 2016, the post-closure plan should be submitted in 2015 a minimum of 12 months prior to the completion of landfill. It was questioned during our meeting on April 5, 2013, whether it would be necessary to update the operations and closure plan in 2014 given the post-closure plan will be submitted the following year. In review of the requirements of the post-closure plan, it is clear that this plan will compliment but not necessarily replace the function of the design, operating and closure plan. The requirements of both sections 4.1.2 and 4.1.4. of the Operational Certificate must each be met.

Post-Closure Security Fund

Section 8 of the Operational Certificate provides specifications for the post-closure trust fund which is to be administered by the Director, who will have authority to access and direct the use of monies from the trust fund specifically for the purpose of post-closure monitoring, maintenance and repair of the landfill site.

Closure Period Plan

Section 9 of the Operational Certificate requires the closure period plan. The “closure period” is defined as “the indeterminate timeline commencing before cessation of landfilling activities and lasting until completion of discrete closure activities such as placement of final cap, establishing sustainable vegetation, etc.” The closure period plan is to provide:

- A list and description of discrete closure activities to be undertaken during the Closure Period;
- A projected timeline for each discrete closure activity from initiation to completion; and,
- Where appropriate, criteria for determining when the closure activity is complete.

The closure period plan will align with and support the closure and post-closure plans mandated in sections 4.1.2 and 4.1.4 of the Operational Certificate. The post-closure fund described in section 8 will be applied to monitoring, maintenance and repair of the closed landfill site after the Director is satisfied closure has been met for the relevant discrete closure activities as described in the closure period plan. The landfill post-closure plan that will be submitted a year prior to closure may also identify refined criteria for closure and post-closure activities based on the qualified professional assessment provided at that time.

For example, the post-closure fund will finance the cost of most monitoring activities associated with the landfill site immediately following the completion of the landfill. However, monitoring activities associated with the off-site migration of landfill gas will not be funded by the post-closure fund until it has been demonstrated that the current off-site migration of landfill gas is controlled in accordance with the specifications in the approved closure period plan. Monitoring activities that are dictated by the Environmental Assessment Certificate for the Cache Creek Landfill Expansion, such as the baseline monitoring program required for the Bonaparte River, will not be funded by this post-closure trust fund.

Attached you will find a draft table outlining the six different categories of closure period activities, these categories were also cited in your letter of April 18, 2013.

- Final Cover
- Re-vegetation
- Landfill Gas Management
- Leachate Management
- Groundwater Management
- Storm water Management

Comment [I1]: Do you want to give them opportunity for input or make it a requirement....I lean towards asking for their thoughts

The table provides a brief summary of the criteria for completion, additional comments and an indication of the discrete closure activities and criteria for completion that are approved and the elements that will require further discussion and specification prior to approval. [I invite your comments on the table.](#) The following provides some elaboration and direction on the elements of the closure period plan which are not yet approved.

Re-vegetation

The criteria for defining completion are agreeable in principle but very conceptual in nature and further detail is necessary. The proposed test plots at representative locations may provide a useful tool for gauging success of the re-vegetation program. However, how will it be confirmed that the test plots are actually representative of similar outcomes in the areas of the landfill that are intended to be represented by the individual test plots? Once a defined standard measure of successful re-vegetation is met, what will be the timeframe that demonstrates self-sustainability? How will the program be adapted as different areas of the landfill become self sustainable at different rates and times?

An overall assessment could be developed where the closed landfill is divided into a grid that can be rationalized based on physical and temporal attributes (location on landfill and completion of final cover, seeding, or history of re-vegetation attempts. Within the grid areas the rate of vegetation cover and diversity can be rated on a scale with a pre- defined standard or range of pass or fail. Completed sections of the landfill with individual grid areas that have all achieved the standard may be approved as complete at different times.

Landfill Gas Management

The criteria for the completion of the landfill gas extraction facilities are agreeable. However, once the criteria for completion are satisfied post-closure, there remains potential that additional extraction wells or other controls may become necessary in the future to address any further landfill gas migration that may occur. Under these circumstances the landfill gas utilization efficiency may be impacted. The closure period plan suggests a need for a strategy to balance the regulatory need to prevent landfill gas emissions and/or offsite migration with the Operational Certificate standard of greater than 75% utilization efficiency. This issue must be addressed in post-closure plan to be submitted in accordance with Section 4.1.4

Landfill gas collection and utilization will remain the responsibility of Wastech post-closure, and will not be funded by the post-closure security fund. Condensate collection from the landfill gas extraction facilities and conveyance to the evaporation ponds will also remain the responsibility of Wastech.

Groundwater Management

~~The requirements of both the Operational Certificate and the requirements of the Contaminated Sites Regulation will apply to the closure of the landfill and the determination of required remediation.~~

The Closure Period Plan proposes the installation of groundwater recovery wells. In further considering this proposal it is appropriate to first determine the applicable water quality

Comment [I2]: I don't really think this paragraph adds anything

standards for the site and the point of compliance that the standards will apply. *Technical Guidance 6 on Contaminated Sites*.

Formatted: Font: Italic

The Ministry policy direction to ensure a consistent approach to closed landfill sites is to have the proponent or landfill owner apply the Technical Guidance 6 on Contaminated Sites (<http://www.env.gov.bc.ca/epd/remediation/guidance/technical/pdf/tg06.pdf>), and to request the Director set the appropriate groundwater standard and point of compliance for the specific site. , provides the guidance for this determination. I request that you retain a qualified professional to provide a recommendation and rational in this regard. (I don't know if you want to say anything about location? I would need to look at TG6 again. For example, maybe we don't want them to provide the point of compliance....instead maybe we want them to only discuss water quality at the property boundary and discuss the zone of attenuation. Sorry, I haven't really got this exactly figured.)

Following receipt of the above information, it is my intention to ~~The~~ determination of the applicable water quality standards and point of compliance. This will establish whether groundwater collection and treatment, or alternatively risk assessment, is a regulatory requirement.

Another important consideration it the implication to the Closure Fund due to long term financing of the groundwater collection and treatment. (sorry, don't have the words off the top of my head for the next sentence...maybe..."I realize this level of detail, will likely not be available until the closure plan????"

I trust that the foregoing is clear, however please do not hesitate to request further clarification where necessary. Please contact Carol Danyluk at 250-371-6229 to discuss any outstanding concerns or questions.

Sincerely,

Jason Bourgeois,
For Director, Environmental Management Act

Attachment: Closure Period Plan Review Table

Final Cover			
Anticipated Completion	Criteria for Completion	Additional Information /Comments	Approval Status
Within 3 months of last load of refuse	- Final cover is completed in accordance with approved Design, Operations and Closure Plan and/or Post-Closure Plan. - Re-vegetation seed applied and irrigation set up. - Windblown litter cleaned up to the satisfaction of the majority of Landfill Advisory Committee Members	Post- Closure Plan may provide additional specification for closure post-closure activities, QAQC, based on QP assessment made at least 12 months prior to closure.	Approved
Within 1 year of last load of refuse.		Post Closure Security Fund will cover the cost of the land lease from the invoice period beginning after completion of the final cover	Approved
Re-Vegetation			
Anticipated Completion	Criteria for Completion	Additional Information /Comments	Approval Status
Minimum of 3 years after closure	- Self-sustaining vegetation without irrigation. - Determined by QP assessment.	Provide additional details in consideration of: - Potentially individual grid areas may be approved as completed at different times. - Establish guiding criteria for QP. Possibly describe percent cover and diversity on a scale (e.g. 1 to 10) and pick a passing grade. Describe measurement/observation criteria. - Once the standard is met, what is the timeframe that demonstrates self-sustainability?	Not Approved. Subject to further discussion.
Minimum of 3 years.	Irrigation systems, fencing and site security maintained until after re-vegetation of specified areas approved.		Approved

Landfill Gas Management			
Anticipated Completion	Criteria for Completion	Additional Information /Comments	Approval Status
Minimum of 2 years after closure.	Landfill Gas Extraction Facilities - QP submits report confirming all LFG facilities are in place and operational. <2.5% methane off-property in monitoring/groundwater wells and <5% LEL at off-site locations/structures for a minimum three consecutive years starting 2015. - LFG collection is >75% efficiency as determined by two consecutive measurements over 2 different seasons in 2016 and 2017.	Once criteria for completion are satisfied, the post-closure fund will be responsible for subsequent on-site and off-site emission monitoring.	Approved
Minimum 2 years after closure.	Landfill Gas Migration	Once criteria for completion of LFG extraction facilities are satisfied, the post-closure fund will be responsible for extraction wells or other controls necessary to address any further LFG migration. LFG utilization efficiency may be impacted.	Subject to Further Discussion
Ongoing responsibility of Wastech	Landfill Gas Collection and Utilization	LFG collection and utilization remains the responsibility of Wastech. It will be at Wastech's discretion to flare or utilize low quality gas while maintaining overall >75% collection efficiency.	Approved
Within 6 months of last load of refuse.	Condensate Management	Condensate collection and conveyance to the evaporation ponds remains the responsibility of Wastech. Once the condensate is conveyed to the evaporation ponds or alternate disposal method as determined by the Director, the cost of condensate management becomes the responsibility of the post-closure fund. Detailed specifications and QA/QC	Subject to further discussion.

