Appendix N

Correspondence with Private Interest Groups

CAMBIUM
ENVIRONMENTAL
1.866.217.7900
www.cambium-env.com

RUBY ROAD WASTE DISPOSAL SITE CAPACITY
EXPANSION ENVIRONMENTAL SCREENING PROCESS

BACKGROUND

Waste management operations development has been ongoing for many years in the Township of Bonnechere Valley. Several studies have been milestones along the journey to develop the municipal waste management operations. Much of the research and discussion have reviewed the available options and associated costs by the Township determined it was necessary to pursue the matter and find a solution to meet the Township's requirements. In approximately 4 years, the existing waste disposal capacity within the Township will be exhausted. A summary of the recent Township waste management planning activities is provided below as a cursory overview of the municipality's efforts to develop a long-term waste management solution.

2004

- Township undertakes a review of a variety of waste management options including: use of private waste contractors, a new waste disposal site location, waste diversion methods, and the Ottawa Valley Waste Recovery Centre (OVWRC).
- Councillors revisit a 2002 consultant's report providing a cost comparison of waste management practices for the Township.
- Township staff work with the Waste Management Committee to prepare background information for future waste management planning.
- Council directs staff to review the cost of participation with the OVWRC versus the costs of expanding an existing site (or sites) and costs of establishing a new waste disposal site.
- Council discusses the possibility of the necessary land acquisitions in regards to waste management.

2005

- Presentation to Council by Township staff about costs of waste management; includes review of the common issues of waste management faced by other municipalities and discusses methods to minimize costs.
- Waste Management Committee reviews status of Township waste management and the need for an Environmental Assessment (EA) to formally progress towards solution.
- Council recognizes that an acquisition of property is necessary to expand any existing landfill.

2006

- Township council instructs consultants to proceed with preparations for Waste Management Plan Development EA.
- A pre-consultation meeting is held with the Ministry of the Environment (MOE) to discuss the details of the EA.
- Council authorizes the commencement of the EA.

2007

- The Township of Bonnechere Valley formally commences the Waste Management Strategic Plan EA to evaluate the alternatives available based on technical, economical, and public opinion criteria.
- A draft Terms of Reference (ToR) document for the Waste Management Strategic Plan EA is completed.
- Ontario Regulation 101/07 (O.Reg. 101/07) emerges under the Environmental Assessment Act (EAA) directed partially at small, rural waste disposal sites whereby select waste projects are deemed exempt from a full EA if the Environmental Screening Process (ESP) is completed.
- A thorough review of pertinent data, annual monitoring reports, and other information associated with the Township is conducted; O.Reg. 101/07 is examined with respect to each of the existing waste disposal sites within the Township were to determine if an Environmental Screening is appropriate.
- Council authorizes the transition from the Waste Management Plan EA to an Environmental Screening of a Capacity Expansion at the Ruby Road Waste Disposal Site

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RUBY ROAD WASTE DISPOSAL SITE CAPACITY
EXPANSION ENVIRONMENTAL SCREENING PROCESS

DISPELLING COMMON MYTHS

Myth 1: The proposed landfill operation is classified as a "Mega Dump".

The capacity of the Ruby Road Waste Disposal Site, even after the proposed expansion, classifies it as a small waste disposal site. It is proposed to be an operation that will fill at a relatively slow rate to provide for the small population that it will serve. An amendment to the current Certificate of Approval by the Ministry of the Environment will limit the capacity to reach no more that approximately 125,000 m^3 on 8 acres of land. This will provided waste disposal capacity for the Township for 25-years or more.

Myth 2: There is a high risk of contamination to Golden Lake.

The risks associated with the site are still under investigation. If the possibility of contamination arises through the numerous studies being done to assess the potential impact, mitigation measures and contingency plans will need to be developed. There are countless guidelines to be followed in the highly regulated Environmental Screening Process. The off-site contamination risks are dependent on many factors such as: the depth of the overburden material, the flow of groundwater, soil composition, as well as the materials that are placed in the waste disposal site. Landfill operations today are strategically placed sites with suitable environmental conditions and the waste is monitored to prevent certain highly toxic substances from entering into the system. Strict monitoring is also necessary throughout the life of a waste disposal site and for many years after it has been closed.

Myth 3: Natural attenuation out-dated method that is unsafe and not used in the province.

Many waste disposal sites of this small size utilize natural attenuation as the means of contaminant suppression. There is a required contamination attenuation zone (CAZ) that must be provided where leachate is expected not to travel beyond and contingency plans must in place in order to deal with the leachate plume nears the boundary of the CAZ. Proper design of the site using engineered specifications, modelling programs, as well as continuous monitoring will aid in the proper containment of the leachate plume.

Myth 4: This is an expensive and quick fix to waste disposal in the Township of Bonnechere Valley.

Expansion of an existing waste disposal site within the Township is the most cost effective means to deal with the rapidly diminishing waste disposal capacity within the Township. In less than five years, the waste capacity within the Township will be utilized. This issue has been reviewed and researched by the municipality for years now and calculations that take into account the many factors related to the subject show that the Environmental Screening Process is a feasible option that is concise yet still incorporates key environmental factors. All other options have been thoroughly reviewed including: use of private waste contractors, expansion of an existing waste disposal site, establishment of a new waste disposal location, waste diversion methods, and export to the Ottawa Valley Waste Recovery Centre. As a result of this review, the Ruby Road site was deemed the most viable option for several reasons.

Myth 5: This is a "new" site.

Although acquiring new land will be required for the site to be expanded, the Ministry of the Environment recognizes this project as an expansion of an existing waste disposal site. A Certificate of Approval (CofA) exists for the current site that documents that the purpose of the site is for waste disposal. In order for the operations to be expanded and new land acquired, it would be necessary to apply for an amendment to the CofA to increase the capacity through the Ministry of the Environment approvals process. A new CofA would be unnecessary and existing structures and monitoring operations on the site reduce the overall cost the project. Details about the current site structure and characteristics have supported the decision to move forward to determine if this is a viable option for expansion.

REMINDER: PUBLIC CONSULATION EVENT NO. 2

When: Saturday, July 26, 2008
Time: 10:00 am to 12 noon
Where: Eganville Curling Club, 8 Foran Street, Eganville

March 4/08

Presentation to Township Council
By the Citizens for the Preservation of the Bonnechere Valley
Regarding the Proposed Ruby Road Landfill Mage-Dump

We are here tonight to follow up the promise we heard at the Feb. 20 sales presentation for a new Ruby Road landfill mega-dump – namely, a revised consultation process that will offer all affected parties a chance to join together to find a new and better solution to the township's waste disposal problems.

Let us be clear: we don't want a new landfill dump on Ruby Road. But this isn't just a reflex NIMBY reaction. We don't want a new landfill anywhere in our township. We don't believe that you should just dig a hole to bury your garbage anymore. The Ruby landfill dump suggested by the township seems to us an ostrich's solution, burying its head in the sands of the Ruby Road pit in an effort to avoid seeing the full range of future problems. It is an old and worn-out answer to a new challenge.

Unfortunately, we fear that a decision will be made based on short-term cost considerations and short-sighted political ones. We are well aware that South Algona is the least-populous component of Bonnechere Valley. But it is cost-efficient. One measure of this 'cost-efficiency' can be seen in the waste management budget. Out of a total expenditure of half a million dollars, South Algona accounts for $18,000 – about three and a half percent. But now, in exchange for all this cost-efficiency, the Township wants us to bury all their garbage in our back yards. That seems to bring up a question of fairness – of basic equity – especially since the overwhelming factor in the Township's mind seems to be dealing with the problem as quickly and cheaply as possible, and as far away as possible from the rest of the Township.

But cost can't be the only consideration. In fact, it isn't. The cheapest option identified in the Township's study was expanding the Sand Road site. But we're told that's not really an option. Why? Well, because of fears of polluting the groundwater.

Guess what – pollution worries us too. We depend on our wells. We depend on an unpolluted Golden Lake – and the township tax base does too. We know that the proposed site contains a creek, and a pond. We know from Environment Canada that all landfills – 100% of them – will fail to contain leachate at some time in their lives. We know that existing landfills in Bonnechere have failed to contain leaching. And we know that new varieties of chemicals make it impossible to predict the long-term environmental dangers of new landfills.

And we know that official assurances are often drastically wrong. When the Ruby dump was originally closed following amalgamation, we were told this was OK because the dump was 'unnecessary' – that there was lots of capacity. Oops – it seems this was a mistake.

Now we're being assured that a Ruby Road landfill will never leak. We're told that only seven and a half acres will ever be used for dumping. We're told that our wells are safe, and that our property values will in no way be affected. But nonetheless, we're worried, because if and when the Township goes "Oops" again, it will be our properties and our lake that will suffer.

We could say that if cost is the main consideration, the Township should have looked more closely at a 'green-field' site development. The established long-term development and maintenance cost of a green-field site is estimated by the Township at just $30 a tonne more than Ruby's exploitation. Actually, I'd wager that by the time the legal and environmental battles are finished being waged, the green-field cost will prove a lot less expensive than the Ruby option.

But it isn't a question of simply finding another place to dig a hole – even if that hole isn't is a populated part of the Township, as Ruby certainly is. It's rather a question of investing in true solutions – processes which don't create the same problems five or ten years down the road.

Therefore we believe that the Township has to give far more serious consideration to non-landfill answers to its garbage disposal problems. For example, it must take a closer look at plasma gasification, which is proven technology that can function on a cost-recovery basis. Moreover, it can operate profitably on a much smaller scale than the Cambium report gave as a threshold for cost-efficient incineration.

Recovery technology is improving all the time. We are told advances in compacting garbage have already lengthened the life span of Sand Road by nearly a year just in the few months since the Ruby mega-landfill was proposed.

Waste recovery is the future – not dumping and filling. We thought that the Township had arrived at this conclusion following amalgamation. The township of Laurentian Valley is certainly doing a good job as a result of its far-sighted investment in recovery technology. We believe the net costs of this option have to be more closely examined. If the township is intent on spending hundreds of thousands of dollars on studies, it should spend this money looking into genuine solutions, not stop-gaps or sales pitches.

Nor should the township have to go it alone. All over Renfrew County, waste disposal is a constantly current issue. We have already been advised of the concerns of the Algonquin community of Pikwakanagan, who are similarly worried about the potential impact on Golden Lake. It is surely time for Bonnechere Valley to advocate county-wide approaches.

Meanwhile, we would like to assure Council that we stand ready to work diligently with the Township on non-landfill positions, in partnership with other concerned groups. We have already contacted the Suzuki Foundation, and we will be contacting other environmental experts

For example, we are well aware that there are factors which would cause the once-over-lightly approach of the current Environmental Screening to be bumped up to a full scale, more costly, and more time-consuming Environmental Assessment. We are prepared to seek every legal and political avenue to check the progress of the proposed Ruby Road mega-dump landfill. We have already started a legal defence fund. We want to make it clear that we also stand ready to do what is necessary to protect our homes and properties from pollution and de-valuation.

However, we would much prefer to work constructively on alternatives which are beneficial, not just for the Ruby & Golden Lake areas or South Algona, but for Bonnechere Valley as a whole.

So tonight, we are asking Council to establish a full review process, covering the range of waste disposal alternatives. Within this process, we are asking Council to include extensive consultations with affected groups, especially in South Algona and Pikwakanagan. We are asking that cost figures be much more carefully scrutinized. We would also like to see a broader range of knowledge and expertise tapped than has been the case so far.

In its 'visioning' process a couple of years ago, Council stated that they were worried about losing "the rural way of doing things". They pledged "greater diligence by those elected to ensure that we do not allow reliance on bureaucracy to lead us away from where the people want us to go." Accordingly, the Council committed itself to more communication with the people it is elected to serve. It outlined its mission as working to achieve a culture "that fosters communication, rural lifestyle, personal growth, and healthy commerce."

We completely agree. And we feel that the proposed Ruby Road mega-dump landfill is a contradiction to these expressed values. So we want to help find solutions which fulfill and not negate this mission. We hope that this Council continues to agree, and that it will increase the extent of its communication on the garbage problem, and invite more involvement in its solution.

To that end, we are making a number of recommendations for improvements to the search for a socially and environmentally responsible solution to waste disposal, as per the attached list.

Improvements Sought in Consultation Process

* extended period of time for replying to questionnaire –
  especially to allow summer residents to respond

* mailing of survey with tax bills

* additional public consultation meetings, including in South Algona,
  and during the summer months

* addition of two representatives of Citizens for the Preservation of the Bonnechere Valley
  to the Public Liaison Committee

* creation of a subcommittee on alternatives to landfills,
  within invitations to present research,
  this sub-committee to report back to a public consultation meeting
    before any further work to re-open the Ruby landfill

Alternatives to Ruby Road Mega-Dump Landfill Requiring Additional Study

* Increased re-cycling

* Smaller-scale incineration

* increased use of OVWRC

* County-wide waste recovery operation

* Plasma gasification

* (last resort) Green-field site

Mounting public resistance to proposed Ruby Road landfill

By STEVE NEWMAN
Weekender Staff

Resistance is rising against the proposed purchase of land to create a new landfill site for Eganville-and-area residents.

The proposal would involve the purchase of 80 acres, of which about eight acres is earmarked for the landfill site. The property is located adjacent to the current transfer station on Ruby Road which was closed as a landfill by Bonnechere Valley council in 2001.

Since area residents heard about the project this past winter, resistance to the possible purchase and creation of a landfill site has been building.

Local residents, which have formed an organization, Citizens for the Preservation of the Bonnechere Valley (CPBV), have been going door to door in the Valley to express their concerns about the proposed project. Group members say they have about 50 members, but expect that number to grow.

Their members include Tony Pearson, a nearby Ruby Road resident, who represented CPBV during a March 4 presentation to council.

Opposition to any landfill site on Ruby Road was evident in such comments as: "We don't want a new landfill anywhere in our township. We don't believe that you should just dig a hole to bury your garbage anymore.

"The Ruby Road dump suggested by the township seems to us (to be) an ostrich's solution, burying its head in the sands of the Ruby Road pit in an effort to avoid seeing the full range of future problems. It is an old and worn-out answer to a new challenge."

Pearson's presentation also showed signs of more than out-and-out resistance, noting the group "would much prefer to work constructively on alternatives which are beneficial, not just for the Ruby and Golden Lake areas or (the former) South Algona, but for Bonnechere Valley as a whole."

Creation of a landfill site, if it happens, will have to happen within the next five years, because that's all the shelf life left at the one remaining landfill in the township, at Sand Lake. Ruby Road and Lake Clear are only transfer stations, after it was found there was leaching from the Lake Clear landfill.

Meanwhile, residents in the former Sebastopol Township part of Bonnechere Valley, in the Highway 41 area south of Eganville, have their garbage trucked to the Ottawa Valley Waste Recovery Centre, off B Line, near Pembroke.

Consultants' report

One solution might be to truck more of Bonnechere Valley's garbage to that same site. That suggestion is among feedback being digested by the township's consultants, Peterborough-based Cambium.

The company is expected to produce a report in the next little while, says Mayor Zig Mintha.

That report could be back to the waste management committee some time this month, said Bonnechere Valley CAO Bryan Martin.

There were 75 to 100 questionnaires sent in from the public, estimated Martin, knowing some questionnaires were sent directly to the township, some directly to Cambium.

"I would certainly think that was a good thing," said Martin.

"We certainly want public input, but generally you don't get any response until something is in someone's backyard."

Fast-tracking regulation

Because the proposed new property is adjacent to the old landfill site at Ruby Road, that land would be eligible for fast-tracking for a landfill of up to 100,000 cubic metres, according to new provincial regulations, explained Martin.

"The regulations were brought out to help smaller municipalities to expand landfill sites to meet their capacity without having to spend millions of dollars.

"Normally it takes three to five years for (the development of) landfill, but this (property) could be expanded within 24 months."

"I can't even tell you (where we're going with this project)," Mayor Mintha told *The Renfrew Weekender.*

"Right now it's in the hands of our consultants," said Mayor Mintha about the public's response via the questionnaires.

"They're working on questions asked by ratepayers. We have a long way to go."

But not too long, said Mintha, noting it's estimated the Sand Lake landfill will be full within five years.

"We have to do something. The (consultation) process has to take place," insists Mintha.

"We're listening to all sides. When all sides are listened to, it will result in what it results in."

A few weeks after Pearson's presentation to council, he told *The Weekender* that the Citizens for the Preservation of the Bonnechere Valley want to find a new solution.

"Why are we going back to the old technology of digging a hole and throwing your garbage in it?" he stressed. As for costs, Pearson says nobody's saying much about costs because he's been told they're "under discussion." Furthermore, he says he wonders why the County of Renfrew isn't looking for solutions on behalf of all local municipalities.

See OPPOSITION, Page 34

'In essence, if they're discussing septage
th pilot projects in Bonnechere Valley
Horton townships), why aren't they dis-
sing garbage, especially if looking (at the
sibility) of conversion," asked Pearson,
ing this technology is gaining popularity
Europe.
Members of the CPBV have also gone
r-to-door explaining their reasons for op-
posing the proposed landfill site.

"I'm not surprised," said Mintha of the reaction. "We don't want (the garbage either), but where do we put it?"

Former Sebastapol Township Reeve Arlene Felhaber, who defeated Mintha to head the first amalgamated Bonnechere Valley council but is retired from municipal politics, is opposed to reopening Ruby Road land to any landfill.

Of the new Ruby Road landfill proposal, Felhaber told *The Weekender:* "I was surprised and I'm almost shocked that they would consider this. We're trying to get away from landfill.

"Even to consider it at this point is really strange to me ... I'm not in favour of opening another problem, and especially with Golden Lake and its proximity (about two kilometres away)."

Citizens for the Preservation of the Bonnechere Valley

March, 2008

To all those interested in protecting the environment and rural values of our area:

We are a group of local property owners who are very concerned with the proposal before Bonnechere Valley Township Council to develop an 80 acre area on Ruby Road into a mega-dump, to bury all the household and construction waste from the entire Township for the next 25 years.

