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Bruce Horide
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Dear Bruce,

Auckland Regional Landfill Section 92 Response

We provide the following in response to further Section 92 requests raised by Auckland Council's reviewer PDP, dated 20 December 2019 in relation to risk assessment and the Risk Management Assessment Report (RMAR) (Technical Report S).

1.0 Introduction

As an initial comment we reiterate the purpose of the RMAR submitted as part of the application. It is an independent technical assessment of the potential risks of the proposed Auckland Regional Landfill. It considers the technical assessments completed for the application, the proposed resource consent conditions and the management and mitigation proposed. Its purpose is to determine whether potential risks have been considered and are adequately controlled or mitigated. The assessment is intended to assess the potential risk scenarios that could reasonably be foreseen if not appropriately designed or managed based on the proposal defined in the application.

The RMAR is used to make a preliminary assessment of the potential risk costs associated with these risk scenarios identified such that operator can ensure adequate contingency provisions as part of their commercial operation.

The RMAR is, as it states, semi quantitative. To undertake a detailed quantitative risk assessment requires detailed design, construction methodologies and operational controls to be fully defined. To expect these to be developed as part of a resource consent application is both impractical and excessive. Furthermore, to complete a detailed quantitative risk assessment at this stage would require numerous assumptions to enable detailed event trees to be developed that would render the risk assessment outcomes spurious. The approach that has been adopted is to use sound engineering and scientific judgement based on the technical assessments completed in support of the application, and extensive experience of other landfill sites across New Zealand and internationally; in order to assess the nature of the risks presented by the proposal, and verify that the mitigation and management measures proposed by the applicant are appropriate.

This risk assessment will be reviewed prior to any hearing and the finalisation of any conditions of resource consent, to ensure that all risks identified in the various assessments have been identified and are appropriately mitigated by the proposed conditions of consent.

2.0 Likelihood, Consequence and Risk Score

The probability for likelihood categories in Table 4 of the RMAR are annual probability of occurrence. The process for assessing a likelihood (subjective probability) is based on considering the steps (or events) that need to occur for the risk scenario to arise including whether engineering controls, operational (or institutional) controls and/or operator error are factors. Engineered controls are firstly assessed in terms of the design criteria, such as return period for a seismic event, or an annual exceedance probability for a rainfall event. In the absence of design criteria, engineering controls which are accepted practice and are designed, constructed and verified are assumed to have indicative annual probability of failure in the order of 0.001. The failure of operational controls or operator error are typically considered to have annual probabilities in the order of 0.01. The estimation of annual probability in this manner needs moderation. An objective probability assessment, based on whether there are known examples of the risk scenario occurring and the frequency of these events, nationally and internationally, is used to moderate the assessed likelihood.

The Council reviewer has sought clarification of assessment of consequence with respect to water quality and specifically what “moderate” means with respect to compliance. The definition, as stated in Table 3 of the RMAR, is “environmental impact requiring treatment inside or outside of the landfill”. An environmental impact requiring treatment would be a discharge event that has the potential to adversely affect water quality with respect to the relevant guidelines. This is not a non-compliance or breach of consent conditions, which depending on severity would have the potential for “regulatory intervention” and would therefore be classified as “major”.

The risk rating matrix (Table 5) of the RMAR takes the assessed likelihood and consequence to determine the risk rating (low, moderate, major and extreme). This is a widely used and accepted risk assessment methodology. It is not subjective, and it defines the action that should be taken to manage the risk.

