

COMPLEXITIES ASSOCIATED WITH INDUSTRIAL RESOURCE CONSENTS FOR LAND TREATMENT SYSTEMS WHERE SPECIFIC LIMITS ARE SET WITH OVERSEER

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Abstract

Fonterra operate sixteen wastewater land treatment systems in NZ, encompassing some 70+ farms. These land treatment systems operate under full discretionary activity resource consents that restrict nutrient loadings and other operational factors to minimise effects on the environment.

In recent years nitrogen leaching rate restrictions based on Overseer calculations have been added. Implementation of these nitrogen leaching allowances is made complex by frequent Overseer upgrades changing the model outputs and the administrative load associated with calculating five year rolling averages for systems which may involve 4-12 individual farms. In the case of the Fonterra Pahiatua wastewater irrigation system, the need for 'farming consents' under Horizon's One Plan, has added a further layer of complexity.

A potential pathway forward has been identified where the farming activity is bundled with the industrial activity and the combined system classed as a point source discharge. A nitrogen leaching allowance is still utilised, however it is reviewable and becomes an 'Objective' (rather than a fixed limit) but with additional consent review clauses should individual annual results be significantly higher or if the objective is not achieved for three consecutive years.

Introduction

Fonterra operate sixteen wastewater land treatment systems (LTS), encompassing some 70+ farms. The LTS operate under full discretionary activity resource consents that restrict nutrient loadings and other operational factors to control environmental effects. Significant programmes for soil, surface water and groundwater quality exist to monitor any effects of the operations. The farming systems involved are tailored to complement the wastewater irrigation activities. New or recently upgraded systems have typically been destocked to < 1.5 dairy cows/ha and excess grass is exported as silage. Sites such as Edendale, Darfield, Clandeboye and Lichfield's largest farm are full Cut & Carry systems with minor drystock.

Previous regulatory focus has been primarily on nitrogen loading limits, but this has changed recently to include nitrogen leaching rate restrictions. Overseer based Nitrogen Leaching Allowances (NLA) now exist at six Fonterra LTS sites. Specific numerical nitrogen leaching limits on these wastewater irrigation consents adds considerable complexity to ensuring

compliance. This is primarily due to the frequent upgrades to Overseer (often twice yearly) and the number of farms involved in each LTS.

These LTS potentially operate at the limits of Overseer's predictive capability due to large daily wastewater volumes (2,000-15,000 m³/day) dictating that irrigation must occur August to May/June i.e. outside the traditional summer irrigation period, as full storage and deficit irrigation of such high daily volumes is impractical. Overseer upgrades often significantly increase predicted leaching rates, putting the factory LTS at risk of non-compliance with a NLA set using an earlier Overseer version. While the consents for three sites allow for review of the NLA when Overseer changes, a considerable amount of work is involved. At times, even before the necessary investigations are made, reported on and a decision issued by council, the next version of Overseer has been released, thus starting the cycle again. A further issue is the 5 year rolling averaging period often applied to the NLA (Freeman et al. 2016). While this averaging period is necessary to even out high and low years, five Overseer files per farm must be updated every six months when a new version of Overseer is released. If the *Best Practice Data Input Standards* (Overseer 2016) have changed, then manual alterations to input parameters are required in addition to simply opening the files in the new Overseer version.

Some regional council Land and Water Regional Plans, such as Horizon's One Plan, various Environment Canterbury catchment plans and the proposed Waikato Regional Council 'Healthy Rivers' Plan Change 1, have requirements for 'farming land use consents' in various circumstances. These consents also typically require Overseer modelling to determine likely nutrient losses from the farming system and a NLA or baseline is often set. There is the potential for substantial duplication of effort when the farm is part of a LTS and investigations have already been conducted in order to obtain the necessary discretionary wastewater 'discharge to land' consents which now always involve a detailed analysis of the LTS including the underlying farming system. In the event that two separate consents are required i.e. wastewater discharge to land plus farming land use, then it is essential that the NLAs, consent terms, monitoring and reporting requirements be consistent.