We oppose this waste disposal, because such landfills are dangerous to the land and water of our neighbourhoods, and could easily affect the whole Bonnechere Valley watershed, to the east and south of Golden Lake. Landfills leak - others in Bonnechere Valley have already done so The proposed Ruby Road mega-dump is in a populated area that depends on wells, and in addition, is very close to Golden Lake. The homes and the lake, and the quality of life in our area, are in danger.

We believe that there are more modern and better solutions to waste disposal - methods that are more environmentally safe and do not threaten people's water supply and lands, or put cottages and tourist developments at risk from pollution and contamination.

If you too are worried, please take a moment to fill out this form and return it to our organization. Your feedback, and your support for a modern,'green' answer to our waste disposal problems, are needed if we are to stop this large and menacing new landfill proposal.

Thank you. Also, if you'd like to help in any way, please let us know.

Citizens for the Preservation of the Bonnechere Valley

PROBLEMS WITH LANDFILLS

Landfill – dumping garbage into a waste site pit – is an outdated system for dealing with garbage, and one which presents a number of environmental hazards:

1. Contaminants can leach into ground water, which inevitably flows into our streams, our wells, and our lake. All of the dump sites in Bonnechere Valley to date have leaked.

2. From Golden Lake, the contaminants can be carried downstream – perhaps, through the Bonnechere River system, as far downstream as Eganville and Douglas.

3. Landfills produce methane – a 'greenhouse gas' which contributes to global warming.

4. Landfills can damage local wildlife and eco-systems – not just from the dump itself, but from the new heavy truck traffic bringing all the Township's wastes along Ruby Road to the landfill.

Let's be clear on the facts:

ALL LANDFILLS CONTAMINATE THE GROUND AND WATER
ALL LANDFILLS PRODUCE GREENHOUSE GASSES
ALL LANDFILLS DISPLACE WILDLIFE AND DISRUPT ECOLOGY

..... and once the damage is done it cannot be reversed.

ALTERNATIVES TO LANDFILLS

We don't have to dig a hole and bury our garbage to get rid of it.

1. We can do a lot more with waste recovery and recycling than we do now.

2. The Ottawa Valley Waste Recovery Centre has just been approved for a major expansion of capacity and coverage.

3. Township-scale incineration is being used cost-effectively in Spain and other countries. Incineration means the garbage never gets dumped in a landfill.

4. New technologies promise techniques which can be self-financing. For example, plasma gasification – currently in use in Ottawa – converts waste into clean energy, and leaves a residue of aggregates which can be used to make construction materials.

Waste processing is good business right now for Laurentian Valley. It can become good business for Bonnechere Valley. Just burying garbage is like burying tax dollars.

Landfills no longer make economic or environmental sense. We support conversion of waste – the cost-effective method for turning garbage into a renewable resource rather a source of pollution. We believe waste conversion offers returns to the taxpayer, not another "money-pit" landfill that will cost us all in the long run.

Citizens for the Preservation of the Bonnechere Valley

March 13, 2008

To: Cairine Cybulski
Chair, Waste Management Committee
Township of Bonnechere Valley

Councillor Cybulski:

We wish to inform you of the creation of "Citizens for the Preservation of the Bonnechere Valley", a group deeply concerned about any proposed solution to the Township's waste disposal needs which involves the development of a new landfill. Thus, we oppose the so-called 'capacity expansion' of the Ruby Road transfer station.

At its March 4th meeting, we informed Township Council of our purpose and of our recommendations for an improved consultation process. As you were absent from this meeting, we append a copy of what we gave Council. At the meeting, Mayor Mintha declared that the next consideration of the Ruby mega-dump landfill proposal would be at your committee. Therefore we would like to request the following from the committee:

a) notice of all meetings of the committee, as well as any other meetings at which the creation of a new landfill at Ruby or any other site might be discussed;

b) a copy of the full terms of reference for the study being carried out by Cambium Research, as well as a statement of the total cost of this study (or studies);

c) (when available) future reports from the Cambium project, including their analysis of the consultation and the questionnaires completed as a consequence of this consultation;

d) a copy of all Township-funded research on the future of waste disposal in Bonnechere Valley, along with the cost of such research.

We would also repeat our requests to Council for broadening the scope of consultation, namely:

1. a further survey of opinion about the proposed new Ruby landfill, along with other waste disposal options under consideration.

We believe that this survey should be included with the Township's mailing of assessments (tax bills). We'd like to assist with the wording of this survey, to ensure it elicits a full range of informed feedback on the waste disposal problem.

2. additional public consultations beyond the November meeting mentioned in the Cambium report, including meetings in South Algona ward, and meetings during the summer months, when seasonal residents are present.

3. addition of two representatives of "Citizens for the Preservation of the Bonnechere Valley" to the public liaison committee on waste management.

4. creation of a further sub-committee to investigate alternatives to landfills, which would issue invitations for people to present research on such alternatives.

No vote

We further recommend that no further spending or preparation work on the proposed Ruby landfill take place until this sub-committee has an opportunity to report its findings. In fact, we recommend that no further steps to develop the Ruby 'capacity expansion' be taken until another round of public consultation has taken place, both by the Waste Management committee and by full Township Council.

We look forward to your response. In your position as the South Algona representative on Council, we are relying on you to keep us fully and promptly informed on all aspects of the Ruby mega-dump landfill issue. We also trust that in your position, you will support the expressed wishes of the people of South Algona, determined through an expanded consultation process, when decisions on the issue are made.

We also repeat the pledge we made at the March 4th Council meeting, to work with the Township on research and development of non-landfill options for Bonnechere Valley's waste management needs. We have volunteers with the expertise and the commitment to undertake such work. We look forward to a collaborative solution.

Tony Pearson R. Barton

FOR "CITIZENS FOR THE PRESERVATION OF THE BONNECHERE VALLEY

Citizens for the Preservation of the Bonnechere Valley

Membership Form

YOUR CONTACT INFORMATION:

Name: _____

Mailing Address: _____

_____

_____

Phone Number(s): _____

E-mail address: _____

I am a local resident ☐ summer resident ☐

local business ☐ concerned citizen ☐

I prefer to be contacted by: phone ☐ mail ☐ e-mail ☐

CPBV mailing address: c/o Roberta Barrow, membership chair

1760 Wolfe Road, RR 4

Killaloe, Ont. K0J 2A0

Citizens for the Preservation of Bonnechere Valley

RUBY LANDFILL FACTS

THE PROPOSAL – A NEW GARBAGE DUMP NEAR GOLDEN LAKE

The Township of Bonnechere Valley is looking for a long-term, low-cost solution to its waste disposal needs. Therefore it is proposing to dig a new landfill on an 80 acre site west of the now-closed Ruby dump. It claims that only 7.5 acres will be needed for the new landfill. It further claims that the site provides the perfect conditions for "natural attenuation" — that is, the environment will absorb all leakage of damaging chemicals and toxic substances (called 'leachate'). The Township believes that there is no risk to area surface or groundwater (including wells), and no threat of contaminating Golden Lake in any of the 25 years that they propose to keep this new dump open. The Township also claims that there is no possibility of environmental damage. Accordingly, there are no plans for leachate containment, capture, or treatment. They have hired a Peterborough engineering firm, Cambium, to a contract amounting to several hundred thousand dollars, to oversee the approval process.

CONSIDER THE PROPOSED NEW RUBY LANDFILL / DUMP

- It is within one and a half kilometres of Golden Lake.
- It is to be an "old-fashioned" landfill — that is, the pit will not be lined, and there will be no capture or treatment of leachate (leakage). Leachate can contain mercury, cadmium, arsenic, and a host of other toxic chemicals and contaminants.
- The threat to the area would increase if, as suggested, construction materials and debris are also sent to this new dump.
- All dumps, even the safest most modern ones, leach after a period of time — 100% of them, according to Environment Canada.
- All landfills within Bonnechere Valley Township have already leaked to some extent.
- The cost of a new landfill (even an old-fashioned one) is not going to be cheap. Land must be purchased or leased, new equipment bought, and on-going monitoring set-up. A township study put the conservative capital and operating costs at hundreds of thousands of dollars per year, for decades to come.
- Should the monitoring process find that the dump is in fact leaking, the extra costs of clean-up could be very high, and a real burden to the taxpayer.
- Golden Lake contains numerous cottages and many businesses — a number of them geared to the tourist trade. These properties produce a lot of tax dollars for the Township, and the businesses help the Township's economy quite a bit. But tourists and new home & cottage buyers tend to react negatively to the idea of a nearby dump.

ARE THERE ALTERNATIVES? YES!

- Laurentian Valley Township operates a high-volume, up-to-date waste treatment facility nearby (Ottawa Valley Waste Recovery Centre on Waito Station Road, near Rankin.)
- This waste recovery centre is currently constructing a leachate capture and treatment facility.
- Bonnechere Valley is already a partial partner in this facility, and could become a full member.
- The cost of joining the Ottawa Valley Waste Recovery Centre appears to be about equal to (or even less than)the cost of building a new landfill at Ruby.
- Plasma gasification of waste — which converts garbage into saleable commodities like electricity and aggregate— is on its way here; Ottawa looks likely to go this route, and Renfrew is now looking into it as well.
- The Township already owns and is operating a 50 acre landfill site which is apparently well short of capacity – which should give time for more consideration of more modern alternatives.

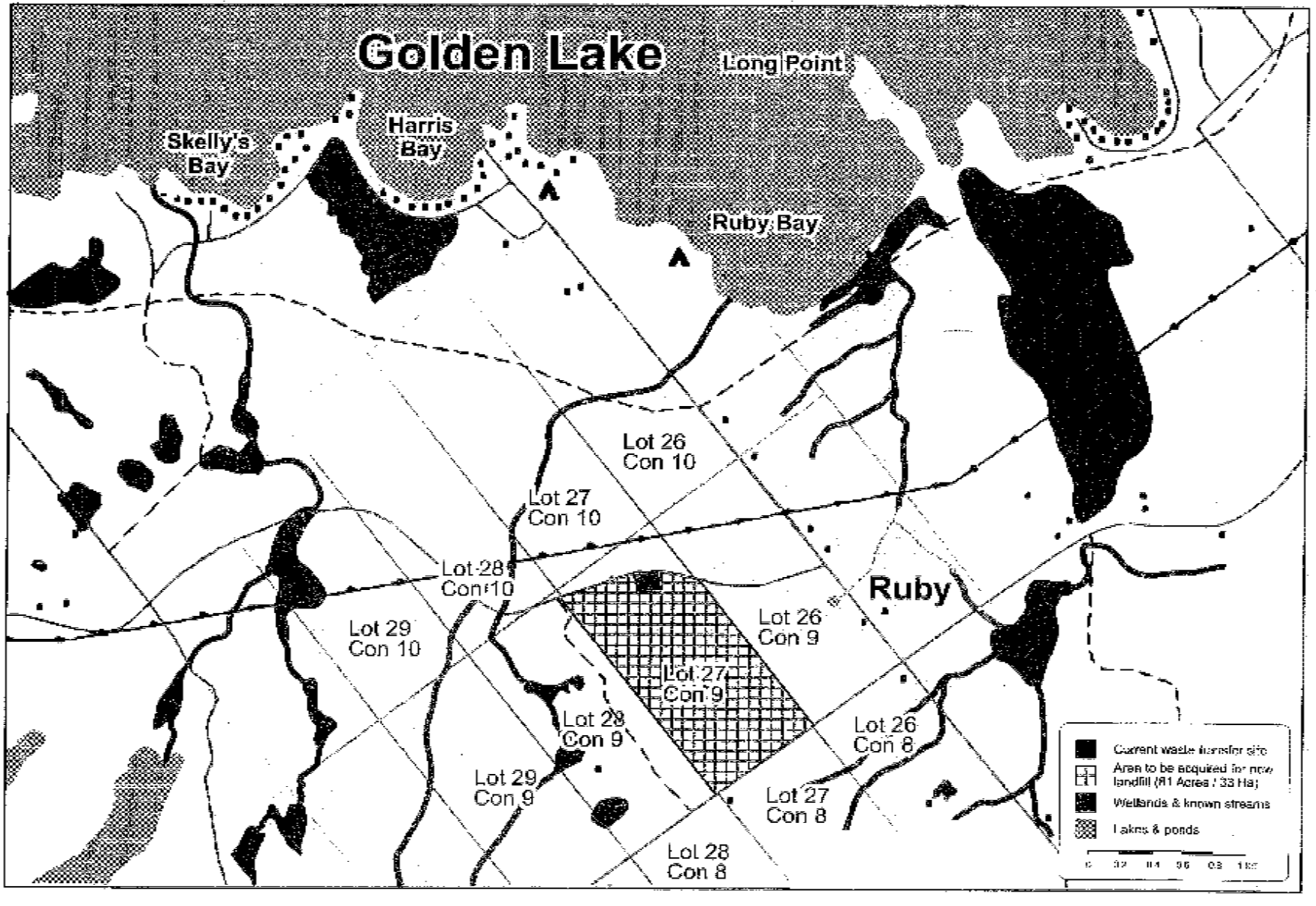
THE DEBATE :

Cambium and the Township contend that the new Ruby landfill will be safe, and that during the screening process, no alternatives should be considered. The Citizens for the Preservation of the Bonnechere Valley ask: "Why dig an old-fashioned — and dangerous— hole in the ground to dump waste into when better, safer solutions are available?"

WHAT DO YOU THINK?

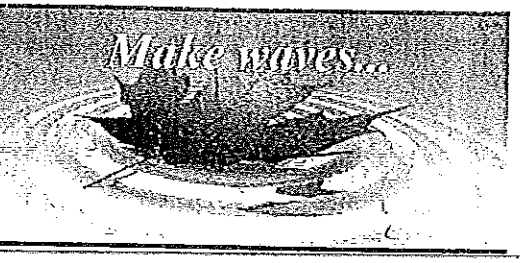
You can express your view on this proposed new landfill at a public meeting which has been called for Saturday, July 26th, at 10 AM at the Legion ballfield park in Eganville.

AREA OF PROPOSED NEW LANDFILL



Citizens for the Preservation of Bonnechere Valley

CPBV NEWSLETTER MAY 2008

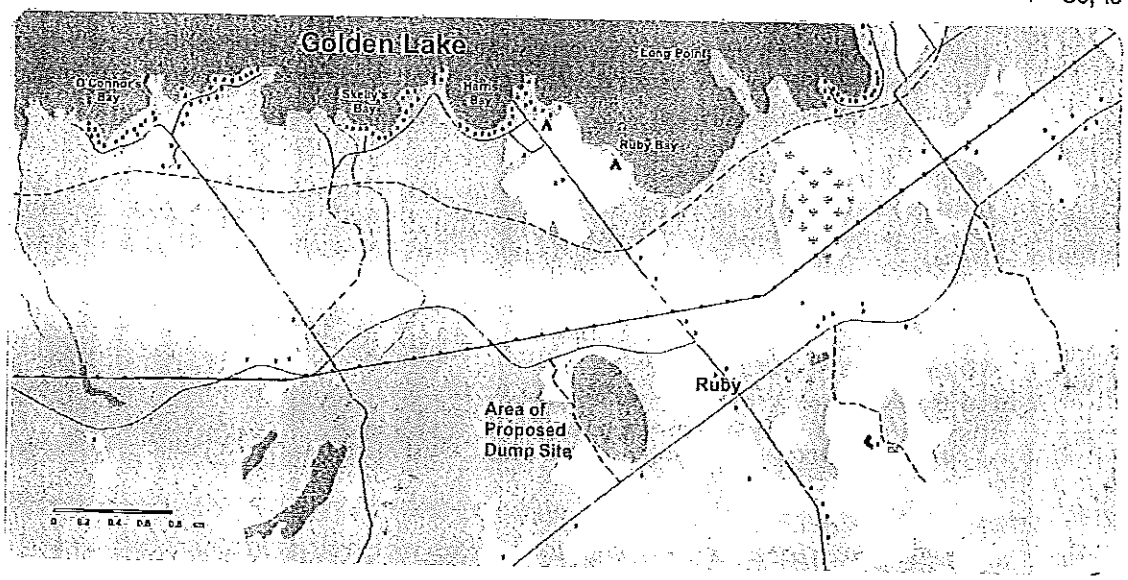


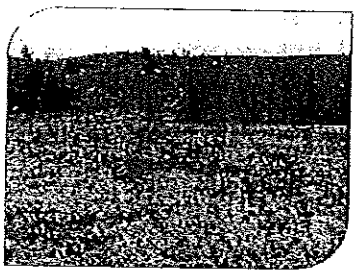
YOUR LAND, YOUR WATER, YOUR CONCERN

Welcome to the first edition of the CPBV newsletter! We hope that in months to come, this little grass-roots publication will help keep CPBV members and concerned citizens informed about the happenings surrounding Bonnechere Valley Township's proposed Ruby Dump "Expansion" (actually, a brand-new dump.)

The Township has hired a consultant to write public relations press releases about the advantages of the new Ruby dump. This newsletter is an effort by concerned local property owners to cut through some of the hype and ask essential questions about efforts to minimize damage to our land and our water.

We also hope to explore some alternate, "greener" solutions to waste disposal over the next several years.





WHY WE'RE WORRIED AND WHY YOU SHOULD BE...

The Township of Bonnechere Valley plans to purchase 80 acres behind the current Ruby Road waste transfer site and turn it into a landfill for all the Township's garbage. We are worried, because of unanswered questions about the effect on the land — your land. We need to know about the potential harmful effects of a large new landfill such as:

- ground and surface water contamination
- loss of air quality
- noise pollution
- risk of fire
- disruption and displacement of wildlife
- negative impacts on tourism

We think that an old-fashioned landfill poses a threat, not only to local wells and to property values in the area — but potentially to Golden Lake. The goal of our organization is to encourage a shift to a better, safer solution than just a hole in the ground.

IF IT LOOKS LIKE A DUMP, IT WILL LEAK LIKE A DUMP...

