



BEFORE

Independent Commissioners appointed
by Tasman District Council

IN THE MATTER

of the Resource Management Act 1991

AND

IN THE MATTER

of an application by CJ Industries Ltd
for land use consent RM200488 for
gravel extraction and associated site
rehabilitation and amenity planting and
for land use consent RM200489 to
establish and use vehicle access on an
unformed legal road and erect
associated signage

**EVIDENCE OF REECE BLACKBURN HILL
ON BEHALF OF CJ INDUSTRIES LTD
(SOIL MANAGEMENT AND LAND PRODUCTIVITY)
SUPPLEMENTARY EVIDENCE**

4 November 2022

1. INTRODUCTION

1.1 My full name is Reece Blackburn Hill. I am a Soil Consultant at Landsystems.

1.2 The applicant has applied for resource consents authorising the extraction of gravel, stockpiling of topsoil, and reinstatement of quarried land, with associated amenity planting, signage and access formation at 134 Peach Island Road, Motueka:

- (a) RM200488 land use consent for gravel extraction and associated site rehabilitation and amenity planting, and
- (b) RM200489 land use consent to establish and use vehicle access on an unformed legal road and erect associated signage.

1.3 The applicant has also subsequently applied for a discharge permit (RM220578).

- 1.4 I produced evidence dated 15 July 2022 addressing the soil management and land productivity of the land use activities.
- 1.5 Since that time, the Government has produced the National Policy Statement on Highly Productive Land 2022 (“NPS-HPL”). This supplementary evidence addresses the NPS-HPL.
- 1.6 Council has also produced a supplementary s 42A report which includes commentary on the *Soil Management Plan and assessment of soil related effects 134 Peach Island Road, Motueka* that was attached as Appendix 1 to my evidence of 15 July, and a Memorandum from Mirka Langford – Senior Resource Scientist, Land. This evidence includes a response to those documents.

Qualifications and Experience

- 1.7 My qualifications and experience were set out in my evidence of 15 July 2022. Since that date, I have also undertaken soil and Land Use Capability (LUC) assessments for subdivision that have required assessment against the NPS-HPL.
- 1.8 I have not undertaken a site visit. My evidence is based on the property scale soil and LUC assessment provided by LandVision, and regional scale soil and LUC map information as well as evidence from Mr Nelson (crop production).

Code of Conduct

- 1.9 I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014 and I agree to comply with it. My evidence is within my area of expertise, however where I make statements on issues that are not in my area of expertise, I will state whose evidence I have relied upon. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in my evidence.

2. EXECUTIVE SUMMARY

NPS-HPL

- 2.1 As set out in the diagram at p6 of the *Soil Management Plan and assessment of soil related effects 134 Peach Island Road, Motueka* (“**SMP**”), the site does not contain LUC 1 or 2 land. The

site contains areas of LUC 3 land within and outside the stop banks. These are the only areas that the NPS-HPL applies to.

- 2.2 The land area outside the stop bank is not suitable for agricultural land development due to limitations of an inherent seasonally high water table, flood risk, and variable or shallow soil depth. In my opinion, it has “permanent or long-term constraints ... that mean the use of the highly productive land for land-based primary production is not able to be economically viable for at least 30 years”, as per clause 3.10(1)(a) of the NPS-HPL, and the other clauses of clause 3.10(1) are also met (to the extent they relate to matters within my expertise).
- 2.3 As set out in my previous evidence, the LUC 3 land inside the stop bank has soil limitations that restrict production and the range of land uses that it is suitable for over the long term. Adherence to the Soil Management Plan will ensure that the removal, management and placement of soil avoids or minimises impacts on the soil properties prior and following placement, and that the re-established soil can over the long term, retain or exceed the soil versatility of the original soil on the site. Reduced site productivity and impacts on soil physical properties following reinstatement of the soil post gravel extraction are anticipated in the short term (0-3 years). However, careful soil management throughout the operation and following reinstatement of the soil will reduce impacts on soil properties such that any impacts are likely to only be short term (0-3 years) while the pasture establishes and restores soil structure and soil biology.
- 2.4 Key to the effective re-establishment of the soil on the gravel extraction site are careful pre-planning, adherence to the guidance provided in the Soil Management Plan, and the training of all staff involved. Staging the gravel extraction reduces the loss of productive land on the site during extraction of gravels and reduces the volume of soil requiring stockpiling and the time the soil is stockpiled. Provided the activity is managed in accordance with those recommendations, the re-established soil is likely to remain productive at a similar level as the original soil and will have similar, or potentially have greater soil versatility than the original soil pre-gravel extraction.
- 2.5 As a result, I consider that the activity can be considered a “temporary land use activity that has no [adverse] impact on the productive capacity of the land” in terms of clause 3.9(2)(g) of the NPS-HPL.