Case study – Fonterra Pahiatua land treatment system

Background

The recent expansion of Fonterra's Pahiatua factory in the Manawatu (adding a new 15 T/hour high efficiency milk drier) is a good case study to examine the issues identified (Brown 2016). The first milk drier at the Pahiatua factory began operation in 1976. A second drier was added in 1990, but the butter manufacturing plant closed in 1996, and since then the three irrigation farms comprising the LTS had been operating at around half the nitrogen loading limit of 500 kg N/ha/yr of the wastewater irrigation resource consent (# 102907) granted in August 2004.

The Horizons Regional Council One Plan and targeted 'Water Management Zones' requirements set the scene for the redevelopment and the resource consenting process. The LTS was redeveloped to include full aerated biological treatment of the factory wastewater, 100,000 m³ storage for treated wastewater and expansion of the irrigation area within the existing three farms plus the addition of a fourth farm (Fig. 1). Transformation of the two Fonterra owned farms (Tui and O'Brien) to duration controlled grazing with cow houses was planned to reduce overall nitrogen leaching losses from the LTS by 48 % (Fig. 2) (Brown, 2016).

After a full council hearing and an appeal to the Environment Court, Horizons Regional Council in October 2014 granted a thirty five year resource consent for the treated wastewater irrigation (# 106632/1, 106633/1, 106634/1, 106635/1). Conditions specific to nitrogen management in the new consent included:

1. Nitrogen loading limit of 250 kg N/ha/yr from all sources on wastewater irrigated areas
2. Combined average annual nitrogen leaching allowance (calculated by Overseer) across the four LTS farms of 28 kg N/ha/yr calculated as a five year rolling average.

