



TECHNICAL MEMORANDUM

To: Vipin Garg [REDACTED]
From: Lindsay Strachan [REDACTED] and
Aidan Nelson [REDACTED]
Date: 18 December 2025 Ref: M2501-3
Re: **NATIONAL GREEN STEEL PROJECT: REQUEST FOR INFORMATION ON
GEOTECHNICAL, EROSION AND SEDIMENT CONTROL PLAN (ESCP) AND
MONOFILL MATTERS – RESPONSES TO REVIEWS FROM GHD**

Dear Vipin,

This memorandum provides responses to requests for further information received from the panel, in Minute 7 and 9 dated 15 and 16 December 2025 respectively.

We have completed responses to the queries presented in the peer reviews for the panel by GHD titled:

- EPA Review - FTAA1074 Green Steel - Geotechnical Advice (09 Dec. 2025)
- Draft EPA Review - FTAA1074 Green Steel – Erosion and sediment control advice (09 Dec. 2025)
- EPA Review – FTAA1074 Green Steel – Landfill Advice (12 Dec. 2025)

Important mention is that the design engineers responsible for the project, namely Aidan Nelson and Lindsay Strachan, now operate within the Envitech entity, which was formed from Earthtech in July 2025. The responses may, therefore, read in personalised ('we') form.

Our responses are provided in the A3 tables, attached, addressing (1) Geotechnical Advice; (2) Erosion and Sediment Control Advice; and (3) Landfill (Monofill) Advice.

We remain available to address any questions or queries.

LINDSAY STRACHAN CPEng.
Specialist Landfill Engineer

AIDAN NELSON CPEng.
Principal Geotechnical Engineer

ENVITECH PROJECTS NZ LIMITED

Attachments: A3 tables of responses by Envitech to queries raised by GHD (EPA Review - FTAA1074 Green Steel – Geotechnical, Erosion and Sediment Control, and Landfill Advice)

Monofill Consent Conditions (Draft-Proposed):

- Monofill Fire Management Plan and
- Monofill Operational Competency

EPA Review - FTAA1074 Green Steel - Geotechnical Advice

| Item | Section | General topic | Reviewer's comments/questions | Applicant responses |
|------|---------|---------------------|---|--|
| 2. | 2.1 | Steel mill platform | <i>The site investigations results are generally consistent with the published geology. The major differences being that the geological map does not show the overlying Hamilton Kaharoa Ashes and the presence of Kaawa Formation (sands) exposed on Harness Road and inferred from the investigations (CPT5 and 11).</i> | Site investigations to date have been preliminary with the detailed investigations to follow once project approval has been received. Notwithstanding the preliminary nature of the site-specific investigations, the applicant's geotechnical team have direct experience with all three major earthworks projects in the vicinity namely: Hampton Downs Landfill Site; Springhill Prison; SH1 Hampton Downs Interchange; and the SH1 Long Swamp Crossing. We have encountered differences of significance against published geology on all 4 sites including this site. Based on this experience, we are confident that any discrepancies between published mapping and site-specific conditions will be appropriately addressed through further investigation and design refinement. |
| | | | <i>A preliminary earthworks balance for the initial formation of the platform has been provided. Noting there are two possible base grade levels presented for the SW monofill, the earthworks volumes appear to be based on the deeper subgrade of RL12-14m. The cut/fill volumes indicate a deficit of fill by 17,120m³ and 126,000m³ of unsuitable material which will be soft soils, peats and organics and with acid sulphate soil potential from the undercut of the stream alluvium. It assumes that all other excavated soils and rock will be suitable for reuse in the engineered fills, noting that some of these materials may be wet of optimum and require conditioning prior to use. There are no material suitability and compaction testing results provided in the documents.</i> | Cut-Fill volumes are preliminary and a deficit or surplus of the order of 100,000m ³ in the context of a total cut and fill movements of some 4million m ³ is not unusual. We have provided estimated cut volumes of the various material types in the Earthworks Management Plan (Table 2, p3). Expecting detailed volumes of different material types is not standard practice at concept design stage. The geotechnical report recognises that some material will require conditioning prior to reuse and there are many ways of improving and/or stabilising the material. The conceptual design also allows for a lower standard of compaction on proposed platforms such as the ELV storage area where settlement is of little consequence. The major structures are all proposed to be located on good founding conditions and/or in some cases, pile foundations will be required. We note that the entire plant was rotated 180 degrees following the preliminary geotechnical investigations to allow for EAF to be founded on the harder underlying material encountered. Loadings and detailed compaction specifications will be provided at detailed design stage, consistent with standard engineering practice. |
| | | | <i>The suggested geotechnical parameters presented in the preliminary geotechnical report are not based on any on site testing. Similarly, the predicted parameters for the fill materials are not supported by testing. GHD considers these parameters optimistic, and these will need to be proven at future stages of the project.</i> | Geotechnical Parameters: The projects referred to above have all been completed using these geological materials (and geotechnical parameters) without any major changes to the appropriately conservative geotechnical design parameters provided. This includes field mapping of bedrock stability controlled by clay-seams. This was followed up with detailed investigations, back-analysis, and provision of a detailed management strategy to counter the effects. Soil sampling (of soils from shallow and deeper profiles) and soils laboratory testing is crucial and must be (will be) carried out during detailed design. We also note that for an earthworks project of this magnitude, it is likely that an on-site soils testing laboratory will be operated. On each of these projects mentioned above, significant differences between published geology and actual site conditions were encountered, yet the adopted parameters proved to be appropriate once validated through detailed investigation. The current parameters, therefore, represent reasonable and conservative assumptions for preliminary design purposes. As with all geotechnical projects, these values will be confirmed and refined through the planned programme of detailed site investigations which is likely to include soil testing using an on-site soils testing laboratory. |
| | | | <i>The recognised geohazards for the site and development are:-</i> <ul style="list-style-type: none"> • <i>Liquefaction- low probability</i> • <i>Compressible soils – present within the northern portion of the site as young stream alluvium and organic materials which will be loaded by up to 12m of fill platform. Ground water in this area is very shallow (c. 0.3-1.2m below ground level).</i> • <i>Existing slope stability in natural soils – observed on the steep slopes to south and east.</i> • <i>Stability of proposed engineered fills and monofils (monofill sites discussed below in section 2.2).</i> • <i>Acid sulphate soils – low – moderate probability, except of areas of undercut in soft soils.</i> • <i>Soil shrink swell behaviour – potential exists in the clays soils and will require management during construction.</i> | Geohazards on site: All hazards listed by GHD are discussed in our geotechnical reports (for the overarching project and specifically for the monofills). Also, the Earthworks Management Plan and Erosion and Sediment Control Plan includes a management plan for acid sulphate soils (addressed in Section 4.4: "Acid Sulphate Soils Management"). This plan has been developed following extensive consultation with the WRC (and the reference to the Technical Guidance for Acid Sulphate Soils, dated 15 Aug. 2025 by GHD) with no issues identified in their comments to the Panel. To date no acid sulphate soils have been identified on the site. |