Section 42A addendum

- 2.6 In response to the opinion in the 42A report addendum about whether the site meets the TRMP definition of high productive value, I maintain that soil rooting depth (pre-gravel extraction) is a limiting factor across most of the site (LUC 3s1, 4s1, 5s1 and 6s1). The combination of features are not such that the land is capable of producing crops at a high rate or across a wide range.
- 2.7 My opinion is that the Peach Island Road site is predominantly LUC classes 4, 5 and 6 (as shown by the property scale soil and LUC assessment by LandVision), and as such, the site as a land unit is not LUC 3 as indicated by the regional scale NZLRI LUC map information.
- 2.8 If treated as a whole unit land for the purpose of assigning a LUC class the areas of LUC class 3 (LUC 3s1 and 3w1) are sub-dominant, and the site would be LUC class 4 (LUC unit 4s1) at best, based on property scale soil and LUC assessment provided by LandVision.
- 2.9 The examples of unsuccessful soil restoration in the region were primarily due to poor adherence to consent conditions and lack of a soil management plan, and do not mean that successful restoration cannot be achieved and the productivity capacity of the restored soil retained.
- 2.10 The provision of the Soil Management Plan and its correct implementation will prevent similar poor practices from occurring and ensure the productivity capacity of the restored soil on the site is at least retained.
- 2.11 In my opinion, the potential for degradation of soil aggregate degradation and compaction through irrigation of topsoil stockpiles and during transport of soil is likely to be minimal.
- 2.12 The restoration of the soil profile post gravel extraction with at least imperfect drainage meets TRMP requirements and is suitable for cropping and orchards. It does not equate to a degradation in productive capacity.

3. EVIDENCE

Applicability of the NPS-HPL to the application site

3.1 Aspects of the NPS-HPL that relate to LUC classification and effects on productive land are within my expertise. My evidence is limited to clause 3.5(7)(a)(ii) – the LUC classification of the site, clause 3.9(3)(a), clause 3.9(2)(g) and clause 3.10(1)(b)(i)

3.2 “Highly productive land” is defined in the NPS-HPL as:¹

means land that has been mapped in accordance with clause 3.4 and is included in an operative regional policy statement as required by clause 3.5 (but see clause 3.5(7) for what is treated as highly productive land before the maps are included in an operative regional policy statement and clause 3.5(6) for when land is rezoned and therefore ceases to be highly productive land)

3.3 I am advised that clause 3.5(7) applies because maps produced in accordance with clause 3.4 have not yet been included in an operative regional policy statement as required by clause 3.5. Clause 3.5(7) says:

(7) Until a regional policy statement containing maps of highly productive land in the region is operative, each relevant territorial authority and consent authority must apply this National Policy Statement as if references to highly productive land were references to land that, at the commencement date:

(a) is

- (i) zoned general rural or rural production; and
- (ii) LUC 1, 2, or 3 land; but

(b) is not:

