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5 July 2015

Department of Environment Regulation
Industrial Regulations, Swan Region
Locked Bag 33
CLOISTERS SQUARE, PERTH
WA 6850

Attention: Rebecca Griffiths

**Subject:** **Opal Vale Chitty Road Landfill Development – Response to DER Letter 26 March 2015 and 19 June 2015**

Dear Rebecca,

Further to your letter dated 26 March 2015 whereby you have raised some queries on the proposed landfill development, our response to your queries dated 15 May 2015, the DER subsequent queries dated 19 June 2015 and our meeting of 29 June 2015, we provide the following updated responses (numbering as per your original letter):

**Proximity and potential risk to human receptors:**

Your application indicates that there is a farmhouse located approximately 400m from the landfill footprint within lot 11, Chitty Road, Hoddy's Well. DER has identified that any residents of this property may be potentially affected by site operations, including odour issues. DER requires the following information to facilitate an assessment of risk to any occupier of the house:

**1.a. Requested Information:**

Confirm the agreement between the ownership of this house, land, and proposed landfill operations.

**Response by IW Projects:**

Section 20.3 – Buffer Zones of the *IW Projects* report, page 72, states "*The farmhouse on Lot 11 is located 400 m to the south west of the landfill footprint; however, is deemed as an internal residence and is ignored when considering the buffer zones. The landowner has provided written consent to the farmhouse being ignored when considering the potential impacts of the landfill.*"

**Attachment A – Landowner's Letter of Exclusion** provides a copy of the letter received from the landowners whereby they acknowledged that the farmhouse is to be ignored with regards to possible landfill environmental impacts. In addition, the attachment includes the Certificate of Title confirming the ownership of the land and house.

**1.b. Requested Information:**

Clarify why the application contains limited assessment of potential risks to this house.

**Response by IW Projects:**

As stated in 1.a above, this house has been ignored from potential environmental impacts, the exception being, the possibility of landfill gas migration from the landfill. This aspect is seen as a potential safety issue and hence has been included in this aspect of the assessment.

**1.c. Requested Information:**

Is the house currently occupied and if not, will it be occupied at any time in the future? If so, an assessment of risk to the occupier from the proposed landfill must be submitted as part of the application.

**Response by IW Projects:**

The house is currently occupied by the farm manager. As stated above, only the potential safety aspect has been assessed, not the potential amenity impact. The landowner has accepted that this house can be ignored when considering receptors. Ultimately, if the landfill does cause an inconvenience to the farmer, based on the relative value between the landfill and the house, the house issues will be resolved by moving the farmer to another location.

**1.d. Requested Information:**

Any other information and agreements pertinent to DER's assessment.

**Response by IW Projects:**

Covered above and a copy of the landowner's agreement provided in **Attachment A – Landowner's Letter of Exclusion**.

**Geological descriptions:**

**2. Requested Information:**

Pg. 21 of the report states that clayey materials continue to at least 15 to 20m beneath the quarry base. This is despite particle size distribution (PSD) tests provided in the *Stass Environmental* Report 2014 (*Stass Environmental* report) indicating in-situ soil samples tested are majority sand (4 to 8% clay, 26 to 33% silt, 53 to 56% sand). Please clarify why the material is referred to as 'clay' or 'clayey' in light of these laboratory test results.

**Response by Stass Environmental:**

The report states that "clayey materials" occurs to depths of 15 to 20m below the ground surface. The PSD results (Martinick 1998) are based on two samples from the floor of Williamson Pit and is not considered representative of the clayey materials at the site.

The Stass Environment report stated that “clayey sands are present in small amounts” (p9). These coarser grained units only occur in some places are not hydraulically connected and hence does not affect the outcome of the assessment.

**3. Requested Information:**

P. 23 of the report indicates that two soil samples were tested for permeability in a laboratory (the report references Martinick/McNulty in 1998). Please indicate the sample depth, location and whether the samples were compacted before testing. Where information is referred to in the application, DER requires that all data associated with that information is provided to support any conclusions made.

**Response by Stass Environmental:**

According to Martinick 1998, the two samples were obtained from the floor of the pit (adjacent to bores WF2 and WF 4) and compacted to 90% compaction at optimal moisture content, prior to permeability testing.

**Data presentation and inconsistencies:**

**4. Requested Information:**

Pg. 22 of the report refers to 10 groundwater monitoring bores installed in 1998 by Wallis Drilling. No other information on these bores appears to be provided in the application. Where information is provided in the application, the applicant is expected to provide all supporting data relevant to that information.

**Response by IW Projects:**

This reference in section 11.2 – Geotechnical Attributes, page 21, to the 1998 Wallis Drilling activity is included in the *IW Projects* report, along with other brief statements relevant to the geotechnical attributes of the site is to demonstrate the extent of geotechnical information known about the site. This information is simply a brief introduction to the section topic without going into too much detail, as this is the subject of the *Stass Environmental* report.

As stated at the end of this section, “*Appendix No. 2 – Stass Ground Water Assessment, Dec 14 provides additional detail of the geotechnical attributes on site.*”
Section 6 – Site Hydrology in the *Stass Environmental* report then provides the details surrounding the Wallis Drilling activity and the outcomes thereof.

**5. Requested Information:**

The application does not appear to include bore logs for the monitoring bores installed within the pit (referred to in the application as ‘pit bores’). DER requires that this information is provided.

**Response by Stass Environmental:**

Bore logs for these bores are now provided in **Attachment B – Stass Environmental Additional Information** at the back of this document.

**6.** DER requests the following clarification in relation to the bore logs presented in the *Stass Environmental* report:

**6.a. Requested Information:**

Slotted casing depths are provided both as text within comments in bore logs and also within bore log illustrations. The two sets of information are inconsistent in logs for SE1, SE2, SE3 and SE6, with very large differences in some. Clarify and provide updated bore logs.

**Response by Stass Environmental:**

The graphic translation from original CAD files to PDF files distorted the graphic bore representation and omitted some aspects of the drawings. This was unfortunately not noticed at the time of report production. These were correctly translated from CAD to PDF and are now provided in **Attachment B – Stass Environmental Additional Information**.

**6.b. Requested Information:**

Text beneath the heading ‘casing type’ in the bore construction diagram is not consistent with the bore installation diagram beneath the heading ‘completion’. Clarify and provide updated bore logs.

**Response by Stass Environmental:**

Again, the reason for the inconsistency is a graphic translation error as with 6a. This has now been corrected and updated logs are provided in **Attachment B – Stass Environmental Additional Information**.

**6.c. Requested Information:**

The first water strike noted in the SE4 bore log was at 30m below ground level (bgl), however the log indicates that slotted casing was installed across the second strike at 46m bgl. Clarify why the screen was not installed to capture the first strike.

**Response by Stass Environmental:**

Refer to 6a and 6b.

At 30m depth, there was a minor reduction in dust output from the bore. As the next sample 1m further down remained dusty (and samples for the next 15 m of drilling), this was at best a minor moist zone in the stratigraphy. It's presence has been modified in the bore log.

**7. Requested Information:**

DER requests that all groundwater level data in Appendix F of the *Stass Environmental* report is presented on one page, with all bore identification information and headings included so that the data is auditable.

**Response by Stass Environmental:**

All groundwater level data, with all bore identification information are provided in one Table in **Attachment B – Stass Environmental Additional Information**.

**8.** Clarify why the data surveyed to m AHD appears to differ markedly from one part of the report to another part. DER have identified the following inconsistencies:

**8.a. Requested Information:**

RLs (m AHD) shown on bore logs in the *Stass Environmental* report do not appear to be consistent with RLs (m AHD) for the same bores shown in Table 4, Pg. 14 of that same report (even when a nominal 0.6m for the casing riser is taken into account).

**Response by Stass Environmental:**

The inconsistency is due to an error. Bore SE5 had mistyped RLs for bore SE6. SE6 had RLs for SE7 etc. This has been corrected and is included in **Attachment B – Stass Environmental Additional Information**.

**8.b. Requested Information:**

Table 3 on Pg. 11 of the *Stass Environmental* report shows top of casting (ToC) in m AHD for bores WF1 to WF11 which differ considerably from ToC in m AHD provided for bores SE1-SE9 and Pit1– Pit5 in Table 4, Pg.14 or on bore logs in the same report.

**Response by Stass Environmental:**

The Martinick reported the WF bore RLs to a local datum. The *Stass Environmental* report provides RTLs as AHDm levels. Table 3 was adjusted to show local RL survey level as opposed to AHDm level.

**8.c.** Pg. 13 of the *Stass Environmental* report indicates a position and level survey was undertaken by a licensed surveyor, however the plans provided in Appendix E are lacking in information, including but not limited to:

**8.c.i Requested Information:**

No bore identification is provided and as such it is not possible to determine which survey data relates to which bore or whether the plans include survey data for all bores (including all pit bores and deeper bores).

**Response by Stass Environmental:**

The surveyor provided map showing the locations of the monitoring bores. Stass surveyed the monitoring bores with a hand-held GPS instrument to an accuracy of +/- 3m. The monitoring bores from the surveyor could therefore easily be reconciled to the bore identification numbers.

Updated in **Attachment M – Ground Water Assessment, 11 Chitty Road, Toodyay, WA, Version 2.5, Stass Environmental July 2015**.

**8.c.ii Requested Information:**

There is no indication of scale or orientation on the plans.

**Response by Stass Environmental:**

The plans are oriented north to the top of the page.

**8.c.iii Requested Information:**

There is no information on who completed the survey or whether the surveyor is a licensed surveyor.

**Response by Stass Environmental:**

The surveyors licensing and registration documents are now provided in **Attachment B – Stass Environmental Additional Information**.

**8.c.iv Requested Information:**

There is no information on the plans indicating what benchmark was used during the survey, including whether the bores were surveyed to AHD.

**Response by Stass Environmental:**

The bores were surveyed to AHD as requested of the surveyor and reconfirmed verbally.

**8.c.v Requested Information:**

There is no information on the plans to indicate the survey method and the accuracy of the results. Pg. 15 of the *Stass Environmenta*l report indicates that GPS instrumentation was used to survey location (easting and northing) but it is not clear as to what method was used to determine elevation.

**Response by Stass Environmental:**

GPS was also used to determine elevation. Surveyor GPS equipment has an accuracy of +/- 2mm.

**8.c.vi Requested Information:**

As there are no bore identification labels provided on the plans, it is not possible to determine whether the data is consistent with information provided in the remainder of the report.

**Response by Stass Environmental:**

The surveyor was not aware of the monitoring bore labelling Location of the bores on surveyor diagram was translocated to *Stass Environmental* reports - see 8.c.i.

**Additional Request:**

DER requires that detailed survey plans are provided and any inconsistencies in the survey data provided in the application are outlined, clarified and/or rectified, as required. One set of survey data referenced to a common benchmark should be provided and should be consistently applied across the whole application (including but not limited to all data relating to the pit, proposed liner, proposed leachate ponds and groundwater elevation).

**Response by IW Projects:**

A comprehensive survey plan of the site has been developed. This plan shows the site base survey and the relevant benchmarks used during the survey, monitoring bore locations and provides details of the groundwater level, existing ground level and design level of a number of on-site features.

This base survey has been used for the design of the landfill infrastructure and the reporting of all groundwater level data.

**Attachment C – Updated Topographic Site Survey** provides a copy of the site survey plan.

**Hydrogeology: Shallow Groundwater**

**9.** Pg. 10 of the *Stass Environmenta*l report indicates the potential presence of non-continuous shallow perched groundwater '…*although groundwater is present there is no defined aquifer system. The sandy clays are partially saturated and local groundwater levels vary with topography*'. DER has the following queries related to the potential for shallow groundwater to be present:

**9.a. Requested Information:**

Comment on whether down-hole hammer rotary technique would identify discrete groundwater inflows including through fractures within quartz veins.

**Response by Stass Environmental:**

The drilling technique used is common for installation of groundwater monitoring bores in hard ground. Dust return from the bore being drilled was taken as indicator of dry ground, and water strikes were inferred when reduced dust levels were observed.

A number of drilling methods were considered. Auguring is only possible to depths of around 30m from the surface in sands, likely less than that in clays. If hard rock is encountered (like hydrothermal quartz veins which are known to occur in this vicinity) there would be a drilling refusal. Diamond drilling was not a cost effective option and would be unlikely to provide any additional information in this geological terrain (RQDs would be small). This allowed only for compressed air driven drill rigs, all of which use air pressure for cuttings return.

**9.b.** Requested Information:

The Geohydrological Conceptual Model (Figure 7 in the *Stass Environmenta*l report) does not indicate the presence of any shallow groundwater. In June 2014, DER observed that the walls of the quarry were mainly composed of clayey coarse sand (Udden-Wentworth grain size classification) with prominent groundwater seepage faces exposed on walls near the quarry base. Springs were also observed in the base of the quarry, which were discharging groundwater into a pond within the quarry. DER requests clarification on whether the applicant has determined whether there is any local shallow groundwater present and whether the conceptual site model (and landfill development and management specifications) has incorporated this.

**Response by Stass Environmental:**

Over the period of three and a half years of quarterly monitoring of the site, no sidewall or floor of the quarry seepages were ever observed. The only time water was observed entering the quarry was after heavy rain events resulting from surface flow. Areas indicated by DER as having seepage faces were investigated by *Stass Environmental*, *Golder Associates* and *IW Projects*. Our opinion is that surface or ponded water in a deep erosion gully behind the quarry face could on occasion seep into the quarry base, but this aspect is not related to groundwater flow

Furthermore, when the northern water pond was pumped dry, it remained dry for the duration of summer, with no seepage faces of any sort visible over the 5 m deep banks of the ponds. Photos provided in **Attachment B – Stass Environmental Additional Information**.

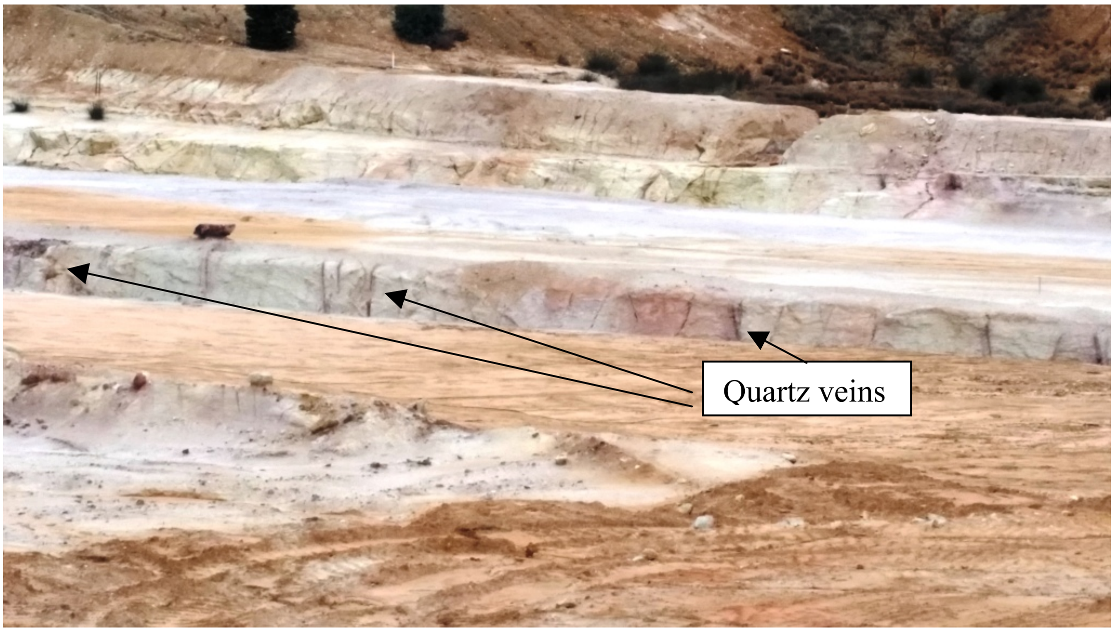
Updated in Appendix L of **Attachment M – Ground Water Assessment, 11 Chitty Road, Toodyay, WA, Version 2.5, Stass Environmental July 2015**.