3.0 Ecological Risk Assessment

The RMAR is not an ecological risk assessment. Council’s reviewer of the RMAR has requested that an ecological risk assessment be provided. There is no relevant New Zealand guidance on undertaking ecological risk assessments, nor is it a specified requirement of an adequate assessment of environmental effects. The US EPA Guidance for undertaking ecological risk assessments is widely accepted international guidance on ecological risk assessments. This guidance, sets out the following steps for undertaking an ecological risk assessment:

1. Scoping including consideration of the extent of any investigation and what is included within the scope;
2. Formation of the problem including identifying what information needs to be gathered to help determine what, in terms of fish and macroinvertebrates, is at risk and what needs to be protected.
3. Analysis to determine what species are exposed and to what degree they are exposed, and if that level of exposure is likely or not to cause harmful ecological effects.
4. Risk characterization includes two major components: risk estimation and risk description. "Risk estimation" combines exposure profiles and exposure-effects. "Risk description" provides information important for interpreting the risk results and identifies a level for harmful effects on the species of concern.

We considered these steps have been addressed across the various technical reports prepared in support of the consent application namely:

- The Ecological Assessment (Technical Report G) includes a field investigation to identify the aquatic ecological values in the WMNZ landholdings, including the sensitive biota present. This has identified that the streams within the WMNZ landholdings include a range of sensitive species.
- Baseline water quality monitoring has also been undertaken and reported in the Hydrogeological Assessment (Technical Report E). This includes sampling for a wide range of contaminants, incorporating contaminants that are indicators of leachate as well as common pollutants within waterways.
- The Ecological and Hydrogeological Assessments noted above have been used to determine the likely sensitivity of the downstream environment and ecological receptors to water quality effects as part of the risk assessment included in the Stormwater and Industrial and Trade Activity assessment (Technical Report P). This, along with the identification of potential contaminant sources and loads have been used to assess the risks within each receiving environment from a water quality perspective. This has identified that the potential unmitigated risk from water quality effects would be high, but with the proposed mitigation (including treatment, source controls and monitoring) the overall risks of effects are low.
- On-going monitoring will be undertaken for a range of parameters. The purpose of the monitoring will be to identify potential effects on the receiving environment as well as indicators for leachate within surface water. The monitoring will be compared to effects-based trigger levels. Trigger levels will be developed based on relevant NZ based guideline values such as the NPS-FM and ANZECC, site specific trigger levels informed by the baseline monitoring results, and detection limits for leachate indicators.

We consider that the information likely to be included in an ecological risk assessment, that would be expected as part of an assessment of environmental effects, has already been provided in the Technical Reports submitted as part of the application and no further assessment is required.

4.0 Questions 91 Specific Responses

Request 91.1: Provide more detail information on the potential quantities and quality of contaminated water that could be released in Risk ID 1.15, 2.2, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.12, 2.13 and 2.15. Qualify the likelihood of any of these events occurring (during operation and aftercare of the landfill) and duration the event could last, and potential ecological receptors that could be affected? What are the potential receptors associated with these risks? Are contaminants of concern likely to exceed (1) acute water quality guidelines, (2) chronic water quality guidelines, (4) exceedance of NPS national bottom line criteria and (3) results in depletion of dissolved oxygen in surface waters?

With respect to potential quality of contaminated water (leachate) highlighted by all of these risk scenarios (Risk ID's) noted above; leachate composition is anticipated to be as per that described in the Hydrogeology Assessment (Technical Assessment E, Section 8.31) and has been based on Redvale Landfill data.

The response to Request 91.4 discusses the NPS and the ANZECC guidelines adopted in the technical assessments.

In addition, a number of these risk scenarios are addressed in subsequent sections specifically, Risk ID 1.15 and Risk ID 2.8 are addressed in the response to Request 91.5, and Risk ID 2.2 is addressed in the response to Request 91.2.

The rationale for the development of the other Risk ID's highlighted in Request 91.1 including their likelihood, event durations and operational phase risks are summarised as follows:-

- ***Risk ID 2.5 - Leachate collection pipework failure within landfill***

This risk scenario relates to blockage of the leachate lines within the drainage blanket. If the leachate line becomes blocked, the drainage blanket is designed to be able to convey the necessary volume of leachate to the collection point. This is a level of redundancy in the engineering design (engineered control) that suggests a likelihood of "rare". Given leachate line blockage is an observed outcome at a number of landfill sites, a likelihood of "unlikely" is adopted for this risk scenario.

