Province of British Columbia

Environmental Appeal Board

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APPEAL NO. 2003-WAS-025(a)

In the matter of an appeal under section 44 of the *Waste Management Act*, R.S.B.C. 1996, c. 482.

BETWEEN:	Ermes Culos	**APPELLANT**
AND:	Assistant Regional Waste Manager	**RESPONDENT**
AND:	Wastech Services Limited	**THIRD PARTY**

BEFORE: A Panel of the Environmental Appeal Board
Dr. Robert Cameron, Panel Chair

DATE: Conducted by way of written submissions concluding on June 21, 2004

APPEARING:

For the Appellant:	Ermes Culos
For the Respondent:	Frank Rhebergen
For the Third Party:	R.S. Black

APPEAL

This is an appeal by Ermes Culos against the November 14, 2003 decision of Frank Rhebergen, Assistant Regional Waste Manager (the "Assistant Manager"), Thompson-Okanagan Region, Ministry of Water, Land and Air Protection (the "Ministry"). The decision is to amend sections of Operational Certificate MR-7577 (the "Certificate") held by Wastech Services Limited ("Wastech") and the Village of Cache Creek. The Certificate authorizes Wastech and the Village of Cache Creek to manage municipal solid waste at a landfill near Cache Creek, B.C. In the Assistant Manager's covering letters, the amendments are described as follows:

(a) Section 1. The legal land description has been amended to include the strips of land to the west and the south of the original lease boundaries to cover these areas where landfill access roads and surface water diversion works are located.

(b) Section 4. References to the 1996 Landfill Gas Management Program and the 2000 Operations and Closure Plan have been added to the Certificate.

(c) Section 7.2 now requires the Annual Reports to be provided to the public libraries in Ashcroft and Cache Creek.

(d) Section 8 has been simplified concerning post-closure security requirements.

(e) Site plan. The Site Plan on Page 11 has been revised to show the additional lands to the west and south as well as the location of the south berm to be constructed.

(f) Other changes. There have been several purely administrative updates made to the Operational Certificate.

(g) In addition, pursuant to section 4.1.6 of the Certificate, authorization is granted to modify the Cache Creek landfill site development plan to construct the "south berm" as requested in the January 8, 2003 letter from Wastech and as described in the following documentation:

Golder Associates report to Wastech, dated November 21, 2001.

Golder Associates letter and attachments, dated August 5, 2003 addressed to Wastech.

Sections 2.0, 4.1 and 6.0 of Golder Associates 2002 Annual Report on the Cache Creek landfill.

Construction of the "south berm" will allow for an estimated increase of 618,000 m^3 in landfill capacity.

The Environmental Appeal Board has the authority to hear this appeal under section 11 of the *Environment Management Act* and section 44 of the *Waste Management Act* (the "*Act*"). Section 47 of the *Act* gives the Board the power to confirm, reverse or vary the decision being appealed, send the matter back to the original decision-maker with directions, or make any decision that the person whose decision is appealed could have made, and that the Board considers appropriate in the circumstances.

Pursuant to section 11(12) of the *Environment Management Act*, the Board invited Wastech and the Village of Cache Creek to participate in the hearing as third parties. Wastech accepted the invitation and has been joined as a party to the appeal. The Village of Cache Creek did not accept the invitation and made no submissions on the appeal.

Mr. Culos raises no objections to the changes to the Certificate identified above as items (a) through (f). He objects to item (g) that allows for the additional 618,000 m^3 of additional landfill capacity.

Mr. Culos states that the authorization that will allow the additional 618,000 m^3 of garbage is in contravention of the Thompson-Nicola Regional District (TNRD) Solid

Waste Management Plan (SWMP). This plan requires a public consultation process if there is a significant increase in the rate of deposition of solid waste imported from outside the TNRD.

Mr. Culos is also concerned that there may be contamination of local well water supplies due to leachate discharge from the landfill into the groundwater and that this condition will be exacerbated by the additional refuse volume.

This hearing was conducted by way of written submissions.

BACKGROUND

Operation of the Cache Creek landfill was first authorized in 1987 under a permit issued by the then Provincial Ministry of Environment and Parks. Waste discharged to the landfill comes from the Greater Vancouver Regional District ("GVRD"), the Village of Cache Creek, and from the surrounding TNRD. The landfill is located on Crown land just south of the Village of Cache Creek. The landfill property occupies about 47 ha of land and is bordered by the Trans-Canada Highway to the east. The Bonaparte River is located approximately 400 to 500 metres east of the Trans-Canada Highway.

Mr. Culos has filed several previous appeals concerning this landfill, primarily based on concerns that leachate from the landfill may be contaminating local groundwater. In 1987, the Board received sixteen appeals against the permit, including one from Mr. Culos. On September 21, 1987, the Board dismissed the appeals, subject to certain amendments to the permit (*Ashcroft Ranchers Association et al. v. Director of Waste Management,* (Appeal No. 87/13 Waste, September 21, 1987)(unreported)). After the permit was reissued in January 1989, Mr. Culos filed another appeal. In that appeal, Mr. Culos raised concerns about groundwater contamination and non-compliance with the permit. The Board dismissed the appeal in a decision dated December 14, 1989 (*E.P. Culos v. Director of Waste Management*, (Appeal No. 89/20 Waste, December 14, 1989)(unreported)).

