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memorandum

TO	Greg Shirras	FROM	Hilary Lough
	Hawke's Bay Regional Council	DATE	28 July 2020
RE	Omarunui Landfill Area B Consent Review – s92 Response Review Summary (DRAFT)		

1.0 Introduction

Hastings District Council (HDC) and Napier City Council (NCC) (jointly the Applicant) have applied to Hawke's Bay Regional Council (HBRC) for resource consents to construct and operate a new area of landfill (Area B) at the Omarunui Landfill. The Assessment of Environment Effects (AEE) has been prepared by Tonkin & Taylor Limited (T+T).

A number of activities are considered to be permitted activities. HDC and NCC are seeking resource consents for the following activities:

- Discharges of contaminants to air (odour, landfill gas, dust and the products of combustion of landfill gas)
- Discharges of contaminants to land and water (from the landfill operation)
- Diversion and discharge of stormwater
- Diversion and discharge of drainage water (from a pumped system)

The applicant is seeking to change conditions associated with the existing air discharge and leachate discharge permits to provide for the Area B extension and is seeking new consents for the other activities.

Pattle Delamore Partners Limited (PDP) has been engaged by Hawke's Bay Regional Council (HBRC) to provide a technical review of the consent application for the following matters:

- Geotechnics
- Landfill design
- Leachate management and irrigation
- Stormwater, hydrology and drainage design
- Air quality
- Surface water quality and aquatic ecology
- Groundwater
- Proposed operation and monitoring
- Waste acceptance criteria

PDP's initial review of the application was provided in a report dated 31 March 2020, with specific matters covered in individual memos appended to the report. A Section 92 request for further information was subsequently issued by HBRC on 17 April 2020 and T + T has responded in a letter dated 25 June 2020.

This memorandum summarises PDP's further technical review of the consent application based on the Section 92 response. The responses provided here are draft comments that are being circulated in advance of the scheduled meeting on Wednesday 29 July between PDP, T + T and HBRC, to facilitate discussion at the meeting.

The Section 92 questions, a summary of the T + T response and PDP's draft comments on the T + T response are provided in Table 1, appended to this memo.

2.0 Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Hawke's Bay Regional Council and others (not directly contracted by PDP for the work), including Tonkin & Taylor Ltd. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This memorandum has been prepared by PDP on the specific instructions of Hawke's Bay Regional Council for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Prepared by

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Reviewed and approved by

Hilary Lough

Technical Director – Water Resources

Table 1 - Section 92 questions, summary of T + T response and draft PDP comments on whether the answer satisfies/does not satisfy HBRC's information requirement

Question No. and Topic	Question(s) to the Applicant	Answer/Clarification Provided by the Applicant	Answer satisfies/does not satisfy HBRC's information requirement
Geotechnics, Landfill Design and Leachate Collection and Irrigation System (Appendix A)			
1	Please provide reasons for not complying with the WasteMINZ guidelines on permeability criteria for the capping layer.	*"The Technical Guidelines for Disposal to Land, WasteMINZ, 2018, describes final cover systems for landfills in Section 5.10. It states that "Final cover design is largely dictated by the site as well as management provisions …" It provides "examples" of four different landfill cover designs described as Minimum, Enhanced Minimum, Cap Including Membrane and Evapotranspiration Cap. All of these have a compacted soil layer with a permeability k = 1 x10^{-7} m/s.* *The selection and reasoning for the proposed cap for Area B is described in Section 6.2 of the Engineering Report. It proposes adoption of an evapotranspirative (ET) cover which suits the climate experienced at Omarunui Landfill, particularly with respect to the low rainfall experienced in the Hawkes Bay. One of the drivers for selecting an ET cover is to make maximum use of the soils available on the Omarunui site. The soils are predominantly silts and sandy silts. These can typically be compacted to achieve a permeability of 1 x 10^{-7} m/s or better. However, due to the large volume of soils required for construction of the cap, near the end of the life of the landfill, it is possible that this low permeability may not be able to be consistently achieved. Therefore, an alternative cap giving the performance required for the Area B landfill and equivalent to the Technical Guidelines is proposed.* *There are two types of ET caps: a capillary break cap (which is the ET cap described in the Technical Guidelines) and a monolithic ET cap which is widely used throughout the world as an effective capping*	Response considered acceptable

		system and is described in the Engineering Report with references to full scale studies in the USA and Australia. All assessments have been based on adopting this capping system."	
2	Clarification is required around the removal of this material, especially in relation to the effect on the liner levels which, if excavated as shown on drawing 1000647.1000-2 would suggest that the alluvial material is not all removed. In addition, clarification on the removal of the limestone should also be provided.	*"The extent of the mapped gully alluvium is shown in plan on Drawing 1000647.1000-04 and is shown on the various geological cross-sections included with the Geotechnical Report. Drawing 1000647.1000-14 shows the construction of the toe bund and shear key, showing complete removal of the alluvium for this construction. However, the gully alluvium is still shown to be present under the landfill footprint in this and other sections. These sections were prepared primarily to show existing geological conditions, rather than construction and hence it was appropriate to show the alluvium found to be present.* *Removal of gully alluvium is described in Section 3.2.1 of the Engineering Report. It describes all of this material being removed from under the toe bund and the landfill liner. This is required to minimise liquefaction potential and to minimise the effects on the liner from excessive or differential settlement of the basegrade. While this layer is quite thick, up to 9 m, at the location of the toe bund, it thins out further up the valley.* *Layers of limestone are encountered at intervals through the depth profile. There is no intent to remove these other than as required for bulk excavation to form the landfill basegrade, as described in Section 3.2.1 of the Engineering Report."*	Clarification provided is acceptable and this aspect needs to be carried through to the detailed design phase.
3	Please provide clarification on the details of how and where the groundwater would discharge to, should seepage zones be encountered during the earthworks constructions phase. In particular, given	*"It is critical that any seepage found beneath the landfill liner can be drained away to avoid groundwater pressure building up beneath the liner and potentially causing damage to the liner prior to the liner being surcharged with waste. The objective for the subsoil drainage design is*	Clarification is acceptable and this proposed approach must be carried through to the detailed design and operations manual

	that the previous stages of the landfill may have already been constructed prior to encountering seepage zones. Further detail is required to ensure that the perched groundwater is dealt with and there are no effects on the liner system resulting in the loss of containment.	*to ensure that there is a means for draining groundwater from beneath the landfill at any stage as development proceeds. Experience in Area D of the landfill has shown that groundwater seeps were rare, and isolated, so we do not consider that a comprehensive subsoil drainage network will be required. The approach will be:* • *Excavate for Stage 1. If seeps are observed, install a subsoil drain in the base of the Stage and connect branch pipes to any observed seepage.* • *Stage 2 is downstream of Stage 1. Any subsoil drain installed beneath Stage 1 would need to be extended beneath Stage 2. If no subsoil drain was installed for Stage 1 and seepage is observed in Stage 2 a central subsoil drain would need to be installed with branches to any observed seepage. The discharge from the subsoil drain would be below the water level in the stormwater pond. The pipe would need to extend beyond the stormwater pond to discharge to the outlet channel from the pond.* • *If seepage is observed during Stage 3 and 4 construction, this would best be drained through a new subsoil pipe installed on the bench above Stages 1 and 2. Any such drain would be extended up to the perimeter of Stages 3 or 4 to collect any subsequent subsoil drainage from Stage 5. Any subsoil drains installed on the bench above Stages 1 and 2 would drain into the perimeter stormwater drain.* *These drains are not shown on plan as they will only be installed in response to observed groundwater seepage during construction."*	
4	The report indicates that the engineered fill areas are to be compacted, however it should refer to the compaction	*"Compaction specifications for engineered fill will be developed during detailed design from specific testing of the materials that will be encountered or used for each stage of development. Compaction will be*	Clarification acceptable and confirms that compaction will be in accordance with the specification contained in the

	specification contained within the geotechnical report. Please provide confirmation of this.	*generally to the specification outlined in Section 5.4.5 of the Geotechnical Report."*	geotechnical report and/or developed during detailed design depending on the soils encountered.
5	The report documents the assumption of 3 manufacturing and 3 installation defects per hectare, however the HELP modelling uses 2 manufacturing and 2 installation defects per hectare. The sensitivity of the HELP model should be checked regarding the difference in terms of seepage flow rates through the liner. Please provide details of this check.	*"The description of the HELP model parameters in Section 4.6 of the Engineering Report does not match the models presented in Appendix C of the report. We had been looking at alternative ways of representing the benefits of undertaking an Electrical Leak Location Survey (ELLS) as part of the liner design/installation. The approach adopted was to reduce the number of defects in the geomembrane from 3 per ha to 2 per ha. The results for 2 defects per ha were given in the report but we omitted to update the description of the model parameters. Furthermore, the liner defined in the models presented in Appendix C comprises a geomembrane overlying a clay layer with k = 1 x 10^{-8} m/s. We adopted this to provide a level of conservatism in the modelled results but again omitted to update the description in Section 4.6 of the report.* *We have now undertaken further modelling as follows:* *i. Original (Model A) with 2 holes per ha (manufacturing and construction defects) overlying a barrier layer with k = 1 x 10^{-8} m/s* *ii. Model B with 3 holes per ha (manufacturing and construction defects) overlying a barrier layer with k = 1 x 10^{-8} m/s.* *iii. Model C with 3 holes per ha (manufacturing and construction defects) overlying a GCL barrier layer with k = 3 x 10^{-11} m/s.* *Case C most closely represents the design liner except that, with the proposed approach which includes an ELLS, we consider that 2 holes per ha is more likely to represent actual conditions.*	Sensitivity of the HELP model has been checked and the proposed design evaluated in comparison. These check details are acceptable.

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<td>The results of this additional modelling are shown below:
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<tr><th>Model</th><th>Average annual seepage (L/d)</th><th>Average seepage maximum year (L/d)</th></tr>
<tr><td>Original model (2 holes/ha)</td><td>3.2</td><td>6.0</td></tr>
<tr><td>Model A (1) (2 holes/ha)</td><td>3.5</td><td>5.6</td></tr>
<tr><td>Model B (3 holes/ha)</td><td>5.2</td><td>8.3</td></tr>
<tr><td>Model C (3 holes/ha + GCL)</td><td>0.24</td><td>0.39</td></tr>
<tr><td colspan="3">(1) Due to the way Visual HELP works it was necessary to recreate the original model to determine the effects of subsequent changes. We were not able to fully replicate the model so the results for Model A differ slightly from those originally reported. Model B has been prepared on the same basis as Model A for direct comparison.</td></tr>
</table>
The results show that, as expected, there is approximately a 50% increase in seepage as a result of increasing the defects from 2 to 3 per ha whilst leaving all other parameters unchanged. However, when the actual proposed liner construction, including the GCL layer, is modelled, the predicted seepage is only approximately 7% of the seepage rates presented for Model A.

Effects assessments have been based on a seepage rate of 6 L/d (maximum year). This is approximately 15 times the expected seepage rate of approximately 0.39 L/d (maximum year), providing a high level of conservatism in the assessment.