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| | | | <p><i>The compressible soils under the platform will require extensive undercut and/or preloading. Under cut will be likely below the ground water table and preload will generate elevated groundwater pressures and result in settlements. There is no discussion in any of the documents reviewed which details a detailed assessment of the quantum of settlements, dewatering requirements or effects on neighbouring properties. Neither are there any construction plans or mitigations recommended to alleviate any potential effects. Given that portions of the platform fill are located close to the legal boundary, fill loading, dewatering and settlements can be expected to impact outside of the fill foot print, such detailed information is considered essential to support this application.</i></p> | <p>Compressible soils and settlement is addressed in the preliminary geotechnical report and are well known to us. AS noted in our geotechnical report: “No significant structures should be placed in these areas unless fully undercut, preloaded or piled”.</p> <p>The potential for high settlement on the peat material and soft alluvial deposits has been identified to the stormwater pond design which covers much of the area. A balance will be achieved by using ‘unsuitable’ soils to form flexible platforms such as the truck parking area, the ELV storage area, the flocc storage area, as well as for landscaping bunds. Note that the unsuitable peat soils will be largely left in place and filled over to provide elevated free-draining and useable platforms – notwithstanding long-term settlement effects which will be managed (and noting the acid sulphate soils management plan). We note that final engineering solutions can only be developed following detailed geotechnical investigations, and whether pre-loading or the many other engineering solution options available will be implemented, remains a decision for detailed design stage.</p> <p>Potential Boundary Effects: With respect to potential boundary effects, we do not consider the concerns raised to be credible. In urban environments, deep basements and vertical retaining structures are routinely engineered and constructed along property boundaries without adverse effects on neighbouring land. The same principles of geotechnical design and construction management will apply here, ensuring that fill loading, dewatering, and settlements are appropriately controlled and do not result in unacceptable off-site impacts.</p> |
| | | | <p><i>The proposed cut and fill slope angles are all 1V:3H. Geogrid reinforcing may be used to stiffen the fill. The long-term stability for the cuts and fills forming the main platform has not been demonstrated for static, seismic or elevated groundwater load cases. There is no information to demonstrate that the fill platform works will be stable and will not have an adverse effect on neighbouring properties.</i></p> | <p>- 1v:3h slopes: these are considered to be appropriately conservative and practical at this conceptual design stage. Both short and long term plus seismic stability conditions will be fully assessed at detailed design stage, as per best engineering practice. There are numerous methods to enhance stability, reduce or control settlement effects and provide safe and stable building platforms that are fit for purpose.</p> <p>The potential for effects on neighbouring properties is addressed above.</p> |
| | | | <p><i>There has been no acid sulphate soil testing for samples from site. On site management is proposed and there are unlikely to any adverse offsite effects.</i></p> | <p>Acid Sulphate Soils – Acid sulphate soil testing has not yet been undertaken and will be included in detailed investigations. Notwithstanding this, on-site management is proposed and adverse off-site effects are unlikely, consistent with GHD’s conclusion.</p> |
| 2 | 2.2 | Monofills | <p><i>For the southwest monofill the documents present 2 possible platform levels. An elevated platform at RL23-20m or a lower platform at RL 12-14m. The remaining natural ground slope below the platform is steep and subject to known slope instability. There have been no investigations targeting the instability and identifying the depth of the shear surface and defining movement triggers. It is proposed to place buttress fill adjacent to the slope as a remedial measure.</i></p> | <p>SW Monofill Slope instability: the unstable natural (existing) slopes to the south / southwest have been mapped and recognised as a geotechnical constraint. There is no intention to place the landfill liner or side slopes on unstable ground. One solution is the buttress fill (as shown) and a second solution is a simple setback distance off the unstable slope. Monofill design will follow standard slope stability assessment methods. Note that the monofill itself will be constructed as <u>stable landform</u> with engineered perimeter bunds and the floc material will not be reliant on the support of the buttress fill. The basic bowl/basin shape of the monofil base, graded into the site, provides a safe and stable platform for the site.</p> |
| | | | <p><i>The buttress material above the natural ground will form the side cover for the monofill and should meet cover specifications for permeability (with further discussion on capping performance discussed in the Landfill Review report).</i></p> <p><i>When the monofill is functional there will be no bulk earthworks on site to produce the substantive quantity soils required for cover and buttress.</i></p> | <p>Cover specifications for permeability of the monofill cap – for this monofill, with the aim of protecting the floc material resource, the capping system as proposed is appropriate and a very low impermeable ‘tombing’ approach is not required.</p> <p>We do not agree with the suggestion that cover material will be insufficient once the monofill is operational. As noted in the Monofill Engineering Report, designated stockpile areas have been identified for excavated materials—including topsoil, cohesive soils (silty clays and clayey silts), cover soils, and probable sandstone intermediate material—which will be located in pre-planned areas to ensure availability for use in cover and buttress construction.</p> |
| | | | <p><i>Importation of soil fill may have an offsite effect on truck and traffic numbers.</i></p> | <p>Truck and traffic numbers – no fill is proposed to be brought onto the site. The project is designed to provide an reasonable cut-and-fill balance using the available resources on site. This will be a governing factor during the detailed design process.</p> |
| | | | <p><i>There is no stability assessments presented which demonstrate that the monofill slopes meet the required long term stability for the standard load cases including elevated leachate levels.</i></p> | <p>General Monofill slope instability: The proposed 1:3 slopes are conservative, driven largely by practical long-term maintenance and aftercare requirements. Detailed design will address all slope stability conditions as per standard landfill engineering design practice. Allowance for elevated leachate levels will be included. We also note the basic bowl/basin shape of the monofil base, graded <u>into the site</u>, which provides a safe and stable platform for the site.</p> |