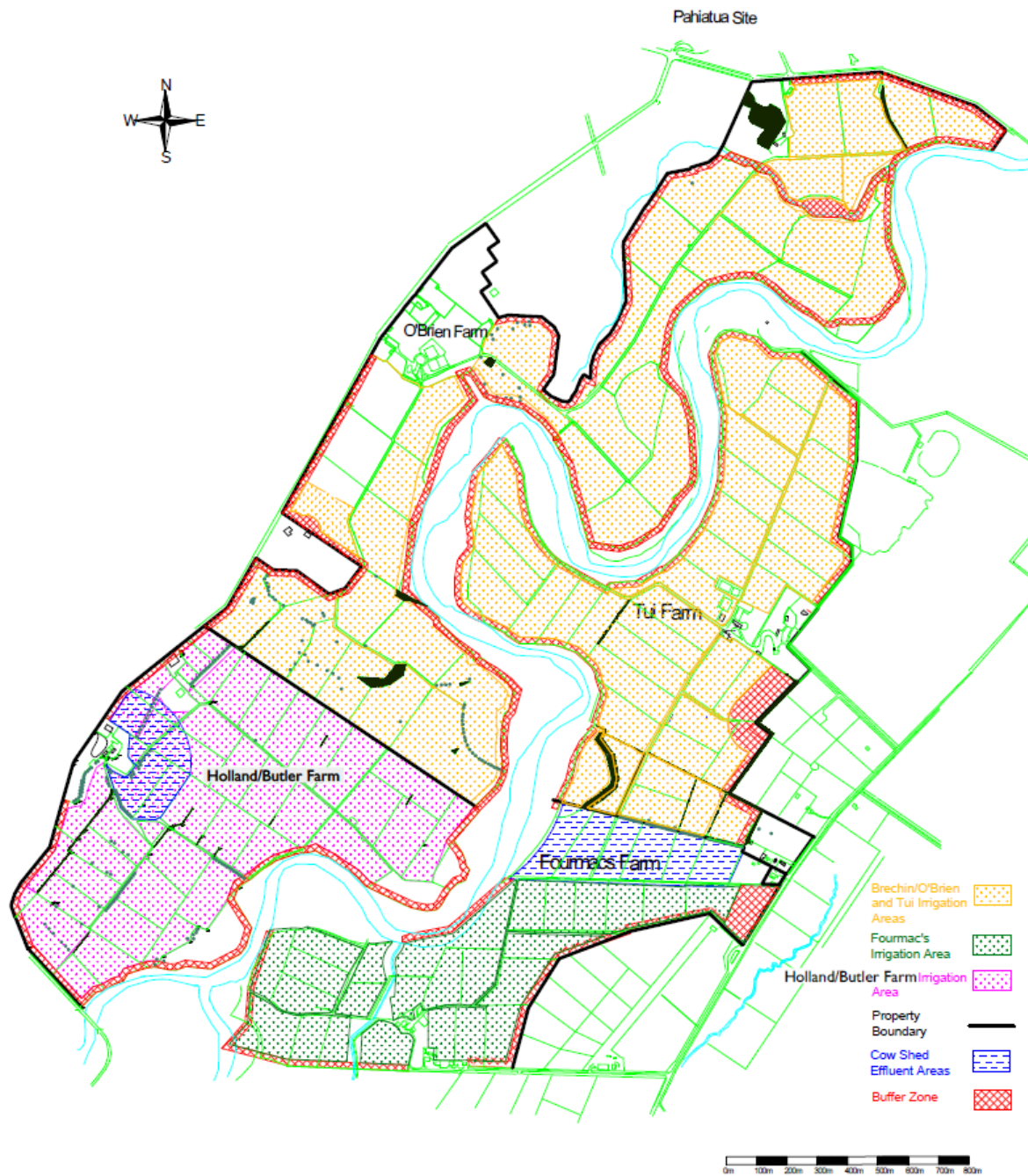


Fig 1 Fonterra Pahiatua land treatment system covering the Tui plus O'Brien farms (Fonterra owned) and FourMacs plus Butler farms (privately owned).

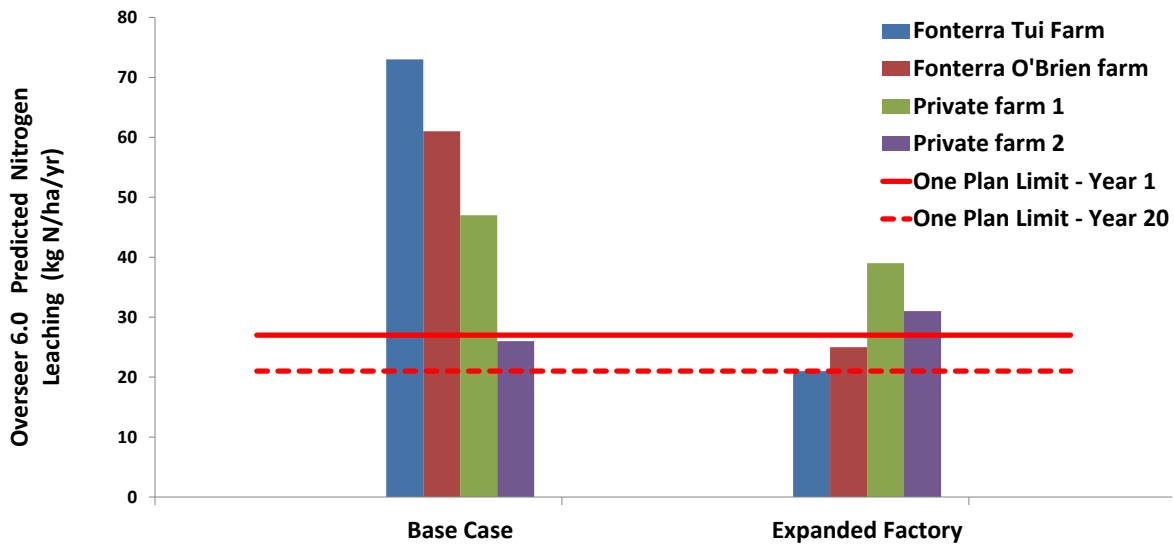


Figure 2. Predicted nitrogen leaching losses for the Fonterra Pahiatua land treatment farms as assessed in 2013 using Overseer 6.0

During construction of the new factory and wastewater treatment system, it was decided to implement an ‘extensive’ dairying system to reduce the capital expenditure associated with the proposed changes on the two Fonterra owned farms. Cow numbers were halved to around 1.3 cows/ha, existing milking sheds plus other farm infrastructure is still utilised and surplus grass is exported as ‘Cut and Carry’ silage. These alterations from the original proposal complied with the NLA using the version of Overseer current at the time thus did not require a resource consent variation.