In 1995, Wastech and the Village of Cache Creek applied to amend the permit, primarily to create consistency with newly approved solid waste management plans for the GVRD and the TNRD. Rather than amending the permit, the Regional Waste Manager issued the Certificate in June 1996. Under sections 18(5) and 21 of the *Act*, a manager is authorized to issue "operational certificates" to replace permits as a means of authorizing a waste management facility under an approved solid waste management plan.

The Certificate included the operational requirements set out in the original permit, and the amendments sought in the application. The Certificate also included requirements for a gas management plan and a stormwater management plan, which were developed after the permit was approved. In addition, the Certificate included an environmental protection monitoring program, including quarterly sampling of fluid from the leachate collection sump.

On February 2, 1998, section 6.1 of the Certificate was amended in accordance with the Board's direction to increase the frequency of leachate monitoring during the summer storm season. Portions of the amended section read as follows:

6.1 Management of Leachate Collection System Fluid

> …Following a period [sic] three calendar years beginning from the date of this amendment, the Regional Waste Manager may reduce the frequency of leachate collection sump fluid sampling if warranted…
>
> …Fluid recovered from the leachate collection system may be used within the landfill footprint for irrigation or dust suppression unless otherwise directed by the Regional Waste Manager. Other methods of treatment and/or disposal of the leachate collection sump fluids must have the prior approval of the Regional Waste Manager.

In 2001, Ministry staff considered whether it was necessary to continue monthly leachate testing during the period from June through September. In her April 30, 2001 Technical Report, Carol Danyluk, a professional engineer and Pollution Prevention Officer for the Southern Interior Region of the Ministry, recommended that the frequency of leachate testing at the landfill be reduced to a quarterly basis from June through September. In support of her conclusion, she cited the 2000 Annual Report prepared on behalf of the Certificate holders by Golder Associates Ltd. ("Golder").

On May 15, 2001, section 6.1 of the Certificate was amended in accordance with Ms. Danyluk's recommendation. Section 6.1 now reads:

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 Regional Waste Manager 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 Regional Waste Manager. Other methods of treatment and/or disposal of the leachate collection sump fluids must have the prior approval of the Regional Waste Manager.

As stated earlier, on November 14, 2003, the Assistant Manager amended the Certificate. Amendment (g) allows for the construction of the "south berm" for an estimated increase of 618,000 m^3 in landfill capacity.

On November 18, 2003, Mr. Culos appealed the decision to increase the tonnage of solid waste to be received at the landfill. He appealed on the basis that the testhole (OW4), furthest southeast from the landfill, has for years shown evidence of leachate and that no additional holes have been drilled to the east or southeast of OW4 to show that leachate is not migrating past OW4. He also is concerned about a rumour that suspicious substances have been detected near the Bonaparte River east of the landfill. He feels that the increase in waste tonnage will add to the amount of leachate moving towards the river and will contaminate water supply wells near the river.

In his initial submissions, Mr. Culos asked that the Certificate holder "go out there & drill a few more testholes in the questionable areas & run a few more tests."

In subsequent submissions, Mr. Culos asked for an order overturning the decision of the Assistant Manager and for an order that the following conditions be met before the proposed expansion takes place:

- The proposal to expand is put through a proper consultation process as required by the Thompson-Nicola Regional District (TNRD) Solid Waste Management Plan (SWMP).

- Thorough and periodic testing be done in all existing water wells near the Bonaparte River as far as Boston Flats, including the well at the Chip Mill and that the results of these tests be made available for public review.

- Install a series of monitoring wells along the road …in the area between the Wastech offices and the Chip Mill, and in the area marked by a red line on Mr. Culos' drawing on p. 15 of his Rebuttal, near OW4, as well as downstream, southeastward, of the so called "infilled channel" past OW4 … for a distance extending ideally all the way to the Bonaparte [River].

- Independent monitors, in addition to Golder Associates be commissioned to sample and analyze the data from these wells.

- All available documentation related to the Cache Creek landfill be made available to the residents at public locations.

The Respondent and Wastech oppose the appeal and request that it be dismissed.

ISSUES

1. Whether the authorization for the additional landfill capacity is in contravention of the TNRD SWMP that requires public consultation if there is a "significant increase" in the rate of deposition of solid waste imported from outside of the TNRD.

2. Whether the additional refuse volume will result in changes to groundwater quality outside of the property boundaries that may result in contravention of landfill requirements.

3. Whether the number and location of existing monitoring and observation wells is sufficient to address leachate effects on groundwater outside of the property boundaries if there is a pathway through the bedrock leading eastward as suggested by Mr. Culos.