The updated HELP modelling results are provided in Appendix C.”</td>
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<td>6</td>
<td>Leachate design flows are calculated from the HELP modelling. The HELP modelling scenarios all assume final capped conditions with only 10 m of waste. The engineering report notes that the maximum depth of waste would be 50 m. Please provide the details of the revised sensitivity of the depth of waste on leachate generation rates.</td>
<td>“Section 5.4 of the Engineering Report describes the approach taken for estimating leachate flow for the new development. The method used describes comparing existing flow data with HELP modelling for the existing areas and then using HELP to provide a means of extrapolating the measured data to apply it to the future development. Using this approach gives us some confidence in the selected design leachate flow rates as existing measured flows provide a calibration.</td>
<td>Sensitivity of leachate design flows are provided and have now been checked. It is shown that the depth of waste has minimal effect.</td>
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		While the Engineering Report gives the maximum depth of waste as 50 m (summary data in Section 1.3) this occurs over a very isolated area towards the south of Stage 3. The typical maximum depth of waste over the entire landfill is no more than 30 m. The depth of waste used for the HELP model typically has little effect on the quantity of leachate generated, and this will typically decrease with the greater waste depth due to the greater flow attenuation provided. To demonstrate this we have taken one of the modelling scenarios (flat slopes on the cap over the landfill floor areas – likely to be the worst case) and re-run it for 30 m depth of waste (rather than 10 m). For that scenario the average annual leachate generation (leachate collected from the drainage layer above the geomembrane) was as follows: • *10 m depth of waste: 291.45727 mm* • *30 m depth of waste: 291.45706 mm* *This shows no measurable change between the two scenarios."*	
7	The layout of the leachate collection system shows the collection pipelines following single contours without an indication of the expected gradients of the collection pipelines. Please provide details of the expected gradients.	*"In accordance with international best practice the leachate pipelines will be laid with a minimum gradient of 2%. Similarly, the minimum surface gradients over which leachate will flow will be formed at 2%.* *The intent of Drawing 1000647.1000-29 was to depict the leachate pipelines being placed at the toe of side slopes. More detailed 3D modelling undertaken for detailed design will more accurately show the breaklines at the toe of the slopes with the correct fall."*	Expected minimum gradients are acceptable and the minimum gradients are to be carried through to the detailed design phase.
8	Details regarding the redundancy of the leachate sump and pumping system are required to evaluate the potential effect of spillage from the leachate sump in the event of pump failure.	*"The leachate pumping arrangement for Area B is the same as that used for Area D. This will comprise two inclined risers laid on the inside slope of the toe bund into a sump at the bottom of the toe bund (inside the landfill). A pump will be installed within each pipe capable of pumping the design leachate flow, i.e. providing 100 % standby capacity. The*	Response is acceptable. Design of the pump station to be confirmed during detailed design. System should include typical measures such as level monitoring and alarms.

		pipework will be configured so that both pumps could operate together if required. There is no risk of spillage as the risers will be laid on the inside face of the toe bund, providing an equivalent 10 m (approx.) deep sump."	
9	Details and calculations regarding the system capacity and leachate water balance are sought to confirm the excess leachate volumes compared with available storage volume to confirm the concept design required leachate storage volumes.	These calculations are described in response to Question 46.	Refer to Question 46.
10	Issues around formalising the existing pit on top of Area A into a new HDPE lined pond are not discussed. Formalising the existing pit into a lined leachate pond will require the excavation of the closed landfill and breaching of the existing cap and the potential effects of this are not discussed. Please provide clarification on the design and how this work is to be carried out in order to assess the potential effects (odour, stability, LFG, etc.)	*"The existing storage pond at the toe of Area A will continue to operate to store the leachate flow from Area A and Area D. This is an HDPE lined pond with a capacity of 3,500 m^3 from which leachate is currently pumped to the irrigation system. The drawings (e.g. Drawing 1000647.1000-31) and the Engineering report describes an additional pond on the surface of Area A to be constructed during 2020. This pond has now been constructed. The pond was formed by lining an existing open liquid waste pit that previously operated at the landfill and that was being used as a leachate storage pond. The works to formalise the existing pond involved only minor earthworks and no disturbance to the Area A landfill cap. It is considered that these works formed part of routine landfill operation activities and are within the scope of the existing resource consent (Consent No. DP040120L).* *This pond will serve as a secondary leachate pond for the operation of the current leachate system and is sized for the current operation of Area A and Area D and the future operation of Area B. While this pond will be used for the management of leachate from the Area B development, it is now an "existing pond" and does not form part of the Area B application. Leachate will be pumped directly from the toe of the*	It appears that the work has already been carried out and therefore clarification is no longer necessary.

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<tr><td></td><td></td><td>Area B landfill to the new pond that has been lined with a composite clay and geomembrane liner."</td><td></td></tr>
<tr><td>11</td><td>The engineering report notes that the location and size of the intermediate bund will be determined at the detailed design stage. However, given that the stability assessment given in the geotechnical report has recommended the incorporation of an intermediate bund for stability reasons, this should be considered part of the conceptual design. The location of the edge of Stage 1 is known and if the intermediate bund is to be located at this edge, then the stability model should re-run with the intermediate bund in the correct location to determine if the FoS remains the same as calculated in the geotechnical report. The stability analysis of this scenario is sought to confirm the results given in the geotechnical report.</td><td>"We have revised the slope stability models for the permanent toe bund design case to reassess the effects of having the starter bund (and associated shear key) act as the intermediate bund. The starter bund will be constructed to an elevation of RL30 m.

The revised models are generally consistent with the original slope stability models. The Factor of Safety for the ULS design earthquake event is slightly reduced but comparable. Yield accelerations (i.e. the ground acceleration required to cause theoretical displacement [FoS of 1.0] remains unchanged).

We have reassessed the expected slope displacements which are consistent with our original range of up to 50mm.

We would stress that the 2-D slope model does not account for 3D buttressing effects of the valley sides, which would be expected to provide significant lateral support to any potential failure scenario. Final design of the bunds will be undertaken at the detailed design stage, at which time the stability modelling should be reassessed.

Summary of updated results:

<table>
<tr><td rowspan="2">Previous Assessment</td><td>Case 5 Seismic Basal Slide (ULS)</td><td>FoS 0.75 @ 0.41g</td></tr>
<tr><td>Case 6 Seismic Basal Slide (Yield)</td><td>FoS 1.00 @ 0.26g</td></tr>
<tr><td rowspan="2">Relocated Bund</td><td>Case 5 Seismic Basal Slide (ULS)</td><td>FoS 0.69 @ 0.41g</td></tr>
<tr><td>Case 6 Seismic Basal Slide (Yield)</td><td>FoS 1.02 @ 0.26g</td></tr>
</table>
Analyses outputs are provided in Appendix D."</td><td>The stability assessment has been revised and the necessary checks carried out. Response is considered acceptable.</td></tr>
</table>

Operations and Maintenance and Waste Acceptance (Appendix B)			
12	Please provide further information on the sources, tonnages and makeup of industrial wastes accepted to the landfill and the waste acceptance principles applied to these wastes to assist in assessing the environmental risks that pertain to disposal of these substances to the landfill.	The MfE waste list (referenced in Appendix Q of the original application) is used to determine whether waste is classified as hazardous and therefore requires treatment prior to disposal. All hazardous waste must be tested and results supplied, which are compared to the TCLP testing criteria for Class A Landfills included in Module 2: Hazardous Waste Guidelines (Mfe, 2004). Waste entering the landfill are recorded against 21 different categories of waste. The RFI response includes a table summarising the waste volumes (tonnes) for each of the 21 categories for 2018 and 2019.	The waste stream make-up is dominated by C&D, C&I and household (83%). Other waste streams – pre-treated hazardous – are identified sufficiently. Response is considered acceptable.
13	Please provide commentary on the previous performance of the landfill operation at the site, including provision of previous monitoring reports that discuss compliance against the consents, to assist in understanding how well the landfill operations have been undertaken in practice. Form this, further refinement of the O & M Manual may be required to address deficiencies that will need to be remedied for activities in Area B.	The response states that the latest monitoring reports are: • HBRC Compliance Monitoring Report for the period 1 January 2018 to 30 June 2019 (prepared by HBRC). • Omarunui Landfill Environmental Monitoring Annual Report 2019 (prepared by Stantec). The response states that the HBRC compliance monitoring report demonstrates full compliance with all consent conditions. The Management Plan (O&M Manual) is reviewed on a regular basis to address changes in the operation of the landfill, changes in regulations or best practice, or in response to any issues that arise.	The compliance reports appear to be high level with little detail to support. O&M Manual may need to be refined to produce more transparent breakdown.
14	Please provide proposed policies and procedures and ongoing reviews for dealing with WAC for emerging contaminants.	All commercial and industrial wastes are subject to waste controls, which consists of evaluating against pre-determined waste acceptance criteria for materials more commonly sought to be disposal at landfill, or on a case-by-case basis for less common waste materials. Specific criteria for many of the emerging contaminants have not been developed due to the large amounts of emerging contaminants, and furthermore many emerging contaminants are rarely elevated above concentrations typically found in general commercial waste to landfill. The approach to waste acceptance is set to screen and testing criteria that would address virtually all wastes other than rare contaminants (e.g. emerging contaminants) from smaller waste delivery that have relatively low impact on the scale of the whole waste mass.	Response is considered acceptable.

		The WAC are linked to MfE criteria. Any update that occurs at a national level and is reflected in a change to MfE criteria will by default also apply at the Omarunui Landfill.	
15	Please provide an updated list of prohibited substances that will apply to wastes disposed of to Area B.	An updated list of prohibited substance, in accordance with WasteMINZ's Technical Guidelines of Disposal to Land (Updated August 2018), is provided in Appendix A of the RFI response.	Response is considered acceptable.
Air Quality (Appendix C)			
General	Refer to Memo dated 30 March 2020 prepared by Deborah Ryan to Greg Shirras. The memo raises generic issues about the air quality assessment that the S92 has not been addressed. My specific concern is the lack of detail and or cross referencing in the air quality assessment to other documents where the detail may exist but would require considerable effort from the reviewer to locate and understand the relevance/application to Area B and/or the impact on consent changes for other areas. There is inadequate information in relation to an odour management plan, contingency procedures, process controls and design, emission controls and engineering risk for system failures (Table 5, MfE GPG for Odour). In our view, the air quality assessment needs to be aligned with other, more detailed, information relating to specific design, monitoring, management and mitigation rather than providing generic statements about minimisation.	These matters were not addressed within the S92 reply	Deb R has started reviewing the related documents e.g. O&M Manual for relevant detail but considers that the links need to be made clearly by the applicant within air quality reporting and/or evidence and notes that gaps may be identified as a result e.g. landfill surface monitoring and trigger levels for odour and consideration of specific mitigation for odour from landfill gas not able to be collected, particularly under katabatic drainage flows as Area B is established. (See further specific comment under topic headings below). Additional gaps noted as: • is weather monitoring (wind direction & strength) done on-site, where addressed in consent/conditions? • Alternative daily covers- some less effective or ineffective for odour therefore are these appropriate?

			• Installing LFG as early as practicable – what does this mean in practice
Dust	A new internal access perimeter road for Area B is also proposed to be located for the long-term along the perimeter of the fill area, which will turn off the main access road from the existing facilities. The perimeter road is proposed to be developed in stages and is proposed to be unsealed all weather access, with additional metalled services roads. Comments are made in the O&M Manual that there are advantages to sealing long-term internal roads.	Not addressed within the S92 reply	Deb R notes that the access road is described in Section 9.4 of the O&M manual, which states that it should be paved and include wheel cleaning measures. It is understood that the access is not altered by this proposal and the potential for dust is covered by the existing air discharge consent, but needs confirmation. Watering and road sweeping are also identified as possible mitigations. Wheel cleaning is discussed in more detail in Section 12 of the O&M.
Odour	T+T states that leachate aeration will be considered but that the current leachate system does not result in adverse odour effects. It appears from the O&M Manual, however, that dissolved oxygen monitoring and aeration is provided for the current leachate pond. Clarification is needed as to how the leachate will be managed to minimise the risk of odour.	Under question 10 of the s92 reply T+T indicates that leachate storage is covered by an existing consent DP040120L. Question 39 of the S92 reply notes the AEE documentation does not include leachate monitoring from the proposed new 4,800 m^3 pond.	Odour management of leachate is not discussed. Needs confirmation for adequacy to deal with additional volumes. Is a consent change needed? See Appendix P – O&M and Table 6 of the AEE. The leachate control system is described in Section 22 of the O&M manual. The manual states that the pond is aerated to maintain dissolved oxygen (DO) levels. DO monitoring and aerator capacity and contingency are not described.

