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Dear Mr. Lindgren,

I am writing today regarding the Richmond Landfill, and about major deficiencies in two reports on the landfill which were recently circulated by Waste Management of Canada Corporation (WMCC).

- The first report was issued for WMCC by Blue Metric Environmental in January 2016 and is entitled “Site Conceptual Model Update and Contaminant Attenuation Zone Delineation” (hereafter referred to as the “**SCM and CAZ Update Report**”).
- The second report was issued for WMCC by Blue Metric Environmental on April 15, 2016 and is entitled “Addendum, Site Conceptual Model Update and Contaminant Attenuation Zone Delineation” (hereafter referred to as the “**Addendum Report**”). The Addendum Report is intended to update and augment the information in the SCM and CAZ Update Report.

1) Background and Introduction

WMCC is the owner/operator of the now closed Richmond Landfill, which is situated near Napanee Ontario. For many years WMCC and its consultants claimed that the Richmond Landfill was not impacting off-site groundwater quality. These claims were incorrect.

The Richmond Landfill has been leaking since it was established in the 1950s, due mainly to the fact that Phase 1 of the landfill (which makes up about 40% of the landfill footprint) is unlined. A landfill at this location was always going to pose a significant threat to the environment and its neighbours, but this threat was exacerbated by WMCC which initiated the practice of recirculating the landfill’s leachate soon after it took ownership of the landfill in 1997.

The company’s recirculation of the landfill’s leachate drove up leachate heads and increased the strength of the leachate - both of these developments increased the threat that the landfill posed to the environment and its neighbours. It was clearly not a good idea for the company to carry out leachate recirculation at this landfill or for the Ministry of the Environment and Climate Change (MOECC) to allow this practice.

Significant groundwater contamination caused by leakage of the landfill's leachate progressed in the years after leachate recirculation began, and measurable contamination crossed the landfill property boundaries and began contaminating off-site properties downgradient of the landfill.

WMCC and its consultants were unaware of the off-site contamination, due to significant deficiencies in the hydrogeological landfill investigations and monitoring programs. As recently as 2010, WMCC's consultants made the following incorrect claim, namely that:

"There is no documented evidence of off-site groundwater impacts arising from the WM Richmond Landfill throughout its operational life".

Following a Hearing before the Environmental Review Tribunal (ERT) it is now known that the landfill has contaminated a vast off-site area on private properties including at least 6 domestic wells. The contaminant plume extends southward and southeastward from the landfill, and crosses the landfill property boundaries across a broad front measuring at least 600 meters in width. Neither the eastern nor the western nor the downgradient limits of the contaminant plume have been delineated at this time - but at its furthest currently known extent the plume extends at least 800 meters from the landfill, and at least 350 meters onto adjacent properties.

The ERT was concerned about the fact that even now (after almost 20 years of monitoring of the site by WMCC and its consultants) the contaminant plume from the Richmond Landfill has not been properly delineated - and in its Decision of December 24, 2015 the ERT required further work to be done in this regard.

In its Decision the Environmental Review Tribunal included an Order with respect to Condition 8.5 of the ECA for the Richmond Landfill. Item 2 of the Order states the following:

2. *Add the following additional provisions to Condition 8.5:*

8.5(c)

v. Submit a report to all the parties and the District Manager, either an independent report on in conjunction with the semi-annual report required by condition 14.1 of this approval, by April 15, 2016 detailing the work carried out and results of all testing obtained further to items 8.5(c) i. to iii. [set out below in Appendix A, which sets out the revised interim order conditions], detailing any additional relevant additional work carried during this time period, and providing an assessment with necessary supporting rationale as to whether the off-site leachate impacted groundwater has been delineated in accordance with the following criteria:

The extent of leachate impacted groundwater shall be delineated if it is demonstrated that water within a sufficient number of monitoring wells at the outer extent of the impacted area that are hydraulically connected to the defined leachate impacted groundwater does not exceed any reasonable use limits (RUL) as defined in Guideline B-7 and its corresponding procedure, B-7-1 or any RUL set out in this approval.

The first report which was issued for WMCC as a submission under the ERT Order is the SCM and CAZ Update Report, and the second report is the Addendum Report. It is my understanding that WMCC intends the SCM and CAZ Update Report and the Addendum Report to constitute the entirety of its submissions regarding Item 2 of the ERT's December 24, 2015 Order.

I have reviewed these two reports and I regret that I must inform you and our clients and the MOECC that it is my professional opinion that the reports are unsatisfactory and seriously deficient with respect to *providing an assessment with necessary supporting rationale as to whether the off-site leachate impacted groundwater has been delineated as required by the ERT Order.*

I have reached this conclusion that the reports are unsatisfactory and seriously deficient in terms of providing an assessment as to whether the contaminant plume from the landfill has been delineated, for the following reasons:

- the eastern margins of the plume have not been delineated, including the extent of an area of urgent concern - the contamination on the adjacent privately owned (Martin) property north of Beechwood Road;
- the downgradient extent of the plume has not been delineated, and the recently confirmed contamination of a whole new aquifer off-site has not been investigated or addressed;
- the western margins of the plume have not been delineated, including a newly discovered area of shallow groundwater contamination on the west side of the landfill access road near well M54-4 and a massive hole in the plume delineation which extends down almost the entire western plume boundary over 450 meters from Beechwood Road to M189.

The following sections of this report discuss these deficiencies in detail.

2) Failure to Delineate Eastern Boundary of Contaminant Plume

There are numerous problems with WMCC's attempts at delineation of the east boundary of the contaminant plume. I will deal with each of these in turn.

a) Contaminant Plume on Martin Property North of Beechwood Road has not been Delineated

WMCC has failed to delineate the contamination known to be present on the privately owned Martin property (east of the landfill and north of Beechwood Road), and has downplayed the significance of the contamination of the Martin property. The newest test results for well M170 which the Martins claim is on their property (just past the landfill property boundary) confirm that contamination is present at far above Reasonable Use limits and is increasing in this area.

Table 1 (on the following page) shows the rising levels and Reasonable Use Limit (RUL) exceedences of 3 key leachate indicator parameters at well M170, which as indicated is just off the landfill property boundary (and on the Martin Farm).

The Reasonable Use Limit (RUL) for each parameter is shown at the bottom of the **Table 1**, and any levels in excess of the RUL are highlighted in **bold type**. As can be seen from the table, levels of each parameter are rising and the levels detected at M170 are above the RUL for each of these parameters at well M170.