Comment [I1]: Completion in 3 years right? See first column

		to be provided in post-closure plan to be submitted in accordance with Section 4.1.4	
Leachate Control			
Anticipated Completion	Criteria for Completion	Additional Information /Comments	Approval Status
Minimum One year following last load of refuse.	- QP submits report confirming evaporation ponds are complete. - No above-ground or at-ground surface off-site discharge of leachate for one year following last load of refuse.	Detailed specifications and QA/QC to be provided in post-closure plan to be submitted in accordance with Section 4.1.4	Approved
Groundwater Management			
Anticipated Completion	Criteria for Completion	Additional Information /Comments	Approval Status
Within 3 months of the last load of refuse.	- Final cap completion - Groundwater & Surface Water Monitoring	Post-closure security fund is responsible for cost of environmental monitoring following completion of landfill cap; not including monitoring associated with the Extension (i.e. Bonaparte River baseline study as per EA Certificate)	Approved
Within 3 months of the last load of refuse.	- Groundwater recovery wells are installed along with selected groundwater disposal opinion. - Groundwater monitoring to confirm performance of recovery wells	Disposal option to be selected. A determination of the appropriate water quality criteria and point of compliance must be made with reference to the Contaminated Sites Technical Guidance #6 –Water Use Determination. Exceedence of the criteria once determined would trigger remediation or risk assessment. Long term costs and implication to post-closure fund to be projected. Detailed specifications and QA/QC to be provided in post-closure plan to be submitted in accordance with Section 4.1.4	Not Approved. Subject to further discussion.

Surface Water Management			
Anticipated Completion	Criteria for Completion	Additional Information /Comments	Approval Status
Within 6 months of last load of refuse.	Completion of drainage work upgrades as outlined in Appendix D.	Include Appendix D in Post-Closure Plan	Approved

	Task	Expected Completion	Criteria for Completion	Additional Information/Comments	Approval Status
1	Final Cover	Within 3 months of last load of refuse	• final cap completed. • seed applied and irrigation set up. • QP report submitted and approved by MOE. • Windblown litter cleaned up to the satisfaction of the majority of Landfill Advisory Committee Members	Closure Plan to be submitted in accordance with Section ??? providing specification details, QAQC 12 months in advance of closure.	Approved
2	Re-vegetation	Minimum of 3 years after closure??	• Self-sustaining vegetation without irrigation. • Determined min. 1 year (??, 2 growing seasons?) post irrigation. • Determined by QP assessment.	Provide additional details in consideration of: • Potentially individual grid areas may be approved as completed at different times. • Establish guiding criteria for QP. Possibly describe percent cover and diversity on a scale (e.g. 1 to 10) and pick a passing grade. Describe measurement/observation criteria. • Once the standard is met, what is the timeframe that demonstrates self-sustainability?	Not Approved. Subject to further discussion.
3	Irrigation	Min. of 3 years??	• After re-vegetation of entire site is approved.		Approved
4	Landfill Gas Monitoring (on-site and off-site)	Minimum of 3 years after closure.	• QP submits report confirming all LFG facilities are in place and operational. • 12 consecutive seasonal monitoring	Once criteria for completion is satisfied, the PCF will be responsible for subsequent on-site	Approved

	emissions)		rounds following cap installation showing <2.5% methane off-property in monitoring/groundwater wells. • 12 consecutive seasonal monitoring rounds following cap installation showing <5% LEL at off-site locations/structures. • LFG collection is at minimum >75% efficiency determined by two consecutive measurements over 2 seasons showing methane <27% or less than the methane collection rate averaged over the 30 days in advance of the measurement (???).	and off-site emission monitoring.	
5	Landfill Gas Migration	Minimum 3 years after closure.	• Same as #4, LFG Monitoring	Once criteria for completion is satisfied, the PCF will be responsible for installation or replacement of on or off-site extraction wells or other controls necessary to address LFG migration. Connection of any extraction well to the LFG recovery system will be the responsibility of Wastech. Note that this will be regardless of the quality of the gas. It will be at Wastech's discretion to flare or utilize low quality gas.	Not Approved. Subject to Further Discussion
6	Landfill Gas Collection and Utilization	Ongoing responsibility of Wastech	N/A	Except for extraction wells as per item #5, LFG collection and utilization remains the responsibility of Wastech.	Not Approved. Subject to further discussion.

7	Condensate Management	Within 6 months of last load of refuse.	QP submits report confirming evaporation ponds are complete.	Condensate collection and conveyance to the evaporation ponds remains the responsibility of Wastech. Once the condensate is conveyed to the evaporation ponds or alternate disposal method as determined by the Director, the condensate becomes the responsibility of the PCF. Detailed specifications and QA/QC to be provided in Closure Plan to be submitted in accordance with Section ???.	Not Approved. Subject to further discussion.
8	Leachate Control	One year following last load of refuse.	- QP submits report confirming evaporation ponds are complete. - No above-ground or at-ground surface off-site discharge of leachate for one year following last load of refuse.	Detailed specifications and QA/QC to be provided in Closure Plan to be submitted in accordance with Section ???.	Approved
9	Groundwater & Surface Water Monitoring	Within 3 months of the last load of refuse.	Final cap completion as per Item #1.	PCF is responsible for environmental monitoring following completion of landfill cap and not including monitoring associated with the Extension (i.e. Bonaparte River baseline study as per EA Certificate)	Approved
10	Groundwater Management	Within 3 months of the last load of	- Final cap completion as per Item #1. - Groundwater recovery wells are	Disposal option to be selected. Long term costs and implication to	Not Approved.

		refuse.	installed along with selected groundwater disposal opinion. Groundwater monitoring to confirm performance of recovery wells,	post-closure fund to be projected. Detailed specifications and QA/QC to be provided in Closure Plan to be submitted in accordance with Section ???. <i>[Consider setting land use criteria subject to discussions with Land Remediation...I will have a better idea on Wednesday.]</i>	Subject to further discussion.
11	Surface Water Management	Within 6 months of last load of refuse.	Completion of drainage work upgrades as outlined in Appendix D.	Include Appendix D in Closure Plan to be submitted in accordance with Section???	Approved
12	Land Lease	Within 1 year of last load of refuse.	PCF is responsible for the invoice period beginning after completion of the landfill cap as per #1.		Approved
13	Fencing	Minimum of 3 years.	Until re-vegetation is established as per Item #2.		Approved
14	Site Security	Minimum of 3 years.	Until re-vegetation is established as per Item #2.		Approved

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Friday, January 20, 2012 4:22 PM
To: Pratt, Andrew GCPE:EX
Subject: FW: Draft Notice for Publishing

Hi Andrew, the following text comes from our policy:

Region emails Andrew Pratt Andrew.Pratt@gov.bc.ca in GCPE Graphics with copy laid out in a word document. Please include the name of the newspaper(s) the advertisement will appear in. A PDF will be emailed to you for review.

I won't be able to confirm that this is final version until Monday but thought that this will serve as a heads up. I plan to post this in the Ashcroft Cache Creek Journal and understand their publishing deadline is noon on Thursday

Thanks,

Larry

ENVIRONMENTAL
PROTECTION NOTICE

ENVIRONMENTAL PROTECTION NOTICE

NOTICE OF INTENT TO ISSUE AN AMENDMENT TO AN OPERATIONAL CERTIFICATE MR-7577 UNDER THE PROVISIONS OF THE *ENVIRONMENTAL MANAGEMENT ACT*

Take notice that the Director intends, a minimum of 14 days after the date of this publication, to issue an amendment to Operational Certificate MR-7577 in the name of the Village of Creek and Wastech Services Ltd. for the existing sanitary landfill located at Cache Creek.

The amendment will impose the following new conditions:

- Require utilization of the collected landfill gas by June 30, 2013
- Require submission of a "Closure Period Plan" by August 31, 2012 which describes the timelines for undertaking discrete closure activities following which the Post-Closure Fund will pay for monitoring, repair and maintenance of the landfill.

A copy of the draft amended operational certificate may be viewed on-line at <http://www.gov.bc.ca/env/> or the Ministry of Environment Office at 1259 Dalhousie Drive, Kamloops, BC during normal business hours.