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| 3 | 3.1 | Information Requests | <p>1. Provide a detailed breakdown of the cut and fill earthworks volumes relative to the geological units, and proposed reuse relative to the earthworks staging. Include the main platform, all elements of the monofill including buttress volumes to completion, liner, final capping; as well as stormwater bunds and ponds. In addition, provide an indication of how much soils will be required after completion of stage 3 earthworks during operation and closure of the site. An additional component of the earthworks volumes to be considered is daily and intermediate cover needs as discussed in GHD's Landfill Review report.</p> | <p>1. detailed breakdown of the cut and fill earthworks volumes: the information provided is based on preliminary investigations and our experience from the three major earthworks projects around the site. Detailed design is proposed once the detailed site investigations have been completed. There are numerous geotechnical options to achieve fit-for-purpose earthworks platforms and founding conditions. Cut-Fill volumes are preliminary and a deficit or surplus of the order of 100,000m³ in the context of a total cut and fill movements of some 4million m³ is not unusual. We have provided estimated cut volumes of the various material types in the Earthworks Management Plan (Table 2, p3). Expecting detailed volumes of different material types is not appropriate at the concept design stage.</p> |
| | | | <p>2. Provide details of the proposed disposal or end use for the unsuitable soils generated during construction.</p> | <p>2. Disposal and end-use of unsuitable soils: a balance will be achieved by using 'unsuitable' soils to form flexible platforms such as the truck parking area, the ELV storage area, the floc storage area, as well as for landscaping bunds. Note that the unsuitable peat soils will be largely left in place and filled over to provide elevated free-draining and useable platforms – notwithstanding long-term settlement effects which will be managed (and noting the acid sulphate soils management plan).</p> |
| | | | <p>3. Given that the bulk fills are, in places, located close to the legal boundary the fill loading, dewatering and resultant settlements may have an adverse impact on neighbouring land. Provide a technical assessment of the effects and impacts from the construction of the fill platform (undercut and preload) on the soft soils and associated ground water. In addition, present mitigation measures to prevent adverse effects.</p> | <p>3. Neighbouring land effects: We do not consider the boundary effects referred to as credible, as boundary proximity issues are routinely managed in geotechnical engineering and can be addressed through appropriate engineering at the detailed design process.</p> |
| | | | <p>Provide slope stability modelling of the following slopes to demonstrate there are no adverse effects:- 1V:3H cut slopes natural materials 1V:3H bulk fill slopes (model largest fill height) 1V:3H monofill side slopes Ensure static, seismic and elevated ground water load cases are presented. For the monofills please also present elevated leachate case.</p> | <p>4. Slope Stability Modelling: The unstable natural (existing) slopes to the south / southwest have been mapped and recognised as a geotechnical constraint and there is no intention to place the landfill liner or side slopes on unstable ground. One solution is the buttress fill (as shown) and a second solution is a simple setback distance off the unstable slope. Monofill design will follow standard slope stability assessment methods. Note that the monofill itself will be constructed as stable landform with engineered perimeter bunds and the floc material will not be reliant on the support of the buttress fill. The basic bowl/basin shape of the monofil base, graded into the site, provides a safe and stable platform for the site.</p> <p>All stability concerns will be fully addressed by the detailed design process, based on the finalised arrangements for the steel furnace and associated works. 1v:3h slopes are considered to be appropriately conservative and practical at this conceptual design stage. Allowance for elevated leachate levels will be included. An elevated leachate case is a common consideration, hence the application of engineered leachate drainage systems above the engineered basal lining system. We also note the basic bowl/basin shape of the monofil base, graded <u>into the site</u>, which provides a safe and stable platform for the site.</p> |