**9.c. Requested Information:**

Clarify to what depth the shallow material referred to as sandy clay is partially saturated and how the material became saturated.

**Response by Stass Environmental:**

The sandy clay (or clayey sand) at the base of the quarry is locally partially saturated due to regular surface inflows of water into the quarry during winter. The water held by two deep ponds in the quarry (depth of water estimated to some 8 m in places) provides a hydraulic head, which could cause some water flow along fractured quartz zones (see photo below) that occurs in the quarry walls. As such, there will be areas within the quarry floor, which will be partially to fully saturated from surface flows.




**9.d.** The application includes photographs of Williamson's Pit when dry. It is understood that quarry operations previously diverted significant quantities of stormwater into the pit for water supply purposes. The report appears to indicate that water previously observed in the pit is solely due to surface water diversions, with no groundwater component. DER is of the opinion that the information presented does not conclusively demonstrate this.

**9.d.i Requested Information:**

What was the date when the pit was pumped dry?

**Response by IW Project:**

The pumping of the water storage dam commenced on Friday 21 November 2014 and continued for approximately two and a half days until the morning of Monday 24 November. *IW Project*, *Stass Environmental* and *Golder Associates* all visited the site on Tuesday 25 November.

**9.d.ii Requested Information:**

Has there been any form of water inflow back into the pit since the pit was pumped dry?

**Response by Stass Environmental:**

Some surface runoff flowed into the pit during February and March 2015.

**9.d.iii Requested Information:**

Is there any photographic evidence of a continuously dry pit since it was pumped dry?

**Response by Stass Environmental:**

Yes, provided in photos from November 2014 and again in March 2015 presented in Appendix L, within **Attachment M – Ground Water Assessment, 11 Chitty Road, Toodyay, WA, Version 2.5, Stass Environmental July 2015**.

**9.d.iv Requested Information:**

Is there currently water in the pit and is surface water still being directed into the pit?

**Response by Stass Environmental:**

There is some water in the base of the pumped out north pond (it was never pumped dry). Rain water is still diverted into the pit.

**9.d.v Requested Information:**

Clarify whether shallow groundwater is present and update the conceptual site model, if required to account for any uncertainty.

**Response by Stass Environmental:**

The Martinick McNulty report of 1998 referred to this zone as an aquiclude with no shallow groundwater. Our findings concur with the original assessment. The conclusion Martinick (1998) from hydraulic testing of bores was that: *"That is to say, although groundwater is present there is no defined aquifer system. The sandy clays are partially saturated and the local groundwater levels vary with changes in topography."*

*Stass Environmental* tested permeabilities of bores around the pit in July 2015. These tests confirmed previous findings and are provided in **Attachment M – Ground Water Assessment, 11 Chitty Road, Toodyay, WA, Version 2.5, Stass Environmental July 2015**.

**Hydrogeology: Deep Groundwater**

**10.** The *Stass Environmenta*l report indicates that there is a groundwater flow divide in the underlying schist close to or beneath the pit, with groundwater moving in two separate directions away from the pit (west/southwest and north/northeast). The report also indicates that the quality of groundwater differs in each direction. DER requires your response to the following request for clarification:

**10.a. Requested Information:**

DER notes that groundwater divides typically occur within aquifer recharge areas. DER requests clarification as to whether the general location of the pit is considered to be an area of recharge for the underlying aquifer.

**Response by Stass Environmental:**

Our opinion is that only limited rainfall recharge occurs in the area of the quarry because of the low permeability of the underlying soils, which limits infiltration. As noted earlier, the material at the quarry is an aquiclude (or aquitard), which would not be conducive to the transfer of water.

The brow of the hill is considered a groundwater divide and the creeks boundaries to water flow. Groundwater flows regionally through the more permeable quartzites to the East (where groundwater quality is good) and the water quality deteriorates during the passage of water westwards and southwards through the clays.

**10.b. Requested Information:**

Further information and clarification as to why differences in groundwater quality would be due to diverging groundwater flow patterns from a central recharge area.

**Response by Stass Environmental:**

The DER is making an assumption about a "central recharge area affecting groundwater quality". The water located in the quarry is of very good quality and as such could not deteriorate the below surface water quality, rather it would improve it. That is not the case. The groundwater to the south of the quarry is of exceptionally poor quality with reference to TDS and heavy metal content, likely reflecting its deep seated origins within the basement rock. The groundwater to north is of much better quality and may reflect more recent origins of the water. The quarry is criss-crossed by quartz veins, which may further compartmentalize the groundwater regime.

Our opinion is that the poor quality water across most of the site reflects the stagnant conditions of an environment with very little rainfall recharge and low groundwater flow rates and is in line with our assessment of the site. However, there may be localised infiltration of ponded surface water along some higher permeability quartz veins, which could introduce some good quality water through the screens of the monitoring bores.

**10.c.** The title of the groundwater contour plan (Figure 4 in the *Stass Environmenta*l report) is 'highest recorded *groundwater levels, 2011 to 2014, and flow directions'.* DER requires the following:

**10.c.i Requested Information:**

Clarification on the data used to generate the contour plan, including whether data over several monitoring events was used. DER notes that only data from one monitoring event should be used to generate a groundwater contour plan.

**Response by Stass Environmental:**

Data used to generate the contour plan took the highest possible groundwater elevation in each of the monitoring bores over the full period of the study (3.5 years). This was done to provide a conservative scenario in line with the precautionary principle (the highest static water level) for landfill design purposes.

Two other (actual) highest water events have now been selected and included in **Attachment B – Stass Environmental Additional Information**, but these no longer indicate the highest possible groundwater levels.

**10.c.ii Requested Information:**

Provide several contour plans over the 2011 to 2014 period (with one monitoring event per plan), showing any seasonal variations in groundwater flow.

**Response by Stass Environmental:**

These have been generated and are provided in **Attachment B – Stass Environmental Additional Information**, as indicated in 10.c.i.See 10.c.i.

**10.c.iii Requested Information:**

Addition of SWLs specific to each bore (in m AHD), in addition to m AHD at each contour interval.

**Response by Stass Environmental:**

The contour plots have been annotated as requested.

**10.d. Requested Information:**

Figure 4 of the *Stass Environmenta*l report appears to indicate that groundwater flows towards the pit (noting that the data may not be suitable depending on the response to 10 above). DER requires a complete assessment of groundwater flow, including clear conclusions as to whether the site is in an area of groundwater recharge or discharge and how the findings influence the conceptual site model. As part of this, an overall assessment of both regional and local groundwater flow is required, including the potential influence of the pit and drainage channels within the site on local flow directions.

**Response by Stass Environmental:**

The regional groundwater flow direction mimics topography and flows to drainage channels (creeks, brooks etc). The creek to the north west of the quarry flows in the north-westerly direction, as does Jimperding Brook to the south of the quarry. This indicates that the regional groundwater flow directions are likely to be to the south and north-west with the groundwater divide in the area of the quarry. Local groundwater flows may not necessarily mimic the regional groundwater as they may be subjected to variations in lithology and structural geological features, which may cause localised preferential flow directions.

The site is not considered an area of groundwater recharge as little to no infiltration takes place into the underlying the low permeability units (aquiclude/aquitard). The groundwater flow directions in the figures based on the morphology of the potentiometric groundwater surface, does not imply significant groundwater movement.

**10.e.** Pg. 10 of the *Stass Environmenta*l report indicates that water was not encountered in monitoring bores drilled in 1998, with exception of bores located 1km northwest of the pit. The report then indicates that hydraulic testing (falling head tests) was completed at all 11 bores indicating the site is underlain by a low permeability aquiclude or aquitard. DER requires clarification on the following:

**10.e.i Requested Information:**

Explain how falling head tests were completed at all bores when the report indicates the majority was dry.

**Response by Stass Environmental:**

Table 6 of the Martinick McNulty report (1998) shows that water was observed in the monitoring bores. The report says that water was "not encountered during drilling". However, as with the Stass monitoring bores drilled later, there was slow groundwater inflow, which filled the bores over time. However, the monitoring bores were installed below the water table hence falling head permeability test are considered appropriate. Analysis of the responses was completed using the Bower and Rice method. Samples of the geologic materials were also independently tested by geotechnical laboratories, also indicating a low hydraulic conductivity of the sandy clays.

These are further updated by *Stass Environmental* bore testing of July 2015 and included in **Attachment M – Ground Water Assessment, 11 Chitty Road, Toodyay, WA, Version 2.5, Stass Environmental July 2015**.

**10.e.ii Requested Information:**

Confirm which bores were tested and the proximity of those bores to the proposed landfill.

**Response by Stass Environmental:**

10 bores were tested, 5 bores on the perimeter of the quarry and five bores installed in the base of the quarry. All showed low to very low hydraulic conductivities consistent with the material composition.

Perimeter bores WF1 to WF5 and in pit bores WF6, WF7, WF9, WF10 and WF11 were tested in 1998 by Martinick McNulty team.

All bores tested were proximal to the proposed landfill, or immediately below the proposed landfill.

Also see comments above.

**10.e.iii Requested Information:**

Provide supporting data for the hydraulic tests, including methodology, field data, data analysis and assumptions used.

**Response by Stass Environmental:**

Also see comments above.

**10.e.iv Requested Information:**

Indicate how sensitive the hydrogeological conceptual site model is to the results of this hydraulic testing.

**Response by Stass Environmental:**

Martinick McNulty provide the following: *Hydraulic testing of all of the monitoring bores (WF1 to WF10) was undertaken to determine the in-situ hydraulic properties of the sandy clay. Testing comprised injection of a known volume of water into the bore and subsequently monitoring the rate at which the water level declined. Analysis of the response was completed using the Bower and Rice method. Plots of water level versus time included in Appendix C and the results are summarised in Table 6.*

*From the results of the hydraulic testing it is concluded that the sandy clay present in the pit and its vicinity has a low to very low permeability and that the ground water regime in that area is classified as an aquiclude. That is to say, although groundwater is present there is no defined aquifer system. The sandy clays are partially saturated and the local groundwater levels vary with changes in topography.*

The Appendix C of the report has not been made available to *Stass Environmental*. The table referred to as Table 6 is provided in the *Stass Environmental* report as Table 3.

Also see comments above.

**10.f. Requested Information:**

Graphs showing groundwater level fluctuations between 2011 and 2014 are presented on Pages 17 to 19 of the *Stass Environmnetal* report. DER notes that groundwater levels in bores closest to the pit and drainage channels (SE1, SE2, SE5, SE8 and SE9) appear to show a higher response to rainfall than bores further from the pit. This indicates that the aquifer beneath the pit is not solely recharged from distant recharge areas but from rainfall (and/or accumulation of surface water diversions) infiltrating the pit.

This response to rainfall does not appear to be consistent with the hydrogeological conceptual site model presented, which indicates the pit is underlain by a vertically extensive aquiclude or aquitard comprising of 15 to 20m of clay. DER requests clarification on this aspect. DER note that, although the natural permeability of the underlying soils has not been relied upon when designing the liner, the conceptual site model must be an appropriate representation of the investigation data collated for the site to demonstrate that the local hydrogeology is understood and appropriately informs leachate management practices and the risk to groundwater and surface water receptors.

**Response by Stass Environmental:**

The DER conclusion that bores closest to the quarry show higher responses to rainfall are not correct. Bore SE 6 is on the edge of the quarry and shows only a declining water level over the monitoring period, with level variation in the order of 0.2 m over the wet to dry weather cycle. Bore SE 9 is located furthest from the quarry and shows the highest water level response to the wet/dry weather cycle of over 1.1 m. Likewise bore SE 8 shows a similar response.

In our opinion, two factors affect the water levels in the bores

1. localised variation in geology e.g. variation in storage characteristics (specific yield). Materials with a lower specific yield (lower storage capacity) will show a greater groundwater level response; and,
2. Seasonal rainfall accumulation in the quarry, which acts as a hydraulic head influencing groundwater levels in a localized area around the quarry.

**10.g. Requested Information:**

The report does not indicate why salinity levels in SE4, SE8 and SE9 are low or variable compared to other bores and how this information 'fits' the hydrogeological conceptual site model. DER request clarification as to whether this is due to groundwater mixing with water from other sources, such as surface water in drainage channels (e.g. SE8, SE9) and/or in the case of SE4 is representative of groundwater quality up-gradient of the quarry.

**Response by Stass Environmental:**

As discussed earlier, the bores likely intersect discrete and hydraulically disconnected groundwater units and ponded good quality surface water (from the quarry or gully) infiltrated these geological units.

Also see comments above.

**10.h. Requested Information:**

Clarify why all 'pit bores' were monitored on only three occasions and indicate how the pit bore data was used in the assessment of groundwater flow, depth to groundwater beneath the pit and in the assessment of the hydrogeological conceptual site model. Also provide all data including logs and survey data relating to the bores.

**Response by Stass Environmental:**

The pit bores were not accessible during some of the monitoring events, when the quarry was inundated with surface runoff water. Photographs of these situations are provided in **Attachment B – Stass Environmental Additional Information**.

Logs provided as per earlier DER request in **Attachment M – Ground Water Assessment, 11 Chitty Road, Toodyay, WA, Version 2.5, Stass Environmental July 2015**.

**10.i. Requested Information:**

The report indicates that the pit bores are up to 10m deep and groundwater was identified in all. Provide information on the strike elevation in these bores compared to the deeper monitoring bores and whether the strike elevations are consistent across the site and between the pit bore and deeper bores. As part of this, clarify whether the pit bore data indicates any potential for shallower groundwater than that indicated during the drilling of the deeper bores.

**Response by Stass Environmental:**

The pit bores did not indicate water strikes during drilling because of the very low inflow of groundwater - water slowly seeped into these bores. The origin of these waters may be the nearby water storage ponds whose depths are up to 8 m and may provide sufficient hydraulic head to drive water laterally along discrete hydraulically disconnected fractured quartz veins. Intersection of such quartz veins would provide water conduits to the bores.