Mr. Culos raises several additional issues in his submissions to the Board. He makes a number of arguments, including those concerning (1) existing fly ash disposal in the landfill, (2) waste reduction in the GVRD, (3) an underground lake north of the proposed addition, (4) existing recirculation of leachate in the landfill, (5) leakage below and through the existing membrane liners, (6) change of external consulting engineers and, (7) existing groundwater flow rates and volume.

However, the decision that is the subject of this appeal only relates to public consultation and possible effects on leachate discharge due to the increased volume of garbage that will be disposed of in the landfill as specified in the Certificate. Therefore, the additional issues raised by Mr. Culos are beyond the jurisdiction of the Board under this appeal and will not be addressed by the Panel.

RELEVANT LEGISLATION

The following sections of the *Act* are relevant to this appeal:

Powers of manager respecting operational certificates

21 A manager may exercise a power or authority in relation to an operational certificate in the same manner and to the same extent as provided by this Act with respect to a permit.

Amendment of permits and approvals

13 (1) A manager may, subject to this section and the regulations, *and for the protection of the environment*,

(a) on the manager's own initiative if he or she considers it necessary…

amend the requirements of the permit or approval.

…

(4) A manager's power to amend a permit or approval includes all of the following:

(a) authorizing or requiring the construction of new works in addition to or instead of works previously authorized or required;

...

(f) authorizing or requiring a change in the quantity of waste discharged, stored, treated, handled or transported;

...

[emphasis added]

Also relevant is the following section of the *Public Notification Regulation*.

Duties of the applicant and manager

4 (6) A manager must, at least 14 days before an operational certificate or amended operational certificate is issued,

(a) give written notice to the person to be named in the operational certificate or amended operational certificate of the manager's intention to issue the operational certificate or amended operational certificate, and

(b) do *one or more* of the following:

(i) serve a copy of the notice given under paragraph (a) on every person who *in the opinion of the manager*, may be adversely affected by the discharge, emission or storage of recyclable material or waste:

(ii) post a copy of the notice given under paragraph (a) in one or more post offices serving the area affected by the discharge, emission or storage of recyclable material or waste:

(iii) publish a copy of the notice given under paragraph (a) in one or more local newspapers.

[emphasis added]

DISCUSSION AND ANALYSIS

1. Whether the authorization for the additional landfill capacity is in contravention of the TNRD SWMP that requires public consultation if there is a "significant increase" in the rate of deposition of solid waste imported from outside of the TNRD.

Both Mr. Culos and the Assistant Manager quote the same portion of section 5.9.3.a of the TNRD's SWMP. This requires that

> significant increases in the **rate** of deposition of waste imported from outside the Thompson-Nicola Regional District to existing landfills involve a public consultation process with the community or communities within the Thomson-Nicola Regional District along the transportation corridors. [emphasis added].

In his opening argument, Mr. Culos says that it is the additional amount of garbage, rather than rate, that is at issue. He then goes on to argue why it should be the amount of garbage rather than the rate that would trigger the need for public consultation.

The Assistant Manager disagrees. He believes that the TNRD SWMP's requirement for public consultation is clearly concerned with the rate rather than the total amount and, in particular, the "**rate of deposition of waste imported…** ." He then explains why the rate would be more important to the TNRD Board than the total amount of garbage.

In his rebuttal, Mr. Culos states "Mr. Rhebergen correctly indicates that 5.9.3 deals with the increase in the rate of deposition rather than with the increase in the actual amount of garbage imported, something which I freely acknowledged myself." Mr. Culos agrees with the Assistant Manager's comments that the rate of deposition would have an effect on landfill site life and would have socio-economic implications for the area, as well as implications for traffic, noise, dust and other operational concerns, which could be of interest to the public. However, Mr. Culos goes on to argue that the local citizenry would also be affected by an increase in the total amount of garbage and that the implications would be similar.

The Panel agrees that local residents may be affected, to a greater or lesser extent, by an increase in the total amount of garbage delivered as well as by an increase in the rate of garbage delivery. The Panel notes however, that the TNRD's SWMP wording is specific. If the TNRD had meant to say "total amount" it would have said so. It is not possible to correctly interpret the word "rate" to mean "total amount."

The Panel concludes that, because the amendment to the Certificate does not change the rate of delivery of garbage to the landfill, the TNRD's requirement for public consultation under section 5.9.3.a of the SWMP is not applicable.

Nevertheless the Ministry, in accordance with section 4(6) of the *Public Notification Regulation*, did notify relevant agencies and potentially interested members of the public (including Mr. Culos) of the proposed November 2003 amendments to the Certificate. Copies of the draft amended Certificate, and a letter of notification explaining the amendments and inviting questions, comments or concerns were included in the notification. Mr. Culos was the only party to express concerns. The Assistant Manager further stated that all other responses indicated that there were no concerns with the proposed amendments.

2. Whether the additional refuse volume will result in changes to groundwater quality outside of the property boundaries that may result in contravention of landfill requirements.

