Ref: 00733/200625
Date: 09/04/2021

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RE: Walleys Landfill – Capping SRAR Revision 2

Land and Minerals Consulting Limited (LMCL) were commissioned by Egniol Consulting Limited (Egniol) to prepare a Stability Risk Assessment Report (SRAR) for the proposed geosynthetic capping at Walleys Quarry Landfill Site. The original capping SRAR report was issued in July 2020.

On the 3rd March 2021, the Environment Agency issued a Schedule 5 notice requiring additional information. Revision 2 of the SRAR report has been issued in order to address the queries and requirements laid out in the Schedule 5 notice.

We have to following comments on how and where we believe the requirements of the Environment Agency's March2021 Schedule 5 Notice have been addressed in the revised SRAR report.

Schedule 5 Notice – Comments 9a, 9b and 9c (See Excerpt 1)

9a: We have listed all available CQA validation reports referenced in Table SRA1 on Pages 2 and 3. Sections 1.2.4 to 1.2.8 detail the previously installed basal and sideslope systems and waste mass in the line of the model section.

9b: Although the initial Capping SRAR report mentioned an SNRHW cell at the site, it has since been agreed with the Environment Agency that there is no SNRHW cell at the site. All cells at the site are understood to contain Non-Hazardous waste and future inputs are understood to be non-hazardous waste. Whilst long-term *differential* settlements *within* the non-hazardous waste will be modelled, there are not considered to be any *different* waste *types* placed in different cells at the site.

9c: This statement has been clarified in Section 1.2.6.

9. Site conceptual model [Sections 1.2.1 to 1.2.8]

a] Please give actual specifications of the components of the landfill infrastructure that were constructed by referring to the information in CQA validation reports, which should be listed and referenced in the SRA.

Reason

Specifications of the landfill infrastructure constructed often vary slightly from those given in the conceptual design presented in the original permit application. Therefore it is important that information from the CQA process is used to confirm the actual specifications of the various components.

b] Clarify the types of waste placed in each cell, and account for this in the waste parameters in SRA 2.4 Table 2 / Table SRA4, Table SRA4a, and take account of the differences in waste properties in the settlement calculations.

Reason

It is not clear that consideration has been given to compressibility, consolidation and settlement of the different waste types placed in different cells. This is important since this would affect the amount of differential settlement across the landfill. In turn this needs to be taken into account in the assessment of the integrity of the new capping system.

c] Basal Lining System Model [Section 1.2.6]

Correct the statement:

'Previous reports (Reference 1) indicate that a minimum 3.0m thick low permeability clay

(AEGB) basal liner was placed at the site to a level of 2.0m above the base of the cells.'

Reason

The thickness of the AEGB is not clear, the statement is contradictory and does not make sense.

Excerpt 1

Schedule 5 Notice – Comments 10a, 10b (See Excerpt 2)

10. Scope of modelling

a] Clarify whether or not it was your intention to determine the strains in the basal and side slope lining system in assessing the factors of safety for the proposed capping system, and on the basis of your answer revise the stability risk assessment.

Reason

It is not clear whether or not the statement is correct in section 2.3 para.1 'finite element analyses has been used to determine the strains in the mineral component of the basal and side-slope lining system, and for the calculation of factors of safety', since these factors were discounted during the risk screening. On the other hand if you meant to determine the side slope strains because of the effect these may have on cap stability and integrity, please amend your report accordingly.

b] Clarify the proposed design (with detailed cross-sections and map of cap layout) where the LLDPE cap would tie into the steeper clay cap section in the south west of the landfill. Model and assess the stability and integrity at this boundary.

Reason

The area in question has not been assessed in the SRA and the reason for excluding it is not clear. Potentially the area where the two capping systems are joined is a zone of weakness where differential strains may be greatest. This requires assessment.

Excerpt 2

10a: This typographical error has been corrected in Section 2.3.

10b: There is no longer proposed to be a clay capping area. The whole site is now proposed to be capped with geosynthetics.