**10.j. Requested Information:**

Were continuous groundwater level loggers ever installed in any monitoring bores on the site and if so, is this data available for inclusion in the application?

**Response by Stass Environmental:**

No continuous water loggers were installed at the site, as the conclusion that underlying ground indicated an aquiclude and groundwater level loggers will not provide any significant value to the study.

**Groundwater quality data:**

**11. Requested Information:**

Provide an assessment of the validity of the water quality data presented in the application, highlighting any field and laboratory quality assurance and quality control issues.

**Response by Stass Environmental:**

The groundwater quality has been consistent over the three and a half years of quarterly sampling events. As such, neither field nor laboratory QA/QC is considered to be inaccurate.

RPDs are now provided in the report tables contained within **Attachment M – Ground Water Assessment, 11 Chitty Road, Toodyay, WA, Version 2.5, Stass Environmental July 2015**.

**Groundwater velocity calculations and Bioscreen model (Pg. 28 - 30 of *Stass Environmenta*l report):**

**12. Requested Information:**

Clarify the reason why seepage velocity used in the Bioscreen model (31.5m/year) is different to that used in the manual calculation of flow velocity, with 9.5m/year estimated. Also clarify how the velocity in Bioscreen 31.5m/year was calculated, as the inputs shown in the model input page do not generate this value.

**Response by Stass Environmental:**

Manual calculations include the porosity factor for calculation of seepage velocity. Also, Stass have converted Bioscreen to a metric modelling system, so if DER are using the original (ft. etc) model, different outputs will be generated.

**13. Requested Information:**

Clarify why three different hydraulic conductivity estimates are referred to and used as input values (0.08m/d (9.3 x 10-7mm/s), 1 x 10-6mm/s and 1 x 10-7mm/s) on Pg. 29 and on the input page of the Bioscreen model.

**Response by Stass Environmental:**

The Freeze and Cherry literature conductivity value 9.3 x 10-7m/s was rounded to 1 x 10-6m/s in the direct calculations. This value should also have been used in the Bioscreen model (1x10-4cm/s), and was mistyped in the input, which then generated an output error.

**14. Requested Information:**

Dispersion estimates based on plume length are only valid if the plume length is known or estimated through field studies (as Bioscreen is intended for modelling of existing plumes which have been investigated and delineated). Please comment on the validity of the dispersion estimates in the model.

**Response by Stass Environmental:**

Only a "worst case" scenario assumption was assessed for the calculation estimates, as no plumes are present. Other modelling tools do consider plumes but *Stass Environmental* used Bioscreen as the model is the preferred model by the DER.

**15. Requested Information:**

As outlined above the Bioscreen model is intended for predictive modelling of existing plumes of known current extent, as calibration against monitoring data is an integral part of the model. Please comment on the overall suitability of Bioscreen to predict the breakthrough of landfill leachate through a liner and the movement of a leachate plume for a new site.

**Response by Stass Environmental:**

As provided above, Bioscreen was used because it is the preferred DER modelling tool.

**16. Requested Information:**

Provide clear justification for all model inputs and outline all assumptions used.

**Response by Stass Environmental:**

Inputs were based on the two field programs as outlined in the *Stass Environmenta*l report and are provided in the manual calculation section.

A table with input parameters and justification is provided in the **Attachment B – Stass Environmental Additional Information**.

**17. Requested Information:**

Outline the uncertainties in the inputs and outputs of the model.

**Response by Stass Environmental:**

As the modelling was conducted assuming a "worst case condition" and the actual contaminant travel time will be slower. A number of factors would reduce or attenuate the contaminant travel time; (i) attenuation of contaminates during solute transport, (ii) the low overall hydraulic conductivity of the material and the fact that no known hydraulic connection exists between the site and Jimperding Brook.

Literature values were used in this exercise.

**18. Requested Information:**

Comment on why a 50m wide x 2m wide was used as an estimate of the total area of pinholes or tears developing in the liner over time.

**Response by Stass Environmental:**

It is a 50 m wide and 2 m deep zone, 912 m in length. 2 m was chosen as the required saturation zone between the liner and the highest point of ground water table. The 50 m was considered as a worst case scenario and based on previous experience, the preferential flow path along fractures/joint planes etc. would not be expected to be much narrower (5 to 10 m).

**19. Requested Information:**

Explain why the model was run over a 10 year period when waste mass will continue to degrade for many years after that. DER notes that Bioscreen is intended to be run until steady state is achieved and this is usually demonstrated by running the model over 1000 years. DER ran the model for more than 10 years and noted that the contaminant plume was still expanding after 10 years.

**Response by Stass Environmental:**

It is correct to say that the plume will expand. The point of interest was at which time there would be a breakthrough of contamination to the Jimperding Brook under a "worst case scenario". The model was run for 100 years, to provide the breakthrough period. The model provides animation in 20 year time steps, from which it was estimated that the period 80 to 100 years indicated a first impact of contaminant at Jimperding Brook from an initial concentration of 600 mg/l at the landfill.

**20. Requested Information:**

The report states that '*the first 'breakthrough' of contamination to the Brook is possible within 17 years of the landfill developing a leak'*. Please clarify how this was estimated as the report indicates the model was only run for 10 years and the outputs shown are for 10 years. Also clarify whether the applicant considers this timeframe to be acceptable given the fate and transport properties of contaminant types likely to be generated from the waste streams.

**Response by Stass Environmental:**

See above.

The report concluded that:

*This concludes that if in fact there was a direct hydraulic connection between the base of the landfill and the Jimperding Brook, of higher permeability then the surrounding geology (for example a fractured quartz vein or similar structural geological; feature), the time frame for any water quality impact to the Jimperding Brook would be close to a century, providing ample time for corrective action to be taken if required*.

**Final profile of pit:**

**21. Requested Information:**

DER understands that Drawing OV-WA-24 shows the final profile of the pit. Please confirm this is correct. Pg. 21 of the report indicates quarrying has progressed to 'an average depth of 15 m' but does not state the final depth of the pit.

**Response by IW Projects:**

Drawing OV-WA-24 – Landfill Earthworks Layout Plan does not show the final profile of the pit, but the earthworks profile of the base and side walls of the landfill (red lines) after the existing pit has been reshaped to suit the proposed landfill design levels.

The grey contour lines below the red landfill design profile provide the shape of the existing pit.

The lowest point of clay excavation is at RL 272 mAHD (excluding the depth of the water storage ponds within the pit), while the maximum height of the edge of the clay void is at RL 291 mAHD. This gives a maximum height difference of 19 m. The minimum height difference between the quarry base and the top of the lowest side wall is 6 m (which is immediately adjacent to the lowest point).

**22. Requested Information:**

Please indicate whether Drawing OV-WA-24 is based on a survey plan prepared by a licensed surveyor, which includes contours of the final base and walls of the pit prior to construction of the proposed landfill.

**Response by IW Projects:**

The base survey contours (grey contour lines) was done by a licensed surveyor.

**Attachment B – Stass Environmental Additional Information** provides evidence of the surveyor's registration.

**23. Requested Information:**

Pg. 26 of the report states that '*the highest seasonal potentiometric head stabilises within 10m to 20m from the natural ground surface, but is also below the level of excavation within the existing clay pit'*. DER requires clarification (including drawings) on the minimum depth to groundwater beneath the final maximum base of the pit.

**Response by IW Projects:**

The highest groundwater elevation used in the landfill base design is a compilation of the highest measured levels at each bore throughout the period of monitoring (not a single monitoring event).

Three sections have been drawn through the base of the landfill to indicate the height of the highest compilation water table and the underside of the landfill. The shortest distance between the base and the water table potentiometric level is 2.95 m, which is greater than the minimum 2.0 m required, which is again a conservative level.

**Attachment D – Earthworks Sections** provides a copy of the landfill plan with the position of the section lines indicated and then the sections through the landfill showing the position of the water table, the existing ground level and the proposed landfill liner profile, including the depth between the landfill liner and the water table.

**Conceptual Site Model presentation:**

**24.** Provide at least three representative cross sections of the site, showing as minimum:

**24.a. Requested Information:**

The elevation of the base of the pit and drainage channels relative to maximum groundwater elevations / potentiometric surface beneath the site and in the surrounding area (including both pit bores and deeper bores);

**Response by IW Projects:**

**Attachment C – Updated Topographic Site Survey** provides the information on the depth from the existing ground levels to the water table level in each monitoring bore, including the in pit bores.

**Attachment D – Earthworks Sections** provides three sections indicating the base of the existing pit, the base of the proposed landfill liner, the highest recorded water table and the minimum level between the base of the landfill and the water table.

**24.b. Requested Information:**

Monitoring bores;

**Response by Stass Environmental:**

An extra cross section was generated and is provided by *IW Projects*.

**24.c. Requested Information:**

Presence of any shallow / perched water bearing zones indicated on P.10 of the *Stass Environmental* report;

**Response by Stass Environmental:**

No shallow/perched water is present at the site. Page 10 provides detail of historical investigations.

**24.d. Requested Information:**

Groundwater flow directions;

**Response by Stass Environmental:**

Provided earlier in response to queries by DER.

**24.e. Requested Information:**

Aquifer recharge and/or discharge areas, including any in the vicinity of the pit.

**Response by Stass Environmental:**

Provided earlier in response to queries by DER.

**Landfill Design: Sub-base**

**25.** Please provide the following information in relation to the proposed raising of the base of the pit by 3m prior to installing the liner:

**25.a. Requested Information:**

Clarify how raising the base of the pit by 3m achieves the required groundwater separation distance. Provide this information in the context of shallow and deep groundwater level data beneath the pit (including data from pit bores and deeper bores) and the conceptual site model, including illustrations provided in response to item 24.

**Response by IW Projects:**

Based on the worst-case scenario of where the highest recorded water table has been detected, the landfill base was raised to ensure that there was a minimum 2 m attenuation zone between the base of the landfill liner and the highest measured water table. A conservative position was taken to raise the base of the landfill by 3 m, which ultimately provided an attenuation zone of minimum 2.9 m.

**Attachment D – Earthworks Sections** provides three sections indicating the base of the existing pit, the base of the proposed landfill liner, the highest recorded water table and the minimum level between the base of the landfill and the water table.

**25.b. Requested Information:**

Clarify how the in-situ material at the base of the pit became saturated (including any potential for groundwater inflows) and clarify how raising the base by 3m will prevent any such inflows re-saturating the imported material in the future.

**Response by Stass Environmental:**

Responded to earlier. Water inflows were due to surface water runoff and direct rainfall, not groundwater.

**25.c. Requested Information:**

Please confirm the type, source and volume of material needed to raise the base. Include the permeability following compaction.

**Response by IW Projects:**

Based on the landfill base and sidewall design and the configuration of the existing excavation, there is a net requirement for 29,200 $m^3$ of fill material. This material will be sourced from the waste material (unsuitable material for bricks and tile manufacturer) from the existing Austral Bricks clay material excavation, as well as the waste material from the adjacent BGC clay pit.

In discussion the two clay extraction companies, there is a combined current available quantity of waste clay material of approximately 20,000 $m^3$, the majority (approximately 12,000 $m^3$) being the unsuitable material in the vicinity of the small farm dam within the landfill footprint. In addition, there is also an annual production of an estimated 5,000 $m^3$ of this material that will progressively become available. There is also the adjacent Boral clay pit that will also produce a similar type of clay waste material, which will also be used for fill material if available.

The fill material will be needed over the five years of cell construction, with the vast majority being in the last two cells (Cell 5 and 6), so there is ample time to generate the fill material as and when required. There is sufficient fill material currently available for the first four landfill cells.

This material is well suited for engineered fill as it is the elevated salt content or colour that makes it unsuitable for clay products. These elements will not negatively impact the engineering ability of the soil for use as fill. In addition, there will be a full time CQA geotechnical engineer on site during all earthworks to confirm that all fill material is suitable for the intended purpose.

The fill material technical requirements are only based on the material's structural integrity and not its ultimate permeability as the liner leakage rate, as assessed by *Golder Associates*, has excluded the substrate below the synthetic liner; consequently, the liner design is not reliant on any maximum permeability through the substrate.

The landfill cell construction specifications (*Appendix No. 32 - IWP Opal Vale Class II Landfill Cell Specification 21 Dec 14*, from the original application documentation submitted on 23 December 2014) sets out the following:

- Construction Quality Assurance methodology (section 2.2);
- The earthworks inspection requirements (section 2.5.2), including the requirement for the full-time Geotechnical Engineer to approve the suitability of all fill material used in the works;
- The specification for suitable fill material (section 2.5.6.2);
- The specification for unsuitable material (section 2.5.6.3);
- The foundation preparation requirements (section 2.5.7);
- The fill placement and compaction inspection requirements (section 2.5.8.1);
- The placement and compaction standards for the fill material;
- The surface preparation of the compacted fill material (section 2.5.8.3); and,
- The testing requirements of the compacted fill material.

All of these components of the specification deal with the quality of the material, construction methodology and the testing to confirm the suitability thereof.

In addition to the above detail, *Golder Associates,* as the Geotechnical Engineer has reviewed and signed off on the suitability of the earthworks specification as required by the DER landfill development guidelines.

As stated above, there is no technical requirement to achieve a maximum permeability in the compacted fill material; however, based on knowledge of the insitu material, it is anticipated that a permeability of at least 5 x $10^{-8}$ m/s will easily be achieved.

**25.d. Requested Information:**

Stockpiled materials intended to be used to raise the base are likely to be exposed to freshwater run-off. There is a risk that this material could become dispersive and wash into waterways during heavy rainfall events. Please provide information on how this risk will be managed?

**Response by IW Projects:**

Any stockpiles of fill material will only be short-term stockpiles between being either excavated or delivered to site and then being incorporated into the construction works. This stockpiling will typically only be for a few days or a maximum of one week. The vast majority of the fill material will be incorporated directly into the works as it is either excavated from other areas of the void or delivered to site and will not be stockpiled.

If there is a need for short-term stockpiling of fill material, the stockpiles will be located within the clay void immediately adjacent to the works area (to reduce haulage distance); hence, if there is any exposure to fresh-water run-off and associated erosion, there will be no possibility of any fines being washed into the waterways.

**Site water balance, leachate recirculation and management:**

**26. Requested Information:**

It is not clear from the information provided why Opal Vale Pty Ltd (Opal Vale) intend to recirculate 20-40% of the captured leachate back into the waste mass. The information provided in Pg.48/49 on leachate recirculation is indicative of a bioreactor landfill rather than a conventional putrescible landfill, as outlined in the Victorian Best Practice Environmental Management, Siting, Design, Operations and Rehabilitation of Landfills 2014 ('the BPEM'). Section 6.5.2 of the BPEM states '*spraying or otherwise disposing of leachate over any part of the site that has received waste is only to be considered if it forms part of the essential operation of a bioreactor landfill or dust suppression operations'.* DER requires the applicant to clarify whether they intent to operate the proposed landfill as a bioreactor landfill. Please note that, DER is unlikely to approve a bioreactor landfill unless it has been fully assessed in accordance with the BPEM, meets the BPEM requirements for a bioreactor landfill as a minimum and the application includes a comprehensive assessment demonstrating an acceptable level of risk. DER further notes that the application provided does not appear to have assessed the proposed landfill in the context of it operating as a bioreactor landfill.