The Township, through its agent Cambium Engineering of Peterborough, is claiming that this is to be a "modern" landfill. What does that mean? According to the Ministry of the Environment's web page regarding landfills:

"Moisture and water can filter through the [garbage], picking up metals, minerals, organic chemicals, bacteria, viruses and other toxic materials. This contaminated water is called leachate. If the leachate is not contained, it can travel from the site and contaminate our ground and surface water.

Modern landfills are engineered to meet strict rules and standards to collect and treat leachate."

So, is the Township planning to capture and treat leachate — the poisons leaking into the ground and water? Well, no. They have stated that they don't plan to do this at all. So we don't know how it can be claimed that this is anything other than the old-fashioned "hole in the ground."

John Desbiens, president of Cambium, has admitted that there will be a leachate plume but there are no current plans to deal with it other than letting the Ruby environment handle it as best it can. We think the public must ask if Council is aware of the Ministry of the Environment's Clean Water Act, which requires municipalities to develop plans to protect source water.

Get Involved, Stay Informed

CPBV MEMBERSHIP IS ABSOLUTELY 100% FREE! JUST STAY INFORMED, OR JOIN THE FIGHT TO KEEP BONNECHERE VALLEY CLEAN! ALL ARE WELCOME!

e-mail • CPBVmembership@gmail.com
phone • 613-625-2227

A clean and safe environment is everyone's concern!

TRASH TALK : HAZARDOUS MATERIALS

One way to reduce the potential harmful effects of a landfill is to ensure that nothing dangerous gets into the landfill – no cadmium from batteries, no arsenic from electronics and treated lumber, no formaldehyde from plywood, no mercury from light bulbs.

Did you know that the new "long-life" compact fluorescent bulbs we're being urged to use in our lamps contain a significant amount of mercury?

So we'd like to know how the Township is planning to keep such substances out of its new landfill. In modern landfills, all garbage is inspected for hazardous substances before it's dumped in the ground. As far as we know, the Township doesn't have any plans to do such inspection. They want us to trust that it won't happen. When the future of Golden Lake and the Bonnechere Watershed is at stake, we think this is too big a risk.

SIZE MATTERS

In Cambium's public relations material, The Township states that it only needs seven and a half acres for the landfill. Yet they plang to buy 80 acres. They say this is only for protection. But if the landfill is as safe as they claim, why do they need so much of a buffer zone?

They also claim that "it would be very short-sighted" to take additional waste from outside the Township in future. Yet who's to say that a future Town Council won't be tempted to get themselves extra money by selling off space, so that Ruby becomes a dumping ground for larger towns and cities? If they only need seven acres for 25 years, then there's a lot of space left over. And a lot of places would love to ship their garbage to someone else's front door.

LETTERS TO THE EDITOR : SHORTSIGHTEDNESS OR WHITEWASH?

"It seems that Bonnechere Valley council will, once more, miss the boat!

First time, was not joining the group at Laurentian Valley (OVWRC) a few years ago. Reason: 'It was too expensive.' Now we (the taxpayers) have to purchase or lease land (this is not clear yet) so that we can make another 'Sand Road Landfill.' We all know the condition [the Sand Road landfill] is in. The cost of joining OVWRC has increased dramatically, so we get the usual 'It's too expensive' again. The door is still open but our council seems a little misguided and is balking again.

When the landfills have leachate and they do, they need to be cleaned up at great cost. Are the citizens of Bonnechere Valley ready to dig even deeper into their pockets to pay for this? Did the council even ask what the citizens thought about this possibility? I don't think they did. Or is this whole project a case of consultants (Cambium) whitewashing Townships into thinking that this is the way to go?

It is old fashioned technology : burying garbage and covering it daily, in a big hole. This proposed site is 7½ acres. The land it will be on, the other 72½ will be worthless as it has a GARBAGE DUMP IN THE MIDDLE OF IT! You may be able to disguise it with grass and shrubs but it's under there for sure! So whoever owns it will be solely responsible for any clean up that is necessary. Are you ready for that?"

TBV taxpayer

If you would like to speak your mind, please email your thoughts to CPBVmembership@gmail.com

UPCOMING EVENTS

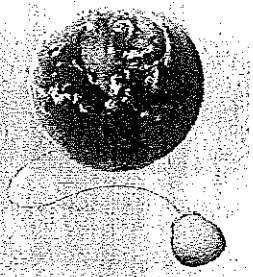
Thanks to the urging of our group, there will be an additional public consultation to allow summer residents to have a say on this issue. The meeting will be held at the Legion field in Eganville on Saturday, July 26th at noon. If you have any concerns or questions about the proposed new dump, you owe it to yourself to attend.

NEXT ISSUE

Coming up in our June newsletter, we will be examining some of the "greener" solutions our township is rejecting.

WEB LINKS

SOME INTERESTING READING...



MOE Landfills — http://tinyurl.com/4fsclx
CWI solid waste — http://tinyurl.com/5u2zm3
Water contamination — http://tinyurl.com/5ynj9n
Arsenic leachate — http://tinyurl.com/4vxtfp
Landfill contaminants — http://tinyurl.com/4jecnw
MOE Clean Water Act — http://tinyurl.com/3h29mr
MOE CWA Fact Sheet — http://tinyurl.com/4o6uuz
Clean water for ON — http://tinyurl.com/6j2yxk
Species At Risk registry — http://tinyurl.com/6adjez
MNR SARA — http://tinyurl.com/62wqmo
COSEWIC — http://tinyurl.com/4nrtl8
Ottawa V. Waste Recovery — http://www.ovwrc.com
Plasma Gasification — http://tinyurl.com/4n24js
CELA — http://www.cela.ca/
E-Laws — http://www.e-laws.gov.on.ca/
Stop Dump Site 41 — http://tinyurl.com/49m328
CLEAN — http://tinyurl.com/4gvd6a
Ruby topography — http://tinyurl.com/5s8xy6
Ruby land use (PDF) — http://tinyurl.com/4nzyp9
John Baird, MOE — http://tinyurl.com/4dogwn

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Citizens for the Preservation of Bonnechere Valley

RUBY LANDFILL FACTS

THE PROPOSAL – A NEW GARBAGE DUMP NEAR GOLDEN LAKE

The Township of Bonnechere Valley is looking for a long-term, low-cost solution to its waste disposal needs. Therefore it is proposing to dig a new landfill on an 80 acre site west of the now-closed Ruby dump. It claims that only 7.5 acres will be needed for the new landfill. It further claims that the site provides the perfect conditions for "natural attenuation" — that is, the environment will absorb all leakage of damaging chemicals and toxic substances (called 'leachate'). The Township believes that there is no risk to area surface or groundwater (including wells), and no threat of contaminating Golden Lake in any of the 25 years that they propose to keep this new dump open. The Township also claims that there is no possibility of environmental damage. Accordingly, there are no plans for leachate containment, capture, or treatment. They have hired a Peterborough engineering firm, Cambium, to a contract amounting to several hundred thousand dollars, to oversee the approval process.

CONSIDER THE PROPOSED NEW RUBY LANDFILL / DUMP

- It is within one and a half kilometres of Golden Lake.
- It is to be an "old-fashioned" landfill — that is, the pit will not be lined, and there will be no capture or treatment of leachate (leakage). Leachate can contain mercury, cadmium, arsenic, and a host of other toxic chemicals and contaminants.
- The threat to the area would increase if, as suggested, construction materials and debris are also sent to this new dump.
- All dumps, even the safest most modern ones, leach after a period of time — 100% of them, according to Environment Canada.
- All landfills within Bonnechere Valley Township have already leaked to some extent.
- The cost of a new landfill (even an old-fashioned one) is not going to be cheap. Land must be purchased or leased, new equipment bought, and on-going monitoring set-up. A township study put the conservative capital and operating costs at hundreds of thousands of dollars per year, for decades to come.
- Should the monitoring process find that the dump is in fact leaking, the extra costs of clean-up could be very high, and a real burden to the taxpayer.
- Golden Lake contains numerous cottages and many businesses — a number of them geared to the tourist trade. These properties produce a lot of tax dollars for the Township, and the businesses help the Township's economy quite a bit. But tourists and new home & cottage buyers tend to react negatively to the idea of a nearby dump.

ARE THERE ALTERNATIVES? YES!

- Laurentian Valley Township operates a high-volume, up-to-date waste treatment facility nearby (Ottawa Valley Waste Recovery Centre on Woito Station Road, near Rankin.)
- This waste recovery centre is currently constructing a leachate capture and treatment facility.
- Bonnechere Valley is already a partial partner in this facility, and could become a full member.
- The cost of joining the Ottawa Valley Waste Recovery Centre appears to be about equal to (or even less than)the cost of building a new landfill at Ruby.
- Plasma gasification of waste — which converts garbage into saleable commodities like electricity and aggregate— is on its way here; Ottawa looks likely to go this route, and Renfrew is now looking into it as well.
- The Township already owns and is operating a 50 acre landfill site which is apparently well short of capacity - which should give time for more consideration of more modern alternatives.

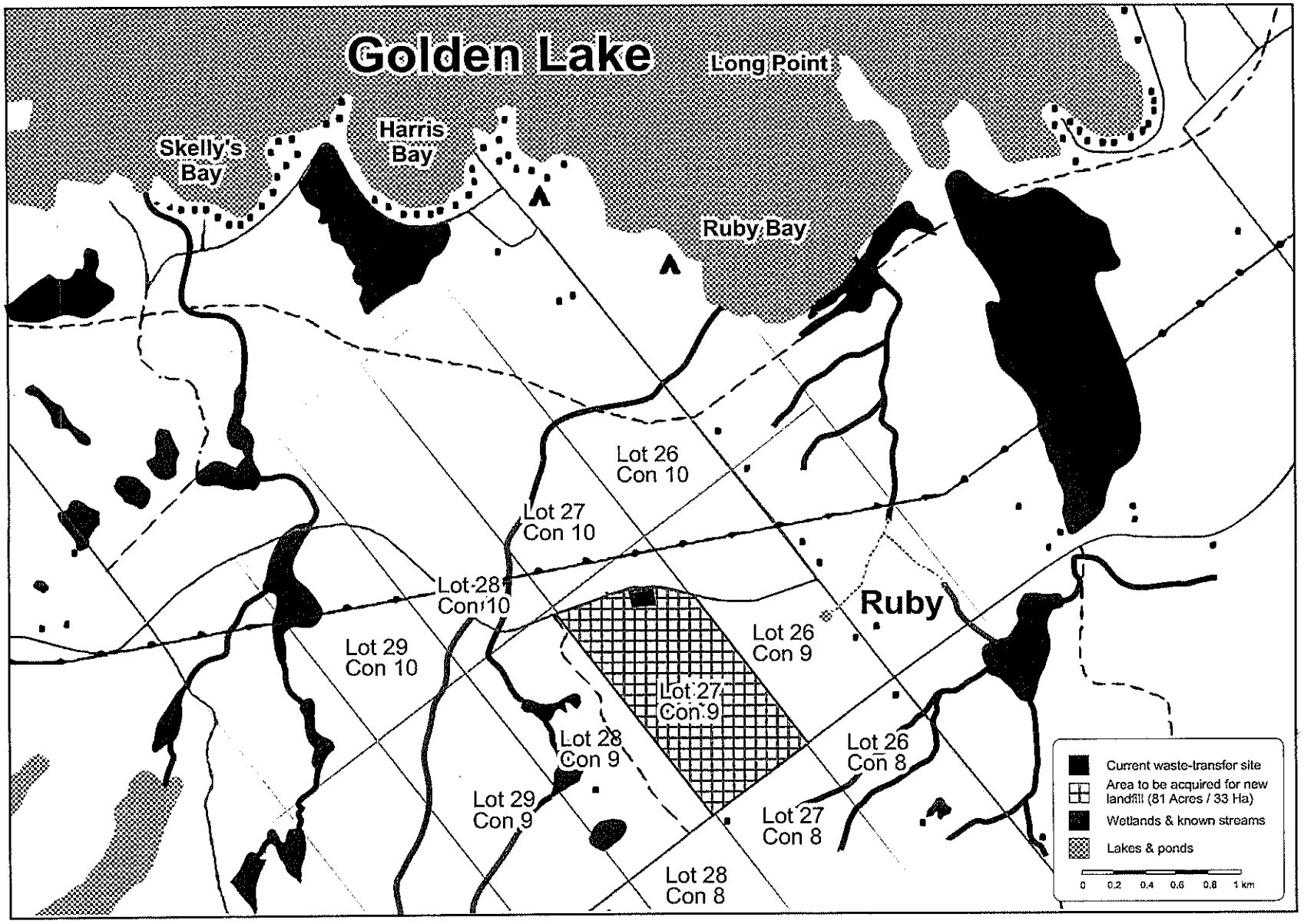
THE DEBATE :

Cambium and the Township contend that the new Ruby landfill will be safe, and that during the screening process, no alternatives should be considered. The Citizens for the Preservation of the Bonnechere Valley ask: "Why dig an old-fashioned — and dangerous— hole in the ground to dump waste into when better, <u>safer</u> solutions are available?"

WHAT DO YOU THINK?

You can express your view on this proposed new landfill at a public meeting which has been called for Saturday, July 26th, at 10 AM at the Legion ballfield park in Eganville.

AREA OF PROPOSED NEW LANDFILL



Golden Lake
Property Owners Association

Box 99, Golden Lake, Ontario K0J 1X0
www.goldenlake.info
info@goldenlake.info

Mr. Bryan Martin, C.A.O.
Township of Bonnechere Valley
Box 100,
Eganville, Ontario KoJ ITo

November 8, 2010

Re: Proposed Ruby Road landfill

Dear Mr. Martin,

As you know, the Golden Lake Property Owners Association has retained consultant Wilf Ruland to conduct a review of the technical documentation supporting the Township's proposal to site a new landfill near the Ruby Road waste transfer site. Attached please find Mr. Ruland's information request. We would very much appreciate your cooperation in providing him with the information he needs to complete the work we have asked of him.

President Kevin O'Connor is away until the third week of the month and he has asked me to forward this correspondence to you. Please send your response directly to Mr. Ruland, with a copy to Kevin and myself.

Thank you for your assistance.

Sincerely,

Gail McPhee, Vice-President

Encl.

Mr. Bryan Martin
Township of Bonnechere Valley
49 Bonnechere St. West
P.O. Box 100
Eganville, Ontario
K0J 1T0

November 6, 2010

Dear Mr. Martin,

I have not been able to find the following information pertaining to site hydrogeology in the documents which you have provided to my clients for my review, and thus would like to ask that you convey the following information request to the Township's consultants.

Please provide the following information at your earliest convenience:

A) Questions About Existing Landfill, Including Monitoring and Impacts

1) Please confirm your agreement that the existing landfill represents a "case history" which can provide valuable insights into the hydrogeology of the area, including insights into how the contaminant plume from the proposed landfill might move through the groundwater flow system.

2) Was the waste in the existing (closed) landfill disposed of in excavated trenches? If so, then how deep were those trenches? How much waste is in the closed landfill?

3) Why is there no leachate well in the existing landfill to test the actual raw leachate composition and to check for leachate mounding?

4) Why has the impacted downgradient well (BH-1) at the existing (closed) landfill not been tested for VOCs (volatile organic chemicals)?

5) Given that the contaminant plume from the existing landfill has been shown to be leaking from the property and the location of the plume front is not known, has there been any precautionary testing of downgradient domestic wells to the east and northeast of the existing landfill site for leachate contaminants?

6) Why are groundwater samples being filtered before analysis? Won't this reduce the levels of various contaminants which may be present in the samples?

7) Why is the existence and the data from the 4 new monitoring wells not disclosed in the landfill's Annual Reports? The new wells could be useful in providing bigger-picture groundwater contour maps, as well as reliable background monitoring locations.

B) Questions About Design and Operations of Proposed Landfill

1) Will the waste in the proposed landfill be disposed of in excavated trenches? If so, then how deep will those trenches be?

2) What final cover material is proposed for the new landfill? What will the hydraulic conductivity of the final cover be?

3) Are any measures being planned to contain or collect leachate from the proposed landfill?

4) The land surface in the area of the proposed landfill slopes to the west. Please confirm where surface water runoff from the proposed landfill will be diverted to?

5) How much leachate is estimated to be generated by the proposed landfill on a yearly basis?

6) It appears that the proposed landfill will have a high, steep slope on its western side. Given that the underlying soils are likely to be less permeable than the wastes themselves, this would be a likely location for leachate springs to develop - how often will there be inspections for leachate springs, and if found how will such leachate springs be handled?

C) Questions About Hydrogeology of Proposed Landfill and Surrounding Area

1) My understanding is that an attenuation landfill is proposed, with no effort being made to contain or collect leakage of leachate into the groundwater flow system - is this correct?

2) At attenuation landfills, ownership of downgradient properties is an important consideration as these are at heightened risk of becoming contaminated. Please provide a map showing property ownership within a 2 km radius of the proposed landfill.

3) Please provide a groundwater contour map showing water levels for all 8 monitoring wells for April 10, 2010.

4) Is there a perched water table in the overburden unit? If so, then could it provide a pathway for off-site contaminant movement?

5) The existing (closed) landfill cell is already in violation of the MOE Reasonable Use Policy. How will this liability be dealt with in the context of the proposed expansion?

6) Why was a hydraulic conductivity not calculated for BH-1?

7) Is it possible that the creek west of the site (represented by locations 77, 78, and 121 in the Initial Natural Environment Impact Study) provides fish habitat anywhere along its length?

8) a) Please provide an explanation for the stripping of vegetation from the wetland and regrading/rerouting of the creek to the immediate west of the proposed landfill?

b) Please indicate what impacts the vegetation stripping in the wetland and the regrading/rerouting of the creek (including the high turbidity observed downstream on the date of the site tour) might have on the downgradient aquatic ecosystem in the creek?

c) Please provide an estimate of travel time of contaminants in the creek - from the point closest to the proposed landfill to Golden Lake?

D) Questions About Computer Modelling in Support of the Proposed Landfill

1) Please provide an explanation of the implications for the landfill proposal if the 300 mg/L of chloride (used as the simulated "worst-case" contaminant concentration) proves not to be conservative in terms of future critical leachate contaminants and/or concentrations?