EPA Review - FTAA1074 Green Steel – Erosion and sediment control advice

| Item | Section | General topic | Reviewer's comments/questions | Applicant responses | | | | | | | | | | | | | | | | | | | | | | |
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| 2 | 2.1 2.2 | Preliminary assessment Figures for clarity when reviewing Questions | <p>The site will be subject to significant earthworks, over three stages with the formation of an elevated platform at RL14m for the steel mill and shredding equipment. This platform will be formed from filling of the northern area and cut towards the south. Other platforms will be formed for the southwestern and northeastern monofills and the materials and finished products storage platform. A preliminary erosion and sediment control plan for the initial formation of the platform has been provided.</p> <p>The following questions should be considered for further detailed design of the erosion and sediment controls:- (Table of Comments provided)</p> | <p>GHD correctly acknowledge that the ESCP is a preliminary document, intended to be refined and revised once the earthworks detailed design is finalised.</p> <p>It is further noted that the ESCP has been reviewed and accepted by WRC sediment control experts. During this review process, WRC staff requested that the preliminary design focus on the major treatment control devices, rather than providing full details (more drawings) on smaller treatment devices serving the small sub-catchments. We, therefore, acknowledge that some detail is not yet included but is standard practice with such information to be provided at the detailed design stage.</p> <p>All GHD's queries relate to detailed design requirements and all can be readily resolved by minor amendments.</p> | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | Information Requests | <p>Contributing catchments for sediment retention ponds (SRP's) must not exceed 5.0 hectares. Preliminary design suggests the following catchment areas are too large and additional devices may be required:</p> <table border="1"> <thead> <tr> <th>Retention Pond ID</th> <th>Maxumim Area (ha)</th> <th>Note</th> </tr> </thead> <tbody> <tr> <td>SRP1-3 stage 2</td> <td>6.7</td> <td rowspan="2">SRP catchments should not exceed 5.0ha. It is noted that catchment 14 (monofill) may not be contributing to this pond during stage 1 earthworks. With monofill catchment, SRP 1-6 is still expected to service a catchment area of at least 5.1ha</td> </tr> <tr> <td>SRP1-6 stage 1</td> <td>6.0</td> </tr> </tbody> </table> <p>Contributing catchments for decanting earth bunds (DEB's) must not exceed 0.3 hectares. Preliminary design suggests the following catchment areas are too large, and additional devices may be required:</p> <table border="1"> <thead> <tr> <th>DEB ID</th> <th>Catchment Area (ha)</th> </tr> </thead> <tbody> <tr> <td>D-EMa 1</td> <td>1.2</td> </tr> <tr> <td>D-EMa 2</td> <td>0.6</td> </tr> <tr> <td>D-EMb 1</td> <td>0.9</td> </tr> <tr> <td>D-EMb 2</td> <td>0.8</td> </tr> <tr> <td>D-EMb 3</td> <td>1.4</td> </tr> <tr> <td>D-EMb 4</td> <td>1.2</td> </tr> </tbody> </table> | Retention Pond ID | Maxumim Area (ha) | Note | SRP1-3 stage 2 | 6.7 | SRP catchments should not exceed 5.0ha. It is noted that catchment 14 (monofill) may not be contributing to this pond during stage 1 earthworks. With monofill catchment, SRP 1-6 is still expected to service a catchment area of at least 5.1ha | SRP1-6 stage 1 | 6.0 | DEB ID | Catchment Area (ha) | D-EMa 1 | 1.2 | D-EMa 2 | 0.6 | D-EMb 1 | 0.9 | D-EMb 2 | 0.8 | D-EMb 3 | 1.4 | D-EMb 4 | 1.2 | <p>As noted above, it is premature to provide the level of detail suggested at this stage.</p> <p>For example, querying a variance as small as 0.1ha above the 5.0 ha limit is counterproductive. The 5.0ha catchment area is intended as a guide and constructing a second device for the minor exceedance would create unnecessary earthworks and disturbance, resulting in an overall negative effect.</p> <p>In our opinion the GHD comments are more appropriately considered at the detailed design stage where they will be useful in informing refinements of the final detailed design. At this preliminary stage, the finer details are of limited value as adjustments will be required at the detailed design stage.</p> <p>In response to the Panel's overarching request: - the Panel would like to know if and how the questions raised can be addressed in the ESC design, and whether the ESCP will meet the requirements of the WRC guidance – we confirm the questions raise can be addressed through the ESC design process and that the ESCP will meet WRC guidance.</p> <p>WRC's technical representatives have been fully involved in the review of the ESCP and the final design will be adjusted / updated in consultation with WRC.</p> <p>The preliminary ESC Plan will require refinement and additional details. This will be provided at detailed design stage, incorporating GHD's comments.</p> |
| Retention Pond ID | Maxumim Area (ha) | Note | | | | | | | | | | | | | | | | | | | | | | | | |
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| D-EMb 2 | 0.8 | | | | | | | | | | | | | | | | | | | | | | | | | |
| D-EMb 3 | 1.4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| D-EMb 4 | 1.2 | | | | | | | | | | | | | | | | | | | | | | | | | |

EPA Review - FTAA1074 Green Steel - Landfill Advice

| Item | Section | General topic | Reviewer's comments/questions | Applicant responses |
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| 1 | 1 | Introduction | <p>The proposed two landfills are intended to dispose of a single waste type and are referred to as monofills.</p> | <p>Introductory comment: It is apparent that GHD's 'landfill advice' review has approached the proposed monofill as though it were a conventional landfill. While there are similarities in operation and engineering approach, monofills are distinctly different in terms of material type, design, operation, and environmental considerations. The Ministry for the Environment provides a useful definition: 'Industrial monofill facility means a facility that accepts for disposal waste that discharges or could discharge contaminants or emissions and is generated from a single industrial process (for example, steel or aluminium making, or pulp and paper making).' The regulations further distinguish cleanfills and industrial monofills, noting that these sites are not prescribed disposal facilities. The site-specific purpose of the proposed monofill is to isolate the floc resource from the general mixed waste stream to enable future reuse. Against this context, many of the comments in the GHD report appear to be based on fundamentally incorrect assumptions about the nature of monofills, and are instead directed at landfills, which have distinct characteristics and risks.</p> |
| 2 | 2.1.1 | Fire | <p>The documentation reviewed suggests that cover material would only be applied when a lift of floc reaches 3 m so there would likely be times when the floc would not be covered.</p> <p>Other aspects that increase the risk of a surface fire is the area of the active landfill, and the project documentation indicates that it could be up to 1,000 m² (Section 8.1.1 of the Management Plan), which is a very large area considering the relatively small tonnes of waste floc to be landfilled.</p> <p>It is recommended that a fire management plan should be developed addressing the above issues and including but not limited to:</p> <ul style="list-style-type: none"> - all floc waste is covered at the end of each day's operations by a non-combustible soil/crushed rock of a depth of 150 mm (and this is a recommended deviation from the WasteMINZ Guideline, the daily cover depth of 150 mm is an industry standard). Intermediate non-combustible cover of 300 mm of the same material should be applied on any landfill surface not landfilled over after 3 months - Committing to limit the active landfill area of no more than 200 m² of uncovered floc waste - Setback distances from the landfill area and vegetation surrounding the landfill - Availability of a secure and sufficient water supply close to each monofill and a tanker with a water cannon to apply water for fire suppression - the application of IR camera/s to monitor the landfill for surface fires during operations - Procedures to monitor and remove batteries from the floc to be landfilled (batteries are a common cause of landfill fires) <p>Procedures to monitor for the presence of possible subsurface fires</p> <p>The importation of cover soils risks introducing other contaminants that have not been assessed by the project (and associated impacts with increased traffic and noise).</p> | <p>Fire risk is of high importance and is addressed in Section 11.3 of the Engineering Report. The landfill fire of 2019 at Hampton Downs offers good a example of uncovered wastes on large scale.</p> <p>We support a fire management plan as a condition of consent, and an appropriate condition is appended.</p> <p>In response to the matters that the fire management plan should address we note the following:</p> <ul style="list-style-type: none"> - The assumption that our report infers that 'floc will reach 3m so there would be times when the floc would not be covered' is incorrect. – In fact, our report clearly refers to cover material immediately upon placement of the floc (refer pg 14 of the Eng. Report for example "... It will then be off-loaded within the lined area of the monofill and pushed by a dozer to the final placement area, <u>followed by track rolling and placement of temporary cover material</u>". Also: "The filling operation should adopt a technique of constructing landformed terraces that are <u>continuously compacted and covered</u> with other layers of waste and/or cover soil (at least 100mm thick)"; - 150mm soil cover: Noted and known as industry standard to cover MSW (Municipal Solid Waste) type landfills, containing biologically active wastes with 150mm soil cover - for <u>landfills</u>. However, we note that this is a site-specific monofill which is intended to store and reuse the floc resource at a later date. As the potential circularity / reuse will be compromised by excessive use of soil, it is appropriate to retain a reduced soil cover and use alternative covers such as spray-on foam, or heavy duty tarpaulins. We note the significant differences between the nature of the proposed monofills and a Class 1 (or Class 2) large landfill site. - Also note, the daily volume is small (say 200m³ per day) and can be placed in an area say 12m(L)x7m(W) 3m deep. The 0.1ha (1000m²) reference is to the maximum operational area and the 'uncovered' operational area will be significantly less than this. Temporary covers can be used, and are intended to be used. - Soil cover is preferred to water for firefighting purposes floc material. However, water supply will be readily available on site – note nearby location of a water reservoir to the SW monofill - The presence of batteries in the floc, post-shredder and sorting plant, is highly unlikely. It appears that GHD may be contemplating the disposal of MSW type wastes into a landfill on the Green Steel site as opposed to single type ELV floc material stored in a monofill. These represent significantly different types of site. - Additional mention of risk of fire in or on Monofill: <ul style="list-style-type: none"> ▪ National Steel does not accept combustible material like lithium ion batteries and others in any form and inspects all incoming material to ensure they do not enter the shredding process, in saying that, it has gone through a shredding process and all the combustible material would have been destroyed in the shredding process. There won't be any combustible residual left in the flock which can ignite any fires in the monofill. - The importation of cover soil onto the site is not envisaged, and no reference to this appears in our reporting. |