Leachate lines are designed with surface rodding points such that the lines can be flushed should they become blocked. Any effect as a result of blockage is therefore at most transient and if problematic could be resolved in a timeframe of weeks. The Hydrological Assessment (Technical Report E) indicates the impact of a range of leachate head conditions and the associated environmental effects at POE#1 are "negligible". Given the above a mitigated risk consequence score of "negligible" was assigned.

The risk event has the potential to occur during the operational and post closure phases at the site.

- ***Risk ID 2.6 - Leachate disposal tanker accident***

This risk scenario requires a vehicle incident with a leachate tanker, that in turn results in a leachate containment being compromised and failure to contain the leachate with the emergency spill response measures. Human error in conjunction with failure of institutional controls is therefore required for the event to occur. A likelihood of "rare" is assigned as the annual probability would be less than 0.001 but is not "inconceivable" ($p <= 0.0001$). The event is a one off and very short term in nature (days at most) and the release is finite quantity as a single tanker load would be involved, however this could potentially result in some "minor" environmental damage if it occurred during a period of low surface water runoff. Given the above an unmitigated and mitigated risk consequence score of "minor" was assigned.

The risk event is only present during the early stages of the operational phase at the site as leachate evaporators are expected to be used once there is sufficient landfill gas.

- ***Risk ID 2.7 - Toe bund failure***

The toe bund is the lowest point in the leachate collections system. This risk scenario considers a breach in the integrity of this bund, which could result in a leachate release to surface water or groundwater. The design of the bund includes detailed design review and comprehensive construction quality assurance. An earthquake event is a potential trigger for this scenario, and as noted in the Tranche 2 response, probabilistic seismic hazard analysis with ultimate limit state (ULS) events with a 2500 year return period event have been considered. A mitigated risk likelihood score of "rare" was assigned because the event is not entirely "inconceivable".

Failure of the bund integrity would be apparent either on inspection post an extreme event (such as an earthquakes) or as a result of measurable changes in water quality. In the event that bund integrity was compromised, with a resultant release, this could be mitigated within a period of weeks with temporary works and remediated within a period of months. This would involve works outside the landfill footprint and the consequence of the risk event could potentially result in releases to the stormwater ponds and the receiving environment with adverse environmental effects. Given the above a mitigated risk consequence score of "major" was assigned.

The risk event has the potential to occur during the operational and post closure phases at the site, although the post closure risk reduces with time.

- ***Risk ID 2.9 & Risk ID 2.10 - Liner materials failure***

Two risk scenarios have been considered with respect to liner material failure:

a) Poor quality of materials and/or construction:-

A mitigated risk likelihood of "inconceivable" has been assigned as this risk scenario requires repeated multiple failures of the construction specification not being met (engineered control), the independent quality assurance not detecting this (institutional control) and the independent peer review panel not identifying this omission (human error).

A failure of the liner construction methodology of this type would likely be detected by monitoring the groundwater cut-off drains and as such it is not conceivable that this could occur across the complete landfill footprint. A deficiency of this type would likely be clearly present in underdrains within for 1 to 2 years of it occurring. Refuse placed in cells that did not have the liner performing to specification would lead to regulatory involvement, as this would be in breach of resource consents and permanent remedial works would need to be implemented. As such the unmitigated and mitigated risk consequence has been assessed as "catastrophic".

The risk scenario has the potential to occur during the operational phase but could result in consequences extending into the post closure phase at the site.

b) Post placement damage by operating equipment

A mitigated risk likelihood of "rare" has been assigned as this risk scenario requires operator error in the use of mechanical plant (human error) combined with failure of the engineered measures in the design to prevent mechanical damage, in the form of geotextile and the composite liner (engineered control), and inadequate installation of an initial "fluff" layer as liner protection (operational control). It is also noted that damage of this type is likely to be observed as part of operational controls of the site and if identified would be repaired prior to refuse placement.