2) Please explain why an organic contaminant like vinyl chloride was not used to model potential groundwater impacts of the proposed landfill? Are you aware that vinyl chloride has been shown to be persistent over many hundreds of meters in leachate plumes in Ontario?

3) Please provide justification for the assumed porosity of 0.15 which is used throughout the model? Why not a value of 0.25 to 0.4 in the overburden, and a value of <0.1 in the bedrock (as suggested by Freeze and Cherry, 1979)?

4) The assumed recharge used in the model (8.75 cm/year) seems very low - please provide all lines of field evidence which were considered in deciding on this assumed recharge rate?

5) My initial rough estimate of the amount of leachate which would be generated by the proposed landfill (which is to have an area of 2.5 hectares) is on the order of 8 to 10 million liters of leachate per year - why is the model only assessing the groundwater impacts of 2.2 million liters per year?

6) How does the model account for the observed groundwater discharges to springs which feed wetlands and creeks to the east and west of the proposed landfill?

E) Questions About Monitoring and Contingency Plans for the Proposed Landfill

1) Have recommendations been developed yet for on-site and off-site groundwater and surface water monitoring of the proposed landfill (and if so, please provide the proposed locations, frequencies, and parameter lists)?

2) In the event that the computer modelling proves to be inaccurate, what contingency plans are proposed to deal with a stronger than anticipated plume that goes off-site to the east or north east and onto neighbouring properties?

F) Missing Reports on the Proposed Landfill

1) Please provide the Preliminary Hydrogeology Assessment report (which was described as being completed on page 18 of the presentation materials for the second 2008 Public Consultation Event).

The report is said to include:

- the findings from 3 additional monitoring wells installed to better understand groundwater dynamics at the subject property;
- completed preliminary mass balance calculations using worst-case scenario concentrations of typical leachate indicators;
- concentrations of typical leachate indicator parameters.

2) Please provide the Detailed Hydrogeological Study which was said on page 26 of the presentation materials for the 2nd 2008 Public Consultation Event to be "in progress".

3) Please provide the Environmental Screening Report, which is cited on page 5 of the Sept. 20, 2010 Modelling Report, and is said to have been "completed by Cambium".

The report apparently discusses "the proposed volume and operational life" of the proposed landfill "in detail, suggesting a 25 year site life".

Mr. Martin, I am not trying to be difficult. But the documentation provided to my clients to date is simply not adequate to support an attenuation landfill of up to 100,000 m3 of waste at the proposed location.

With this information request I am hoping to obtain the additional information which I need to properly assess the landfill proposal for my clients.

Thank you in advance for your assistance with this matter,

Yours sincerely,

Wilf Ruland (P. Geo.)

766 Sulphur Springs Road
Dundas, Ontario
L9H 5E3
tel: (905) 648-1296
deerspring1@gmail.com

P.S. It is not clear to me whether your consultants are working from any sort of guidelines for attenuation landfills in designing and assessing impacts of the proposed landfill. I have in my possession a set of suggested guidelines for attenuation landfills which were developed for the Ministry of the Environment by myself and 2 co-authors. These may prove helpful in the further work on this proposal. Please let me know if you would like me to send you a copy.

MEMORANDUM

Cambium Environmental Inc.
P.O. Box 325
52 Hunter Street East
Peterborough, Ontario, K9H 1G5
Telephone: (705) 742.7900 1 (866) 217.7900
Facsimile: (705) 742.7907

To: Bryan Martin

From: John Desbiens

Date: December 1, 2010

Copies: Cambium File, Sadie Bachynski,

Re: **Ruland Request dated November 6, 2010**
Ruby Road Waste Disposal Site Capacity Expansion Environmental Screening
Cambium Ref.: 07-1219-001

As requested, Cambium is providing the following responses to the information request from Mr. Ruland dated November 6, 2010 (Ruland Request) that was forwarded by the Golden Lake Property Owners Association in correspondence to the Township of Bonnechere Valley dated November 8, 2010. The answers are provided in the same numbering format as the Ruland Request.

A) Questions About Existing Landfill, Including Monitoring and Impacts

1) The hydrogeological modeling report provided includes information derived from the existing closed landfill. This report provides valuable insights into the hydrogeology of the area and how the contaminant plume from the proposed landfill is expected to move through the groundwater flow system.

2) A review of the following documents may answer your questions:

    a. Site Capacity Study, Ruby Road Landfill (The Greer Galloway Group Inc., July 21, 1999). [ATTACHED]

    b. Site Closure and Waste Transfer Facility Operations Plan, Ruby Road Waste Disposal Site (Jp2g Consultants Inc., August 2002). [ATTACHED]

    c. Amended Provisional Certificate of Approval Number A411501 [ATTACHED]

3) Refer to Response A2b. The downgradient well (BH-1) would have been deemed sufficient to provide a representative characterization of the leachate at this closed landfill.

4) VOC analysis is not included in the monitoring of the currently closed site. Refer to Response A2b.

5) No domestic well sampling has been conducted to our knowledge. The closest residential wells are greater than 500 metres from the existing Ruby Road Waste Disposal Site. It should be noted that this item has been raised in the most recent annual monitoring report review and will be addressed in the 2011 monitoring program as it is agreed that the sampling would be a valuable precautionary measure to confirm the those non-health related parameters believed to be travelling beyond the property boundary are not impacting those residential wells.

6) As the method used for well development and sampling at the Ruby Road site (sample tubing and foot-valve) disturbs the groundwater environment, a turbid free sample cannot be collected and therefore field filtration is required. The field filtering is also intended to maintain consistency with the historical analytical results data for the monitoring well network.

7) The new wells were established for the purpose of conducting the hydrogeological investigations for an expanded site; not for the monitoring of the existing closed site. The existing background well (BH-2) is appropriate and representative of the groundwater entering the existing closed site.

B) Questions About Design and Operations of Proposed Landfill

1) The conceptual plan for the landfill development currently does not use trenches.

2) The final cover material will be identified based on the performance of the landfill at the time of closure; however, at this time it may be assumed that a low permeability soil (clay) will be used. The hydraulic conductivity of the soil will be determined by what suitable material is locally or regionally available.

3) It is proposed that the landfill will be natural attenuation landfill that will not employ leachate collection.

4) The surface water runoff will be directed to remain on the site and allowed to infiltrate to the subsurface.

5) The estimated quantity of leachate to be generated by the expanded landfill is based on the recharge rate (87.5 mm/yr) and the full area of the waste disposal site expansion footprint (2.5 ha) which equates to 2,187 m^3/yr. See Section 6.1.2 and 8.1 of the hydrogeological modeling report.

6) Operational activities will be detailed in the Design and Operations Report; however, it may be assumed that informal inspections will occur on days of operation. Formal inspections would occur on a quarterly basis with special attention to more frequent inspections during the spring season. In the event of the presence of a “leachate spring”, it would be addressed in a manner appropriate for the circumstance and conditions.

C) Questions About Hydrogeology of Proposed Landfill and Surrounding Area

1) See Response B3.

2) To date, such a map has not been prepared for this study.

3) See Figure 7 of the hydrogeological modeling report.

4) No. See borehole logs in Appendix A of hydrogeological modeling report.

5) The issues at the existing closed landfill site will be addressed in the appropriate manner in consultation with the MOE regardless of whether an expansion of the disposal capacity at the site occurs.

6) A slug test was attempted at this monitoring well; however, the water level stabilized too quickly for measurements to be obtained. Subsequently, a bail test was attempted and similarly, the water level stabilized almost immediately, making drawdown measurements impossible. As such, the greatest hydraulic conductivity was applied in the hydrogeological model to the localized area at BH-1.

7) See page 5 of Supplemental Studies for Natural Environment Features of Ruby Road Waste Disposal Site dated November 2008 in your possession, *"The watercourses of the stream system closest to the proposed waste site represented by numbers 77, 78 and 121 are defined as intermittent watercourses that do not directly provide fish habitat in the vicinity of the road crossing."* Further commentary on this matter will be provided in the Environmental Screening Report.

8) The municipality would not own the land to the west of the proposed expansion area. Therefore:

    a. This is not planned.

    b. This is not planned.

    c. No such time of travel estimate has been calculated since surface and subsurface conditions would be such that contamination of the intermittent creek is not anticipated.

D) Questions About Computer Modelling in Support of the Proposed Landfill

1) The simulated worst-case scenario in the hydrogeological model employs not only an exaggerated value for the contaminant concentration, but also employs exaggerated values for other aspects affecting the aggregate prediction. Therefore implications of a chloride concentration realized at a value

greater than 300 mg/L in the generated leachate, however unlikely, would be countered by the more probable, non-exaggerated values of the other aspects affecting the contaminant transport.

2) Please refer to section 7.1 of the modelling report. In the model, the chloride was represented as a non-reactive, conservative species, which effectively makes it perpetually persistent. Using vinyl chloride in this circumstance has no merit. Yes, the persistence of vinyl chloride in the environment is well documented.

3) See section 6.2.2 and section 8.5 of hydrogeological modeling report. Note that a porosity was chosen which would best represent the water flow at the overburden-bedrock interface zone where the groundwater is observed.

4) See Section 6.1.2 and 8.1 of the hydrogeological modeling report.

5) See Response B5. Given that you have not provided your calculations in your rough estimate, no further comment may be provided. Please provide your calculations and assumptions.

6) The modeling does not support the hydraulic connection between any shallow groundwater discharges to surface at locations west or east of the site. Therefore these features are localized and independent of the bedrock aquifer underlying the unsaturated overburden at the landfill expansion area.

E) Questions About Monitoring and Contingency Plans for the Proposed Landfill

1) Recommendations have not yet been developed as this will be addressed the Design and Operations Report; however, rest assured that several monitor locations will be proposed down-gradient, cross gradient, within, and up-gradient of the landfill expansion area. The frequency of sampling and parameters of analysis will be prepared in consultation with the MOE standards, guidelines, and staff.

2) See Section 10.0 of the hydrogeological modeling report.

F) Missing Reports on the Proposed Landfill

1) To correct a misinterpretation, no preliminary hydrogeological assessment report was prepared, nor was this ever stated. The preliminary hydrogeological information was maintained as a growing body of work which culminates in the hydrogeological modeling report. To suggest otherwise is misleading.

2) Similar to Response F1, the study culminated in the hydrogeological modeling report; no detailed hydrogeological study report has been prepared nor was this ever stated.

3) The wording in the hydrogeological modeling report has been prepared with the understanding that it will support the Environmental Screening Report. The Environmental Screening Report is still in draft format and not available to the public. Only once the report is completed, submitted to municipal Council and approved as final by Council will the report be released. It is not the practice of the municipality to release technical documents in draft format.

Closing

Please be advised that the existing publicly available information requested relating to this Environmental Screening has been provided. The Township has endeavoured to answer all questions accurately in as transparent a manner as possible. It is important to recognize that regardless of the schedule you may personally have set for your review of the documentation prepared to date, the Township has interpreted your request for this information “at the earliest possible convenience” to be that and has responded accordingly. Professional and respectful dialogue on this matter is paramount for the process to achieve its full value. The Township is pleased to receive meaningful and honest opinions from the public regarding the progress of the Environmental Screening to date.

Independent Review of Hydrogeological Issues Pertaining to the Proposed Ruby Road Landfill near Golden Lake, Ontario

Prepared for:

The Golden Lake Property Owners Association

Prepared by Wilf Ruland (P. Geo.)

766 Sulphur Springs Road
Dundas, Ontario
L9H 5E3
(905) 648-1296
deerspring1@gmail.com

February 18, 2011

1) Introduction

I am a hydrogeologist, and I have worked as an environmental consultant for 25 years (2 years in Germany and 23 years in Canada). I am a specialist in landfill-related groundwater and surface water contamination issues, and have investigated many such issues over the course of my consulting career.

I have given testimony as an expert witness on landfill-related hydrogeological issues before various boards, including the Environmental Assessment Board, the Joint Board, and the Niagara Escarpment Commission. A copy of my Curriculum Vitae is available upon request.

I have been retained as an expert (by the Golden Lake Property Owners Association, or GLPOA) to provide independent advice with respect to the potential hydrogeological impacts of an "attenuation landfill" which is proposed to be situated near Golden Lake, Ontario. This review outlines my findings, conclusions and recommendations regarding the proposed landfill and its potential impacts.

In order to carry out my review work, I have reviewed a series of documents and the most important of these are listed as references in **Appendix A** of this review. I have also toured the landfill and the surrounding area (on Nov. 1, 2010), and corresponded with the Township's staff and consultants. **Appendix B** of this review contains my November 6, 2010 letter to the Township (which contains a series of questions about the proposed landfill) - the Township's letter of response to my questions (dated December 2, 2010) can be requested from the Township.

2) Background on the Proposed Landfill

The Township of Bonnechere Valley is proposing to build and operate a 2.5 hectare "attenuation landfill" - this is the term used for a landfill with no facilities for collection or treatment of its leachate (the contaminated liquid which forms when rainfall leaches contaminants out of the wastes).

If the landfill proposal is approved, the intention is for all of the proposed landfill's leachate to simply be allowed to leak into the ground. The assumption being made is that the leachate will all be "attenuated" (ie. filtered, absorbed, and diluted) on the proposed landfill property, with no off-site impacts occurring.

It is my position based on my review of the publicly available information that this assumption is not reasonable, and that the proposed landfill is likely to cause extensive and unacceptable off-site contamination of groundwater and/or surface water. A detailed discussion of my reasons for this position is provided in **Section 6** of this review.

3) Description of Site Topography, Geology, Drainage, and Climate

a) Geographical Setting

The proposed landfill is situated on an 80 acre (32 hectare) property which is part of Lot 27, Concession 9, Township of South Algona in the amalgamated Township of Bonnechere Valley in Renfrew County. The proposed landfill property is adjacent to a small, closed landfill which was operated by the Township until it was closed at the end of 2003.

The proposed landfill location is on top of a ridge just south of Ruby Road and is less than 2 km southwest of Golden Lake.

b) Topography and Geology

The ridge on which the landfill is proposed to be situated is a glaciofluvial kame moraine feature. The ridge rises well above the surrounding area, and has steep slopes to the east and north and gentler slopes to the west. The terrain on top of the ridge is gently rolling, though there is a notable westward sloping valley feature in the immediate location of the proposed landfill. The regional slope is to the north and east from the area of the proposed landfill towards Golden Lake.

The overburden on the ridge is composed of a 2 to 20 meter (m) thick deposit of mixed sand and gravel, overlain by up to 11 m of silty sand. Underlying the overburden deposits is Precambrian bedrock which is described as fractured granite.

c) Drainage

Drainage from the proposed landfill will be to the west toward an unnamed stream on the adjacent property which flows directly into Golden Lake. This stream flows most of the year, but was reported to have standing water only on July 30, 2008.

Certainly this stream could provide an effective potential pathway for the rapid transport of contaminants from the landfill into Golden Lake - I estimate that travel times would be less than a day for any contamination which reaches the creek to be discharged into Golden Lake.

A major shortcoming of the hydrogeological investigation of the proposed landfill is the fact that this stream and the role it may play in causing contamination of Golden Lake has not been identified or assessed. This issue is discussed in more detail in the following sections of this review.

d) Climate

The proposed landfill is situated in Eastern Ontario. The climate of this region is characterized by long cold winters, with the other seasons relatively shorter. Summers are warm and pleasant. Precipitation averages about 900 mm/year.

4) The Township's Investigation of Site Hydrogeology

a) Introduction

The Township has yet to provide the public with a report on the hydrogeology of the proposed landfill site, even though detailed knowledge of a proposed site's hydrogeology is an essential prerequisite for any attenuation landfill.

Recall that at an attenuation landfill, there are no provisions for leachate collection. The design goal for the landfill is for all of its leachate leak into the underlying groundwater flow system.

Off-site groundwater and surface water contamination is an ever-present threat that must be very carefully assessed when an attenuation landfill is being proposed - I am not persuaded that this threat has been assessed carefully enough with respect to this landfill proposal for reasons which are outlined in detail below.

b) Missing Hydrogeological Information

As discussed above, the threat of off-site groundwater and surface water contamination must be carefully assessed in any proposal for an attenuation landfill. The only way to do this is to carry out a detailed hydrogeological investigation of the property on which the landfill is proposed to be situated as well as of the surrounding area.

Following below is a list of the hydrogeological information which appears to have not been obtained for this proposal:

- regional groundwater flow directions and flow divides need to be understood and identified, but there are no off-site monitoring wells that would allow the proponent to do so;
- a firm understanding of where groundwater contamination from the proposed landfill would be moving once it crosses the downgradient (east and north) property boundaries is needed;
- local domestic wells, significant springs, and larger groundwater users (eg. resorts on Golden Lake) which are downgradient of the proposed landfill need to be identified;
- there does not appear to have been any effort to use the case history provided by the nearby existing closed landfill, by tracing the off-site contamination plume from that landfill (this would provide real-world evidence to compare to predicted groundwater flow directions);
- there has been no effort to properly characterize the leachate from the existing landfill (no leachate well and no testing for potentially hazardous contaminants);
- there is no water balance for the proposed landfill site or the surrounding area;
- the extent of the possible perched overburden groundwater flow system to the immediate west of the proposed landfill does not appear to have been mapped or characterized;
- the possibility of shallow groundwater flow to the west from the proposed landfill (with discharge to a creek which flows into Golden Lake) has apparently not been identified.

c) Misconstrued Hydrogeological Information in Modelling Report

Several aspects of the site hydrogeology appear to have been misconstrued in the computer modelling done in support of the proposed landfill:

- The rates of leachate generation being used for the proposed landfill are too low - they have been estimated at 8.75 cm/year, when in fact they are likely to be closer to 40 cm/year. The recharge rates being used for the local groundwater flow system are also too low.
- The hydraulic conductivity of the overburden units has been significantly underestimated.
- The porosity of the overburden has been estimated to be a uniform 15% - in fact it will be much higher in the overburden (about 25%) and much lower in the bedrock (about 5%).
- The model incorrectly assumes that there is no silty sand overburden layer in the proposed landfill area, and does not account for the creek and wetland west of the proposed site.
- The model suggests that interface aquifer groundwater flow is due east - this is not consistent with actual water level observations which suggest flow to the northeast and/or east.

d) Summary

The sparse hydrogeology information which has been provided to the public to date by the Township does not inspire confidence. Key aspects of site hydrogeology do not appear to have been investigated, and others appear to have been misconstrued. There is nothing to suggest that the very detailed knowledge base required for an attenuation landfill has been assembled. I am recommending that extensive further hydrogeology investigations are needed as outlined in subsequent sections of this review.