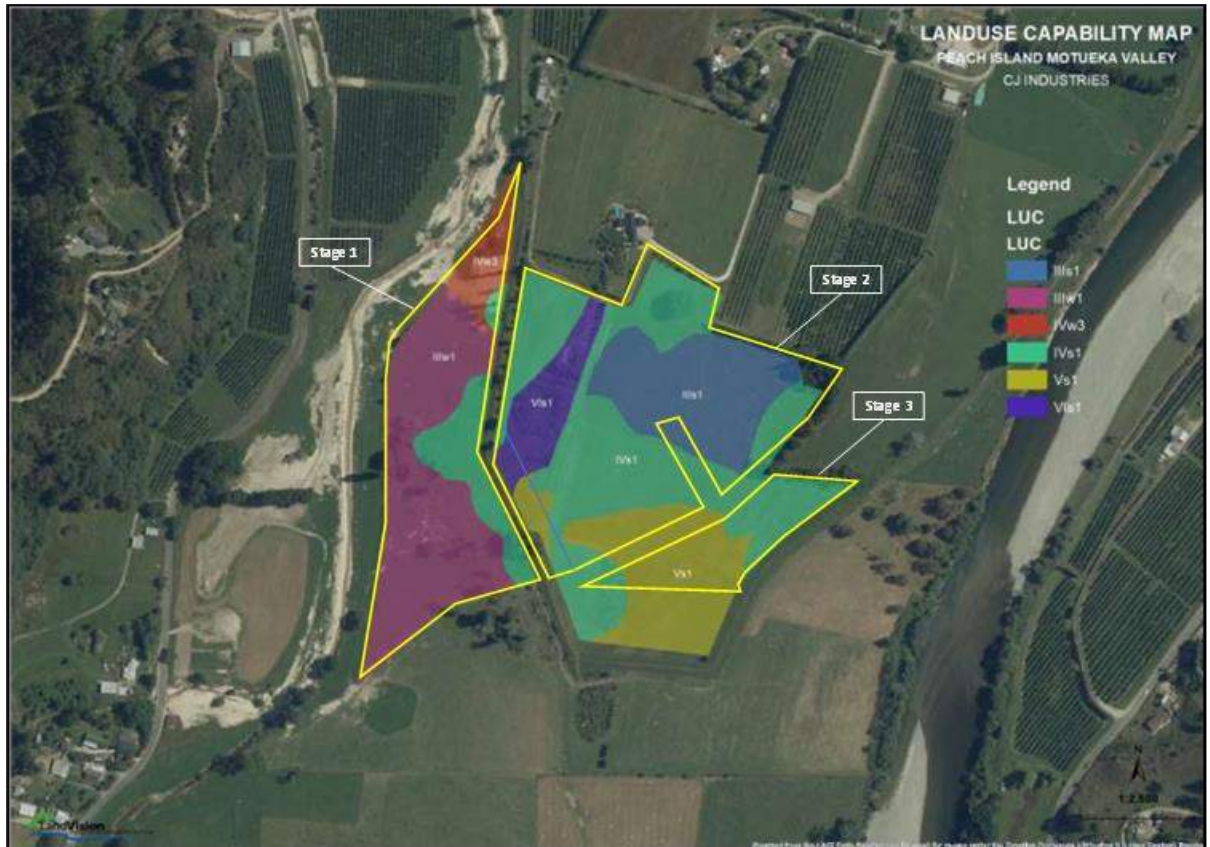
- (i) identified for future urban development; or
- (ii) subject to a Council initiated, or an adopted, notified plan change to rezone it from general rural or rural production to urban or rural lifestyle.

3.4 “LUC 1, 2 and 3” is defined as:

LUC 1, 2, or 3 land means land identified as Land Use Capability Class 1, 2, or 3, as mapped by the New Zealand Land Resource Inventory or by any more detailed mapping that uses the Land Use Capability classification

¹ Clause 1.3 Interpretation

3.5 The LUC units on the site were assessed in the field by Landvision at property scale using the national Land Use Capability Classification criteria² (used for the New Zealand Land Resource Inventory), and the mapped units were shown on page 6 of the SMP (reproduced below). The site does not contain LUC class 1 or 2 land. The site contains two discrete areas of LUC class 3 land (LUC 3s1 and 3w1). One area of LUC class 3 land (LUC 3s1) is on the landward side of the stopbanks (shaded blue) and the other area (LUC 3w1) is on the river side of the stopbanks (shaded pink):



3.6 I confirm that the LUC units shown in that figure are in accordance with the definition of LUC 1, 2 and 3 as provided in the NPS-HPL.

3.7 I have estimated the area of LUC class 3 within the Stage 1, 2 and 3 areas shown in the figure above (yellow lines and labelled). The combined area (Stage 1, 2 and 3 areas) is ~8.8 ha.