Schedule 5 Notice – Comment 11 (See Excerpt 3)

11. Geotechnical parameters selected for analysis [SRA 2.4, 2.5]

We need you to clarify and confirm the values for each of the geological and geosynthetic parameters in the tables represent the conservative mean for each parameter [or using EC 7 terminology, characteristic values].

We note that for waste properties you have referred to the information in R&D P1-385 TR1, and request that you clarify that the properties you have used represent the different waste types permitted for disposal at the landfill.

Reason

Parameter values that are used in the model need to represent the range of properties that geological and geosynthetic materials display. This may be achieved from measured values of the parameter to derive the conservative mean value, or the characteristic value if using the EC7 partial factors approach. It is not clear that the values in the tables represent these. For example Equation 7.4 in R&D P1-385 TR1 provides a method of calculating these from a parameter dataset. MSW waste properties are highly variable due to its heterogeneity but also then vary spatially in 3D and with time in the landfill; therefore the variety of waste types including SNRHW deposited at the landfill introduces greater variability. This needs to be taken into account. Also it is apparent that due to the waste being placed in 2m lifts, it will not be compacted adequately as compared with if it were placed in 0.5m lifts. [e.g. see P1-385 TR1 section 8.2.4, Table 8.2].

Excerpt 3

11: Where historic site specific data is available from the CQA validation reports, this has been used to create 'Characteristic Values' for the basal and sidewall liner and engineered fill for the modelled section. These are described in Section 2.4 and in Tables SRA 5, 5a, 6 and 6a.

As noted in 9b, it has been agreed with the Environment Agency that there is no SNRHW cell at the site. All cells at the site are understood to contain Non-Hazardous waste and future inputs are understood to be non-hazardous waste. We accept that non-hazardous waste is variable both spatially and over time and have made the following amendments in this revised SRAR:

- The basic model of the site now includes four different waste types with varying weight and stiffness properties dependent upon depth and location with lighter, less-stiff waste being modelled as placed most recently at the site; and

- the effect of long-term *differential* settlements *within* the non-hazardous waste has been modelled to assess the long term integrity of the geomembrane under lifetime differential settlements in the region of 23% to 36%.

Schedule 5 Notice – Comment 12 (See Excerpt 4)

12. Interface properties [SRA Table SRA 6, Table SRA 7]

Clarify which properties you have assigned to the interfaces by presenting a sectional drawing. Clarify how you have derived the interface properties for the two surfaces input to PLAXIS paying particular attention to the residual strengths, since they are higher than we would expect and therefore not conservative.

Reason

It is not clear how you have derived the interface input parameters, and the properties you have listed appear to be too high, particularly for residual strength. Because PLAXIS 2D models just two interfaces for one geosynthetic it is important that the model limitations and the assumptions are fully understood and clear about the difference between the proposed cap design and the modelled scenario.

Excerpt 4

12: A Sectional drawing detailing the three proposed capping systems is presented in Section 1.2.9. The possible interfaces in the 3 capping systems are discussed in Section 2.1.6. Table SRA7 lists the possible interfaces from the 3 proposed capping systems. However, as no actual interface shear testing data is currently available for materials which would be used on site, Table SRA7 can only list the indicative interface shear strength values for a textured geomembrane to non-woven geotextile interface from The Guidance (TR1).

Without the site specific interface data, the aim of the finite / infinite slope capping stability analysis will be to determine suitable minimum requirements for the interface strengths based on the worst case slope geometry and proposed capping systems. The Finite and Infinite slope assessments will therefore have to derive the minimum required values for the other interfaces based on obtaining a minimum factor of safety of 1.3 for peak values and 1.0 for residual values.

The interfaces modelled in the finite slope calculations are clearly presented on the calculation sheets in Appendix SRA1.