Any comments regarding the draft operational certificate must be sent to the Regional Manager, Environmental Protection, Ministry of Environment, within 14 days of the date of this publication. Comments may be made on-line at <https://extranet.gov.bc.ca/forms/gov/contact/index.html> (Please start your comment with "Attn: EP Manager, Kamloops") or mailed to 1259 Dalhousie Drive, Kamloops, BC V2C 5Z5.

A copy of any comments should also be sent to Wastech Services Ltd at jtecklenborg@wastech.ca or 1200 United Boulevard, Coquitlam BC V3K 6T4

Dated at Kamloops, British Columbia on January 26, 2012.

[Note that the on-line address may change prior to posting.]

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Tuesday, June 5, 2012 11:31 AM
To: Danyluk, Carol ENV:EX; Perkins, Megan ENV:EX
Subject: FW: Meeting Follow Up
Attachments: RE: Meeting Follow Up

Importance: High

From: Gardner, Larry ENV:EX
Sent: Wednesday, May 30, 2012 3:10 PM
To: 'tporter@bonaparteindianband.com'
Cc: Perkins, Megan ENV:EX; Adams, Rick MEM:EX; Bourgeois, Jason ENV:EX
Subject: RE: Meeting Follow Up
Importance: High

Chief Porter,

Further to our meeting of May 2 with yourself, Bert William, Vi Antoine, Dave Antoine and Gerald Etienne regarding the Thompson-Nicola Regional District's request to amend their Solid Waste Management Plan to include the Cache Creek Landfill Extension, I've taken this opportunity to reiterate the points of discussion. I apologize for the delay in getting this to you.

Thompson Nicola Solid Waste Management Plan Amendment

- **Amendment** - The purpose of this amendment is essentially to authorize the Cache Creek Landfill Extension (CCLE). Should the Minister approve this amendment request, the MOE Director will proceed with issuance of an *Operational Certificate* that sets out operating requirements for the landfill.
- **Area of Disturbance** - I understand that Bonaparte Indian Band (BIB) is not in support of the landfill, however, the Band is accepting of it. In this regard, BIB favours that the land area authorized for use be minimized for only what is needed. BIB understands the balance in a company having certainty in what is authorized to determine if the activity is a viable venture versus granting an authorization that is excessive. BIB understands that the project plan is for progressive use and closure of the 42 hectares; only a portion of the 42 hectare would be disturbed at one time. If the plan amendment is approved, the Operational Certificate that would be issued by the Director is an appropriate tool to regulate the development and disturbance area of the site.
- **Archaeology Assessment** - BIB had received the July 2010 Archaeological Impact Assessment Report prepared by Terraarchaeology. The final report that includes all of the detail of the assessment work carried out is anticipated to be completed within the month and a copy provided to BIB. I understand that this final report will document additional detail but will not change the conclusions and recommendations of the 2010 report. Please advise me if you do not receive this final report by the beginning of July.

Existing Landfill Related Items

- **Projected closure** of the existing Cache Creek landfill is for end of 2016 based on current fill rates. The Operational Certificate was recently amended to require a "closure period plan" which is to be submitted by the end of August 2012. The purpose of this plan is to provide a timeline for undertaking discrete closure activities such as placement of the final cap, establishing sustainable vegetation and ongoing monitoring. Once these closure activities are complete, a trust fund, managed by the province, will finance the ongoing maintenance and monitoring of the closed site. BIB has an on-going interest in the post-closure care of the landfill particularly around re-vegetation of the site and administration of the trust fund.

Following receipt of the “closure period plan” in August, I will update BIB on these planned activities. Having the landfill “Monitoring Committee”, of which BIB participates, continue after landfill closure may serve as a good way to keep the community apprised of the on-going maintenance and management of the site after closure.

- **Liner System** of the pre-annex landfill. I will provide a plan, section and brief explanation in a follow-up post.
- **Value of Post-Closure Fund** – value as of January 2012 was approximately \$12.7 million.
- **Presentation on Monitoring and Assessment** – BIB expressed an interest in a presentation that explains the existing monitoring program and assessment work for the landfill. I had a follow up conversation with Russ Black, Belcorp Project Manager, and he would be pleased to arrange a presentation by the environmental consultants that are working on the site. I would be pleased to facilitate such a meeting. I didn’t understand this to be an immediate need and will, therefore, work to arrange a session sometime between now and the fall of this year.

Other Concerns Raised

- **Graymont Western Canada Inc., Pavillion Lime Plant** – BIB stated environmental concerns with this operation. Based on the last inspection reports and stack sampling, the facility is compliant with MOE requirements. I will provide copies of these inspection reports under a separate post. I have also copied this email to Jason Bourgeois and Rick Adams so they are aware of your concern. Jason is the Ministry of Environment representative dealing with this facility; Rick Adams in the Ministry of Energy and Mines (MEM) contact.
- **HDI Mining** – BIB stated environmental concerns based on the limited understanding of this project. Based on Rick Adams followup email of May 5th (attached) it appears that BIB is the most informed and that MEM has not received any Notice of Work applications. Rick provided a link to the *Handbook for Mineral and Coal Exploration* which is guidance on best management practices. I trust this document might answer some of your questions you have on what to expect with this, or similar, exploration projects. As for the *Environmental Management Act* which our office administers, it is unlikely that any application/authorization is triggered by exploration work. It is not until a mine approaches the “operational” stage that our office gets involved in regulating the activity.

I believe Rick answered your question about the need for archeology work. He advises that, following receipt of a Notice of Work application, if sources of information (e.g. government data, First Nations referrals) indicate that archeological sites may be present, the Inspector of Mines can require assessment work to be carried out prior to starting work. The Inspector also has the authority to require a program for the conservation of cultural heritage resources, and/or include permit conditions requiring the protection of cultural heritage resources.

- **Ashcroft Terminal Expansion** – I have had conversations with Chris Shubert, Senior Manager, Ashcroft Terminal and Hamid Mohmand, Project Manager, Transport Canada, and advised them BIB has environmental concerns with this project and in particular the need for an archaeological assessment. I understand that since our meeting, Bert William and Vi Antoine met with Chris Shubert and were updated on the current status of this project. Furthermore, I understand that TERRA ARCHAEOLOGY LIMITED has been retained to carry out the archaeology assessment work and that Ashcroft Terminal plans to involve BIB directly in this work.

I trust this responds to the items raised during our meeting. If I have overlooked anything, please let me know. Thank you for the time you and the other Councillors took to meet with me.

Sincerely,

Larry Gardner
Environmental Management Section Head

Kamloops, BC
250-371-6226
Larry.Gardner@gov.bc.ca

BC Pollution Free

From: tporter@bonaparteindianband.com [<mailto:tporter@bonaparteindianband.com>]
Sent: Thursday, May 3, 2012 5:04 PM
To: Gardner, Larry ENV:EX
Subject: Re: Meeting Follow Up

Thanks for everything, will expect further correspondence, thanks again

From: "Gardner, Larry ENV:EX" <Larry.Gardner@gov.bc.ca>
Date: Thu, 3 May 2012 16:56:07 -0700
To: 'tporter@bonaparteindianband.com' <tporter@bonaparteindianband.com>
Cc: Adams, Rick MEM:EX <Rick.Adams@gov.bc.ca>
Subject: Meeting Follow Up

Chief Porter,

My apologies that I wasn't able to get any further information today on HDI or their regulatory obligations regarding exploration work and associated archaeological work. I know you have a meeting with them tomorrow so I had hoped to provide you something. I won't have a chance to inquire to Ministry of Mines until next week and will follow up then.

Sorry I couldn't get something in advance of your meeting,

Larry

Page 231 redacted for the following reason:

Not responsive

Not Responsive

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Thursday, September 6, 2012 2:51 PM
To: Henry, Larry FLNR:EX
Subject: FW: Meeting Follow Up - read first - MR-7577
Attachments: RE: Meeting Follow Up

Importance: High

fyi

From: Gardner, Larry ENV:EX
Sent: Wednesday, May 30, 2012 3:14 PM
To: Adams, Rick MEM:EX; Bourgeois, Jason ENV:EX
Cc: Perkins, Megan ENV:EX; Baric, Gordana ENV:EX
Subject: FW: Meeting Follow Up - read first - MR-7577
Importance: High

Hey guys, I thought I would re-send this with the sections highlighted which are pertinent to you...you can ignore the rest...