Table 1 - Contamination at Well M170 on Martin Farm (East of Richmond Landfill)

<u>Date</u>	<u>1,4-Dioxane (ug/L)</u>	<u>Alkalinity (mg/L)</u>	<u>DOC (mg/L)</u>
13/08/2013	< 1	430	2.8
21/10/2013	1.37	500	3.4
05/09/2014	1.97	460	2.6
26/11/2015	6.3	620	5.0
08/03/2016	8.1	700	4.9
21/03/2016	8.7	690	6.9
----- Reasonable Use Limit (RUL)	1.0	400	3.5

The SCM and CAZ Update Report and the Addendum Report make almost no mention of the rising levels of off-site contamination at well M170 on the neighbouring Martin property, nor is there any disclosure of the fact that the landfill’s Contaminant Attenuation Zone (CAZ) will have to expand onto the Martin property.

The map of the proposed CAZ in the report (Figure 2) does not in any way indicate that there is any intention to expand the CAZ northward and across Beechwood Road to encompass the area of contamination on the Martin property. The CAZ will have to expand onto the Martin property, so this figure is not adequate for the known circumstances of the Richmond Landfill.

WMCC’s recent reports indicate that two wells (M192 and M193) were drilled on the Martin property, and came up clean. This is not as reassuring as it seems. This is because WMCC has generally failed to screen its wells in this area (including well M170 and new well M192) to allow testing of a high hydraulic conductivity (high-K) feature which is likely to be a pathway for leachate contamination from the landfill.

For some strange reason the new M192 well was not screened at the depth of a high-K feature with $K = 5 \times 10^{-6}$ m/s at about 12 meters below ground surface (mbgs), or about 115.5 meters above sea level (masl).

A similar high-K feature with $K = 10^{-5}$ m/s was found in nearby well M170 at about 12 mbgs (or 115.5 masl) - and was likewise not screened by WMCC.

The M170 well screen is centered in a lower-K zone about 15 meters deeper at an elevation of about 101.5 masl, which marks the bottom of the contaminant plume at that location - as evidenced by a dilute signature of deeper naturally saline groundwater which can be seen in the water chemistry of the well. I believe that it was a significant mistake not to screen the shallower high-K feature at 115.5 masl when M170 was drilled, and that likewise it was a mistake not to screen the shallower high-K feature at the same elevation when M192 was drilled.

It should be noted that the shallower high-K feature was also found (but not screened) when the boreholes for other nearby wells were drilled - so it clearly has a significant lateral extent making it much more likely to be a pathway for groundwater flow and contaminant migration.

WMCC and its consultants have generally failed to screen this shallower high-K feature in the wells installed in this area. To illustrate this concern I have prepared **Table 2** (which is provided on the following page) - **Table 2** provides an overview of wells in the vicinity of M170, and the depths of the 2 highest-K features in each well. It can be seen from the table that there are 2 high-K features in each well - a deeper one at about 100 masl and a shallower one at 115 masl.

In some wells the deeper feature has the higher hydraulic conductivity, but hydraulic conductivity values are equal at M192 (on the Martin property), and the hydraulic conductivity is actually higher in the shallow feature at M170 - making the solid steel casing of the well at the depth of the feature (which makes it impossible to do water testing) particularly inexplicable.

WMCC has not screened the shallower high-K layer at M166, M167, M168, M170, or M192 near the corner of the Martin property where landfill contamination is most likely - so it is worth considering the only water quality data which are available for this layer (from well M70-2).

Well M70-2 was installed by WMCC in 1998, and it is screened in the shallower high-K feature. It was only ever tested twice (in 1998 and in 1999), and it was showing signs of possible leachate impacts at that time. The bulk of WMCC's leachate recirculation took place after the last sampling of the well in 1999. I consider it quite likely that there has been landfill-related degradation of water quality at M70-2 (and also in other parts of the shallow high-K feature being sampled by the well) since 1999 as the impacts of the leachate recirculation began working their way through the groundwater flow system.

Notable features of the 1998/1999 water quality results for M70-2 include:

- alkalinity levels of 357 mg/L in 1998 and 399 mg/L in 1999;
- phenol levels of 3 ug/L;
- chloride levels of 440 mg/L in 1998 and 462 in 1999; sodium levels averaging 410 mg/L
- average levels of benzene (2.25 ug/L), toluene (6.2 ug/L), and xylenes (4.5 ug/L)

All of these are indicators of possible leachate contamination, which warranted follow-up testing - but no further testing was done. The well has never been tested for the key leachate indicators (1,4-dioxane and tritium).

Table 2

High-K Features in Vicinity of Martin Farm (East of Richmond Landfill)

<u>Well Location</u>	<u>Depth of Upper High-K Feature</u>	<u>Hydraulic Conductivity</u>	<u>Depth of Lower High-K Feature</u>	<u>Hydraulic Conductivity</u>
M170	12 mbgs, or 115.5 masl	10^{-5} m/s (unscreened)	26 mbgs, or 101.5 masl	6×10^{-7} m/s (screened)
M70	12 mbgs, or 115 masl	M70-2, screened but untested	29 mbgs, or 98 masl	M70-1 screened but untested
M192	12 mbgs, or 115.5 masl	5×10^{-6} m/s (unscreened)	27 mbgs, or 100.5 masl	5×10^{-6} m/s (screened)
M166	7 mbgs, or 115 masl	2×10^{-6} m/s (unscreened)	24 mbgs, or 98 masl	6×10^{-4} m/s (screened)
M167	11 mbgs, or 114.2 masl	10^{-6} m/s (unscreened)	25 mbgs, or 100.5 masl	10^{-4} m/s (screened)
M168	11 mbgs, or 114.2 masl	5×10^{-7} m/s (unscreened)	25 mbgs, or 100.5 masl	8×10^{-6} m/s (screened)

Note:

- mbgs = meters below ground surface
 - masl = meters above sea level
 - screened means that the borehole was screened at this depth to allow water sampling
 - unscreened means that the borehole was not screened at this depth, water sampling not possible
 - untested means well was not tested for key leachate indicators (tritium and 1,4-dioxane)
 - all depths are approximate
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In summary, it is my professional opinion that there is landfill-related contamination present on the southwest corner of the Martin property (north of Beechwood Road and immediately east of the landfill). By failing to properly investigate and address this contamination, WMCC and its consultants have failed to delineate the landfill contaminant plume in this area as required by the Environmental Review Tribunal. The proposed Contaminant Attenuation Zone (CAZ) is incomplete given that it fails to include this area.