**Response by IW Projects:**

**Appendix No. 30.1 – IWP Landfill Development Guidelines Comparison Dec 14**, page 23 states: "*The landfill will not be a bioreactor landfill.*"

**Appendix No. 30.1 – IWP Landfill Development Guidelines Comparison Dec 14**, page 19 states: "*The landfill is not a bioreactor landfill; however, leachate evaporation from the waste surface will be an important leachate management technique. The leachate will be applied by water cart (for dust suppression), sprinklers and/or surface hoses. Leachate will only be applied to the exposed waste surface or areas of daily or temporary cover that are contoured such that surface water is contained within the landfill footprint and does not exit the landfill footprint. As the waste mass develops, subsurface leachate injection will be used to manage leachate volumes and also increase the moisture content of the dry waste in the landfill.*"

**Appendix No. 30.1 – IWP Landfill Development Guidelines Comparison Dec 14**, page 23 states: "*Most landfills incorporate some degree of leachate recirculation; however, are not classified as bioreactor landfills and hence are also not "dry tomb" landfills. Leachate recirculation is widely used in WA to manage leachate volumes and wet the dry waste to increase the rate of waste decomposition and landfill stabilisation.*

*There will be a degree of leachate recirculation within the waste mass (primarily for leachate management purposes), but not to the extent that the landfill will be classified as a bioreactor landfill.*"

As additional information:

It is acknowledged that leachate recirculation is not specifically encouraged within the Victorian landfill development guidelines, unless for dust suppression purposes. However, leachate recirculation can be a very effective means for the management of leachate on site as well as having some significant long-term benefits to the overall landfill stabilisation.

The Victorian landfill development guidelines cover the two extremes of landfills, either a “dry tomb” or a “bioreactor” landfill. There is no middle ground between either of these types of landfills. The presumption is not that it is detrimental to landfill development to be somewhere in between, but simply that it is very difficult to document the guideline requirements as each landfill site is different and hence, should be considered on its individual merits. It is also pointed out that the NSW EPA has recently release a draft landfill development guideline (*Draft Environmental Guidelines – Solid Waste Landfills, Second Edition, 2015 – NSW EPA*), which allows for the recirculation of leachate into and onto the waste mass in a controlled manner.

Although leachate recirculation is proposed, the landfill is not defined as a bioreactor as the primary objective of the recirculation activity is to evaporate the leachate from the waste surface and not to wet up the waste mass (which is the primary intent of a bioreactor landfill). Only when the landfill gas production starts to be negatively impacted by the lack of moisture in the waste will recirculation focus on injection into the waste mass. The volume of moisture added to the waste will be significantly less than that which would be added to a bioreactor, where 100% of the leachate is recirculated, primarily into the waste (not onto the waste) as well as substantial quantities of additional water added from external sources.

From a leachate management point of view, the recirculation of leachate onto and into the surface of the landfill is an effective means of permanently consuming volumes of leachate; hence, a desirable mechanism for leachate management on site. This primarily utilises the available surface area of the uncapped waste mass on the landfill to evaporate leachate. With relatively large areas being available, relatively large volumes of leachate can easily be evaporated.

From a landfill benefit point of view, the vast majority of waste anticipated to be coming into the landfill will arrive in a relatively dry state (this is however, not the conservative assumption in the *Golder Associates* leachate modeling – refer later for detail). In the absence of any leachate recirculation, during the long dry summer, this waste is incorporated within the landfill and remains dry. Only in winter, is the incoming waste wet from direct rainfall and is incorporated within the landfill in a relatively moist condition.

Once the active landfill gas extraction system has been installed, the gas being extracted will be high in moisture and hence, the waste mass in the vicinity of the gas wells will gradually dry out. As the waste mass dries out, the biodegradation of organic material within the landfill decreases and hence, the landfill gas production decreases proportionally. The dry areas in the landfill become “dry tomb” areas and the organic degradation within the waste mass is substantially slowed down; consequently, the landfill takes significantly longer to stabilise and become benign.

With targeted leachate recirculation on and within the waste mass, the moisture content will be maintained at a level where biodegradation continues at a reasonable rate to reach a state of stabilisation in approximately 30 years from the closure of the facility (as stated in the Victorian landfill development guidelines).

Based on the above, it can be seen that there is significant benefit in the recirculation of leachate onto and within the waste mass.

The mechanism for recirculation is not to saturate large areas of waste, but to wet the surface of the waste to enable evaporation to remove the vast majority of the leachate. This will be achieved primarily via the use of the water tanker for dust suppression within the landfill footprint. In addition, as the landfill surface expands, surface sprinklers will be used to spray leachate on portions of the uncapped waste mass.

*Golder Associates* has undertaken a leachate modelling and water balance exercise of the proposed development, which has calculated the quantity of leachate likely to be generated on site. This modelling was undertaken in an extremely conservative manner to ensure that the facility design was appropriate for the intended purpose. For the determination of the maximum annual quantity of leachate being generated, this modelling incorporated the following conservative assumptions:

- Leachate generation calculation based on the worst case scenario of two consecutive wet years (as required by the Victorian landfill development guidelines);
- HELP modelling utilising the wettest year on record between 1984 and 2014 (as required by the Victorian landfill development guidelines);
- Assumption that the waste enters the landfill at Field Capacity (This is a very conservative position as the vast majority of the waste will be significantly dryer than Field Capacity. The moisture absorption capacity of the waste will be highly dependant on a number of factors including the type of waste and the local weather conditions. As an example, numerous studies {*Rovers and Farquhar, 1973; Walsh and Kinman, 1979, 1981; Wigh and Brunner, 1981; Fungaroli and Steiner, 1979*} determined that municipal waste can absorb an additional 21 cm of water in a 1m layer of waste. It is pointed out that this assumption was simply used by *Golder Associates* as a conservative position during modelling. In reality, this is not the condition that the waste is anticipated to be in when received on site, where it will be significantly drier than Field Capacity and there is also no proposal to deliberately wet up the waste prior to it being placed in the landfill.);

- Water absorption in the waste is considered negligible. (As described above, there is significant potential for moisture to be absorbed in the waste mass. In reality, there will be a large proportion of the rainfall and recirculated leachate absorbed into the waste mass; hence, reducing the generation of leachate in comparison to the *Golder Associates* modelling.);
- All runoff from the waste slopes enters the leachate system. (In reality, all final capped areas and some intermediate covered areas will shed surface water runoff away from the leachate collection system.);
- A coefficient of runoff of 1. (This results in no soaking of rainfall into the waste surface or covered surfaces. In reality, a significant portion of the rainfall will be absorbed into the waste or covered surface and hence reduce the quantity of leachate being generated.);

For the total quantity of leachate being generated over the life of the landfill, the following assumptions were made:

- 1,600 $m^3$/ha/yr of leachate generation over the full 11 year life of the Stage 1 landfill. (In reality, there will never be 11 consecutive years of the wettest rainfall in recent records; however, this conservative position does ensure that in any one year during the life of the Stage 1 landfill, that the evaporation pond configuration will be able to contain all leachate being generated and maintain the necessary 500 mm freeboard.);
- Leachate being generated at this worst-case scenario over the full area of the landfill waste mass. (In reality, the landfill will be progressively capped and rehabilitated; hence, at any one time, there will only be approximately 2 years of exposed landfill for the generation of leachate. The remaining areas of landfill will have been capped and rehabilitated; hence, significantly reducing the rate and quantity of leachate generation over the life of the landfill. This assumption does not imply that the landfill will not be progressively capped, but is simply another conservative assumption included in the *Golder Associates* modelling. It is confirmed that the landfill will be progressively capped as described in the Landfill Management Plan);
- No progressive capping of any waste, with all capping only occurring after landfill closure. (This assumption has been explained above, including the commitment that there will be progressive capping of the closed landfill areas);
- All recirculated leachate ends up in the leachate sump, with no evaporation or absorption occurring to reduce the volume. (As described above, in reality, there will be significant evaporation from the landfill surface and absorption of rainfall and leachate within the waste mass.);
- No seepage through the liner (this is a less significant, conservative position as there will be some minor leakage through the synthetic liner; however, as calculated by *Golder Associates,* this leakage will be within the allowable limits stipulated in the Victorian landfill development guidelines.); and,

- Pan evaporation conversion factor of 0.75. (This is yet another minor conservative assumption, whereas the Victorian landfill development guidelines recommend a value of 0.8).

Based on the above conservative assumptions, the annual generation of leachate in the worst-case scenario was calculated as being 1,600 $m^3$/ha and this was used to determine the annual leachate generation over the life of the Stage 1 landfill. As can be seen by the above commentary on the relative comparison between the *Golder Associates* assumptions and the anticipated real situation on site, the results of the modelling exercise produce highly conservative results. This is deemed an acceptable practice, as it is preferable to have conservative modelling to ensure that the facility design is adequate to cater for the worst-case scenario; however, these conservative assumptions are not to be taken as the way that the facility will be operated. These are simply conservative assumptions for modelling purposes only.

It is also confirmed that the *Golder Associates* modelling has taken into account the recirculation of 20% of the leachate for the first 7 years of landfilling and then 40% recirculation from years 8 to 11 when calculating the capacity of the leachate ponds. But as discussed above, this recirculated volume simply reports back to the leachate sump and does not reduce in volume through evaporation or absorption.

With regards to the reason as to why values of 20% and 40% leachate recirculation were adopted in the *Golder Associates* modelling, these were seen as easily achievable and conservative values, where in reality, it would be reasonable to anticipate that there would be more leachate that could be recirculated over the landfill surface. In substantiation of the utilised recirculation values, **Table 26.1 – Leachate Irrigation Areas** summarises the areas of the landfill required for the recirculation of the stated quantities of leachate.

**Table 26.1 – Leachate Irrigation Areas**

| Time (Years) | Total Uncapped Landfill Area | Irrigated Landfill Area | % of Total Landfill Area Irrigated |
|---:|---:|---:|---:|
| 1.8 | 12,500 $m^2$ | 1,500 $m^2$ | 12% |
| 4 | 28,000 $m^2$ | 1,500 $m^2$ | 5% |
| 5 | 38,000 $m^2$ | 2,129 $m^2$ | 6% |
| 6.9 | 50,000 $m^2$ | 2,757 $m^2$ | 6% |
| 8.2 | 69,000 $m^2$ | 7,629 $m^2$ | 11% |
| 11 | 88,000 $m^2$ | 9,514 $m^2$ | 11% |

The above calculations have been based on the following assumptions:

- The quantity of annual leachate generated is the worst-case, conservative value that was determined by the *Golder Associate* modelling;
- The water tanker spreads leachate on 100 m of roadway that is 6 m wide and a 30 m x 30 m vehicle turning area. Other exposed areas of the landfill are irrigated using small (5 m radius sprinklers);
- A 0.8 conversion factor used from pan evaporation to large surface evaporation;
- Recirculation only to occur from October to April each year, even though there is net evaporation on site during May and September;
- Only 50% of the irrigated surface gets sprayed; hence, effective evaporation is reduced by a further 50%;
- The irrigation area is the landfill plan area and not the larger waste surface area, which in reality could be some 15% to 20% greater than the plan area; and,
- Only sufficient leachate is irrigated that will evaporate from the landfill surface each day. In reality, there will be more leachate irrigated over the area and some will percolate into the waste and be absorbed into the dry waste or eventually report to the leachate sump. The *Golder Associates*' modelling has presumed that there is no evaporation and that all leachate eventually reports to the leachate sump.

As can be seen from the above table, in order to recirculate 20% (year 1 to 7) to 40% (year 8 to 11) of the leachate and evaporate all of the recirculated leachate, there is a need to irrigate between 5% and 12% of the landfill waste mass area, which includes the landfill internal access roads. Hence, the assumption of 20% to 40% recirculation is conservative and deemed easily achievable.

In reality, there will be significantly less leachate generated in comparison with the *Golder Associates* conservative modelling; hence, if the above surface area were irrigated, a far larger percentage of the actual leachate volume generated will be evaporated from the waste surface.

With regards to the staged capping of the landfill and the modelling undertaken by *Golder Associates*, as stated above, the modelling of the annual leachate generation volumes was carried out based on the assumption that the full area of the landfill was exposed and would generate leachate for 11 consecutive years and the modelling under these extremely conservative conditions still demonstrated that the evaporation ponds where adequate to cater for the forecast leachate volumes. In reality, there will only be approximately 2 years of landfill area exposed at any one time and the remaining areas will be capped and rehabilitated progressively; hence, less leachate will be generated than modelled by *Golder Associates*.

The calculation of the irrigation area used the same assumption that the complete area of the landfill was uncapped. In reality, there will be far less leachate generated than determined in the conservative modelling and hence, 20% to 40% of this lower leachate generation value will be all that will be required to be irrigated; hence, there will be a proportionally smaller area required for irrigation.

The recirculation of leachate onto the waste surface will increase the level of odour on the landfill; however, this increase is seen as relatively minor in comparison to the overall activities of the facility. The impact and odour risk of this proposed activity has been included in the odour management assessment within the Landfill Management Plan.

Potential impacts and risks associated with leachate recirculation:

- Side slope seeps – this is when excessive leachate seeps from the side of the landfill. This only becomes an issue when the landfill waste placement progresses above the height of the landfill side slope liner. In this situation, the slope of the landfill final profile is relatively gradual at a maximum slope of 1 vertical in 5 horizontal. This relatively gradual slope will not be prone to excessive leachate seeps; however, there is the possibility that seeps may occur. To prevent the occurrence of seeps, the landfill will be progressively developed vertically in lifts. These lifts will be developed with a slight slope into the landfill so that any perched leachate flows into the landfill and not out of the landfill. In addition, if there are any access roads that are located on the edge of the landfill final profile, the road material will be removed prior to the waste profile being completed. This will reduce the local accumulation of perched leachate on the edge of the final profile. All of these measures are deemed temporary while the final waste profile is being finished off. Once the landfill capping system is installed, there will be a gas drainage layer below the landfill cap that will intercept any continuing leachate seeps and the synthetic lining system on top of the gas collection layer to prevent the emergence of any leachate seep onto into the landfill capping material above the synthetic liner. This will effectively eliminate any long-term possible impact from leachate seeps.
- Accelerated clogging of the leachate drainage system – as described above, the recirculation of leachate is primarily to evaporate leachate and not to saturate the waste mass. When leachate is injected into the landfill, this will be focused in areas where the waste mass has dried out due to the extraction of moist landfill gas and the gas production has tapered off. Consequently, there is unlikely to be much recirculated leachate eventually reporting to the leachate sump; hence, this activity will not add significantly to the volume of leachate flowing through the leachate collection pipe work and hence, not accelerate the clogging of the leachate collection system.