From: Gardner, Larry ENV:EX
Sent: Wednesday, May 30, 2012 3:10 PM
To: 'tporter@bonaparteindianband.com'
Cc: Perkins, Megan ENV:EX; Adams, Rick MEM:EX; Bourgeois, Jason ENV:EX
Subject: RE: Meeting Follow Up
Importance: High

Chief Porter,

Further to our meeting of May 2 with yourself, Bert William, Vi Antoine, Dave Antoine and Gerald Etienne regarding the Thompson-Nicola Regional District's request to amend their Solid Waste Management Plan to include the Cache Creek Landfill Extension, I've taken this opportunity to reiterate the points of discussion. I apologize for the delay in getting this to you.

Thompson Nicola Solid Waste Management Plan Amendment

- **Amendment** - The purpose of this amendment is essentially to authorize the Cache Creek Landfill Extension (CCLE). Should the Minister approve this amendment request, the MOE Director will proceed with issuance of an *Operational Certificate* that sets out operating requirements for the landfill.
- **Area of Disturbance** - I understand that Bonaparte Indian Band (BIB) is not in support of the landfill, however, the Band is accepting of it. In this regard, BIB favours that the land area authorized for use be minimized for only what is needed. BIB understands the balance in a company having certainty in what is authorized to determine if the activity is a viable venture versus granting an authorization that is excessive. BIB understands that the project plan is for progressive use and closure of the 42 hectares; only a portion of the 42 hectare would be disturbed at one time. If the plan amendment is approved, the Operational Certificate that would be issued by the Director is an appropriate tool to regulate the development and disturbance area of the site.
- **Archaeology Assessment** - BIB had received the July 2010 Archaeological Impact Assessment Report prepared by Terraarchaeology. The final report that includes all of the detail of the assessment work carried out is anticipated to be completed within the month and a copy provided to BIB. I understand that this final report will document additional detail but will not change the conclusions and recommendations of the 2010 report. Please advise me if you do not receive this final report by the beginning of July.

Existing Landfill Related Items

- **Projected closure** of the existing Cache Creek landfill is for end of 2016 based on current fill rates. The Operational Certificate was recently amended to require a “closure period plan” which is to be submitted by the end of August 2012. The purpose of this plan is to provide a timeline for undertaking discrete closure activities such as placement of the final cap, establishing sustainable vegetation and ongoing monitoring. Once these closure activities are complete, a trust fund, managed by the province, will finance the ongoing maintenance and monitoring of the closed site. BIB has an on-going interest in the post-closure care of the landfill particularly around re-vegetation of the site and administration of the trust fund.

Following receipt of the “closure period plan” in August, I will update BIB on these planned activities. Having the landfill “Monitoring Committee”, of which BIB participates, continue after landfill closure may serve as a good way to keep the community apprised of the on-going maintenance and management of the site after closure.

- **Liner System** of the pre-annex landfill. I will provide a plan, section and brief explanation in a follow-up post.
- **Value of Post-Closure Fund** – value as of January 2012 was approximately \$12.7 million.
- **Presentation on Monitoring and Assessment** – BIB expressed an interest in a presentation that explains the existing monitoring program and assessment work for the landfill. I had a follow up conversation with Russ Black, Belcorp Project Manager, and he would be pleased to arrange a presentation by the environmental consultants that are working on the site. I would be pleased to facilitate such a meeting. I didn’t understand this to be an immediate need and will, therefore, work to arrange a session sometime between now and the fall of this year.

Other Concerns Raised

- **Graymont Western Canada Inc., Pavillion Lime Plant** – BIB stated environmental concerns with this operation. Based on the last inspection reports and stack sampling, the facility is compliant with MOE requirements. I will provide copies of these inspection reports under a separate post. I have also copied this email to Jason Bourgeois and Rick Adams so they are aware of your concern. Jason is the Ministry of Environment representative dealing with this facility; Rick Adams in the Ministry of Energy and Mines (MEM) contact.
- **HDI Mining** – BIB stated environmental concerns based on the limited understanding of this project. Based on Rick Adams followup email of May 5th (attached) it appears that BIB is the most informed and that MEM has not received any Notice of Work applications. Rick provided a link to the *Handbook for Mineral and Coal Exploration* which is guidance on best management practices. I trust this document might answer some of your questions you have on what to expect with this, or similar, exploration projects. As for the *Environmental Management Act* which our office administers, it is unlikely that any application/authorization is triggered by exploration work. It is not until a mine approaches the “operational” stage that our office gets involved in regulating the activity.

I believe Rick answered your question about the need for archeology work. He advises that, following receipt of a Notice of Work application, if sources of information (e.g. government data, First Nations referrals) indicate that archeological sites may be present, the Inspector of Mines can require assessment work to be carried out prior to starting work. The Inspector also has the authority to require a program for the conservation of cultural heritage resources, and/or include permit conditions requiring the protection of cultural heritage resources.

- **Ashcroft Terminal Expansion** – I have had conversations with Chris Shubert, Senior Manager, Ashcroft Terminal and Hamid Mohmand, Project Manager, Transport Canada, and advised them BIB has environmental concerns with this project and in particular the need for an archaeological assessment. I understand that since our meeting, Bert William and Vi Antoine met with Chris Shubert and were updated on the current status of this project. Furthermore, I understand that TERRA ARCHAEOLOGY LIMITED has been retained to carry out the archaeology assessment work and that Ashcroft Terminal plans to involve BIB directly in this work.

I trust this responds to the items raised during our meeting. If I have overlooked anything, please let me know. Thank you for the time you and the other Councillors took to meet with me.

Sincerely,

Larry Gardner
Environmental Management Section Head
Kamloops, BC
250-371-6226
Larry.Gardner@gov.bc.ca

BC Pollution Free

From: tporter@bonaparteindianband.com [<mailto:tporter@bonaparteindianband.com>]
Sent: Thursday, May 3, 2012 5:04 PM
To: Gardner, Larry ENV:EX
Subject: Re: Meeting Follow Up

Thanks for everything, will expect further correspondence, thanks again

From: "Gardner, Larry ENV:EX" <Larry.Gardner@gov.bc.ca>
Date: Thu, 3 May 2012 16:56:07 -0700
To: 'tporter@bonaparteindianband.com' <tporter@bonaparteindianband.com>
Cc: Adams, Rick MEM:EX <Rick.Adams@gov.bc.ca>
Subject: Meeting Follow Up

Chief Porter,

My apologies that I wasn't able to get any further information today on HDI or their regulatory obligations regarding exploration work and associated archaeological work. I know you have a meeting with them tomorrow so I had hoped to provide you something. I won't have a chance to inquire to Ministry of Mines until next week and will follow up then.

Sorry I couldn't get something in advance of your meeting,

Larry

Pages 236 through 237 redacted for the following reasons:

Not responsive

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Monday, January 14, 2013 3:52 PM
To: Caunce, Cassandra ENV:EX
Subject: FW: Presentation Materials for DEC



Closure Period Closure Plan
Plan Concerns.d... notes jan 14.docx...

Cassandra,

Presentation materials. The first document gives you an overview of issues, the second a bit more of the specifics.
Megan picked out some random photos found here:
L:\General\CCLF Jan 2013

Let me know if you need something else.

Larry

Considering Closure of the Cache Creek Landfill

The Cache Creek Landfill (CCLF) is scheduled to close in 2016. When the site was originally authorized in 1987, a post-closure fund was established for the monitoring, maintenance and repair of the landfill. The value of the fund, as of January 2012, was approximately \$12.7 million held in an internal trust managed by government. The fund is to be administered by the Director for the benefit of the Village of Cache Creek.

Essentially, on closure of the site, the Ministry of Environment becomes the contract manager for the site and the Director shall disperse funds for all post-closure activities. MOE remains as the regulator, but also becomes the financier and pays the owner/operator for all post-closure activities. Any residual from the fund, will ultimately be released to the Village of Cache Creek.

This arrangement sets up some unique challenges:

- The current thinking is that Wastech will submit an annual budget which will be approved by the Director. Administration of monthly disbursement will be carried out by the Village of Cache Creek. A third party monitor, paid for by the fund, will provide oversight on disbursement of the fund and will report directly to the Ministry. Additional considerations are:
 - Currently Wastech's contract with Metro, sets a fixed profit at 12%. However, there is no contract in place with the Ministry, and as Wastech and the Village are site owners and Wastech is the operator, Wastech will be the sole source of all work. There is really nothing that prevents them from increasing their profit margin.
 - The way the trust has been set up, really removes any motive on the part of Wastech from preserving the value of the trust.
 - If the trust is depleted, through contractual arrangements, Metro indemnifies Wastech and the Village for 25 years post closure. Beyond 25 years, liability provisions of the contaminated sites regulation kick in.
- At what point does the Closure Fund start to pay for activities?
 - For example:
 - environmental monitoring will likely be paid from the fund the last day garbage is received;
 - cap maintenance: a couple of months within the time when the last load of waste has been deposited, the final cap is completed;
 - vegetation: likely a few years after closure once viable vegetation has been demonstrated to be established. Adequate re-vegetation is determined by a professional and based on percent cover and species composition. Is there a potential need for on-going irrigation? What is the water source?

