

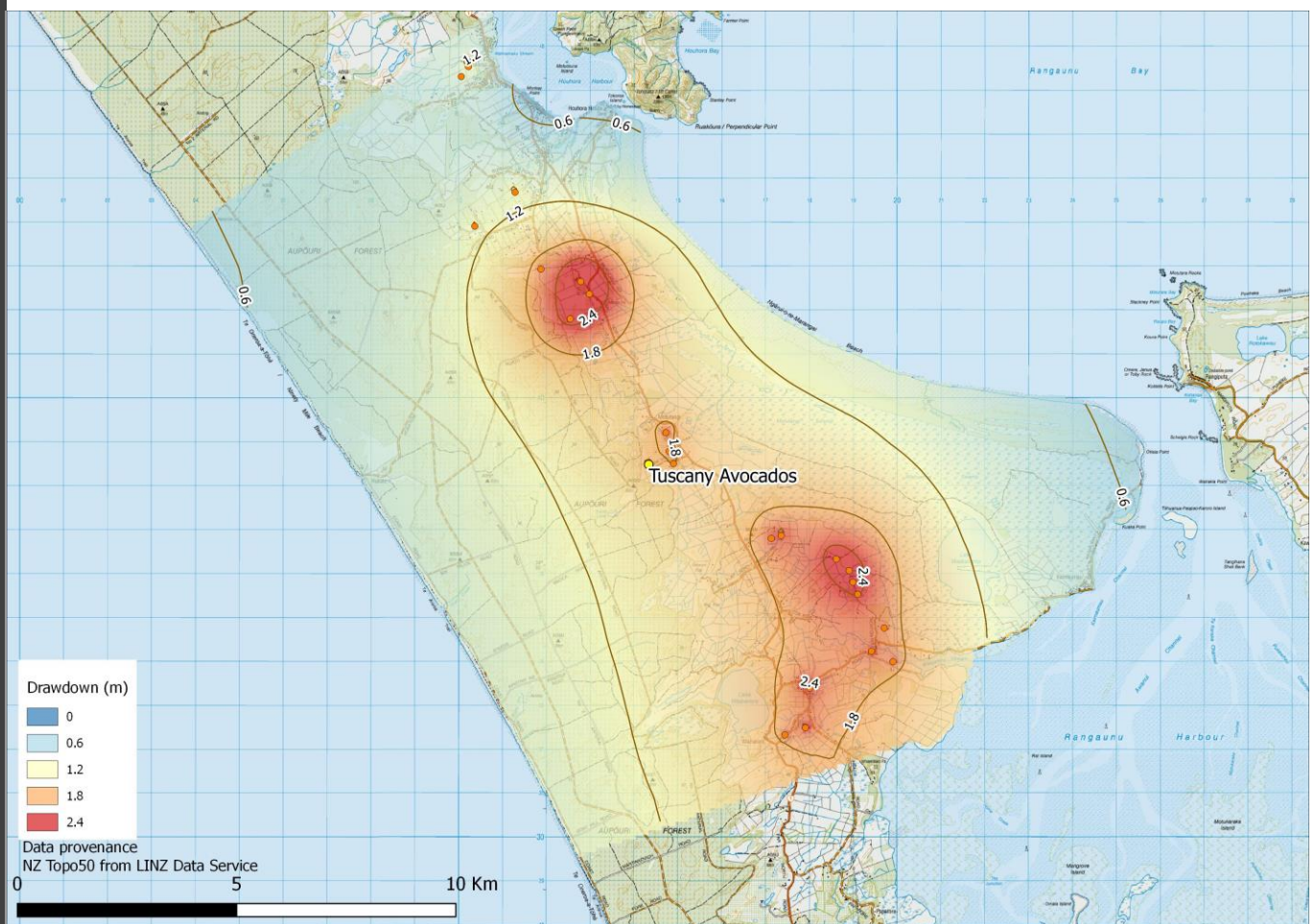
## Irrigation Water Take Consent

### Resource Consent Application & Assessment of Environmental Effects

TUSCANY VALLEY AVOCADOS LIMITED

WWA0051 | Rev. 2

15 June 2018



## **Irrigation Water Take Application**

Project no: WWA0051  
Document title: Tuscany Avocados Take Application  
Revision: 2  
Date: 15 June 2018  
Client name: Tuscany Valley Avocados Limited  
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File name: G:\Team Drives\Projects\Tuscany Avocados\Deliverables\AEE\Tuscany Avocados  
AEE\_rev2b.docx

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### **Document history and status**

Rev	Date	Description	By	Review	Approved
1	16 May 2018	Draft for internal review	Hangjian Zhao and Jessie Loft	Jon Williamson	
2	18 June 2018	Final			Jon Williamson

### **Distribution of copies**

Rev	Date issued	Issued to	Comments
2	18 June 2018	Northland Regional Council	Consent Application

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# 1. Introduction

This document and attachments comprise a Resource Consent Application and an Assessment of Environmental Effects report associated with a water take permit for irrigation of a 15-hectare Total Orchard Area<sup>1</sup> development at Turk Valley Rd, Motutangi, on behalf of Tuscany Avocados.

The background details of this application using Northland Regional Council's(NRC) "Application for Resource Consent" form is provided in **Appendix A**. Further details of various items where marked on the form are provided in the **Section 2**.

## 1.1 Report Structure

The report comprises:

- **Section 2** – a description of the proposed activity and suggested consent conditions;
- **Section 3** - background details of the application;
- **Section 4** – an assessment of environmental effects;
- **Section 5** – an assessment of cultural effects;
- **Section 6** - an assessment of statutory considerations;
- **Section 7** – a discussion of the notification process;
- **Section 8** – a discussion consideration of consultation; and
- **Section 9** – summary and conclusions.

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<sup>1</sup> Total Orchard Area was selected as the area metric for calculation of the irrigation water daily application volume by the Commissioners at the Hearing of 17 groundwater take applications for the Motutangi-Waiharara Water User Group in June 2017. The volume of water applied to this Total Orchard Area was 25 m<sup>3</sup>/ha/day (see paragraphs 132 and 133 of the Commissioners Decision - June 2018). In the Commissioner's Decision they defined the Total Orchard Area as the area where the canopy occupies 80%.

## 2. Description of Proposed Activity

### 2.1 Location

**Figure 1** provides a map of the project area. The subject bore is located at end of Turk Valley road, Motutangi (see **Appendix A**).

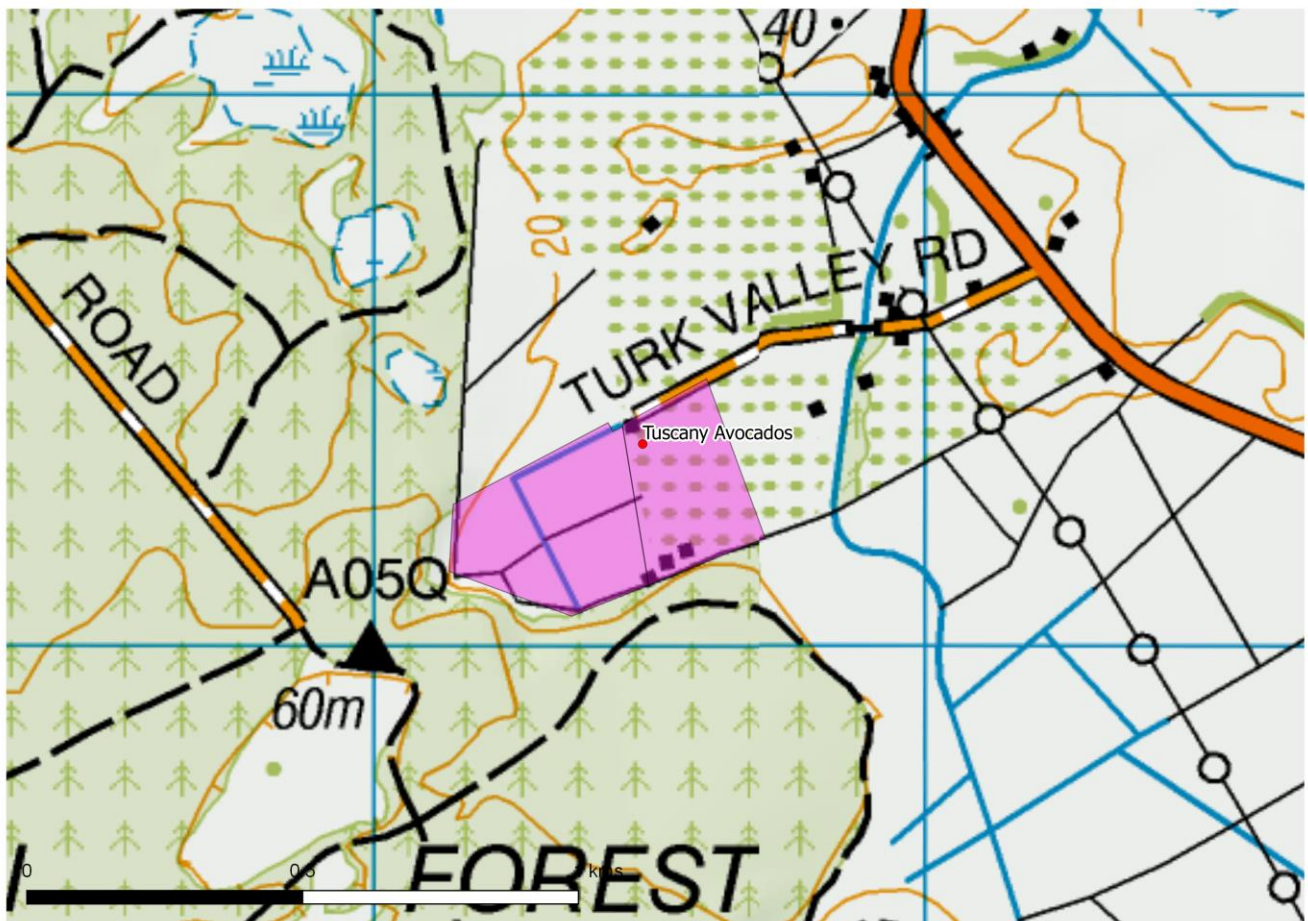


Figure 1. Project locality map.

### 2.2 Description of Proposed Activity

The resource consent application for Tuscany Avocados seeks to take and use groundwater from a current bore to develop and irrigate a new avocado orchard. The Total Orchard Area of the property is 15 ha, as shown in **Figure 1**. The current bore on the property will be used as the irrigation bore for the new avocado orchard, and the bore details are shown in **Table 1**.

Table 1. Bore details of the proposed application.

IRISID	Easting	Northing	Depth (m)	Diameter (mm)	Cased Interval (m)	Screened Interval (m)	Static Water Level (mBGL)	Aquifer
LOC.209585	1614333	6138477	114	100	0 - 106	106 – 112	6.6	Aupouri shellbed



This groundwater take is to irrigate the avocado orchard based on the assumption that 60% of the 15 ha Total Orchard Area will comprise the canopy of the crop. The take will be exercised from October to April, in accordance with the following conditions:

- Maximum daily volume of 375 m<sup>3</sup>/day; and
- Maximum annual volume of 36,000 m<sup>3</sup>/yr.

The maximum daily volume has been calculated at 25 m<sup>3</sup>/ha/day over the Total Orchard Area, in accordance with the decision made in the Motutangi-Waiharara Water User Group (MWWUG) decision<sup>2</sup>.

The maximum annual volume has been calculated from the canopy area, which for this orchard (given the topographic and existing building constraints) is 60% of the Total Orchard Area or 9 ha<sup>3</sup>. The maximum annual volume has been calculated on the basis of 400 mm/annum, which is consistent with the Council Officers' recommendation in the MWWUG Hearing. This irrigation requirement is adequate to meet up to a 1 in 10 years drought requirement (**Section 3.1.4**).

### 2.2.1 Consent Duration, Lapse and Review

A consent duration of 30 years is sought subject to a lapse period of 5 years from commencement of consent, and review conditions have been proposed for the purposes laid out in **Section 2.3**.

## 2.3 Proposed Consent Conditions

This section contains the proposed conditions for the water permit sought by the Applicant.

### Water Extraction Volumes

1. The rate of take shall not exceed the limits set out as follows:
  - (a) Maximum daily volume of 375 m<sup>3</sup>/day (being any 24 consecutive hours); and
  - (b) Maximum annual volume of 36,000 m<sup>3</sup>/annum (being 1 July to 30 June).

### Notification of Irrigation

2. The Consent Holder shall advise the Council's assigned Monitoring Officer in writing when irrigation is to commence for the first time each season, at least five days beforehand.

### Metering and Abstraction Reporting

3. The Consent Holder shall install a meter to measure the volume of water taken, in cubic metres, from each production bore. Each meter shall:
  - (a) Be able to provide data in a form suitable for electronic storage;
  - (b) Be sealed and as tamper-proof as practicable;
  - (c) Be installed at the location from which the water is taken; and
  - (d) Have an accuracy of +/-5%.

<sup>2</sup> The maximum daily volume can also be calculated on the basis of 41.6 m<sup>3</sup>/day per canopy hectare (4.16 mm irrigation system capacity) on the basis of a peak daily soil requirement of 3.74 mm/day per canopy hectare and allowing for 10% system losses in delivery and application.

<sup>3</sup> The maximum annual volume can also be calculated on the basis of approximately 96 days at full daily volume, which is equivalent to approximately 400 mm/year. In practice the maximum daily rate will only be required on consecutive days during the peak of summer and when this coincides with drought.

The Consent Holder shall, at all times, provide safe and easy access to each meter installed for the purposes of undertaking visual inspections and water take measurements.

4. The Consent Holder shall verify that the meter required by Condition 3 is accurate. This verification shall be undertaken prior to 30 June:
  - (a) Following the first taking of water from each production bore; and
  - (b) At least once in every five years thereafter.

Each verification shall be undertaken by a person, who in the opinion of the Council's Compliance Manager, is suitably qualified. Written verification of the accuracy shall be provided to the Council's assigned Monitoring Officer by 31 July following the date of each verification.