5) My Interpretation of Site Hydrogeology

The key to an accurate assessment of the potential impacts of a proposed attenuation landfill on its surroundings is the investigation and description of the site hydrogeology. The indications from the publicly available information are that an inadequate hydrogeological site investigation has been carried out to date, as described and discussed in **Section 4** above.

This section of my review provides a synopsis of my interpretation of the site's hydrogeology based on my independent review of the available data. A more detailed discussion of my interpretation of the site's hydrogeology is provided in **Appendix C** of this review.

Overall the impression conveyed by my review of the publicly available information material is that at present the Township does not have a good understanding of the hydrogeology of the proposed attenuation landfill location. The site hydrogeology is very complex, and this complexity has not been adequately discussed in the materials issued in support of the proposed attenuation landfill to date.

My interpretation of the site's hydrogeology is as follows:

a) Complex and Variable Overburden Geology

The limited number of monitoring wells which have been drilled in the area of the proposed landfill have revealed that the site's overburden geology is quite complex and highly variable. In the relatively small 32 hectare area from which borehole information is available, we see the following:

- the thickness of the surficial silty sand layer varies from 2.3 to 11.3 meters;
- the thickness of the underlying gravel/sand deposit is even more variable - ranging in thickness from 1.5 to 23.3 meters;
- overall the overburden thickness varies from less than 9 to over 27 meters thickness;
- the bedrock surface elevation varies by over 25 meters.

b) Hydraulic Conductivities

I believe that the computer modelling done for the site has not used overburden hydraulic conductivities which will accurately reflect the actual hydraulic conductivities of the overburden units in the field.

Hydraulic conductivities appear to have been underestimated by a factor of over 30 times in the silty sand unit (which I estimate has a hydraulic conductivity of about 10^{-5} m/s) and by a factor of over 10 times in the gravel and sand (which I estimate has a hydraulic conductivity range of 10^{-3} m/s to 10^{-5} m/s, with an average of about 10^{-4} m/s).

c) Porosities

The porosity of the overburden was estimated to be 15% throughout the overburden and the bedrock. In my opinion, porosity in the overburden will be considerably higher (about 25%), and will be considerably lower in the bedrock (about 5%).

d) Groundwater Flow Directions

The proposed landfill location is on a ridge from which groundwater potentially flows in several directions, and once the leachate has leaked into the groundwater system it will be carried along by the groundwater which is flowing beneath the site. Broadly speaking, the groundwater (and leachate) from the landfill area could move in two possible directions:

-> laterally westward from the western parts of the site through the silty sand, discharging to the creek just west of the property boundary;

-> vertically downward through the gravel and sand, and then laterally outward to the east and northeast in the interface aquifer and the bedrock.

e) Groundwater Flow Rates

I estimate that potential rates of groundwater flow in the proposed landfill vicinity are as follows:

- rate of westward flow (through silty sand) - about 19 meters per year
- rate of east/northeast flow (through interface aquifer) - about 275 meters per year
- rate of east/northeast flow (through bedrock aquifer) - hundreds of meters per year

In the interface aquifer groundwater will likely be moving to the east (where it may discharge from springs at the base of the ridge) and/or the northeast toward Golden Lake. Flow rates in the interface aquifer are likely to be quite rapid (in the 100s of meters per year).

Factors that may cause a deflection of groundwater flow directions downgradient of the proposed landfill area include surface springs and large volumes of human groundwater use (eg. intensively used domestic wells, farm wells, and resorts on Golden Lake).

f) Water Balance

For the purpose of this review I am providing a rough estimate of water balance parameters. The water balance of a landfill can be expressed as follows:

precipitation = evaporation + runoff + leachate generation

Precipitation in the area of Golden Lake is about 900 mm/year. Of this amount on a landfill site with no vegetation about 400 mm/year will be lost to evaporation, and about 100 mm/year will run off the site during rainfall events and spring runoff. This leaves about 400 mm/year which will infiltrate into the landfill wastes and generate leachate.

g) Summary

My interpretation of the site hydrogeology is described above. It differs significantly from the interpretation of site hydrogeology provided in the Township's information materials.

There are significant implications arising from this disagreement - namely the answer to the question of whether or not the proposed landfill site could be suitable for an attenuation landfill. Overall, I am concerned that this site is not nearly as suitable for an attenuation landfill as has been publicly suggested, and may in fact be unsuitable. This issue is discussed in more detail in the following sections of this review.

6) Potential Impacts of the Proposed Township Landfill

a) Introduction

The Township is proposing to build an "attenuation landfill" - this is a euphemism for a landfill with no leachate collection or treatment. The design goal is for all of the landfill's leachate to leak into the ground. The assumption being made is that the leachate will all be "attenuated" (ie. filtered and absorbed) on the proposed landfill property, with no off-site impacts occurring.

In practice, it appears that constructing an attenuation landfill at this location could cause two major problems:

- off-site contamination of the downgradient groundwater flow system to the northeast;
- off-site contamination of surface water in the creek to the west of the site, with the contaminants flowing downstream into Golden Lake.

To gain an understanding of the implications of the potential problems posed by this leaky landfill site design, it is important to first consider in more detail the subject of landfill leachate.

b) The Nature of the Proposed Landfill's Leachate

"Leachate" is the term for the contaminated liquid which is generated inside a landfill, when water seeping into the landfill (from rainfall or melting snow) comes into contact with the landfill's wastes and "leaches" chemicals from the wastes. A landfill's leachate directly reflects the contents of the landfilled wastes.

Leachate derived from modern municipal waste streams contains thousands of chemicals (Cherry et al, 1987). Many of these chemicals are harmless, but some are problematic if they get into the environment, and a few may be hazardous if present even in minute amounts. Thus landfill leachate is a noxious liquid which should not be ingested, and which should be prevented from coming into contact with plants, fish or animals in the natural environment.

It is interesting that despite proposing a landfill which by design would leak all of its leachate into the natural environment, the Township has not provided the public with a detailed description of what kinds of contaminants can be expected to be leaking from the landfill.

Experience at other Ontario landfills has shown that the following types of contaminants can be expected at any landfill:

- common inorganic parameters including salts such as sodium and chloride, and nutrients such as ammonia and nitrate;
- heavy metals such as arsenic, lead, cadmium, chromium and mercury - many of which are toxic or neurotoxic and which pose significant threats to aquatic life forms due to bioaccumulation if they get into surface waters;
- organic chemicals found in petroleum hydrocarbons such as benzene (a known carcinogen), and toluene (a neurotoxin), both of which are problematic contaminants in groundwater;
- organic chemicals found in solvents such as trichloroethylene (a known neurotoxin and suspected carcinogen), which is an especially problematic contaminant in groundwater.

It would be naive to assume that these types of chemicals which are common at other Ontario landfills will not also be present in leachate from the proposed attenuation landfill. However to date there has not been detailed information provided to the public by the Township of potential leachate quality and the implications for contamination of groundwater and/or surface water from the proposed landfill.

As is discussed in more detail below, it is my expectation that an attenuation landfill at this location will develop a groundwater contamination plume which will cross the boundaries of the proposed landfill property and cause off-site exceedences of the Ministry of the Environment (MOE) Reasonable Use Policy. It is also possible that there would be contamination of the creek to the west of the proposed landfill location, with rapid flow of contaminants to Golden Lake.

c) Landfill Leachate Generation Rates

Landfill leachate is formed when precipitation (rain or melted snow) comes into contact with a landfill's wastes, thus the total amount of leachate which may be generated in a given year is determined by the amount of precipitation in that year and by the size of the waste footprint.

For example, the proposed Township landfill is to have a waste footprint of 2.5 hectares (which equals 25,000 square meters). As discussed earlier, average annual precipitation in the Golden Lake area is about 900 mm/year, and a reasonable estimate is that about 400 mm (or 0.4 meters) will be seeping into the wastes to form leachate.

Thus the total leachate generated by the proposed landfill can be calculated as follows:

leachate generation rate = 0.4 m x 25,000 square meters
= 10,000 cubic meters per year
= 10 million liters of leachate per year.

It should be noted that the information materials made available to the public by the Township have suggested that the rate of leachate generation will be only about 2.2 million liters per year - over 75% less than what I am estimating. The basis for this estimate is an unrealistically low infiltration rate of 87.5 mm, but this is figure is not consistent with the experience at other Ontario landfills.

The proposed landfill will have no leachate collection facilities, thus the 10 million liters per year of leachate being generated will cause contamination of the groundwater flow systems beneath and downgradient of the site. The possible pathways for leachate leakage are discussed in more detail in the next section of this review.

d) Leakage of the Landfill Leachate

Leachate will be leaking into the groundwater flow system from the proposed Township landfill from the time it opens (if it goes ahead). Since the landfill is on a high point of land from which groundwater potentially flows in several directions, once the leachate has leaked into the groundwater system it may start moving in several directions carried by the groundwater which is flowing beneath the site.

Broadly speaking, the leachate leaking from the landfill area could move in two directions:

-> laterally westward through the silty sand;
-> vertically downward through the gravel and sand, and then laterally outward to the east and/or northeast in the interface aquifer and the bedrock.

Westward Leachate Movement in the Silty Sand

Just 100 meters or so to the west of the proposed landfill, there is a creek which flows by from south to north and ultimately discharges into Golden Lake. So certainly at that location the water table is at the ground surface. This may be a "perched" water table in the silty sand. It is quite possible that at least some leachate from an attenuation landfill at the proposed location would either run overland or flow to the west through the silty sand and discharge to this creek, from where it would flow quickly to Golden Lake.

Northeastward Leachate Movement in the Interface Aquifer

Leachate will also be leaking downward from the landfill into the interface aquifer at the base of the sand and gravel aquifer at the bedrock surface. From here leachate will be moving to the east and/or northeast toward Golden Lake. Flow rates in the interface and bedrock aquifers are likely to be quite rapid (in the 100s of meters per year).

Factors that may cause a deflection of leachate flow directions include surface springs and large volumes of human groundwater use (eg. for intensively used domestic wells, farm wells, and resorts on Golden Lake).

I do not believe that the proposed landfill property is sufficiently large that the leachate plume would be contained, and I anticipate exceedence of the Ministry of the Environment (MOE) Reasonable Use Policy and unacceptable off-site groundwater quality impacts.

It must be remembered that leachate leakage from the proposed landfill is not unexpected - it is inherent in the design of the landfill. So the question is not whether there will be contamination of groundwater, but whether the contaminated groundwater will mostly remain confined to the proposed landfill property - and what will happen if it doesn't. In considering this question the case history of the nearby closed landfill offers some useful information.

7) Case History of the Nearby Closed Landfill

The Township's nearby closed landfill provides a case history which is instructive from a number of perspectives:

- the closed landfill provides some real world evidence of how leachate will move through the local groundwater flow system;
- the Township's handling of the contamination issues pertaining to the closed landfill provides some insight into its possible handling of similar issues pertaining to the proposed landfill.

These issues are discussed in turn below.

Leachate Movement from Closed Landfill

The nearby closed landfill was in operation since the 1970's, and closed in 2003. Landfilling was carried out using trenches in the early years, and a modified area method in the years before closure. Waste burning was carried out on an occasional basis.

Based on the available information, I would estimate that about 20,000 cubic meters of waste and ash were disposed of at the landfill over the time it was in operation. Monitoring wells have been installed at 3 locations, with a well nest (with one overburden and one bedrock well) at the downgradient BH1/BR1 location.

A plume of leachate contamination is present in both the downgradient overburden (BH1) and bedrock (BR1) wells, though the contaminant levels are considerably higher in the overburden well. Leachate contaminants which are present include conductivity, TDS, chloride, alkalinity, hardness, nitrate, and boron. The landfill is not in compliance with the MOE Reasonable Use Policy, and off-site contamination of private property is occurring.

Groundwater movement is to the northeast, and this is confirmed by the fact that there is no leachate present in the other observation wells to the northwest and southeast of the waste footprint.

The Township's Handling of Current Contamination Issues

The Township's track record in the handling of contamination issues associated with its nearby closed landfill has not been proactive or precautionary. I say this for the following reasons:

i) There has been no effort made to fully characterize the leachate from the closed landfill. In particular, there has been no testing to see if potentially hazardous volatile organic chemicals (VOCs) are present in the landfill leachate.

ii) The leachate plume from the closed landfill clearly goes off-site, however there is no way of knowing how far it extends and the Township has made no effort to find out. Given the direction of groundwater flow, it is a certainty that the contaminant plume from the closed landfill extends under Ruby Road and onto one or more private properties to the northeast.

iii) Given the fact that the closed landfill has a plume of unknown extent extending off-site to the northeast, the Township has a responsibility to ensure that no domestic water supplies are affected by the leachate plume. There is no evidence that the Township has acted to fulfill that responsibility.

iv) The 2009 Monitoring Report on the closed landfill states the following about the off-site plume:

> *"Based on the 2009 Monitoring Program, Cambium provides the following conclusions regarding the Ruby Road waste disposal site.*
>
> - *Concentrations of the general water quality indicators TDS, hardness, nitrate, and alkalinity, at the downgradient monitor BH1 reported greater than the reasonable use criteria determined for the Ruby Road site. The RUC for nitrate is preliminary, and is based on only 2 years of data. Given the proximity of BH1 to the property boundary, the Site is considered non-compliant with the Reasonable Use policy in 2009 (MOE Guideline B-7). As there are no downgradient groundwater users in the direction of groundwater flow and the water quality is expected to improve with time, it is recommended that no direct action is required.*
>
> - *As there are no downgradient groundwater users in the direction of groundwater flow and the water quality is expected to improve with time, no direct mitigative actions are considered necessary."*

There is a similar statement in the 2008 Annual Report.

v) The problem with the above statements is that they appear to be incorrect. There are two domestic wells (one of which is shown on Figure 4 of the September 20, 2010 Modelling report) about 570 meters to the northeast of the closed landfill. A precautionary and conscientious approach to managing the off-site leachate plume would have resulted in these wells being tested for potential leachate impacts years ago.

vi) On December 2, 2010 I received the following response to my specific question about this matter from the Township's consultants:

> *"No domestic well sampling has been conducted to our knowledge. The closest residential wells are greater than 500 meters from the existing Ruby Road waste disposal site."*

vii) Landfill leachate plumes are known to have travelled distances of much further than 500 meters through various groundwater flow systems around the province. There is an urgent need to immediately sample these downgradient wells for leachate contaminants.

8) Viability of an Attenuation Landfill at the Proposed Location

In 1993 I co-authored a report on attenuation landfills (Ruland, Schellenberg, and Farquahar, 1993) which was commissioned by the Ministry of the Environment. That report included suggested guidelines for Attenuation Landfill Sites, and those guidelines have been reproduced in **Appendix D** of this review**.** Comparison of the criteria in the guidelines to the Township's attenuation landfill proposal reveals serious deficiencies, including the following:

Monitoring Network is Inadequate

The understanding of the hydrogeology of the proposed landfill property and surrounding area is not as good as it needs to be - there are not enough on-site wells and there are no off-site monitoring wells. At proposed attenuation landfill sites a detailed and proven monitoring network must be in place - that is not the case for this proposed landfill.

Inadequate Understanding of Local Hydrogeology

The understanding of the hydrogeology of the surrounding area is not as good as it needs to be - there is virtually no information available on the off-site hydrogeology. Two issues in particular are poorly understood:

- The fact that the water table is at the ground surface just to the west of the proposed landfill footprint is inconsistent with the conceptual model for the site and has not been satisfactorily explained.

- Groundwater and contaminant flow paths in the interface and bedrock aquifers downgradient of the proposed landfill (to the east and northeast) are unknown.

The Hydrogeological Setting is Problematic

The presence of the gravel and sand layer beneath the silty sand poses major problems, as leachate will flow straight downward through the gravel and sand to the high hydraulic conductivity interface and bedrock aquifers - where attenuation will be minimized and flow paths are irregular and unpredictable.

East/northeastward movement of the contaminant plume in the interface and bedrock aquifers will be rapid (my estimated flow rate is 100s of meters per year) and unpredictable.

The aquifers proposed to be used for leachate attenuation currently have excellent water quality and are a viable groundwater resource (ideal sites for attenuation landfills are ones where the groundwater quality is naturally poor).

The Township Does Not Control the Downgradient Groundwater Flow Path

There is private property within less than 200 meters downgradient of the proposed attenuation landfill, and it is my expectation that groundwater contamination will cross the downgradient property boundaries at levels exceeding regulatory limits. If contamination of adjacent properties occurs there may be massive remedial costs imposed on the Township, and it is possible that the landfill will be closed by the Ministry of the Environment.

Water Balance Needed for the Proposed Landfill

The unrealistically low estimate provided by for leachate generation rates suggests that a detailed water balance calculation has not yet been carried out. This is required for any proposed attenuation landfill.

9) Discussion

The Township is proposing to construct an attenuation landfill on Ruby Road, upgradient and upstream of Golden Lake. I have no particular knowledge of these matters, but my understanding is that the primary motivation for the proposal is that the proposed attenuation landfill is perceived by the Township to be the least expensive of the available waste management options.

The full costs of an attenuation landfill at the proposed location are currently unknown, but certainly significant further costs will be incurred to determine whether the proposed location is even feasible. Moreover mitigation measures such as purge wells, leachate collection/treatment, downgradient property acquisition, and clay landfill cover need to be explicitly identified and budgeted.

Overall I am concerned that this site is not nearly as suitable for an attenuation landfill as has been suggested in information made available to the public, and that it may in fact be unsuitable. The hydrogeological investigation which has been carried out to date is incomplete and inadequate, and does not provide the information needed about the local hydrogeology to determine whether the proposed location is suitable for an attenuation landfill.