			The Q39 reply indicates that leachate monitoring at the outlet of Area B leachate pond is proposed to be undertaken every six months and includes DO with a detection limit noted as on-site? This needs clarification.
Waste acceptance	Putrescible and particularly odorous wastes are treated as special wastes, requiring pre-approval prior to acceptance so that the potential for odours off site is minimised. The O&M Manual also discusses using alternate working faces and considering the times of day special wastes are accepted as possible mitigations, however, this is not referred to in the air quality assessment.	Not addressed within the AQ S92 reply	Waste acceptance is also described in Section 21.1.2.1 of the O&M Manual, putrescible wastes are identified as offal, sewage sludge and food wastes, which are to be disposed of at the tip face: *"delivered prior to putrefication, and early in the day or at a specified time to allow for immediate burial and cover. Spread into thin layers at tip face and immediately covered with general refuse."* This procedure is unclear and/or appears to be ambiguous and should be clarified. Dust-type waste are identified as being disposed of away from the tip face and are to be:

			"Packaged in secure, biodegradeable packaging, buried in a sheltered are, in trenches dug in refuse, covered immediately without spreading. Not accepted on very windy days. Map area of disposal and avoid disturbing in future. Water sprays may be used to dampen the waste."
Fugitive LFG particularly in early phase	There is either a lack of or limited LFG capture in the early stages of filling, which in our view has the potential for adverse effects due to offensive or objectionable odour. T+T describes that LFG will tend to pool and travel downhill with the katabatic drainage flows but has not specifically assessed the potential of LFG during this phase to impact on amenity at the dwelling at 419 Omarunui Road or further downwind. In our view, the frequency and duration of the events whereby gas collection will be either inefficient or not operating requires further assessment as to the odour impacts.	Not addressed within the AQ S92 reply	Further assessment, consideration, & mitigation is needed.
LFG/ Surface monitoring	That surface monitoring of methane may be proposed to detect cracks or defects in the capping layer so that remediation can	See also question 16	Gas surface monitoring are set out in the O&M Manual. The monitoring programme for the integrity of the final

	be undertaken as required, but this is not referenced in the air quality assessment. The only monitoring proposed in the air quality assessment is by odour complaint.		cover is set out in Section 8.5.3. Inspections are noted as being both visual and with a LFG meter. The frequency is stated as daily or as necessary, and programmed cap inspection (as per resource consent). There is a gap in the current O&M regards Area B and whether the monitoring remains fit for purpose.
LFG Flare	There is a lack of integration of the information relating to LFG combustion in the air quality assessment. The flare is not well described in the air quality assessment, for example, in terms of compliance with the National Environmental Standards for Air Quality (NESAQ). In our view, this should be addressed within the air quality assessment.	See questions 17 to 19	
Mitigation	Minimal to no detail is referenced or provided about what the mitigations mean in practice, for example, management and maintenance of the LFG and flare and/or generator is not well described or otherwise referenced in the air assessment. Therefore, we consider there is a great deal of uncertainty associated with the overall assessment		The application appears to rely on the O&M Manual for detail relating to the management and mitigation of air and odour discharges. The version submitted with the applications contains refences to Areas A & D (but not B), and conditions of consents. Relevant details will need to be updated to ensure that the documentation

	and the recommended mitigation measures. Leachate collection and management is not well described in the air report. The air report identifies that there are no odour issues currently associated with leachate, and that aeration is not undertaken. The O&M Manual, however, indicates that dissolved oxygen monitoring and aeration are in place. In our experience leachate can be a major source of odour if it is inappropriately stored, and this issue should be clearly addressed in the odour assessment and management and mitigation measures, including appropriate consideration of effects resulting from leachate irrigation.		incorporates Area B, and the measures should be assessed to ensure they are appropriate for management of the potential effects at Area B, and expansion of leachate etc.
16	Surface monitoring of methane is not described in the air discharge assessment, but is an important control for odour, and should be included. It is recommended that monitoring for temporary and final cover is needed to identify hot spots and using trigger thresholds set for odour management to identify where remedial action is required. Please provide comment on this.	The S92 reply refers to the existing consent for Areas A and D, Condition 13, and identifies that that consent contains surface monitoring requirements and states that they will be applied to Area B for temporary and final cover.	Are there monitoring trigger levels for final and intermediate cover and are these at a level appropriate for preventing/minimising effects from odour?
17	The standard of the flare specifications and monitoring and maintenance details are not referred to in the air quality	The S92 reply states that the flare meets all of the requirements of Regulation 27(2) of the NESAQ including a temperature of 750^{o}C and 0.5 seconds residence time. T+T states that this is on the basis that the	No supporting documentation e.g. commissioning reports or monitoring results are provided/referenced.

	assessment, which are important for ensuring good operations and minimising HAPs and should be included. Please provide these.	requirements of 27(2) were included in the contract specification for the flare.	
18	The AEE/air quality assessment refers to minimisation of flare outages. Please provide detail on how flare outages will be minimised, including what testing or maintenance will be undertaken to ensure flare efficiency and reliability.	The S92 advises that key instruments monitoring the flare are connected to the SCADA, and that it measures oxygen, temperature, and flare operation, but is not currently alarmed. T + T advises that there is currently a manual check of the parameters by staff throughout the day, with actions taken if anything is out of specification. And they advise that alarms are currently being procured. T+T advises that servicing and calibration of instruments is done under contract every six months. With mechanical equipment serviced as required.	What are the set points and where is this documented? Where is this documented, is there back-up or contingency?
19	How will NESAQ flare standards be complied with (Regulation 27)?	Table 19.1 of the S92 states that a backup flare will be installed to comply with the NESAQ. This flare is intended to start manually when the principal flare is not operating.	When is this programmed to be done?
20	It appears that the flare will burn the majority of the gas i.e. there is not enough generator capacity to handle the gas flow. Since gas flow is permanently going to the flare, Regulation 27(5) requires that a back-up flare be provided, please confirm/clarify the provision for a back-up flare.	T + T advises that at some point an additional gas engine will be installed when sufficient LFG volumes are reached.	Unclear if this would require a consent change.
21	While there is a section on fires included in the O&M manual, there is no mention of fires in the air quality assessment or management of fire risk. Please confirm how fire risk will be mitigated for Area B and what the contingency is for fire.	T + T describes the fire risk as being potentially present from certain wastes. T + T notes that the potential impacts are managed through prevention, monitoring and response. Section 18 of the O&M Manual describes the facilities for fighting fires. T + T summarises the key measures in theS92 response at paragraph 21.	PDP agrees that these represent good practice measures for fire risk management.

22	What is meant by "judicious use" of odour masking or deodorant sprays?	T + T explains that judicious essentially means as required, based on the activity and wind direction, i.e. there is no intent to use deodorising equipment at all times.	This still lacks detail, what methods/how is this deployed/triggered/what chemicals/have they been proven effective/are records kept – how often have they been used in practice?
23	The assessment that the working face size should be minimised appears at odds with the proposal to increase the working face area compared to the current consent. What is best practice for working face size?	In paragraph 23 of the S92 T + T provides an explanation for the open tipping area requirement to be 20 m wide by 60 m or 1200 m^2.	PDP accepts the rationale provided as being a factor for efficient and safe operation, while keeping the working face as small as possible.
Stormwater, Hydrology and Leachate Irrigation (Appendix D)			
24	The Appendix D – Stormwater Calculations of the Engineering Report provides a comparison of peak runoff rates, calculated using the rationed method, for three scenarios. The assessment states that *"design rainfall intensifies were sourced from NIWA's High Intensity Rainfall Design (HIRDs) version 4",* however the rainfall intensities values were not specified. Please specify the rainfall intensities used for the peak flow calculations (Table 3.1). Furthermore, please advise how climate change was accounted for.	The Applicant has clarified that rainfall intensities were derived from NIWA's High Intensity Rainfall Design System V4 (HIRDS v4) for the site. The RFI response states that upon reviewing the data, an error was found in the calculations where the rainfall intensities for the 20 minute duration storm events was used instead of the 10 minute duration storm events. The correct rainfall intensities are included in Table 24.2 of the RFI response. The applicant has also derived rainfall intensities for 11 and 12 minute durations via linear interpolation. The Applicant has clarified that in this portion of the assessment, no allowance was made for climate change as the intent was to determine the predicted increase in flows based on different development scenarios, and there would have been a similar percent change when using climate change rainfall intensities. We note that the Applicant's response to question 25 includes peak flow calculations using historical rainfall data as well as climate change scenarios.	Response considered acceptable
25	Table 2.1 of the Stormwater Calculations states that the slope of Area B in the 'Developed – capped Stage 5' scenario is	The Applicant has updated the runoff coefficients as requested, and updated their peak runoff calculations in Tables 25.1-25.2 in their	Response considered acceptable, however we consider there may potentially be an effect on peak flows

	21%. The runoff coefficient (0.3) does not appear to have been adjusted for the slope. Table 6-1b of the Hawke's Bay Waterway Guidelines Stormwater Management specifies slope corrections for runoff coefficients. Please revise the assessment or otherwise advise why slope correction is not necessary.	response. The applicant has also provided peak flow calculations taking climate change into account. For the historical rainfall data, the calculate peak flows have increased for all development scenarios (existing, intermediate – operational and developed – capped), however the % change has decreased for the intermediate – operational scenario (now +7.9%, previously +17%). For the developed phase, the results now predict a decrease in peak flows (now -9.9%, previously 0%). The Applicant states that by installing contour drains in the cap and/or changing the slope of the perimeter road, the post development flow can be made to equal the pre-development flows, which the Applicant states will be addressed during the detailed design and final closure plan.	from the discharge point to the Upokohino Stream.
26	Table 2.1 of the Stormwater Calculations states that the time of concentrations (t_c) for the various sub-catchments for the three scenarios range from 10 to 12 minutes. Given the size of the sub-catchments, the values for t_c appear to be low. Please confirm the t_c values and any changes to the peak flow, if necessary.	The Applicant has confirmed the t_c values, which were calculated via three methods as recommended in the Hawke's Bay Waterway Guidelines for Stormwater Management.	Response considered acceptable.
27	Please provide an assessment of the capacity of the farm drain (to which the proposed Stage B sediment pond/wetland would discharge to) with reference to the above assessment, in particular with respect to any potential increases in peak runoff as a result of the proposal.	The Applicant's analysis indicates that flow from the three undeveloped valleys contributing to the discharge point at the boundary of the Omarunui Landfill site is greater than 7 m^3/s and greater than 2 m^3/s for the 100 and 2 year events. The farm drain is stated to have a very low capacity (expected to be < 10 L/s) and would be unable to carry even relatively frequent rainfall events from its natural catchment, and therefore most of the flows during significant rainfall events would be overland. The response states that HDC is currently consulting with the property owner and is willing to formalise the drain if this is what the property owner wants. (Also note: the response to Question 25 indicates an increase in peak flows during the 'intermediate – operational' scenario (+7.9%))	Response considered acceptable, but we note the applicant's analysis indicates an increase in peak flows during the 'intermediate -operational' scenario, which suggests a potential increase in flooding around the farm drain.

28	Section 6.6.6 of the AEE states that the southern extent of Area B currently drains to the south, and that this southern portion of Area B will become incorporated into the landfill. Please advise whether the incorporation of the southern portion of Area B has been included in the peak flow calculation (Table 3.1 of the Appendix D – Stormwater Calculations).	The Applicant has clarified which portions of Area B drain to the south and which portions are including the peak flow calculations, as shown in Figure 28.1.	Response considered acceptable.
29	The application states that all short-term drains will be designed for a 10-year ARI event, and all permanent drains for a 100-year ARI event. Based on the information provided in Section 3.5, the expected lifespan of the landfill is approximately 30 years, with 10+ years between Stage 4 and 5. To better understand the proposed drains, and how long the drains would be operational for, a) Please clarify what constitutes a “short-term” drain – how long would a “short-term” drain be operational for (e.g. up to x number of years). Similarly, please confirm what constitutes a “permanent” drain 9e.g. operational for more than x number of years). b) Please provide further details on the (conceptual) design and dimensions of the stormwater drains.	a) The Applicant has clarified that “short-term” infrastructure includes infrastructure around the perimeter of a stage (which could be 2-5 years, or less). It also includes drainage on intermediate cover outside of immediate working areas, which may be present for a few months or for the life of a stage (up to 2-5 years). “Permanent” infrastructure would include infrastructure such as the perimeter access road and perimeter drain, works around stormwater ponds etc., which will be designed for the 1:100 year event. The response notes that occasionally, it might become apparent that some infrastructure may need to be in place longer than the “short-term” scenario, e.g. infrastructure that needs to remain in place for more than one stage, but is not permanent. b) The response states that details and dimensions of all drains will be determined as part of the detailed design, and the Applicant does not consider it necessary to provide that level of detail at this stage and sufficient information is available to understand potential effects of stormwater discharges. Drains will be similar to those currently in place elsewhere on the site. In the absence of further details relating to the design of the stormwater drains, we recommend that the Applicant confirm the design capacity for stormwater infrastructure. This should be	Response considered acceptable, however we recommend the design capacity for stormwater infrastructure be confirmed (i.e. what ARI event infrastructure will be designed to). This should be incorporated as consent conditions (e.g. “temporary drains” sized to at least xx-year ARI event)