5. The Consent Holder shall, using the meter required by Condition 3, keep a record of the daily volume of water taken from each production bore in cubic metres, including all nil abstractions.
6. If the instantaneous rate of taking is equal to or greater than 10 litres per second, then the water meter required by Condition 3 shall have an electronic datalogger for automatic logging of meter data. A copy of the electronic data records shall be forwarded to Council's assigned Monitoring Officer by the 7th of the following month, and immediately on written request from the assigned monitoring officer.
7. The Consent Holder shall measure, and keep a record of, the static water level in each production bore at least once each month. This measurement shall be taken at least eight hours after cessation of pumping. The Consent Holder shall also monitor electrical conductivity at least once a month during any irrigation season when the bore is in use.
8. A copy of the records required to be kept by Conditions 5, 6 and 7 for the period 1 July to 30 June (inclusive) shall be forwarded each year to the Council's assigned Monitoring Officer by the following 31 July. In addition, a copy of these records shall be forwarded immediately to the Council's Compliance Manager on written request. The records shall be in an electronic format that has been agreed to by the Council.

**Advice Note:** If no water is taken during the period 1 July to 30 June (inclusive) then the Consent Holder is still required to notify the Council's Monitoring Manager in writing of the nil abstraction. Water use record sheets in an electronic format are available from the Council's website at [www.nrc.govt.nz/wur](http://www.nrc.govt.nz/wur).

9. Easy access for a water level probe shall be provided and maintained at the production bore wellhead to enable the measurement of static water levels in the bore.

### Water Use Efficiency

10. The Consent Holder shall prepare an Irrigation Scheduling Plan (ISP) that outlines how irrigation decisions will be made. The ISP shall be prepared by a suitably qualified and experienced person and submitted to the Council's Compliance Manager for written approval. The ISP shall, as a minimum, address:
  - Water balance and crop water requirements;
  - Subsurface drainage; and
  - Overall irrigation strategy.

For each irrigation area, the ISP should include:

- (a) A description of how water requirement for each irrigation cycle is calculated;
- (b) Method(s) for assessing current soil moisture levels;
- (c) Method(s) for assessing potential evapotranspiration (PET) and rainfall to date;
- (d) Assessment of other inputs such as effluent irrigation and effect on irrigation requirement;
- (e) Soil moisture target to be maintained in each zone by irrigation;
- (f) How measured data will be used to assess irrigation requirements over the next irrigation cycle; and

- (g) A description of proposed method(s) for remaining within consent limits at each borehole or group of boreholes.

**Advice Note:** The ISP seeks to ensure that an irrigation efficiency of a minimum 80% is achieved.

11. The Consent Holder shall not exercise this consent until the ISP required by Condition 10 has been certified by the Council's Compliance Manager.
12. The ISP certified in accordance with Condition 11 shall be implemented prior to the first irrigation season, unless a later date has been approved in writing by the Council's Compliance Manager.
13. The Consent Holder shall, within six months of the first exercise of this consent, undertake an audit of the irrigation system and the ISP described in Condition 10 using a suitably qualified and experienced person. The irrigation system audit shall be prepared in accordance with Irrigation New Zealand's "Irrigation Evaluation Code of Practice" (dated 12 April 2010), including recommendations on any improvements that should be made to the system to increase water efficiencies. The results of the audit and its recommendations shall be submitted in writing to the Council's assigned Monitoring Officer within one month of the audit being undertaken. A follow-up audit shall occur at five yearly intervals throughout the term of this consent, with a focus on the efficiency of water use.
14. The Consent Holder shall, within three months of notification in writing by the Council's Compliance Manager, implement any recommendations of the audit referred to in Condition 13.
15. The reticulation system and components shall be maintained in good working order to minimise leakage and wastage of water.
16. there shall be no significant ponding of irrigated water within any irrigated area, or significant runoff from either surface or subsurface drainage to a water body, as a result of the exercise of this consent.

#### Review Condition

17. The Council may, in accordance with Section 128 of the Resource Management Act 1991, serve notice on the Consent Holder of its intention to review the conditions annually during the month of June for any one or more of the following purposes:
  - (a) To deal with any adverse effects on the environment that may arise from the exercise of the consent and which it is appropriate to deal with at a later stage; or
  - (b) To review the allocation of the resource.

The Consent Holder shall meet all reasonable costs of any such review.

#### Lapsing Condition

18. This consent shall lapse on the **30 June 2023**, unless before this date the consent has been given effect to.

**Advice Note:** An application can be made to the Council in accordance with Section 125 of the Act to extend the date after which the consent lapses. Such an application must be made before the consent lapses.

EXPIRY DATE: 30 June 2048



### 3. Background Information

#### 3.1 Site Conditions

##### 3.1.1 Soils

There is no Landcare Research S-map soil data available for this site, however there is Fundamental Soil Layer information, pre-dating S-Map, which describes the soil around the property as having slow permeability densipan podzol<sup>4</sup>, weakly developed sandy recent soils<sup>5</sup>, brown soils<sup>6</sup> which occur in places where summer drought is uncommon, and Mesic organic soils<sup>7</sup> which is moderate decomposed peat. These soils display the following properties:

- **Physical properties** – Densipan podzol are commonly cemented or compacted B horizons which relates to the slow permeability of the soil and its limited root depth, there is extreme limitations for arable use. Sandy recent soils occur on young land surfaces generally having deep rooting and high plant – available water capacity. Brown soils are relatively stable topsoils with a well-developed structure. Mesic organic soils occur in areas of wetlands or under forests which produce acidic litter, with low bulk density, bearing strength and thermal conductivity but high total available – water capacity.
- **Chemical properties** – Densipan podzol are highly acidic which secondary clays and minerals strongly differentiate with depth. Densipan podzol have generally low natural fertility while sandy recent soils have high natural saturation with high base saturation. Brown soils have low to moderate base saturation. Part of Mesic organic soils have mineral material but is dominated by organic matter.
- **Biological properties** – Densipan podzol have generally low biological activity while sandy recent soils have a continuous cover of vascular plants. Brown soils are associated with high biological activity (earthworms are prominent). Organic soils have restricted biological activity of organisms due to the anaerobic conditions, leading to a slow decomposition rate.

##### 3.1.2 Geology

Tuscany Avocados bore is underlain by the Aupouri Aquifer, comprising an extensive sequence of fine-grained sands, interspersed with sporadic iron pan, peat, and silt near the surface and shellbed in the deep layer. This consists of Pleistocene and Holocene unconsolidated sedimentary materials deposited in beach and dune (abandoned shorelines and marine terraces) and associated alluvial, intertidal estuarine, shallow marine, lakebed and wetland environments.

With distance inland from the coast, the sand deposits become progressively older and have a higher degree of compaction and weathering compared to the younger foredune sands located at the coast.

With increasing depth, the occurrence of shellbed layers increases. The shellbeds comprise layers that typically range in composition from 30-90% medium to coarse shell and 10-70% fine sand. The shellbed aquifer typically resides from approximately 70 to 120 mBGL. Underlying the shellbed aquifer are basement rocks of the Mount Camel Terrain, which typically comprise hard grey to dark green / black igneous rocks described in Isaac (1996) as intercalated basalt and basaltic andesite lava, pillow lava, rhyolitic tuff, tuff-breccia, conglomerate, sandstone and mudstone.

<sup>4</sup> <https://soils.landcareresearch.co.nz/describing-soils/nzsc/soil-order/podzol-soils/>

<sup>5</sup> <https://soils.landcareresearch.co.nz/describing-soils/nzsc/soil-order/recent-soils/>

<sup>6</sup> <https://soils.landcareresearch.co.nz/describing-soils/nzsc/soil-order/brown-soils/>

<sup>7</sup> <https://soils.landcareresearch.co.nz/describing-soils/nzsc/soil-order/organic-soils/>

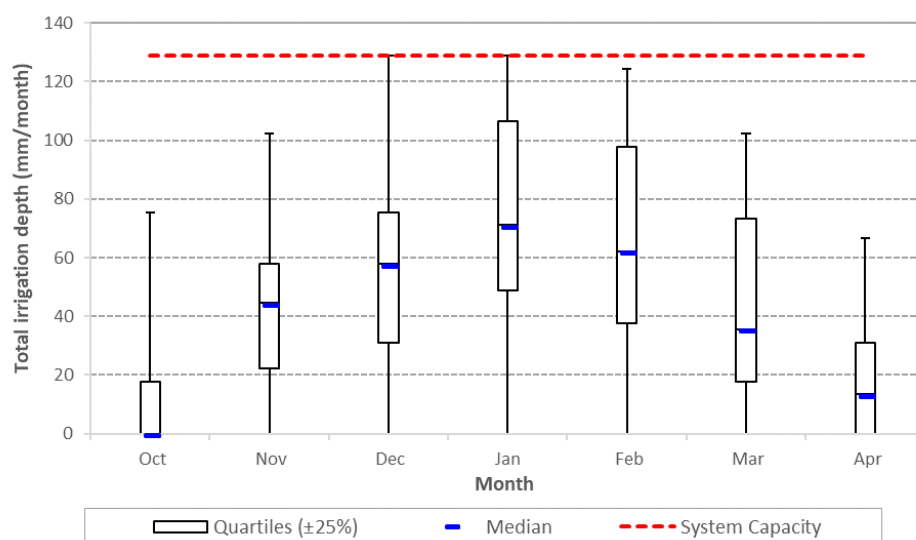
### 3.1.3 Hydrogeological Interpretation

The sands deposited on the east and west coast are generally younger and more permeable than the weathered sand in the central area. The shell content in the sand increases with depth, and the shell-rich sand layer is the most prolific water yielding aquifer in the region and hence the target for irrigation bores.

The aquifer system is unconfined at the surface but behaves in a manner that suggests a progressive degree of confinement with depth (leaky confinement). There is no well-defined regionally extensive confining layer but there are numerous low-permeability layers (e.g. iron pan, brown (organic) sand, silt, peat) that vary in depth and thickness, which over multiple occurrences collectively provide a degree of confinement that leads to the development of vertical pressure gradients

### 3.1.4 Irrigation Requirements

The peak water requirement is 41.6 m<sup>3</sup>/day per canopy hectare, which is equivalent to 4.16 mm per day. The irrigation requirement was simulated on a daily basis with the Soil Moisture Water Balance Model (SMWBM) using historical rainfall and evaporation data from 1957 to 2016. The simulation results are portrayed statistically on a monthly basis in **Figure 2**, which is a box and whisker plot showing the monthly median, lower quartile (25<sup>th</sup> percentile), upper quartile (75<sup>th</sup> percentile) and minimum and maximum recorded monthly values. The graph shows the seasonal irrigation profile and likelihood of water requirements each month.



**Figure 2. Simulated monthly statistical irrigation profile.**

During the irrigation season, the rate of application will remain the same, but the number of days between irrigation events will increase during the shoulders of the season (i.e. typically in spring and autumn), which is exemplified in the monthly statistics shown in **Figure 2**.

**Table 3** provides information on the frequency of monthly irrigation requirements and the number of days irrigation is likely required. The 1-year recurrence interval represents the typical monthly requirements and indicates that on average irrigation will not be required in October and April, and between November and March will vary from 18 mm to 47 mm per month.

In a 10-year drought year, the irrigation requirement for the season is likely to approximately 400 mm, with peak monthly totals up to approximately 120 mm, hence the amount of water being applied for is adequate to fully meet the requirements up to the 10-year drought.

**Table 2. Frequency of monthly and annual irrigation requirements (mm) and days of irrigation [days].**

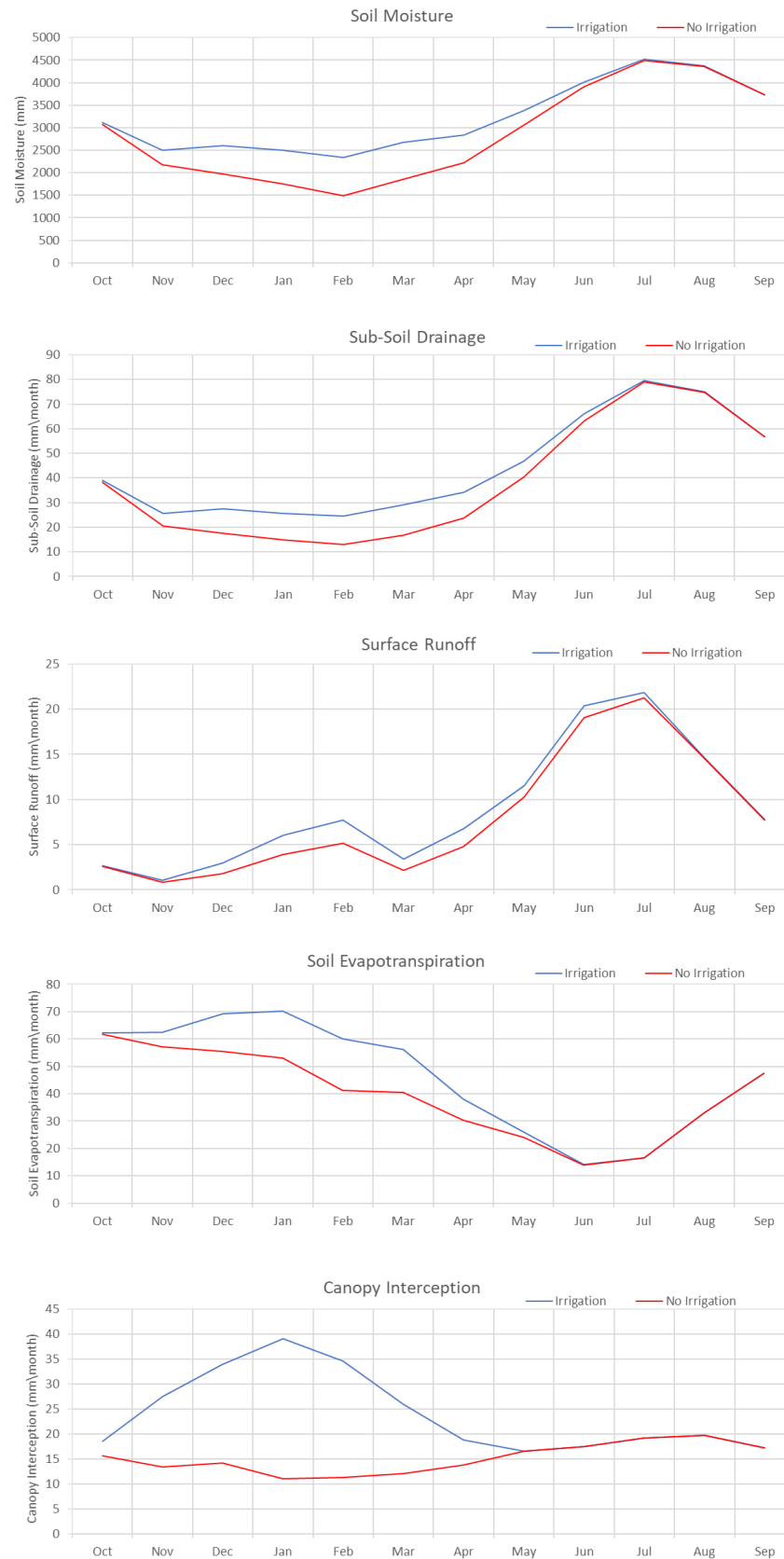
Average Recurrence Interval	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Annual
1 yr	0 [0]	23 [6]	31 [7]	47 [11]	40 [10]	18 [4]	0 [0]	250 [60]
2 yr	0 [0]	44 [11]	58 [14]	69 [17]	62 [15]	36 [9]	16 [4]	307 [74]
4 yr	18 [4]	58 [14]	76 [18]	107 [26]	98 [24]	74 [18]	31 [7]	369 [89]
5 yr	18 [4]	62 [15]	76 [18]	107 [26]	98 [24]	80 [19]	40 [10]	382 [92]
10 yr	31 [7]	76 [18]	104 [25]	117 [28]	116 [28]	84 [20]	50 [12]	401 [96]
100 yr	53 [13]	102 [25]	124 [30]	129 [31]	124 [30]	100 [24]	64 [15]	545 [131]

**Table 3** provides the orchard water balance under dryland and irrigated conditions and **Figure 3** shows the mean monthly seasonal breakdown of this data. The data represents the mean annual water balance components from the 59-year simulation. It is evident that under the irrigated orchard profile, soil moisture content typically resides at a higher status (which is the intention) during summer, and surface runoff, sub-soil drainage, soil evaporation and canopy interception all increase.