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| 2.1.2 | Leachate quantities and disposal | <p><i>The quantities of leachate predicted to be generated by the monocells have potentially been underestimated. For example, the proposed capping profile does not include a low infiltration sealing layer and even the permeability recommended in the WasteMinz Guideline (10-7 m/s) would likely result in more rainfall infiltration than the assumed amount (of 7% of rainfall). A geosynthetic (geomembrane and geosynthetic clay liner (GCL)) sealing layer in a cap can generally result in less than 1% of rainfall generating leachate.</i></p> <p><i>The consequence of underestimating leachate volumes is: Increased levels of leachate in the landfill increasing the leakage rate to the groundwater and potentially polluting the groundwater above assessment criteria Making it difficult to landfill, particularly in the early stages of the landfilling in each cell as the leachate level can be at the surface Increased risk of waste instability by increased leachate levels Increased risk of batter seepages of leachate and impacting surface water quality</i></p> <p><i>It is recommended that the applicant should provide further information on the following:</i></p> <p><i>Justification of the rainfall infiltration rates (using a model e.g. HELP1) over into daily, intermediate and final capped waste</i></p> <ul style="list-style-type: none"> <i>– Assume 100% infiltration for the active tipping area (200 m2)</i> <i>– Include the volumetric contribution from the subsoil drainage system (as it is acknowledged by the applicant that the liner system will leak and to not assume this water can be directed to the stormwater system). The basis for the potential subsoil drainage system’s collected volume should be justified.</i> <i>– Undertake a water balance model for wet rainfall conditions (1,400 mm year) based on a monthly timestep to demonstrate there is sufficient disposal capacity (tankering off-site)</i> <i>– Evidence that WaterCare will accept the predicted volumes and quality of leachate (see the section below as further testing of the floc waste is recommended)</i> <p><i>It is important that the floc waste is covered (as discussed above) and the active area is minimised to reduce the potential for rainfall runoff (leachate) from the surface of the floc to enter surface water.</i></p> | <ul style="list-style-type: none"> - Leachate formation is caused by the ingress of rainfall into the waste body. Leachate production or generation is related to several other factors, one being field capacity. The lysimeter trials demonstrated the field capacity of the floc. Additional parameters such as slope or grade also play a role. GHD has raised concerns regarding leachate production in relation to the final capping of the monofill. It should be noted that allowance for 1% ingress as opposed to our more conservative 7% presupposes a landfill capping system that is near leak-proof. Our position has been to adopt a conservative approach to estimating leachate production. - GHD’s assumption of 100% infiltration into a waste body is unrealistic. Leachate production is strongly dependent on the field capacity of the waste body. Lysimeter testing conducted on the actual floc material, has confirmed its field capacity is higher than MSW waste. - It appears that GHD has not fully considered the arrangement of the underlying leachate drainage blanket. When in operation – this site (specifically this site – refer to operational drawings provided in Figure D in the Engineering Report, and Fig. 5.1) will allow for the drainage of leachate to the exposed sides of the operation until the last quarter is infilled. This will allow for complete extraction of leachate. The statement “<i>Making it difficult to landfill, particularly in the early stages of the landfilling in each cell as the leachate level can be at the surface</i>” – likely reflects the reviewer’s experience with poorly operated landfills. - In response to the further information proposed we note: <ul style="list-style-type: none"> - Monofill is significantly different to a common MSW type landfill site. - The HELP model is a highly theoretical tool and the Darcian outputs do not reflect real world leachate production rates. - We have based our production rates on monitored landfills, and our experience in operating landfills – and the design and operation of leachate treatment plants - Our leachate production calculations are based on 1,400mm pa, which is appropriate. - WaterCare have been consulted as too has the Pukete WWTP, who both require that effluent must conform to their chemical concentration and volume loading limits. We have thus noted in the Engineering Report: “All leachate will be collected and transported by tanker off-site to a suitable trade waste disposal point, i.e. Watercare’s Trade Waste in Wiri, Auckland or alternatively at a suitable site in Hamilton, for example, Pukete Wastewater Treatment Plant (WWTP)”. A trade waste agreement will be required. There are no concerns with meeting the effluent discharge limits based on the predicted leachate quality data provided in Table 6.3 of our Engineering Report. Admitted that this will require agreement following detailed design. - GHD’s statement that leachate can enter surface water is not credible for this site-specific monofill. The ‘bowl nature’ of the design (refer drawing Fig ,,, etc) prevents potential contact. |
| 2.1.3 | PFAS and liner selection | <p><i>A pilot scale test was undertaken to evaluate the potential concentrations of PFAS2 (and other substances) in the leachate (Appendix A of Attachment 19, lysimeter trial). The pilot scale test indicated that the waste has the potential to discharge PFAS to the environment. To manage uncontrolled PFAS leachate discharge risks to the groundwater, the proposed liner system is a single composite liner (geomembrane, GCL and compacted soils).</i></p> <p><i>The NEMP 3.0 includes guidance on the concentrations of PFAS in leachate and waste and based on the concentrations, recommends the landfill type (and its liner) to protect groundwater from leachate. Very low concentrations of PFAS allow the waste to be landfilled in an unlined landfill and as the concentrations increase the recommendation is a single composite liner and for the highest concentrations is a double composite lined landfill. NEMP 3.0 notes that ‘the environmental regulator may determine that these criteria are not suitable for a specific landfill or landfills and derive and implement alternative criteria’.</i></p> <p><i>The NEMP also states that ‘in New Zealand, provisions in the Hazardous Substances (Storage and Disposal of Persistent Organic Pollutants) Notice 2024 must be followed’. The requirements of this Notice have not been considered by the applicant.</i></p> <p><i>The pilot scale test used by the applicant did not use the PFAS leachate testing methodology (ALSP) recommended in the NEMP 3.0 guidance and also did not assess the total concentration on a mass basis for PFAS. Further, it is expected that PFAS concentrations (and other substances)</i></p> | <ul style="list-style-type: none"> ▪ PFAS consideration: notwithstanding the reference to the NEMP 3.0 (and assuming Section 14 of PFAS NEMP 3.0 is implied), the reviewer has not fully engaged with the assessment of PFAS in leachate over time for <u>this specific site</u>. It is helpful to look beyond the NZ/Australia context as real-case intensive studies have examined PFAS behaviour in numerous landfills, including concentrations and management approaches. For example the recent Investigation of persistent organic pollutants (POPs), per- and poly-fluoroalkyl substances (PFAS) and other Water Framework Directive priority substances in landfill leachates (March 2024, by Robinson and Knox et al) – conducted by the UK’s Environment Agency provides relevant insights. We note that NEMP 3.0 primarily addresses PFAS disposal to landfill and separation techniques, and “treatment” remains limited. . Although PFAS is now widely referenced by by professionals, actual treatment – where PFAS are actually tested for and detected – remains very rarely implemented. - PFAS was encountered in the early flush of rainfall through the floc wastes, but thereafter was near-detection limit. - Ongoing testing of leachate for PFAS is included in the Monitoring Plan and Draft Conditions. - The selected lining system is a Class 1 type composite lining system comprising highly resilient materials used for the lining of even hazardous type wastes. The suggestion that this system Reference may not be appropriate to the presence of PFAS is misplaced particularly when compared with its application in NZ’s largest biologically active landfills, which accept special wastes and have recorded elevated PFAS levels. - A recent publication by Prof. Kerry Rowe (Internationally recognised eminent Engineer and Professor of Geotechnical and Geoenvironmental Engineering, Queen’s University), “Transport parameters for PFOA and PFOS migration through GCL’s and composite liners used in landfills” (2024), is useful literature expressing the very newness of liner design and |