A failure of the liner of this type would not be as extensive as Risk ID 2.9 and can be largely mitigated by good construction management particularly with interfaces the between each stage of liner construction. Damage of this type is likely to be localised, but a defect could be present for an extended period, if undetected prior to placement of refuse in the area. The potential mitigated risk consequence was therefore assessed as "moderate", given the adverse effect would be persistent.

The risk event only has the potential to occur during the construction and operational phases at the site but could have a continued effect during the post closure phase.

- ***Risk ID 2.12 - Lining system failure***

This risk scenario considers the groundwater inflow into the landfill from base through the liner in localised areas. The presence of inward groundwater gradients is in general beneficial in terms of minimising the potential for offsite migration of leachate via the groundwater pathway. However, the consequence of groundwater inflow into the landfill is an increased leachate volume to be managed. This risk scenario does not increase the potential for adverse environmental effects but has a cost implication over the landfill life due to the increased volume of leachate that requires management.

The standard engineering control, as adopted by this design, is to install groundwater cut off drains to prevent excessive upward pressure across the liner. These cut off drains in conjunction with the compacted soil layer minimising the potential for damage to the GCL and HDPE liner components provides two levels of engineered control making the mitigated likelihood of this scenario “rare” at most.

Once the vertical load from refuse is placed on the liner the risk scenario is further mitigated and therefore only has the potential to occur during the construction and operational phases at the site. However, should the risk scenario occur it is expected that inflow would continue over the operating life of the site and into post closure phases.

A mitigated risk consequence score of “moderate” has been assigned to this scenario as the incremental increase in leachate volume is likely to be a small portion of the volume of leachate produced.

- ***Risk ID 2.13 - Cover failure***

This risk scenario relates to a failure of the cover materials resulting in the infiltration of surface water and the generation of additional leachate volumes. The risk scenario has the potential to occur during the operational and post closure phases at the site.

As with the Risk ID 2.9 (liner failure) there is a high level of engineering and quality assurance associated with the construction of the cover. However, the settlement of refuse has the potential to influence the cover performance over time. Overall, the mitigated likelihood of this scenario was assessed to be “rare”.

Visual inspection and maintenance provide the means to readily mitigate any issues around leachate breakout on increased leachate production that could occur. Where an environmental effect is identified either by monitoring or routine visual inspections works can be implemented to repair the area of compromised cover. As such the duration of any event associated with cover failure with good operational controls should be limited to one to two months at most. Taking this into consideration, a mitigated risk consequence score of “moderate” was assigned.

The risk event has the potential to occur during the operational and post closure phases at the site.

- ***Risk ID 2.15 - Leachate surface breakouts***

This scenario specifically relates to leachate breakout from the waste placement regime whereby perching of leachate occurs within the waste profile leading to lateral seepage through the cover. While leachate breakouts are observed at landfill sites, their likelihood from the mechanism outlined above was assessed as “possible” as other factors that cause leachate breakout are assessed separately in Risk ID 2.2 and Risk ID 2.13.

Where identified this risk can be readily mitigated with cover repair to direct leachate back into the landfill and cover reinstatement. Leachate breakouts can be identified and mitigated prior to them resulting in anything more than a minor environmental effect with good site management (visual inspections and monitoring). The duration of these events should therefore be limited to one to two months at most. Taking this into consideration, a mitigated risk consequence score of “minor” was assigned.

The risk scenario has the potential to occur during the operational and post closure phases at the site.

Request 91.2: Provide more information regarding what an unforeseen leachate production event is, what is the mechanism that could give rise to such an event, quantify potential frequency of such events, what sort of event could give rise to an ecological impact and what are the potential contaminants of concern and what are the potential sensitive ecological receptors?