- Clogging of the landfill gas extraction system – The reinjection of leachate into the landfill will be focused to wet up the waste in the vicinity of the gas wells where the gas extraction has dried out the waste mass. The intention is not to saturate the waste mass (as this will have a negative impact on gas production), but to inject leachate for a short period and then let the waste absorb the leachate, with this process being repeated over time to optimise the moisture absorption within the waste. All leachate recirculation will be done in conjunction with the landfill gas contractor to ensure that there is no negative impact on the landfill gas system and that the appropriate areas of the waste mass receive the necessary leachate.
- Stability within the waste mass – Again, the recirculation will not add significantly to the moisture content within the waste mass. In addition, *Golder Associates* modelled the stability of the waste mass with all waste being at Field Capacity, which is a worst-case scenario that will not be representative of the actual situation within the landfill; hence, the minor quantity of leachate from recirculation that does infiltrate the waste mass will have no negative impact on the stability of the landfill.
- Wind drift of aerated leachate – Leachate irrigation will only occur in areas where the wind will not blow the leachate onto the active areas. Fine mist sprays will not be used on the landfill surface, as these tend to result in aerated leahate blowing around the waste surface. The spray nozzles also tend to clog up more than the larger aperture spray nozzles.

With regards to contingencies in the event that leachate recirculation must be ceased at any time, it is pointed out that the *Golder Associates* modelling did not take into account any evaporation from the surface of the landfill and that all leachate recirculated eventually reports to the leachate sump. However, in reality, leachate will only be recirculated if there is an ability to evaporate significant quantities of leachate from the surface of the landfill. Hence, the only time that recirculation will be suspended would be if there was rain around and there was no net evaporation, which has been accommodated in the anticipated duration when recirculation is proposed. Based on the *Golder Associate* modelling, even in these circumstances leachate could be recirculated as evaporation was not a factor that was considered.

The calculation for the quantity of leachate being recirculated only relied on irrigation for seven months of the year, only over a small portion of the landfill area, only 50% of that area being effectively sprayed and only recirculating 20% to 40% of the generated leachate. Consequently, there is significant opportunity to catch up on leachate recirculation if there is a period when leachate is unable to be recirculated. This aspect of leachate management has again been covered in the response under section 27c below.

**27.** The water balance appears to be heavily reliant on leachate recirculation, with an assumption that between 20% and 40% of leachate will be recirculated per year for the operational lifetime of the landfill. DER requires clarification on the following:

**27.a. Requested Information:**

How will 40% recirculation towards the end of the landfill life impact on the requirement for leachate management post-closure?

**Response by IW Projects:**

Section 16.13.4 – Leachate Ponds of the *IW Projects* report, page 49, states "*A space allocation has been made for up to six leachate ponds to cater for possible future leachate quantities, including Stage 2 landfill development. Initially only two leachate ponds will be constructed, with the other leachate ponds being constructed as and when required*."

On full closure of the landfill, there will no longer be the opportunity to recirculate leachate onto the landfill surface as it would have all been capped; however, there will also be the reciprocal consequence of reduced leachate generation due to the full surface of the landfill having been capped.

Once the full landfill area has been capped, it is anticipated that the quantity of leachate being generated will gradually decline; however, there will still be the full complement of leachate ponds that were progressively constructed during the operational life of the active landfill. Consequently, there will be adequate leachate management options available without relying on the need for recirculation of leachate onto the waste mass. There will however still be recirculation of leachate into gas wells and also into dedicated subsurface leachate injection wells.

**27.b. Requested Information:**

Outline the reasons and justification for the reliance on leachate recirculation.

**Response by IW Projects:**

As mentioned above, this is an accepted and highly efficient practice in the WA landfill industry and has been condoned by the DER since the development of lined landfills in WA.

The Opal Vale proposal is simply being consistent with DER accepted practice for lined landfills.

**27.c. Requested Information:**

Outline any circumstances when leachate recirculation to the extent indicated will not be possible and indicate how leachate will be management during those times.

**Response by IW Projects:**

Section 16.13.2 – Leachate Generation of the *IW Projects* report, page 48, states: "*This modelling has determined that two evaporation ponds are adequate for the management of anticipated leachate volumes for the first four years and in the fifth year a third leachate pond will be required. This assessment is based on 25% of the generated leachate being recirculated onto or within the landfill waste mass. This is a conservative assumption and should easily be able to be achieved.*"

During winter months when rainfall results in the surface of the landfill being unable to effectively receive leachate recirculation onto the waste surface, this activity will be suspended. There will however still be the opportunity for recirculation within the waste mass; hence, not all leachate recirculation needs to be suspended.

The modelling of leachate generation quantities undertaken by *Golder Associates* has taken into account the reduced ability to recirculate leachate during the winter months and has concluded that two leachate ponds are adequate for the first four years of operation, with a third pond being required in the fifth year.

Section 16.13.3 – Leachate Management Options of the *IW Projects* report, page 49, states: "*Leachate management options to be utilised on site, in the order of priority, include the following:*

- *Evaporation from the surface of the leachate ponds – ongoing without any operator effort;*
- *Leachate recirculation onto the waste surface using drip irrigation and/or low pressure sprays (large nozzle diameters to prevent them blocking up) – active landfill areas and temporary capped areas draining into the landfill footprint;*
- *Leachate recirculation into the waste mass – via injection wells and drains installed into the waste mass. The landfill gas wells can also be used for this purpose;*
- *Use of a water cart to spray leachate onto the internal landfill roads (only over the lined landfill area);*
- *Micro-sprays over the leachate pond surface or on the landfill surface (nozzle blockage is a concern with this method) – wind direction is also important, as the spray drift needs to remain on the lined surface;*
- *Accumulation in the leachate ponds (typically over winter);*
- *If needed, large volumes of leachate can be pumped directly onto the incoming waste as it is being placed and compacted in the landfill. The dry incoming waste (even in winter) absorbs a significant volume of leachate and the waste placement activities mix the moisture evenly through the waste.*
- *In the case of an emergency, leachate can be trucked off site to the water Corporation or to a composting facility.*

*The evaporation and recirculation activities are far more efficient during summer; however, during winter, with a concerted effort during favourable weather conditions, reasonable leachate volumes can be "consumed" by these methods.*"

As can be seen from the above, there are numerous other leachate management options available if recirculation onto the waste mass is not possible for short periods.

Section 16.13.8 – Leachate Contingency Planning of the *IW Projects* report, page 52, states: "*Being a critical aspect of landfill management, should the ongoing monitoring of leachate on site indicate that there is a net accumulation of leachate over time, the following contingency actions can be implemented:*

- *Employ an additional staff member to concentrate solely on leachate management activities (increased treatment effort);*
- *Apply thicker intermediate cover over temporary closed areas to increase the retention of rainwater within the soil and hence, reduce leachate generation;*
- *Bring forward the timing of subsequent leachate pond construction;*
- *Last resort, tanker excess leachate off-site.*

*From a day-to-day operational consideration, spare pumps, pipe lines and fittings will be kept on site so that in the event of a system breakdown, there are readily available items of equipment to ensure continuity of leachate management.*"

Hence, there are also contingency plans in place should the normal leachate management mechanisms not prove adequate.

**27.d. Requested Information:**

The *Golder Associates* report in Appendix 5 indicates that additional ponds may be constructed to assist in leachate management. It is not clear to DER whether some or all recommendations in this report and other reports included in the Appendices are to be adopted.

**Response by IW Projects:**

All of the *Golder Associates* recommendations and the recommendations of the other reports have been adopted.

With regards to the requirement for additional leachate ponds, the proposal includes the initial construction of two ponds, with a third pond anticipated to be required in year 5, which is the duration of the anticipated Works Approval. The documentation (section 16.13.4) does however mention that there has been space allocated for up to six leachate ponds to cater for future cell development beyond the validity period of the current Works Approval.

The *Golder Associates* report recommends a maximum of four leachate ponds within the first 11 years of landfill operations. Even this recommendation is less that what has been considered for the proposed development.

**27.e. Requested Information:**

The values for evaporation rate and mean annual rainfall appear to be incorrect in Section 16.13.5 on Pg. 50. Please confirm the calculated required leachate pond volumes.

**Response by IW Projects:**

The values for evaporation and rainfall have been accidentally transposed.

This section should read:

- Median annual rainfall = 427.6 mm;
- Median annual evaporation = 2,054.8 mm;

**27.f. Requested Information:**

There is no clear contingency planning and risk management should the leachate collection system fail. DER requires this information.

**Response by IW Projects:**

Failure of the leachate collection system could be caused by the following:

- Reduced leachate flow within the leachate aggregate;
- Reduced leachate flow within the leachate collection pipes;
- Reduced access through the leachate extraction pipes;
- Breakdown of the leachate extraction pump.

Appendix No. 30.1 – IWP Landfill Development Guidelines Comparison Dec 14, page 13 states: "*The leachate collection system has been designed to include all of the required components:*

- *The leachate extraction pumps and pipework are adequately sized to extract leachate at a rate of at least double the predicted rate of generation (as predicted by Golder Associate modelling).*
- *The leachate ponds are adequately sized to be able to cater for the predicted leachate volumes (as predicted by Golder Associate modelling).*
- *The leachate aggregate to be used in the leachate drainage layer is good quality, virgin bluemetal. This provides the ideal material to ensure longevity on the drainage layer and minimising the chance of crushing, breakdown or clogging.*
- *The leachate extraction pipework has been designed with a central core that is 200 mm in diameter, which enables a camera to be inserted down the pipe for inspection purposes and also allows pipe-cleaning equipment to be installed. The access point to the leachate pipe is mounted at the leachate extraction point and hence is always accessible.*"

There is little that can be done to retrospectively repair any reduced flow rate within the leachate collection aggregate; hence, the good quality of the original aggregate material used (this is the most expensive component of the landfill lining system) to ensure that there is minimal chance of failure in this component of the works. In addition, the geotextile separation layer placed on top of the aggregate layer reduces the movement of fines down into the aggregate layer, which could eventually clog up the aggregate. If there were to be a failure in the leachate aggregate, it would only be a localised failure (clogging) and any accumulated leachate within this area would simply flow around the failed portion of aggregate and progress under gravity into the leachate extraction sump.

If there is a problem with the leachate collection pipes, as stated above, they can be inspected and if necessary cleaned out to improve the pipe flow capacity.

As can be seen in the facility design drawings (OV-WA-28; OV-WA-29 and OV-WA-30), the leachate sump for Cells 1 to 4 has three leachate extraction pipes. One active pipe and two standby pipes. Either of these two standby pipes can be used for leachate extraction purposes in the event that the active pipe is crushed and accessibility is reduced. The leachate sump to Cells 5 and 6 has an active extraction pipe and a standby pipe.

If the leachate extraction pump breaks down, it can simply be removed and replaced with a new pump.

Ultimately, the initial leachate extraction system has been designed based on best practice industry standards to achieve an extraction system that is highly unlikely to fail; however, should a component of the system fail, there are contingency measures in place to enable the leachate extraction system to be repaired to improve its overall performance.

Additional information on this subject has been provided in the Landfill Management Plan

**28. Requested Information:**

Why has a leakage detection system not been considered as part of this application?

**Response by IW Projects:**

Based on the Victorian landfill development guidelines, a landfill liner leak detection system is not a requirement for a Class II putrescible landfill site. Leak detection systems are typically only associated with Class IV landfills. In addition, the following aspects of the proposed development result in a leak detection system not being necessary:

- The incoming waste only being Class II material;
- The lining system adequately complies with the minimum leakage rate allowed with in the Victorian landfill development guidelines;
- The leachate water balance calculations clearly demonstrate that the leachate level within the leachate sump can be maintained at the maximum 300 mm depth and that the leachate ponds are able to accommodate the forecast (highly conservative) leachate generation volumes;
- The insitu soil below the landfill has a natural low permeability; and,
- No adjacent sensitive receptors surrounding the landfill.

**29.** **Requested Information:**

The management of leachate (including in the leachate pond) must be further discussed and detail the associated environmental risks (including odour) and actions/contingencies to be implemented.

**Response by IW Projects:**

**Attachment E – Landfill Management Plan** provides additional information on this aspect of the operations.

**Surface Water**

**30.** DER understands that surface water runoff was previously directed into the pit. The application indicated that the proposed landfill is designed so that stormwater drainage will circumvent the pit and be directed to a stormwater pond. Please provide further information on the following:

**30.a.** **Requested Information:**

Outline how drain erosion and sediment transport will be managed as part of the application.

**Response by IW Projects:**

As part of water harvesting for the clay extraction operation and the farming activities, water was previously diverted into the clay void from adjacent farmlands to the southeast. This was achieved by installing a stormwater cut-off diversion drain that is approximately 0.5 m to 1 m deep, 2 m wide and 330 m long. This diversion drain effectively cuts off and diverts the adjacent valley into the clay void, hence, significantly increasing the area of surface water catchment.

As part of the landfill development, this diversion trench will be filled in and the surface water will once again be allowed to flow down the adjacent valley, to the west, away from the landfill and into two farm dams. This will allow the surface water to follow its original, natural watercourse.

Section 16.3 – Surface Water Management of the *IW Projects* report, page 37, states: "*The site is located on the crest of a hill and does not intersect any drainage lines and receives no upstream run-off water; consequently, there is no major work associated with the diversion of surface water away from the landfill development.*" Consequently, there will only be minor flow of surface water that is generated from the immediate surrounds around the landfill. This surface water will be diverted into shallow (1 m deep) perimeter drains around the landfill and from there, into either the creek line to the north of the landfill or the natural valley line to the southwest of the landfill.

The northern creek line, which will receive the surface water generated from the northern portion of the landfill, will have the newly constructed surface water storage dam, which will capture all of the surface water runoff and allow for the settlement of sediment load. The southern valley has two farm dams, which again capture the surface water and allow for the settlement of the sediment load.

There is significantly more, similar information in section 16.3 – Surface Water Management of the *IW Projects* report.

Due to the minimal flow anticipated around the landfill, and the fact that all surface water will be flowing into storage dams and subsequently being consumed by the landfill operations or stock watering, there is an extremely low chance of surface water discharge from the dams and in addition, the dams act as large sediment ponds to remove the vast majority of the sediment.

**30.b. Requested Information:**

Clarify why surface water captured in the stormwater pond needs to be released and discharged to the drainage channel.

**Response by IW Projects:**

There will be no discharge of any collected stormwater from the clay void.

This is a change from the position stated in the original application documentation. This is a more conservative approach and eliminates any concerns tat the DER has with the quality of any surface water discharge that was associated with the original position.

This change in position will not negatively impact the operation of the landfill or adjacent clay extraction, as the operations require water for dust suppression and other related activities and in all likelihood will consume all water that is collected within the clay void.