The groundwater model appears to be based on an incomplete and/or incorrect understanding of the local hydrogeology and water balance, and I am concerned that its predictions are not reasonable because of a variety of inappropriate input parameters which were the basis for the modelling. In particular it is my interpretation that the following major issues are skewing the modelling results:

- the hydraulic conductivities used for the silty sand layer and for the underlying gravel and sand layer are unrealistically low;
- the recharge rates being used for the local groundwater flow system are too low;
- the rates of leachate generation being used for the proposed landfill are too low;
- the model incorrectly assumes that there is no silty sand overburden layer in the area of the footprint of the proposed landfill;
- the model does not account for the creek and wetland immediately west of the proposed site.

As a result the model appears to miss the (possibly perched) water table at the ground surface just west of the landfill, and the potential for a westward flow and discharge of leachate to the creek just west of the landfill footprint.

It is not possible at this point to quantify the extent of the potential impacts on off-site groundwater (which would be to interface and bedrock aquifer quality east/northeast of the proposed site) and on off-site surface water. This is because the impact assessment which has been carried out does not even identify the potential for surface water impacts west of the proposed landfill, and because the amounts of leachate which the landfill would generate have been underestimated by over 80%.

But the landfill will be generating about 10 million liters of leachate a year, and the only places that these 10 million liters of leachate can be going under the attenuation design philosophy which is the basis for the landfill proposal is into the surface water flow system or the groundwater flow system

- The risk of unacceptable impacts to Golden Lake is much higher if there is a significant amount of leachate moving west in the silty sand and getting into the creek west of the proposed landfill footprint (the creek provides a very effective pathway for contaminants to quickly reach Golden Lake - travel time would likely be under a day).
- On the other hand, if most or all of the leachate is flowing downward to the interface and bedrock aquifers then it will be carried rapidly off-site to the east/northeast. This scenario raises the risk of unacceptable impacts to groundwater quality on adjacent private properties and to domestic wells downgradient of the proposed landfill.

It is my professional opinion based on the available information, that without major mitigation an attenuation landfill will not be viable at this location because it will cause unacceptable off-site impacts on groundwater and/or surface water quality.

The currently available information about the landfill proposal has provided little disclosure about possible mitigation measures. The only explicit reference to possible mitigation measures I could find in public information made available by the Township is on page 31 of the September 20, 2010 Modelling report. The report simply lists the following possible mitigation measures:

- acquisition of additional land;
- applying a low-permeability clay cover to parts of the site which have reached final contours;
- installing a collection system consisting of purge wells and/or leachate collection pipes.

There is no information or discussion about the potential costs of these mitigation measures, and their likelihood of success. Acquisition of additional land is likely to be costly and controversial, and if property owners downgradient of the proposed landfill do not wish to sell then the Township may resort to making use of its expropriation powers. Applying a low-permeability cover will not be possible until near the end of the landfill's life, and will be costly. Leachate collection measures will also be costly, and unless they are built into the design from the outset their likelihood of being successful in preventing/mitigating off-site impacts is not very high.

I expect that if mitigation measures as described above are required then the costs of this proposal will escalate to the point where it is more expensive than the alternatives. Thus it is critically important for the Township to gain a better understanding now of whether such measures will be needed. As discussed earlier, it is my opinion is that major mitigation measures will be needed.

Further research and field investigations are urgently needed and should be carried out before any decision is made on whether or not to proceed with the proposed landfill site. Further research and field investigations which are urgently needed include the following:

- A water balance should be prepared for the proposed landfill, with the explicit goal of developing the best possible estimate of leachate generation rates for the landfill. Likewise, a water balance for the study area should be developed with the goal of determining a reasonable estimate of infiltration rates across the study area.

- Additional monitoring wells should be installed off of the proposed landfill property to the west (at least two nests of wells completed in the silty sand and the gravel and sand layers), to the north, to the northeast, and to the east.

- Additional monitoring wells should be installed on the proposed landfill property in the northwest of the property, in the center of the proposed landfill footprint, on the east property boundary, and in the south half of the proposed landfill property.

- All new wells should be surveyed in, and be incorporated into a quarterly water level monitoring program which is synchronized with that of the wells from the nearby closed landfill - the existing wells on the proposed landfill property (MW4-08, MW5-08, MW6-08, and MW7-09) should also be incorporated into this monitoring program.

- A leachate well should be installed in the existing landfill, and tested for major ions, metals, and volatile organic chemicals (VOCs).

- Downgradient wells should be installed to the northeast and east of the nearby closed landfill, using the leachate contamination plume from the landfill as a tracer to try to confirm the model predictions of flow rates, flow directions, and contaminant transport.

- Downgradient domestic wells to the northeast of the nearby closed landfill site should be tested for the possible presence of leachate indicator parameters and volatile organic chemicals (VOCs), both for use in assessing groundwater flow directions and as a matter of protection of public health and safety.

10) Conclusions

1) It is my professional opinion based on my review of the Township's documents and information materials listed in **Appendix A** of this review, that these do not provide a complete or adequate description, study or assessment of the potential impacts of the proposed Township of Bonnechere Valley landfill on downgradient groundwater and downstream surface waters as is required for Steps 4 and 6 of the Environmental Screening Process under Ontario Regulation 101/07.

My concerns about the hydrogeological investigation and impact assessment conducted by the Township are outlined in **Sections 4, 6, 8, and 9** of this review.

2) It is my professional opinion based on my review of the Township's documents and information materials listed in **Appendix A** of this review, that these do not provide complete or adequate impact management (mitigation) measures for the potential impacts of the proposed landfill on downgradient groundwater and downstream surface waters as is required for Step 7 of the Environmental Screening Process under Ontario Regulation 101/07.

There has been little disclosure by the Township about possible mitigation measures. The only explicit reference to possible mitigation measures I was able to find simply lists the following:

- acquisition of additional land;
- applying a low-permeability clay cover to parts of the site which have reached final contours;
- installing a collection system consisting of purge wells and/or leachate collection pipes.

There is no information about the advantages and disadvantages of these mitigation measures, their potential costs, and their likelihood of success. There is also no indication of whether there is any commitment by the Township to pursue any mitigation measures if they prove to be needed. When mitigation was needed at the nearby closed landfill, the Township simply closed the landfill.

3) It is my professional opinion based on my review of the Township documents and information materials listed in **Appendix A** of this review, that the proposed landfill could have significant negative impacts (ie. net effects) on downgradient groundwater and/or downstream surface waters outside of the identified property boundaries. My professional concerns about the proposal have not been resolved by the documentation/information provided to date by the Township.

I estimate that the proposed landfill will be generating about 10 million liters of leachate a year, and under the attenuation design philosophy which is the basis for the landfill proposal this leachate will be leaking into the surface water flow system and/or the groundwater flow system.

- The risk of unacceptable impacts to Golden Lake is much higher if there is a significant amount of leachate moving west to the creek west of the proposed landfill footprint.
- On the other hand, if most or all of the leachate gets into the groundwater flow system then unacceptable impacts to groundwater quality on adjacent private properties and to domestic wells downgradient of the proposed landfill become much more likely.

4) Under Step 9 of the Environmental Screening Process under Ontario Regulation 101/07 significant net effects and/or unresolved concerns should trigger additional studies and assessment of net effects and impact management measures.

5) I have detailed recommendations about further research and field investigations which should be completed in order to provide a better understanding of the proposed landfill and its potential impacts on off-site groundwater and surface water features, and these recommendations are summarized in **Section 11** of this review.

11) Recommendations

1) This matter should not be moved forward in the Environmental Screening Process under Ontario Regulation 101/07 because Steps 4, 6, and 7 of the Screening Process have not been adequately completed - as discussed in the Conclusions in **Section 10** of this review.

2) I have significant unresolved concerns about this proposal. It is my professional opinion based on the currently available information that the proposed landfill will have unacceptable net effects in the form of unacceptable off-site impacts on groundwater and/or surface water quality (including possible contamination of Golden Lake via the creek to the west of the proposed landfill location).

3) Step 9 of the Environmental Screening Process under Ontario Regulation 101/07 indicates that significant net effects and/or unresolved concerns should trigger additional studies and assessment of net effects and impact management measures. The following further research and field investigations should be carried out before any decision is made on whether or not to proceed with the proposed landfill site:

- A water balance should be prepared for the proposed landfill, with the explicit goal of developing the best possible estimate of leachate generation rates for the landfill. Likewise, a water balance for the study area should be developed with the goal of determining a reasonable estimate of infiltration rates across the study area.

- Additional monitoring wells should be installed off of the proposed landfill property to the west (at least two nests of wells completed in the silty sand and the gravel and sand layers), to the north, to the northeast, and to the east.

- Additional monitoring wells should be installed on the proposed landfill property in the northwest of the property, in the center of the proposed landfill footprint, on the east property boundary, and in the south half of the proposed landfill property.

- All new wells should be surveyed in, and be incorporated into a quarterly water level monitoring program which is synchronized with that of the wells from the nearby closed landfill - the existing wells on the proposed landfill property (MW4-08, MW5-08, MW6-08, and MW7-09) should also be incorporated into this monitoring program.

- A leachate well should be installed in the existing landfill, and tested for major ions, metals, and volatile organic chemicals (VOCs).

- Downgradient wells should be installed to the northeast and east of the nearby closed landfill, using the leachate contamination plume from the landfill as a tracer to try to confirm the model predictions of flow rates, flow directions, and contaminant transport.

- Downgradient domestic wells to the northeast of the nearby closed landfill site should be tested for the possible presence of leachate indicator parameters and volatile organic chemicals (VOCs), both for use in assessing groundwater flow directions and as a matter of protection of public health and safety.

4) Once this information has been obtained, the site impact assessment and modelling should be redone in order to obtain a more comprehensive and accurate assessment of potential impacts of the proposed landfill. If the revised site impact assessment indicates that there will be unacceptable off-site impacts (and I expect that they will), then detailed information will be required about the necessary mitigation measures including an explicit discussion about advantages and disadvantages, costs, and their likelihood of success.

Appendix A - References

The following major references were considered in the course of preparing this review:

Cambium Environmental Inc. March 24, 2008. *2007 Annual Report, Ruby Road Waste Disposal Site*.

Cambium Environmental Inc. March 26, 2009. *2008 Annual Report, Ruby Road Waste Disposal Site*.

Cambium Environmental Inc. March 19, 2010. *2009 Annual Report, Ruby Road Waste Disposal Site*.

Cambium Environmental Inc. September 20, 2010. *Numerical Hydrogeological Modelling Report for Expansion Feasibility of the Ruby Road Waste Disposal Site*.

Cherry, J.A., MacQuarrie, K.T.B., and Ruland, W.W. 1987. *Hydrogeologic Aspects of Landfill Impacts on Groundwater and Some Regulatory Implications*. Paper presented at the PCAO/MOE Seminar on Landfill Regulations May 13, 1987.

Domenico, P.A. and Schwartz, F.W. 1990. *Physical and Chemical Hydrogeology*.

Freeze, R.A. and Cherry, J.A. 1979. *Groundwater*.

Jp2g Consultants Inc. August 2002. *Ruby Road Waste Disposal Site, Site Closure and Waste Transfer Facility Operations Plan*.

Ontario Ministry of the Environment. December 18, 2002 and January 17, 2008. *Amendments to Provisional Certificate of Approval for Waste Disposal Site No. A 411501*.

Robinson Consultants. April 2002. *South Algona Landfill Site, Hydrogeologic Investigation*.

Ruland, W.W., Schellenberg, S.S., and Farquhar, G. 1993. *The Fate of Landfill Leachate in Waste Water Treatment Plants and in Groundwater at Attenuation Landfills*. Report prepared for the Ontario Ministry of Environment and Energy.

Snider Ecological Services. May 2008. *Initial Environmental Impact Study, Ruby Road Waste Disposal Site*.

Snider Ecological Services. November 2008. *Supplemental Studies for Natural Environment Features of Ruby Road Waste Disposal Site*.

Township of Bonnechere Valley. Public Consultation Events: February 20, 2008; July 26, 2008; November 25, 2008. *Factsheets, posters, and presentations*.

Note: A number of other materials including correspondence, maps, air photos etc. were also considered in the course of preparing this Review.

Appendix B

November 6, 2010 Information Request

Sent to the Township of Bonnechere Valley

My November 6, 2010 letter to the Township (which contains a series of questions about the proposed landfill) is reproduced in this Appendix.

The Township's letter of response to my questions (dated December 2, 2010) can be requested from the Township.

Mr. Bryan Martin
Township of Bonnechere Valley
49 Bonnechere St. West
P.O. Box 100
Eganville, Ontario
K0J 1T0

November 6, 2010

Dear Mr. Martin,

I have not been able to find the following information pertaining to site hydrogeology in the documents which you have provided to my clients for my review, and thus would like to ask that you convey the following information request to the Township's consultants.

Please provide the following information at your earliest convenience:

A) Questions About Existing Landfill, Including Monitoring and Impacts

1) Please confirm your agreement that the existing landfill represents a "case history" which can provide valuable insights into the hydrogeology of the area, including insights into how the contaminant plume from the proposed landfill might move through the groundwater flow system.

2) Was the waste in the existing (closed) landfill disposed of in excavated trenches? If so, then how deep were those trenches? How much waste is in the closed landfill?

3) Why is there no leachate well in the existing landfill to test the actual raw leachate composition and to check for leachate mounding?

4) Why has the impacted downgradient well (BH-1) at the existing (closed) landfill not been tested for VOCs (volatile organic chemicals)?

5) Given that the contaminant plume from the existing landfill has been shown to be leaking from the property and the location of the plume front is not known, has there been any precautionary testing of downgradient domestic wells to the east and northeast of the existing landfill site for leachate contaminants?

6) Why are groundwater samples being filtered before analysis? Won't this reduce the levels of various contaminants which may be present in the samples?

7) Why is the existence and the data from the 4 new monitoring wells not disclosed in the landfill's Annual Reports? The new wells could be useful in providing bigger-picture groundwater contour maps, as well as reliable background monitoring locations.

B) Questions About Design and Operations of Proposed Landfill

1) Will the waste in the proposed landfill be disposed of in excavated trenches? If so, then how deep will those trenches be?

2) What final cover material is proposed for the new landfill? What will the hydraulic conductivity of the final cover be?

3) Are any measures being planned to contain or collect leachate from the proposed landfill?

4) The land surface in the area of the proposed landfill slopes to the west. Please confirm where surface water runoff from the proposed landfill will be diverted to?

5) How much leachate is estimated to be generated by the proposed landfill on a yearly basis?

6) It appears that the proposed landfill will have a high, steep slope on its western side. Given that the underlying soils are likely to be less permeable than the wastes themselves, this would be a likely location for leachate springs to develop - how often will there be inspections for leachate springs, and if found how will such leachate springs be handled?

C) Questions About Hydrogeology of Proposed Landfill and Surrounding Area

1) My understanding is that an attenuation landfill is proposed, with no effort being made to contain or collect leakage of leachate into the groundwater flow system - is this correct?

2) At attenuation landfills, ownership of downgradient properties is an important consideration as these are at heightened risk of becoming contaminated. Please provide a map showing property ownership within a 2 km radius of the proposed landfill.

3) Please provide a groundwater contour map showing water levels for all 8 monitoring wells for April 10, 2010.

4) Is there a perched water table in the overburden unit? If so, then could it provide a pathway for off-site contaminant movement?

5) The existing (closed) landfill cell is already in violation of the MOE Reasonable Use Policy. How will this liability be dealt with in the context of the proposed expansion?

6) Why was a hydraulic conductivity not calculated for BH-1?

7) Is it possible that the creek west of the site (represented by locations 77, 78, and 121 in the Initial Natural Environment Impact Study) provides fish habitat anywhere along its length?

8) a) Please provide an explanation for the stripping of vegetation from the wetland and regrading/rerouting of the creek to the immediate west of the proposed landfill?

b) Please indicate what impacts the vegetation stripping in the wetland and the regrading/rerouting of the creek (including the high turbidity observed downstream on the date of the site tour) might have on the downgradient aquatic ecosystem in the creek?

c) Please provide an estimate of travel time of contaminants in the creek - from the point closest to the proposed landfill to Golden Lake?

D) Questions About Computer Modelling in Support of the Proposed Landfill

1) Please provide an explanation of the implications for the landfill proposal if the 300 mg/L of chloride (used as the simulated "worst-case" contaminant concentration) proves not to be conservative in terms of future critical leachate contaminants and/or concentrations?

2) Please explain why an organic contaminant like vinyl chloride was not used to model potential groundwater impacts of the proposed landfill? Are you aware that vinyl chloride has been shown to be persistent over many hundreds of meters in leachate plumes in Ontario?

3) Please provide justification for the assumed porosity of 0.15 which is used throughout the model? Why not a value of 0.25 to 0.4 in the overburden, and a value of <0.1 in the bedrock (as suggested by Freeze and Cherry, 1979)?

4) The assumed recharge used in the model (8.75 cm/year) seems very low - please provide all lines of field evidence which were considered in deciding on this assumed recharge rate?

5) My initial rough estimate of the amount of leachate which would be generated by the proposed landfill (which is to have an area of 2.5 hectares) is on the order of 8 to 10 million liters of leachate per year - why is the model only assessing the groundwater impacts of 2.2 million liters per year?

6) How does the model account for the observed groundwater discharges to springs which feed wetlands and creeks to the east and west of the proposed landfill?

E) Questions About Monitoring and Contingency Plans for the Proposed Landfill

1) Have recommendations been developed yet for on-site and off-site groundwater and surface water monitoring of the proposed landfill (and if so, please provide the proposed locations, frequencies, and parameter lists)?

2) In the event that the computer modelling proves to be inaccurate, what contingency plans are proposed to deal with a stronger than anticipated plume that goes off-site to the east or north east and onto neighbouring properties?

F) Missing Reports on the Proposed Landfill

1) Please provide the Preliminary Hydrogeology Assessment report (which was described as being completed on page 18 of the presentation materials for the second 2008 Public Consultation Event).