This questions to relates to Risk ID 2.2 which considers a prolonged high rainfall which leads to a large increase in leachate generation. This risk scenario is related to Risk ID 2.15 (leachate breakouts), which can be an outcome of high rainfall events. The distinction between the two events is that discharge to the surface water system is considered under Risk ID 2.15 with the receptor being the Unnamed Tributary of the Hoteo River. The risk scenario under Risk ID 2.2 is an increase in leachate head within the landfill. If the landfill operations are appropriately managed the risk is minimised, as for any covered areas leachate production is limited to the rate of percolation through the cover. Once saturated flow through the cover is reached more extreme rainfall will only result in increased runoff. The rate of saturated flow through cover materials should be considered in the design and sizing of the leachate drainage system. As such high rainfall could only result in unforeseen leachate productions from open areas of refuse.

A high rainfall event would need to occur in conjunction with areas of inadequate daily, intermediate and final cover to result in unforeseen leachate production.

- The Engineering Report (Technical Report N) provides empirical data for leachate production at the Whitford and Redvale Landfills. The leachate production from these operating sites provides the range of leachate production that could be expected over a 30-year period. The HELP model uses a simulated 50-year data set, so considers the climatic conditions that could occur with an annual probability of 0.02. A high rainfall event resulting in unforeseen leachate production would therefore have an annual probability of less than the above modelled and empirical data sets.
- Cover placement and performance have operational controls (visual inspections and leachate volume records) that would identify any significant areas that are compromised.

A persistent failure of operational controls in conjunction with an unforeseen rainfall event is therefore assessed as having a likelihood of “rare”.

The impact of the high rainfall event is increased leachate head, which then leads to increased leachate discharge. Potential increases in leachate head from high rainfall would be well within the range of leachate discharge volumes considered in Tranche 1 PDP16 response.

As noted in the Hydrological Assessment (Technical Report E) these are, with the most conservative assumptions around leachate head, orders of magnitude below the potential concentrations that would result in adverse effects at the nearest point of exposure POE#1. Hence the environmental effect is “no measurable of detectable adverse effect” and a consequence of “negligible” has been assigned.

Request 91.4: What criteria were used in the Risk Assessment to assess low risk to ecological receptors in terms of:

a) percentage of acute water quality criteria

b) percentage of chronic water quality criteria

c) Numeric Attribute State as outlined in the NPS freshwater (2014) (amended 2017)

d) Percent saturation dissolved oxygen

e) How were bioaccumulation and secondary toxicity effects accounted for when assigned low risks?

As noted above the RMAR is based on the technical assessments provided in the application. As such the groundwater pathway to surface water in the Hydrogeological Assessment (Technical Report E, Section 8) considers the relevant receiving water criteria, for surface water at POE#1, POE#2 and POE#6 this is ANZECC trigger levels for protection of 95% of species in freshwater.

We note that the Hydrogeology Assessment (Technical Report E) does not specifically assess the parameters considered in the NPS Freshwater 2017, specifically Total Phosphorus, Total Nitrogen, Nitrate, Ammoniacal Nitrogen and Dissolved Oxygen. In this regard we note that these parameters are not likely to be contaminants of concern via the groundwater pathway as:-

- Total phosphorus will be strongly attenuated within the groundwater system.
- Total nitrogen, ammoniacal nitrogen and nitrate will be either attenuated or strongly retarded in terms of their movement in groundwater effectively reducing the mass flux of these species at the point of discharge.
- The volume of groundwater discharging at POE#1 will not increase as a result of the landfill development. Given the dilution at the point of discharge, the potential for groundwater influenced by leachate to measurably influence surface water is therefore negligible. It is also noted that the current groundwater seepage to surface water at POE#1 is already relatively low in dissolved oxygen the potential to measurably influence surface water is therefore very low.

Parameters that are susceptible to bioaccumulation and secondary toxicity are also typically immobile in the groundwater system and as such the direct discharge to surface water is the primary pathway that could resultant in these effects. The proposed monitoring and controls provide the basis for assessing these effects.