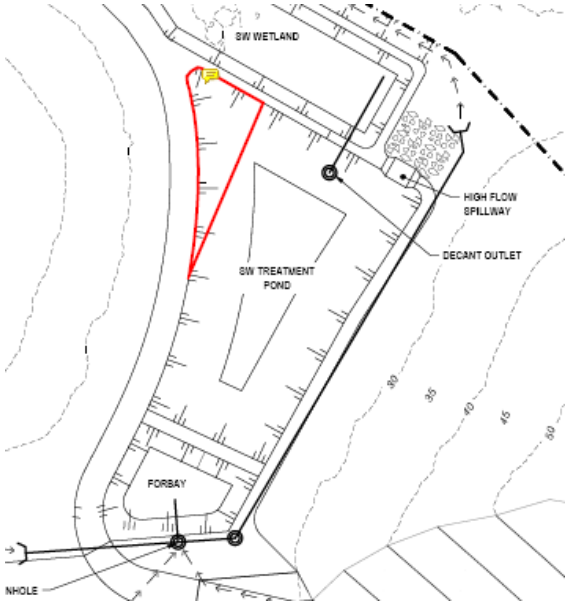
		incorporated as consent conditions, which at a minimum should define what is considered a "temporary drain" and "permanent drain" (i.e. temporary drains present up to 2-5 years) and what the required design capacity is. For example, temporary drains that are present up to 2-5 years shall be sized to at least the 20-year ARI event, and any permanent drains be sized to at least the 100-year ARI event.	
30	The application states that only runoff that has not come into contact with waste will enter the stormwater system. Please clarify what measures are proposed to ensure only clean stormwater is able to enter the stormwater system.	The response states that permanent or short-term drains will be installed around stage perimeters to divert clean water away from operational landfill stages, and to provide conveyance for sediment laden runoff from development areas to the stormwater pond. Measures would typically include cut-off drains to divert runoff away from the landfill working area, and bunds (or similar) downslope of working areas to prevent runoff from working areas from leaving the area. The layout of drains and bunds will need to be determined onsite on an ongoing basis by the operations team depending on the shape and location of the working area/tip head.	Response considered acceptable, and we agree that the layout of bunds, drains and other measures will need to be determined onsite on an ongoing basis in response to changes on site.
31	The application states that the Stage B sediment pond will be designed to meet or exceed the requirements of the Hawke's Bay Waterway Guidelines – Erosion and Sediment Control 2009 ("the guidelines"). The guidelines provide sizing criteria for sediment retention ponds, which were used to size the proposed Area B pond as described in the AEE. The guidelines refer to sediment retention ponds as temporary ponds ,and states that where they are used for more than two years, *"further measures to ensure stability and effectiveness are likely to be needed"*. The	The response states that the expected treatment efficiency of the Area B pond is 75% for sediment removal. The wetland provides additional polishing of the outflow from the Area B pond. The size of the wetland has been maximised subject to site limitations. The response states that the wetland has been designed to treat the Water Quality Volume (V_{WQ}), in accordance with the Hawkes Bay Waterway Guidelines – Stormwater, calculated to be 865 m^3. The wetland has been designed for an average depth of 0.75 m and 1,140 m^2 surface area. The expected treatment efficiency when the Area B pond and wetland operate in series is stated to be 95%.	Response considered acceptable, but we recommend a consent condition be included requiring a minimum level of sediment removal for the pond and/or a maximum TSS concentration in the treated discharge.

	application states that the proposed Area B pond will form the basis for sediment treatment for all works within Area B. Area B is expected to provide approximately 30 years of landfill capacity, which suggests the pond will be operating for at least 30 years. To understand the operation of the pond and the potential effect on the receiving environment, please specify:	We note that a 75% treatment efficiency for sediment removal for a stormwater pond seems quite high and may prove difficult to achieve. However, if sediment removal is indeed found to be lower than 75% (via monitoring), consideration could be given to the use of flocculants and coagulants if required. In order to ensure that stated efficiency is achieved, a consent condition could be included requiring that the Area B pond achieves a minimum of 75% sediment removal and/or specify a maximum TSS concentration, which should be monitored as part of the stormwater monitoring requirements.	
	a) What is the expected treatment efficiency of the Area B pond and wetland;		
	b) What ARI storm event the sediment pond is able to accommodate;	The Applicant has confirmed that the Area B sediment pond (and associated hydraulic structures) will be designed for the 1:100 year event (3.14 m^3/s). The pond's decant will be sized for approximately 3 L/s per hectare of contributing catchment, with excess flows spilling over the spillway (and bypassing the wetland). Elsewhere, in response to Question 32, the Applicant has stated that if the proposed pipe (from the Area C valley) were to become blocked, flows would enter and flow through the Area B pond and discharge via the spillway and bypass the wetland. Based on the response to Question 32, the high-level spillway should be designed to be able to pass flows from Area B and the Area C catchment to the 1:100 year event .	Based on the response to Question 32, we consider that the high-level spillway should be designed to pass flows from the Area B and C catchments to the 1:100 year event.
	c) An indication of the likely performance of the sediment pond during storm events greater than the design storm, and/or how these peak flows will be managed and/or if they will mobilise contaminants in the sediment pond and/or wetland;	The response states that for storms in excess of the 10 year event, flows will bypass the wetland, indicating that storms up to and including the 10 year storm would pass through the wetland. In order to assess the potential for sediment and contaminants becoming re-entrained, the Applicant has calculated the peak flows in the Area B pond and wetland. For the Area B pond, the flow has been calculated to be 0.03 m/s during the 1:10 year event and 0.05 m/s during the 1:100 year	Response considered acceptable.

		event. For the wetland, the flows are reported to be 0.1 m/s during the 1:2 year storm and 0.2 m/s during the 1:10 year storm. Based on the calculated peak velocities, the applicant considers remobilisation of sediment unlikely. We agree with the Applicant that the calculated velocities are sufficiently low to reduce the risk of remobilising sediments and contaminants.	
	d) How the potential risk of spills, for example form machinery and vehicles operating during the construction and operation of the landfill will be managed;	The Applicant responded that the existing Landfill Management Plan includes spill response measures, which will continue to be implemented during Stage B. The Applicant therefore considers the existing controls are appropriate, and does not propose any changes. Section 6.8.2 of the original application refers to the Omarunui Landfill Management Plan in Appendix 24 of the Proposed Hastings District Plan. We have checked Appendix 24 of the Proposed Hastings District Plan, and we could not find any reference to the potential risk of spills. However, Appendix F of the original application contains the O&M manual for the landfill, which in 'Section 20.3.13 Accidental Spillage of oil or Grease within site' states: "*Ensure material does not enter the vegetated area by isolating the stormwater pond. The material is to be skimmed or pumped off and deposited in the landfill. Use spill kit in the staff compound to contain spills in the compound area. Refer to Emergency Management Manual – see Landfill Fires section of this manual same link*" It appears the Applicant's response intended to refer to the O&M manual. Clarification from the Applicant is therefore requested if our interpretation is correct. If yes, we note that the Applicant has stated the existing controls will remain in place, which as per above includes isolating stormwater ponds if necessary, use of spill kits, and/or skimming/pumping of the spill. We would therefore consider the	Clarification sought from Applicant. If our interpretation of the response is correct, then we consider the existing controls are sufficient, however O&M manual should be updated to specifically address the risk of spills in Area B.

		existing controls to be adequate, however recommend a consent condition requiring that measures to address the risk of spills, including for Area B, be specified in the O&M manual.	
	e) How the potential risk of run-off or additional leachate generation will be managed in the event of landfill fires, with consideration of the potential contaminants contained in this. There is some information on this in the O&M manual but specific information for Area B is required;	The response states that fires requiring a response by the Fire Service and fire-fighting using water are rare at the Omarunui Landfill, with one event approximately 3 years ago in Area D and a significant fire in Area A approximately 15 years ago. Minor events, where the operator notes small whiff of smoke and uses the excavator to extinguish the potential fire with soil, occur on a more regular basis. The Applicant states neither of the two events led to a discharge to the stormwater system. Fires would typically occur in the open waste area, and any water applied to the open area would flow down through the waste through the leachate system. Where a fire occurs in a covered area, the cover would be removed to allow fire-fighting water to reach the fire. Water applied would similarly flow through the leachate system.	Response considered acceptable, risk of additional leachate controlled via landfill operations. Consider whether it may be appropriate to check (visually) for runoff, and if runoff from firefighting enters the stormwater system, collecting a sample (if safe to do so).
	f) The expected sediment load of treated stormwater discharged to the unnamed farm drain. How much sediment is expected to deposit in the unnamed farm drain and the Upokohino Stream;	The Applicant has estimated sediment loss based on Universal Soil Loss Equation (USLE) calculations. Assuming the whole landfill cell is open without any stabilisation in place, the total sediment load is 17 tonnes/year, representing an increase of 4 tonnes/year (compared to 13 tonnes/year from the existing pasture. The Applicant states this is a very conservative assessment, as it is unlikely the site would be operated without any additional controls (e.g. progressive stabilisation, interim sediment ponds, minimising open areas, etc.) and the actual sediment load would be significantly less.	Response considered acceptable.
	g) Please provide details of when/if accumulated sediment would be removed from the proposed sediment pond and wetland;	The response states accumulated sediment will be removed once it reaches 20% of the design volume. We agree this is appropriate.	Response considered acceptable.

	h) Does the proposed geometry of the Area B sediment pond (i.e. the non-rectangular shape) affect the expected treatment efficiency of the pond;	The response states that while the geometry is not ideal, the design is based on providing the design volume within the space available, however the Applicant considers it suitable given that the width increases towards the outlet (thus decreasing velocities). During detailed design, the Applicant will make changes to the design geometry to the extent possible to soften the sharp corner the north-west corner of the pond, and locate the decant outlet manhole more centrally. The Applicant considers that the pond can be operated without a decrease in efficiency. We agree that while the pond geometry is not necessarily ideal, it has been designed within the site constraints, and agree that the width increase towards the outlet end of the pond being beneficial in reducing velocities and thus aiding settling of sediments. However, given pond's current geometry, we expect that the north-west corner would reduce the effective area of the pond, and increase the surface overflow rate (SOR). The surface area of the pond, as measured from drawing 1000647.1000-30, is approximately 3,200 m^2. The north-west corner, which is anticipated to effectively become dead storage, is approximately 300 m^2 (as shown in the below screenshot) which would represent an approximately 9% decrease in the pond's effective area. The peak design flow for the Area B pond is reported to be 3.14 m^3/s for the 100 year event, and the surface overflow rate would increase by approximately 10% when adjusting for the 300 m^2 north-west corner of the pond (SOR increases from 0.00981 m/s to 0.00108 m/s).	We consider the pond's geometry may affect the treatment efficiency, however measures would be available to address this (operational changes, consideration of flocculants and coagulants, etc.)