The report is said to include:

- the findings from 3 additional monitoring wells installed to better understand groundwater dynamics at the subject property;
- completed preliminary mass balance calculations using worst-case scenario concentrations of typical leachate indicators;
- concentrations of typical leachate indicator parameters.

2) Please provide the Detailed Hydrogeological Study which was said on page 26 of the presentation materials for the 2nd 2008 Public Consultation Event to be "in progress".

3) Please provide the Environmental Screening Report, which is cited on page 5 of the Sept. 20, 2010 Modelling Report, and is said to have been "completed by Cambium".

The report apparently discusses "the proposed volume and operational life" of the proposed landfill "in detail, suggesting a 25 year site life".

_____

Mr. Martin, I am not trying to be difficult. But the documentation provided to my clients to date is simply not adequate to support an attenuation landfill of up to 100,000 m3 of waste at the proposed location.

With this information request I am hoping to obtain the additional information which I need to properly assess the landfill proposal for my clients.

Thank you in advance for your assistance with this matter,

Yours sincerely,

Wilf Ruland (P. Geo.)

766 Sulphur Springs Road
Dundas, Ontario
L9H 5E3
tel: (905) 648-1296
deerspring1@gmail.com

P.S. It is not clear to me whether your consultants are working from any sort of guidelines for attenuation landfills in designing and assessing impacts of the proposed landfill. I have in my possession a set of suggested guidelines for attenuation landfills which were developed for the Ministry of the Environment by myself and 2 co-authors. These may prove helpful in the further work on this proposal. Please let me know if you would like me to send you a copy.

Appendix C- My Interpretation of Site Hydrogeology

The key to an accurate assessment of the potential impacts of a proposed attenuation landfill on its surroundings is the investigation and description of the site hydrogeology. The indications are that an inadequate hydrogeological site investigation has been carried out to date, as described and discussed in **Section 4** of this review.

In this part of my review, I will provide my interpretation of the site's hydrogeology based on my independent review of the available data. Overall, I have found that the current understanding of the site hydrogeology as presented to the public by the Township appears to not be very good.

Some information on site hydrogeology can however be gleaned from sifting through information found in a number of sources, including:

- information materials from the Township's 3 public consultation events about the proposed landfill;
- a September 2010 modelling report done in support of the proposed landfill;
- an April 2002 evaluation of the nearby small landfill which was operated by the Township until it was closed in 2003;
- the annual reports for the closed landfill;
- observations from my tour of the site and surrounding area.

Overall the impression conveyed by review of this information material is that at present there is not a good understanding of the hydrogeology of the proposed attenuation landfill location. The site hydrogeology is very complex, and this complexity has not been adequately discussed in the documents issued in support of the proposed attenuation landfill to date.

a) Hydrostratigraphy of Proposed Landfill Area

There are 3 major hydrostratigraphic layers which will influence the directions of leachate movement from the proposed landfill:

i. the surficial silty sand layer;
ii. the underlying sand/gravel;
iii. the fractured granite bedrock.

i) The Surficial Silty Sand Layer

There is a surface layer of silty sand of highly variable thickness present across the site. The sandy silt extends from the ground surface down to depths of between about 2 meters and 11 meters below the ground surface.

The site borehole logs show the following approximate thicknesses for the silty sand layer:

Location	Thickness of Silty Sand
BH1/BR1	6.5 meters
BH2	11.3 meters
BH3	9.0 meters
MW4-08	6.1 meters
MW5-08	2.3 meters
MW6-08	6.1 meters
MW7-09	9.1 + 8.6 meters

The silty sand layer is thickest on the northeast side of the ridge in the area of BH2, BH3, and especially MW7-09. At MW7-09 there are two thick layers of silty sand, separated by a 1.6 meter gravel/sand layer which is sandwiched between them. The silty sand layer is much thinner (just a couple of meters thick) on the east slope of the ridge in the area of MW5-08.

The hydraulic conductivity of the silty sand is clearly much lower than that of the underlying sand and gravel deposits. It is possible that a perched water table may develop in the silty sand layer - certainly the water table is at the ground surface in the silty sand within 100 m to the west of the proposed landfill in the stream which runs west of site.

In areas where there is a perched water table, lateral groundwater movement within the silty sand will likely tend to follow the topography in a westerly direction from the proposed landfill location toward the stream to the west of the proposed landfill.

ii) The Underlying Gravel/Sand Deposit

There is an underlying deposit of gravel and sand beneath the surficial layer of silty sand which is extremely variable in thickness - ranging from less than 2 meters to over 20 meters thick.

The borehole logs show the following approximate thicknesses for the gravel/sand deposit:

Location	**Thickness of Gravel/Sand**
BH1/BR1	19.0 meters
BH2	16.7 meters
BH3	17.5 meters
MW4-08	5.4 meters
MW5-08	23.3 meters
MW6-08	1.5 meters
MW7-09	1.6 meters

The gravel/sand deposit is thickest on the east side of the ridge in the area of BH1/BR1, BH2, BH3 and MW5-08. The gravel/sand deposit is much thinner on the west side of the ridge in the area of MW4-08, MW6-08 and MW7-09. At MW7-09 there is only a 1.6 m thick gravel/sand layer sandwiched between thick layers of silty sand.

Groundwater flow directions in the gravel/sand deposit will be downward to the interface aquifer at the base of the gravel/sand deposit, and then laterally outwards following the direction of hydraulic gradients to the east and/or northeast toward Golden Lake.

iii) Overburden Thickness

Overburden thicknesses do not appear to have been determined. This is a significant omission, given that the key to a successful attenuation landfill is a comprehensive understanding of the overburden beneath the site.

Overburden thicknesses are highly variable, and tend to increase from west to east, with a total overburden thickness at MW6-08 on the west side of the proposed landfill property of only 8.6 meters vs. a thickness of 27 meters or more on the northeast side of the ridge in the vicinity of the nearby closed landfill.

iv) Bedrock Surface Elevations

Bedrock surface elevations do not appear to have been determined.

However consideration of topographic contours and the borehole logs allows estimation of the approximate elevations of the top of the bedrock, which are shown below in elevations of meters above sea level (masl):

Location	**Bedrock Surface**
BH1/BR1	187 masl
BH2	188 masl
BH3	189 masl
MW4-08	197 masl
MW5-08	189 masl
MW6-08	212 masl
MW7-09	198 masl

These bedrock surface elevations suggest that the topographic ridge on which the proposed landfill is to be situated has a bedrock ridge at its core, and that just as the ground surface elevations along the ridge rise to the south so too do the bedrock elevations rise to the south - with a marked bedrock high for the monitoring well borehole logs being shown at MW6-08.

Drilling records from the site indicate that the granite bedrock is fractured, becoming more competent with depth. Water movement within the bedrock will be through the fractures, with much bedrock groundwater flow occurring within the upper few meters of the bedrock.

Groundwater flow directions in the granite bedrock will generally follow the direction of hydraulic gradients to the east and/or northeast toward Golden Lake.

v) Summary of Hydrostratigraphy

The limited number of monitoring wells which have been drilled in the 32 hectare area of the proposed landfill have nonetheless revealed that the site's overburden geology is quite complex and highly variable.

In the small 32 hectare area from which borehole information is available, we see the following:

- the thickness of the surficial silty sand layer varies from 2.3 to 11.3 meters;
- the thickness of the underlying gravel/sand deposit is even more variable - ranging in thickness from 1.5 to 23.3 meters;
- overall the overburden thickness varies from less than 9 to over 27 meters thickness;
- the bedrock surface elevation varies by over 25 meters in the small area from which borehole information is available.

Given this variability in thicknesses and depths of hydrostratigraphic units, predicting and monitoring the movement of groundwater at this proposed landfill site would be very challenging.

Significant further investigations involving drilling new boreholes and installing monitoring wells will be required off of the proposed landfill property to the west, north, northeast and east in order to provide information about regional trends in hydrostratigraphy and groundwater flow directions.

Further on-site investigations are also required including new boreholes outfitted with new monitoring wells which are needed in the northwest of the property, in the center of the proposed landfill footprint, on the east property line, and in the south half of the proposed landfill property.

b) Hydraulic Conductivities of Hydrostratigraphic Units

The rate at which groundwater (and contaminants) can move through the subsurface in the area of the proposed landfill is mainly dependent upon the hydraulic conductivities of the hydrostratigraphic units. Thus characterizing this parameter is a critically important part of the site investigation and description.

The hydraulic conductivities (often abbreviated as K) of the hydrostratigraphic units have been characterized as shown in **Table C-1** below:

Table C-1 - Hydraulic Conductivities in proposed Landfill Area

Hydrostratigraphic Unit	Township K Estimate (from computer model)	My K Estimate
surficial silty sand	3.1×10^{-7} m/s	1×10^{-5} m/s
gravel and sand	8.8×10^{-6} m/s	1×10^{-4} m/s
upper bedrock	6×10^{-5} to 2×10^{-6} m/s	no issue
deeper bedrock	5×10^{-7} m/s	no issue

I believe that the computer modelling done for the site has not used overburden hydraulic conductivities which accurately reflect the actual hydraulic conductivities of the overburden units in the field. Hydraulic conductivities appear to have been underestimated by a factor of over 30 times in the silty sand unit and by a factor of over 10 times in the gravel and sand.

The reason for my opinion can be found in a table in a standard reference text on Hydrogeology (Freeze and Cherry, 1979). Table 2.2 of that text shows ranges of hydraulic conductivity values for various geologic materials as follows:

Silty Sand

The range of hydraulic conductivity values indicated for silty sand in Table 2.2 is from around 10^{-7} m/s to 10^{-3} m/s - based on my inspection of this sand in the field, I anticipate that the midpoint of this range (10^{-5} m/s) is a reasonable estimate of that unit's hydraulic conductivity.

It should be noted that in the Township's Open House handout materials a hydraulic conductivity value of 10^{-4} m/s to 10^{-6} m/s was used to describe the surficial layer (the silty sand). This range supports my estimate of 10^{-5} m/s, but is inconsistent with the much lower hydraulic conductivity of 3.1×10^{-7} m/s used in the computer model.

Gravel and Sand

The range of hydraulic conductivity values indicated for gravel and sand in Table 2.2 is from around 10^{-5} m/s to about 1 m/s - based on my inspection of this gravel and sand unit in the field, I anticipate that a hydraulic conductivity just below the middle of this range (ie. 10^{-3} m/s to 10^{-5} m/s, with an average of about 10^{-4} m/s) is a reasonable estimate of that unit's hydraulic conductivity.

The hydraulic conductivity of the gravel/sand has been estimated to be about 9×10^{-6} m/s, which seems to be much too low. Using this hydraulic conductivity estimate for the gravel/sand deposit will tend to underestimate the potential for groundwater (and contaminant) movement in the area of the proposed landfill.

The underestimation of hydraulic conductivities of the overburden units has significant implications for the computer modelling and the impact assessment which was done for the proposed attenuation landfill, as discussed in **Section 9** of this review.

It should be noted that the above discussion about hydraulic conductivity pertains to the immediate landfill area only, where information is available from the wells installed by the Township. Hydraulic conductivity is a highly variable parameter, and can change by orders of magnitude even within the same geologic formations. It is quite possible that hydraulic conductivities are quite different outside of the immediate 32 hectare proposed landfill property - the only way to determine whether this is the case is to install and test more wells.

It is critical that additional monitoring wells be installed off-site to the east and northeast, in the anticipated direction of deeper groundwater flow. Other wells are also needed - this issue is discussed in more detail in **Section g)** below

c) Porosity

The porosity of the overburden was estimated to be 15% throughout the overburden and the bedrock. This is the figure provided on page 26 of the September 20, 2010 report on the computer modelling in support of the proposed landfill.

The report's authors state that their assumed porosity was "determined from the literature" and cite Freeze and Cherry (1979) as the source. Review of the discussion of porosity in Freeze and Cherry (on pages 36 to 38) does not however support the 15% figure given in the September 20, 2010 modelling report.

Porosity in the overburden will be considerably higher (about 25%), and will be considerably lower in the bedrock (about 5%).

d) Groundwater Flow Directions

The proposed landfill location is on a ridge from which groundwater potentially flows in several directions, and once the leachate has leaked into the groundwater system it will be carried along by the groundwater which is flowing beneath the site.

Broadly speaking, the groundwater (and leachate) from the landfill area could move in two directions (which are discussed in more detail below):

-> laterally westward through the silty sand;
-> vertically downward through the gravel and sand, and then laterally outward to the east and northeast in the interface aquifer and the bedrock aquifer.

Potential Westward Groundwater Movement in the Silty Sand

Just a 100 meters or so to the west of the proposed landfill, there is a creek which flows by from south to north and eventually discharges into Golden Lake. So certainly along the path of the creek the water table is at the ground surface. This may be a "perched" water table in the silty sand, or it may be that the creek and surrounding wetland mark the actual water table elevation in that area.

It is quite possible that there is a westward component of groundwater flow in the silty sand in the area of the proposed landfill, especially in the western part of the proposed landfill footprint.

East and Northeast Groundwater Movement in the Interface and Bedrock Aquifers

Rainfall onto the much of the area of the proposed landfill currently seeps into the ground and flows downward through the silty sand and into the interface aquifer at the base of the sand and gravel aquifer (at the bedrock surface). In the interface aquifer and in the underlying bedrock aquifer groundwater will likely be moving to the east (where it may discharge from springs at the base of the ridge) and/or the northeast toward Golden Lake. Flow rates in the interface and bedrock aquifers are likely to be quite rapid (in the 100s of meters per year).

Factors that may cause a deflection of groundwater flow directions downgradient of the proposed landfill area include surface springs and large volumes of human groundwater use (eg. for intensively used domestic wells, farm wells, and resorts on Golden Lake).

e) Groundwater Flow Rates

The rate of groundwater movement can be estimated using Darcy's Law as follows:

rate of groundwater movement = (hydraulic conductivity x hydraulic gradient) / porosity

Solving for this equation using average parameter values for various units and flow directions in the vicinity of the proposed landfill yields the following estimated rates of groundwater flow:

- rate of westward flow (through silty sand) - about 19 meters per year
- rate of east/northeast flow (through interface aquifer) - about 275 meters per year

f) Water Balance

A water balance should be prepared for the proposed landfill. I am providing a rough estimate of water balance parameters for the purpose of this review, but a more detailed water balance calculation needs to be carried out.

The water balance of a landfill can be expressed as follows:

precipitation = evaporation + runoff + leachate generation

Precipitation in the area of Golden Lake is about 900 mm/year. Of this amount on a landfill site with no vegetation about 400 mm/year will be lost to evaporation, and about 100 mm/year will runoff the site during rainfall events and spring snowmelt.

This leaves about 400 mm/year which will infiltrate into the landfill wastes and generate leachate.

g) Summary

My interpretation of the site hydrogeology is described above. It differs significantly from the interpretation of site hydrogeology provided by the Township in the information materials which have been presented to the public.

I disagree with the Township's information materials about many of the fundamental aspects of the site hydrogeology. There are significant implications arising from this disagreement - namely the answer to the question of whether or not the proposed landfill site could be suitable for an attenuation landfill.

Overall, I am concerned that this site is not nearly as suitable for an attenuation landfill as has been suggested, and may in fact be unsuitable.

The groundwater model appears to be based on an incomplete and/or incorrect understanding of the local hydrogeology, and I am concerned that its predictions are not reasonable because of a variety of inappropriate input parameters which were the basis for the modelling.

Further research and field investigations are urgently needed and should be carried out before any decision is made on whether or not to proceed with the proposed landfill site. Further research and field investigations which are urgently needed include the following:

- A water balance should be prepared for the proposed landfill, with the explicit goal of developing the best possible estimate of leachate generation rates for the landfill. Likewise, a water balance for the study area should be developed with the goal of determining a reasonable estimate of infiltration rates across the study area.

- Additional monitoring wells should be installed off of the proposed landfill property to the west (at least two nests of wells completed in the silty sand and the gravel and sand layers), to the north, to the northeast, and to the east.

- Additional monitoring wells should be installed on the proposed landfill property in the northwest of the property, in the center of the proposed landfill footprint, on the east property boundary, and in the south half of the proposed landfill property.

- All new wells should be surveyed in, and be incorporated into a quarterly water level monitoring program which is synchronized with that of the wells from the nearby closed landfill - the existing wells on the proposed landfill property (MW4-08, MW5-08, MW6-08, and MW7-09) should also be incorporated into this monitoring program.

- A leachate well should be installed in the existing landfill, and tested for major ions, metals, and volatile organic chemicals (VOCs).

- Downgradient wells should be installed to the northeast and east of the nearby closed landfill, using the leachate contamination plume from the landfill as a tracer to try to confirm the model predictions of flow rates, flow directions, and contaminant transport.

- Downgradient domestic wells to the northeast of the nearby closed landfill site should be tested for the possible presence of leachate indicator parameters and volatile organic chemicals (VOCs), both for use in assessing groundwater flow directions and as a matter of protection of public health and safety.

Once the research and field investigations are carried out, they should be used as the basis for further work which is needed in order to obtain a more comprehensive and accurate assessment of potential impacts of the proposed landfill.

Appendix D

Suggested Guidelines

for Attenuation Landfill Sites

The Guidelines on the following pages are taken from Appendix C of a report prepared for the Ministry of the Environment in 1993, entitled:

> "The Fate of Landfill Leachate in Waste Water Treatment Plants and in Groundwater at Attenuation Landfills. Report prepared for the Ontario Ministry of Environment and Energy",
>
> by Ruland, W.W., Schellenberg, S.S., and Farquhar, G. 1993.

Appendix D: Suggested Guidelines for Attenuation Landfill Sites

By definition, attenuation landfills are designed to allow the migration of leachate from the landfill into the surrounding groundwater environment. At such landfills, the natural attenuating mechanisms of the local groundwater flow system are relied upon for leachate treatment (Cherry et al, 1987).