However, avoidable losses due to surface runoff have not change appreciably, and the additional runoff that has occurred is due to rainfall excess rather than too much irrigation, demonstrating that the irrigation applications of 4.16 mm/day are efficient.

**Table 3. Summary of average annual water balance components under irrigated and unirrigated profiles (mm/yr unless specified otherwise).**

Annual Average	Dryland	Irrigated
Average Soil Moisture Content (mm)	92	104
Sub-Soil Drainage	452	522
Surface Runoff	93	105
Soil ET	467	547
Canopy Interception	179	284
TOTAL	1,191	1,458



**Figure 3. Comparison of water balance components.**

### 3.2 Neighbouring Bore Information

There are 30 bores registered within the NRC database within a 2 km radius of the Tuscany Avocados site (**Figure 4**). Statistics on the 30 bores are as follows:

- 29 are active and one is pending.
- The bores range in depth from 0 m to 120 m with an average of 82.5 m.
- 30 bores have information attached in terms of the purpose of the bores:
  - one is for domestic purposes;
  - two are for domestic and irrigation use;
  - five for domestic and stock;
  - nine are for irrigation
  - five are for stock use; and
  - two for stock and irrigation.

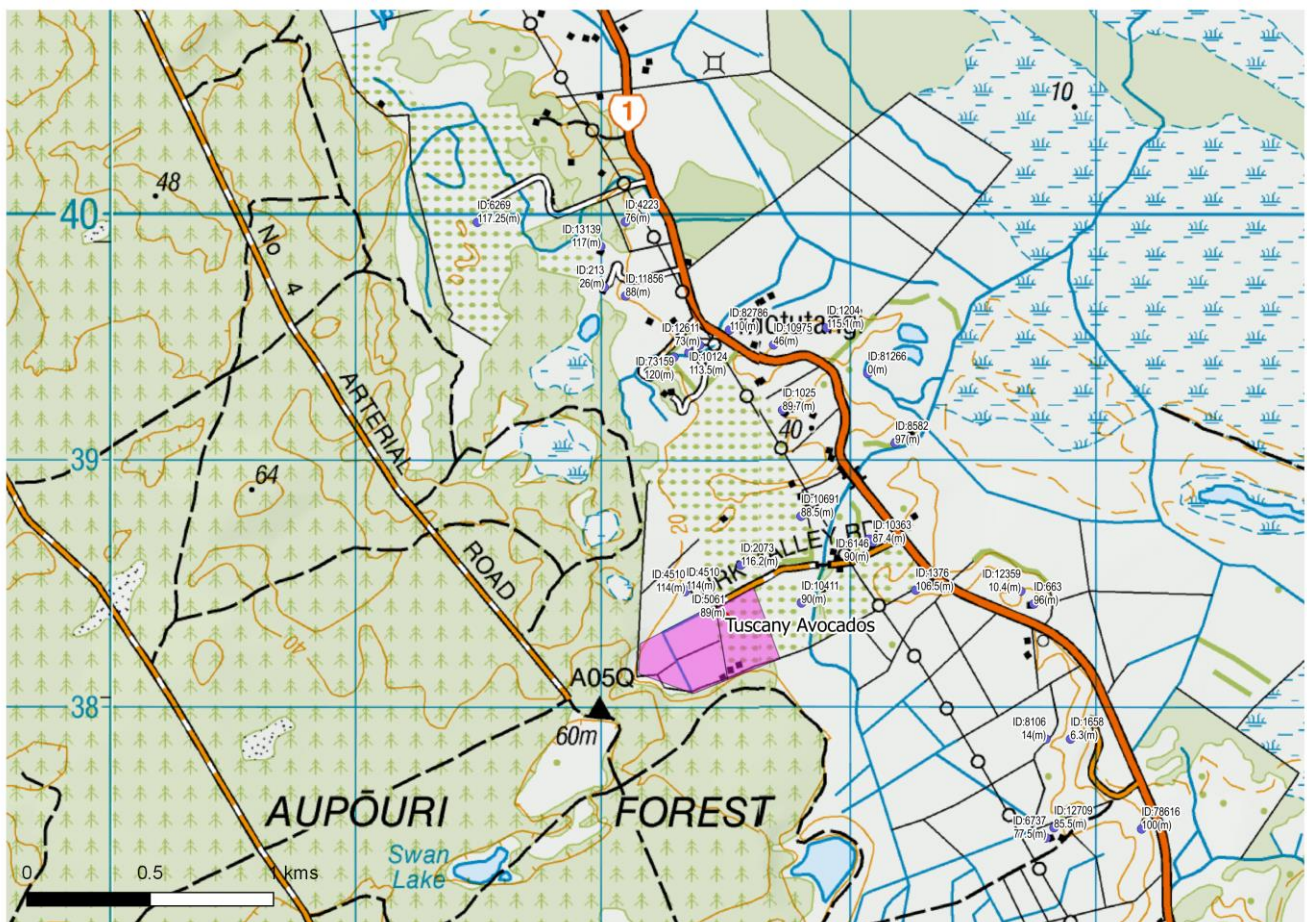


Figure 4. Neighbouring bores within a 2 km radius of Tuscany Avocados.



### 3.3 Relevant Statutory Documents

#### 3.3.1 Section 104(1)(b) of the RMA

Schedule 4 of the RMA requires that when applying for a resource consent for any activity an assessment of activities against the matters in any relevant provisions of a statutory document referred to in s104(1)(b) of the RMA must be provided. These matters are described below and **Section 6** provides an assessment against the relevant documents.

The documents referred to in Section 104(1)(b) of the RMA are:

- a national environmental standard;
- other regulations;
- a national policy statement;
- a New Zealand coastal policy statement;
- a regional policy statement or proposed regional policy statement;
- a plan or proposed plan;

The following section provides details of the relevant Regional Planning provisions, while assessment of which documents listed is above are relevant is provided in **Table 4**.

**Table 4. Summary of relevance of Section 104 statutes.**

Statute	Relevance	Requirement of Statute
National Environmental Standards	There are no national environmental standards that are applicable to the proposed activity.	None
Resource Management (Measurement and Reporting of Water Takes) Regulations 2010	This regulation applies to a water permit that allows fresh water to be taken at a rate of 5 litres/second or more and is consumptive. Therefore, this regulation is relevant for this water take consent.	In summary, the regulations require permit holders to keep records that provide continuous measurement of the water taken under a water permit, including water taken in excess of what the permit allows. These records are to comprise measurements of the volume of water taken each day (in cubic metres) or each week (if approved by the Regional Council), and must be in an appropriate format for auditing, and in a form suitable for electronic storage. The regulations also specify the required accuracy of any metering device (to within $\pm 5\%$ of the actual volume taken if from a full pipe (e.g. bore)).
National Policy Statement for Freshwater Management 2014	<p>The following objectives and policies of the NPS are relevant to this proposal:</p> <p><i>Water Quality</i></p> <ul style="list-style-type: none"> <li>• Objectives A1, A2, and A4.</li> <li>• Policies A2, A3, and A7.</li> </ul> <p><i>Water Quantity</i></p> <ul style="list-style-type: none"> <li>• Objective B2, B3 and B5.</li> <li>• Policies B2 to B6.</li> </ul> <p><i>Integrated Management</i></p> <ul style="list-style-type: none"> <li>• Objective C1.</li> <li>• Policies C1 and C2.</li> </ul>	<p><i>Water Quality</i></p> <ul style="list-style-type: none"> <li>• Objective A1 seeks to safeguard the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems of fresh water, in sustainably managing the use and development of land, and of discharges of contaminants.</li> <li>• Objective A2 required that the overall quality of fresh water within a region is maintained or improved while improving the quality of fresh water in water bodies that have been degraded by human activities to the point of being over-allocated.</li> </ul>

Statute	Relevance	Requirement of Statute
		<ul style="list-style-type: none"> <li>Objective A4 seeks to enable communities to provide for their economic well-being, including productive economic opportunities.</li> <li>Policies A2, A3, and A7 are considered relevant to this application and give effect to Objectives A1, A2, A4.</li> </ul> <p><i>Water Quantity</i></p> <ul style="list-style-type: none"> <li>Objective B2 seeks to avoid any further over-allocation of fresh water and phase out existing over-allocation.</li> <li>Objective B3 seeks to improve and maximise the efficient allocation and efficient use of water.</li> <li>Objective B5 seeks to provide for communities' economic wellbeing within freshwater quantity limits.</li> <li>Policies B2 to B6 are considered relevant to this proposal.</li> </ul> <p><i>Integrated Management</i></p> <ul style="list-style-type: none"> <li>Objective C1 seeks to improve integrated management of fresh water and the use and development of land in whole catchments, including the interactions between fresh water, land, associated ecosystems and the coastal environment.</li> <li>Policies C1 and C2 are relevant to this application and give effect to Objective C1.</li> </ul>
Regional Policy Statement for Northland	<p>The Regional Policy Statement (RPS) was made operative on 9 May 2016. The RPS provides a broad direction and framework for managing Northland's natural and physical resources. These include land, water, air, soil, minerals, plants, animals and all built structures.</p> <p>The following Objectives are considered relevant to this proposal:</p> <ul style="list-style-type: none"> <li>Objective 3.2, 3.3, 3.5, and 3.10.</li> </ul> <p>The following Policies give effect to the above Objectives, and therefore are considered relevant to this application:</p> <ul style="list-style-type: none"> <li>Policy 4.3.2, 4.3.3.</li> </ul>	<ul style="list-style-type: none"> <li>Objective 3.2 seeks to maintain and improve water quality for human use and ecological health.</li> <li>Objective 3.3 seeks to safeguard the flows and flow variability required to maintain water's life-supporting capacity, for ecological processes, and to support indigenous species.</li> <li>Objective 3.5 requires that the region's resources are sustainably managed in a way that is attractive for business and investment that will improve the economic wellbeing of the region and its communities.</li> <li>Objective 3.10 requires efficient use and allocation of common natural resources with a particular focus on maximising the security and reliability of supply for users.</li> <li>Policy 4.3.2 requires regulatory methods to avoid over-allocation of region-wide ecological flows and water levels.</li> <li>Policy 4.3.3 requires the allocation and use of water efficiently within allocation limits.</li> </ul>
Regional Plans	<p>The Proposed Regional Plan for Northland (pRPN) sets out policies and rules for how Northland's water, soil, air and coast are used and was publicly notified on 6 September 2017 and closed for submissions on 26 March 2018. The pRPN will replace the Regional</p>	<p>From the pRPN:</p> <ul style="list-style-type: none"> <li>Objective F.0.1 seeks to manage the use, development, and protection of Northland's natural and physical resources which enables people and</li> </ul>

Statute	Relevance	Requirement of Statute
	<p>Water and Soil Plan for Northland (RWSPN), which has been operative since 28 August 2004.</p> <p>At present, the rules in both these plans have legal effect, with weight given to whichever plan has the more restrictive rule for the same activity if there is a conflict between the two plans, or the later plan if no submissions were received on certain aspects.</p> <p>Both plans address groundwater abstractions that have the potential to adversely affect the environment. However, there are no specific aquifer allocation limits set in the RWSP.</p> <p>The following objectives and policies of the pRPN are considered relevant to this proposal:</p> <ul style="list-style-type: none"> <li>• Objective F.0.1.</li> <li>• Policy D.2.2.</li> <li>• Policy D.2.5.</li> <li>• Policy D.4.5.</li> <li>• Policy D.4.13.</li> <li>• Policy D.4.17.</li> <li>• Policy D.4.18.</li> <li>• Policy D.4.20.</li> <li>• Policy D.4.23.</li> </ul> <p>The following objectives and policies of the RWSPN are considered relevant to this proposal:</p> <ul style="list-style-type: none"> <li>• Objective 7.4.</li> <li>• Objective 10.4.1.</li> <li>• Policy 10.5.1.</li> <li>• Policy 10.5.2.</li> <li>• Policy 10.5.4.</li> <li>• Policy 10.5.7.</li> <li>• Policy 10.5.9</li> </ul>	<p>communities to provide for their social, economic and cultural well-being while</p> <ol style="list-style-type: none"> <li>1. sustaining the natural resources to meet the reasonable foreseeable needs of future generations,</li> <li>2. safeguarding life-supporting capacities of water, and</li> <li>3. avoiding, remedying, or mitigating adverse effects on the environment.</li> </ol> <ul style="list-style-type: none"> <li>• Policy D.2.2 requires that regard is had to the social, cultural, and economic benefits of the proposed activity when considering resource consents.</li> <li>• Policy D.2.5 requires an authority to have regard to community and tangata whenua values</li> <li>• Policy D.4.5 seeks to maintain overall water quality.</li> <li>• Policy D.4.13 seeks to achieving freshwater quantity related outcomes and inn particular manage the taking, use, damming, and diversion of fresh water so that (with relevance to this application) saline intrusion in, and land subsidence above, aquifers is avoided (amongst other things).</li> <li>• Policy D.4.17 considers allocation limits for aquifers and requires rules and applications to meet allocation limits</li> <li>• Policy D.4.18 concerns conjunctive surface water and groundwater management.</li> <li>• Policy D.4.20 requires the reasonable and efficient use of water for irrigation and sets requirements for a resource consent application to take water for irrigation purposes.</li> <li>• Policy D.4.23</li> </ul> <p>From the RWSPN:</p> <ul style="list-style-type: none"> <li>• Objective 7.4 requires the maintenance or enhancement of water quality of natural water bodies.</li> <li>• Objective 10.4.1 maintains the sustainable use and development of the region's groundwater resources while avoiding, remedying, or mitigating actual and potential adverse effects on groundwater quantity and quality.</li> <li>• Policy 10.5.1 seeks to ensure the sustainable use of resources by avoiding takes that exceed recharge. Saltwater intrusion, reduced groundwater quality, significant drawdown, and adverse effects on surface water resources can arise where takes exceed recharge.</li> </ul>

Statute	Relevance	Requirement of Statute
		<ul style="list-style-type: none"> <li>Policy 10.5.2 recognises that aquifers are at risk in certain circumstances and that adverse effects on water quality should be avoided.</li> <li>Policy 10.5.4 seeks that groundwater allocations take into account reduction in recharge that may occur in time.</li> <li>Policy 10.5.7 requires the Northland Regional Council to consider effects of a groundwater take and use on surface water bodies.</li> <li>Policy 10.5.9 seeks to avoid, remedy or mitigate any ground subsidence as a result of groundwater takes, use or diversion, where this is likely to cause adverse flooding, drainage problems, or building damage.</li> </ul>

### 3.3.2 Activity Status

The activity status of the proposed activity under both the RWSPN and pRPN is considered a discretionary activity – details of this conclusion are summarised in **Table 5**.