Influence of Overseer upgrades

Wastewater irrigation consent NLA files

Initial pre-consenting investigations used Ovr 5.4.11, with the consent application and decision using Overseer v6.0. There have been a further eight Overseer versions (6.1, 6.1.1, 6.1.2, 6.1.3, 6.2, 6.2.1, 6.2.2 & 6.2.3) since then. While most Overseer upgrades have altered the outputs slightly, v6.2.0 and then v6.2.2 resulted in substantial changes. The outcomes for the formal NLA reviews for v6.2.0 and v6.2.2, plus new data for v6.2.3 are shown in Table 1.

Changes to the individual farm files and the four-farm NLA are also shown graphically in Figure 3. There was a 6-38% increase for v6.2.0 accompanying the major upgrade to the model’s sub-routines for irrigation and soil drainage. The increase was understandably greatest for the Tui and O’Brien farms which are irrigated to a greater degree.

When v6.2.2. was released the increase above the base v6.0 NLA files was substantial at 23-57%. For v6.2.2 the four-farm NLA was revised up to 38 kgN/ha/yr, an increase of 36% above the original figure.

Table 1. Fonterra Pahiatua land treatment systems nitrogen leaching allowance reviews

Farm	Area (ha)	Farm Type	'Whole farm' Nitrogen Leached (kgN/ha/yr)				
			Overseer Version				
			6.0	6.2.0	6.2.2	6.2.3	One Plan ¹
Tui	109	DCG ²	21	29	33	24	20
O'Brien	167	DCG ²	25	31	34	18	21
FourMacs	92	Dairy	39	45	50	49	20
Butler	106	Dairy	31	33	38	38	23
Four-farm NLA³			28	33	38	30	-

¹ Horizons One Plan year 20 requirement for each farm.
² Duration controlled grazing
³ Area weighted average N leached for four farms in combination

The new v6.2.3 has had little effect on the two private dairy farms, however there has been a dramatic drop for the two Fonterra farms. For the O'Brien farm the v6.2.3 result drops to 18 kgN/ha/yr which is lower than the original v6.0 value. These large fluctuations, both positive and negative, suggest that the modelled farm systems are significantly outside the original farm-let studies used for Overseer calibration and that the predictive capability of the model is being challenged in this instance.