Firstly, there is without question contamination present on the Martin property in the deeper high-K feature which is screened by wells in the area, given the 8.7 ug/L of 1,4-dioxane which was detected in M170 (which is on the Martin property). The Reasonable Use Limit (RUL) for 1,4-dioxane is 1 ug/L. It should be noted that there are also RUL exceedances for other leachate indicator parameters including alkalinity and DOC at M170 (as shown in **Table 1**).

Secondly, there is also quite likely additional contamination in the shallower high-K feature which WMCC and its consultants have neglected to properly investigate in all of the years since WMCC took ownership of the landfill in 1997. The water chemistry for the two tests of well M70-2 (on the WM-Martin property boundary) done in 1998 and 1999 suggests that leachate impacts were occurring in the late 1990s, and given the many years of leachate recirculation carried out after 1999 it is likely that any leachate impacts will have gotten worse since then.

Recommendation 1

- a) The MOECC should make clear to WMCC that the eastern boundary of the landfill's groundwater contamination plume has not been delineated in the area east of the landfill property and north of Beechwood Road, and that the company has failed to address the contamination known to be present on this private property.**
- b) Consequently, the MOECC should reject the Contaminant Attenuation Zone (CAZ) which has been proposed by WMCC and its consultants because it does not include an area east of the landfill and north of Beechwood Road.**
- c) Further investigations are required in this area to properly delineate the contamination. Such investigations should include the following:**
 - adding well M70-2 to the EMP, with regular monitoring for all leachate indicator parameters commencing immediately**
 - installing a well (screened in the shallow high-K feature) at the M192 location**
 - installing a well (screened in the shallow high-K feature) at the M168 location**
 - installing a well nest (screened in both the shallower and the deeper high-K feature) along the landfill property line about 75 meters south of M170**
 - installing a well nest (screened in both the shallower and the deeper high-K feature) along the landfill property line about 75 meters north of M170**
 - if the well nest north of M170 shows Reasonable Use exceedances for any parameter then an additional well nest should be installed a further 75 meters north along the property boundary**
 - all of the above new wells shall be tested at least 4 times within one year (on a quarterly basis) for all leachate indicator parameters as required by the Revised Interim Order of the Environmental Review Tribunal.**

b) Inadequate Delineation on East Side of Plume South of Beechwood Road

The shallow high-K feature which was discussed in the previous section is also present south of Beechwood Road, including at the M166, M167 and M168 locations.

At all of these locations the borehole which had been drilled was cased with a solid steel casing at the depth of the shallower high-K feature, making it impossible to test the groundwater in the feature. This mistake could be corrected by installing a second well at each of these locations, with the well screened at the depth of the shallower high-K feature - however I only see a need for an additional well at the M168 location (as described above).

Contamination is present in the deeper high-K feature at each of these locations, so none of them are suitable for use in delineating the eastern boundary of the Richmond Landfill's contaminant plume in any event - except for demarcating where the plume is known to be present.

Gap Between Beechwood Road and M186

Moving further east, there are only two wells east of the area of known contamination at M166, M167, and M168 - namely well M191 (situated just south of Beechwood Road) and M186 (situated about 275 meters south of Beechwood Road). I will deal with each of these wells in turn.

Well M191 was screened in the highest-K feature found in the borehole, a fracture found at a depth of 30 meters below ground surface (mbgs) or about 92.8 masl. This is far below the depth of any contamination found further to the west, and in fact the well is sampling the high-salinity and unpotable groundwater which is naturally found at depth in these parts. A shallower zone of modest hydraulic conductivity (about 5×10^{-7} m/s) was sealed off with a solid steel casing, making water sampling and testing impossible. As a result M191 is utterly useless for delineation of the east boundary of the contaminant plume.

Well M186 encountered only one fracture which might be worth sampling (with a modest hydraulic conductivity of about 10^{-7} m/s), and was screened at the depth of this fracture (about 110 masl). I am willing to accept that this is the best that can be done at this location. Since the well is situated about 275 meters south of Beechwood Road, I recommend that wells be installed for delineation of the eastern plume boundary at Beechwood Road and half way between M186 and Beechwood Road (with the wells to be installed in a line north of M186).

Gap Between M186 and M179

Moving down the line of wells on the east side of the CAZ, there is then a gap of some 320 meters between M186 and the next well (M179). I recommend that a well nest be installed in this gap if possible, with any higher-K features of 10^{-6} m/s or greater being screened.

Well M179

I have no issue with the depth at which M179 was screened, as it nicely covers a higher-K zone at around 101 masl (which has $K = 3 \times 10^{-5}$ m/s). However I am concerned that the M179 borehole was sealed off at the 107 masl depth interval, where another promising fractured zone with $K = 10^{-5}$ m/s is found). I recommend that a second well be installed at the M179 location, to cover off this depth interval.

Recommendation 2

- a) **The MOECC should make clear to WMCC that the eastern boundary of the landfill's groundwater contamination plume has not been delineated in the area east of the landfill property and south of Beechwood Road.**
- b) **Further investigations are required in this area to properly delineate the contamination. Such investigations should include the following:**
- **A number of monitoring wells should be installed at a number of locations along the eastern CAZ boundary. If at any given location permeable fracture zones with $K = 10^{-6}$ m/s or higher are found at several depths, then additional wells shall be installed - one for each depth interval.**
 - **Two new monitoring well locations should be established north of M186 - the first near Beechwood Road north of M186, and the second north of M186 about halfway between M186 and Beechwood Road.**
 - **A monitoring well location should be established between M186 and M179.**
 - **A second well should be installed at the M179 location, screened to cover off the depth interval with a 10^{-5} m/s fracture zone at about 107 masl.**
 - **All of the above new wells shall be tested at least 4 times within one year (on a quarterly basis) for all leachate indicator parameters as required by the Revised Interim Order of the Environmental Review Tribunal.**

3) Failure to Delineate South Boundary of Contaminant Plume

There are numerous problems with WMCC's efforts at delineation of the south boundary of the contaminant plume. I will deal with each of these in turn.

a) Area East of the M178R Well Nest

Moving further southwest from well M179 (which was discussed in the previous section of this report) we come to well M190. Pump testing has shown that there is a hydraulic connection between M178R-3 (to the northwest and in the plume) and M190. I have no issues with the screened interval of well M190, which has shown no sign of contamination to date.