We have changed the assessment technique for interface shear strength / stability from Plaxis finite element assessment to Finite Slope / Infinite Slope techniques as detailed in Section 2.3 of the SRAR report. Finite and Infinite slope calculations will be used to determine the lateral sliding stability for cover soils on the upper geosynthetic and integrity in tension of the geosynthetic elements of the proposed capping systems. The aim will be to identify minimum interface parameters for the proposed capping systems, based on the proposed slope geometry and available parameters. Calculation spreadsheets have been based on calculations by Koerner, R. M (Designing with Geosynthetics) and on work by Jones, D.R. V. and Dixon, N. (1998b)

Schedule 5 Notice – Comment 13a, 13b, 13c, 13d, 13e (See Excerpt 5)

13. Model selection, scenarios and analysis [section 3]

a] Describe and explain how the PLAXIS model you have used to simulate conditions accounts for:

- plasticity in elastoplastic behaviour of the components
- secondary settlement which is time dependent due to, for example, waste degradation
- parallel saturation ratio [PSR]

b] Assess the effects on the capping system by incorporating the groundwater drainage system beneath the sidewall lining system, which will provide preferential pathways for groundwater potentially under artesian pressure under the side slope lining.

c] We require an assessment of the effects of differential settlement on capping stability, tension in the capping system components and its integrity. This must also take into account the different waste types in different cells. Please also compare the total settlement derived from your model results with measurements of settlement observed at similar landfills where we would expect to see around at least 20% settlement.

d] Assess the stability of the capping system during construction due to construction traffic loading.

e] You also need to provide us with a stability analysis of the effects of landfill gas pressure on the underside of the cap.

Reason

Fig SRA 2 presents conceptual model idealised sections of the main features of the landfill, but do not show the groundwater drainage system. This is considered to be an important feature of the landfill engineering and when groundwater is no longer pumped it will rebound. The groundwater is the drainage blanket will provide a preferential pathway for artesian rebound up the sides of the landfill beneath the lining. The possibility of this occurring needs to be accounted for.

Effects of construction loading, gas pressure, and settlement caused by differences in waste composition, and time dependent waste degradation do not appear to have been taken into account in the analysis of the capping system stability and integrity. This is required. [Note Table SRA 9 needs to be correctly labelled – is it presenting results for Model 2 ?]. Please refer to capping guidance available at GOV.UK Design and build your landfill site - Landfill operators: environmental permits - Guidance - GOV.UK (www.gov.uk).

Excerpt 5

13a:

- Section 2.3, Page 13, provides information on how Plaxis deals with plasticity in elastoplastic behaviour.
- Plaxis does not model biodegradation settlement. However, this can be simulated by artificially lowering waste stiffness parameters to create the necessary settlement for the modelling of lifetime waste mass settlements. A model has been created to simulate long term settlements of between 23% to 36% of waste depth (at the time of capping) in line with settlements seen on other similar non-hazardous landfill sites.
- Plaxis does not specifically model PSR. This modelling has been undertaken using finite slope techniques and reported in Table SRA11 and on the calculation sheets in Appendix SRA1.

13b: This aspect has not been undertaken in the revised Capping SRAR.

13c: A model has been created to simulate long term settlements of between 23% to 36% of waste depth (at the time of capping) in line with settlements seen on other similar non-hazardous landfill sites. Illustration SRA1 on Page 30 of the report indicates the differential settlements modelled. Integrity of the geomembrane has been assessed using finite element analysis through all life stages of the capping, restoration soils and lifetime settlement of the waste.

Tension in the capping system components has been assessed using Finite slope techniques and is presented on the calculation sheets in Appendix A. All minimum values calculated for the interfaces are based on achieving factors of safety for the tension in the geosynthetics as well as for stability.

13d: Section 2.5, Table SRA8 describes the technique used for assessment of construction plant loadings on the stability and integrity of the capping system. With the results being presented in Table SRA14 and SRA15.

13e: Infinite slope analysis has been used to assess gas pressure on the various capping systems proposed, the results being presented in Table SRA12.

We hope the above is sufficient for your present needs, please let us know if you need any additional information.

Yours sincerely

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