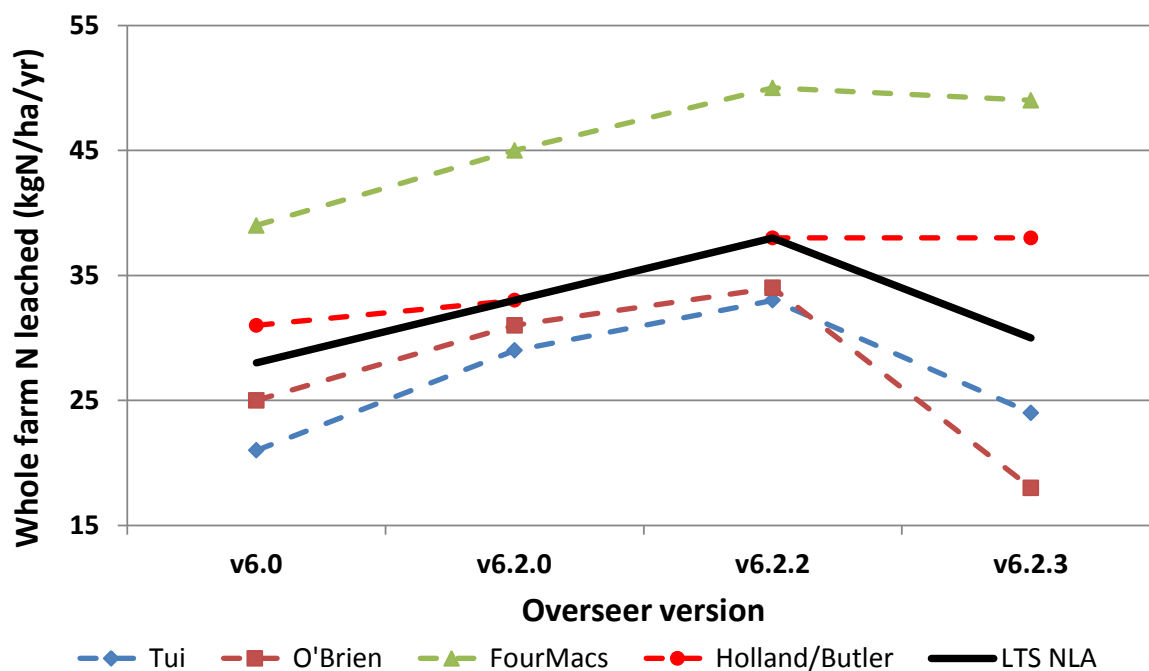


Figure 3. Changes to the individual farm files used for consenting and the overall land treatment system four-farm NLA with successive versions of Overseer.

As outlined above, following the granting of the wastewater irrigation consent and during the factory expansion, it was decided to investigate an ‘extensive’ dairying system with around 1.3 cows/ha and export of excess grass as silage on the Fonterra owned properties (Tui and O’Brien). Modelling of these farm system alterations showed compliance with the NLA using v6.0, therefore the farm system changes were implemented.

Horizons ‘consent to farm’ files

The Pahiatua LTS lies in the Mangatainoka river catchment which drains to the Manawatu River. The catchment comprises a ‘targeted water management zone’ under the One Plan. As the LTS farms fit within the Plan’s definition of *intensive agriculture* a ‘consent to farm’ is also required for each farm. The baseline season for these farm consents is 2012/13 for which an Overseer file is constructed (different from the 2010/11 & 2011/12 irrigation consent baseline). If the farm nitrogen losses are higher than those allowed via the One Plan (Table 1) a ‘restricted discretionary’ farm consent is required and the application must show farm system alterations that will decrease nitrogen losses downwards towards the One Plan targets.

The 2012/13 baseline results for the Fonterra Tui and O’Brien farms, together with those for the extensive dairy systems are detailed in Table 2. For O’Brien in 2016/17 the losses will decrease by nearly 50% from the 2012/13 baseline and will be at the level of the farm v6.2.2 NLA file. For the Tui farm the originally proposed 2016/17 policy farm file, which equalled the NLA file value in earlier Overseer versions, gave 46 kgN/ha/yr with v6.2.2, thus a further endeavour to reduce wastewater nitrogen loading rates by 50 kgN/ha/yr was offered to drop to the NLA file value.

Unfortunately with v6.2.3 the NLA file values (farm system = DCG) have dropped substantially, whereas those for the alternative ‘extensive dairy’ farming system have remained static. This will mean that while compliant under v6.2.2, under v6.2.3 compliance is uncertain. Also, while the NLA file results edge closer to the One Plan targets, the results for the actual extensive dairy system do not.

Compliance administrative load.

The wastewater irrigation consent NLA limit is assessed as a five year rolling average. Thus formal assessment with the NLA cannot occur until September 2020. This will involve 20 annual Overseer files (5 years x 4 farms) all of which must be updated to the latest version of Overseer and any changes required by the *Data Input Standards*.

However to track likely compliance, the interim period will see all existing farm files updated for each new Overseer version. Added to this will be the four individual farm NLA files, plus four forecasting nutrient management plan files for the upcoming season, resulting eventually in 28 files needing to be updated every six months which represents a significant administrative burden for processing, file storage, and reporting. It is currently unclear if the farming consent 2012/13 baseline and 2016/17 policy files will also require updating, if so it would bring the total to 36.

Table 2. Farm consent nutrient modelling results

Farm	Area (ha)	Farm Type	'Whole farm' Nitrogen Leached (kgN/ha/yr)					
			Overseer 6.2.2			Overseer 6.2.3		
			Farm consent 2012/13 Baseline	Farm consent 2016/17 Policy	NLA file	Farm consent 2016/17 Policy	NLA file	One Plan ^a
Tui	109	Ext. dairy	74	(46) 33	33 ^b	33	24 ^b	20
O'Brien	167	Ext. dairy	62	33	34 ^b	33	18 ^b	21
FourMacs	92	Dairy	46	47	50	47	49	20
Butler	106	Dairy	30	52	38	51	38	23
Four-farm Losses^c			54	40	38	40	30	21
^a Horizons One Plan year 20 requirement for each farm. ^b Duration controlled grazing ^c Area weighted average N leached for four farms in combination								

Comparison to Horizon's 'One Plan' targets

The One Plan contains targets for compliance at Year-20 of its implementation. These targets are not automatically subject to review in the event of changes in Overseer.