Continuing southwest we come to the M185 well nest. The geophysical log for the M185 borehole indicates that the most promising fractures were situated at about 5.1 and 7.8 mbgs (or 108.7 to 111.4 masl). The M185 well nest did not include a well screened to cover these fractures, which did not show a higher-K signature in the packer tests. Instead well M185-2 was screened over the 100-103 masl depth interval, far below this shallower fracture zone - and M185-1 was screened even deeper.

I have no issues with the depth intervals covered by M185-1 and M185-2, however I recommend that at this critical location a shallow well should be installed and screened to cover the fractures observed in the geophysical logs at 5.1 and 7.8 mbgs.

b) Gap in the Area South of the M178R Well Nest

The M178R well nest replaces an earlier well nest at the M178 location which was plagued by various issues which convinced WMCC to replace and then abandon the well nest.

I can accept the screened intervals of the 4 wells in the well nest, although I would have done it a bit differently myself - with the aim of squarely covering the karstified very high-K fracture zone at around 20 mbgs (elevation 96.5 masl) with a dedicated well. The hydraulic conductivities measured in packer tests in this zone (2×10^{-2} m/s and 2×10^{-3} m/s) are possibly the highest in the landfill area. But this zone is covered (albeit not ideally) by the sand pack of well M178R-2.

A pumping test at M178R-3 has revealed hydraulic connections to numerous nearby wells including M185-2, M188, and M190.

The M178/M178R wells mark the furthest southern extent of the detection of the landfill's contaminant plume. Contamination has gone further from here - but exactly where is an open question at this time.

WMCC appear to be hoping that the groundwater contamination from the landfill has moved steadily southward to the M178R well nest, and then just stopped. This is of course not the case. Water is moving through the karstified high-K fractures at M178R, and going somewhere. The fact that WMCC has not determined where the contaminated groundwater from M178R is going does not imply that the plume is delineated - it simply implies that there is more work to do.

In the critical area immediately south of M178, there is a gap of over 200 meters from the M185 well nest to the next well (M188). Given the gap's critical location immediately south of the M178R wells and with no other detections of the contaminant plume beyond the M178R well nest, I recommend that a well nest should be installed in order to close the 200+ meter gap between the M185 and M188 locations.

c) Gaps in the Area West of the M178R Well Nest

At the M188 location, a single well was installed deep in the bedrock at about 30.5 meters below ground surface (an elevation of about 85.5 masl). I agree with the placement of a well at this depth. Given the proximity of the M188 location to the southernmost known extent of the contaminant plume at the M178R well nest, I believe a shallower well should also be installed at this location to try to tap the high-K features which are carrying leachate at M178R-2 and/or M178R-3.

In trying to determine the optimal depth of a second well at the M188 location, I am having trouble reconciling the packer test results and the geophysical log for the M188 borehole. The packer test results seem to indicate only modest hydraulic conductivities at best (with a maximum of $K = 10^{-7}$ m/s at about 12 mbgs (or 104 masl)). By contrast, the geophysical log is showing what appears to be a major water-bearing fracture at about 6.5 mbgs. I recommend that a well with an extra-long screen and sand pack be installed to cover all fracture zones between about 6 and 12 mbgs (similar to what was done at the M178R-2 well).

Looking further westward there is then a gap of about 200 meters between M188 and the next well (M177). This gap straddles a low area which has a surface drainage feature running through it, with surface flow running from east to west down this feature. The origin of the surface drainage feature is in a low area with a small pond on the east side of the quarry access road, and as it moves west it picks up contaminated surface drainage from the M178/M178R area.

Water quality testing and visual observations confirm that groundwater is carrying contamination upward and discharging to seeps in the M178/M178R area. Contamination of a whole new off-site aquifer unit (the shallow aquifer) has been found in the area of the M178 and M178R well nests, where upwelling shallow groundwater has been shown to contain 1,4-dioxane (the best leachate indicator for the Richmond Landfill). 1,4-dioxane levels of 1.5 and 4 ug/L were found in 2 tests of surface seeps near the well nests.

There is no sign that WMCC has undertaken any further investigations to determine the extent of the shallow groundwater contamination since finding the contaminated discharges in the M178/M178R area in the fall of 2015.

I consider these contaminated surface discharges to be the “tip of the iceberg”, representing the surface expression of a major area of shallow groundwater contamination which is bound to be present in the area around M178/M178R. It is probable that the soils and shallow bedrock groundwater in this area are contaminated by landfill leachate - and such contamination is most likely to extend downgradient to the southwest following the topography of the low area through which the surface drainage feature flows to the southwest.

I recommend that a well nest be placed into this low area between M188 and M177. One well should target the shallow overburden/bedrock surface aquifer, and additional wells should be completed deeper into the bedrock into any higher-K features of 10^{-6} m/s or greater which are found.

At the M177 location the only fractures worth covering are found within about 5 meters of the ground surface, and the existing well is screened such that it covers this zone.

Well M187 is the final well along the south boundary of the contaminant plume. For some reason there are no packer test results available for this well. WMCC should confirm whether packer testing was carried out for this well, and if not then it should explain why no packer testing was done. I have no issue with the well which was installed at the M87 location, however I recommend that a shallower well also be installed in the vicinity. If packer testing information is available then it will assist with the placement of this well.

It is worth noting at this point that a near-surface karst feature was found in the CAZ, about 50 m southwest of well M187. Regarding this feature page 9 of the report states that “*a local surface water course enters into the ground in what appears to be a karstic feature*”.

This confirms my observation that hydraulic conductivities in the limestone bedrock in the landfill area are in the karstic range. Where the water which is draining into the karst feature flows to from there is currently unknown, and extensive further investigations are urgently required.

Unfortunately no photos of the karst feature have been provided by WMCC, and the karst feature was not properly described in the Fall 2015 Monitoring Report in which its discovery was announced. For example it is not clear if the karst feature is taking all of the flow from the surface water course, or if at times there is overflow which continues downstream at the ground surface.

It should be noted that the surface water course which drains down the karst feature is the same one which receives the potentially contaminated runoff from the contaminated seeps at the M178 and M178R well nests (discussed above). If contamination is making it to the karst feature, then that feature will provide an extraordinarily efficient mechanism for rapidly carrying that contamination further off-site through the groundwater flow system.

Immediate commencement of water quality monitoring for water flowing into the karst feature is indicated, to confirm whether landfill-derived contamination is present in the surface water flowing down the feature. The shallow well which I am recommending for the vicinity of M187 could be installed in the immediate vicinity of the karst feature, in order to provide a better understanding of subsurface conditions in the area.