² Lynn IH, Manderson AK, Page MJ, Harmsworth GR, Eyles GO, Douglas GB, Mackay AD, Newsome PJF. 2009. Land Use Capability Survey Handbook – a New Zealand handbook for the classification of land 3rd ed. Hamilton, AgResearch; Lincoln, Landcare Research; Lower Hutt, GNS Science. 163p.

- 3.8 The area of LUC 3s1 is 1.3 ha and located entirely within the Stage 2 area. The area of 3w1 is 1.8 ha and located entirely within the Stage 1 boundary.
- 3.9 The combined area of LUC class 3 land in the combined stage 1, 2 and 3 areas is 3.1 ha (35% of the site) and the balance of the area is LUC 4s1 with lesser areas of LUC 6s1, 5s1 and 4w3 (collectively 5.7 ha or 65% of the site). Based on the property scale field LUC assessment and applying the NPS-HPL, the site is predominantly not highly productive land.
- 3.10 If mapped as a whole unit as suggested by Ms Langford (Memorandum, p103 of s 42A report), the whole land unit would be assigned a LUC class of LUC 4 (LUC unit 4s1), based on conventional mapping procedures, whereby the dominant LUC unit present is used, as opposed to the subdominant LUC units within the area. However, I consider the property scale LUC assessment should be used as it is the best available information on LUC class and is one of the acceptable forms of LUC assessment in the NPS-HPL definition of LUC 1, 2 and 3. Therefore, I disagree with the s 42A assessment that “the entire application site is defined as highly productive land under the NPS-HPL”.³

LUC class 3 land outside the stop bank

- 3.11 The LUC class 3 (LUC 3w1) land outside the stop bank is not suitable for agricultural land development due to limitations of an inherent seasonally high water table but more so flood risk. In my opinion, it has “permanent or long-term constraints ... that mean the use of the highly productive land for land-based primary production is not able to be economically viable for at least 30 years”, as per clause 3.10(1)(a) of the NPS-HPL.
- 3.12 Clause 3.10(1) has additional requirements that:
- (b) the subdivision, use, or development:
 - (i) avoids any significant loss (either individually or cumulatively) of productive capacity of highly productive land in the district; and
 - (ii) avoids the fragmentation of large and geographically cohesive areas of highly productive land; and

³ Paragraph 7.10

(iii) avoids if possible, or otherwise mitigates, any potential reverse sensitivity effects on surrounding land-based primary production from the subdivision, use, or development; and

- (c) the environmental, social, cultural and economic benefits of the subdivision, use, or development outweigh the long-term environmental, social, cultural and economic costs associated with the loss of highly productive land for land-based primary production, taking into account both tangible and intangible values.

3.13 In my opinion, development of the site will avoid loss of productive capacity of highly productive land in the district, because rehabilitation will ensure that the productive capacity is retained.

3.14 Also, the development avoids fragmentation of large and geographically cohesive areas of highly productive land (the areas that meet the highly productive land definition are not large or geographically cohesive).

3.15 It is beyond my expertise to comment on clause 3.10(1)(b)(iii) and clause 3.10(1)(c).

3.16 NPS-HPL clause 3.10(1)(a) requires the applicant to demonstrate that the permanent or long-term constraints on economic viability cannot be addressed through any reasonably practicable options that would retain the productive capacity of the highly productive land, by evaluating options such as (without limitation):

- (a) alternate forms of land-based primary production:
- (b) improved land-management strategies:
- (c) alternative production strategies:
- (d) water efficiency or storage methods:
- (e) reallocation or transfer of water and nutrient allocations:
- (f) boundary adjustments (including amalgamations):
- (g) lease arrangements.

3.17 The constraints on the use of the land (LUC units 3w1, 4w1 and 4s1) outside the stopbank arise from its inherent susceptibility to flooding, rather than from the form of land-based primary production or any allocation or legal constraints.