None of the parties provided documentary evidence in the way of tabulated results from the testing of samples from the various groundwater monitoring wells. No evidence was provided showing the changes in groundwater quality over the life of the landfill. No evidence was presented relating the quality of the upstream and downstream groundwater to the Provincial Government's "Approved and Working Criteria for Water Quality."

As indicated by the fact that leachate is being collected from sumps (leachate collection points within the landfill) there is no dispute that leachate has been produced by the landfill.

Golder provides an understanding of the direction of groundwater movement in relation to the landfill as follows:

> The Cache Creek Landfill is located within a south-southeast trending glacial valley that became partially infilled with glacial and post-glacial sediments during the last glaciation. The valley, which is approximately centered [sic] on and parallel to the Trans Canada [sic] Highway, narrows at the north end and widens downgradient to the south toward the Bonaparte River valley. It is separated from the Bonaparte River Valley to the northeast by a drumlinized bedrock ridge and to the east by a medial moraine ridge… Groundwater flow is directed towards the east-northeast…on the sloping portion of the landfill site… At the base of the hillslope, groundwater is discharged from the shallow bedrock into the base of the infilled valley. Within the infilled valley, groundwater flows towards the southeast within the sand and gravels along the valley axis.

In his section on groundwater chemistry, Mr. Culos makes a few comments regarding the analytical test results from groundwater samples from downgradient wells outside of the landfill property boundaries.

OW2 is a monitoring well on the east side of the Trans-Canada Highway (the "Highway"). It appears to be within the infilled valley and is southeast of the landfill and is outside the landfill property boundary. Appearing to quote from a Golder report, Mr. Culos states:

> Since 2001, chloride has been relatively stable at a concentration of about 30 mg/L, with the exception of the most recent sampling event…(when) chloride increased from 27.4 mg/L to 67.1 mg/l, a level consistent with that currently observed at OW4.

Mr. Culos comments that "Clearly chloride is present in significant quantities at this well, which indicates that leachate is moving beyond the confines of the landfill. Same is true of OW4. Nickel too is found at OW2."

OW4 is another monitoring well on the east side of the Highway. It also appears to be within the infilled valley. It is located further to the southeast than OW2. Mr. Culos comments that "This well shows an increase in just about everything: chloride, conductivity, nickel, uranium, etc.…"

The Panel notes that the British Columbia "Approved and Working Criteria for Water Quality" establishes the following relevant criteria for chloride:

- Drinking water 250 mg/L maximum
- Irrigation 100 – 700 mg/L depending on crop

Other comments include what appears to be a quote from a Golder report that "a statistically significant increase in uranium was identified historically at OW4."

A final comment provided by Mr. Culos is that "Golder notes that 15 of 16 parameters showed a statistically significant increase in the groundwater relative to background/baseline data at OW1, just inside the site, while 14 of 16 parameters showed a similar change at OW4…." The meaning of the expression "statistically significant increase" was not given.

In terms of constituents in the liquid analyzed at the monitoring wells, the Assistant Manager addresses only the question of uranium at wells OW2 and OW4. He discussed the situation with Dr. Narender Nagpal of the Ministry's Water Protection section in Victoria. Dr. Nagpal indicated that the 0.01 mg/L total uranium criterion for continuous or intermittent irrigation is "very shaky" and he would not be too concerned about higher levels. He indicated that the U. S. Environmental Protection Agency does not have a specified guideline for uranium in groundwater and that the 0.01 mg/L working criterion is based on only one study – a 1971 Russian study which concluded that, with irrigation water applied at 0.01 mg/L total uranium, it would take over 200 years for uranium to build up to 10 ppm (parts per million) in any soil. Dr. Nagpal advised that this criterion is on the Canadian Council of Ministers of the Environment list of criteria that require review and that "the results …would not likely be available for another couple of years."

Golder, responding on behalf of the Certificate holders, states "We concur that changes in groundwater chemistry for some constituents have been observed that may be attributable to landfill activities; however, there continues [sic] to be no changes in groundwater chemistry related to the landfill that would require a change in groundwater use downgradient of the site, with the possible exception of one of two Ministry working irrigation guidelines for uranium."

The Ministry of Environment, Lands and Parks (now Ministry of Water, Land and Air Protection) issued "Landfill Criteria for Municipal Solid Waste" (the "Landfill Criteria") in 1993. Section 4.1 of the Landfill Criteria clarifies a portion of the above Golder comment. The section reads:

> Landfills must not be operated in a manner such that ground or surface water quality in existing or potential future water supply

> aquifers or surface waters decreases beyond that allowed by the Approved and Working Criteria for Water Quality prepared by the Water Management Division of the Ministry of Environment, Land and Parks…at or beyond the landfill property boundary.

For the example of chloride cited above for OW2, where the chloride concentrations ranged from 27.4 mg/L to 67.1 mg/L, this means that the chloride concentration in the groundwater outside of the property boundaries should not exceed 250 mg/L for drinking water.