Recommendation 3

- a) **The MOECC should make clear to WMCC that the southern boundary of the landfill's groundwater contamination plume has not been adequately delineated in the area between M190 and M179.**

- b) **Further investigations are required in this area to properly delineate the contamination. Such investigations should include the following:**
 - **A third, shallower well should be installed at the M185 location, screened to cover off the depth interval between 5 and 8 meters below ground surface.**
 - **A monitoring well location should be established in the critical gap between M185 and M188. Wells should be installed to cover all depth intervals of permeable fracture zones with $K = 10^{-6}$ m/s or higher.**
 - **A second, shallower well should be installed at the M188 location, screened over an extra-long depth interval between about 6 and 12 meters below ground surface.**
 - **A monitoring well location should be established in the critical gap between M185 and M188. A shallow aquifer well should be installed, screened to cover the overburden/bedrock surface. Below this additional wells should be installed to cover any permeable fracture zones with $K = 10^{-6}$ m/s or higher.**
 - **A new shallower well should be installed in the vicinity of M187 (ideally in the immediate vicinity of the newly discovered karst feature), in order to provide a better understanding of subsurface conditions in the area.**
 - **All of the above new wells shall be tested at least 4 times within one year (on a quarterly basis) for all leachate indicator parameters as required by the Revised Interim Order of the Environmental Review Tribunal.**
 - **Monthly water quality monitoring of the surface water flowing into the karst feature should commence immediately, to confirm whether landfill-derived contamination is present in the surface water flowing down the feature.**

4) Failure to Delineate Western Boundary of Contaminant Plume

There are numerous problems with WMCC's lack of effort at delineation of the western boundary of the contaminant plume. I will deal with each of these in turn.

a) The Line of Contaminated Wells on the West Side of the Contaminant Plume

M64

The M64 well nest was installed in 1998, shortly after WMCC took ownership of the landfill. Two wells were installed, with their screens centered at an elevation of 86 masl for M64-1 and an elevation of 111 masl for M64-2. As such these wells are not screened at the elevation of the deeper major high-K feature which was later identified in wells M121, M122, M123, M166, M167, and M168 to the north (which is at an elevation of about 100 masl). If the feature is present in this area, then it is not being sampled by M64-1 or M64-2.

The techniques for deciding on depths for well screens in 1998 were not as sophisticated as those being employed currently - and it is very difficult from the available documentation to understand how historical decisions were made about what depths to place well screens at. I recommend that a well be added to the M64 well nest, and that its screen be centered on a depth of around 100 masl, in order to confirm whether the contaminant plume which is known to be present further north (at about 100 masl) extends this far south and west.

Well M64-2 is of course contaminated by leachate from the landfill. 1,4-dioxane levels have been slowly rising, and the last 3 tests show levels of 2.2, 2.7, and now 3.1 ug/L in well M64-2. The Reasonable Use Limit (RUL) for 1,4-dioxane (which is classified by the US EPA as a "probable carcinogen") is 1 ug/L, so 1,4-dioxane is present at 3 times the RUL.

M121

North of M64-2 is M121, which is also contaminated by the Richmond Landfill - even more so than M64-2. The Spring 2016 monitoring results (a summary of which was released by WMCC to local residents) present a concerning picture:

- 1,4-dioxane is present at 10 ug/L, which is 10 times or 1000% of the RUL of 1 ug/L.
- Alkalinity is present at 520 mg/L, which is about 33% above the RUL of 390 mg/L.
- Chloride is present at 390 mg/L, which is 3 times (or 300% of) the RUL of 130 mg/L.
- DOC is present at 5.2 mg/L, which is almost 50% above the RUL of 3.5 mg/L.
- Benzene is present at 34 ug/L, which is 24 times (or 2400% of) the RUL of 1.4 ug/L.

The benzene concentration is anomalous, and urgently requires further investigation. When the well was first tested in 2013/2014 the first two test results were 6.6 and 1.5 ug/L. In 2015 they spiked upward to 45 ug/L, before falling back slightly to 34 ug/L in Spring 2016 as indicated above. The matter of the anomalous benzene contamination in M121 is of particular concern because the Ontario Drinking Water Quality Standard (ODWQS) for benzene (a known carcinogen) is dropping from 5 ug/L to 1 ug/L at year-end. As a result the new RUL for benzene will be dropping sharply.

I recommend that the water quality sampling frequency of M121 be stepped up to twice per year commencing immediately. The matter is of significant concern, because there are no clean wells anywhere to the west of M121 - and thus the fate of the groundwater carrying the anomalously high benzene contamination from M121 is an open question.

M63-2

North of M121 is the M63 well nest. The deeper well (M63-1) is completed at an elevation of 87 masl, and is unpotable with naturally occurring briny deep groundwater. As occurred at the M64 well nest, there is no well screened at the elevation of the major high-K feature (at an elevation of about 100 masl) which was later identified in wells M121, M122, M123, M166, M167, and M168 to the north. If the feature is also present in this area, then it is not being sampled by M63-1 or M63-2.

Instead, the shallower well at this location (M63-2) is screened at a depth of about 111.5 to 113.5 masl - which is close to the depth interval at which the further south well M64-2 (which is contaminated with leachate) is also screened.

M63-2 has alkalinity levels of 400 mg/L, and chloride levels of 300 mg/L - both of these are leachate indicators and both are above the RULs for these parameters. 230 ug/L of acetone were also found in the well - acetone is occasionally found in tests of leachate from the Richmond Landfill. I consider this well to be showing potential signs of leachate impacts.

For some reason M63-2 has yet to be tested for 1,4-dioxane. I recommend that such testing and ongoing monitoring for 1,4-dioxane and other leachate indicator parameters should commence immediately (with well M63-2 being added to the EMP).

M114-1

North of M163-2 (at Beechwood Road) is the M114 well nest. M114-1 is screened across the same high-K feature which is present at M121 (at an elevation of about 96 masl). Numerous leachate indicator parameters including 1,4-dioxane, alkalinity, and DOC have been found above the RULs in M114-1.

b) Delineation of Western Plume Boundary from Beechwood Road to M189

I have spent some time in the previous section of my report describing the recent test results for M114-1, M121, M63-2 and M64-2 (which show concerning leachate contamination, with contaminant levels well above the RULs for various parameters) because there are currently no monitoring wells at all to delineate the western boundary of the landfill's contaminant plume in a giant 450 meter long gap which runs from Beechwood Road all the way south to M189 (to the southwest of M64-2).