LUC class 3 land inside the stop bank

- 3.18 As set out in my previous evidence, the LUC class 3 land inside the stop bank (LUC 3s1) has soil limitations that restrict production and the range of land uses that it is suitable for over the long term. These soil limitations are related to the shallow and variable soil depth to gravels which reduce rooting depth for orchard trees, restrict cultivation for arable use and increase the within site management requirements for production.
- 3.19 Adherence to the Soil Management Plan will ensure that the removal, management and placement of soil avoids or minimises impacts on the soil properties prior and following placement, and that the re-established soil can over the long term retain or exceed the soil versatility (and range of land use options) of the original soil on the site.
- 3.20 Reduced site productivity and impacts on soil physical properties following reinstatement of the soil post gravel extraction are anticipated in the short term (0-3 years). However, careful soil management throughout the operation and following reinstatement of the soil will reduce impacts on soil properties such that any impacts are likely to only be short term (0-3 years) while the pasture establishes and restores soil structure and soil biology.
- 3.21 Key to the effective re-establishment of the soil on the gravel extraction site are careful pre-planning, adherence to the guidance provided in the Soil Management Plan, and the training of all staff involved. Staging the gravel extraction reduces the loss of productive land on the site during extraction of gravels and reduces the volume of soil requiring stockpiling, and the period the soil is stockpiled. Provided the activity is managed in accordance with those recommendations, the re-established soil is likely to remain productive at a similar level as the original soil and will have similar, or potentially have greater soil versatility than the original soil pre-gravel extraction.
- 3.22 As a result, I consider that the activity can be considered a “temporary land use activity that has no [adverse] impact on the productive capacity of the land” in terms of clause 3.9(2)(g) of the NPS-HPL.
- 3.23 Also, effects on the land within the stop back can be managed in a way that minimises or mitigates any actual loss or potential cumulative loss of the availability and productive capacity of highly productive land in the district in terms of clause 3.9(3)(a).

Section 42A Report addendum

3.24 The following part of my evidence addresses matters raised by Council in the s 42A report addendum (Section 7, and the memo provided by Ms Langford – p99-103).

TRMP – “high productive value”

3.25 Referring to the TRMP definition of “high productive value”, Ms Langford contends (p 99 - s 42A report addendum) that based on the combination of the TRMP criteria that this site meets, and the fact that rooting depth varies across the site but is not a limiting factor across the whole site, the land is capable of producing at a high rate and/or across a wide range.

3.26 I have provided a detailed assessment of the site (pre-gravel and post-gravel extraction) against the TRMP definition in the draft Soil Management Plan (p 23-25).

3.27 I maintain that soil rooting depth (pre-gravel extraction) is a limiting factor across most of the site (LUC 3s1, 4s1, 5s1 and 6s1) and restricts the productive capacity of the site and preventing the land from being considered land of high productive value based on TRMP criteria.

3.28 The TRMP states “where that combination is to such a degree that it makes the land capable of producing crops at a high rate or across a wide range”. My interpretation is the wording “where that combination” means that the criteria must be considered, at least two or more criteria met, and once considered and met, the combination of features must be to such a degree that it makes the land capable of producing crops at a high rate or across a wide range.

3.29 In considering the combination of the criteria (TRMP criteria (a) to (f)) five of the six criteria were met. However, for the areas mapped as LUC 3s1, 4s1, 5s1 and 6s1 (the majority of the site) TRMP criterion (d) was not met and the soil depth and variability across those area, in my opinion would exclude the site from being suitable for intensive cropping and deep rooted horticulture crops (orchards) – i.e. the land would not be capable of producing crops at a high rate or across a wide range. Mr Nelson’s evidence confirms that the land is not capable of producing crops at a high rate or across a wide range.