**Table 5. Summary of activity status against Regional Plan Provisions.**

Plan	Relevant Rules	Comment
RWSPN	<p>Rule 25.03.01 of the plan states that “The taking, use or diversion of groundwater from an aquifer, and any associated discharge of groundwater onto or into land or into water, which does not meet the requirements of the permitted, controlled or non-complying activity rules is a discretionary activity.” In essence, the discretionary activity rule is for takes that are not for domestic or stock watering purposes (Rule 25(A)) and exceed the permitted activity thresholds (Rule 25.01.01) of a daily volume of 10 m<sup>3</sup>/d and instantaneous rate of 5 L/s per bore.</p>	Under this plan and until such time as the equivalent provisions within the Proposed Regional Plan for Northland (pRPN) are no longer contested, the proposed activity would be considered Discretionary Activity.
pRPN	<p>Rule C.5.1.10 states that the taking and use of fresh water is a discretionary activity unless it is one of the following:</p> <ol style="list-style-type: none"> <li>1) a permitted activity under C.5.1.1 'Minor takes – permitted activity', or</li> <li>2) a permitted activity under C.5.1.2 'Temporary take for road construction or maintenance – permitted activity', or</li> <li>3) a permitted activity under C.5.1.3 'Water take from an off-stream dam – permitted activity', or</li> <li>4) a permitted activity under C.5.1.4 'Water take from an artificial watercourse – permitted activity', or</li> <li>5) a permitted activity under C.5.1.5 'Water take associated with bore development, bore testing or dewatering – permitted activity', or</li> <li>6) a controlled activity under C.5.1.6 'Replacement water permits for registered drinking water supplies - controlled activity', or</li> <li>7) a controlled activity under C.5.1.7 'Takes existing at the notification date of the plan - controlled activity', or</li> </ol>	The proposed groundwater take does not conform to any of the activities in listed in 1) to 10) above, and as indicated in the following <b>Section 3.3.3</b> does not exceed an allocation limit, therefore the proposed activity constitutes a Discretionary Activity under the pRPN.

	<p>8) a restricted discretionary activity under C.5.1.8 'Supplementary allocation – restricted discretionary activity', or</p> <p>9) a discretionary activity under C.5.1.9 'Takes existing at the notification date of this plan – discretionary activity', or</p> <p>10) a non-complying activity under C.5.1.11 'Water take below a minimum flow or water level-non-complying activity', or</p> <p>11) a non-complying activity under C.5.1.12 'Water take that will exceed an allocation limit - non-complying activity', or</p> <p>12) a prohibited activity under C.5.1.13 'Water takes that will exceed an allocation limit - prohibited activity'.</p>	
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### 3.3.3 Allocation Zones

The Aupouri Peninsula Aquifer is divided into different allocation zones for management purposes. The Tuscany Avocados property sits within the Aupouri-Motutangi allocation zone. The allocation limited, current level of allocation and the level of allocation should this consent be granted are shown in **Table 6**.

**Table 6** shows that the granting of the additional 36,000 m<sup>3</sup>/yr for the Tuscany Avocados application will take the allocation status to 91% of the allocation limit, hence under the pNRP this consent maintains Discretionary Activity status.

**Table 6. Aupouri Aquifer Limits<sup>8</sup> and Allocation Status.**

Sub-aquifer	Allocation Limit		Allocation Status (Current)		Allocation Status (if Granted)	
	m <sup>3</sup> /year	% ann. ave. recharge	m <sup>3</sup> /year	%	m <sup>3</sup> /year	%
Aupouri-Motutangi	1,069,600	10	941,457 <sup>1</sup>	88	977,457	91

**Notes:** 1. Includes the recently granted (June 2018) MWWUG consents, which equated to 566,960 m<sup>3</sup>/year in the Motutangi zone.

<sup>8</sup> According to NRC's allocation maps at <http://gis.nrc.govt.nz/LocalMaps-Viewer/?map=895e0785f7054d47b10a72edc38022dc>



## 4. Assessment of Environmental Effects

The proposed take is located in the Motutangi-Waiharara Groundwater Model (MWGM) domain, therefore additional drawdown from the proposed take (36,000 m<sup>3</sup>/year) calculated using analytical methods was superimposed on the drawdown simulation results from the MWGM to assess the cumulative impact – noting that the MWGM included existing takes and the proposed MWWUG takes at the time (see WWA, 2017).

The methodology and results of the groundwater and surface water impact analysis are detailed in **Appendix B**.

### 4.1 Pumping Interference Effects

Drawdown due to proposed take was analysed using Theis (1935) and Feather and Williamson Solution (unpublished)<sup>9</sup>. A maximum drawdown ranging between of 1.1 m (Feather and Williamson) and 1.7 m (Theis) and was estimated in the deep aquifer adjacent to the pumping bore. A drawdown of 0.02 m was estimated near the pumping bore in the shallow aquifer with the Feather and Williamson Solution.

The superimposition of the Theis Solution onto the MWGM drawdown from the low leakage simulation (MWGM Scenario 4c) shows the cumulative drawdown impact on neighbouring bores ranged from 0.7 m to 2.3 m, and provides the most pessimistic perspective on the drawdown estimates (out of the two solutions considered).

The proposed take is unlikely to cause significant additional drawdown for majority of the existing bores. Additional drawdown of 0.2 m was estimated for KSL Ltd, and additional drawdown of 0.1 m was estimated for the De Bede and Subritzky bores, which in the context of the >100 m deep aquifer and available drawdown is insignificant.

The interference effects on existing groundwater uses considering the available drawdown of the aquifer is considered less than minor.

### 4.2 Surface Water Effects

As discussed in **Appendix B**, there are five potential surface water features that may be impacted by this proposal:

- Selwyn Drain (0.4 km);
- Unnamed dune lake to northwest (0.8 km)
- Unnamed dune to south (1.0 km);
- Unnamed dune to southwest (1.5 km);
- Kaimaumu wetland to east (2 km); and
- Lake Waiharara to south (5 km).

However, analysis indicated that the maximum potential drawdown impact in the shallow aquifer in the location of these surface water features is less than 0.02 m, which would translate to an unmeasurable impact within a standing or flowing water body.

The findings of the MWGM were accepted with respect to impacts on the wetland (and by inference surface waters) with the Commissioners stating in paragraph 153, “our view is that there are many influences on the wetland that are far greater than the MWWUG abstractions”.

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<sup>9</sup> Feather and Williamson Solution - a multi-layer model based on Hemker and Maas (1987) and Hunt and Scott (2007).

Given that the additional impacts predicted from this bore are similarly negligible, the same conclusion can be drawn.

Therefore, the impact on surface water due to proposed abstraction in the deep aquifer is considered less than minor.

### 4.3 Saline Intrusion

The risk of saltwater/freshwater interface upconing and lateral migration was in **Appendix B.3.1** based on the analysis conducted in MWGM report (Section 5.2.6, WWA, 2017).

The potential rise in the saline interface is considered insignificant given that the depth of the interface remains significantly below the pumping bore and original saltwater/freshwater interface.

The proposed take is located in central sand area, which is away from the coastlines. The additional drawdown is unlikely to change the potential saltwater lateral migration profile assessed from MWGM report (WWA, 2017).

The impact on saltwater intrusion due to proposed take will be less than minor.

### 4.4 Ground Settlement

The potential maximum ground settlement was estimated from the cumulative drawdown in **Appendix B**.

Within 1.5 km of proposed take, the estimated cumulative subsidence is 0.01 m, calculated from a maximum drawdown of 0.26 m and 2.12 m in the shallow and deep aquifers, respectively. In a rural setting, settlement effects of this magnitude are less than minor for the following reasons:

- There is no sensitive urban infrastructure like water or wastewater mains or high-rise buildings to rupture or crack; and
- The changes in land surface due to farm machinery (e.g. rotary hoeing) would likely mask impacts of this magnitude (<0.3 m) if materialised.

In summary, the potential settlement effects are considered less than minor.

### 4.5 Water Quality

The potential risk to water quality from the leaching of fertilisers and pesticides that may be associated with horticulture is not a relevant consideration for a water take application under the current Northland Regional planning framework. With reference to the effects from horticultural sprays the Commissioners for the MWWUG water take applications stated in their Hearing Decision Report (June 2018) that:

“such are not matters that are directly engaged by the present applications for water abstraction. Accordingly, we have no present jurisdiction to consider those putative effects. If resource (or other) consent is subsequently required, then such will need to be applied for and considered at the appropriate time”.

Nevertheless, there are a range of factors that make the leaching of fertiliser and pesticides unlikely to impact water quality:

- In practice orchardists in this area tend to apply fertiliser efficiently via fertigation as part of their irrigation water using a small dosage regularly, which is driven by both the soil conditions (i.e. high permeability and lacking in nutrients) and economic considerations.

- Inefficient irrigation practice will lead to root rot, thus because orchardists will actively avoid this, excessive leaching of nutrients is unlikely.
- Both fertiliser and approved pesticides are applied in accordance with permitted activity rules within the pRPN and rules needing to be met to become certified under the AvoGreen Assured program by the Avocado Industry Council Ltd. One of the key aims is “environmental sustainability by only using sprays when required”.
- Due to the presence of significant amounts of organic matter within the shallow sand deposits, shallow groundwater is likely to be reducing. Under such conditions, nitrate concentrations are likely to be low in groundwater (consistent with available groundwater quality data) due to denitrification within the aquifer system. The presence of organic matter is also likely to substantially decrease the mobility of any pesticide compounds prone to leaching.

#### **4.6 Consideration of Alternatives**

An AEE must include a description of alternative locations or methods for undertaking an activity, if it is likely that the activity will result in any significant adverse effect on the environment.

The effects of the proposed taking and using of groundwater were assessed above as being no more than minor on the environment and less than minor on other groundwater users. As such, no alternatives have been considered for this proposal.

## **5. Assessment of Cultural Effects**

Northland Regional Council have an internal procedure where they circulate all applications to local Iwi and Maori Groups that have registered with the Council as having an interest in the area. If a local Iwi or Maori Group is considered to be affected by the effects of the proposed activity the Group must be notified as part of the consultation process.

The proposed groundwater abstraction lies within the rohe of Te Aupōuri, Ngāti Kurī, and Ngāi Takoto iwi. Consultation with these iwi has not been carried out stage based on the understanding that if physical effects of an application are less than minor, then any meta-physical (cultural and spiritual) effects would commensurately also be less than minor.

In this rohe we are aware that at least two of the three iwi groups have recently lodged applications for water takes, and we are aware of a third planning to do so. That signals that the taking of water itself is not an activity that iwi are adverse too.

Therefore, given the less than minor impact of this proposal, we do not consider iwi consultation is necessary for this application.

## 6. Assessment Of Statutory Considerations

**Table 7 to Table 10** provide assessments of the relevant statutory documents as were identified in **Section 3.3**.

Overall, this resource consent application is consistent with the objectives and policies of the National Policy Statement for Freshwater Management 2014, incumbent regional plan (RWSPN) and proposed regional plan (pRPN).

**Table 7. Assessment against relevant objectives and policies for the National Policy Statement for Freshwater Management 2014.**

No.	Objective / Policy	Assessment
Water Quality		
Objective A1	<ul style="list-style-type: none"><li>Seeks to safeguard the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems of fresh water, in sustainably managing the use and development of land, and of discharges of contaminants.</li></ul>	This proposal is consistent with these objectives and policies and either supports them or at the least maintains them.
Objective A2	<ul style="list-style-type: none"><li>Required that the overall quality of fresh water within a region is maintained or improved while improving the quality of fresh water in water bodies that have been degraded by human activities to the point of being over-allocated.</li></ul>	
Objective A4	<ul style="list-style-type: none"><li>Seeks to enable communities to provide for their economic well-being, including productive economic opportunities.</li></ul>	
Policies A2, A3, and A7	<ul style="list-style-type: none"><li>Give effect to Objectives A1, A2, A4</li></ul>	
Water Quality		
Objective B2	<ul style="list-style-type: none"><li>Seeks to avoid any further over-allocation of fresh water and phase out existing over-allocation.</li></ul>	This proposal is consistent with these objectives and policies.
Objective B3	<ul style="list-style-type: none"><li>Seeks to improve and maximise the efficient allocation and efficient use of water.</li></ul>	
Objective B5	<ul style="list-style-type: none"><li>Seeks to provide for communities' economic wellbeing within freshwater quantity limits.</li></ul>	
Policies B2 to B6	<ul style="list-style-type: none"><li>Give effect to Objectives B2 to B5.</li></ul>	
Integrated Management		





No.	Objective / Policy	Assessment
Objective C1	<ul style="list-style-type: none"> <li>Seeks to improve integrated management of fresh water and the use and development of land in whole catchments, including the interactions between fresh water, land, associated ecosystems and the coastal environment.</li> </ul>	This proposal is consistent with these objective and policies.
Policies C1 and C2	<ul style="list-style-type: none"> <li>Give effect to Objective C1.</li> </ul>	

**Table 8. Assessment against relevant objectives and policies for the Regional Policy Statement for Northland.**

No.	Objective / Policy	Comment
Objective 3.2	<ul style="list-style-type: none"> <li>Seeks to maintain and improve water quality for human use and ecological health.</li> </ul>	This proposal is consistent with this objective as it will at the least maintain water quality.
Objective 3.3	<ul style="list-style-type: none"> <li>Seeks to safeguard the flows and flow variability required to maintain water's life-supporting capacity, for ecological processes, and to support indigenous species.</li> </ul>	The proposal is consistent with this objective as it will have a no more than minor impact on surface water resources.
Objective 3.5	<ul style="list-style-type: none"> <li>Requires that the region's resources are sustainable managed in a way that is attractive for business and investment that will improve the economic wellbeing of the region and its communities.</li> </ul>	The proposal is consistent with this objective as it will efficiently utilise a natural resource to facilitate development of economic wellbeing.
Objective 3.10	<ul style="list-style-type: none"> <li>Requires efficient use and allocation of common natural resources with a particular focus on maximising the security and reliability of supply for users.</li> </ul>	The proposal is consistent with this objective.
Policy 4.3.2	<ul style="list-style-type: none"> <li>Requires regulatory methods to avoid over-allocation of region-wide ecological flows and water levels.</li> </ul>	The proposal does not exceed allocation limits, hence is consistent with this policy.
Policy 4.3.3	<ul style="list-style-type: none"> <li>Requires the allocation and use of water efficiently within allocation limits.</li> </ul>	The proposal will use water efficiently and will not exceed allocation limits, hence is consistent with this policy.