The western boundary of the contaminant plume can not be considered delineated until wells are installed to close this monstrous gap. I recommend that a series of well nests need to be installed to the west of the contaminated wells, and screened in all zones with $K = 10^{-6}$ m/s or higher. Spacing of the nests should be on the order of 100 meters.

c) Delineation of Western Plume Boundary from M189 to M187

My comments and recommendations regarding the M187 well are provided in Section 3c) and Recommendation 3 of this report.

At M189, for some reason the geophysical log is incomplete and the packer tests did not start until 15 meters below ground surface at an elevation of about 104 masl. The very first packer test encountered a feature with $K = 5 \times 10^{-6}$ m/s and this is where the well screen was placed (from about 103.5 to 106.5 masl). There is no shallower well at this location. Likewise at M187, where the well is screened at 87.5 to 90.5 masl - and there is no shallower well.

This means that in fact there currently is no clean well which is screened above 106.5 masl over the entire western boundary of the contaminant plume - from Beechwood Road through M187. And yet no further wells have been proposed by WMCC and a CAZ application has been submitted to the MOECC. Moreover M189 is the only well screened above 90.5 masl (at about 105.5 masl). This is beyond absurd, it is unconscionable.

It is not that there are no fractures above that depth which could be carrying contaminated groundwater to the west past the known position of the Richmond Landfill's contaminant plume - which extends southward from Beechwood Road through M64-2 (a distance of almost 400 meters). Fractures are shown on the borehole logs of M189 and M187! But if the borehole logs can be believed then WMCC and its consultants have not bothered to do any packer testing above the elevation of 104 masl.

I recommend that an additional borehole needs to be drilled at M189 (to a depth of about 106 masl), with all higher-K features of $K = 10^{-6}$ m/s or greater being screened. But even if no features of $K = 10^{-6}$ m/s are found, at least one new shallower well should be installed at this location - with the well screen centered at 113 masl to cover the 2 fractures shown on the M189 borehole log.

Recommendation 4

- a) **The MOECC should make clear to WMCC that the western boundary of the landfill's groundwater contamination plume has not been adequately delineated.**
- b) **Further investigations are required in this area to properly delineate the contamination. Such investigations should include the following:**
 - **A series of boreholes should be drilled between Beechwood Road and M189, spaced about 100 meters apart with the northmost well at Beechwood Road. Wells should be installed to cover all depth intervals of permeable fracture zones with $K = 10^{-6}$ m/s or higher.**
 - **A second, shallower well should be installed at the M189 location, screened at about 113 masl. If another high-K feature is found above 106 masl it should also be screened.**
 - **All of the above new wells shall be tested at least 4 times within one year (on a quarterly basis) for all leachate indicator parameters as required by the Revised Interim Order of the Environmental Review Tribunal.**

5) Shallow Groundwater Plume North of Beechwood Road and West of Landfill Access Road

a) Introduction

A new issue has come to light in the most recent (Spring and Fall 2015) Semi-Annual Monitoring Reports for the landfill. It is becoming obvious that WMCC has a problem with shallow groundwater contamination (in the shallow overburden/bedrock interface aquifer) around well M54-4 which is described below.

In order to give WMCC and its consultants notice of this issue and a chance to address it, I provided written comments in a letter dated February 23, 2016 which was provided to WMCC. The company and its consultants elected not to respond to the letter or not to address the substantive issues which I had raised.

b) Shallow Zone Trigger Well M54-4 is Impacted and Investigation is Required

One of the shallow trigger wells in the Interim EMP (well M54-4) is clearly contaminated by landfill leachate, even though no 1,4-dioxane has been detected in the well to date. Alkalinity is at 410 mg/L (above the Reasonable Use Limit or RUL of 390), chloride is elevated at 89 mg/L, DOC is elevated at 3.4 mg/L, TDS are at 662 mg/L (above the RUL of 452 mg/L) and numerous manmade volatile organic chemicals including dichloroethylene, trichloroethylene, and tetrachloroethylene are present at low concentrations.

Most notably, the known carcinogen vinyl chloride is present at 0.66 ug/l (above the current Reasonable Use Limit or RUL of 0.5 ug/L). To date there has been no disclosure by WM of this issue - the results are simply tucked away in tables found at the back of the Spring and Fall 2015 Reports.

Vinyl chloride levels at well M54-4 have been rising over time as follows:

- prior to and including 2012, vinyl chloride had not been detected in the well
- in Spring 2013, vinyl chloride levels were 0.3 ug/L
- in Spring 2014, vinyl chloride levels were 0.46 ug/L
- in Spring 2015, vinyl chloride levels were 0.55 ug/L
- in Fall 2015, vinyl chloride levels were 0.66 ug/L

The RUL for vinyl chloride is 0.5 ug/L, and in 7 months it will be coming down to 0.25 ug/L as a tightening of Ontario's drinking water standards comes into effect.

Well M54-4 is a shallow trigger well in the Interim EMP, and is situated over 200 meters south of the landfill and west of the landfill access road. It is only about 200 meters from the northwest boundary of the CAZ, and shallow groundwater flow is southwest toward the CAZ boundary from M54-4.

These RUL exceedences for vinyl chloride were not disclosed in the Spring or Fall 2015 Report, nor was the significance of the contamination which is present at M54-4 discussed. Likewise the RUL exceedences for vinyl chloride were not disclosed in the SCM and CAZ Update Report or the Addendum Report, nor was the significance of the contamination which is present at M54-4 discussed.

Although 1,4-dioxane has not been detected in Well M54-4 to date - in my professional opinion the presence of numerous other leachate indicator parameters including manmade organic chemicals which have been detected in the landfill like vinyl chloride (and its parent products dichloroethylene, trichloroethylene, and tetrachloroethylene) which are not present in natural background groundwater confirms that landfill impacts are occurring in this area.

I believe 2015 was the first time the RUL of 0.5 ug/L was exceeded at trigger well M54-4 for vinyl chloride - as such, public notification should be provided by WMCC of this upset and unexpected situation.

It is not clear where the VOC contamination at M54-4 is coming from, but the Richmond Landfill has a long and problematic history with many possible explanations for what is turning up at M54-4. One possibility which should be considered is whether nearby “open hole” wells such as PW1 or Well 2054 could be allowing the upward migration of contaminants from deeper levels into the shallow aquifer.