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| | | | <p><i>in the waste may vary over time as the source of the waste is variable. Therefore, it is unclear if the waste used in the pilot scale testing will be representative of the waste to be landfilled over time.</i></p> <p><i>Based on the above, it is considered that the applicant has not provided sufficient information to determine if the liner system is appropriate for the proposed waste stream, and / or provide controls to confirm that the (future) waste stream is appropriate for the liner proposed to be installed (e.g. through regular testing of the waste). The Panel should consider seeking this information from the applicant.</i></p> | <p>consideration of PFAS. Notwithstanding this, GHD have not fully understood the findings of the lysimeter trials and establishing that PFAS levels reduced to only traceable levels (following initial filling) over time.</p> <ul style="list-style-type: none"> - Overall, we consider that sufficient information has been provided. |
| | 2.1.4 | Stability | <p><i>Landfill liners have the potential to move or 'slip' on interfaces and steep slopes, therefore presenting the potential to cause uncontrolled leachate contamination of the groundwater and surface water and increase the risk of fire from exposed waste.</i></p> <p><i>GHD in separate advice has commented on the stability of aspects of the monofills.</i></p> <p><i>It is considered that the applicant has not provided sufficient information to determine if the liner stability will be sufficient to manage potential adverse discharge risks.</i></p> <p><i>In addition to the other GHD advice on the stability aspects of the monofills, it is recommended that further stability analysis is completed for the concept design base and the sidewall lining system for both the SW and NW monofills (note detail shows 1 in 3 but excavation on NE cell is 1 in 2). Also this work should include veneer stability analysis of the sidewall liner.</i></p> | <ul style="list-style-type: none"> ▪ Stability (Liner Stability) - The proposed design incorporates a flat floor design with limited side slopes which effectively eliminate the likelihood of any instability. <p>The design team has a comprehensive understanding of liner interface design parameters and the need for site specific testing of the friction angle between a synthetic liner and various natural soils. These tests will be undertaken as part of detailed design. Importantly, there are no significant steep lined slopes in this particular design. Taken together, the geometry of the site and the planned testing regime provide confidence that liner stability will be sufficient to manage potential discharge risks and that further stability analysis is not justified.</p> |
| | 2.1.5 | Operational competence | <p><i>Our experience in the industry is that there is a deficit of capable and experienced people in the operation of landfills. We have had recent experience with newer landfills which have suffered a number of operational issues and in particular with fires, leachate management and the pollution of surface waters.</i></p> <p><i>This presents a significant environmental risk and it is recommended that the should the project be approved that a condition of the approval require the operational staff have sufficient experience and capability to operate the monofills appropriately.</i></p> | <ul style="list-style-type: none"> ▪ Operational competence – - We acknowledge GHD's observations regarding the importance of experienced and capable landfill operators. - The Green Steel monofills will demand and receive a high level of engineering skill and careful operational oversight. - However, we agree that operational staff should be required to have sufficient experience and capability to operate the monofills appropriately. - Green Steel has prepared a condition of consent to reflect this. A proposed Draft Condition in this regard is appended. |
| | 2.1.6 | Cumulative environmental impacts | <p><i>The application has not assessed cumulative environmental impacts to groundwater and surface water quality in the locality from the nearby operational Hampden Downs landfill. It is recommended that the application consider and assess any cumulative environmental impacts to water quality from the existing Hampden Downs landfill and the project's monofills.</i></p> | <ul style="list-style-type: none"> ▪ Cumulative environmental impacts - The Hampton Downs Landfill has a design capacity of over 30 million m3 of municipal solid waste, including commercial, industrial, special wastes and biosolids, producing over 200m3 per day of high strength methanogenic leachate and over 5000m3 of landfill gas per hour. The site is 2km to the west with a dividing ridge in a separate surface and groundwater catchment. By contrast, the monofill has a design capacity of some 0.5million m3 of single type commercial waste producing a leachate of very low biological strength and low chemical parameters. The PFAS levels, for example, are significantly lower and barely detectable over time. <p>Given the fundamental differences in scale, waste type, leachate characteristics, and catchment separation, the suggestion of cumulative impacts between the Hampton Downs Landfill and the proposed monofill is not credible.</p> |
| 3. | 3.1 | Landfill concept design review | <p>Review table provide by GHD which covers, we'd understand, all points stated above, and below, addressing:</p> <p>Siting; Liner; Leachate Drainage System; Surface and Stormwater Management; Landfill Gas; Capping</p> | <ul style="list-style-type: none"> ▪ The comments provided in this section are too general to be helpful and most relate to standard landfill design details that will be undertaken at detailed design stage. - We recognize that the NE monofill design is more complicated than the SW monofill. - Items relating to hydrogeology, leachate drainage and landfill gas are addressed by other sections. - Drainage Aggregate: <p>Kerry Rowe, (an internationally recognised eminent Engineer and Professor of Geotechnical and Geoenvironmental Engineering, Queen's University), who GHD mention, in a paper prepared with Yu, has addressed the debate regarding the inclusion of geotextile above the drainage layer debate. In NZ the disposal to land guidelines are in the process of being updated (noting that we are technically supporting the lead professional at Tonkin + Taylor, namely Jonathan Shamrock) with a recommendation that a geotextile layer be incorporated above the leachate drainage layer. This approach is consistent with international best practice, as a geotextile filter layer is required under the Australian BEPM guidelines and the South African landfill regulations, providing strong international precedent. As Kerry Rowe notes, "A filter-separator layer between the waste material and drainage layer minimizes the physical intrusion of waste material into the upper zone of drainage layer."</p> |