		 Based on this, we consider that the pond's geometry could potentially affect the level of treatment efficiency, and the stated efficiency is therefore not a conservative estimate. However, as discussed in relation to Question 31a), a consent condition could be included requiring that the Area B pond achieves a minimum of 75% sediment removal and/or specify a maximum TSS concentration; if the system is unable to achieve this requirement, the Applicant could consider further measures such operational changes, the use of flocculants and coagulants if required, etc.	
	i) Appendix D – Stormwater Calculations of the Engineering Report notes that the sediment pond and wetland would provide additional storage capacity and could cause a further lag in the stormwater	The response states that for smaller rainfall events from Area B, flows will be attenuated by the Area B pond. For larger events the attenuation volume of the Area B pond would be quickly exceeded, and flows would discharge over the spillway. The Applicant notes that the	Based on the information provided, PDP is unable to assess the Upokohino Stream's ability to flush accumulated sediments.

	runoff and potentially reduce the peak flow rate for smaller storm events. Please advise whether the pond and wetland are expected to attenuate flows, and what impact, if any, this may have on the ability of the farm drain and the Upokohino Stream to flush accumulated sediments.	flow from Area C and the valley to the north of Area C, which all discharge at the same location, will not be attenuated, and the combination of these flows is significantly larger than that from Area B. Furthermore, elsewhere the Applicant has also stated (Question 27) that the existing farm drain is expected to have a very low capacity (< 10 L/s) and would be unable to carry even relatively frequent rainfall events from its natural catchment, with most of the flows during significant rainfall events would therefore be overland. The Applicant has provided a qualitative assessment in response to this question. Based on the information provided by the Applicant, we consider there is unlikely to be an adverse effect on the farm drains ability to flush accumulated sediments. However, given the lack of a quantitative assessment of the potential effect on the Upokohino Stream, we are unable to assess the potential effect on the Upokohino Stream's ability to flush accumulated sediments. We also note that based on the information provided in response to Question 25, we consider there may potentially be an effect on peak flows from the discharge point to the Upokohino Stream, namely a decrease in post development flow (noting that the Applicant states this could be addressed during detailed design and the final closure plan).	
32	Section 6.6.6 of the application states that the proposed Area B sediment pond will block the outlet from the Area C valley, and that it is proposed to install a pipeline within the pond bund to by-pass the Area B sediment pond and discharge to the farm drain downstream of the pond. Please provide details on the proposed bypass pipeline, in particular what the design capacity will be and what the implications would be if the pipeline failed or the	The Applicant has undertaken a high-level pipe sizing calculation and has determined a DN1200 concrete pipe (Titan 1200 Class 2 or similar) is sufficient. The pipe has been sized for the 1:100 year event, the flows for which have been calculated to range between 2.77 m^3/s (historical rainfall data – no climate change allowance) to 3.74 m^3/s (RCP8.5 2090). The Applicant states that the top of the Area B pond's embankments are likely to be 26 m RL, and at this level the flow through the DN1200 pipe is significantly higher than the design flow. If the pipe were to become blocked, flooding in Area C would overtop the Area B pond's embankments, flow through the pond and discharge over the spillway (thereby bypassing the wetland).	Response considered acceptable, and we agree it is appropriate to confirm the final design details during detailed design.

	capacity was exceeded (e.g. potential flooding, potential for washing out the sediment pond or wetland).	The Applicant states that the design of the pipe will need to be confirmed during detailed design. We consider this provides sufficient information at this stage, and that it is appropriate to confirm the final design details during detailed design.	
33	The application states that visual checks of the landfill surface will be carried out on a regular basis to check for any potential leachate breakouts. Please specify what the proposed frequency of the visual inspections are to be.	The response states that visual inspections of the landfill surface are currently undertaken daily, which are manually recorded on daily inspections sheets and later transferred to the "Infrastructure Data" computer system used by HDC. Similar inspections will be undertaken for Area B.	Response considered acceptable, and we agree this is appropriate.
34	Please advise if and what type of regular inspections are proposed for monitoring the stormwater system (stormwater drains, sediment pond, etc.).	The response states that visual inspections of the stormwater system are currently undertaken daily, which are manually recorded on daily inspections sheets and later transferred to the "Infrastructure Data" computer system used by HDC. Similar inspections will be undertaken for the Area B stormwater system. We agree this is appropriate.	Response considered acceptable, and we agree this is appropriate.
35	The proposed stormwater monitoring (Table 6.1 of the AEE) specifies stormwater monitoring at six monthly intervals for water clarity, pH and conductivity. If the stormwater system were to be impacted by leachate, the proposed sampling would only detect such impacts after potentially six months. Please clarify why more frequent sampling was not considered appropriate, or potentially continuous monitoring of pH and conductivity, which could detect leachate impacts more quickly and allow a more rapid response.	The response states that the proposed monitoring was based on the requirements of the existing resource consents, however agrees that a more immediate indication of potential leachate contamination is required. The applicant has therefore proposed to undertake continuous monitoring of conductivity where flows enter the Area B pond. The output of the conductivity probe would be linked to the site telemetry system. The Landfill Management Plan will specify the trigger level, which the Applicant states is typically 1,000 µS/cm. If the trigger is exceeded, a response would include an immediate visual inspection to determine any potential leachate sources, with any defects found being immediately rectified, and sampling the stormwater inflow to deduce whether the high conductivity is likely due to leachate or another source.	Response considered acceptable.

		We agree that the proposed continuous monitoring of conductivity, and the proposed typical response to an exceedance, are appropriate.	
36	The proposed stormwater monitoring (Table 6.1 of the AEE) specifies that *"a more extensive suite"* will be analysed on a yearly basis. Please advise which parameters are proposed to be included in the "more extensive suite".	The applicant has clarified which parameters are proposed, which are based on Condition 14 of existing consent DP040121Wa. We note that the current consent is DP040121Wb, which lists the same parameters as DP040121Wa however includes one additional parameter (absorbance). While we consider that the proposed parameters are appropriate, we note that no heavy metals are proposed. In response to question 44, the applicant has calculated that over 35 years, chromium may accumulate in the landfill cap soils to a level exceeding the Environmental Investigation Level of 230 mg/kg. To demonstrate that the leachate irrigation activity is not having an effect on runoff/stormwater quality, it would be prudent to include heavy metals in the stormwater monitoring suite (Al, As, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Ni, Hg, Zn).	We recommend the "more extensive suite" include heavy metals. See the response to Question 45 on potentially including emerging contaminants.
37	Section 10.6.2.2 of the application proposes to *"monitor spray drift under different weather conditions for the potential to enter stormwater drains to the extent that this may cause contamination".* Please provide further details of what spray drift monitoring is proposed, and how this will be undertaken to avoid spray drift from potentially entering any temporary or permanent stormwater drains.	The Applicant states that leachate irrigation has been undertaken across Area A since 2016, with no issues relating to spray drift reported. The operators check wind conditions and weather forecasts prior to starting leachate irrigation each day. If the operator considers that wind conditions are sufficiently strong that spray drift may enter the buffer area then irrigation does not occur. If irrigating, the operator observes the extent of spray drift at the start of irrigation; if the wetted perimeter comes within 10 m of surface water drains, irrigation either ceases or the irrigators are moved. The operator checks the irrigation activity throughout the day. Moreover, the Applicant states the majority of irrigation areas are separated from surface water channels. We consider that the above measures are appropriate, and help to reduce the potential for spray drift. However, we recommend that a	Response considered acceptable, however we request that the applicant proposes a maximum wind speed above which irrigation ceases (based on drop sizes and calculated travel distances). Spray drift monitoring procedures should be included in the O&M manual.

		consent condition should be included stating a maximum wind speed, above which leachate irrigation should cease. We request the Applicant propose a limit which they consider appropriate, which should be based on drop sizes irrigators and calculated travel distances. We also recommend that a consent condition be included that requires spray drift monitoring procedures to be detailed in the Landfill Operations and Maintenance Manual.	
38	Section 6.6.6 of the application states that it is proposed to divert run-off water from Area C around the Area B sediment pond, and that clean water diverted from the Area B site will also be diverted to this by-pass where possible. Please advise how it will be determined whether runoff can be diverted to this by-pass, and whether any further ongoing monitoring is proposed to monitor the quality of water diverted by this by-pass.	The Applicant's response states that "clean water" in this context means runoff from vegetated surfaces of the landfill surface, or vegetated surfaces on completed areas of landfill cap. Water is considered "clean" solely from the vegetation cover on the contributing catchment. In their response, the Applicant has not proposed any monitoring of the diverted "clean" runoff. We agree that runoff from upstream catchments (upstream of landfill areas) that has not come into contact with the landfill should be diverted from the landfill to avoid overburdening the stormwater system. However, for runoff generated from vegetated surfaces of the landfill surface, we consider that monitoring is appropriate to confirm the runoff is not potentially impacted by leachate, for example from any potential seeps of leachate. The proposed monitoring (i.e. no monitoring of the diverted "clean" water) would not identify any such potential leachate impacts. Moreover, the response does not state whether "the vegetated surfaces on completed areas of landfill cap" includes or excludes areas where leachate irrigation is proposed to occur. We consider that runoff from the Area B landfill that is proposed to be diverted to the by-pass should be monitored, and request that the Applicant confirms whether areas where leachate irrigation is proposed are included in the "vegetated surfaces on completed areas of landfill cap ". We recommend that monitoring include conductivity, ammonia-N, nitrate-N and suspended solids at a minimum to confirm diverted runoff from Area B is "clean". However, should runoff from areas	We consider there is a potential risk, and monitoring should be undertaken to confirm that "clean water" is not impacted by leachate irrigation.

		recently irrigated with leachate also be diverted via the by-pass, then the monitoring should include the full suite of parameters for stormwater monitoring.	
39	The Operations and Maintenance Manual (Appendix P) specifies leachate monitoring of the existing leachate collection pond, in accordance with the existing consent DP040120Lb. The proposed environmental monitoring (Table 6.1 of the AEE) does not include leachate monitoring from the proposed new 4,800 m^3 pond. Please confirm whether it is proposed to monitor leachate from the new 4,800 m^3 leachate pond, and what parameters would be included, or otherwise clarify why this is not considered necessary.	The Applicant states that any monitoring of leachate is undertaken only to determine whether there is any change in the characteristics of the leachate over time that may impact on any treatment or disposal of leachate, and provides useful information. The Applicant proposes to monitor leachate at the outlet of the pumping main from Area B, and at the outlet of the Area B leachate pond at six monthly intervals. The analysis will include a range of parameters as summarised in the Question 39 table in the response.	Response is considered acceptable, however it may be beneficial to monitor more frequently (e.g. quarterly) and monitor for specific emerging contaminants such as PFAS (to be discussed at meeting).
40	The application proposes a 10 m separation distance between the spray zone and stormwater drains. To better understand the proposal and potential effects, please advise: a) Whether the 10 m separation distance applies to permanent stormwater drains only, or whether this applies to all drains (including temporary stormwater drains). It is noted that existing condition 4 of DP 160044L does specify 10 m from any stormwater drain, overland flow paths or other surface water body.	a) The Applicant has clarified that the 10 m separation distance applies to any stormwater drain (including temporary), overland flowpaths or other surface water body. b) The Applicant states that leachate irrigation has been undertaken since 2016 in Area A, with a 10 m separation distance from surface drainage, and reports that contaminants have not been reported in stormwater over this period. The risk of contaminants entering stormwater is also reduced by monitoring requirements, including sampling stormwater drains and daily visual inspections of the irrigation system. The Applicant concludes that the 10 m separation distance is therefore appropriate. As noted in our assessment of the response to question 37, we request that the applicant provide calculations of travel distances of drops from	a) Response considered acceptable. b) See question 37 regarding calculating drop travel distances and max. operating wind speed. We recommend soil moisture monitoring, at least for sloped areas, and furthermore that if a flow is observed in stormwater drains during dry weather, a sample be collected.