In any event, it appears increasingly possible that shallow aquifer contamination spreading southwestward from M54-4 could breach the CAZ boundaries which are downgradient and only about 200 meters away. There are no shallow wells between M54-4 and the CAZ boundary.

Further investigation is urgently required, and should explicitly evaluate whether shallow aquifer contamination from the Richmond Landfill has crossed Beechwood Road onto the neighbouring properties to the south. It is quite possible that the proposed CAZ boundaries in this area are not adequate.

I recommend the placement of at least one new shallow monitoring well south of Beechwood Road and west of M114-2 near the northwest corner of the CAZ.

The RUL exceedences at M54-4 also have implications for the Environmental Monitoring Plan (EMP) including the trigger monitoring program which is part of the EMP, however discussion of these issues is beyond the scope of this report.

Recommendation 5

- a) The MOECC should make clear to WMCC that it has not properly handled the recent discovery of shallow aquifer contamination at M54-4 to beyond the RUL for vinyl chloride, and that the landfill's shallow groundwater contamination plume in the area downgradient of M54-4 has not been adequately delineated.**
- b) The placement of at least one new shallow monitoring well south of Beechwood Road and west of M114-2 near the northwest corner of the CAZ is recommended.**
- c) Proper public notification of the contamination of shallow trigger well M54-4 by the known carcinogen vinyl chloride is required.**

6) April 2016 Proposed EMP

There have been numerous versions of the Environmental Monitoring Program (EMP) for the landfill. Over time the EMP has improved to the point where it is now a reasonably useful document.

The current August 2015 EMP is an “Interim EMP”, designed to bring the previous draft of the EMP into compliance with the Orders of the Environmental Review Tribunal.

The EMP is a living document, and a further revised version was produced by an ERT-imposed deadline of April 15, 2016. In my letter of February 23, 2016 I provided comments and recommendations intended to assist WM in improving the Interim EMP so that it would be better able to provide for adequate monitoring of the landfill. My initial review of the April 15, 2016 Proposed EMP suggests that many of my recommendations have been ignored.

I will provide a brief summary of where things stand below. The lettering and titles follow the lettering and titles of my February 23, 2016 letter. The full text of my comments and recommendations (and the current status following issue of the Proposed April 15, 2016 EMP) is provided in Appendix A at the back of this report.

a) EMP Needs to Reflect Lowered RULs for Vinyl Chloride and Benzene

- **This issue has not been addressed.**

b) The Leachate Indicator Parameter / RUL List in the EMP Requires Changes

- **This issue has not been addressed.**

c) Intermediate Zone Well M74 is Damaged and Needs Replacement

- **This issue has not been addressed.**

d) Additional Trigger Wells are Required for Intermediate Zone

- **This issue has not been addressed.**

e) Contaminated M178 Seeps, Nearby Surface Water Course, and Karst Feature Need to go into EMP

- **The recommendation for surface water monitoring at S2-15, S3-15 and S4-15 has been addressed (though the stations have been renumbered S18, S19, and S20).**
- **The recommendations for continued seep monitoring and monitoring of flows into the karst feature have not been addressed.**

f) ERT Recommendations re EMP Need to be Implemented

- **Recommendation 22 has been addressed.**
- **Recommendation 23 has been partly addressed, however I continue to recommend that M100 and M102 should be added to the shallow groundwater quality monitoring program (and that part of my recommendation has not been addressed).**
- **Recommendation 24 has been partly addressed, however I continue to recommend that M63-2, M70-2, and M174 should be added to the intermediate depth groundwater quality monitoring program (and this part of my recommendation has not been addressed).**

- **Recommendation 25 has been partly addressed, however I continue to recommend that M70-2 and M70-3 should be added to the intermediate depth groundwater quality monitoring program - and monitored twice yearly for all EMP Table 3 and Table 4 parameters.**
- **Recommendation 26 has been addressed.**
- **The remaining Recommendations (2, 4, 7, 10, 12, 19) do not appear to have been addressed by WMCC. If any have, then I would request that WMCC indicate how and where in the EMP this has been done.**

As can be seen, some recommendations have been partly or fully addressed - but most have not. If the MOECC wishes to adopt the April 2016 Proposed EMP, then this is acceptable provided there have been no other changes to the EMP.

All parties should however be aware that I will continue to pursue adoption into the EMP of those recommendations which I made to the ERT and which have yet to be addressed by WMCC.

7) Discussion and Conclusions

To say that I am disappointed as a professional after reviewing the SCM and CAZ Update Report and the Addendum Report is an understatement - in fact, I am appalled.

The recent ERT Hearing and the ERT's December 24, 2015 Decision marked a chance for WMCC and its consultants to turn over a new leaf - to put the environment and public health and safety first, and to work with the other parties to finally properly delineate the massive off-site groundwater contamination plume emanating from the Richmond Landfill. The environmental catastrophe which the Richmond Landfill represents is entirely the responsibility of WMCC and its consultants, and it is high time for them to be taking a new proactive and protective approach.

But this was not done. Instead, the SCM and CAZ Update Report and the Addendum Report which I reviewed simply represent a continuation of the same failed approach which has been taken for almost 20 years by WM and its consultants.

At this point I can summarize the current state of affairs as follows:

- The eastern margins of the plume have not been delineated, including the extent of an area of urgent concern - the contamination on the adjacent privately owned (Martin) property north of Beechwood Road. An eastward expansion of the CAZ onto the Martin property is necessary but has not been proposed by WMCC.
- The downgradient extent of the plume has not been delineated, and the recently confirmed contamination of a whole new aquifer off-site (the shallow aquifer contamination at M178/M178R, which extends downgradient an unknown distance) has not been investigated or addressed.
- The western margins of the plume have not been delineated, including a newly discovered area of shallow groundwater contamination on the west side of the landfill access road near well M54-4 and a massive hole in the intermediate zone plume delineation which extends over 450 meters from Beechwood Road to M189.

It is my professional opinion (having reviewed the SCM and CAZ Update Report and the Addendum Report) that these reports are unsatisfactory and seriously deficient with respect to *providing an assessment with necessary supporting rationale as to whether the off-site leachate impacted groundwater has been delineated* as required by the ERT Order.

I have provided 5 Recommendations to address my concerns in the previous sections of this report.

In the event that WMCC proceeds with the (unsatisfactory and severely deficient) results of the CAZ contaminant plume investigation and delineation outlined in the SCM and CAZ Update Report (and its Addendum Report), then I will be recommending to our clients that they appeal any move by the MOECC to accept the resulting CAZ boundaries.