The Panel concludes that there is migration of leachate from the landfill site to the wells beyond the property boundary. The limited evidence presented does not indicate that the quality of the groundwater at the monitoring wells outside the property is being impaired beyond that allowed under section 4.1 of the "Approved and Working Criteria for Water Quality".

Mr. Culos states that "the addition of 600 000 tonnes of garbage would make a bad situation much worse than it already is." Mr. Culos later acknowledges that he should have said 618 000 m^3 rather than 600 000 tonnes.

Mr. Culos also likens the addition of another layer of garbage on top of a previous layer to the action of a winepress. With every turn of the threaded winepress bar, pressure is applied to the fermented mash and wine is pressed out. Therefore, he appears to conclude that, with each added layer of garbage, greater pressure will be exerted on underlying layers and leachate will be squeezed out. The Panel notes that fermented mash is essentially 100% saturated with liquid whereas, according to "Solid Waste: Engineering Principles and Management Issues" by Tchobanoglous, Theisen and Eliasen, solid waste may be expected to have a moisture content of between 15% and 40%. The turn of the winepress bar analogy does not apply.

Golder responds that "This landfill performance to date indicates that the relatively small additional refuse tonnage (less than 9% increase of design capacity) should not result in leachate impacts to groundwater usage."

The Assistant Manager states that "some of the issues I discussed with the proponent and Golder included: …filling in of the natural drainage gully in the area where the south berm was to be constructed, diversion of surface runoff from this natural drainage gully, origin of the drainage gully (related to any natural fault systems?) and whether or not it represented any possible leakage paths into the groundwater, tightness of the bedrock, recharge versus discharge areas, potential for leachate escapement from the landfill area, contingency options in case off-site groundwater contamination became a problem in the future, overall water balance for the site… . I was satisfied that the proposed amendment would have no significant effect on environmental protection related issues…."

In rebuttal, Mr. Culos states that "If the addition of 9% more waste makes no difference, then one could add another 9%, and another 9% on top of that, without

ever noticing any difference. Mathematically, the old-time argument that one straw can break a camels back is a more weighty argument than Golder's."

The Panel has been provided with no technical information regarding the proposed expansion. There is mention that the base of the fill will be in or near a drainage gully. There is no mention of a synthetic liner system to collect leachate. There is no information supplied regarding the depth of the new garbage to be placed. There is no mention of the depth of garbage that will lie under the new garbage fill. No information is provided on the nature, thickness and hydraulic conductivity of intermediate and final soil covers for the expansion. The Panel was given no information on the mechanism of leachate formation (e. g. whether totally due to incident precipitation or partially due to uncontrolled or unexpected stormwater discharge). No information has been provided to the Panel regarding dilution effects, if any.

The Panel has been provided with no technical information to show what magnitude of change has taken place in groundwater quality for the various constituents analyzed. However, the Panel believes that it is reasonable to conclude that the Assistant Manager would have commented if the terms of section 4.1 of the Landfill Criteria were not being met. What the Assistant Manager does say is "If there was a clearly increasing trend in the landfill leachate indicator parameters in groundwater monitoring or if Provincial Water Quality Guidelines were to be exceeded, additional exploratory work would be warranted and required."

The Panel was provided with no evidence that the additional refuse volume will cause the groundwater quality requirements of the Landfill Criteria to become exceeded, and cause impairment of the groundwater quality outside of the property boundaries. However, the Panel has concluded that the proposed expansion may result in some increase in volume of leachate produced, and may also result in changes in the concentration of groundwater constituents at the downgradient monitoring stations.

Given the possibility of changes in the quality and quantity of leachate that may be discharged from the landfill, it is considered to be prudent to examine the possibility of the alternative leachate flow path as suggested by Mr. Culos.

3. Whether the number and location of existing monitoring and observation wells is sufficient to address leachate effects on groundwater outside of the property boundaries if there is a pathway through the bedrock leading eastward as suggested by Mr. Culos.

This section deals with technical considerations relating to underground bedrock. Mr. Culos presented no documentary evidence to support his assertions. Golder presented some limited documentary evidence in the form of four drawings (Site Plan, Regional Geologic Cross Section, Bedrock Contours and only one of the three new seismic lines (Seismic Line SL-3) Profile).

Mr. Culos quotes a consultant for Brown, Erdman and Turner Ltd. ("Brown, Erdman"). The quote is: "It is impossible to find a more fractured group of rocks…" "the area is actually a giant fault or breccia or mélange." Other quotes in the Brown, Erdman study are: "bedrock units in the area are pervasively sheared, fractured, faulted and jointed" and "near Cache Creek, rocks…are a mixture of isolated blocks of deformed limestone, basalt…lithic sandstone, and thin bedded chert surrounded by silicious [sic] argillite (and this) sheared argillite composes about 75% of the total Cache Creek group." Mr. Culos also quotes from Golder's 1988 report: "The Melange unit of the cache [sic] Creek Group…consists of blocks of limestone, greenstone, tuffs, chert and siliceous volcanics in a variably sheared matrix of carbonaceous argillites…The block [sic] range in length from centimeters [sic] to hundreds of meters [sic]…tectonic activity and metamorphism has [sic] caused extensive shearing of the matrix and rotation of the blocks. This has caused the bedrock underlying the site to be highly variable in both rock type and competency."