**Table 9. Assessment against relevant objectives and policies for the Proposed Regional Plan for Northland.**

No.	Objective / Policy	Comment
Objective F.0.1	<ul style="list-style-type: none"> <li>Seeks to manage the use, development, and protection of Northland's natural and physical resources which enables people and communities to provide for their social, economic and cultural well-being while               <ol style="list-style-type: none"> <li>sustaining the natural resources to meet the reasonable foreseeable needs of future generations,</li> <li>safeguarding life-supporting capacities of water, and</li> <li>avoiding, remedying, or mitigating adverse effects on the environment.</li> </ol> </li> </ul>	The proposal is consistent with this objective.
Policy D.2.2	<ul style="list-style-type: none"> <li>Requires that regard is had to the social, cultural, and economic benefits of the proposed activity when considering resource consents.</li> </ul>	As discussed in Section 6, proposal will facilitate the economic and social benefits of both the landowner, their employees and the wider community through flow on effects of purchases made to operate and maintain the orchard.
Policy D.2.5	<ul style="list-style-type: none"> <li>Requires an authority to have regard to community and tangata whenua values</li> </ul>	The proposal is not inconsistent with either community values, as there has been conversion to market gardening and horticulture in the area that has benefitted the community and tangata whenua through employment opportunities.
Policies D.4.5	<ul style="list-style-type: none"> <li>Seeks to maintain overall water quality</li> </ul>	This proposal is consistent with this policy as it will not impact water quality.
Policy D.4.13	<ul style="list-style-type: none"> <li>Seeks to achieve freshwater quantity related outcomes and in particular manage the taking, use, damming, and diversion of fresh water so that (with relevance to this application) saline intrusion in, and land subsidence above, aquifers is avoided (amongst other things).</li> </ul>	This proposal is consistent with this policy as it will avoid the saline intrusion and subsidence impacts, as discussed in <b>Section 4.3 and 4.4.</b>
Policy D.4.17	<ul style="list-style-type: none"> <li>Considers allocation limits for aquifers and requires rules and applications to meet allocation limits.</li> </ul>	This proposal is consistent with this policy as the proposed take will not exceed allocation limits within the Aupouri-Motutangi zone.
Policy D.4.18	<ul style="list-style-type: none"> <li>Concerns conjunctive surface water and groundwater management.</li> </ul>	This application is not inconsistent with this policy, in that the groundwater take will not adversely impact on surface water through stream depletion.
Policy D.4.20	<ul style="list-style-type: none"> <li>Requires the reasonable and efficient use of water for irrigation and sets requirements for a resource consent application to take water for irrigation purposes.</li> </ul>	This proposal is consistent with this policy as the daily irrigation rate and annual volume are considered efficient and just meet 10-year drought requirements, but provide reduced reliability for more severe droughts.

No.	Objective / Policy	Comment
Policy D.4.23	<ul style="list-style-type: none"> <li>Requires conditions on water permits that               <ol style="list-style-type: none"> <li>clearly define the take amount in instantaneous take rates and total volumes, including by reference to the temporal aspects of the take and use, and</li> <li>require that the water take is metered and information on rates and total volume of the take is provided electronically to the regional council, and</li> <li>for water permits for takes equal to or greater than 10 litres per second, require the water meter to be telemetered to the regional council, and</li> <li>clearly define when any restrictions and cessation of the water take must occur to ensure compliance with freshwater water quantity limits set in this plan, and</li> <li>require the use of a backflow prevention system to prevent the backflow of contaminants to surface water or ground water from irrigation systems used to apply animal effluent, agrichemical or nutrients, and</li> <li>specify when and under what circumstances the permit will be reviewed pursuant to Section 128(1) of the RMA, including by way of a common review date with other water permits in a catchment.</li> </ol> </li> </ul>	The proposal is only partially consistent with this policy, as the applicants are arguing that so long as pumping data is recorded electronically and available for the council upon request, telemetry is not required. All other provisions will be met.

**Table 10. Assessment against relevant objectives and policies for the Regional Water and Soil Plan for Northland.**

No.	Objective / Policy	Comment
Objective 7.4	<ul style="list-style-type: none"> <li>Requires the maintenance or enhancement of water quality of natural water bodies.</li> </ul>	This proposal is consistent with this objective as the effects of the take and use of the water will have no more than minor impacts on the shallow aquifer and other surface water bodies, as discussed in <b>Section 4.2</b> .
Objective 10.4.1	<ul style="list-style-type: none"> <li>Seeks to maintain the sustainable use and development of the region's groundwater resources while avoiding, remedying, or mitigating actual and potential adverse effects on groundwater quantity and quality.</li> </ul>	Ditto above.
Policy 10.5.1	<ul style="list-style-type: none"> <li>Seeks to ensure the sustainable use of resources by avoiding takes that exceed recharge. Saltwater intrusion, reduced groundwater quality, significant drawdown, and adverse effects on surface water resources can arise where takes exceed recharge.</li> </ul>	This proposal is consistent with this policy as the cumulative allocation in this aquifer management zone is only 11% of mean annual recharge, which is a low limit on a national scale.



No.	Objective / Policy	Comment
Policy 10.5.2	<ul style="list-style-type: none"> <li>Recognises that aquifers are at risk in certain circumstances and that adverse effects on water quality should be avoided.</li> </ul>	This proposal is consistent with this policy in that current water quality will be maintained.
Policy 10.5.4	<ul style="list-style-type: none"> <li>Seeks that groundwater allocations take into account reduction in recharge that may occur in time.</li> </ul>	This proposal is consistent with this policy in that the analysis assumed no rainfall for the entire 96 days of pumping.
Policy 10.5.7	<ul style="list-style-type: none"> <li>Requires the Northland Regional Council to consider effects of a groundwater take and use on surface water bodies.</li> </ul>	This proposal is consistent with this policy as the effects of the take and use of the water will have no more than minor impacts on the shallow aquifer and other surface water bodies, as discussed in <b>Section 4.2</b> .
Policy 10.5.9	<ul style="list-style-type: none"> <li>Seeks to avoid, remedy or mitigate any ground subsidence as a result of groundwater takes, use or diversion, where this is likely to cause adverse flooding, drainage problems, or building damage.</li> </ul>	This proposal is consistent with this policy as subsidence effects will be no more than minor in the context of a rural setting, as discussed in <b>Section 4.4</b> .

## **7. Notification**

Section 95 sets out the decision-making steps for the determining of public notification and limited notification of applications and the timeframe Councils have for making the notification decision.

## **8. Consultation**

Schedule 4 of the RMA requires that an AEE should identify (amongst other things) the persons affected by the activity, any consultation undertaken, and any response to the views of any person consulted.

Potentially affected parties in relation to this application could include other groundwater users and occupiers of the land within the pumping induced groundwater cone of depression.

However, it should also be noted that while it is considered good practice and “neighbourly” to undertake consultation, under Section 36A of the RMA there is no requirement for an applicant or council to undertake any consultation with any person in regard to an application.

In this case, no consultation has been undertaken with other water users and landowners because the assessment of effects and in particular the bore interference assessment provided in **Section 4.1** concludes that no other groundwater users are considered to be adversely affected by the granting of this application.

## **9. Summary and Conclusions**

Tuscany Valley Avocados Limited own a 15-hectare orchard at Turk Valley Road, Motutangi and are seeking a groundwater take to facilitate the development of an 9 canopy hectare development.

The groundwater take will be exercised from October to April, in accordance with the following volumes:

- Maximum daily volume of 375 m<sup>3</sup>/day; and
- Maximum annual volume of 36,000 m<sup>3</sup>/yr.

A consent duration of 30 years is sought, subject to a lapse period of 5 years.

If granted, this consent taken with another application we are aware of, will take the allocation status for the Aupouri-Motutangi allocation zone to just approximately 91% of full allocation. The activity status thus remains Discretionary.

The AEE has demonstrated that the potential adverse effects of the proposed water take and use on the environment will be less than minor, and the effects on persons will also be less than minor.

The proposal is also considered to be consistent with the relevant objectives and policies of the NPS, the RPS, the PRP, the RWSPN, and Part 2 of the RMA. The applicant considers that in light of the less than minor effects of the application, the decision made following the recent hearing for the MWWUG consent applications, the consent should proceed without public notification and be granted on a non-notified basis.



## **10. References**

Feather and Williamson (currently unpublished). An Analytical Tool for Drawdown Analysis in Multi-Layered Aquifer Systems. (App soon to be publicly available on [www.wwa.kiwi](http://www.wwa.kiwi))

Hemker, C.J., and Maas, C., 1987. Unsteady flow to wells in layered and fissured aquifer systems. Journal of Hydrology, 90 (1987) 231-249.

Hunt, B. and Scott, D., 2007. Flow to a well in a two-aquifer system. Journal of Hydrologic Engineering, 12(2), 146-155.

HydroGeo Solutions, 2000. Aupouri Aquifer Sustainable Yield Groundwater Modelling Study. Consultancy report prepared for Northland Regional Council.

Lincoln AgriTech, 2015. Aupouri Aquifer Groundwater Model. Consultancy report prepared for Northland Regional Council.

SKM, 2007b. King Avocado Orchard Groundwater Take Consent Application (AEE Final). Consultancy report prepared for King Avocado Limited.

Williamson Water Advisory, 2017. Motutangi-Waiharara Groundwater Model Factual Technical Report – Modelling. Consultancy report prepared for Motutangi-Waiharara Water Users Group.

**Appendix A. Form A - Application For Resource Consent**

# APPLICATION FORM FOR RESOURCE CONSENT



**Putting Northland first**

Whāngārei Office	Phone:	(09) 470 1200
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Kaitiāia Office	Phone:	(09) 408 6600
Ōpua Office	Phone:	(09) 402 7516
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Website		www.nrc.govt.nz

**This application is made under Section 88/127  
of the Resource Management Act 1991**

**To:** Consents Department  
Northland Regional Council  
Private Bag 9021  
Whāngārei Mail Centre  
Whāngārei 0148

## IMPORTANT NOTES TO APPLICANTS

- Please read fully** the notes below and the Information Brochures and Explanatory Notes available from the Council, **before** preparing your application and any supporting information.
- The Resource Management Act 1991 sets out the information you must provide with your application for a resource consent. If you do not provide adequate information, your application cannot be received nor processed by the Council and will be returned to you. If you are unsure of what information should be included with your application, please contact the Council before submitting the application.
- Applications require notification (public advertising calling for submissions) unless the Council is satisfied that the adverse effects on the environment of the activity for which consent is sought will be minor; and written approval has been obtained from every person who the Council is satisfied may be adversely affected by the granting of the consent. The Council also has available a form "Form 8A – Affected Person's Written Approval", to help you record such approvals for applications that may be processed without public notification.

## PART A – GENERAL

APPLICANT	Full Names
(1) Full Name of Applicant(s): (in full e.g. Albert William Jones and Mary Anne Jones. For Companies, Trusts and other Organisations, commonly used name)	Malcolm Owen Bellette and Lindsay Ruth Bellette
	Tuscany Valley Avocados Limited
Phone Number – Business:	Fax:
Home:	09-406-8551
E-mail:	Mobile:
	bellettelm@gmail.com

*For applications by a company, private trusts or other entity/organisations, the Directors; Trustees and Officers' full names must be supplied and Section (12) completed and signed.*

(2) Postal Address: (in full)	101 Turk Valley Road, RD4, Motutangi, Kaitiāia, 0484

(3) Residential Address: (if different from postal address)	

(4) Address for Service of Documents: (if different from postal address e.g. Consultant)	Jon Williamson (jon.williamson@wwa.kiwi)
	c/o Williamson Water Advisory
	PO Box 314
	Kumeu, 0812
Auckland	

(5) Owner/Occupier of Land/ Water Body: (if different from the Applicant)	N/a

<b>(6) Type(s) of Resource Consent sought from the Regional Council:</b>	
You will need to fill in a separate Assessment of Environmental Effects Form for each activity. These forms can be obtained from the Northland Regional Council.	
<b>Coastal Permit</b>	
<input type="checkbox"/> Mooring	<input type="checkbox"/> Marine Farm
<input type="checkbox"/> Other (specify) _____	<input type="checkbox"/> Structure
	<input type="checkbox"/> Pipeline/Cable
<b>Land Use Consent</b>	
<input type="checkbox"/> Vegetation Clearance	<input type="checkbox"/> Quarry
<input type="checkbox"/> Earthworks	<input type="checkbox"/> Construct/Alter a Bore
<input type="checkbox"/> Other (specify) _____	<input type="checkbox"/> Structure in/over Watercourse
	<input type="checkbox"/> Dam Structure
<b>Water Permit</b>	
<input type="checkbox"/> Stream/Surface Take	<input type="checkbox"/> Damming
<input type="checkbox"/> Other (specify) _____	<input checked="" type="checkbox"/> Groundwater Take
	<input type="checkbox"/> Diverting Water
<b>Discharge Permit</b>	
<input type="checkbox"/> Domestic Effluent to Land	<input type="checkbox"/> General Discharge to Land
<input type="checkbox"/> Air	<input type="checkbox"/> Water
<input type="checkbox"/> Other (specify) _____	<input type="checkbox"/> Farm Dairy Effluent to Land/Water

<b>(7) Other Resource Consents required from the District Council:</b>	
Where other Resource Consents are required for the same activity, they must be applied for at the same time. Not doing so will delay the processing of this application.	
<b>What other Resource Consents are required from the District Council?</b>	
<input type="checkbox"/> None	<input type="checkbox"/> Land Use Consent
<input type="checkbox"/> Have the applications been made?	<input type="checkbox"/> Subdivision Consent
<input type="checkbox"/> Yes	<input type="checkbox"/> No

<b>(8) Description of the Activity:</b>
Please briefly describe the activities and duration for which Consent(s) are being sought. It is important you fill this out correctly, as the Council cannot grant Consent for any activity you do not apply for.
Groundwater take consent to enable development of 15 ha Total Orchard Area of avocados.
The details of the take are as follows:
Daily rate - 3,75 m3/day (25 m3/day per Total Orchard Area)
Annual volume - 36,000 m3/annum (based on a maximum of 400 mm per annum over 9 ha canopy area.

