

**HUNTLY QUARRY – FILL DISPOSAL SITES
SUMMARY REGISTER OF GEOTECHNICAL COMMENTS FROM PEER REVIEWER**

Project:	Huntly Quarry – Fill Disposal Sites
Subject:	Resource Consent Report

DOCUMENT REVISION:	02	Name of Reviewer(s):	Cameron Lines
Document Issue Date:	17 th October 2019	Organisation:	Baseline Geotechnical
Purpose of Review:	Peer Review of geotechnical report to advise Waikato Regional Council.	Available Documents:	1) 2325-12-GQ-01 (Huntly Quarry Disposal Sites – Geotechnical Assessment)_Rev B. 2) 2325-12-GQ-01 (Huntly Quarry Disposal Sites – Geotechnical Assessment)_Rev C.

No.	Element	Peer Reviewer Comment Description	Gaia Response	Closed Out (Y/N) Comment	Further Reviewer Comment	Gaia Response	Closed Out (Y/N) Comment
1	Ground Model	<p>Date (09/10/19)</p> <p>Provide reference to the key geotechnical risk presented by each lithological unit.</p> <p>Specific reference to:</p> <p>a) Potential presence and orientation of low strength, bedding parallel shears within Waikato Coal Measures</p> <p>b) Fast groundwater seepages within historic mining fill</p> <p>c) Trial Pits failing to intersect contact between mining fill and underlying material</p> <p>d) Depth of the Newcastle Group Greywacke and relationship to the development</p>	<p>Date (15/10/19):</p> <p>a) During our previous test-pit investigation only limited evidence of bedding planes were observed due to the depth reached with test-pits. Where bedding was observed it was most visible in the moderately weathered material half way up the gullies. In the base of the gullies relatively unweathered Waikato Coal Measure mudstone was encountered where a more chaotic fabric was exhibited. As such, absolute bedding direction was difficult to ascertain.</p> <p>We consider bedding plane weaknesses to be of low risk to the development due to the nature of the fill being constructed from the fill toe (where the ground is relatively flat) and back up the gully, effectively buttressing the Waikato Coal Measure slopes.</p> <p>No major cuts exposing bedding aligned weakness planes are proposed as part of the development.</p> <p>Sensitivity of the foundation material at the fill toe can be tested based on different configurations of potentially present bedding fabric. If bedding direction cannot be determined reliably during detailed investigations, generalised anisotropic strength models can be applied to simulate a range of potential bedding parallel weaknesses.</p> <p>b) Subsequent to the release of the report the client has proposed the installation of deep counterfort drains at Fill Site 3 to relieve the groundwater from the historic mining fill. This will form part of the detailed investigation and design. Response of the</p>		<p>Date (3/11/19):</p> <p>a) For Overburden Disposal Areas (OBDA) paced on a foundation of Waikato Coal Measures (WCM). Bedding orientation and strength is a key geotechnical risk. The chaotic fabric described may be as a result of faulting, suggesting low strength, pre-sheared surfaces on bedding are a strong possibility.</p> <p>Currently Gaia have not demonstrated a good understanding of the actual WCM bedding orientation or condition and have not analysed worst case combinations of orientation/strength. Given this, we don't understand how Gaia can classify the risk as low, when every major slope failure in adjacent coal mine cuts or fills have occurred on these very structures. It has been our experience that pre-sheared, gently inclined bedding surfaces within WCM can result in failure even at the toe of gently inclined slopes.</p> <p>There are any number of investigation techniques available to confirm bedding orientation and condition. Gaia are not limited to test pits if other techniques would provide better data.</p>	<p>Date (07/11/19):</p> <p>Please refer to Rev. C of the report which now includes Section 4.3 which discusses geological risk and mitigation strategies including Waikato Coal Measures bedding.</p> <p>a) It is accepted that the general bedding direction is difficult to ascertain at this time. As such we have undertaken preliminary stability analysis assuming worst case bedding direction with a credibly low strength (shallow dipping out of the slope). The analysis is discussed in Section 7.0 of the Rev. C report</p> <p>The analysis shows that the overall stability of the fill is still largely governed by the design and construction of the fill itself.</p> <p>During detailed design, if failures along low angle bedding shears near the toe of the fill are found to be a risk to the fill then these can be mitigated with specifically designed toe-keys.</p> <p>It is anticipated that detailed investigation and design will confirm whether or not these</p>	<p>Comment</p> <p>Closed Out</p>