Please feel free to contact me if there are any questions about any of the issues raised or recommendations made in this review.

Yours sincerely,



WRuland

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Appendix A - Update on My Comments on August 2015 Interim EMP

There have been numerous versions of the Environmental Monitoring Program (EMP) for the landfill. Over time the EMP has improved to the point where it is now a reasonably useful document.

The current August 2015 EMP is an “Interim EMP”, designed to bring the previous draft of the EMP into compliance with the Orders of the Environmental Review Tribunal.

The EMP is a living document, and a further revised version was produced by an ERT-imposed deadline of April 15, 2016. In my letter of February 23, 2016 I had provided comments and recommendations intended to assist WM in improving the Interim EMP so that it would be better able to provide for adequate monitoring of the landfill. My initial review of the April 15, 2016 Proposed EMP suggests that many of my recommendations have been ignored.

I will provide a brief summary of where things stand below (**in bold type**, following each section of the text of the February 23, 2016 letter). The lettering and titles follow the lettering and titles of my original letter. The full text of my comments and recommendations (and the current status following issue of the Proposed EMP) is provided in Appendix A at the back of this report.

a) EMP Needs to Reflect Lowered RULs for Vinyl Chloride and Benzene

The MOECC has made changes to the Ontario Drinking Water Quality Standards (ODWQS), which come into effect after December 31st, 2016. Two of the announced changes are particularly relevant to this site, and will have implications for the EMP and for CAZ monitoring:

- The ODWQS for vinyl chloride (a known carcinogen) will be dropping from 2 ug/L to 1 ug/L. As a result the new RUL for vinyl chloride will be 0.25 ug/L - which means that vinyl chloride will need to be more carefully considered in the EMP. Vinyl chloride is a man-made contaminant which is not found in nature, and which has been found in the landfill’s leachate (together with its parent products dichloroethylene and trichloroethylene). Any vinyl chloride in groundwater in the landfill area is a sure sign of the presence of contamination derived from the landfill’s leachate. There are locations where vinyl chloride is present in association with other leachate indicators but with no 1,4-dioxane being detected (for example at well M54-4). In such areas, vinyl chloride will supplant 1,4-dioxane as driving the trigger monitoring for the landfill.
- The ODWQS for benzene (another known carcinogen) is dropping from 5 ug/L to 1 ug/L. As a result the new RUL for benzene will be 0.25 ug/L - which means that benzene will need to be more carefully considered in the EMP. While benzene is often present in the deep saline groundwater found below the Intermediate Zone, it is also present in the landfill’s leachate. There are locations where benzene is present in association with other leachate indicators and with no indication of any influence by saline groundwater. In some such areas, it is possible benzene may join or supplant 1,4-dioxane as driving the trigger monitoring for the landfill.
- **This issue has not been addressed.**

b) The Leachate Indicator Parameter / RUL List in the EMP Requires Changes

The leachate indicator parameter / RUL list is provided in Table 6 of the EMP. Given the aforementioned changes to the ODWQS and RULs for vinyl chloride, it should be added to the leachate indicator parameter list. Its parent product trichloroethylene (which is often found in association with it) should also be added.

- **This issue has not been addressed.**

c) Intermediate Zone Well M74 is Damaged and Needs Replacement

The conclusions of the Fall 2015 Report indicate that well M74 is damaged and should be decommissioned. The well is at a key location on the northwest side of the landfill, and has shown increasing levels of inorganic leachate indicators - it should be replaced, and the replacement well should take its place in the EMP.

- **This issue has not been addressed.**

d) Additional Trigger Wells are Required for Intermediate Zone

Groundwater sampling locations for the Intermediate Zone are provided in Figure 4b of the Interim EMP. There is a huge gap with no clean trigger wells on the west side of the plume in the CAZ, and likewise there are gaps on the east side of the plume. There are also problems with the proposed downgradient monitoring well network.

My recommendations pertaining to the CAZ investigation which I had provided at the recent ERT Hearing (Recommendations 14, 15, 16) would close these gaps - and I strongly recommend that WM implement these recommendations, and then adjust the well network after evaluating the findings. Please note that my ERT Hearing Recommendations are provided in **Attachment A** of this Report.

- **This issue has not been addressed.**

e) Contaminated M178 Seeps, Nearby Surface Water Course, and Karst Feature Need to go into EMP

The recent findings of leachate contamination in seeps near the M178 and M178R well nests are described in the SCM and CAZ Update Report. The seeps which were sampled should be added to the surface water monitoring program in the Interim EMP, and monitoring should commence immediately.

The seeps are uphill of a surface water course, and heavy rains and/or snow melt will be able to wash the contamination into the water course. The sample locations along that water course (S2-15, S3-15, and S4-15) should be added to the EMP, and monitoring should commence immediately.

Finally, the watercourse apparently drains into a karst feature about 50 m southwest of well M187. Monitoring of the flows and water quality of water draining into the karst feature should commence immediately.

All of the above stations recommended for monitoring should use the same parameter list and the same sampling frequency as other surface water stations listed in the EMP.

- **The recommendation for surface water monitoring at S2-15, S3-15 and S4-15 has been addressed (though the stations have been renumbered S18, S19, and S20).**
- **The recommendations for continued seep monitoring and monitoring of flows into the karst feature have not been addressed.**

f) ERT Recommendations re EMP Need to be Implemented

My recommendations pertaining to the EMP which I had provided at the recent ERT Hearing (Recommendations 2, 4, 7, 10, 12, 19, 22, 23, 24, 25 and 26) need to be implemented, and this should be done in the next draft of the EMP - due April 15th, 2016. Please note that my ERT Hearing Recommendations are provided in **Attachment A** of this Report.

- **Recommendation 22 has been addressed.**
- **Recommendation 23 has been partly addressed, however I continue to recommend that M100 and M102 should be added to the shallow groundwater quality monitoring program (and that part of my recommendation has not been addressed).**
- **Recommendation 24 has been partly addressed, however I continue to recommend that M63-2, M70-2, and M174 should be added to the intermediate depth groundwater quality monitoring program.**
- **Recommendation 25 has been partly addressed, however I continue to recommend that M70-2 and M70-3 should be added to the intermediate depth groundwater quality monitoring program - and monitored twice yearly for all EMP Table 3 and Table 4 parameters.**
- **Recommendation 26 has been addressed.**
- **The remaining issues do not appear to have been addressed by WMCC. If any have, then I would request that WMCC indicate how and where in the EMP this has been done.**