The siting of attenuation landfills is made difficult by two major areas of uncertainty pertaining to leachate and the local environment of such sites:

-> the types and concentrations and trends over time of chemicals in the landfill leachate are difficult to predict;

-> the types and attenuative mechanisms which will act on the leachate in the groundwater flow system at a given site, and the effectiveness of those mechanisms, are very difficult to predict.

Nonetheless, there are situations where an attenuation landfill will appear to provide the most appropriate or effective method of leachate treatment. In such cases, there are a number of basic requirements which should be met if a particular location is to be used as the site of an attenuation landfill:

1) The hydrogeology must be suitable for leachate attenuation.

i) The preferred type of hydrogeology for an attenuation landfill site will be one where the processes of attenuation are maximized. A deposit of silty sand with some clay and some organic carbon is one possible example of a desirable site, but is not necessarily the only type of deposit suitable for an attenuation landfill.

ii) High hydraulic conductivity geologic deposits (such as sandy gravels and highly fractured bedrock) should usually be avoided, because these are generally good quality aquifers and because the high flow rates in such deposits may decrease the effectiveness of some attenuative mechanisms (Barker et al, 1986).

iii) Geologic deposits with very low hydraulic conductivity (such as clays) where problems with leachate mounding are likely to arise should generally be avoided (Bagchi, 1987), unless it can be convincingly demonstrated that mounding will not be a problem.

iv) Geologic deposits where groundwater flow paths are irregular and unpredictable should generally be avoided. The Joint Board under the Consolidated Hearings Act, in its decision on the siting of a new landfill in halton Region, emphasized the Board's wish that the hydrogeology in the vicinity of <u>any</u> new landfills be comprehensible to the Board (Joint Board, 1989).

v) It is preferable that the local groundwater resource be naturally of such quality that the attenuation of leachate would be a reasonable use for that groundwater.

vi) Since the design will allow for a certain amount of groundwater contamination to take place, detailed site specific studies are

required to "prove" a site's suitability for the location of an attenuation landfill.

2) There must be a clear understanding of the hydrogeology of the site, based on both a review of all pertinent published materials and a detailed field investigation.

   i) There should be a general understanding of the regional hydrogeological setting of the site. This should include knowledge of the following:

      - directions and rates of groundwater flow;

      - flow divides, recharge and discharge areas;

      - background groundwater quality;

      - all known wells and groundwater uses in the area.

   ii) There should be a detailed understanding of the site hydrogeology. This should include knowledge of the following:

      - the site's overburden and bedrock geology;

      - the hydraulic conductivity of the major geologic units underlying the site;

      - all potential pathways for leachate to escape from the landfill;

      - hydraulic heads and gradients across the entire site;

      - leachate heads within the landfill, measured in leachate monitoring wells;

      - background (pre-landfill) groundwater quality on-site;

      - background (pre-landfill) surface water quality on-site, in particular the water quality of the receiving water body;

      - detailed knowledge of that portion of the groundwater flow system which is expected to provide leachate attenuation;

      - any special characteristics of the groundwater flow system which will affect the attenuation of leachate (eg. the presence or absence of clay and organic carbon).

3) A water balance should be established for the landfill, and rates of loading of contaminants to the aquifer should be calculated.

   Dilution will be the most important attenuative mechanism in the vicinity of a prospective attenuation landfill. It thus appears reasonable that a detailed investigation be carried out, to try to

determine both the capacity of the groundwater flow system for providing dilution and the expected rate of mass loading of various contaminants to the system from the landfill.

4) Migration of leachate from the landfill must take place in accordance with the landfill design, in a controlled fashion.

It must be convincingly demonstrated during the design stage, and confirmed through subsequent monitoring, that leachate migration will follow the anticipated flowpath(s) and that escape of leachate from the landfill along undesirable pathways can be prevented from occurring.

5) The landfill owner/operator should control the entire groundwater flowpath, from the landfill downgradient to the area of discharge.

The uncertainty inherent in hydrogeological predictions may cause even the best estimates of attenuative capacity to prove inaccurate, and may lead to unexpected but unavoidable contamination of a property situated downgradient of an attenuation landfill.

MOE Reasonable Use Policy guidelines for groundwater must be met at all property boundaries of the landfill. Cherry et al (1987) indicate that for attenuation landfills it is unreasonable to expect that attenuation will prevent off-site groundwater from becoming unpotable. As a result it appears imprudent to situate an attenuation landfill upgradient of a neighbouring property, unless a groundwater “easement” has been obtained for that property.

Only in rare cases where it has been clearly and convincingly established that the attenuative capacity of the groundwater flow system by far exceeds the anticipated rates of mass loading to the system, should applications to site attenuation landfills upgradient of neighbouring properties be entertained.

6) The assimilative capacity of the surface waters which are to receive the discharge of attenuated leachate must not be exceeded.

MOE Provincial Water Quality Objectives (PWQOs) must be met at the landfill’s downstream property boundary. If it appears likely that PWQOs will not be met by groundwater discharging from the attenuation zone, then the leachate-contaminated groundwater should be collected and treated before being discharged to surface waters.

The use of passive treatment systems, such as those provided by either pre-existing or specially constructed on-site wetlands, may prove helpful in such situations.

7) The groundwater flow system being used for leachate attenuation should have little or no value as a groundwater resource.

The groundwater flow system being used for leachate attenuation must not be a regionally, provincially, or nationally significant aquifer. The use of locally significant aquifers for leachate attenuation can only be justified if it can be convincingly demonstrated the future off-site Reasonable Uses of groundwater will not be impaired.

8) A detailed and proven monitoring network must be in place.

The detailed hydrogeological investigation of a proposed attenuation landfill site will require the installation and sampling of considerable numbers of groundwater monitors.

These monitors, together with any additional monitors which may be required to fill gaps in the monitoring network, should be incorporated into the monitoring network for the landfill.

A regular and thorough monitoring program is required for all attenuation landfills. Any monitors which are part of such a program and which are found to not be functioning should be replaced immediately.

9) Complete and detailed contingency plans must be in place.

These plans should demonstrate that the landfill owner/operator is prepared for any unexpected failures in the predicted functioning of the landfill or the groundwater attenuation system. Such plans may involve the installation of purge wells or other types of hydraulic barriers, and they may involve the collection and subsequent on-site or off-site treatment of leachate.

A contingency plan should, at a minimum, include consideration of the following issues:

- alternative plans for a given contingency;
- time required for implementation of the contingency plan;
- any MOE approvals which might be required before the contingency plan can be implemented, and the time required to obtain such approvals;
- the possible environmental consequences of implementing the contingency plan;
- the anticipated costs and the economic feasibility of implementing the contingency plan;
- the feasibility and chances of success of the contingency plan.

The following table provides a summary of the concerns identified within the report prepared for the Golden Lake Property Owners Association (GLPOA) entitled "*Independent Review of Hydrogeological Issues Pertaining to the Proposed Ruby Road Landfill near Golden Lake, Ontario*", (Ruland, 2010). The numbered references indicated in the left hand column correspond to the section of the report in which the concern was identified. The right hand column includes the response of the proponent to the concern raised by the GLPOA Report author.

Concerns Raised in GLPOA Independent Review of Hydrogeological Issues Pertaining to the Proposed Ruby Road Landfill near Golden Lake, Ontario	**Explanation of How Concerns are Addressed**
3) Description of Site Topography, Geology, Drainage, and Climate	
3b) Notes silty sand layer in the overburden to be up to 11 metres in depth.	- Based on data collected on site when drilling the monitor wells, the actual depth of silty sand in the overburden is as much as 19.4 metres (MW7-09).
3c) Indicates that surface water drainage from the Site will be to the west toward an unnamed tributary to Golden Lake.	- While limited surface water drainage from the proposed waste disposal footprint location currently flows to the west toward the tributary, this drainage will be controlled by the design of the expanded waste disposal area. Swales and temporary containment ponds, which will be detailed in the Design and Operations Plan for the Site, will be constructed to prohibit surface water drainage from flowing toward the west. Containment features will encourage infiltration. Any infiltrated groundwater will be transported to the east by groundwater flow.
3d) Notes that average annual precipitation for the area is 900mm/yr.	Data obtained from Environment Canada indicates an annual precipitation rate of 800mm/yr for the Renfrew/Petawawa area. The model is actually based on groundwater recharge rates, not precipitation rates. The use of recharge rates and their effect on the model is discussed thoroughly in Sections 6.1.2 and 8.1 of the Numerical Hydrogeological Modeling Report for Expansion Feasibility at the Ruby Road Waste Disposal Site (Cambium, 2010), which is included as Appendix L of the ESR.

Concerns Raised in Independent Review of Hydrogeological Issues Pertaining to the Proposed Ruby Road Landfill near Golden Lake, Ontario	**Explanation of How Concerns are Addressed (section references are to those within Numerical Hydrogeological Modeling Report)**
4) The Township's Investigation of Site Hydrogeology	
4b) Indicates that the following hydrogeological information appears to be missing from the Numerical Hydrogeological Modeling Report: **i. Regional groundwater flow direction** **ii. A firm understanding of where groundwater goes once it crosses the downgradient property line** **iii. Local domestic wells, significant springs and larger groundwater users** **iv. No effort to use case history of landfill onsite by tracing off-site contamination plume from landfill, which would provide real world evidence to compare the predicted groundwater flow to.** **v. No effort to properly characterize leachate from existing landfill** **vi. No water balance provided** **vii. Extent of possible perched groundwater table flow to west of property** **viii. Possibility of shallow groundwater flow to west from proposed landfill via shallow groundwater discharge to creek flowing into Golden Lake**	The hydrogeological information is provided as follows: i. Groundwater flow direction obtained using MOE well records. Cambium considered such features as the surrounding low lying wet areas and Golden Lake as probable discharge areas by using constant head boundaries. See Sections 6.2.3 and 6.1.1, respectively, for further discussion of groundwater flow direction. ii. Downgradient groundwater flow direction was estimated using MOE well records. iii. Downgradient domestic groundwater users were identified using MOE well records. No evidence of springs or large groundwater users surrounding the Site other than what is already incorporated into the groundwater flow determination from measurements and observations collected on-site. iv. Used actual data from all wells to determine groundwater flow directions and gradients. v. Used values from all Township of Bonnechere Valley waste sites to determine leachate characteristics typical of the township residents. See Section 7.1 of Numerical Hydrogeological Modeling report for further information no parameter selection. Specifically "To determine the potential concentrations of the leachate that will be produced by the expanded Site, historical leachate concentrations were considered from the Ruby Road WDS, the Sand Road WDS, and the Eganville WDS, all located within the Township of Bonnechere Valley. By considering the other WDS located within the Township, the types and volumes of waste that are characteristic of the residents of the Township of Bonnechere Valley expected to be emplaced at the expanded Site may be represented accurately. vi. Water balance is automatically completed within the model. vii. Due to finding only porous dry material in the overburden, it is interpreted that there is no shallow groundwater flow or perched flow on-site; therefore, flow to the west is not reasonably understood to occur. viii. Similarly, due to finding only porous dry material in the overburden, it is interpreted that there is no shallow groundwater flow or perched flow on-site; therefore, flow to the west is not reasonably understood to occur.

Concerns Raised in Independent Review of Hydrogeological Issues Pertaining to the Proposed Ruby Road Landfill near Golden Lake, Ontario	Explanation of How Concerns are Addressed
4c) Indicates that several aspects of the site hydrogeology appear to have been misconstrued in the modeling completed in support of the proposed landfill: **i. Rates of leachate generation are too low – 8.75cm/yr opposed to 40cm/yr** **ii. Hydraulic conductivities of overburden are significantly underestimated** **iii. Porosity of overburden is too low for overburden and too high for bedrock** **iv. Model incorrectly assumed no silty sand overburden material in proposed landfill area and does not account for the creek and wetland west of the proposed site** **v. Model suggests interface aquifer flow is due east which is not consistent with water level observations which suggest flow is northeast and/or east**	The opinion that any hydrogeological data has been misconstrued is unfounded. The data used in the model was measured and observed on site, and is representative of the conditions at the Site. i. The value of 40 cm/yr suggested in the GLPOA report, is unfounded and based on several arbitrary assumptions, none of which take into account actual observed site conditions. For example, the assumption that if the landfill were not vegetated, leachate generation would be as high as 40 cm/yr has no regard for the reductions to occur within the average of 6 metres of silt and sand and subsequent 5.5 metres of sand and gravel that the leachate travels through before reaching the water table. ii. The values used by Cambium were *not estimated;* these are actual values measure from in-situ testing. iii. As described in Section 6.2.2 of the Numerical Hydrogeological Modeling report, an average value was used. "Effective porosity and total porosity were set to the same value of 0.15, which was selected based on observations of a combination of sand, gravel and fractured crystalline rock." Sensitivity analysis showed variations of these values to not greatly influence the outcome of the model. iv. Silty sand was included in the landfill areas. The GLPOA report author may have misunderstood the use of an example within the Numerical Hydrogeological Modeling report. The example used presents the values shown are for one layer of 13, and 1 row of 100 – showing an example of the model output. The overburden geology is recognized as complex and the boundaries were interpreted using data obtained from the existing well network. The creek is represented using constant head boundaries, as shown in Section 6.1.1 and Table 1 of the Numerical Hydrogeological Modeling report. v. As shown on Figure 7 of the Numerical Hydrogeological Modeling report, the flow is actually to the northeast from the proposed landfill footprint and to the east from the south portion of the property where there will be no waste.

Concerns Raised in Independent Review of Hydrogeological Issues Pertaining to the Proposed Ruby Road Landfill near Golden Lake, Ontario	Explanation of How Concerns are Addressed
5) GLPOA hydrogeologist's Interpretation of Site Hydrogeology	
5b) States that silty sand hydraulic conductivity should be 10^{-5} cm/s; gravel/sand should be average of 10^{-4} cm/s. Agrees with the bedrock values used. **and,** **5c) Poorly estimated porosity**	GLPOA report author determined his values from literature (Freeze and Cherry, 1979). Initially these same values from Freeze and Cherry were used. Upon review of the report by the MOE Technical Support Section, the MOE required the proponent to use site specific values; therefore, in-situ hydraulic conductivity (slug) tests were conducted to provide actual values which were used in the Numerical Hydrogeological Modeling Report that has been approved by the MOE. In the preparation of the hydrogeological model, the proponent used actual data from on site observations and test results for hydraulic conductivity and porosity.
5d) Groundwater flow directions, **i. laterally westward in silty sand discharging to creek** **ii. vertically downward through the gravel and sand, and then laterally outward to the east and northeast in the interface aquifer and the bedrock**	As explained previously, there is no evidence to suggest that there is lateral westward movement of groundwater at this site. The proponent concurs with the downward vertical migration through the silty sand, sand and gravel to bedrock, and then a lateral migration of groundwater to the east and northeast at the bedrock interface and within the bedrock.
5f) Water balance; **GLPOA report provides a very rough estimate of a water balance for the site**	The water balance suggested by the GLPOA report author is unfounded and considered to be a very rough estimate; in part given that even the precipitation rate used is 100mm/yr greater than the data held on file by Environment Canada for the site area. No basis was provided for the evaporation and infiltration rates presented by the GLPOA report author. Detailed values for the site area were obtained from Environment Canada, and data from the US Geological Survey which are assigned by tertiary watershed.
5g) States that the GLPOA report's interpretation of the site hydrogeology differs significantly from that of the Township's consultant.	It is no surprise that an interpretation based on literary values differs significantly from an interpretation based on actual values collected in situ. The proponent has invested significant effort into generating a model that is as representative of actual conditions at the site. The MOE has been consulted throughout the process, and has provided confirmation that the Ministry is satisfied with the model accuracy.
6) Potential Impacts of the Proposed Township Landfill	
6b) Indicates that the Township has not provided public with detailed description of kinds of contaminants.	As described previously in response to comment 4b), it is reiterated that the leachate indicator parameters selected are based on waste generation rates and types documented to be present at the Township's waste disposal sites. Section 7.1 of Numerical Hydrogeological Modeling report discusses parameter selection in greater detail.
6c) Discrepancy between leachate generation rate calculated in GLPOA report and by the Township's consultant.	The differing values for factors such as precipitation rates, depth/type of overburden, porosity and hydraulic conductivity, used in the GLPOA report to determine the leachate generation rates results in a discrepancy from the leachate generation rates calculated in the Numerical Hydrogeological Modeling report. The proponent is confident that the site specific data used in the prepared model has produced an accurate calculation of the leachate generation rate.
6d) Leakage of the landfill leachate toward the west.	There is no evidence to suggest that there is lateral westward movement of groundwater at this location; therefore, therefor it is unreasonable to expect lateral westward movement of leachate. The precautionary modeling that has been completed, and accepted by the MOE, indicates that leachate impacted groundwater will meet the Reasonable Use Policy at the property boundaries, and there will not be unacceptable off-site groundwater quality impacts.

Concerns Raised in Independent Review of Hydrogeological Issues Pertaining to the Proposed Ruby Road Landfill near Golden Lake, Ontario	Explanation of How Concerns are Addressed
8) Viability of an Attenuation Landfill at the Proposed Location	
Comparison of the criteria in the MOE guidelines for natural attenuation landfills to the Township's proposed attenuation landfill reveals the following deficiencies: **i. Monitoring network is inadequate** **ii. Understanding of local hydrogeology is inadequate** **iii. Hydrogeological setting is problematic** **iv. Township does not control the downgradient groundwater flow path** **v. Water balance required**	These perceived deficiencies may be disregarded as per the following : i. Additional monitoring wells, both on and offsite would be identified and installed upon the approval of the proposed site expansion. ii. As has been thoroughly discussed, the proponent's understanding of the localized hydrogeology is based on actual site specific data that has been collected for the purpose of ensuring that the most accurate model is produced for the site. This site specific information is capable of producing a far more accurate result than using generic data, as suggested in the GLPOA report. iii. Site specific data does not reveal any issues with the hydrogeological setting for the proposed undertaking. iv. Should the unlikely circumstance present itself, the Township has included in its contingencies, the purchase of surrounding land as an increase to the contaminant attenuation zone, if this action is deemed to be required. v. A water balance is completed within the Numerical Hydrogeological Model, and is reflective of the site specific data collected in situ.