**(9) Location of Property/Waterbody to which Application relates:**

Describe the location in a manner which will allow it to be readily identified, e.g. street address, legal description, harbour, bay, map reference etc. Attach appropriate plans and/or diagrams.

Property Address: Turk Valley Road, Houhora Locality: North Auckland  
(see rate demand)  
Legal Description: Lots 5 & 6 being sub-division of Lot 2 Blk: 111 Opoe SD:   
DP 174312  
Other Location Information:

**PART B – ASSESSMENT OF EFFECTS ON THE ENVIRONMENT**

You must include an assessment of the effects of your activity on the environment as part of your application.

The Resource Management Act 1991 requires that each application include an assessment of the actual and potential effects of the activity on the environment in accordance with the Fourth Schedule.

To assist you to supply this assessment of effects, the Council has prepared specific forms for various consent activities. For minor activities, all that will be required is for you to complete the specific form. Where the potential effects of the activity are more significant, we recommend you undertake a full assessment of effects, with professional assistance if necessary.

If you are unsure of what information to include with your application and the assessment of effects, please contact the Council before submitting your application. A pre-lodgement meeting with relevant Consent Staff is recommended.

**PART C – GENERAL****(10) Renewal of an Existing Resource Consent:**

☐ Yes ☒ No ☐ A change in conditions of a current Resource Consent

**(11) Fee/Deposit Enclosed with Application(s):**

Application to be processed as: ☐ Notified ☐ Limited Notified ☒ Non-notified

<input type="checkbox"/> Coastal Permit:	\$ <u></u>	<input type="checkbox"/> Land Use Consent:	\$ <u></u>
<input checked="" type="checkbox"/> Water Permit:	\$ <u>3,296.00</u>	<input type="checkbox"/> Discharge Permit:	\$ <u></u>
<input type="checkbox"/> Bore Permit:	\$ <u></u>	<input type="checkbox"/> Change Conditions:	\$ <u></u>

**(12) Signature of Applicant(s) or Persons authorised to sign on behalf of Applicant(s):****IMPORTANT NOTES TO APPLICANTS**

- (a) Your application must be accompanied by the minimum fee (deposit) as determined by the Council. A schedule of the fee/deposits for different consent applications is annexed. Please note that applications by private trusts and other group entities require the personal guarantees of the Trustees and/or Officers for the payment of costs to be submitted with the application.
- For complex applications, the Council may require an additional deposit pursuant to Section 36(3) of the Act, based on the estimated costs for processing such complex applications and may require progressive monthly payments during consent processing.
  - The final fee is based on actual and reasonable costs including disbursements and where this fee exceeds the fee/deposit, the additional fee is subject to objection and appeal.
- (b) All accounts are payable by the 20<sup>th</sup> of the month following the date of invoice. Any actual and reasonable costs, including but not limited to legal costs, debt collection fees or disbursements incurred as a result of any default in payment, shall be recoverable from the Applicant and is so notified in compliance with the Credit Contracts and Finance Act 2003. Submitting this Application authorises the Council to, if necessary, provide your personal information to a Credit Reporter in order to employ in its debt collection services in compliance with the Credit Reporting Privacy Code 2004, should payment default occur.
- (c) Resource Consents usually attract an annual fee to recover the reasonable costs of the Council's monitoring, supervision and administration of the Consent during its term.
- (d) The information you provide is official information. It will be used to process the application and, together with other official information, assist the management of the region's natural and physical resources. Access to information held by the Northland Regional Council is administered in accordance with the Local Government Official Information and Meetings Act 1987 and the Privacy Act 1993.

*Application Form continued on next page*

I/we declare that, to the best of my/our knowledge and belief, the information given in this Application and attached Assessment of Environmental Effects is true and correct. I/we unconditionally guarantee jointly and severally to pay the actual and reasonable costs of processing this Application as and when charges become due and payable. I/we acknowledge that I/we understand the consequences of signing this Application.

Signature: \_\_\_\_\_ PP. \_\_\_\_\_

Full Name (print): Jon Williamson

Date: 18/03/2018

Signature: \_\_\_\_\_

Full Name (print): \_\_\_\_\_

Date: \_\_\_\_\_

Continue with Trustees' and Authorised Officers' signatures below, as necessary.

**Personal details and signatures of Trustees\*, or Officers authorised to sign on behalf of and to bind Trusts, Societies and Unincorporated Entities.**

\* Private and Family Trusts only

**Full Name and Status:**

(Trustee, Officer etc)

**Full Residential Address:**

**Signature:**

**Full Name and Status:**

(Trustee, Officer etc)

**Full Residential Address:**

**Signature:**

**Full Name and Status:**

(Trustee, Officer etc)

**Full Residential Address:**

**Signature:**

**Full Name and Status:**

(Trustee, Officer etc)

**Full Residential Address:**

**Signature:**

**CHECKLIST – Have you remembered to...**

- ☐ Complete all details set out in this Application Form
- ☐ Include an Assessment of Effects of the activity on the environment, set out in the attached form
- ☐ Sign and date the Application Form

- ☐ Include a Site Plan
- ☐ Include the appropriate fee as set out in the "Schedule of Minimum Estimated Initial Fees"
- ☐ Complete details of Trustees and/or Authorised Officers on this page



## Appendix B. Environmental Impact Analysis

### B.1 Drawdown analysis

The drawdown analysis was conducted based on the peak daily groundwater take of 375 m<sup>3</sup>/day, which will be applied to Total Orchard Area development of 15 ha. The drawdown was evaluated after 96-days of pumping at the maximum rate, which equates to an application of 400 mm over the canopy area. The drawdown impact was analysed using:

- **Theis Solution:** Analytical solution to compute drawdown in abstraction layer with a confined non-leaky condition.
- **Feather & Williamson Solution:** Analytical solution to compute drawdown in a multi-layer aquifer system considering elastic storage within layers.

The hydrogeological parameters of the abstraction layer were sourced from relevant pumping test data in the region, shown in **Table B1**.

**Table B1. Summary of hydrogeological parameters of shellbed analysed from pumping test data.**

Bore	Screen depth	Depth	Lithology	Transmissivity	Thickness	Specific storage	Leakance	Analysis method	Source
	mBGL	mBGL		m <sup>2</sup> /day	m	m <sup>-1</sup>	d	-	
King Avo1	110.5	-	Shell	305	26	2.7x10 <sup>-5</sup>	0.0003	-	Aupouri Aquifer Groundwater Model (Lincoln AgriTech, 2015)
King Avo2	110.5	-	Shell	370	17	6.5 x10 <sup>-5</sup>	0.0003	-	
184	101	110	Shelly sand	140-340	-	-	-	-	Aupouri Aquifer Sustainable Yield Groundwater Modelling Study (HydroGeo Solutions, 2000)
SKM101b	84.5-100	100	Sand/shell	496	15.5	-	-	-	King Avocado Orchard Groundwater Take Consent Application (AEE Final) (SKM, 2007b)
SKM102b	112-122	122	Sand/shell	130	10	-	-	-	
SKM103b	114-124	124	Sand/shell	300	10	-	-	-	
SKM104b	82-94	94	Sand/shell	444	12	-	-	-	
Stanisich Pumping bore	87-101	-	Shell	485	14	-	-	Single well Jacob	Motutangi-Waiharara Groundwater Model Factual Technical Report – Modelling. (Williamson Water Advisory, 2017)
				512		-	-	Theis Recovery	
				471		-	-	Single well Jacob leaky solution	
Stanisich Monitoring bore	77-85	-	Shell	356	8	4.4 x10 <sup>-3</sup>	-	Theis (point match)	
				138		1.6 x10 <sup>-4</sup>	0.00183	Hantush-Jacob	
				408		3.0x10 <sup>-4</sup>	0.00135	Hantush-Jacob	
				348		3.1x10 <sup>-4</sup>	0.000736	Hantush-Jacob	

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Bore	Screen depth	Depth	Lithology	Transmissivity	Thickness	Specific storage	Leakance	Analysis method	Source
	mBGL	mBGL		m <sup>2</sup> /day	m	m <sup>-1</sup>	d	-	
Honeytree Pumping bore	62-68,68-71,84-93	-	Shell	618	18	-	-	Single well Jacob	
				511		-	-	Theis Recovery	
Honeytree Monitoring bore	63-69,69-72,86-95	-	Shell	751	18	3.0x10 <sup>-4</sup>	-	Theis (point match)	
				784		3.0x10 <sup>-4</sup>	-	Cooper Jacob	
				579		1.6x10 <sup>-5</sup>	0.00015	Hantush-Jacob	
				484		2.2x10 <sup>-5</sup>	0.000284	Hantush-Jacob	
				707		1.7x10 <sup>-5</sup>	0.0000509	Hantush-Jacob	
De Bede Pumping bore	91-97	-	Shell	377	6	-	-	Single well Jacob	
				363				Theis Recovery	
				273					
Minimum				130	6	1.6 x10 <sup>-5</sup>	5.1x10 <sup>-5</sup>		
Median				444	14	1.6x10 <sup>-5</sup>	3.0x10 <sup>-4</sup>		
Average				444	14	5.4x10 <sup>-4</sup>	6.3x10 <sup>-4</sup>		
Maximum				784	26	4.4x10 <sup>-3</sup>	1.8x10 <sup>-3</sup>		

### B.1.1 Theis Drawdown Solution

The median aquifer hydraulic property values from **Table B1** were used to represent the deep shellbed aquifer. The estimated drawdown after 96-days of pumping at various distance from pumping bore is shown in **Figure B1**. At 0.1 m radius from the pumping bore, a drawdown of 1.7 m was calculated, and a drawdown of 0.12 m was estimated at 10 km radius from the pumping bore.

Due to the existence of discrete low-permeable geological materials (e.g. iron pan, silt, peat), the regional aquifer is a leaky confined system, showing a progressive confinement with depth. The confined (non-leaky) condition of the Theis solution will lead to an appropriately conservative overestimation of drawdown in the deep shellbed.

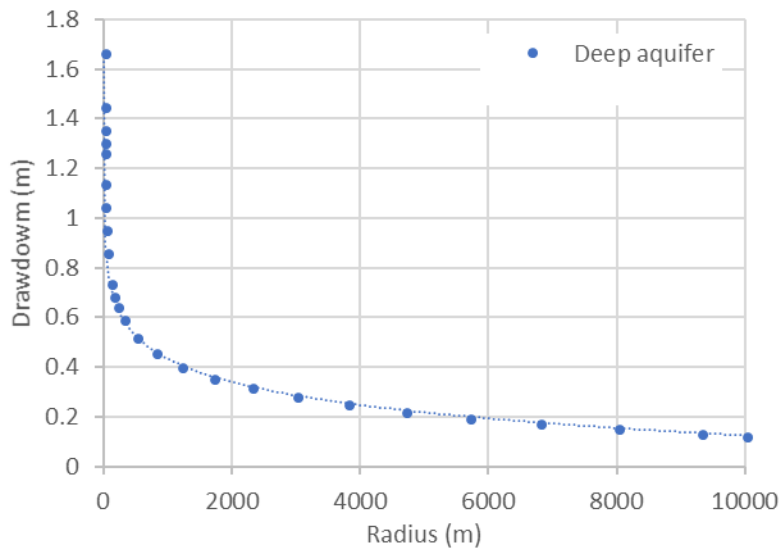


Figure B1. Calculated drawdown of abstraction layer (Theis).

### B.1.2 Feather & Williamson Solution

Feather and Williamson (unpublished) developed a solution for drawdown calculation in a multi-layer aquifer system considering elastic storage, which by coincidence was an extension of the solution by Hemker and Maas (1987) for unsteady flow to well in layered aquifer systems, and an extension of the solution by Hunt and Scott (2007) for two-layered systems. By assigning the hydrogeologic parameters and thicknesses of individual layers, drawdown is calculated for each individual layer using an inversion of Laplace transformation of the groundwater flow equation.

A 6-layer single well pumping model was setup, and the hydrogeologic parameters of Layer 1 to Layer 5 were sourced from the MWGM (WWA,2017), with the hydrogeologic parameters for the shellbed (Layer 6) taken as the median value from **Table B1**, as shown in **Table B2**.

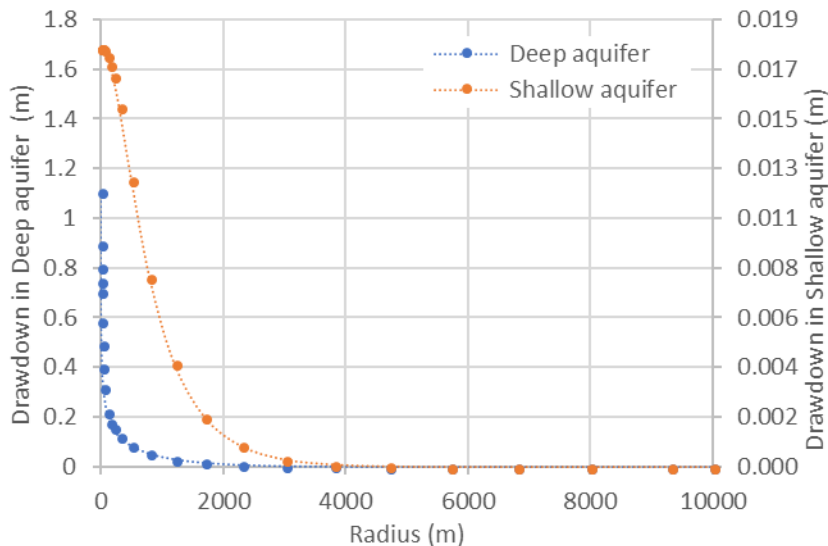
Table B2. Hydrogeologic parameterisation in the Feather and Williamson model.