NPS-HPL definition of highly productive land

- 3.30 Ms Langford, in her memo, agrees with the detailed mapping of the soils at the property but disagrees that the detailed soil map should be used to dissect the land unit into parts of lesser or more productive areas, maintaining that the land unit as a whole needs to be assessed (p103).
- 3.31 If mapped as a whole unit as suggested by Ms Langford, the whole land unit would be assigned a LUC class of LUC 4 (LUC unit 4s1), based on conventional mapping procedures⁴, whereby the dominant LUC unit present is used, as opposed to the subdominant LUC units within the area. However, I consider the property scale LUC assessment should be used as it is the best available information on LUC class and is one of the acceptable forms of LUC assessment in the NPS-HPL definition of LUC 1, 2 and 3. Therefore, I disagree with the s 42A assessment that “the entire application site is defined as highly productive land under the NPS-HPL”.⁵
- 3.32 Ms Langford is of the opinion that the detailed mapping cannot be accepted due to the absence of a guidance document, and as such the regional scale map information provided by the 1:50,000 scale NZLRI should be used to determine whether the land on the site is considered highly productive land.
- 3.33 In my opinion, the detailed soil and LUC assessment undertaken by LandVision provides the best available map information at an appropriate scale for the site and should be used in preference to the regional scale NZLRI LUC map information.
- 3.34 I have previously noted the limitations of applying the regional map information at property scale in the draft SMP (p25). The LandVision report (p7) discusses these limitations, commenting that “the LUC survey is 1:50,000 scale then one square cm on the map represents 25 ha. Therefore, the property may or may not have an observation on it considering the land in question is about 11 ha. The paddock scale mapping, ie 1:7000 scale, there should be an observation approximately every 0.5 ha over the survey area. This is significantly greater than regional scale mapping and is more fit for purpose.”

⁴ http://www.nzsoils.org.nz/Topic-Basics_Of_Soils/Soil_Naming_and_Soil_Maps/

⁵ Paragraph 7.10

Implementation of Soil Management Plan

- 3.35 The s 42A addendum (5.25 - p19, p102) notes continued concern regarding the successful implementation of the Soil Management Plan, commenting that “this has not been shown as possible elsewhere in the district”.
- 3.36 I have discussed in detail the two examples being referred to in the Soil Management Plan (p20-21). For both examples, either there was no soil management plan, or if there was one the soil management plan was clearly not adhered to, and that is the reason for poor soil condition following restoration. CJ Industries has obtained and I have reviewed a copy of the resource consent for the Stapleton Farm quarry at 554 Waimea West Road. Photos provided in Campbell (2017) assessment report clearly indicate that resource consent conditions for that site were not adhered to.
- 3.37 In my opinion, these examples do not mean that successful restoration cannot be achieved and the productivity capacity of the restored soil retained. They do not demonstrate that soil restoration is inherently difficult in this region. They are simply examples of poor practice.
- 3.38 The provision of the Soil Management Plan and its correct implementation will prevent similar poor practices from occurring and ensure the productivity capacity of the restored soil on the site is at least retained. The inherent characteristics of the land in question lend themselves to positive restoration outcomes.

“Conflict” between management plans

- 3.39 The s 42A addendum (5.35 – p21, p100) notes concerns including a potential conflict with the Dust Mitigation Management Plan (DMMP) regarding handling soil in dry condition, irrigation of stockpiled soil, and potential for the degradation of soil aggregates during transport.
- 3.40 In retrospect my use of the phrase “dry soil condition” may in part lead to some confusion and interpretation of potential conflict with the Dust Mitigation Management Plan (DMMP) regarding handling soil in dry condition.
- 3.41 To clarify, the term dry soil condition means that the soil is not saturated and above the soil plastic limit. Plastic limit can be defined as the water moisture content at which a

thread of soil with 3.2mm diameter begins to crumble⁶. This means that the soil does not have to dry to be handled but can be handled in moist to dry condition to avoid soil degradation and soil compaction. To provide some context, soil handling should be carried out when soil moisture is similar to that when cultivating the soil for cropping.

- 3.42 The Soil Management Plan (p9) includes a practical method for determining when the soil moisture condition is suitable for handling (reproduced below).

A useful field method of deciding whether a soil is sufficiently dry to be moved safely is the spade test: plasticity is determined by hand-rolling a sample from the relevant horizon on the back of a spade to see if a thread of 3 mm diameter can be formed without crumbling. If a thread can be formed the soil is too wet for working (Ramsay, 1986).

- 3.43 Referring to the irrigation of stockpiled soil for dust suppression purposes, I have discussed the intention to irrigate the stockpiled soil with Mr Bluett. Based on our discussion my understanding is that irrigation (at a very low application rate) will only be undertaken only if there is a risk of dust and only for the period until a grass vegetation cover has been established.