	b) Why a 10 m separation distance is sufficient, taking into account slopes of the areas proposed to be irrigated in Area B and the potential from contaminants to be entrained in the runoff (as shown in Drawing 1000647.1000-31).	irrigators to help demonstrate why a 10 m separation distance is considered sufficient under proposed maximum operating wind speed. We consider that there is a potential risk for contaminants to enter stormwater drains (either via runoff, or potentially via interflow as discussed in question 41), in particular where irrigation occurs on sloped areas of up to 1V:5H – 1V:4H, given the slope 10 m distance between the irrigation activity and stormwater drains. To mitigate this potential risk, we recommend that should irrigation occur on these sloped areas, buffer distances should be increased for sloped areas, and soil moisture probes and/or a soil moisture deficit calculator be developed to check soil moisture conditions each day to help inform what level of irrigation is appropriate for that day. We note that this is in line with the Applicant's response to question 46, where the Applicant has stated that the use of tensiometers could be considered to optimise leachate irrigation. In response to question 34, the Applicant advised that the stormwater system, including stormwater drains, will be visually inspected on a daily basis. We recommend that should a flow in stormwater drains be observed during dry weather conditions, then a sample be collected from the drain and should the results be indicative of leachate impacts, then leachate irrigation shall cease until the cause of the seep is identified and rectified.	
41	Please advise whether the potential for leachate impacted water to enter stormwater drains via interflow through the growth layer of the capping layer has been considered, and how this potential risk has been mitigated or avoided.	The Applicant considers this an unlikely path for leachate contamination of stormwater drains, as generally leachate would be irrigated when soil is below its field moisture content and leachate would be stored in upper layers, later lost by evapotranspiration. Furthermore, irrigation would occur over a large surface area, much larger than the cross-sectional area of the capping layer downstream of	We consider that a risk exists, which may be able to be mitigated via increasing buffer distances in sloped areas and soil moisture monitoring (see response to question 40)

		the irrigation area. When the upper layer becomes saturated, surplus leachate would preferentially flow vertically downwards. Any leachate seeping through the upper layers in such a manner would be minor, and would furthermore flow through 10 m of soil (thereby removing contaminants) before entering a stormwater drain. The Applicant concludes any seepage would be very minor compared to flows in the drain. The applicant has provided a qualitative response to this question. However, given that irrigation is proposed on sloped surfaces of 1V:5H-1V:4H, and the Applicant's proposed buffer distance is 10 m, we consider there is a potential risk for leachate impacted water to drain to stormwater drains via interflow or runoff. As outlined in our assessment of question 40 above, we recommend buffer distances be increased where irrigation occurs on sloped areas, soil moisture probes and/or a soil moisture deficit calculator be used. Furthermore, if a flow is observed in stormwater drains during dry weather conditions, a sample be collected from the drain and should the results be indicative of leachate, irrigation ceases until the cause of the seep is identified and rectified.	
42	The application proposes a maximum leachate irrigation of 3 mm/day. Section 5.5.3 of the Engineering Report includes the results of an irrigation capacity versus leachate storage volume assessment, and Section 5.2 provides reductions in leachate irrigation capacity during wetter months which are reported to have been back calculated from the existing leachate irrigation activity. In order to better understand the potential risk of leachate	The Applicant has undertaken soil moisture deficit modelling using daily rainfall data from NIWA's Cliflo station 2980 (Napier Aero Aws; located 12 km away) from the past 20 years and Penman Potential Evapotranspiration data from NIWA's VCSN (2 km north of the Landfill). The modelling uses a maximum irrigation rate of 3 mm/day; the optimised irrigation rate is calculated each day based on the previous day's soil moisture deficit value and the current day's rainfall and evapotranspiration data.	The response is acceptable. We consider there is a potential risk of leachate impacts in stormwater, however our recommendations for stormwater monitoring (questions 35-38) and soil moisture monitoring (question 46) will help address this risk.

	generating runoff or becoming entrained in stormwater runoff, please provide details of soil moisture deficit modelling to justify why the proposed irrigation rates are suitable, how irrigation rates will be managed in consideration of potential lower permeability cap rates, and how the risk of leachate being entrained in stormwater runoff will be mitigated or avoided.	The modelling assumed a maximum drainage capacity of 8 mm/day, based on a permeability of 1 x 10^{-7} m/s in the layer below the soil. The model allows for up to 8 mm/day of drainage as an output, with any excess attributed to surface runoff. The modelled allowable irrigation is summarised in Table 42.1 of the RFI response, with average daily irrigation rates ranging from 20% in June to 97% in January of the proposed maximum daily rate of 3 mm. The average % of maximum daily irrigation is generally lower than what was previously assumed in the original AEE, and the implications of this are considered in response to Question 46. Modelling results are illustrated in the Appendix E graphs, which indicate that the irrigation activity will result in additional runoff being generated. We consider the soil moisture deficit modelling undertaken by the Applicant to be adequate. Based on the modelling results, we consider there is a potential risk of leachate impacts in runoff generated from rain falling on recently irrigated areas. The stormwater monitoring, as recommended in PDP's assessment of the responses to Questions 35, 36 and 38 will help detect any such potential leachate impacts. Furthermore, in response to Question 46, the Applicant has stated that the use of tensiometers could be considered to optimise leachate irrigation. We recommend that where irrigation occurs on sloped surfaces (up to 1V:5H), soil moisture probes and/or a soil moisture deficit calculator be used to help inform the irrigation rate for the day.	
43	The irrigation of leachate has the potential to lead to an accumulation of sodium in soils in the proposed irrigation areas. Please provide an assessment of the	The Applicant has calculated the sodium adsorption ratio (SAR), using the most recent leachate analysis data from the Omarunui Landfill (11 October 2019), giving a SAR of 48.6. The Applicant states that an	Response is considered acceptable, however we recommend annual soil sodium and permeability monitoring.

	potential for sodium accumulation within the proposed irrigation area soils, and any potential increase in the exchangeable sodium percentage (ESP) and any potential effect on surface soil permeability and generation of runoff. Proposed sodium mitigation measures are also requested.	acceptable SAR for silty loam (which is expected in the Landfill cap) is in the range of 8 to 20, indicating that the calculated SAR is high and could lead to soil sodicity, which could decrease soil permeability. The Applicant suggests that the proposed low irrigation rates will reduce this effect, however acknowledges this will need to be carefully monitored over the operational period of the irrigation system. If required, corrective actions would be undertaken which could involve the application of calcium to ameliorate sodicity. We agree that soil permeability will need to be monitored over the operational period of the irrigation activity. It is therefore recommended that annual soil sodium and permeability monitoring is conducted within the irrigation areas, along with a non-irrigated areas (as back ground), assessing for the exchangeable sodium percentage (ESP) and top soil and sub soil (K_{sat} and K_{-40}) hydraulic conductivity. Monitoring shall be representative of the entire irrigation area, with composite samples for ESP monitoring and at least 6 cores collected for top soil and 6 cores collected for subsoil K_{sat} and K_{-40} analysis.	
44	The irrigation of leachate furthermore has the potential to lead to the accumulation of heavy metals in soils with the proposed irrigation areas. Please provide an assessment for the potential of heavy metal accumulation, and whether this may have an effect on vegetative cover landfill cap or on the quality of stormwater and the receiving environment, associated with runoff.	The Applicant has calculated the expected accumulation of heavy metals in the landfill cap as a result of leachate irrigation, using the average leachate heavy metals concentrations over the period 2001-2019. The calculations are based on the assumed irrigation rates as presented in the original AEE; as per the response to Question 42, the irrigation rates have been decreased based on soil moisture deficit modelling, thus the heavy metal accumulation calculations are conservative. The calculations (Appendix F of the RFI response) assume that the suspended metals mix with the 100 mm of topsoil in the landfill cap, and dissolved metals concentrations partition in accordance with the Soil-Water Partition Equation. The results are summarised over 100	We recommend monitoring of heavy metals as part of the stormwater monitoring.

		years, at year 35 (corresponding to the consent period) and year 100. The results suggest that arsenic, cadmium, copper, lead, mercury, nickel and zinc remain below the NES Soil Contaminants Standards for recreational land use, and Ecological Investigation Levels at 35 and 100 years, however chromium is predicted to exceed the Environmental Investigation Limit at year 35 (492 mg/kg) and year 100 (515 mg/kg). The applicant states that the restriction of irrigation to times when the cap is not saturated, and vegetative cover of the cap, mean elevated contaminant concentrations are not expected in the runoff. In order to confirm the absence of elevated heavy metals in stormwater runoff, we recommend the addition of heavy metals in the stormwater monitoring suite as described under Question 36.	
45	Please provide information on the risk of other contaminants including emerging contaminants, accumulating in soils, being entrained in runoff or being discharged from the underdrainage system, in line with PDP's review memorandum of the waste acceptance criteria.	The Applicant expects that emerging contaminants would behave in a similar manner to the predicted behaviour of metals, as described in response to Question 44, namely that with low irrigation rates of leachate, there would not be significant accumulation in the landfill cap. Using PFAS compound concentrations as reported by Gallen *et al.* (2007), and assuming equilibrium partitioning, the Applicant has calculated that PFAS compounds in the landfill cap are predicted to accumulate to 1 µg/kg or less. The Applicant concludes that with the vegetation of the cap and restricting irrigation to times when the cap is not saturated, elevated concentrations are not expected in stormwater runoff.	Response is acceptable. To discuss whether specific emerging contaminants (e.g. PFAS) should be monitored.
46	The Engineering Report specifies that the average leachate generation rate, as modelled in HELP, is expected to be 105 m^3/day during Stage 5 of the landfill (estimated filling period of 2043 to 2060). Please provide further details on the design	The Applicant has provided leachate water balance calculations in Appendix G of the RFI response. These calculations have been updated using the percentage irrigation for an 'average year' as described under Question 42. Analysis undertaken by the Applicant using HELP indicates that over the 50-year period modelled, the leachate generation for the	Response is acceptable.

	of the leachate system, in particular with reference to the risk of leachate spilling and whether this could enter the stormwater system should the design capacity of the system be exceeded (for a year with greater than average rainfall), or in the event of a leachate pump failure.	peak rainfall year is 1.58 times that of an average year. Based on this, the Applicant has undertaken leachate water balance calculations for three scenarios: 1) average rainfall year, 2) high rainfall year (1.25 x average rainfall) and 3) peak rainfall (1.58 x average rainfall). The total existing leachate storage is 8,800 m^3 (3,500 m^3 + 5,300 m^3). The Applicant's calculations indicated that under the third scenario for peak rainfall, an additional 5,800 m^3 of storage would be required. The Applicant states that until this additional storage is provided, surplus leachate would need to be tankered off site during peak rainfall years. This practice currently occurs when the leachate system capacity is exceeded, and has been required on a number of occasions in recent years and remains as a contingency action for ongoing operation of the Landfill. The Applicant considers that with this contingency in place, there is no potential for excess leachate to enter the stormwater system. When the existing leachate ponds are nearly full, action is taken to provide additional capacity (by trucking leachate offsite). Furthermore, if necessary, pumping of leachate from the landfill can be halted for a short period to prevent any overflows while tankers are arranged. To minimise the cost associated with tankering, the Applicant may consider constructing an additional leachate storage pond , however, this does not form part of the current application.	
47	Please provide details of a refined irrigation area to optimise the proposed leachate irrigation area but minimise irrigation of steep slopes.	The Applicant has advised that the landfill cap topographical model has been updated, and based on the new contours the irrigation area has been modified slightly (as per Drawing 1000647.1000-31, appended to the RFI response) to achieve the areas described in the report and make	We consider that a slope of 1V:4H is steep, and irrigation should be restricted to slopes of 1V:5H or less. Aqualinc (2017)[1] suggests a slope of < 20°.

[1] Aqualinc 2017. Guidelines for Reasonable Irrigation Water Requirements in the Otago Region. Prepared for Otago Regional Council.

		most use of flatter portions of the Area A and Area D cap. The Applicant states it is not intended to irrigate on steep slopes; instead, completed cap areas will be irrigated with slopes on the upper surfaces of approximately 1V:20H and on the sloping faces of the fill with slopes typically of 1V:5H but up to 1V:4H in places.	
48	In line with the geotechnical review further information request, please provide details on the calculations regarding the system capacity and leachate water balance to confirm the excess leachate volumes in a year with greater than average rainfall compared with available storage volume to confirm the concept design required leachate storage volumes. The highest year on record rainfall needs to be included in this calculation with allowance for climate change.	The Applicant has stated that this question has been answered as part of Question 46. The response the Question 46 models a 'peak rainfall' scenario based on the HELP analysis, which indicated a 1.58 increase in leachate generation during the peak rainfall year compared to the average leachate generated.	The response does not address climate change, and we request that the applicant undertake an assessment with an allowance for climate change.
49	Also, in line with the geotechnical review further information request, please provide details on the design of the proposed new leachate storage lagoon and how the potential for differential settlement will be managed, particularly in relation to the storage lagoon liner integrity.	The Applicant has clarified that the pond is not part of the application, and has already been constructed. Based on this, Question 49 is no longer relevant.	It appears that the work has already been carried out and therefore clarification is no longer necessary.
Surface Water Quality and Ecology (Appendix E)			
50	The assessment provides a good baseline overview of the Upokohino Stream, detailing its existing condition and the proposed effects from stormwater. It is noted that this assessment has been conducted during summer low flow	*"Our ecological site assessment was undertaken during the summer period which is good practice for stream assessments and appropriate for assessing receiving environment ecological values. Our assessment of the magnitude and level of ecological effects for the proposed stormwater discharge focusses on fine sediment, considers event-based discharges, the proposed erosion and sediment controls and the*	The Applicant has reiterated that *"any effects are not expected to extend past the mixing zone within the Upokohino Stream and very unlikely to extend to*