Layer	Transmissivity (m <sup>2</sup> /day)	Horizontal hydraulic conductivity (m/s)	Vertical anisotropy (-)	Storativity (-)	Layer thickness (m)
1	140	4.05E-05	80	2.50E-01	40
2	75	3.47E-05	80	1.25E-02	25
3	60	3.47E-05	80	1.00E-02	20
4	210	3.47E-04	1	1.12E-02	7
5	18	6.94E-05	30	1.50E-03	3
6	444	3.67E-04	1	2.17E-03	14

The estimated drawdown in the deep and shallow aquifer is shown in **Figure B2**. At a radius of 0.1 m from the pumping bore, drawdown of 1.1 m and 0.02 m were calculated for the deep and shallow aquifer, respectively.

The calculated drawdown extent and magnitude from Feather and Williamson Solution is less than from the Theis Solution, due to the vertical leakance simulated in the model. The drawdown estimated from Feather and

Williamson Solution is considered a more realistic solution for leaky-confined aquifer systems, nevertheless the Theis Solution has value as an upper range estimate and therefore conservative approximation.



**Figure B2.** Estimated drawdown in deep aquifer and shallow aquifer (Feather & Williamson).

## B.2 Cumulative Impact

The cumulative impact of all existing consents and the Tuscany consent was assessed by overlying the estimated drawdown discussed above (for operation of the Tuscany consent) with the selected drawdown simulations from MWGM (WWA,2017), referred to below as the base drawdown in **Table B3**.

**Table B3.** Selected drawdown simulation for cumulative impact assessment.

Aquifer	Base drawdown simulation	Additional drawdown
Deep aquifer	MWGM Scenario 4c	Feather & Williamson L6 drawdown
	MWGM Scenario 4c	Theis drawdown
Shallow aquifer	MWGM Scenario 2	Feather & Williamson L1 drawdown

**Figure B3** and **Figure B4** show the cumulative drawdown in the deep aquifer for each neighbouring bore located in the MWGM domain, and **Table B4** summarises this information.

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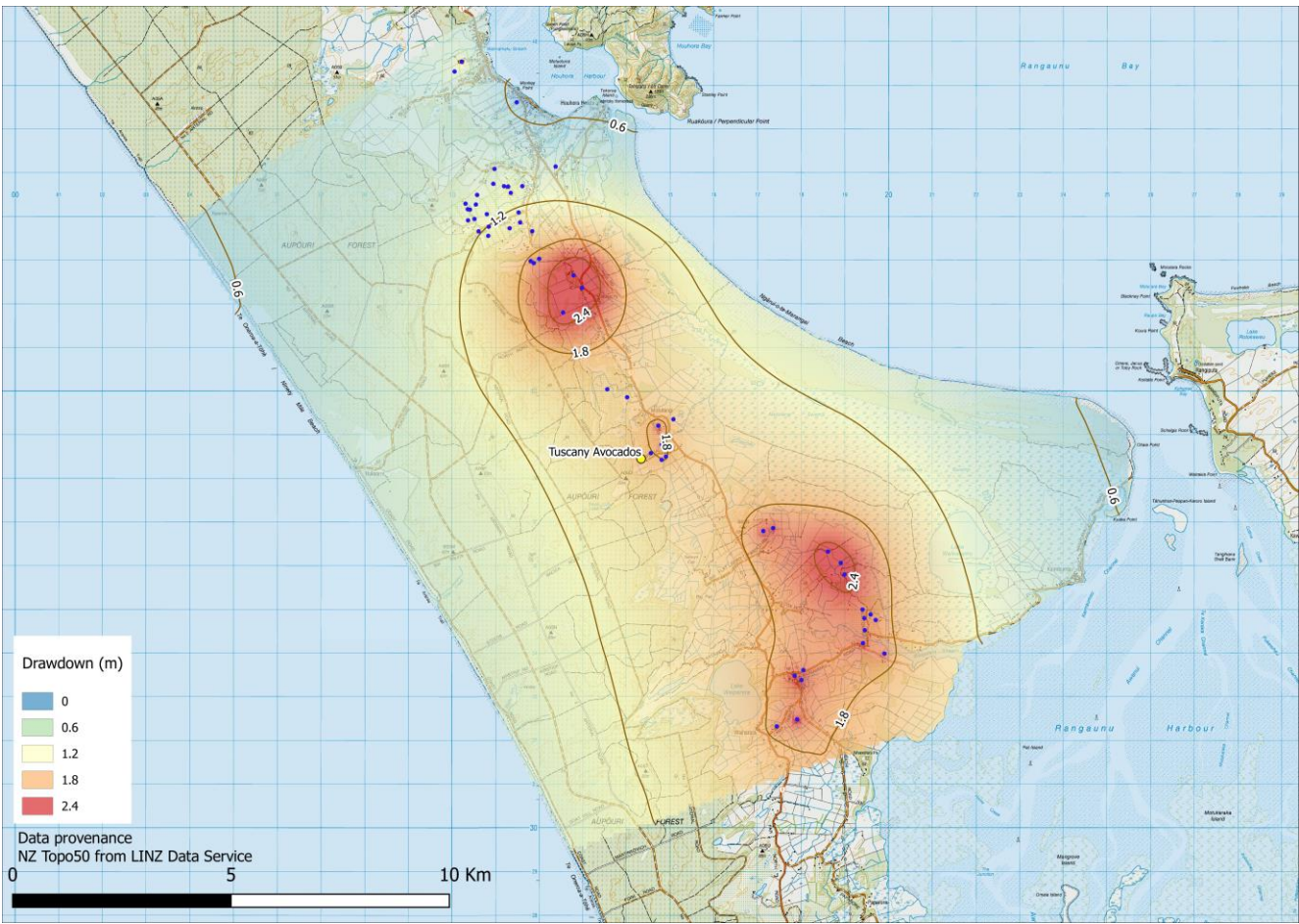
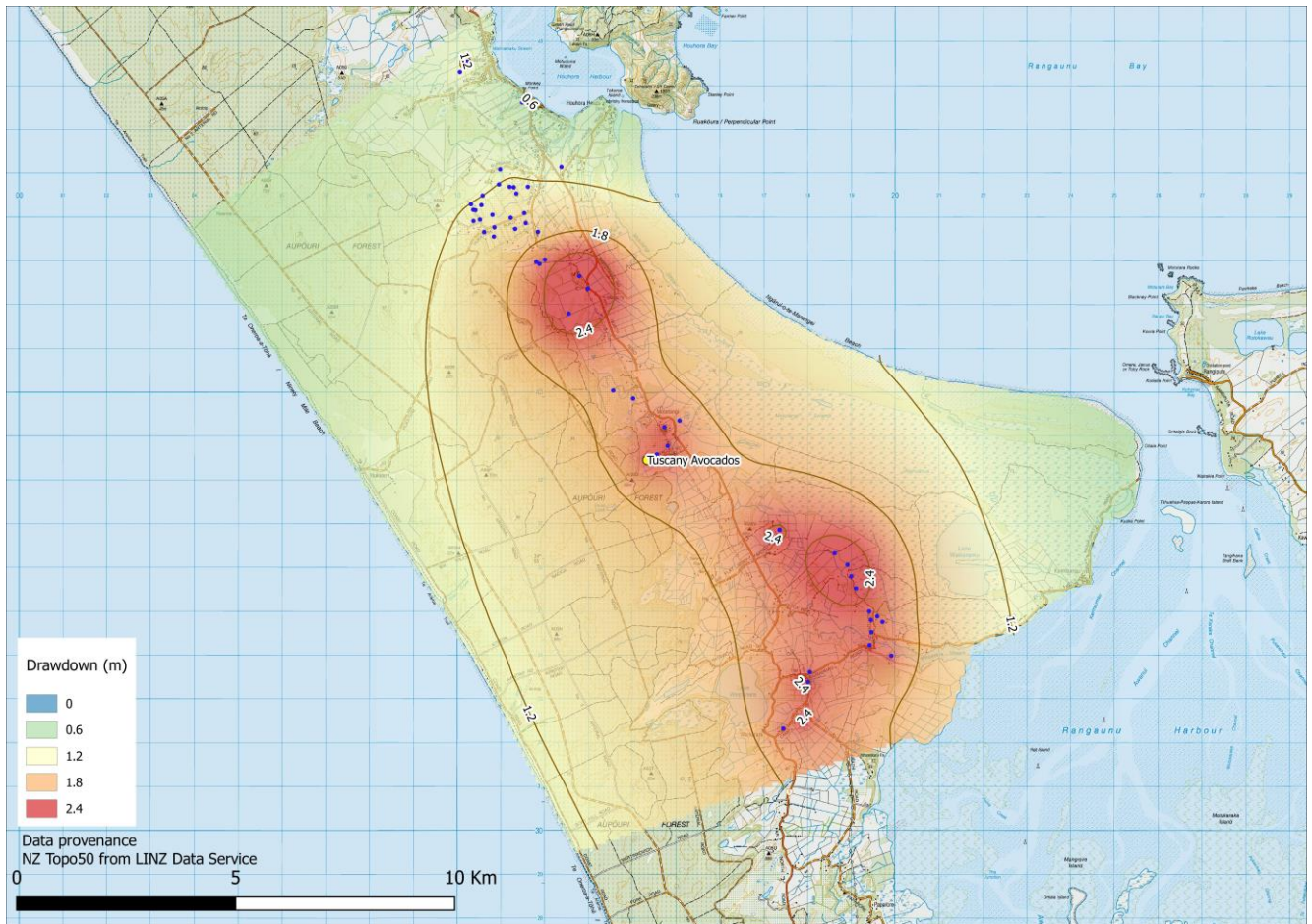


Figure B3. Cumulative drawdown in deep aquifer - MWGM Scenario 4c + Feather and Williamson Analysis.



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**Figure B4. Cumulative drawdown in deep aquifer - MWGM Scenario 4c +Theis Analysis.**

**Table B4. Drawdown estimated for existing groundwater take locations.**

Neighbouring bore	Distance From Tuscany Bore (m)	Drawdown (m)			Additional Drawdown	
		Scenario 4c (MWGM)	Scenario 4c (Feather and Williamson)	Scenario 4c (Theis)	Scenario 4c (Feather and Williamson)	Scenario 4c (Theis)
KSL Ltd	0.26	1.64	1.79	2.29	0.15	0.66
JR Avocados Ltd	0.47	1.68	1.77	2.21	0.08	0.53
Thompson	0.57	1.90	1.98	2.42	0.08	0.52
Cypress Hills Ltd	0.57	1.78	1.85	2.29	0.07	0.51
Candy Corn Ltd	0.85	2.07	2.12	2.54	0.05	0.46
De Bede	1.17	1.63	1.67	2.04	0.04	0.41
Subritzky	1.44	1.54	1.57	1.94	0.03	0.39
Shirttail Orchards	1.77	1.54	1.56	1.90	0.02	0.36
Covich	3.25	2.32	2.33	2.60	0.00	0.28
Covich	3.41	2.83	2.83	3.09	0.00	0.27
Mapua Ltd1	3.80	3.62	3.62	3.87	0.00	0.26



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Neighbouring bore	Distance From Tuscany Bore (m)	Drawdown (m)			Additional Drawdown	
		Scenario 4c (MWGM)	Scenario 4c (Feather and Williamson)	Scenario 4c (Theis)	Scenario 4c (Feather and Williamson)	Scenario 4c (Theis)
Mapua Ltd2	4.14	5.44	5.44	5.69	0.00	0.24
Mapua Ltd3	4.47	4.78	4.78	5.01	0.00	0.23
Honeytree2	4.78	2.99	2.99	3.21	0.00	0.22
Whaler's Rd, Houhora	5.14	1.92	1.92	2.13	0.00	0.21
Soltysik-Freeman Fam Trust	5.19	1.86	1.86	2.07	0.00	0.21
Valadares	5.11	1.98	1.98	2.19	0.00	0.21
Honeytree1	5.16	3.07	3.07	3.29	0.00	0.21
Ngai Takoto2	5.36	2.74	2.74	2.94	0.00	0.21
Ngai Takoto1	5.59	2.58	2.58	2.78	0.00	0.20
EJ Wagener	5.78	1.47	1.47	1.67	0.00	0.20
RB Freeman	6.08	1.31	1.31	1.50	0.00	0.19
McQuarrie	6.08	1.31	1.31	1.51	0.00	0.19
I J & B M Broadhurst	6.13	2.07	2.07	2.26	0.00	0.19
Stanisich	6.09	2.55	2.55	2.74	0.00	0.19
IA Stanisich	6.10	2.11	2.11	2.31	0.00	0.19
RB Freeman	6.19	1.25	1.25	1.44	0.00	0.19
J P Broadhurst	6.28	2.03	2.03	2.21	0.00	0.19
I M Fulton	6.35	2.01	2.01	2.20	0.00	0.18
Largus Ltd	6.26	2.63	2.63	2.81	0.00	0.19
Whispering Pines Ltd	6.30	1.25	1.25	1.44	0.00	0.19
Trebcombe Limited	6.36	1.21	1.21	1.39	0.00	0.19
Trebcombe Limited	6.35	1.23	1.23	1.42	0.00	0.19
Matalaka Trust	6.40	1.19	1.19	1.38	0.00	0.18
I M Fulton	6.45	2.03	2.03	2.21	0.00	0.18
Hine & Associates Ltd	6.62	1.14	1.14	1.32	0.00	0.18
Holloway	6.52	2.02	2.02	2.20	0.00	0.18
Shine	6.61	2.16	2.16	2.34	0.00	0.18
S127 change to consent for groundwater take	6.69	1.15	1.15	1.33	0.00	0.18
Ongare Trust	6.78	1.16	1.16	1.33	0.00	0.18
Brien(Hukatere Rd)	6.75	1.22	1.22	1.40	0.00	0.18
Ongare Trust	6.81	1.09	1.09	1.27	0.00	0.18
Far North Avos Limited	6.92	1.09	1.09	1.27	0.00	0.17
Wagener Houhora Heads Properties Limited	6.97	0.90	0.90	1.08	0.00	0.17
Far North Avos Limited	6.94	1.08	1.08	1.25	0.00	0.17
Hewitt	6.87	2.06	2.06	2.24	0.00	0.18