- 3.44 The intended irrigation rate is only 1/mm per hour, sufficient to moisten the stockpiled soil surface to a depth of a few millimetres. This low rate of application is very unlikely to degrade soil aggregates and in my opinion is not a concern.

Handling and transporting topsoil

- 3.45 Referring to the potential for the degradation of soil aggregates during transport, I provide the following comments.

- 3.46 The greatest potential for soil degradation is associated with the removal and placement of soil. The degradation of soil aggregates during transport is minimal (Ramsay 1986 - p32)⁷.

⁶ <https://www.sciencedirect.com/topics/engineering/plastic-limit>

⁷ Ramsay WJH. 1986. Bulk soil handling for quarry restoration. Soil and land use management Volume 2, No. 1. Pp30-39.

- 3.47 Ms Langford's has raised the question regarding the transport of topsoil from offsite and the requirement to travel at 15 km/hour (s 42A addendum – p100) to avoid soil compaction.
- 3.48 In response, the limit of 15 km/hour relates to transport speed restrictions on site to minimise dust. However, the risk of topsoil aggregate degradation (albeit minimal) is likely to reduce as a consequence.
- 3.49 The need to import topsoil is likely to be minimal as topsoil from onsite will be reused, and for the transport of any topsoil from offsite, travelling at 15 km/hour will not be required.
- 3.50 In response to paragraph 7.37 of the s 42A addendum, I see no issue with the use of topsoil from one area being used in another area. Of most importance is that the replaced topsoil is distributed to ensure an even depth (as stipulated in the Soil Management Plan) and the variability of the topsoil is minimised to enable even productive capacity across the restored site. However, it seems unlikely that topsoil from Stage 1 would be used in the Stage 2 and 3 areas because Stage 1 is proposed to commence after Stages 2 and 3.
- 3.51 In response to the comment that the land being left “at least imperfectly drained” will lead to a degradation in productive capacity (Memorandum at p 101), and that condition 43(c) should be at least “well drained” I provide the following comments.
- 3.52 The Soil Management Plan (p12) states: “Be at least imperfectly drained, preferably moderately well or well drained where the inherent soil drainage characteristics of the land allow.”
- 3.53 The wording “where the inherent soil drainage characteristics of the land allow” acknowledges that localised inherent water table effects (predominantly in the areas of LUC 3w1 and 4w1) may result in the reinstated soil profile being less well drained (i.e. imperfectly drained).
- 3.54 I do not agree that the inclusion of imperfectly drained will result in a degradation in productive capacity when comparing the pre-gravel extraction soils on the site with the post-gravel extraction reinstated soil. An assessment against the TRMP criteria is provided in the Soil Management Plan (p26) supporting this.

- 3.55 Of note is that TRMP criteria include imperfectly-drained to well-drained soils which would mean that TRMP criterion (c) would be met for the reinstated soil. Additionally, the soil depth limitations existing for the pre-gravel extraction soils (in areas LUC 3s1, 4s1, 5s1 and 6s1) will be removed and TRMP criterion (d) will be met, given the improved soil depth and increased soil moisture holding capacity resulting from the reinstated finer soil matrix in the subsoil.
- 3.56 The reinstated soil profile, even with imperfect drainage will be suitable for cropping and orchards.⁸
- 3.57 Council has proposed a new condition (condition 40C in Mr Piggott's memorandum at page 84), which states that "The Consent Holder may use polymer or chemical stabilization to limit the dust generation".
- 3.58 I was not familiar with these products so I have discussed the use of polymer or chemical stabilization with Mr Bluett. My understanding from our discussion is that it is unlikely that these will be used in preference to dust mitigation by irrigation, but that the products are non-toxic, relatively environmentally benign, and have been accepted for use by other territorial authorities⁹. If used, I do not foresee any soil quality related issues and consider their use as posing minimal risk to the soil.

Reece Hill

4 November 2022

⁸ Well-established productive orchards exist on imperfectly drained soils in Lower Moutere and on the Waimea Plains.

⁹ Jeff Bluett, Maria de Aguiar and Neil Gimson (2017) Impacts of exposure to dust from unsealed roads. NZ Transport Agency research report 590. 104pp.