**30.c.** The conclusion in section 23.6 of the application documentation does not support the statement that there is no environmental risk of discharging stormwater to the creek line. Provide further detail and justification for this statement including:

**30.c.i Requested Information:**

The reasons why stormwater is to be discharged to the drainage channel rather than captured and used on-site.

**Response by IW Projects:**

There will be no discharge of any collected stormwater from the clay void.

**30.c.ii Requested Information:**

Whether the stormwater will potentially contain elevated suspected or dissolved solids or contaminants which may impact the drainage channel or any surface watercourses to which that channel discharges.

**Response by IW Projects:**

There will be no discharge of any collected stormwater from the clay void.

**30.c.iii Requested Information:**

Further detail on the sampling regime, methods and potential impacts is required.

**Response by IW Projects:**

There will be no discharge of any collected stormwater from the clay void.

**Stability assessment:**

**31. Requested Information:**

DER notes the application includes three separate stability reports and associated engineering designs. Please remove any information that is not relevant to this application. DER requires one stability report only to be submitted. As DER is unclear on which stability assessment is submitted as part of this application, we have suspended our review of these aspects pending clarification and receipt of one holistic report. DER may require further clarification once this has been received.

**Response by IW Projects:**

This response was provided to the DER in a letter from *IW Projects*, dated 30 March 2015. For completeness, the response is hereby repeated:

The three stability reports cover the history of the stability assessments undertaken for the proposed development. The first being the initial assessment undertaken by *CMW Geosciences* in August 2012, which concluded that the proposed design was stable from a geotechnical point of view.

As part of the State Administration Tribunal (SAT), the proponent was required to undertake a further stability assessment based on agreed Australian Standards (*AS4678-2002 and AS1170.4-2007*). Consequently, the February 2013 *CMW Geosciences* report was produced, which again demonstrated that the proposed design was stable from a geotechnical point of view.

Following the receipt of the DER comments on the previous Works Approval application (*DER letter dated 20 October 2014*) there was a requirement to provide additional information that was not covered in the original two reports. Hence, the third report was compiled (*Golder Associates*), which again confirmed that the proposed design was stable.

All three reports were included in the Works Approval as the first two were linked to SAT approval conditions (of which it was presumed that the DER would need to know that these particular technical conditions were complied with) and the third report was included as this was the latest report covering all of the necessary stability assessments pertaining to the proposed development.

From a technical assessment point of view, only the third (*Golder Associates*) report is the document that the DER needs to consider.

**Landfill gas:**

**32.** DER understands that the generation of landfill gas is likely to take a number of years before significant levels accumulate. However the landfill design must consider how future gas generation and migration will be managed, ensuring appropriate infrastructure and pipe work as part of the initial design. Provide the following information to allow DER to continue the assessment:

**32.a. Requested Information:**

A landfill gas assessment should include, predictions of landfill gas volumes generated, possible landfill gas migration pathways, proximity to areas where gas could accumulate (e.g. enclosed buildings and structures), proximity and risk to sensitive receptors, details and timing of monitoring to ensure any impacts are identified at the earliest opportunity, together with an outline of possible mitigation measures in the event a potential or known impact is identified. As part of this consider how recirculation or any other form of adding moisture to the waste will accelerate gas generation and subsidence.

**Response by IW Projects:**

Predictions of landfill gas volumes:

Section 16.14.1 – Landfill Gas Quantity and Treatment of the *IW Projects* report, page 53, states: "*To determine the potential landfill gas management requirements and the likelihood of any off-site impacts, it is necessary to estimate the quantity of landfill gas that may be generated within the landfill.*

*The quantity of landfill gas has been calculated using the Intergovernmental Panel on Climate Change 2006 IPCC Guidelines for National Greenhouse Gas Inventories model. The inputs into the model include:*

- *Landfill capacity – 1.5 M* $m^3$*;*
- *Annual waste input quantity – 150,000 tonnes. It is noted that the model is not able to manage a "ramp up" of annual waste quantity; hence, the worst case scenario has been adopted;*
- *Landfill closure year – 2025;*
- *Gas capture percentage – 75%. This is the accepted industry norm;*
- *Methane oxidation factor through the landfill cap – 0.025. Based on 10% oxidation of the 25% landfill gas that is not extracted by the active extraction system (refer to the 75% gas capture percentage above); and,*
- *Waste composition – MSW= 30%, C&I = 60% and C&D = 10%.*

***Table 16.14.1.1 – Landfill Gas Quantities*** *provide the IPCC model outputs based on the above inputs. The quantities of gas generated are for methane ($CH_4$).*

***Table 16.14.1.1 – Landfill Gas Quantities***

| Year | CH4 Tonnes | $CH_4$ Volume $m^3$) | $m^3$/hr | Generation Potential (MW) |
|---|---|---|---|---|
| **Landfill commences operation in late 2015** | | | | |
| 2015 | | | | |
| 2016 | | | | |
| 2017 | | | | |
| 2018 | 458 | 681691 | 77.8 | |
| 2019 | 895 | 1331263 | 152.0 | |
| 2020 | 1311 | 1950267 | 222.6 | |
| 2021 | 1707 | 2540173 | 290.0 | |
| 2022 | 2085 | 3102383 | 354.2 | 1 |
| 2023 | 2445 | 3638228 | 415.3 | 1 |
| 2024 | 2788 | 4148978 | 473.6 | 1 |
| 2025 | 3115 | 4635835 | 529.2 | 1 |
| **Landfill ceases operation sometime in 2025** | | | | |
| 2026 | 3427 | 5099948 | 582.2 | 1 |
| 2027 | 3724 | 5542408 | 632.7 | 1 |
| 2028 | 3550 | 5282561 | 603.0 | 1 |
| 2029 | 3384 | 5035203 | 574.8 | 1 |
| 2030 | 3225 | 4799725 | 547.9 | 1 |
| 2031 | 3075 | 4575548 | 522.3 | 1 |
| 2032 | 2931 | 4362121 | 498.0 | 1 |
| 2033 | 2795 | 4158922 | 474.8 | 1 |
| 2034 | 2665 | 3965453 | 452.7 | 1 |
| 2035 | 2541 | 3781239 | 431.6 | 1 |
| 2036 | 2423 | 3605833 | 411.6 | 1 |
| 2037 | 2311 | 3438805 | 392.6 | 1 |
| 2038 | 2204 | 3279749 | 374.4 | 1 |
| 2039 | 2102 | 3128277 | 357.1 | 1 |
| 2040 | 2005 | 2984023 | 340.6 | 1 |
| 2041 | 1913 | 2846637 | 325.0 | 1 |
| 2042 | 1825 | 2715784 | 310.0 | |
| 2043 | 1741 | 2591150 | 295.8 | |
| 2044 | 1661 | 2472433 | 282.2 | |
| 2045 | 1585 | 2359348 | 269.3 | |
| 2046 | 1513 | 2251621 | 257.0 | |
| 2047 | 1444 | 2148994 | 245.3 | |
| 2048 | 1378 | 2051221 | 234.2 | |
| 2049 | 1316 | 1958068 | 223.5 | |
| 2050 | 1256 | 1869311 | 213.4 | |
| 2051 | 1199 | 1784739 | 203.7 | |
| 2052 | 1145 | 1704151 | 194.5 | |
| 2053 | 1094 | 1627355 | 185.8 | |
| 2054 | 1044 | 1554168 | 177.4 | |
| 2055 | 998 | 1484417 | 169.5 | |
| 2056 | 953 | 1417937 | 161.9 | |
| 2057 | 910 | 1354570 | 154.6 | |
| 2058 | 870 | 1294168 | 147.7 | |
| 2059 | 831 | 1236589 | 141.2 | |
| 2060 | 794 | 1181697 | 134.9 | |

*As can be seen from the above table, predicted methane gas generation peaks at 632.7 m$^3$/hr 12 years after commencement, which is two years after Stage 1 operations have ceased. Maximum potential power generation is 1 MW, for approximately 20 years (2022 to 2041).*"

It is unsure what additional information is required in this regard as the above provides extensive information on landfill gas volume predictions. This modelling guidance was provided by a specialist landfill gas contractor that manages the gas extraction from two of the largest landfill is WA and this is the modelling that they use to design their gas infrastructure requirements.

The IPCC model was used to forecast landfill gas generation quantities as it is deemed as an acceptable model, as it is used by the landfill gas industry and also the Federal Government. It is pointed out that the IPCC model is ultimately designed to calculate landfill gas emissions from landfills. However, in order to calculate these emissions, it has a comprehensive calculation component dedicated to assess the quantity of landfill gas generated within a landfill waste mass. It is this component of the IPCC model that was used to generate the above annual landfill gas quantities. The model was not used to calculate the landfill gas emissions from the landfill or any related odour impacts as this model is a general model applicable to a wide range of landfill types and seriously over predicts the quantity of landfill gas being emitted from a comprehensively lined and capped landfill. Hence, only the applicable component of the model (gas generation quantities) was utilised for this application.

With regards to any limitations associated with the IPCC model, to the extent that it was used for this application, being landfill gas generation quantities, the only issue that has been identified is that the model does not allow for a ramp up of annual waste tonnage for a new landfill facility. It simply presumes that the landfill will be receiving the same annual tonnage throughout the full period of operation, which is not likely to be the case for the Opal Vale landfill, where it is anticipated that the annual waste tonnage will gradually ramp up over the first few years of the facility operations. This is not a significant limitation, as the impact of the model inflexibility simply predicts the landfill gas production to occur slightly earlier that would be the case in reality. Within the context of in excess of 40 yeas of landfill gas production, a year or two either way is deemed insignificant.

Overall, it is felt that if the Federal Government has confidence to use the IPCC model to, amongst other things, predict the quantity of landfill gas anticipated to be generated in a waste mass, and use this output in a multi-billion dollar, national carbon trading scheme, that this model should be suitable for the similar purposes at the Opal Vale landfill development.

Possible landfill gas migration pathways:

Section 16.14.3 – Landfill Gas Risk Assessment of the *IW Projects* report, page 57, goes into detail about the condition of the surrounding soil types, the location of the nearest neighboring structure, the proximity of the adjacent farmhouse, the fact that the landfill is lined and capped with synthetic materials and that the farmhouse is 400 m away and aboveground with no belowground service.

All of these above factors result in an extremely low risk of any landfill gas migration to this receptor and that there are no identifiable gas migration pathways.

Proximity to areas where gas could accumulate:

Without there being any identifiable gas migration pathways, there are no areas that have been identified where gas could accumulate outside of the landfill.

Proximity and risk to sensitive receptors:

Section 16.14.3 – Landfill Gas Risk Assessment of the *IW Projects* report, page 57, covers the proximity and risk to the nearest neighboring receptor (1.35 km across a relatively steep valley line – no risk) and the proximity and risk to the adjacent farmhouse (400 m away, no risk of subterranean gas migration impact, minor odour impact).

Details and timing of monitoring to ensure any impacts are identified at the earliest opportunity, together with an outline of possible mitigation measures in the event a potential or known impact is identified:

Section 16.14.4 – Landfill Gas Monitoring of the *IW Projects* report, page 59, states: "*The DER landfill development guidelines cover the need for monitoring landfill gas emissions, primarily via belowground monitoring bores. Monitoring bores in uniform low permeability soils with no development within 150 m have a minimum gas bore spacing of 10 m and a maximum of 50 m. With no development within 250 m the spacing has changes to a minimum spacing of 50 m and a maximum of 150 m. Hence, for a 100 m change in the position of the development (from 150 m to 250 m), the maximum bore spacing have been pushed out by 300%. Consequently, with a single, aboveground farmhouse 400 m from the landfill, it is not deemed necessary to install gas monitoring bores (the guideline does not deal with development beyond 250 m from the landfill).*"

In addition, section 16.14.3 – Landfill Gas Risk Assessment provides further information on the potential impact on the farmhouse.

The above concludes that there is no need for monitoring of landfill gas between the landfill and the farmhouse; consequently, there is no consideration of timing of monitoring.

How recirculation or any other form of adding moisture to the waste will accelerate gas generation and subsidence:

In the correct environmental conditions, increased moisture content will increase the rate of landfill gas generation.

With an active landfill gas extraction system, the moisture in the waste mass in the vicinity of the gas wells is progressively dried out as the moist gas is extracted (removing the moisture from the surrounding waste). Over time, the moisture content of the waste mass decreases substantially; consequently, resulting in decreased production of landfill gas even though there is available organic material that is readily able to decay; however, due to the “dry tomb” nature of the waste material, the gas production process is dramatically slowed down. To counteract this, landfill gas operators inject moisture (leachate and/or gas condensate) into the gas extraction wells to maintain the waste mass moisture content so as to encourage the continuous production of landfill gas. This is a common practice around the world.

As mentioned previously, the Perth coastal area (where the major metropolitan landfills are located) receives approximately 760 mm of rain per year, whilst the Opal Vale site receives 427.6 mm. This is some 330 mm less that the metropolitan landfills; consequently, the waste mass in the Opal Vale facility will be proportionally drier that the metropolitan landfills; consequently, would produce landfill gas at a slower rate.

The rate of landfill gas production is also highly dependent on the available organic fraction (putrescible material) in the waste stream. The lower the organic fraction, the lower the rate of gas production. The majority of the incoming waste will come from the Resource Recovery Solutions recycling and transfer station located in Bayswater (an affiliated company). A large portion of this waste will be residual waste from the facility’s recycling operations, which does not process putrescible waste; hence, this facility is anticipated to receive a lower percentage of putrescible waste than anticipated in the default landfill gas generation modelling.

In summary, with the incoming waste having a lower putrescible content, the annual rainfall being significantly lower than the metropolitan landfills and the fact that the landfill will dry out even further once gas extraction commences, the actual rate of landfill gas production is anticipated to be significantly lower than that of the metropolitan landfills and also lower than the forecast rate of generation as predicted by the IPPC model, which is also used by the metropolitan landfills. The addition of moisture via leachate injection will increase the rate of production of landfill gas, but not to a level where the gas extraction system is unable to manage the flow rate. In reality, the leachate recirculation is a necessary part of the efficient management of the landfill.

In addition, with there being no identified areas of potential subterranean landfill gas accumulation outside the landfill, any increase in landfill gas production will have no associated negative environmental impact.

At forecast maximum gas production, there will only be sufficient gas for a 1 MW generator (if this method of gas destruction is utilised). This is an extremely low gas flow rate in comparison to the other large landfills in the metropolitan area (Tamala Park Landfill generates 5 MW); hence, if the gas production doubled beyond forecast volumes, this will still be easily manageable in the context of normal landfill gas management methods. In addition, any increased gas production rate will be a gradual occurrence and not a rapid ramp-up; hence, the specialist landfill gas contractor will have sufficient time to upgrade the gas extraction and management infrastructure to accommodate the increased gas generation rate.

**32.b. Requested Information:**

The use of the IPCC model has identified the quantities of methane to be generated from the landfill. However, please clarify the significance and importance between the impacts on the greenhouse gases and damage to the ozone layer discussed in this model and why it has been considered.