Originally, for the two Fonterra farms, the DCG systems would have immediately dropped their individual leaching to near the One Plan Year-20 limits. However, the gap to the Year-20 requirements increased substantially with v6.2.0 and again with v6.2.2. Did this mean that the original modelling underestimated the real nitrogen leaching losses and that extra mitigation, beyond the 48% decrease in losses, was required? The answer is now no according to the revised v6.2.3 NLA Tui and O'Brien farm files which have dropped to below the Year-20 limits. But is compliance now assured and will the picture change significantly again with future Overseer upgrades?

The implementation of the 'extensive dairying system' on the Fonterra farms has made the picture more complex. As noted above, originally this system was equivalent in N-leaching losses under the Overseer version at the time. While the DCG system results have gone up and most recently down, results for the extensive dairy system have increased and not come down. The gap between the Year-20 limits and the farming system now implemented is large.

One potential pathway forward nationally ...

At the time of writing (Feb 2017) a minor variation to the wastewater discharge consent is in preparation for the Pahiatua wastewater discharge consent to swap the original DCG files used for the NLA to the extensive dairying files for Tui and O'Brien farms. This will negate the issue of future Overseer upgrades resulting in differing rates of change for the originally

proposed DCG system versus alteration to the extensive dairy farming system. However, the gap between the four-farm average and the eventual One Plan requirements remains.

On a nationwide basis, for renewals of existing or new industrial discharge consents for LTS the following system may be appropriate;

1. Classify LTS as industrial point source discharges irrespective of the underlying farming system.
2. Require a discretionary resource consent for the LTS i.e. covering both the wastewater irrigation discharge to land and the underlying farming system.
3. Have the Overseer NLA reviewable for when Overseer version changes occur.
4. Have the NLA as an 'Objective' rather than a fixed limit.
5. Require additional review clauses in the consent
 - a. If the NLA is exceeded by 20% in any year
 - b. If the NLA is not achieved for three consecutive years

Requirements based on those above have recently been added to the resource consents for the Fonterra Reporoa and Lichfield Waratah/Anchor farms with Waikato Regional Council.

Conclusion

The implementation of nitrogen leaching allowances in resource consents for land treatment systems is made complex by frequent Overseer upgrades changing the model outputs and the administrative load associated with calculating five year rolling averages for systems which may involve 4-12 individual farms.

In the case of the Fonterra Pahiatua wastewater irrigation system, the need for 'farming consents' under Horizon's One Plan has added a further layer of complexity.

A potential pathway forward has been identified where the farming activity is bundled with the industrial wastewater irrigation activity and the combined system classed as a point source discharge. A nitrogen leaching allowance is still utilised, however it is reviewable and becomes an 'Objective' (rather than a fixed limit) but with additional consent review clauses should individual annual results be significantly higher or if the objective is not achieved for three consecutive years.

References

- Brown, J.N., (2016). Improving nutrient management for dairy factory wastewater land treatment systems. In: *Integrated nutrient and water management for sustainable farming*. (Eds. L.D. Currie and R. Singh). <http://flrc.massey.ac.nz/publications.html>. Occasional Report No. 29. Fertilizer and Lime Research Centre, Massey University, Palmerston North, New Zealand. 6 pages.
- Freeman, M., Robson, M., Lilburne, L., McCallum-Clark, M., Cooke, A., & McNae, D. (2016). *Using OVERSEER in regulation – Technical resources and guidance for the appropriate use of OVERSEER by regional councils*, August 2016. Report prepared by Freeman Environmental Ltd for the OVERSEER Guidance Project Board.
- Overseer (2016). *Overseer best practice data inputs standards, Overseer Version 6.2.3*. Overseer Ltd, November 2016. ISSN 2463-5839.