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| | | | | <ul style="list-style-type: none"> - Notwithstanding the ongoing debate regarding filter layers and geotextiles placed above leachate drainage systems, it is important to consider the broader body of research and opinion. For example Prof. Raffaello Cossu (with Stegmann & Christensen), have argued that all geotextiles are susceptible to clogging. The literature also records exchanges between Cossu and Giroud, concluding that <i>'liners leak and filter layers clog'</i>. We are confident that for this specific site, the proposed design - constructed and operated under our engineering guidance – will perform effectively. |
| | 3.2 | Landfill Gas | <p><i>No information is provided to guide whether anaerobic decomposition of the floc may generate estimated quantities of landfill gas (including hydrogen sulphide) and cause odour and subsurface gas migration risks.</i></p> <p><i>Data on the composition of leachate indicates it has up to 2000 mg/L of COD (Appendix A of Attachment 19, lysimeter trial). COD can indicate bioavailability of organics.</i></p> <p><i>The applicant should include a program to assess during operations whether landfill gas extraction and management is needed.</i></p> <p><i>Monitoring of landfill gas and hydrogen sulphide should be included both from the atmosphere in the leachate riser and at the surface of the landfill. The management plan should be updated and also take into account available Australian and New Zealand landfill gas monitoring guidance, and include testing for carbon monoxide as an indicator of a subsurface fire.</i></p> | <ul style="list-style-type: none"> ▪ Landfill Gas – - GHD anticipate a biological breakdown of wastes similar to a common MSW type landfill. This monofill is very different and biological breakdown is very unlikely. - The basis on which GHD assumes that proteins or other substrates are available for bacterial consumption leading to landfill gas generation is unclear. The reference to H₂S is inconsistent with the floc material stored in the monofill. Under these conditions, methanogenesis cannot be expected, and the availability of substrates for sulphur-reducing bacteria is extremely limited. Foundational studies, including Farquhar & Rovers (1973) and Christensen & Kjeldsen (1989), provide clear support for this position. - The basis for GHD’s assumption that COD in the monofill leachate is readily consumable by bacteria also appears unclear. This may reflect a confusion between BOD and COD, or an assumption that a portion of COD is biodegradable. In reality, the leachate from the floc is characterised by ‘hard refractory COD,’ which is not readily available for bacterial degradation. Even if there were a large portion potential consumable by bacteria, such a growth environment in the monofill is highly unlikely. The freely organic content is minimal. - We concur that CO is an extremely dangerous and combustible gas. The management of fire is addressed above.. - For the reasons above it is not necessary to include a program to monitor landfill gas etc in a monofill. |
| | 3.3 | Groundwater | <p><i>The following is advised with respect to protecting groundwater quality:</i></p> <p><i>Sealing the groundwater bore in the footprint of the SW monofill prior to construction</i></p> <p><i>Review by another specialist of the groundwater monitoring network</i></p> <p><i>Review by another specialist of the potential impact on off-site groundwater quality (considering cumulative impacts from the nearby operational landfill). It appears for example the assumed leachate leakage rate may be underestimated for the proposed liner arrangement, does not consider the possible storage leachate (at elevated levels in the monofills) and there are unsubstantiated assumptions in the analytical modelling.</i></p> | <ul style="list-style-type: none"> ▪ Groundwater - The groundwater bore was an exploratory borehole and may not progress to a production bore. - We agree that if this does not progress to a production bore, it will be grouted / sealed - If a production bore is required, it will be located to be clear of the monofil footprint. - If the exact location is required, a suitable engineering solution is provided in the Engineering Report (covered under Section 10.5 in the Engineering Report) - Groundwater monitoring network review: we note that conditions of consent have been reviewed by the WRC . We are not clear as to the purpose of a further review of the groundwater monitoring network. - The inappropriateness of an assessment of the cumulative effects of the monofills on this site with the Hampton Downs Landfill is addressed above. - Storage of leachate in the monofil is not part of the proposal. Such an approach would not represent good practice and would be environmentally unsafe. The assumption of elevated leakage through the liner based on excessive leachate storage does not apply to the proposed design . - Liner leakage rates are based on numerous publications by Rowe, Giroud, Bonaparte and Koerner. |
| 4 | 1 to 5 | Other Issues | <p><i>The following other issues are raised for consideration by the Panel:</i></p> <ol style="list-style-type: none"> <i>1. The concept design should provide details of how seepage of leachate from the batters can be avoided (in addition to the suggest above for removal of cover before placement of further waste). Seepage of leachate from batters is a common problem at landfills (if not well managed) which results in leachate impacting surface water quality discharged off site.</i> <i>2. Considering the small landfilling rate, the stages for the SW monofill would benefit from being reduced in area to assist with site operations (eg leachate and stormwater management). However they should still be large enough to be safely trafficable.</i> <i>3. Peat and organic soils identified in the project site should be subject to a program to exclude them from use as cover soils in the landfill. These soils could generate landfill gas and possibly cause spontaneous combustion and a subsurface fire in the monofills. Similarly no acidic sulphate soils should be utilised for covering the floc waste.</i> <i>4. The monitoring program should measure leachate levels in the landfill.</i> <i>5. The QA/QC plan should be updated to reflect the WasteMinz guidelines and consider the more complete guidance available from the NSW EPA</i> | <ul style="list-style-type: none"> ▪ Other Issues 1. The concept design provides a ‘bowl form’ with the outer (western face) being graded downwards into the monofil – to ensure that perched leachate percolates into the monofill base and does not seep out onto the side slopes. 2. Point 2 is acknowledged – and agreed. We note that a monofill can be lined across a large area, but only a small area compartmentalised for operation – as detailed in Figure 5.1 in the Engineering Report. 3. Point 3 is agreed. Acid sulphate soils should be avoided and if encountered must be managed as per the Earthworks Management Plan (Section 4.4 “Acid Sulphate Soils Management”). 4. Leachate levels will be measured in the leachate sumps and physically controlled by the outlet invert level. The design of a highly permeable leachate drainage system ensures minimal leachate head on the liner. We consider that the WasteMINZ (2023) guidelines (Appendix B.4) are satisfactory and have provided a more site-specific QA/QC specification standard – attached to the Engineering Report i.e. Quality Control Plan (QCP) for Monofill Lining Systems, Green Steel Monofill. |