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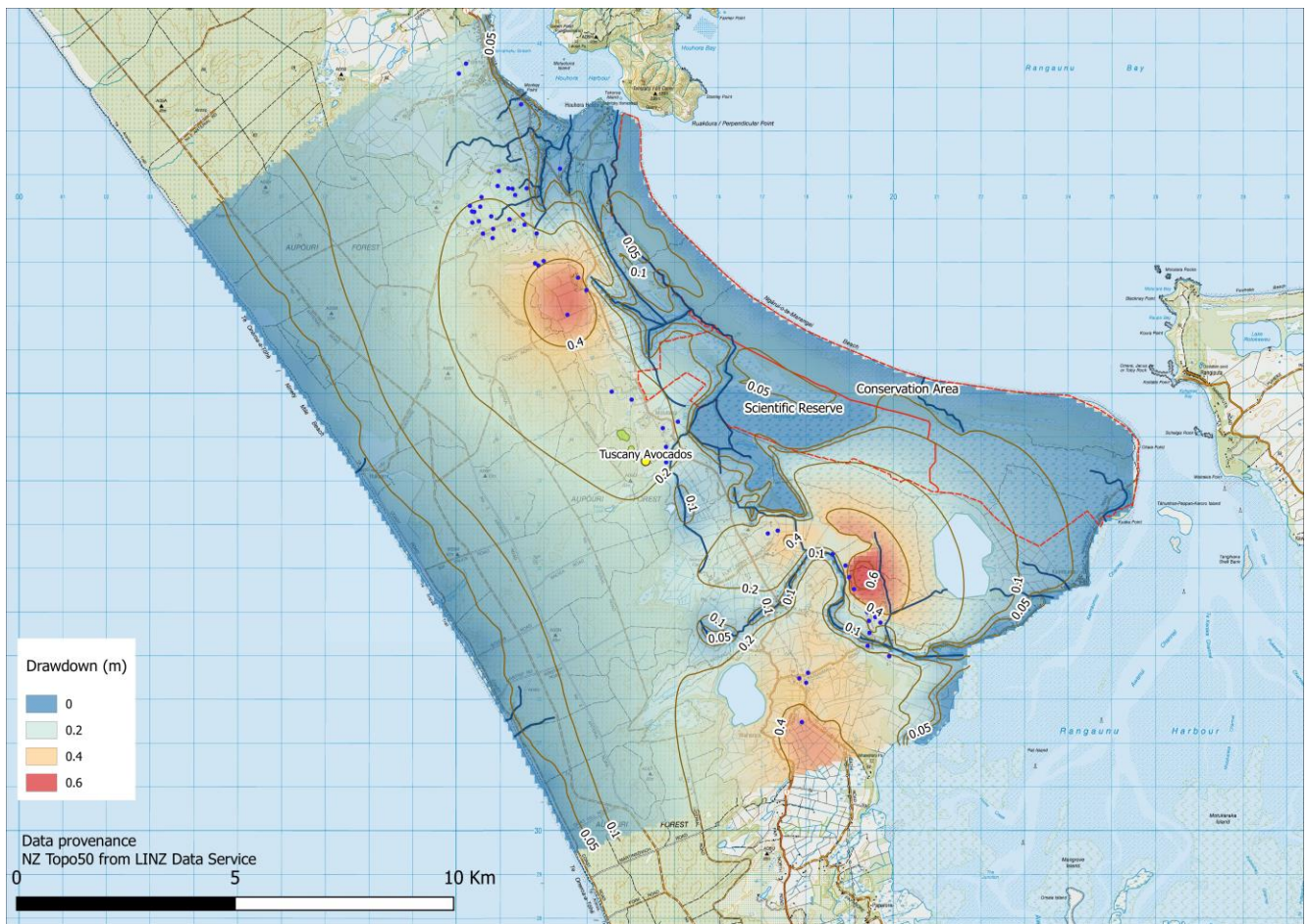
Neighbouring bore	Distance From Tuscany Bore (m)	Drawdown (m)			Additional Drawdown	
		Scenario 4c (MWGM)	Scenario 4c (Feather and Williamson)	Scenario 4c (Theis)	Scenario 4c (Feather and Williamson)	Scenario 4c (Theis)
Honeytree Farms Ltd	6.96	1.08	1.08	1.25	0.00	0.17
The Alligator Pear Partnership	6.99	1.13	1.13	1.30	0.00	0.17
McLarnon	6.94	1.29	1.29	1.47	0.00	0.17
	6.96	2.44	2.44	2.61	0.00	0.17
E J Williams	7.09	1.05	1.05	1.22	0.00	0.17
Tomo Orchard Ltd	7.15	1.04	1.04	1.21	0.00	0.17
B C Smith	7.11	1.03	1.03	1.21	0.00	0.17
Elbury Holdings	7.14	2.10	2.10	2.27	0.00	0.17
Longbeach Trust	7.44	0.95	0.95	1.12	0.00	0.17
LL & DF Rasmussen	8.65	0.55	0.55	0.70	0.00	0.14
Thomas	9.98	1.46	1.46	1.59	0.00	0.12
Brien(Lamb Rd)	9.84	1.07	1.07	1.20	0.00	0.13

**Table B4** indicates, that the proposed take is unlikely to cause additional drawdown in the deep aquifer for majority of the existing bores, over and above the recently granted MWWUG consents (MWGM Scenario 4c) according to the the Feather and Williamson analysis. Eight bores within 2 km of the Tuscany bore may experience an additional drawdown of up to 0.15 m.

The Theis Solution induced additional drawdown ranging from 0.2 to 0.7 m across all the neighbouring bores. The greatest additional drawdown of 0.7 m was observed at KSL Ltd. The fully confined condition implied in the Theis Solution leads to a more pervasive outcome, which is considered unlikely to be realistic because the aquifer is leaky.

The cumulative drawdown in the shallow aquifer is shown in **Figure B5**, which shows the shallow aquifer is less affected by the proposed abstraction. There is no noticeable difference to that of MWGM Scenario 2 (the additional drawdown is less than 0.02 m), which means that no changes in surface water level or flows are expected as discussed in the following section.

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**Figure B5. Cumulative drawdown in shallow aquifer - MWGM Scenario 2 +Feather and Williamson.**

### **B.3 Surface Water Impact**

The surface water features in the area adjacent to Tuscany Orchard are shown on **Figure B5** and include:

- Selwyn Drain (0.4 km);
- Unnamed dune lake to northwest (0.8 km)
- Unnamed dune to south (1.0 km);
- Unnamed dune to southwest (1.5 km);
- Kaimaumau wetland to east (2 km); and
- Lake Waiharara to south (5 km).

As discussed in the previous section, the maximum potential drawdown impact in the shallow aquifer is less than 0.02 m, which would translate to an unmeasurable impact within a standing or flowing water body.

The findings of the MWGM were accepted with respect to impacts on the wetland (and by inference surface waters) with the Commissioners indicating in paragraph 153, “our view is that there are many influences on the wetland that are far greater than the MWWUG abstractions”. Given that the additional impacts predicted from this bore are similarly negligible, the same conclusion can be drawn.

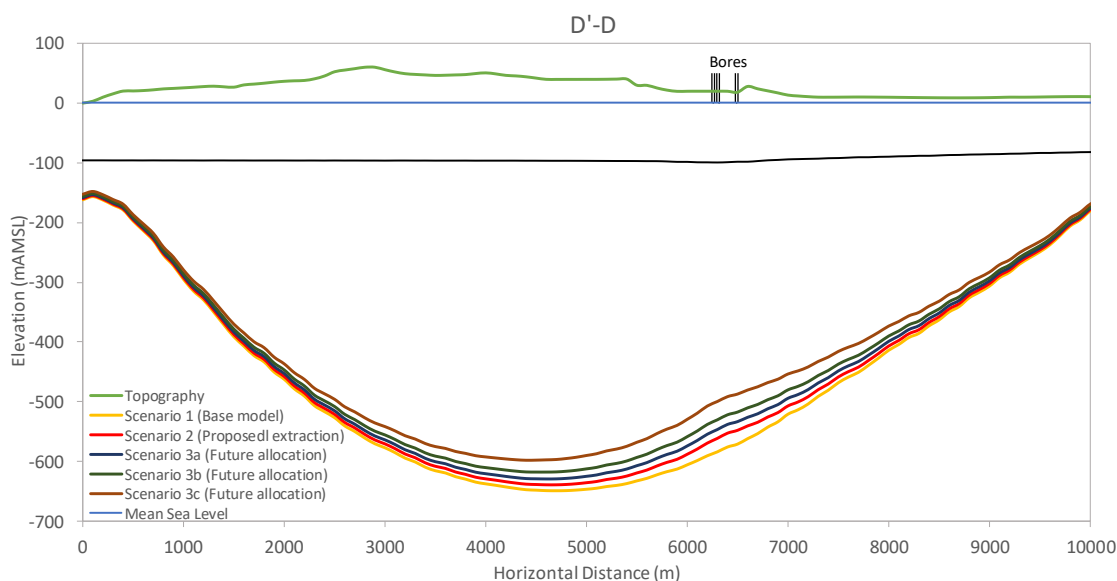
Therefore, the proposed take for the deep aquifer is unlikely to pose significant impact on the surficial hydrological features.

### B.3.1 Saltwater intrusion

Saltwater potential upconing and lateral migration were analysed in MWGM report (Section 5.2.6, WWA,2017) using Ghyben-Herzberg analytical solution.

The proposed take is located in the central sand area, with significant distance (>4 km) away from the coastlines. The additional drawdown of 0.1 to 0.5 m is unlikely to change the potential saltwater lateral migration profile from that assessed in the MWGM report (WWA,2017).

No significant saltwater/freshwater interface upconing was observed in cross-section D'-D (Figure 39, WWA,2017), which is close to the Tuscany bore, shown in **Figure B6**. Based on the proposed take, an additional drawdown of 0.1 m to 0.5 m equates to 4 m and 20 m saltwater interface rise in this location. However, the potential rise is considered insignificant considering the pressure in the deep aquifer (12.5-15 m), which will prevent saltwater intrusion into the pumping bores.



**Figure B6. Calculated saltwater/freshwater interface at cross section D'-D (Figure 39, WWA,2017)**

### B.3.2 Ground Settlement

Groundwater settlement was calculated using the Bouwer (1977)<sup>10</sup> equation:

$$S_u = (P_{i2} - P_{i1}) \frac{Z_1}{E}$$

where  $S_u$  = vertical subsidence (m)  
 $P_{i2} - P_{i1}$  = Increase in intergranular pressure due to drop of the water table  
 $Z_1$  = layer thickness

<sup>10</sup> Bouwer, H., 1977. Land Subsidence and Cracking Due to Ground-Water Depletion. Ground Water 15, 358–364. doi:10.1111/j.1745-6584.1977.tb03180.

$E$  = modulus of elasticity of the soil

The following characteristics were assumed for the aquifer:

- Porosity = 0.25
- Unsaturated water content = 0.08
- Specific weight of aquifer material (consolidated silty sand) = 20 kN/m<sup>3</sup> (Silty sand density ranges between 1,410 kg/m<sup>3</sup> and 2,275 kg/m<sup>3</sup><sup>11</sup>, corresponding to specific weight of 14 kN/m<sup>3</sup> and 22 kN/m<sup>3</sup>)
- Specific weight of water = 9.81 kN/m<sup>3</sup>.

The deep shellbed material is denser and less compressible compared to the mixture of sand, silt and peat overlying above. The subsidence analysis was conducted using three separate layers representing the conceptual hydrogeological units of the sub-surface environment, and the parameter values used are shown in **Table B5**, which were selected from the elasticity values referenced in **Table B6**.

**Table B5. Elasticity and depth of each zone for subsidence estimate.**

Stratigraphy	Total depth	Modulus of elasticity (kPa)*
Silty sand (unsaturated zone)	5	10,000
Silty sand (saturated zone)	70	20,000
Shellbed (saturated zone)	25	50,000

\* Modulus of elasticity ( $E$ ) was sourced from Bouwer, 1977

**Table B6. Modulus of elasticity [ $E$ ] for unconsolidated materials (Bouwer, 1977).**

Material	$E$ (kg/cm <sup>2</sup> )	$E$ (kPa)
Peat	1 – 5	98 – 490
Loose clay	10 – 50	981 – 4,903
Medium clay and silt	50 – 100	4,903 – 9,807
Dense clay and silt	100 – 1,000	9,807 – 98,067
Loose sand	100 – 200	9,808 – 19,613
Dense sand	500 – 2,000	49,033 – 196,133
Dense gravel and sand	2,000 – 10,000	196,133 – 980,665

The cumulative drawdown profile is an overlap of cone of depressions from proposed take and adjacent MWWUG takes. The drawdown magnitude around the proposed take will not attenuate as a circular pattern. Therefore, maximum cumulative drawdown was extracted within a 1.5 km radius of the proposed take, and the estimated maximum subsidence was calculated by combining the Feather and Williamson analysis for the shallow aquifer with the Theis analysis for the deep aquifer, as shown in **Table B7**.

<sup>11</sup> Density ranges for different soil types: [http://structx.com/Soil\\_Properties\\_002.html](http://structx.com/Soil_Properties_002.html)

**Table B7. Calculated subsidence (m) within 1.5 km of the pumping bore.**

Scenario	Scenario 2 (Feather and Williamson)	Scenario 4c (Theis)
<b>Drawdown (m)</b>	0.26	2.55
Unit 1. Sand (unsaturated)	$5.5 \times 10^{-5}$	
Unit 2. Sand (saturated)	$7.4 \times 10^{-3}$	
Unit 3. Shellbed (saturated)		$9.3 \times 10^{-3}$
Maximum Cumulative	0.01	

Within 1.5 km of proposed take, the estimated cumulative subsidence is 0.01 m, with a maximum drawdown of 0.26 m and 2.12 m in shallow and deep aquifer, respectively. In a rural setting, settlement effects of this magnitude (or less as would be more realistic) are less than minor for the following reasons:

- There is no sensitive urban infrastructure like water or wastewater mains or high-rise buildings to rupture or crack; and
- The changes in land surface due to farm machinery (e.g. rotary hoeing) would likely mask impacts of this magnitude (<0.3 m) if materialised.

In summary, the potential settlement effects are considered less than minor.