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			<p>groundwater perched within the historic fill can be monitored during and after construction of the drains.</p> <p>c) As for part (b) the client intends to construct the deep drains with a long-reach excavator. We intend to use this excavator to assess the thickness and basal interface qualities of the historic fill. We consider this work to be part of the site investigation for detailed design of Fill Site 3. If the long-reach excavator is unable to identify the fill and in-situ ground interface, deep geotechnical drilling will be undertaken.</p> <p>d) Except for Fill Site 5 (excluded from peer review) the other three sites are underlain by Waikato Coal Measures. The thickness of this unit (whilst not certain) is considered to be great enough that the influence of the basement greywacke is considered to be inconsequential to the proposed fill development. If greywacke is encountered during detailed design investigations then this position will be revised and the impact analysed accordingly.</p>		<p>b) The deep drains proposed are a good idea. Thought will need to be given to the effect on groundwater in the fill, which will define the groundwater conditions for analysis.</p> <p>c) We are comfortable with the approach, but the stability of this Fill site for a combination of worst-case conditions will still need to be demonstrated at consenting stage (refer 2 below).</p> <p>d) We are comfortable with the approach. This risk is not as great as the WCM bedding shear risk described above.</p>	<p>concerns are present near the toe of the fill and consequently will govern the design of the toe-keys as necessary.</p> <p>b) Conservative groundwater parameters were adopted in the concept stability analysis likewise; residual pore water pressures were modelled the fill.</p> <p>c) Noted, thank you.</p> <p>d) Noted, thank you.</p>	<p>Comment Closed Out</p>
2	Stability Analyses	<p>Date (09/10/19)</p> <p>Expected stability of the proposed fill has not been demonstrated by analysis.</p>	<p>Date (15/10/19)</p> <p>If it is deemed necessary for a Resource Consent application, we propose running preliminary 2D stability analyses of the existing ground and the currently proposed fill profiles at each fill site as a proof of the concept.</p> <p>Preliminary stability calculations will be based on currently known conditions and will require a number of assumptions to be made.</p> <p>Detailed stability calculations and design will still be required as part of the detailed design of each fill after Resource Consent is granted.</p> <p>Please note that based on past experience with similar projects (such as a similar sized fill site at the Drury Quarry) and engineering judgement, it is our opinion that the assessed site is suitable for the proposed development. Detailed design for the construction of the fills will be undertaken as part of the Resource Consent Conditions.</p>		<p>Date (03/11/19):</p> <p>Given that the ground and groundwater conditions are not presently well enough understood at the fill sites to address the key geotechnical risks. We still don't understand the basis on which Gaia consider the sites suitable.</p> <p>However, there is a potential alternative to further time consuming and costly ground investigation. If Gaia can demonstrate that the fills can achieve an acceptable Factor of Safety in preliminary 2D limit equilibrium analyses, for a series of worst-case ground conditions, then this would adequately demonstrate the suitability of the sites (i.e. actual stability can only be better than that analysed).</p>	<p>Date (07/11/19):</p> <p>Concept stability analysis presented in Revision C of the report have shown that the stability of the site is largely controlled by the fill stability itself.</p> <p>It is noted that we have incorporated a low strength, low angle bedding orientation anisotropy in the analysis.</p> <p>We are satisfied that residual risks posed by unknowns related to the underlying geology can be sufficiently mitigated through design of toe-keys, structural bunds and internal drainage blankets during detailed design.</p>	<p>Comment Closed Out</p>

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					The analyses should allow for gently inclined (out of slope) bedding orientations, residual strengths on bedding (or mine fill/WCM contact) and a reasonable assumption around long term groundwater in line with anticipated underfill drainage works.		Comment Closed Out
3	Groundwater	Date (09/10/19) Influence of underlying groundwater conditions in the foundation soils on the stability performance of the fills.	Date (15/10/19) Surficial groundwater regimes are currently heavily influenced by the presence of farm dams, ponds, infilled gullies etc. As such, we have recommended that these dams and ponds be released and drainage measures installed. Subsequent groundwater conditions will be reassessed. It is anticipated that this would happen post Resource Consent and during detailed design and construction stages		Date (03/11/19): We are comfortable with what is proposed. A reasonable assumption around foundation groundwater pressures in line with proposed drainage works will need to be made in analyses discussed in 2. Above.	Date (07/11/19): Noted. See point 2.	Comment Closed Out
9	Fill Extents	Date (09/10/19) Extent of fill footprint not finalised at this pre-application stage will need to be confirmed prior to consent application	Date (15/10/19) It is our understanding that the concept fill footprints provided by our client are representative of the required fill. From discussion with our client we understood that it is desirable to maintain a scope to deviate slightly from the concept footprints where required during the detailed design stage. These deviations are largely for operational reasons and are unlikely to be significant from a geotechnical perspective. We propose that a "Footprint Limit" or similar be added to the concept drawings to aid with visualisation of this.		Date (03/11/19): We understand that during construction deviations in places may need to be made. The proposed footprint limit would assist our understanding of the anticipated extent of the deviations that may occur.	Date (07/11/19): Please see revised drawing included in Appendix A of the Rev. C report. The fill footprints are all confined to the gully they reside in. Comment has been added to Section 8.4 of the Rev C report to discuss this.	Comment Closed Out
11	Whole-of-life considerations	Date (09/10/19) Consideration for in-ground pore water pressure monitoring such as vibrating wire piezometers to be installed within the fill.	Date (15/10/19): In our experience with similar fills a sufficient approach has been to monitor settlement and displacement of the fills with sufficient placement of designed drainage blankets to speed up fill consolidation as each bench is completed. We propose installation of standpipe piezometers or similar as a mitigation strategy should unsatisfactory settlement/displacement be observed within the fills. Settlement and displacement vs time thresholds will be developed for each fill during detailed design.		Date (03/11/19): While monitoring of pore pressure build up in the fill would assist in managing global instability risk, the proposed drainage blankets are largely expected to adequately control this. Having given this further consideration, we are comfortable with the monitoring proposed by Gaia.	Date (07/11/19): Noted, thank you.	Comment Closed Out

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12	Factual Data	Date (09/10/19)	Date (15/10/19):		Date (03/11/19):	Date (07/11/19):	Comment Closed Out
		Show location of historic boreholes on site plans if significant to the project	Historic boreholes and associated logs will be shown on the drawing and included in the appendices. Please note that these boreholes were not oriented so primarily provide stratigraphic depth information only.		Thank you for resolving this. These will assist our further understanding of the site.	Please see revised drawing 2325-12-01 Rev B included in Rev. C of the report. Borehole Logs are included in Appendix B of the Rev. C report	
13	Factual Data	Date (09/10/19)	Date (15/10/19):		Date (03/11/19):	Date (07/11/19):	Comment Closed Out
		Discrepancy between trial pit names between logs and drawing for Fill Site 3	Thank you for pointing this out. Site plans will be amended to match the provided logs.		Thank you for resolving this.	Please see revised drawing 2325-12-01 Rev B included in Rev. C of the report.	