**Response by IW Projects:**

It is unsure how this query relates to environmental performance of the proposed facility. The impact on the ozone layer is a consequence of many factors, of which, operational performance is but one. It is not a function of which model has been used to forecast landfill gas generation quantities as this query seems to suggest.

Methane is a greenhouse gas and as such has a negative impact on the ozone layer and as a consequence, good landfill industry practice is to extract as much landfill gas as is reasonably and combust the methane component.

The use of the IPCC model (as opposed to other models) has no consequence on the actual production of landfill gas and hence no consequence on the ozone layer, it is simply one of many models that can be used to forecast methane production volumes.

The proposed landfill will have a best practice gas extraction system that will optimise the protection of the ozone layer.

The only way that there could be a more negative environmental impact on the ozone layer as a result of the landfill activities on site is if the gas extraction system was less efficient that the other landfills that the same waste could have gone to. For example if the waste was not received at the Opal Vale landfill, but went to the Red Hill landfill, so long as both facilities had equivalent efficiencies of gas extraction and gas destruction, there would be no net negative environmental impact. However, if the Red Hill landfill had a more efficient gas extraction and gas destruction system, then it would be environmentally beneficial to send the waste to Red Hill. With the Opal Vale landfill being a new landfill with the latest, best practice technology, it can be anticipated that the environmental protection will be best practice and that it would ultimately be beneficial for this facility to receive waste in preference to it going to other, older landfills, especially unlined landfills and facilities without landfill gas extraction systems.

**32.c. Requested Information:**

The landfill gas management plan should detail the methodology that will be implemented on site. It should include statements to justify the risk assessments of emissions and actions that will be triggered should significant odour emissions be measured or off-site odour impacts be detected.

**Response by IW Projects:**

As stated in the Works Approval supporting documentation, landfill gas management will be contracted out to a specialist landfill gas contractor (as occurs in all Perth metropolitan landfills). This contractor will have the necessary expertise to adequately manage the landfill gas generation on site. It is for this expert to determine how best to manage the gas; consequently, at this stage, without there being a landfill gas contractor appointed, there can only be conceptual information provided that sets out the parameters around which the landfill gas contractor is to operate the facility as well as the monitoring requirements, triggers and actions to be followed.

**Attachment E – Landfill Management Plan** provides additional information on this aspect of the operations.

**Landfill Management Plan**

**33.** Section 18.5.4 of the application documentation states that a comprehensive landfill management plan (LMP) will be developed prior to landfilling operations. DER considers this to a vital part of assessing the overall application and therefore requires this plan to be provided as part of the works approval application. DER notes the following in relation to the LMP:

**33.a. Requested Information:**

An acceptable management plan must identify potential site-specific problems and provide corrective actions for all possible emissions.

**Response by IW Projects:**

**Attachment E – Landfill Management Plan**, **Attachment F – Asbestos Management Plan**, **Attachment G – Fire Management Plan**, **Attachment H – Rehabilitation Management Plan** and **Attachment I – Dust Management Plan** have been developed to cover the full management of the landfill site.

**33.b. Requested Information:**

The contingencies discussed in the report are currently not detailed or specific enough to serve as the basis for such a plan. Should processes and procedures change once under operation, different versions of this management plan can be considered in the future.

**Response by IW Projects:**

**Attachment E – Landfill Management Plan** provides additional information on this aspect of the operations.

**33.c. Requested Information:**

Due to the considerable community interest in fire management, please include management procedures and training in the LMP.

**Response by IW Projects:**

**Attachment E – Landfill Management Plan** and **Attachment G – Fire Management Plan** provide additional information on this aspect of the operations.

**Odour:**

**34.** Odour is considered a considerable risk with landfill applications and DER recognises there are a number of variables associated with odour. However, there is currently insufficient information to suitably assess the odour management for the site. DER requires the following information:

**34.a. Requested Information:**

All statements regarding the management options for odour need to be clearly explained and justified, particularly where the report indicates that a management option is sufficient to limit risk to acceptable levels.

**Response by IW Projects:**

**Attachment E – Landfill Management Plan** provides additional information on this aspect of the operations.

**34.b. Requested Information:**

The possibility of unacceptable odour impacts from fugitive emissions from the 25% of landfill gas not collected by the landfill gas collection system has not been adequately addressed. Please provide information as to the management and consideration of this.

**Response by IW Projects:**

The *EPA Guidance for the Assessment of Environmental Factors - Separation Distances between Industrial and Sensitive Land Uses No. 3 June 2005* sets out the EPA recommended buffer distances to receptors. In the case of a Class II landfill, the buffer distances are, 500 m for sensitive uses (subdivisions) and 150 m for single residences. Ignoring the dwelling 400 m away (which is still 2.6 times further away than the EPA requirement), the nearest receptor is 1.35 km from the landfill, which is 9 times the EPA recommended buffer distance. The EPA guidance states:

- "*It specifically addresses generic separation distances between industrial and sensitive land uses to avoid conflicts between these land uses. It takes into account protection of the environment as defined by the Environmental Protection Act 1986 (EP Act) with a focus on protecting sensitive land uses from unacceptable impacts on amenity that may result from industrial activities, emissions and infrastructure*."

- "*Where the separation between the industrial and sensitive land uses is* ***greater*** *than the generic distance, there will not usually be a need to carry out site-specific technical analyses to determine the likely area of amenity impacts due to emissions from the industry. The need for technical analyses is likely to be limited to such instances as major industrial developments, industries using new or non-typical processing techniques, or areas subject to cumulative impacts*."

Based on the EPA guidance document, the Opal Vale has clearly complied with the required buffer distances and in reality has 9 times the required buffer distance; consequently, in accordance with the EPA guidance, it should be reasonable to accept that there will be no conflict between these land uses. This includes odour emissions.

Ignoring the fact that the proponent believes that the adequate buffer zones should prevent any negative odour impact at the nearest neighbouring residence 1.35 km away, as further justification, in accordance with the *National Greenhouse and Energy Reporting (Measurement) Determination*, 75% landfill gas capture from the waste is the maximum extraction system efficiency that can be claimed by a landfill operator unless an extensive on-site investigation has been carried out to determine the actual site-specific fugitive gas emissions. Without the facility having been developed, this is not possible; hence, the theoretical maximum 75% capture rate is the best that can be claimed.

In reality, the landfill industry, national and international, believes that modern, best practice landfills have a significantly better capture rate than is allowed to be claimed under *ENGRS*. On 30 January 2015, the *Waste Management Association of Australia* (WMAA) responded to the Federal Government consultation on a draft *National Greenhouse and Energy Reporting (Measurement) Determination No. 2015*. In this response, the WMAA has requested that the collection efficiency of closed and capped landfills be increased to 95%. There would obviously be increased emissions through the active portion of the landfill; however, with progressive landfill closure, there would only be a relatively small area of landfill with these increased emissions.

The University of Central Florida undertook a program of monitoring landfill gas emissions from a number of landfills (*Evaluating Landfill Gas Collection Efficiency Uncertainty – 15th Annual LMOP Conference and Project Expo Baltimore, MD January 17-19, 2012*). The outcome of this investigation concluded that the collection efficiency was as follows:

- Daily cover – 67%
- Intermediate Cover – 75%
- Engineered Final Cover – 87%
- Geomembrane – 90%.

Consequently, based on the above, it is clear that the actual gas collection efficiency of the landfill will be significantly greater than the allowable 75% (25% fugitive emissions). Hence, in reality there will be far less emissions causing odour concerns than is theoretically allowed to be claimed under the Federal Government's recent carbon trading scheme.

As a further consideration, in October 2014, the Victorian EPA amended the Landfill BPEM by lowering the maximum level of gas emissions through various portions of the landfill surface. These set levels are extremely low (100 ppm through final cap and 200 ppm through intermediate cap) and will ensure that landfill gas emissions are maintained well below the level that is likely to cause negative odour impacts on site.

With regards to on-site control and contingency measures, as explained in the Works Approval supporting documentation (*IW Projects* document, section 16.11 - Landfill Liner System, section 16.12 – Landfill Capping System and section 16.4 Landfill Gas Management), the proposed landfill incorporates a comprehensive lining and capping system as well as an active landfill gas extraction system to effectively contain and extract landfill gas. The proposed systems are based on industry best practice and comply with the DER landfill development guidelines; consequently, the management of landfill gas at the proposed landfill will be amongst the best in the landfill industry.

The landfill gas management system will be designed, managed and monitored by a specialist landfill gas contractor with the appropriate skills and experience to undertake the necessary tasks.

As part of the landfill gas contractor's responsibility, will be the ongoing monitoring of the landfill and gas extraction system to detect any areas of the site that are not compliant with the necessary emissions standards and where any excessive emissions are detected, to undertake the necessary remedial action to rectify the situation to ensure compliance with the necessary standards.

The following are a number of remedial actions that will be undertaken by the landfill gas contractor to improve the extraction of landfill gas and minimise the emissions from the landfill:

- Adjusting the extraction pressures on some gas well to increase extraction in certain areas of the landfill;
- Installing additional gas extraction wells in portions of the landfill where excessive emissions are occurring;
- Resealing around penetrations through the landfill cover;
- Localised thickening of the landfill cap or use of hay bales or organic mulch to increase oxidation of fugitive landfill gas.

**Attachment E – Landfill Management Plan** provides the additional information on the landfill gas requirement to be complied with by the landfill gas management contractor.

In summary, there is an expectation that the DER landfill development guidelines set the appropriate technical standards to which the landfill will be constructed, operated and closed as well as stipulating the necessary buffer zones. Should a landfill comply with these development guidelines, there is a likelihood that the facility will not negatively impact on the surrounding environment, including neighbouring receptors. This proposed facility is compliant with the DER development guidelines and also has 9 times the recommended buffer distances; consequently, is even less likely to negatively impact on the surrounding environment.

**34.c. Requested Information:**

The conclusion that odour impacts are unlikely at the nearby farmhouse due to the limited frequency of wind towards this sensitive receptor is not supported by the information provided. DER notes there is a general lack of detail provided on the management of the various odour sources on site. Please further justify this conclusion within the management plan.

**Response by IW Projects:**

As documented above, the farmhouse in not considered as a receptor for any landfill related emissions, except subterranean landfill gas migration (of which there are none that are anticipated).

**34.d. Requested Information:**

The proposed rejection of excessively odorous waste streams needs to be described in more detail. The operational procedure should include how this will be managed and implemented on site, including how the incoming waste loads will be assessed. It should also include the criteria that will trigger the rejection of a load.

**Response by IW Projects:**

Excessively odourous loads are an extremely rare occurrence in the landfill industry and typically relate to a dedicated waste collection emanating from a single source (eg. crayfish factory). These loads are received directly from the waste generator and are not received in bulk transfer trailers from transfer stations (as they would cause odour issues at the transfer stations, which are typically closer to sensitive receptors than the landfill).

Under normal circumstance, the waste collection company would make enquiries with the facility operator as to whether the waste may be accepted at the landfill. In this case, the facility operator would investigate the waste source and type to assess if it is acceptable. If deemed acceptable, then special landfilling conditions may be imposed upon the delivery of the odourous material such as minimum notification period prior to waste delivery, delivery only in certain wind conditions (speed and direction), maximum quantities of waste to be delivered in a single load or day. These conditions would be set to ensure that the landfill was able to adequately manage the waste material and typically would prepare a void in the landfill where the odourous waste would be tipped and immediately covered over. If waste acceptance were agreed to, then a trial would be carried out to assess the effectiveness of the proposed landfill methodology and the odourous nature of the waste. If the trail were successful, then the waste would be accepted. As a result of the trial, or ongoing receival of the waste, from time to time, it may be necessary to amend the acceptance conditions or landfill methodology to improve odour management.

In the event of an excessively odourous waste load arriving at the landfill without prior arrangement, the method of detecting the odourous load will be that the weighbridge operator notices the excessive odour or the plant operators detect the odour on the tipping face.

In the event that the load is still in the vehicle when the odour is detected, the site operators would instruct the vehicle driver not to tip the load and park up the vehicle while investigations are quickly carried out. The driver would be asked about the waste type in the vehicle and its origin. There may be a need to obtain additional information from the waste collection company and/or the waste generator. Once all available information has been collected, the site supervisor would determine if the load be accepted or rejected. Rejected loads would be immediately removed from site and the appropriate rejection information recorded on the vehicle transaction docket via the weighbridge software.

When considering the acceptability of the odourous load, the site supervisor would consider the following influencing factors:

- The customer's past performance with odourous loads;
- The size of the load;
- The level of odour emanating from the load (assessed by a walk around the vehicle and sensing the degree of excessive odour);
- The information provided by the vehicle driver, collection company and waste generator (if obtained);
- The wind speed and direction to likely receptors;
- The track record of odour complaints on site; and,
- The ability to quickly form a void in the landfill to receive the load and cover it immediately.

If the load is acceptable, it will be received and immediately covered over.

The customer will be advised of the prearrangement requirements for any future odourous loads.

**Attachment E – Landfill Management Plan** provides additional information on this aspect of the operations.

**34.e. Requested Information:**

A comprehensive review of the leachate management with the associated risks and actions should be included as part of the assessment of odour emissions.

**Response by IW Projects:**

The practice of leachate management proposed for the site is typical of most metropolitan landfills and with the extensive buffer zones available on site, there will be no adverse odour impacts emanating from the leachate ponds.

**Attachment E – Landfill Management Plan** provides additional information on this aspect of the operations.

**Noise**

**35.** The proposed landfill is located in a rural area and will be operating alongside an existing extractive industry, which singularly or together may be a dominant noise source in an area. To complete the noise assessment DER requires the following information:

**35.a. Requested Information:**

As part of the LMP, outline how Opal Vale will manage possible noise complaints should they occur.

**Response by IW Projects:**

A comprehensive Complaints Management System will be established and maintained on site.

**Attachment E – Landfill Management Plan** provides detailed information on the Complaints Management System.

**35.b. Requested Information:**

The sound power levels quoted in Table 5.2, Page 3 of the Herring Storer Acoustic Report, were "based on file data of similar operations" and not on manufacturer's specifications or on the existing equipment currently used on site. Verify the sound power level of the proposed dozer and existing clay dozer in operation.

**Response by Herring Storer:**

Herring Storer has provided a letter response covering this query.

**Attachment J – Herring Storer Letter Response Dated 28 April 2015** provides a response to this query.

**35.c. Requested Information:**

Due to the risk of being the dominant noise source in the area, obtain background noise levels for a representative period of time at the nearest residential receptor.

**Response by Herring Storer:**

Herring Storer has provided a letter response covering this query.