Mr. Culos also quotes from the 1988 Golder report that: "groundwater movement was upward from bedrock into the overlying overburden [which] indicates that the site is within the regional groundwater flow." Mr. Culos says that this reinforces that water can travel through the sheared and fracture bedrock. He questions, "If water can travel through the lines of shear & fracture & show up at the base of the channel, why can it not also travel a little farther & show up on the eastern slope of the presumed ridge of rock that separates the infilled valley from the Bonaparte River?" He also asks a similar question regarding leachate movement through the shears and fractures to the infilled valley and beyond to the Bonaparte River.

Golder replies

> We concur that a high degree of weathering can be associated with the upper bedrock surface in some areas. However, TH-9 [testhole-9] and TH-7 [testhole-7] were located in the area of this bedrock ridge and at these locations, the hydraulic conductivity within the upper 6 m of the bedrock was measured in 1988 to be two to four orders of magnitude less than the hydraulic conductivity of the overlying sand. This indicates that the groundwater would prefer to flow through the sands within the infilled channel, rather than east through the much lower permeability bedrock. In addition, the upward hydraulic gradients measured in groundwater monitoring well location TH-9 (and at TH-7, although this well was destroyed after installation in June 1988) indicate that, within the infilled valley, groundwater discharges from the underlying bedrock upward into the overlying sediments.

Golder's Figure 4.2 illustrates this upward groundwater flow in the area between the landfill and the Bonaparte River.

In light of the upward groundwater flow and the differences in hydraulic conductivity, the Panel agrees that Golder's conclusion, that groundwater would flow preferentially through the sands in the infilled valley, is reasonable.

Mr. Culos says that Golder believes there is a continuous bedrock ridge that runs along the east side of the infilled valley from a location north of the Wastech offices to the chip mill. (The Wastech offices are located across the Highway from the landfill approximately in line with the centre of the landfill. According to Mr. Culos' sketch on page 13 of his rebuttal, the chip mill seems to be about 400 m to 500 m southeasterly from the Wastech offices).

Mr. Culos relies on information provided in a report by Frontier Geosciences Ltd. ("Frontier") that he states is included in a 1988 Golder report. He quotes the Frontier report as saying, "An alternative possibility [to the southeast flow direction in the infilled valley] is that the channel turns abruptly and heads east." He goes on to say that

> For Golder a bedrock ridge flanks the entire length of the channel and separates it from the Bonaparte valley; for Frontier this ridge is not continuous: somewhere between the Wastech office & the chipmill there is a gap, a break in the ridge's continuity. According to Frontier, the dip indicated by the seismic line [this is seismic line 9, identified on Golder drawings as F9] may well be the start of this gap. And through this gap may flow some or most or [sic] the groundwater (cum leachate possibly) coming from the landfill.

Seismic line F9 is directly on the opposite side of the Highway from the landfill and runs in a southeasterly direction gently angling away from the Highway.

Golder says

> During the 2003 field investigation, a seismic geophysical survey was carried out along three new lines (SL-1, SL-2 and SL-3) as shown in Figure VI-1 (which also shows Frontier Seismic Line 9 as F-9) of the 2003 Annual Report…One of these lines completed in 2003, SL-3, was located in an east-west orientation approximately mid-way along Frontier Seismic Line 9 (this is the approximate location identified on pages 11 and 12 of the Appeal as potentially having the bedrock ridge absent). The results of the geophysical survey (see Figure VI-5 of the 2003 Annual Report which is attached for reference) show a distinct bedrock channel approximately 33 m deep at that location, with the bedrock surface rising to the east of the centre of the infilled valley to within approximately 5 m of the existing ground surface, indicating the presence of a bedrock ridge at this location. In summary, the 1988 Frontier report suggested that, in the vicinity of Seismic Line 9, the buried valley might lie either southwards or turn abruptly eastward. The results of the Golder's 2003 geophysical survey line SL-3 supports

> the interpretation that the buried valley extends southward, as was also assumed for the analyses in Golder's 1989 report, and does not turn abruptly eastward at this location.

In rebuttal, Mr. Culos discusses two items that he feels do not support Golder's conclusion. He quotes a 2003 Golder report comment that "the geophysical data is considered to have a 10% to 20% accuracy… The contour lines shown… do not represent exact bedrock elevations." In a footnote, Mr. Culos interprets the "10% to 20% accuracy" to mean "80% to 90% accurate."

The Panel notes that, in Golder's Figure VI-5 (that shows the 2003 SL-3 seismic profile), the statement is made that "uncertainty in depths to interfaces is within ± 20%." This supports Mr. Culos' interpretation that the contour lines are 80% to 90% accurate. The Panel also notes that, if this 20% uncertainty were applied to the 33 m depth of bedrock mentioned above, the channel would be still be a minimum of about 26 m deep.