	conditions with dry reaches downstream. Although this is the correct procedure for ecological surveys, higher water flows are likely to be present when stormwater runoff is occurring and therefore an assessment of the potential effects over a wider time period, with discussion on downstream transport and cumulative effects to downstream receptors is required.	*proposed stormwater treatment system. Our effects conclusion is relevant to all receiving environment flow scenarios.* *The proposed stormwater treatment system is described in detail in Section 7 of the Engineering report (Appendix I to the application) with summary information provided in Section 3.2.2 of the Ecology report (Appendix L to the Application). The stormwater treatment pond is designed with storage to allow for regular rainfall events. Stormwater will be treated in the sediment pond and a polishing wetland prior to discharge to the Upokohino Stream, and the potential for elevated sediment discharge to the Upokohino Stream is low.* *We maintain our view that any effects are not expected to extend past the mixing zone within the Upokohino Stream and very unlikely to extend to the Tutaekuri River or Lake Te Rotokare. The proposed landfill discharge point is approximately 4 km from the confluence with the Tutaekuri River and 4.3 km from Lake Te Rotokare. In our view any ecological effects on those receptors are unlikely to be measurable."*	*the Tutaekuri River or Lake Te Rotokare".* However, no quantitative measures or evidence have been provided to confirm this, such as mass load calculations, and I therefore cannot come to a conclusion on effects downstream of Upokohino Stream (or within Farm Drain and Upokohino Stream) based on the information provided.
51	An assessment of effects is needed to determine the risk of contaminant transport from landfill activities (leachate, spills etc.) and additional proposed controls to mitigate risk to receiving waterways.	*"The proposed leachate management system is described in detail in Section 5 of the Engineering report (Appendix I to the application) and summarised in the following paragraphs. Spill management is outlined in various sections of the Landfill Operation Manual (Appendix P to the Application).* *All rain falling on exposed waste is to be treated as leachate and will be discharged to the leachate system. Leachate will be pumped out of the base of the landfill using sloping risers and transferred into containment ponds then have a composite geomembrane and compacted clay lining system.* *Only stormwater which has not come into contact with waste will be diverted to the stormwater treatment system.*	I have read the Landfill Operation Manual (Appendix P to the Application) and am satisfied with the controls put in place for spill management in regards to contamination of stormwater drainage channels, silt retention pond and accidental spillage of oil or grease within the Site. However, some actions are still unclear in the Landfill Operation Manual.

		Leachate irrigation will only occur when it can be safely undertaken in a manner that will not result in overland flow. Therefore, no irrigation will occur during significant rainfall or after a period of heavy rain. Typically it is expected that no irrigation will occur if there has been 20 mm or more of rainfall over the previous 24 hours. However, a judgement decision is required each day as to the suitability of conditions for irrigation. *• Irrigation pods will be located so that the spray zone is no closer than 10 m from any surface water channel or flow path.* *• During windy conditions, the irrigation pods will be located so that any spray drift does not impact any surface water. If this cannot be achieved with the irrigation areas available then irrigation will cease* *.* *• Should significant overland flow from the irrigation area be observed during irrigation, irrigation of that area will cease. (Minor overland flow, in the order of 1 to 2 m from the spray zone may be expected from time to time).* *With appropriate and well-maintained stormwater and leachate management systems the potential for contaminants from the landfill operation entering the Upokohino Stream is low.* ***Proposed controls to mitigate risk to receiving waterways*** *Monitoring water quality in the discharge and Upokohino Stream is proposed to detect any accidental contamination from the landfill operation and ecological effects.* *Refer to the response to Question 35 for monitoring of the discharge from the stormwater pond.* *Monitoring of the Upokohino Stream will comprise:*	

		• *Water quality monitoring undertaken at approximately quarterly intervals when discharge is occurring from the sediment pond. Monitoring should be undertaken at the three sites sampled in the current assessment. Samples should be analysed to enable detection of accidental leachate contamination, including, ammoniacal nitrogen, heavy metals and biological oxygen demand.* • *Macroinvertebrate and sediment quality monitoring completed on an annual basis.*	
52	Please provide details of the management/response plan if contaminants are discovered in surface water samples. What are the trigger levels for turbidity/TSS in the stream to warrant action?	*"The stormwater monitoring and management/response plan if contaminants are found in surface water samples will be included in the Landfill Operation Manual.* *Trigger levels for response will be determined following the collection of baseline water quality samples. Baseline water quality monitoring of the Upokohino Stream is recommended prior to construction commencing, at the sites sampled in the Ecology Assessment. We have recommended that monitoring comprise of three sampling rounds during wet weather and three in dry weather with samples analysed for TSS and turbidity.* *Response to trigger exceedances will potentially involve site audit, further water quality sampling, an investigation into the source of the contaminants and review of landfill ESC and operations."*	The applicant has advised that a 'stormwater monitoring and management/response plan', which will outline next steps if contaminants are discovered in surface water samples, will be included within the Landfill Operation Manual. The plan will include trigger levels determined following the collection of baseline water quality samples within the Upokohino Stream, prior to construction commencing. The applicant notes that next steps/responses to trigger exceedances will "*potentially involve site audit, further water quality sampling, an investigation into the source of the contaminants and review of landfill ESC and operations*". These are good controls and should be included in the stormwater monitoring and

			management/response plan and consent conditions. Sites are advised to be the same as those sampled in the Ecology Assessment. While I agree with this, I also suggest that samples are taken (and trigger levels advised for) within the farm drain in which the wetland discharges to. I agree with the recommendation that monitoring comprise of three sampling rounds during wet weather and three in dry weather with samples analysed for TSS and turbidity. I suggest further parameters are collected in this round to confirm there are no other contaminants are being discharged. The stormwater monitoring and management/response plan should be included in the consent conditions and reviewed by HBRC/NDC freshwater scientists before approval.
53	An assessment of effects needs to be completed for the Tutaekuri River and Lake Te Rotokare, including cumulative effects, with controls developed to ensure no effects are caused form the proposed activities.	*"Information from HBRC and historic records have indicated when flows are high in the Upokohino Stream water can flow into Lake Te Rotokare. The Upokohino Stream enters Lake Te Rotokare approximately 4.3 km downstream from the proposed landfill stormwater discharge point. Due to the intermittent nature of the Upokohino Stream in the lower reaches and the distance of the landfill stormwater discharge from Lake Te Rotokare, we consider that the potential for the landfill stormwater*	This answer is qualitative in nature and as discussed in query 50, no quantitative measures or evidence have been provided to confirm this, such as mass load model calculations, and I therefore cannot come to a conclusion

		discharge to have a measurable adverse effect the water quality of the lake is low. *Further to our response to question 50, with an appropriate and well-maintained stormwater and leachate management systems the likelihood of contaminants from the landfill operation entering the Upokohino Stream is low. Any effects are not expected to extend past the mixing zone within the Upokohino Stream and very unlikely to extend to the Tutaekuri River or Lake Te Rotokare. The proposed landfill discharge point is approximately 4 km from the confluence with the Tutaekuri River."*	on potential effects for the Tutaekuri River and Lake Te Rotokare.
54	There is no reference of Figure 4.2 in the report, what is the importance/context of this figure and the spring system to the application?	*"We had included the map as background information with respect to potential sources of flow to the Upokohino Stream. We have discussed the statement in the Figure 4.2 caption with the project hydrogeologist and understand that there is unlikely any link between the Moteo Springs and the Upokohino Stream. Please ignore Figure 4.2 and its associated caption."*	Response considered acceptable.
55	Results indicate that the current and historic landfill activities may already be having an impact on Upokohino Stream, with elevated levels of multiple parameters, including ammoniacal-N at 11.6 g/m^3 (background levels at < 0.010 g/m^3) in water quality samples collected in February 2018. Given these potentially toxic levels and the dead eels observed, further investigation into whether the landfill is currently having an adverse effect on aquatic life is required. Please provide an assessment of the cumulative effects of the proposed discharge on the already stressed environment in Upokohino Stream.	*"No discharge from the closed and operational parts of the landfill enters the Upokinhino Stream. Discharges from closed and operational stages discharge to the "Swamp Road" catchment. The elevated nutrient results reported in the Ecology Report likely reflect present and historic agricultural and horticultural land use within the upper Upokohino Stream catchment. The stream has no riparian buffer planting upstream or adjacent to the landfill boundary and therefore little filtering of runoff from adjacent farmland.* *Water quality and ecological effects associated with the proposed stormwater discharge are as presented in the Ecology Report and our responses above."*	The applicant has stated that the highly elevated nutrient results likely reflect agricultural land use within the catchment. They also state that *"No discharge from the closed and operational parts of the landfill enters the Upokinhino Stream. Discharges from closed and operational stages discharge to the "Swamp Road" catchment".* Due to the known impact from either unrelated land-use, or potentially from groundwater migration from the landfill operations to Upokihino Stream, we suggest that the downstream water

			quality and ecology site is moved to a more appropriate location so not to become influenced by these effects. It is suggested that this is investigated more by the applicant as the current sites show a high level of effect which may not be effectively disseminated from the proposed stormwater discharge effects. This could include sample sites located within the farm drain, as well as up and downstream of the confluence to Upokihino Stream.
56	Please provide an assessment of effects of the potential adverse effects of the treatment pond and wetland, including effects of wildlife using these habitats and proposed maintenance of the pond and wetland (and its effects) for sediment accumulation removal. This should include an assessment of nutrient accumulation in the pond which could lead to nuisance algal blooms.	"The stormwater treatment pond and wetland will receive stormwater only as described in the Engineering Report and are unlikely to receive any leachate contamination (see earlier responses). The proposed pond includes a forebay for sediment management. Maintenance of the forebay, pond and wetland, including removal of sediment, can be implemented as necessary. No adverse effects on wildlife are anticipated. Construction phase and operational water quality monitoring from within the Upokohino Stream will likely pick up any water quality issues from within the pond or wetland. We understand that there are no issues with nuisance algal blooms in other stormwater ponds on site."	The response from the applicant to this query is that the "*stormwater treatment pond and wetland will receive stormwater only as described in the Engineering Report and are unlikely to receive any leachate contamination (see earlier responses)*". They also state that the proposed pond includes a forebay that will be used for sediment management, with the Landfill Operation Manual (Appendix P to the Application) stating that there will be the provision of a deep water zone for sedimentation (sediment forebay) with machine access for de-silting. They acknowledge that maintenance of the forebay, pond and wetland,

			including removal of sediment, can be implemented as necessary; however, no specific maintenance details have been provided in the response, such as frequency and triggers. No monitoring of sediment depths, algal blooms or wildlife issues have been proposed, therefore I do not consider that the responses that "*no adverse effects on wildlife are anticipated*" and that "*we understand that there are no issues with nuisance algal blooms in other stormwater ponds on site*" answer the questions raised.
57	Section 6.1 states that high water temperatures recorded are due to lack of riparian shade, however no mitigation methods are proposed to increase riparian planting along the affected section of Upokohino Stream. Please provide plans for any mitigation or restoration activities planned.	"Elevated temperatures in the Upokohino Stream and the lack of riparian shade are not issues related to the operation of the landfill. We have assessed the ecological effect of the proposed discharge to be "low". In our view no additional mitigation is needed beyond the proposed erosion and sediment control measures, the stormwater management system and the proposed monitoring."	The response from the Applicant related to the issues within Upokohino Stream is that these issues are not applicable to the current application, and that the erosion and sediment control and monitoring is appropriate for activity. It is agreed that temperature issues within Upokohino Stream are not related to the discharge of sediment from the detention basin; however, as the proposed discharge could result in an increase in sedimentation to the catchment, mitigation through enhancement of either the farm drain or the Upokohino Stream should be considered.