- LFG Management: the fund does not pay for LFG utilization but does pay for managing off-site migration. This area of responsibility and cost has potential for conflict;
 - Do Wastech's fees include administration and management costs? To what extent within their organization?
 - All of these pose challenges for apportionment of costs and are likely to be the subject of on-going negotiations. As Metro and the Village will have continued financial interests in the project, no doubt they will want to be part of the negotiations;
 - Wastech has recently submitted a "closure period plan" which starts to form criteria and timelines for the above.
- Leachate Control - Wastech was advised last year of their obligation to give notice of off-site migration. Considerations include:
 - 6 offsite wells appear to be influenced by the landfill above background and exceed CSR in varying amounts (e.g. drinking, aquatic, irrigation and livestock); 1 for sulphate and chloride, 4 for sulphate only, and one for fluoride. Levels are nothing to get excited about, the leachate is being attenuated and there are no receptors being impacted.
 - Wastech is concerned about additional regulatory burden, the perception of pollution that might be created through "notice of offsite migration" and that after a lot of additional assessment work they will end up having to actively collect and treat leachate regardless. Based on advice from LRM, Wastech was asked to hold off giving notice.
 - Wastech has responded proposing a groundwater pump and treat system in the order of 100 m³/day. Options for disposal of the groundwater include: 1) 10 hectares of evaporation ponds, 2) evaporation using waste heat from internal combustion engines at the electrical generation plant, 3) 6 hectares of spray evaporation ponds, or 4) water treatment and on-site spray irrigation. Although costs have not yet been estimated, it will surely be in the multi-millions of dollars.
 - Questions around how long a pump and treat system would be necessary, where would ponds be located, any ancillary impacts to the groundwater regime, have not yet been considered.
 - The pump and treat system is likely unnecessary for environmental protection and but appears to be a response to anticipated controversy in giving notice of off-site migration. Note that under the terms of the contract with Metro, Metro would like finance the capital and the closure fund would finance long term operations.

- Is there enough money in the fund?
 - Intuitively, yes. Cost estimates have not been projected for the above. Sorting out the details for post-closure of the site has just started. Cost estimates will be developed over the next couple of years.
 - If cost estimates predicts surplus in the fund, it is anticipated that the Village will request release of the residual. If the costs predict the fund it inadequate, there is really not an obvious solution for increasing the value of the fund. The initial focus would be on minimizing disbursements.

Review of CCL Period Closure Plan

The closure period is defined as the indeterminate timeline commencing before cessation of landfilling activities, and lasting until completion of discreet closure activities, such as placement of the final cover or establishment of sustainable vegetation.

Defining Final Cover Design Completion

- Adequate soil cover thickness - 1 m thick barrier soil with hydraulic conductivity of 6×10^{-5} cm/sec or less
- 0.2 m thickness of top soil
- Adequate surface drainage works to allow quick runoff away from cover
- Landfill slopes - Landfill slopes are 2.6:1 between benches, and an overall slope of 3:1 including benches
- Compaction of waste and complete coverage with intermediate cover before the application of the final cover
- Installation of all required leachate and water lines, insuring at least 1.2 m of soil cover for winter frost purposes
- Windblown litter collection – litter from the landfill, North Borrow property, and a distance of 300 m beyond the Landfill property – based on the majority of the opinion of the members of the landfill advisory committee

Defining Revegetation Completion

- On average vegetation equal to or equivalent to the vegetation on the landfill prior to the landfill development – 60% cover, species composition to be determined over a period of several years – preferred native species include: Rabbit brush, Bluebunch wheatgrass, Rough fescue, Sandberg's bluegrass, Prairie sagewort, Brittle prickly-pear cactus, UMBER pussytoes, Yarro, Long-leaved daisy, acceptable non-native species: Crested wheatgrass, Hard fescue, Tall wheatgrass, Idaho fescue (weeds are not included in percent cover)
- Application of a growing medium of top soil, organic matter, and other amendments to create a friable and fertile bed
- Corrective reclamation measures (adding growing medium, reseeding, planting seed plugs)
- The percent vegetation cover and species composition will be determined by a competent Professional Biologist or Agrologist, Registered in BC

Defining Irrigation Completion

- Target condition is a combination of drought tolerant grasses, herbs, and forbs that will survive without ongoing watering and with minimal maintenance.
- Will the site require continued irrigation?
- Will current water supply be effect for future water demands?

Defining Landfill Gas Management Completion

- The qualified professional for the Landfill Gas Management Facilities Design Plan confirms that all of the required LFG management facilities are in place and operational.
- No off-property gas or groundwater monitoring wells exceed 2.5 % methane by volume, over 12 consecutive monitoring rounds starting at the beginning of 2015
- No off-property ambient air measurements exceed 5% of the lower explosive limit for methane (0.25% methane by volume), for 12 consecutive monitoring rounds starting at the beginning of 2015. Sampling locations: current Wastech office, Wastech shop, truck wash, crawl space of the trailer on the Coast Range Concrete property, and in the corner of the former chip plant property.
- The LFG collection efficiency is 75% is greater as defined by the Landfill Gas Management Facilities Design Guidelines, or at Wastech's option, as determined by two methane emission discharge rate measurement rounds during two different season in 2016 and/or 2017, which indicate that methane emissions are 27% or less than the methane collection rate averaged over the 30 days leading up to including the day of the measurements.

Defining Leachate Control Completion

- Adequate management of leachate means that the maximum annual volume of leachate can be managed by evaporation in the proposed evaporation ponds, infiltration into the refuse of Stage 5 via the leachate recirculation system, or both.
- No above-ground or at-ground off-site discharge of Landfill leachate to the environment occurs within one year of the final MSW placement at the landfill

Defining Surface Water Management Completion

- All road/bench ditches to be lined with filter cloth and rip-rap
- Ensure correct construction of channel side slopes
- Sediment traps at culvert inlets are clean, and have appropriate side slopes, and have ponding depths of at least 0.3 m.
- Complete all necessary culvert slope improvements, repair damaged culvert inlets or outlets
- Filter cloth and rip-rap berm areas

Notifications and Survey

- Press release eight months prior, bulletin one year prior, posting sign at the landfill one year prior.
- Complete survey of the Landfill
- A post-closure maintenance manual should be prepared which includes: safety considerations, a plan identifying each facility that would need to be maintained, a summary of the design of the landfill, and a timeline of significant events.

Groundwater Flow Notes

- FEFLOW (three- dimensional numerical groundwater flow model) predicts the travel time for groundwater to flow from the Landfill to the Bonaparte River to be between 70 and 165 years
- Based on hydrogeological data from previous site investigations and available regional information.
- Use groundwater extraction wells, to manage migration of groundwater from beneath and around the landfill
- Determined that 8 to 12 pumping wells would be required to account for pumping inefficiencies and heterogeneities
- Wells would have a collective pumping rate of 100 m³/day
- Options for Groundwater disposal:
 - Evaporation ponds – 10 hectares would be required
 - Utilization of waste heat from internal combustion engines – predicted 5000 to 8000 m³/year of water could be evaporated by utilizing the waste heat from the internal combustion engines
 - Spray evaporation ponds – 6 to 8 hectares of evaporation ponds with spray evaporators. Goal is to provide 20 to 30% volume reduction
 - On-site treatment plant – disposed water could be treated in a modular treatment plant. 85% would be suitable for reuse (irrigation) or discharge to surface water. The remainder of the 15% would require 1.5 hectares of evaporation ponds and spray evaporation.

Defining Groundwater Management Completion

- Groundwater recovery wells are installed along with selected groundwater disposal option
- Groundwater monitoring to confirm performance of recovery wells

From: Gardner, Larry ENV:EX
Sent: Monday, April 2, 2012 1:59 PM
To: Hill, Douglas J ENV:EX
Subject: FW: Regional Update

Cache Creek OC Amendment

The Cache Creek Landfill Operational Certificate [was amended last week to:](#)

- Require utilization of the collected landfill gas by June 30, 2013.
- Require submission of a "Closure Period Plan" by August 31, 2012, which describes the timelines for undertaking discrete closure activities following which the Post-Closure Fund will pay for monitoring, repair and maintenance of the landfill.

The Cache Creek landfill produces enough landfill gas to meet the energy consumption needs of more than 2100 homes. The payback on the capital expenditure to recovery the energy from the gas is in the order of about 7 years. MOE has been encouraging utilization of the gas for more than 7 years. The authorized party, Village of Cache Creek and Wastech Services Ltd. failed to make a commitment to voluntarily utilize the gas [and, therefore, the OC was amended to compel the requirement. The current timeline for closure of the existing site is 2016.](#)

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Wednesday, January 18, 2012 5:27 PM
To: Rhebergen, Frank ENV:EX
Subject: LFG Utilization Plan2.doc

Importance: High



LFG Utilization
Plan2.doc

Your thoughts....