The second point Mr. Culos makes is

> …that the new SL-3 does not tell us what the bedrock profile is like for the 400-500 feet that separate the new SL-3 from the old SL3, that is, the one that intersected the southern end of Frontier's SL9. (Golder simply assumes that the bedrock rises east of the "channel" right through the whole stretch from the old SL3 to the new SL3.) Given the reportedly poor reliability of the bedrock contours shown in Figure VI-1, attached in Golder's response, Frontier Geosciences theory of a buried east-flowing channel in the general vicinity of–and perhaps running parallel to–the old road going down to the Chip Mill office and the Bonaparte River is not robbed of any of its strength.

The Panel assumes that Mr. Culos meant to say Figure VII-2, rather than Figure VI-1, because Figure VI-1 is the site plan and Figure VII-2 is the bedrock contour plan.

The Panel also observes that a statement on the Figure VII-2 bedrock contour plan says "Bedrock contours were generated by interpolation between seismic lines, borehole locations, and from mapping of exposed bedrock, and must be considered to be approximate."

The Panel disagrees that all of these considerations, particularly the mapping of exposed bedrock and the borehole logs, lead to the conclusion that the bedrock contours are "poorly reliable."

The Panel has also examined the new seismic profile SL-3. The profile of seismic line SL-3 shows two dips with the deeper one being about 25 m east of the

shallower dip. There is only about 0.5 m to 1 m difference between the elevation of the bottoms of the two dips.

On Golder's site plan (Figure VI-1), SL-3 is shown to intersect Frontier's seismic line 9 (F-9). Based on the scale in the Legend on Figure VI-1, the intersection between F-9 and SL-3 is about 55 m from the west end of SL-3 and about 195 m from the east end of SL-3. This gives a total length of about 250 m for SL-3. From the horizontal axis of Figure VI-5, the horizontal length of SL-3 is shown on Figure VI-5 to be about 237 m – a difference of about 13 m.

Allowing for this 13 m discrepancy, the distance from the east end of SL-3 to its intersection with F-9 would be between about the 182 m and 195 m distances shown on the horizontal axis of the SL-3 plot in Figure VI-5.

On the same drawing, the two dips in the bedrock are shown to be about 130 m and 156 m from the east end of SL-3. From all of the above information, the Panel finds that the intersection of SL-3 and F-9 occurred between about 52 m (171 ft) and 65 m (213 ft) west of the deeper dip and between about 26 m (85 ft) and 39 m (128 ft) west of the shallower dip. From the vertical elevation scale on Figure VI-5, the elevation of the bedrock at the point of intersection of the two seismic lines is between about 6 m (20 ft) and 8.5 m (28 ft) higher than the elevations of the bedrock at the bottom of the two dips.

It is clear from the above, that the intersection of the SL-3 and F-9 lines does not occur in the bottom of the infilled channel.

From all of the foregoing, the Panel concludes that seismic line 9 neither followed "along the bottom of the infilled channel" nor did it "run along the base of the infilled channel" as stated by Mr. Culos in the discussion of his reasons for the "gap" or "discontinuity" in the ridge between the infilled valley and the Bonaparte River.

Respecting Mr. Culos' quote from Frontier that "…the channel turns abruptly and heads east", the Panel observes that Seismic Line F-9 would have intersected the channel at an angle of at least 50º. If the channel flowed northeasterly the angle of intersection would have been up to about 75º. The Panel also notes that this channel depth through the bedrock to the east would be about 30 m or nearly 100 feet. A 100 feet depth of channel between the "new SL-3" and "the old SL-3", as described above by Mr. Culos, over the "400-500 feet" distance between the two lines, is not, in the Panel's view, reasonably consistent with the elevations that were, as described above, determined from these two seismic lines as well as test holes and exposed bedrock.

Both seismic line 9 and the infilled valley run in approximately southeasterly directions. The Panel believes that the greater probability is that seismic line 9 intersected the bottom of the infilled channel at a very shallow angle and that the "dip" shown is not a "channel that turns abruptly and heads east" but simply the bottom of the infilled channel that is running southeasterly. The Panel further notes

that when a profile of seismic line 9 from Golder's Bedrock Contours map (Figure VII-2) is plotted, it is in reasonable agreement with Mr. Culos' sketch on page 10 of his argument that shows the "dip."

The Panel is satisfied, on a balance of probabilities, that there is no channel for leachate flow running eastward toward the Bonaparte River in the approximate vicinity of the middle of seismic line 9, and that the bedrock ridge in this area is continuous.