With respect to stormwater ponds discharging to surface water, the proposed monitoring assesses these parameters, and mitigation and management of these discharges is reliant on operational controls. The applicant has demonstrated that the measures that are practiced at other operating sites provide a level of institutional control that would ensure persistent adverse effects do not result (consequence = “minor”) and these controls would require human error and failure of operational control which as noted in previous s92 responses has a likelihood of annual probability of <0.001 (mitigated likelihood = “rare”) resulting in and assessed risk of “low”.

Request 91.5: What are the types, duration, potential receiving environment (and size of impacted area) and potential sensitive receptors associated with the "moderate" risk associated with Risk ID 1.15, 2.8, 2.11, 2.17, 2.16. and 5.16.

As identified in Appendix A of the RMAR, Risk ID 1.15 (water Quality criteria not met in the discharge from Pond 1, Pond 2 or Pond 3. Located in Valley 1), and Risk ID 2.17 (stormwater pipe or swales fail/block and up catchment stormwater can't discharge) are assessed as scenarios that result in a potential risk to the surface water discharge from the site. In terms of the type and duration of these risk scenarios they differ as follows:-

- ***Risk ID 1.15 - Water Quality criteria not met in the discharge from Pond 1, Pond 2 or Pond 3. Located in Valley 1***

This risk scenario covers instances where surface water is influenced by leachate to a degree that has the potential to adversely affect aquatic organisms. The receiving environment is therefore the considered to be the un-named tributary of the Hoteo River, at the point of discharge from Pond 1. The fundamental principle with the site water management is that leachate influenced water is managed as leachate. The proposed continuous monitoring of water quality in the stormwater ponds for conductivity provides the ability to detect the presence of leachate influence at low levels enabling a timely response to mitigate potential effects. The risk scenario as assessed in the RMAR is a sufficiently large event that it has a potential to adversely affect water quality with respect to the guidelines (consequence = “moderate”). Continuous monitoring would detect leachate influence at orders of magnitude below the level of leachate influence at which an adverse effect would occur. For the risk scenario to occur it therefore requires the absence of a response from the site operator (human error), or equipment malfunction, and a corresponding leachate release of a sufficient quantum to have an adverse effect. This is conservatively assessed as having a likelihood of “possible” as the probability of the two events occurring concurrently is assessed as having an annual probability approaching “unlikely”.

- ***Risk ID 2.17 - Stormwater pipe or swales fail/block and up catchment stormwater can't discharge***

This risk scenario relates to upcatchment water which cannot be conveyed beneath or past the placed waste, leading to a large volume of surface water potentially entering the refuse and becoming leachate. This increases the potential for surface breakout of leachate and resulting adverse effects on surface water. The level of redundancy in the design along with the potential to mitigate the risk with active management reduces the likelihood to “unlikely”. While the mitigation measures and risk management would ensure such an event is rectified expediently, the scale of the event is still considered to have the potential to result in serious environmental harm and would necessitate remedial works on the clean surface water diversions in the immediate vicinity of the landfill footprint which are constrained by the site topography, as such the unmitigated risk consequences are considered to be “major”.

As identified in Appendix A of the RMAR Risk ID 2.8 (lining system settlement and failure), Risk ID 2.11 (liner interface failure) and Risk ID 2.16 (landfill instability) are assessed as events that result in a potential risk to groundwater discharges from the site. In terms of the potential surface water receiving environment this is POE#1, POE#2 or POE#6. Other receptors include recreational POE#3, stock watering POE#4 and domestic use POE#5. POE#1 has the smallest delta to the relevant receiving water criteria and therefore subsequent discussion considers the implications for this receptor. In terms of the type and duration of these risk events they differ as follows:

- ***Risk ID 2.8 - Lining system settlement and failure***

This risk scenario is a breach of the liner components during the operational or post closure phases due to an event such as a differential settlement. An event of this type could result in a localised area where liner containment is partially compromised, the risk scenario assumes this is located beneath refuse such that remediation of the compromised area is not viable and therefore permanently damaged.