In accordance with....is hereby amended.

3.2 Recovery of Energy Potential From Landfill Gas

3.2.1 On or before June 30, 2013, energy potential from the landfill gas shall be recovered in accordance with the plan approved under section 3.2.2

3.2.2 On or before **[dated 14 days from signing]**, a plan referred to as the “*LFG Utilization Plan*” shall be submitted for approval of the Director. The plan shall include at least the following:

- Description of the process to recover the energy potential from the waste;
- Projected energy recovery expressed in joules;
- Efficiency of energy recovery; and,
- A critical path to achieve recovery by June 30, 2013.

3.2.3 On or before the first day of each quarter, until project completion, a project progress report relative to the critical path shall be submitted to the Director.

3.2.4 The Director may require revision of, or addition to, the LFG Utilization Plan.

3.2.5 The *Post-Closure Fund* described in Section 8.0 shall not be applied to the recovering the energy potential from the landfill gas. For certainty, the post-closure fund shall not be applied to operation, maintenance, monitoring, capital upgrades or investigation related to the landfill gas utilization.

9. Closure Period Plan

The “*Closure Period*” is the indeterminate timeline commencing in advance of cessation of landfilling activities until completion of discrete closure activities such as placement of final cap, establishing sustainable vegetation, etc. Closure activities shall be completed to the satisfaction of the Director before the *Post-Closure Fund* described in Section 8.0 shall be used for monitoring, repair and maintenance of the landfill. It is expected that discrete closure activities will be completed on different timelines and that the Post-Closure Fund will be administered on a corresponding staggered timeline.

On or before August 31, 2012, a plan referred to as the “*Closure Period Plan*” shall be submitted for approval of the Director. The plan shall include at least the following:

- A list and description of discrete closure activities to be undertaken during *the Closure Period*;
- A projected timeline for each discrete closure activity from initiation to completion; and,

- Where appropriate, criterion for determining when the closure activity is complete.

The *Closure Period Plan* shall align with the *Closure Plan* as set out in Section 4.1.2

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Monday, February 6, 2012 1:07 PM
To: Meier, Kristi GCPE:EX
Cc: Wilson, Anna ENV:EX
Subject: OC Amendment Publication

Doc1.doc

Hi Kristi, it looks like I am back on track for this. I made a view minor revisions from the earlier version. Can you stick handle through to posting in the Cache Creek/Ashcroft Journal. I believe their publishing deadline is noon Thursday. I trust you will still have a copy of the associated forms required.

(Anna, I copied you as I wouldn't mind confirming I got the hyperlinks correct.)

Thanks,

Larry

Environmental Protection Notice

Notice of Intent to Issue an Amendment to an Operational Certificate MR-7577 Under the Provisions of the Environmental Management Act

Take notice that the Director intends, a minimum of 14 days after the date of this publication, to issue an amendment to Operational Certificate MR-7577 in the name of the Village of Creek and Wastech Services Ltd. for the existing sanitary landfill located at Cache Creek.

The amendment will impose the following new conditions:

- Require utilization of the collected landfill gas by June 30, 2013.
- Require submission of a "Closure Period Plan" by August 31, 2012, which describes the timelines for undertaking discrete closure activities following which the Post-Closure Fund will pay for monitoring, repair and maintenance of the landfill.

A copy of the draft amended Operational Certificate may be viewed on-line at <http://www.env.gov.bc.ca/epd/> under the *Publication Notifications* banner. A copy may also be viewed at the Ministry of Environment Office at 1259 Dalhousie Drive, Kamloops, B.C. V2C 5Z5 during normal business hours.

Any comments regarding the draft Operational Certificate must be sent to the Regional Manager, Environmental Protection, Ministry of Environment, within 14 days of the date of this publication at the address above or on-line at <https://extranet.gov.bc.ca/forms/gov/contact/index.html> (Please start your comment with "Attn: EP Manager, Kamloops).

A copy of any comments should also be sent to Wastech Services Ltd at jtecklenborg@wastech.ca or 1200 United Boulevard, Coquitlam B.C. V3K 6T4

Dated at Kamloops, B.C. on February 9, 2012.

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Monday, July 29, 2013 9:13 AM
To: Bourgeois, Jason ENV:EX
Subject: RE: Cache Creek Landfill Closure Period Plan

Sure...given me a call anytime. I am pretty much around all week.

From: Bourgeois, Jason ENV:EX
Sent: Friday, July 26, 2013 4:35 PM
To: Gardner, Larry ENV:EX
Cc: Danyluk, Carol ENV:EX
Subject: FW: Cache Creek Landfill Closure Period Plan

I need to pick your brain again on your take of pro, con, risk with regard to approval of CPP.

From: Bourgeois, Jason ENV:EX
Sent: Friday, July 26, 2013 4:30 PM
To: 'Janet Tecklenborg'
Cc: Danyluk, Carol ENV:EX
Subject: FW: Cache Creek Landfill Closure Period Plan

Janet, further to our telephone discussion today, I propose that Carol and I meet with Wastech to discuss any outstanding issues that may remain with the Cache Creek Landfill Closure Plan (CPP). By the CPP, I refer to the original document provided on September 7, 2012 and the supplemental materials provided in May of 2013.

I understand from conversations with Carol that, on several occasions, she has offered to share with Wastech, our draft response to the current draft of the CPP. I understand further that you informed us that that would not be necessary and it was not urgent for Wastech to receive our comments, in draft, or otherwise. However, I think in order to facilitate our upcoming discussion, and focus our attention on any truly outstanding issues, it would be best that our draft response is shared in advance. Unfortunately, will the holiday season upon us, we will not be in a position to do that until August 13, at the earliest.

With regard to possible dates for a face to face meeting, I tentatively propose August 27-30, Sept 3-5, Sept 9, Sept 11 pm, Sept 12 pm, or Sept 13 for now. Once Carol and I can discuss additional possible dates on August 13th, we can provide you with an update at that time.

Regards,
Jason

From: Sharlyne Jay [<mailto:sjay@wastech.ca>]
Sent: Thursday, April 18, 2013 10:07 AM
To: Bourgeois, Jason ENV:EX
Cc: Caunce, Cassandra ENV:EX; Gardner, Larry ENV:EX; Danyluk, Carol ENV:EX; Ted Rattray; David Thompson; Janet Tecklenborg
Subject: Cache Creek Landfill Closure Period Plan

Please see attached letter from Janet Tecklenborg. Hard copies will be sent by mail.

Regards,
Sharlyne

Sharlyne Jay
Executive Assistant
604-517-6558

From: Gardner, Larry ENV:EX
Sent: Wednesday, May 30, 2012 11:33 AM
To: Perkins, Megan ENV:EX
Subject: RE: Meeting Follow Up
Attachments: RE: Meeting Follow Up

Importance: High

Didn't you send me your meeting notes?...I went to check to make sure I covered everything off. Anyway, give this a read to see if I missed anything.

Chief Porter,

further to our meeting of May 2 with yourself, Bert William, Vi Antoine, Dave Antoine and Gerald Etienne regarding the Thompson-Nicola Regional District's request to amend their Solid Waste Management Plan to include the Cache Creek Landfill Extension, I've taken this opportunity to reiterate the points of discussion. I apologize for the delay in getting this to you.

Thompson Nicola Solid Waste Management Plan Amendment

- **Amendment** - The purpose of this amendment is essentially to authorize the Cache Creek Landfill Extension (CCLE). Should the Minister approve this amendment request, the MOE Director will proceed with issuance of an *Operational Certificate* that sets out operating requirements for the landfill.
- **Area of Disturbance** - I understand that Bonaparte Indian Band (BIB) is not in support of the landfill, however, the Band is accepting of it. In this regard, BIB favours that the land area authorized for use be minimized for only what is needed. BIB understands the balance in a company having certainty in what is authorized to determine if the activity is a viable venture versus granting an authorization that is excessive. BIB understands that the project plan is for progressive use and closure of the 42 hectares; only a portion of the 42 hectare would be disturbed at one time. If the plan amendment is approved, the Operational Certificate that would be issued by the Director is an appropriate tool to regulate the development and disturbance area of the site.
- **Archaeology Assessment** - BIB had received the July 2010 Archaeological Impact Assessment Report prepared by Terraarchaeology. The final report that includes all of the detail of the assessment work carried out is anticipated to be completed within the month and a copy provided to BIB. I understand that this final report will document additional detail but will not change the conclusions and recommendations of the 2010 report. Please advise me if you do not receive this final report by the beginning of July.