Mr. Culos also expresses concern that there may be a pathway from the infilled channel to the Bonaparte River in the vicinity of OW-4 (the monitoring well furthest to the southeast of the landfill). Mr. Culos quotes Golder to say "Newly-installed monitoring well MW03-2 was installed east of OW4…both shallow and deep piezometers…at MW03-2 were found to be dry, whereas OW4 contains water. This suggests that there is a low permeability ridge that separates the groundwater at OW4 from MW03-2." Mr. Culos notes that this says that MW03-2 was dry but on

> …page 2 of App. VII we read that 'At both locations (MW03-1 and MWO3-2)…the bedrock was overlain by **saturated** sands and gravels… .' [Emphasis added.] Now if the sand and gravel of MW03-2 is indeed saturated, …that water must come from somewhere. Since it is hardly likely to come up from the river, it must find its way to MW03-2 by infiltration through the bump that separates MW03-2 from OW4 – in which case water DOES flow east and down to the river-or it somehow finds an east-leading conduit somewhere north of OW4. …Page VIII-3 also points out that the 'valley appears to widen south of the landfill.' …it seems probable to me that there is no such thing as an infilled valley southeast of OW4. …that if we continue for another couple of hundred meters [sic] or so past OW4 we might discover that the bedrock at that point begins to drop steeply towards the Bonaparte. If this assumption is correct, then one more thing follows: that the advective travel time of any groundwater that makes it past OW4 will be far shorter than we have been led to believe over the years.

In response, Golder referred to "…a reference from page 2 of Appendix VII of the 2003 Annual Report was provided that suggested that saturated sands and gravels are present at **MW03-1**." [Emphasis added.] Golder said that: "The second sentence in Section 1.22 of Appendix VII of the 2003 Annual Report is incorrect and should be revised to read: 'At both drilling locations (MW03-1 and MW03-2; Figure VII-1), the bedrock (Unit 9) was overlain by sands and gravels (Unit 4), which were in turn overlain by sand (Unit 3) and sands and gravels (Unit 2).' We apologize for any inconvenience this has caused."

The Panel notes that, on Golder's Bedrock contours plan (Figure VII-2), the word "Dry" appears below MW03-2.

In his rebuttal, Mr. Culos refers to a report that shows water to a depth "from 460 to 480 meters [sic] approximately" in MW03-1A/B. He then goes on to quote that: "tritium levels in MW03-1A and 1B were low, ranging from below detectable limits to 1,2 TU." He adds "reference to water samples collected at this well are made elsewhere in the report as well-e.g., on p. VIII-23." He concludes "It [Golder] cannot claim dryness and report high water levels and detection of tritium at the same time."

It is clear that Mr. Culos' rebuttal argument above has no relation to conditions at MW03-2, which was the subject of his concern in his appeal. However, it also seems that Golder's response to Mr. Culos' concern about conditions at MW03-2 may have been misleading and that, perhaps the removal of the word "saturated" should have been applied only to MW03-2 and not to MW-03-1. From Mr. Culos' comments above and from the groundwater contours shown on Figure VII-2, it seems clear that there is water in MW03-1.

The Panel accepts the Golder correction that removes the word "saturated" from the description of MW03-2, and that this well is dry. On this basis, the Panel considers the conclusion that Golder has drawn, that there is a suggestion of a low permeability ridge that separates the groundwater at OW-4 from MW03-2, to be reasonable.

In his rebuttal, Mr. Culos suggests a new third pathway from the infilled channel towards the Bonaparte River. The Panel stresses that introduction of new information in rebuttal (i.e. information not arising from replies to Mr. Culos' appeal) is inappropriate and is normally not given any consideration. In this case, where the appellant is obviously concerned and has obviously spent considerable time on this appeal and reply, the Panel will address the subject of the third pathway.

Mr. Culos provides a sketch, on page 15 of his rebuttal, taken from Golder's Bedrock Contours map (Figure VII-2). He has drawn a red line showing a pathway leading toward the river. The red line pathway runs about halfway between, and roughly parallel to, both the 470 m and 475 m bedrock contours. The contour map shows the bedrock dropping from the 475 m contour to the 470 m contour to the 465 m contour and then down to about 461 m at wells OW2 and OW4. There is no reason to expect that water would preferentially flow horizontally along a sideslope at an elevation of about 472 m and not flow down the surface of the bedrock to lower elevations, especially when the lowest elevation is about 10 m below the indicated sideslope pathway.

The Panel concludes that this third pathway is highly improbable.

The Panel is satisfied that there are no pathways leading to the Bonaparte River in the locations indicated by Mr. Culos, and that any flow of leachate and groundwater leading from the landfill is, in all probability, flowing along the infilled valley as put forward by Golder. It is clear that leachate in the groundwater is migrating beyond

the property boundaries. However, the Panel is satisfied that the existing monitoring wells are located in positions where they will provide both the necessary information to ensure that downgradient water quality does not decrease beyond that allowed by the Landfill Criteria, and advance warning of any potential adverse effects on downstream groundwater quality.

DECISION

In making this decision, the Panel has considered all of the evidence before it, whether or not specifically reiterated herein.

For all of the foregoing reasons, the appeal is dismissed.

"Robert Cameron"

Dr. Robert Cameron, Panel Chair
Environmental Appeal Board

August 23, 2004