MONOFILL CONSENT CONDITIONS (DRAFT-PROPOSED):

Monofill Fire Management Plan

1. Preparation and Certification

At least 10 working days prior to the commencement of disposal activities at the monofills, the Consent Holder shall prepare and submit to the Waikato Regional Council a Fire Management Plan (FMP). The FMP and any update shall be prepared by a suitably qualified and experienced person and certified by Fire and Emergency New Zealand (FENZ), or prepared in consultation with FENZ, to the satisfaction of the Waikato Regional Council.

2. Objective

The FMP shall demonstrate how the risks of fire associated with the construction, operation, and closure of the monofills will be avoided, remedied, or mitigated, and how fire events will be safely and effectively managed should they occur.

3. Content

The FMP shall include, but not be limited to:

- a. Identification of potential fire risks;
- b. Procedures for screening, handling, storage, and placement of floc to minimise fire risk;
- c. A maximum of 200m² of uncovered floc at any one time, and setbacks from any vegetation surrounding the monofills;
- d. Limits on the size, height, and duration of waste floc stockpiles;
- e. On-site fire prevention measures, including water supply, fire-fighting equipment;
- f. Procedures for monitoring for heat, smoke, or other indicators of fire;
- g. Emergency response procedures, including notification protocols, and coordination with Fire and Emergency New Zealand;
- h. Training requirements for staff and contractors, including induction and refresher training;
- i. A site plan showing fire access routes, fire-fighting water supplies;

4. Implementation

The Consent Holder shall implement the Fire Management Plan at all times during construction, operation, temporary closure, and permanent closure of the monofills.

5. Review and Updating

The Fire Management Plan shall be reviewed:

- a. At least every five years;
- b. Following any fire incident; and
- c. When there is a material change to the site layout, or operational practices that may affect fire risk.

Any revised Fire Management Plan shall be provided to the Waikato Regional Council prior to implementation of the changes.

6. Availability

A copy of the current Fire Management Plan shall be kept on-site at all times and made available to the Waikato Regional Council or Fire and Emergency New Zealand upon request.

Monofill Operational Competency

1. Staff Experience and Capability

The Consent Holder shall ensure that the industrial monofill is operated at all times by suitably trained, experienced, and competent personnel with sufficient knowledge and capability to operate the monofill in accordance with:

- a. the conditions of this approval;
- b. the approved operational and management plans; and
- c. recognised best practice for the safe operation of industrial monofills.

2. Training and Induction

All operational staff and contractors involved in monofill activities shall receive an appropriate site-specific induction and ongoing training relevant to their roles, including waste acceptance procedures, environmental controls, health and safety requirements, and emergency response procedures.

3. Records

The Consent Holder shall maintain records of staff training, qualifications, and relevant experience, which shall be made available to the Consent Authority upon request.