Existing Landfill Related Items

- **Projected closure** of the existing Cache Creek landfill is for end of 2016 based on current fill rates. The Operational Certificate was recently amended to require a "closure period plan" which is to be submitted by the end of August 2012. The purpose of this plan is to provide a timeline for undertaking discrete closure activities such as placement of the final cap, establishing sustainable vegetation and ongoing monitoring. Once these closure activities are complete, a trust fund, managed by the province, will finance the ongoing maintenance and monitoring of the closed site. BIB has an on-going interest in the post-closure care of the landfill particularly around re-vegetation of the site and administration of the trust fund.

Following receipt of the "closure period plan" in August, I will update BIB on these planned activities. Having the landfill "Monitoring Committee", of which BIB participates, continue after landfill closure may serve as a good way to keep the community apprised of the on-going maintenance and management of the site after closure.

- **Liner System** of the pre-annex landfill. I will provide a plan, section and brief explanation in a follow-up post.
- **Value of Post-Closure Fund** – value as of January 2012 was approximately \$12.7 million.
- **Presentation on Monitoring and Assessment** – BIB expressed an interest in a presentation that explains the existing monitoring program and assessment work for the landfill. I had a follow up conversation with Russ Black, Belcorp Project Manager, and he would be pleased to arrange a presentation by the environmental consultants that are working on the site. I would be pleased to facilitate such a meeting. I didn't understand this to be an immediate need and will, therefore, work to arrange a session sometime between now and the fall of this year.

Other Concerns Raised

- **Graymont Western Canada Inc., Pavillion Lime Plant** – BIB stated environmental concerns with this operation. Based on the last inspection reports and stack sampling, the facility is compliant with MOE requirements. I will provide copies of these inspection reports under a separate post. I have also copied this email to Jason Bourgeois and Rick Adams so they are aware of your concern. Jason is the Ministry of Environment representative dealing with this facility; Rick Adams in the Ministry of Energy and Mines (MEM) contact.
- **HDI Mining** – BIB stated environmental concerns based on the limited understanding of this project. Based on Rick Adams followup email of May 5th (attached) it appears that BIB is the most informed and that MEM has not received any Notice of Work applications. Rick provided a link to the *Handbook for Mineral and Coal Exploration* which is guidance on best management practices. I trust this document might answer some of your questions you have on what to expect with this, or similar, exploration projects. As for the *Environmental Management Act* which our office administers, it is unlikely that any application/authorization is triggered by exploration work. It is not until a mine approaches the "operational" stage that our office gets involved in regulating the activity.

I believe Rick answered your question about the need for archeology work. He advises that, following receipt of a Notice of Work application, if sources of information (e.g. government data, First Nations referrals) indicate that archeological sites may be present, the Inspector of Mines can require assessment work to be carried out prior to starting work. The Inspector also has the authority to require a program for the conservation of cultural heritage resources, and/or include permit conditions requiring the protection of cultural heritage resources.

- **Ashcroft Terminal Expansion** – I have had conversations with Chris Shubert, Senior Manager, Ashcroft Terminal and Hamid Mohmand, Project Manager, Transport Canada, and advised them BIB has environmental concerns with this project and in particular the need for an archaeological assessment. I understand that since our meeting, Bert William and Vi Antoine met with Chris Shubert and were updated on the current status of this project. Furthermore, I understand that TERRA ARCHAEOLOGY LIMITED has been retained to carry out the archaeology assessment work and that Ashcroft Terminal plans to involve BIB directly in this work.

I trust this responds to the items raised during our meeting. If I have overlooked anything, please let me know. Thank you for the time you and the other Councillors took to meet with me.

Sincerely,

Larry Gardner
Environmental Management Section Head
Kamloops, BC
250-371-6226
Larry.Gardner@gov.bc.ca

From: tporter@bonaparteindianband.com [<mailto:tporter@bonaparteindianband.com>]
Sent: Thursday, May 3, 2012 5:04 PM
To: Gardner, Larry ENV:EX
Subject: Re: Meeting Follow Up

Thanks for everything, will expect further correspondence, thanks again

From: "Gardner, Larry ENV:EX" <Larry.Gardner@gov.bc.ca>
Date: Thu, 3 May 2012 16:56:07 -0700
To: 'tporter@bonaparteindianband.com' <tporter@bonaparteindianband.com>
Cc: Adams, Rick MEM:EX <Rick.Adams@gov.bc.ca>
Subject: Meeting Follow Up

Chief Porter,

My apologies that I wasn't able to get any further information today on HDI or their regulatory obligations regarding exploration work and associated archaeological work. I know you have a meeting with them tomorrow so I had hoped to provide you something. I won't have a chance to inquire to Ministry of Mines until next week and will follow up then.

Sorry I couldn't get something in advance of your meeting,

Larry

Pages 256 through 257 redacted for the following reasons:

Not responsive

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Thursday, April 4, 2013 9:24 AM
To: Caunce, Cassandra ENV:EX
Cc: Bourgeois, Jason ENV:EX
Subject: RE: Wastech meeting tomorrow?

Yes, I'm attending. Purpose is to discuss the Period Closure Plan and will be attended by Janet Tecklenborg, David Thompson and Ted Rattray. I'm reviewing the plan now and am working on getting you an electronic copy this a.m.

Larry

From: Caunce, Cassandra ENV:EX
Sent: Thursday, April 4, 2013 9:14 AM
To: Gardner, Larry ENV:EX
Cc: Bourgeois, Jason ENV:EX
Subject: Wastech meeting tomorrow?

Hi Larry,

What is happening with this Wastech meeting tomorrow? I seem to recall you stated you would be attending. Is there an agenda? Background materials? I don't want to go into this meeting cold.

Cassandra Caunce

Regional Director, Environmental Protection
Thompson & Cariboo Regions

Ministry of Environment

1259 Dalhousie Drive
Kamloops, BC V2C 5Z5
(direct) 250.371-6225 • (fax) 250.828-4000 • (reception) 250.371-6200

www.gov.bc.ca/env

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Thursday, April 25, 2013 10:25 AM
To: Danyluk, Carol ENV:EX
Subject: RE: Wastech Response on Closure Period Plan

A clarification...equipment required to management post-closure of the landfill is to be purchased and is owned by Wastech...the PCF will pay the depreciation

From: Gardner, Larry ENV:EX
Sent: Tuesday, April 23, 2013 2:31 PM
To: Danyluk, Carol ENV:EX
Cc: Bourgeois, Jason ENV:EX
Subject: Wastech Response on Closure Period Plan

A couple of thoughts for the letter:

- The letter should state it approves the Closure Period Plan as per the table I sent you yesterday which sets out discrete closure activities, the expected timeline for completion and the criteria for determining when the discrete activity is complete.
- I had thought they are required to have a closure plan 12 months in advance of closure. I messed up here as they are to have post-closure plan instead (see OC). The Operations and Closure Plan is to be updated every 5 years which I think was due 2012...but I recall in our meeting Janet said it was due this year or next? Anyway, we should include detailed specification and QA/QC in the updated OCP if possible...that way we are only approving concepts in the CPP and not specifications. The main purpose of the PCP will deal with administration of the site and management/disbursement of the closure fund.
- It might be worth explaining the OCP, PCP and CPP in the letter.
- **We should say all equipment is owned by Wastech...i.e. if the PCF buys a pump, Wastech owns it.**
- Although post-closure cost is part of the PCP, we really need those projections to approve the groundwater management so we know implications to the trust fund.

I had a long chat with both Janet and Russ separately today. They are frustrated that we (I) are not just approving the CPP....the groundwater component. I tried to explain that I wouldn't be prepared to approve it because on approval it becomes a regulatory obligation. At this point I am not convinced it is necessary. I did explain I have a call tomorrow with our Land Remediation program to discuss the contents of the attachment. Basically, I would prefer to go down the path of determining appropriate criteria and point of compliance...once we do this, if they exceed the remedy is remediation or risk assessment. In their case, they have already picked remediation. I'll have a better understanding of this process following the call with Land Remediation tomorrow. I copied Jason because if we go down this path of determining criteria, the decision would rest with him or Cassandra. Perhaps, he (or Cassandra) would prefer to not go down this path. Clearly Wastech would prefer that we just approve their groundwater remediation path outright. When Wastech asked what the possible consequence of a decision to approve the plan as is, I responded that it is an appealable decision.