The liner is engineered to have a degree of tolerance for settlement with multiple lines of defence to ensure the liner would not be fully compromised making the event highly improbable. Differential settlements occur at interfaces between natural ground and fill or transitions from weathered soil to rock. The current base grade plan indicates that while there are multiple areas where this could potentially occur, they are localised in extend and generally located on the side slopes where the tolerance is greater, and the risk is therefore minimal. The greatest risk is therefore the fill in lower sections of the valley footprint where displacement could transect the greatest area of landfill footprint and the leachate collections system. This risk is mitigated by the landfill staging as this is the last phase of landfill development allowing the maximum timeframe for fill placement compaction and performance verification. Considering the above a likelihood of “rare” was assigned.

As such the risk is minimal until late in the operational phase and during the post closure phase the risk reduces with time as refuse degrades and stabilises. Nevertheless, the risk event could potentially result in discharge to groundwater for a prolonged period of time and the mitigated risk consequence score of “catastrophic” has been assigned.

- ***Risk ID 2.11 - Liner interface failure***

This risk scenario is effectively a slope movement between the liner components. An event of this type could result in a localised area where liner containment is partially compromised, this could potentially be located beneath refuse such that remediation of the compromised area is not viable and any effects would persistent. As such the discharge to groundwater could potentially occur for a prolonged period of time. Considering this, a mitigated risk consequence score of “catastrophic” has been assigned.

In this instance the liner would be under some load from refuse making the event highly improbable and localised in that it could only conceivably occur in sidewall areas of the landfill footprint. The risk is present primarily during the construction and operational phase but is “inconceivable” post closure once design vertical load is in place on the liner. Therefore, a mitigated risk likelihood of “rare” has been assigned.

- ***Risk ID 2.16 - Landfill instability***

This risk scenario is effectively a slope movement within the placed refuse that results in refuse being displaced to outside the liner footprint. The risk is present primarily during the operational phase but also post closure. While movement within the refuse mass is observed at landfill sites events of a scale that result in refuse outside the landfill footprint are highly unlikely with appropriate design. Conservatively, a likelihood score of “unlikely” has been assigned.

An event of this type would be expected to be remediated to provide containment of waste and mitigate the risk of uncontained waste. As such the discharge to groundwater is only present until the remedial work is implemented which would be a period of months at most. It is also noted that refuse instability is limited to the immediate vicinity of the landfill footprint with the short-term remedial response being focussed on isolation of refuse from the surface water system. The potential for adverse effects on the receiving environments at Auckland Regional Landfill is limited by the natural containment of the site and the relatively low groundwater volumes discharging from beneath the site. The potential for measurable adverse effects beyond POE#1, are considered negligible given the relative volumes of groundwater and surface water. On this basis a mitigated risk consequence of “major” has been assigned.

- ***Risk ID 2.16 - Waste acceptance criteria not met and hazardous waste received.***

As identified in Appendix A of the RMAR Risk ID 5.16 is assessed as a scenario that results in a potential risk to the human health of workers and discharges to the environment. This risk scenario considers the adverse reaction between incompatible waste materials and is present only during operational phases of the landfill. The risk scenario has a mitigated risk consequence assessed as “major”. The risk scenario is mitigated by institutional controls including the waste preapproval and manifests as well as waste screening at the gate. Given these controls a mitigated risk likelihood of “unlikely” has been assigned.

Request 91.6: Provide a quantitative ecological risk assessment to answer questions 4.1.2 to 4.1.8 above.

As noted above the assessment is not an ecological risk assessment and these aspects are considered by the relevant technical assessments with further information also included in Tranche 3 response around ecology.

Request 91.7: Provide further information around lining system settlement and failure including possible ecological effects from such a failure, quantity of leachate that might be released, potential sensitive receptors, an estimate of the area of surface water potentially impacted and likely requirements to mitigate adverse effects.

This is addressed above in the response to Request 91.5.

Yours faithfully

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