**Attachment J – Herring Storer Letter Response Dated 28 April 2015** provides a response to this query.

Further to DER comments relating to the need for background noise level monitoring, Herring Storer comment accordingly:

"*As per our meeting of 29 June, the DER confirmed that under the Regulations they do not consider background noise levels and background monitoring is not required and was to be taken as an advisory note and hence is to be considered as being addressed.*"

**35.d. Requested Information:**

Given that the slope of the terrain increases towards the visible residents with no apparent barriers, the predicted levels seem lower than expected, particularly as worst case meteorological conditions are assumed. Obtain noise levels relating to the existing quarrying operations at the nearest residential receiver, and relate to concurrent clay extraction operations. Then reassess the noise model and output, including validation with the measured levels.

**Response by Herring Storer:**

Herring Storer has provided a letter response covering this query.

**Attachment J – Herring Storer Letter Response Dated 28 April 2015** provides a response to this query.

Further to DER comments relating to the need for the verification of actual site noise levels during the assessment, Herring Storer comment accordingly:

"*From the meeting of 29 June, DER acknowledged that as the quarry was not operating there was no opportunity for verification measurements at the residence. Hence this item has been addressed. It is an advisory note and considered to have been addressed.*

*We also note that as part of the previous response, the equipment that would be used for the clay operations were measured at another location, with the noise levels compared to those used in the noise model. This confirms the acoustic data in the model.*"

**35.e. Requested Information:**

Noise levels received at a distance are very dependent on meteorological conditions. Therefore, detailed meteorological data needs to be obtained for the verification/background measurement periods.

**Response by Herring Storer:**

Herring Storer has provided a letter response covering this query.

**Attachment J – Herring Storer Letter Response Dated 28 April 2015** provides a response to this query.

Further to DER comments relating to the need for data on metrological conditions during monitoring, Herring Storer comment accordingly:

"*For any noise monitoring undertaken, a weather station will be set up at the weighbridge. The weather station will record, temperature, wind speed and direction.*"

**35.f. Requested Information:**

Based on item 1, the nearest residential receptor is likely to be further than the farmhouse, located 400m away.

**Response by IW Projects:**

As discussed in item 1 above, the farmhouse in not considered as a noise receptor. The nearest noise receptor is the neighbouring residential property 1.35 km to the north east.

**Dust:**

**36.** To appropriately assess the dust emissions expected from the premises, DER requires the following information:

**36.a. Requested Information:**

The discussion within the application on dust emissions is too limited in the report to support the assertion that pollution from this source is negligible. Please provide appropriate dust management processes and procedures within a dust management plan.

**Response by IW Projects:**

**Attachment I – Dust Management Plan** provides information on dust management.

**36.b. Requested Information:**

Major sources of dust are listed within the application, however, the management of the dust per source including the causes of emissions, the associated risks and the related dust suppression actions must be detailed in a dust management plan.

**Response by IW Projects:**

**Attachment I – Dust Management Plan** provides information on dust management.

**36.c. Requested Information:**

Guidance on dust management (A Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and Other Related Activities, 2011) is available on the DER website. It is recommended that this document is considered in a dust management plan for the premises.

**Response by IW Projects:**

This document has been reviewed and the pertinent aspects incorporated into the dust management portion of the Landfill Management Plan.

**Attachment I – Dust Management Plan** provides information on dust management.

**Active cell waste cover material:**

**37.** Cover material used for the landfill is a significant part of onsite management of odour and vermin. To continue the assessment of this management please provide the information below:

**37.a. Requested Information:**

Outline the type and quantity of material expected to be used to manage daily cover requirements and other measures to meet the Industry Guidelines.

**Response by IW Projects:**

<u>Daily Cover – Type</u>

Daily cover to be used will be a combination of the following:

- On-site clayey material that is unsuitable for clay product manufacturer;
- Soil that is received over the weighbridge (eg. from local earthworks projects);
- Soil material specifically imported onto site for use as cover material;
- Alternative daily cover:
    - Tarpaulin covers;
    - Chemical emulsions; or,
    - Paper Mache.

The most likely cover material source will be on-site waste clay material that is unsuitable for clay product manufacture, thereafter, soil received over the weighbridge. The selection of the other materials will be dependent on the quantity of cover material required and the availability of the first two choices.

The DER landfill development guidelines do not prefer the use of clayey material as cover due to the potential for developing perched water tables within the waste mass and above the height of the liner, there is increased chance of leachate emerging from the site of the landfill as its vertical progression is hindered by the clay layer. In the ideal world, sand would be the preferred daily cover material, however, in this application, due to the readily available waste clay material on-site, this material will be used.

The use of clay cover material can easily be accommodated so as to limit or eliminate the concerns of leachate seeping out of the side of the landfill. The waste lifts will to be formed so that there is a slight fall into the waste mass and not sloping towards the outside of the landfill. This should occur in any well managed landfill in order to ensure any surface water generated on the waste surface stays on the landfill and does not flow down the external slope. The same occurs if there is a perched water table within the landfill, the water will again flow into the waste mass and not emerge out of the side of the landfill. Additional information on the management of leachate seeps has been provided in response 26 above.

The soil material that is received over the weighbridge is likely to be similar to the naturally occurring soil material in the region, which is gravel or clay, with minimal sandy material.

The specifically imported cover material will be sandy, rubble material from the Resource Recover Solutions Bayswater recycling process. This is ideal cover material and there is effectively an endless supply of this material. Hence, this is the back-up product that will ensure that there is always a ready supply of cover material.

Daily Cover – Quantity

The waste will be placed in benches of maximum 2 m high, with a 150 mm cover of soil applied daily. This is a conservative position as in most circumstances, in a single day, there will be at least two benches placed on top of each other and only the final surface of the waste covered at the end of the day; hence, only requiring half the cover material.

Based on 150 mm cover per 2 m bench, there will be approximately 75,000 $m^3$ of cover material required for the 1.5 M $m^3$ of landfill airspace in Stage 1.

The daily or weekly cover material requirements will be highly dependent on the waste tonnage throughput.

At 50,000 t/yr waste throughput there will be a need for approximately 15.3 $m^3$/day or 84 $m^3$/week of cover material, this increases to 30.6 $m^3$/day or 168.3 $m^3$/week for 100,000 t/yr and 45.9 $m^3$/day or 252.5 $m^3$/week for 150,000 t/yr.

**37.b. Requested Information:**

Detail how the amount of material required has been calculated and include those calculations.

**Response by IW Projects:**

Daily Cover – Quantity Calculation

Based on the above configuration of cover material consumption, the following are the quantity calculations:

0.15 $m^3$ of cover per 2.15 $m^3$ of landfill airspace consumed = 0.07 $m^3$ cover/$m^3$ of airspace.

For 1.5 M $m^3$ of airspace = 1.5 M $m^3$ x 0.07 $m^3$ = 105,000 $m^3$ of cover for Stage 1.

With the site operating for 5.5 days per week, this equates to an average of 286 days/yr of operation.

At 50,000 t/yr waste throughput = 175 t/day, at a compacted waste density of 0.8 t/$m^3$ for newly compacted waste, this equates to 218.5 $m^3$/day of landfill airspace consumption. Which, at 0.07 $m^3$ cover/$m^3$ of airspace = 15.3 $m^3$/day of cover material consumption, or 84 $m^3$/week.

For 100,000 t/yr = 30.6 $m^3$/day or 168.3 $m^3$/week.

For 150,000 t/yr = 45.9 $m^3$/day or 252.5 $m^3$/week.

**37.c. Requested Information:**

Indicate the source/s of the material to be used for cover. Where quarrying material is to be used, include calculations showing the volume of suitable material that can and will be sourced from quarrying.

**Response by IW Projects:**

The sources of daily cover material include:

- On-site cover – waste clay material from the clay extraction operation. This excludes overburden material from the top 2 m of the soil profile, as this will be used for landfill capping material. During clay excavation, there is some material that is excavated from the pit that is not suitable for brick or tile manufacture. As mentioned in response 25c above, some of this waste material will be used for fill material, but there will still be substantial quantities available for use as daily cover;
- Soil received over the weighbridge. This is an unknown quantity and material type, but is likely to be similar to the surrounding soil types in the region (gravel, clay);
- Soil material specifically imported onto site. The cover material will be sandy, rubble material from the Resource Recover Solutions Bayswater recycling process. There is ample (60,000 t/yr) supply of this material, well in excess of what is required for daily cover;

As can be seen from the above, there are a number of options available for the supply of cover material.

**37.d. Requested Information:**

If the material being taken from borrow pits, indicate if planning approval for the borrow pits is in place and if not, what is the status of the planning application.

**Response by IW Projects:**

No borrow pits will be developed to source cover material for landfill daily cover.

**37.e. Requested Information:**

The proposed mitigation measures in the application for cover material are consistent with the guide in Chapter 7 of the BPEM. However, details must be provided and should demonstrate how the active cell management will prevent significant odour emissions from this source.

**Response by IW Projects:**

Although cover material retains a portion of the odour within the waste and hence reduces odour emission from the landfill, this is only one of a number of mechanisms that control odour emissions on the active landfill. In combination, the following mechanisms will be utilised to control odour:

- Blending of waste at the tipping face – this occurs during the pushing up of the tipped waste into the final waste bench position; however, if there is a large portion of homogeneous waste from a single load, this will be further blended to ensure that there is a relatively uniform waste structure within the waste bench. From an odour point of view, this results in a more uniform distribution of odour within the waste and reduces the likelihood of odour spikes from areas of concentrated odour (there are also leachate management and stability/settlement benefits);
- Compacting the waste benches - this is the primary odour control mechanism as the waste mass is compacted into a more dense structure and larger waste items are broken down. This removes the voids in which the odour can accumulate and hence reduces the near surface generation of odour;
- Smoothening the waste surface prior to cover placement – this seals off the waste mass and provides a smooth surface on which the daily cover can be applied. Having a smooth surface enables a more efficient use of cover material and a more comprehensive cover of the waste, without big clumps of waste sticking out of the daily cover; and,
- Application of daily cover material or alternative daily cover (if utilised) – this assists in filling the surface voids and sealing off the waste surface, of which both assist in reducing odour emissions from the near waste surface.

The above mechanisms improve the control of odour from the new waste that has recently been placed in the landfill. However, when landfilling in areas of deeper waste (+8 m to 10 m), the older waste in the lower portion of the landfill would have started to generate volumes of landfill gas, which is typically more odourous than freshly placed waste. Consequently, there will be progressive landfill gas extraction wells installed in the waste mass (well depth and spacing details were provided in the original application, OV-WA-42 and OV-WA-43). These wells will a combination of horizontal and vertical wells, depending on the waste depth. These wells will provide an active mechanism to extract the gas out of the waste; hence, reducing the quantity of fugitive gas emissions from the active landfill.

All of the above mechanisms operating in combination will adequately manage the odour emissions within the active landfill.

**Capping and Rehabilitation:**

**38. Requested Information:**

Provide details of sand and growing medium (including source and volume required) to be sourced for landfill capping and rehabilitation including any uncertainties and requirements for planning approval.

**Response by IW Projects:**

<u>Sand</u>

The sand is part of the engineered section of the landfill cap and hence, needs to be clean, free draining sand. This material will be purchased from a commercial sand supplier. There will be 500 mm of sand per square metre of landfill cap. This will be in two layers, the 200 mm gas collection layer below the synthetic liner and the 300 mm drainage layer above the synthetic liner.

There is approximately 90,200 $m^2$ of capped surface in Stage 1; consequently, there will be a need to import approximately 50,000 $m^3$ of good quality sand. This includes 10% extra to allow for material wastage.

<u>Growing Medium</u>

There will be between 1 m and 2 m of growing medium placed over the engineered portion of the landfill cap. The cap thickness will be dependent on the availability of the suitable growing medium, the ideal being a 2 m thick layer.

Austral Brick has advised that they remove between 1 m and 2 m of overburden from the pit prior to excavating of useful clay material. This overburden has been stockpiled on site for future site rehabilitation. With the development of the landfill, Austral Bricks no longer needs this overburden and consequently, this material is available and will be used for the growing medium. Based on the capped surface area being approximately 10% greater than the pre-excavated surface area, the amount of over burden will be approximately 10% thinner than the original layer of overburden. This will however be at least 1 m thick. It is not foreseen that there will be a need to import any growing medium.

It is noted that the removal and management of overburden forms part of the clay extraction activity, which will be undertaken by Austral Bricks and is not part of the proposed works associated with this application.

**Attachment H – Rehabilitation Management Plan** provides additional information on capping and rehabilitation.

**Other:**

**39. Requested Information:**

Please indicate whether any clearing of native vegetation will occur. Please refer to the attached letter sent to DER from Department of Parks and Wildlife (DPAW).

**Response by IW Projects:**

There is a need to clear about 0.6 ha of small to medium trees (some of which are re-growth within the clay void). A Clearing Permit has been submitted to the Native Vegetation Branch for approval.

**Attachment K – Clearing Permit** provides a copy of the permit recently submitted to the DER.

In addition to the above information, an updated version of the *Stass Environmental* ground water assessment for the site has been provided at **Attachment L – Ground Water Assessment, 11 Chitty Road, Toodyay, WA, Version 2.2, Stass Environmental May 2015**. This document was again amended as a result of consultation with the DER and a copy has been provided at **Attachment M – Ground Water Assessment, 11 Chitty Road, Toodyay, WA, Version 2.5, Stass Environmental July 2015**.

Should you have any further queries, please do not hesitate to contact the undersigned.

Yours Sincerely,

**Ian Watkins**

Director IW Projects

**Attachments:**

## Attachment A – Landowner's Letter of Exclusion

## Attachment B – Stass Environmental Additional Information

Provided as part of the 15 May 2015 response. There has been no change to this attachment as a result of this latest response.

## Attachment C – Updated Topographic Site Survey

Provided as part of the 15 May 2015 response. There has been no change to this attachment as a result of this latest response.

## Attachment D – Earthworks Sections

Provided as part of the 15 May 2015 response. There has been no change to this attachment as a result of this latest response.

## Attachment E – Landfill Management Plan

## Attachment F – Asbestos Management Plan

Provided as part of the 15 May 2015 response. There has been no change to this attachment as a result of this latest response.

## Attachment G – Fire Management Plan

Provided as part of the 15 May 2015 response. There has been no change to this attachment as a result of this latest response.

## Attachment H – Rehabilitation Management Plan

Provided as part of the 15 May 2015 response. There has been no change to this attachment as a result of this latest response.

## Attachment I – Dust Management Plan

Provided as part of the 15 May 2015 response. There has been no change to this attachment as a result of this latest response.

## Attachment J – Herring Storer Letter Response Dated 28 April 2015

Provided as part of the 15 May 2015 response. There has been no change to this attachment as a result of this latest response.

## Attachment K – Clearing Permit

Provided as part of the 15 May 2015 response. There has been no change to this attachment as a result of this latest response.

## Attachment L – Ground Water Assessment, 11 Chitty Road, Toodyay, WA, Version 2.2, Stass Environmental May 2015

Provided as part of the 15 May 2015 response. This document has been changed, with the amended document being attached as Attachment M below.

**Attachment M – Ground Water Assessment, 11 Chitty Road, Toodyay, WA, Version 2.5, Stass Environmental July 2015**