Larry

<< Message: Technical Guidance 8 versus Landfill Criteria >>

From: Gardner, Larry ENV:EX
Sent: Tuesday, February 7, 2012 11:26 AM
To: Hill, Douglas J ENV:EX
Subject: Regional Update

Cache Creek OC Amendment

A decision to amend the Cache Creek landfill Operational Certificate is under consideration to:

- Require utilization of the collected landfill gas by June 30, 2013.
- Require submission of a "Closure Period Plan" by August 31, 2012, which describes the timelines for undertaking discrete closure activities following which the Post-Closure Fund will pay for monitoring, repair and maintenance of the landfill.

The Cache Creek landfill produces enough landfill gas to meet the energy consumption needs of more than 2100 homes. The payback on the capital expenditure to recovery the energy from the gas is in the order of about 7 years. MOE has been encouraging utilization of the gas for more than 7 years. The authorized party, Village of Cache Creek and Wastech Services Ltd. failed to make a commitment to voluntarily utilize the gas. The basis for this is speculated to be due to contract complications with Metro Vancouver.

Of note, the Public Notification states that a copy of the draft amended Operational Certificate may be viewed on-line at <http://www.env.gov.bc.ca/epd/> under the Publication Notifications banner. Comments are being encouraged to be submitted on-line at <https://extranet.gov.bc.ca/forms/gov/contact/index.html> (Comments are to start with "Attn: EP Manager, Kamloops"). This is being done to make the information more accessible to interested parties and in line with province's initiative on open government.

From: Gardner, Larry ENV:EX
Sent: Tuesday, April 23, 2013 2:31 PM
To: Danyluk, Carol ENV:EX
Cc: Bourgeois, Jason ENV:EX
Subject: Wastech Response on Closure Period Plan

A couple of thoughts for the letter:

- The letter should state it approves the Closure Period Plan as per the table I sent you yesterday which sets out discrete closure activities, the expected timeline for completion and the criteria for determining when the discrete activity is complete.
- I had thought they are required to have a closure plan 12 months in advance of closure. I messed up here as they are to have post-closure plan instead (see OC). The Operations and Closure Plan is to be updated every 5 years which I think was due 2012...but I recall in our meeting Janet said it was due this year or next? Anyway, we should include detailed specification and QA/QC in the updated OCP if possible...that way we are only approving concepts in the CPP and not specifications. The main purpose of the PCP will deal with administration of the site and management/disbursement of the closure fund.
- It might be worth explaining the OCP, PCP and CPP in the letter.
- We should say all equipment is owned by Wastech...i.e. if the PCF buys a pump, Wastech owns it.
- Although post-closure cost is part of the PCP, we really need those projections to approve the groundwater management so we know implications to the trust fund.

I had a long chat with both Janet and Russ separately today. They are frustrated that we (I) are not just approving the CPP....the groundwater component. I tried to explain that I wouldn't be prepared to approve it because on approval it becomes a regulatory obligation. At this point I am not convinced it is necessary. I did explain I have a call tomorrow with our Land Remediation program to discuss the contents of the attachment. Basically, I would prefer to go down the path of determining appropriate criteria and point of compliance...once we do this, if they exceed the remedy is remediation or risk assessment. In their case, they have already picked remediation. I'll have a better understanding of this process following the call with Land Remediation tomorrow. I copied Jason because if we go down this path of determining criteria, the decision would rest with him or Cassandra. Perhaps, he (or Cassandra) would prefer to not go down this path. Clearly Wastech would prefer that we just approve their groundwater remediation path outright. When Wastech asked what the possible consequence of a decision to approve the plan as is, I responded that it is an appealable decision.

Larry



Technical
Guidance 8 versus L&

Donchi, Erin CSNR:EX

From: Gardner, Larry ENV:EX
Sent: Friday, March 15, 2013 11:49 AM
To: McCammon, Alan W ENV:EX; Love, Mark P ENV:EX; Sundher, Avtar S ENV:EX; Stroich, Chris ENV:EX
Subject: Technical Guidance 8 versus Landfill Criteria

Tracking:	Recipient	Recall
	McCammon, Alan W ENV:EX	
	Love, Mark P ENV:EX	
	Sundher, Avtar S ENV:EX	Succeeded: 2013-03-18 10:23 AM
	Stroich, Chris ENV:EX	Succeeded: 2013-03-19 8:21 AM

Hi all, I think we all found the discussion on Tuesday valuable...I definitely did. As Alan pointed out, there is really no replacement for getting together face to face to work on this type of subject matter.

We spent a fair bit of time talking about TG8, *Groundwater Investigation and Characterization* and the *landfill criteria*. I thought I would look into this a little more and post my thoughts while the matter is fresh in my mind. Alan made the comment (or similar) that, "We are trying to protect the same things; the science is the same; we should be able to harmonize an approach." This is a great comment that we want to keep reminding ourselves of.

So here are my thoughts:

- The draft landfill criteria default for design of new MSW landfills is for composite lined sites. It proposes that the appropriate water quality criteria must be satisfied at and beyond the "landfill site boundary", or 150 m from the "landfill footprint", whichever is closer. As the design proposes a barrier system, applying the most restrictive water quality criteria (e.g. DW) to new sites would not be problematic.
- TG8 and the companion document is excellent work. The main difference I see is that TG8 starts with a very robust approach and suggests you can do less with rational; conversely, the *Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills*, start off with less robustness and suggest more may be necessary. Probably, we should be somewhere in the middle. A few specific areas where TG8 may drive unnecessary robustness regarding application to landfills are:
 - The reference to potential contaminants of concern (PCOCs). This language works really well for contaminated sites as usually discrete contaminants are being dealt with. Conversely, MSW landfills have such a broad range of wastes, the use of the term PCOCs may be interpreted as investigation is needed for anything that may be in the landfill.
 - The spacial distribution of wells; for example, TG8's default is for a horizontal spacing of less than 5m.

I realize TG8 states there is flexibility based on rational. However, I do believe it would generally be interpreted as requiring much more investigation than is proposed by the landfill monitoring guidelines, and maybe more effort than is necessary. To validate my perception, I posed the following question to Jill Sacre at Golder: "If you apply TG8 to groundwater investigations at landfills, does it change your approach?" Jill said she will consider the question and get back to me. I think she will be a good gauge for this as she is a senior hydrogeologist with Golder, primarily works in the landfill area, has significant experience with contaminated sites, cognizant of the companion document produced by Golder, and has demonstrated excellence in her approach for investigation on the sites I have worked with her on. If Jill responds that application of TG8 to landfills wouldn't change her approach, I would be very confident just adopting it as is and replacing the landfill monitoring guidelines. By the way, Jill was very pleased to hear that we are working to harmonize our regulatory approaches in this area and is going to banter around the topic with others in her organization.

- Similarly TG6, Water Use Determination, is excellent work. It provides excellent guidance for determining the appropriate criteria for landfills. I have a few thoughts here:

- o I believe in EM we have not done a very good job of putting our minds to what criteria applies to a site. I know some authorizations state the Director may set the criteria and in others we are silent on this point. The SDM definitely has the authority to do this but I believe it is rarely done. This determination would be analogous but separate from CSR Sec. 12 *"Specification of applicable land, water, sediment and vapour uses and site-specific factors"* If EM put more rigour around setting the appropriate criteria using TG6 as guidance, I think this would go a long way to harmonization. We might need to ask Dennis Doyle advice on how a SDM's decision to set a criteria might way into a future SDM's determination under CSR Sec. 12. Off-hand, I would assume it is the same sort of process as a future SDM making a permit amendment.
- o It seems the application by LRB to apply DW criteria as the default has made this much more complicated. Perhaps it is just my misunderstanding on how this criteria is being applied. Maybe this is simply a communication piece as application of TG6 to many landfills would not result in DW applying.
- o I have no doubt that application of TG6 to some landfills will result in DW criteria applying. However, as this is just guidance, the SDM can still vary this with good rational either by adjusting the appropriate criterion, the point of compliance or risk assessment. For example, where downstream water use has been eliminated by virtue of a community water supply (e.g. increased Fe), maybe the SDM need not go any further and either modify the criteria that applies or eliminating Fe as a target parameter.
- o If EM SDMs were to put more effort into establishing the appropriate criteria, this would assist with the complication of giving *Notice of Offsite Migration*. As I understand it, NOM would only be triggered when the establish criteria is exceeded. Where we have decided on an appropriate criteria and it is exceeded, it would almost certainly trigger remediation or risk assessment.

Perhaps the above will make more sense with some graphics as we talked about. Maybe it is not that complicated of a matter to draft another Technical Guidance Document, *"Groundwater Investigation and Characterization for Landfills"* that refers to TG8 and TG6 but explains the specific application to landfills.

We still have lots of pieces to work on but if the above makes sense, it gets us a good start on harmonization and maybe to the appropriate middle ground. I would be happy to turn the above text into a presentation for us to kick around if you think that would be helpful.

Larry