Groundwater (Appendix F)			
58	Please provide details of the calculations (for example a spreadsheet print-out) for auditing purposes of the leachate dilution modelling.	An output table summarising the results of the dilution modelling shows the median and maximum concentrations for typical leachate indicator parameters and concentrations measured from leachate samples collected at the Landfill as part of compliance reporting. The Applicant has compared the results of the assessment against the ANZECC (2000) guidelines and concludes that dilution of any leachate contamination will be sufficient such that any surface water receiving environments will not exceed the relevant ANZECC (2000) guidelines with the exception of chromium. The assessment provided by the Applicant indicates that even with a dilution factor of 300, the maximum recorded chromium concentration of 1.1 g/m^3 will result in a concentration of around 0.004 g/m^3 which exceeds the ANZG (2018) 95% protection of freshwater aquatic species default guideline value of 0.0033 g/m^3 for chromium (III). The Applicant notes that the median leachate concentration of 0.37 g/m^3 will not result in an exceedance of the ANZG (2018) guideline.	As part of the dilution modelling, it is recommended that the Applicant provides an assessment for ammoniacal-N and compares the results of the dilution modelling against the relevant ANZG (2018) guidelines.
59	There is a potential pathway form the irrigation of leachate in the landfill cap, should runoff or underflow occur outside the landfill footprint, resulting in leaching to groundwater. This should be further considered based on the runoff and underflow issues raised in PDP's review memorandum of the stormwater, drainage and leachate irrigation. Please provide comments on this.	The Applicant has indicated that the irrigation of leachate to the landfill cap will be managed to avoid runoff which will stop any leachate associated with irrigation entering groundwater. The Applicant also indicates that underflow is unlikely to occur at the Landfill based on the following reasons (based on the Applicant's response to Query 41 of the S92): • Irrigation is likely to occur when the soils are below field capacity (on occasions). • The large surface area will be greater than the cross-sectional area of the capping layer. • The thickness of the capping layer (10 m) will attenuate any leachate percolating downwards. • Any seepage from irrigation of leachate is expected by the Applicant to be minor compared to stormwater	A copy of a management plan providing details of how leachate irrigation will be further managed at the site is required for review. See also recommendations to questions related to leachate irrigation above.

		While the Applicant has indicated that the irrigation of leachate will be managed to avoid runoff, they have not provided any specific further details of the management or mitigation measures (i.e. management plan) to stop leachate runoff during irrigation.	
60	Comparison of water quality sampling with the NZDWS, 2018 and ANZG, 2018 and explanation of the choice of the 95% protection values. The long-term groundwater record provided with the application is relatively short and there appears to be some uncertainty regarding the existing groundwater divide and the groundwater flow directions. Bores located further away from Area B should also be included in any groundwater level monitoring/piezometric surveys to determine groundwater flow directions in the wider area. Any existing water level information should be considered together with the levels recorded in the bores around Area B to help refine and understand the groundwater flow directions. A longer groundwater level record would also be useful to determine how groundwater levels change seasonally and if seasonal fluctuations result in any changes in flow direction or groundwater divides. It is recommended the applicant commence this as soon as possible, or provide information on why this is not considered to be required at this stage.	The Applicant has broken this query into three sections which are detailed below: <u>Water quality standard selection</u> The Applicant has indicated that the ANZECC 2000 95% guidelines are relevant to compare groundwater quality data against based on information provided in the Technical Guidelines for Disposal to Land. PDP note that the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018) (referred to as ANZG, 2018) have now replaced the ANZECC 2000 Guidelines. The ANZG (2018) incorporate a more ecoregional context to the default guideline values (DGV) for New Zealand's fresh waters. For parameters that result in physical and chemical stressors to freshwater aquatic life, sites are now categorised by their River Environment Classification code (REC). This code relates to a specific regional set of water quality guideline values that were determined through multivariate modelling of chosen reference sites across New Zealand. It should be noted that these guideline values represent the 80th percentile values from the reference sites in a relatively unmodified environment. For water quality parameters that do not have REC guideline values, default guideline values (DGV) should be used. <u>Long-term groundwater levels</u> The Applicant indicates that they will continue to undertake groundwater level monitoring at the Landfill and indicates that they do not propose to undertake any groundwater level monitoring in any neighbouring bores located outside of the Landfill footprint on adjacent properties based on the following reasons: • The existing network of monitoring bores are assumed to provide adequate coverage.	<u>Water quality standard selection</u> It is recommended that the Applicant assess available water quality data against the relevant ANZG (2018) REC and DGV guidelines to assess the existing water quality of the receiving environment (Upokohino Stream) and also for trigger values to compare results of the groundwater quality monitoring in future. <u>Long-term groundwater levels</u> Given the relatively complex groundwater flow patterns at the site, possible perched groundwater table (BC7A) as well as documented groundwater contamination in the vicinity of the active part of the Landfill, historic landuses (quarrying and backfilling) and anomalous nitrate-N concentrations in an upgradient bore (BH10) at the site, it would be useful to monitor groundwater levels and groundwater quality in BH9 as part of the monitoring for Area B as this bore is understood to be upgradient of all activities occurring at the Omarunui Landfill site. This bore would be useful to help establish groundwater levels and quality data for Area B.

		• The footprint of proposed Area B overlies the Petane Formation whereas the area to the East of proposed Landfill Area B includes the low-lying alluvial deposits associated with the Tutaekuri River. Groundwater within the low-lying alluvial deposits are assumed to be subject to different landuse impacts (farming, horticulture etc) compared to the effects arising from the proposed Landfill. • Bore BC6 is located at the toe of the proposed Landfill at Area B (northern most extent) and provide information regarding the potential effects on groundwater in this area of the Landfill. • Ecological monitoring is proposed for Upokohino Stream to assist with identifying any potential effects from the Landfill. • The Land to the East of Area is not owned by the Applicant. The existing bores that are currently monitored appear to provide groundwater level and water quality data for the existing and historic Landfill as well as the area immediately surrounding the proposed Area B Landfill footprint. It is noted that annual compliance report for the Omarunui Landfill indicates that there has been leachate contamination of groundwater to the south of the existing Landfill Area A as a result of the existing and historic landfill activities at site. The monitoring report also indicates that unexplained elevated nitrate-N concentrations have been detected in bore BH10 which is located near the western extent of Area B. In addition to this, the Applicant has indicated that other historic landuses (i.e. quarrying and backfilling) have potential to cause contamination (particularly in the vicinity of Area B). <u>Seasonal groundwater level fluctuations and groundwater flow directions</u> The available groundwater level data provided with the original application was noted to be relatively short with groundwater level data only provided for the period between June 2018 and August 2018. This data included timeseries water level data in six bores and manual water level measurements for 9 bores measured in August 2018. The	<u>Seasonal groundwater level fluctuations and groundwater flow directions</u> Groundwater levels and flow directions do not appear to change significantly as a result of seasonal fluctuations. However, since bore BC7A is located within the proposed footprint of Area B and if water levels are perched in this part of the Landfill, it would be recommended that groundwater level and groundwater quality monitoring is undertaken in bore BC7A as any contamination of shallow groundwater associated with perched groundwater in this area of the site could provide a pathway for any contaminants to migrate to deeper groundwater. In addition, Appendix I is listed in the s92 response as providing updated timeseries plots of groundwater levels for the Area B monitoring bores but this appendix does not appear to be attached with the s92 response. It would be useful to view a copy of this appendix.

		manual water level data measured in August 2018 was used to create a piezometric contour map for proposed Area B. In addition to this existing groundwater level data provided in the original application, the Applicant has provided additional piezometric contour plots based on manual measurements for April 2010, July 2018 and January 2020. In addition to these piezometric contour maps, a table with manual groundwater levels measured in June 2020 is also provided with the s92 response. The Applicant indicates that groundwater levels display seasonal fluctuations, and notes that the seasonal fluctuations do not appear to result in any change in groundwater flow directions. The additional piezometric contours provided by the Applicant in the s92 response generally indicate groundwater flow directions are relatively consistent with the various datasets used to generate the piezometric contour maps. The piezometric contours indicate seasonal fluctuations of up to approximately 1.5 m with lower levels generally occurring in April 2010 and higher levels occurring January 2020. A timeseries plot of groundwater levels of existing monitoring bores that are monitored as part of Area A and Area C resource consent compliance is provided in the annual compliance monitoring report for the Omarunui Landfill (2019). This plot (Figure 3-3 of the annual monitoring report) includes a timeseries of groundwater levels for bores BH9 (water level data available between 2005 and 2019) and BH10 (water level data available between 2006 to 2019). Both of these bores are understood to be included as part of the background monitoring for Area B and were used to generate the various piezometric contour maps provided by the Applicant. The data for BH9 appears to indicate that groundwater levels generally fluctuate between around 20.8 and 21.7 mRL. The data for BH10 appears to indicate that groundwater levels generally fluctuate	

		between around 19.7 and 20.6 mRL. It is worth noting that both bores display some relatively large increases and decreases between monitoring rounds of around 1 m before recovering, although the cause of these sudden fluctuations is not explained. The water level record for both data sets does not appear to display any obvious seasonal fluctuations, although this may be due to manual water level measurements measured quarterly each year. Overall, the groundwater level data for BH9 and BH10 is relatively consistent with the other monitoring bores monitored in the area and therefore is considered to be generally consistent with the information provided by the Applicant. The original application indicated that bore BC7A had a much higher water level than the other monitoring bores at the Landfill (around 10 m higher than the bore with the next highest groundwater level) and therefore was interpreted as being a perched water table and was excluded from the piezometric contour maps generated by the Applicant. Given the significant difference in water levels in bore BC7A, the Applicant concluded that the water level in this bore is perched.	
61	Groundwater quality data suggest some localised contamination has occurred in the groundwater system beneath the proposed Area B landfill from localised landuse potentially not associated with landfill activities, although leachate contamination from adjacent landfill activities cannot be ruled out. A review of historic landuse information would be useful to confirm if any elevated concentrations area related to historic landuse. Comparison with water quality monitoring data for all bores around the landfill beyond would be useful to help establish whether the elevated	The Applicant has reviewed historic imagery for the footprint for Area B which is available from Retro lens between 1949 and 1996, and Google Earth imagery was reviewed for the period between 2003 and 2019. The Applicant indicates that the landuse at the footprint of Area B was open grazing farmland (1949 – 1987) and quarrying (1994 – 2019). The Applicant indicates that the quarrying activities also included back filling with material. Based on this, the elevated concentrations in the upgradient monitoring bores at Area B may be related to quarrying activities with refuelling of vehicles and also any contaminated material placed in the quarry during backfilling. It is noted in the annual compliance monitoring report (2019) for the active landfill, that upgradient monitoring bores BH8 and BH10 appear to have slightly elevated concentrations of arsenic (around 50% of the MAV of 0.4 mg/L) which may be naturally occurring. The annual compliance report	The review of historic imagery is deemed to be adequate. However, given the potential for contamination as a result of historic quarrying and possible backfilling at Area B, it is recommended that bore BH9 is also included as a monitoring bore as part of the groundwater monitoring for Area B to provide additional background and upgradient water quality data.

	concentrations could be due to existing landfill impacts.	(2019) also notes that elevated nitrate-N concentrations have been recorded in BH10 which is also located upgradient of the active landfill. The Applicant proposes to continue monitoring groundwater quality to establish baseline water quality for Area B.	
62	Groundwater sampling over a long time period (ideally at least one year) would be useful to determine if there are any seasonal trends in contaminant concentrations. It is recommended the applicant commence this as soon as possible, or provide information on why this is not considered to be required at this stage. Bores located within a wider radius from the boundary of the Area B landfill should also be included during any groundwater level monitoring and groundwater sampling to provide additional background water level and quality information.	The Applicant indicates that they will continue monitoring groundwater quality in bores BC9, BC14, BC10, BC6 and BC5 which are all located around the footprint of Area B. As identified by the Applicant, it appears that there is potentially some contamination from historic landuse activities (quarrying and back filling). Based on this it is recommended that some additional bores located outside of the existing and proposed landfill footprints are monitored to establish background water quality and confirm if the elevated concentrations observed in the monitoring bores for Area B are naturally occurring or as a result of either leachate contamination or from other historic landuses (i.e. quarrying).	In addition to the proposed monitoring bores, it is recommended that BH9 is also monitored to provide upgradient/background water quality in addition to the bores listed by the Applicant. Furthermore, given that bore BC7A is interpreted by the Applicant to intercept a perched groundwater table, it is recommended that this bore is included as a groundwater level and quality monitoring bore as the perched water table could potentially provide a pathway for contaminants to migrate to deeper groundwater beneath the Landfill.
Consultation (HBRC)			
63	During the site visit on 30 January 2020 it was discussed that ongoing consultation has been undertaken with relevant mana whenua, statutory acknowledgement groups and local residents. Please provide an update on the consultations and any issues/outcomes/proposals that have arisen as a result of the consultation.	*"Hasting District Council has continued to engage with mana whenua on the applications for construction and operation of Area B (see Appendix B). Engagement with mana whenua will continue throughout both the consenting and operation of Area B. Regular updates on ongoing engagement with mana whenua will be provided."*	For discussion at meeting.