BEFORE THE NORTHLAND REGIONAL COUNCIL

under:	the Resource Management Act 1991
in the matter of:	Resource consent applications by the Motutangi-Waiharara Waters Users Group for new groundwater takes from the Aupouri aquifer subzones: Houhora, Motutangi and Waiharara

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Statement of evidence of **James Mitchell Blyth** for the Director-General of Conservation

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(Wetland hydrology)

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STATEMENT OF EVIDENCE OF JAMES BLYTH

INTRODUCTION

1 My full name is James Mitchell Blyth

2 I am employed by Jacobs New Zealand Ltd, an engineering and environmental consulting firm. I am contracted to provide wetland hydrology expertise on resource consent application REQ-581172 to the Department of Conservation (DOC). I hold a Master of Science (MSc) Degree with first class Honours from the University of Waikato.

3 I am a Certified Environmental Practitioner (CEnvP) under the Environmental Institute of Australia and New Zealand (EIANZ).

4 I am familiar with the Kaimaumau wetland to which these proceedings relate. I have recently completed a wetland hydrological investigation and designed a water level monitoring programme for DOC in the western Kaimaumau-Motutangi Wetland, for the purposes of understanding wetland hydrology to help plan long term restoration goals.

5 I have worked on numerous wetland projects around New Zealand, with some of these described below;

- Whangamarino Wetland – 16 month MSc investigation on the impact of a flood control regime on wetland eco-hydrology, and ongoing project work relating to water balance modelling, weir operation on minimum water levels and adaptation of flood gate controls to improve wetland health.

- Kaimaumau-Motutangi Wetland (Northland), Moawhitu Wetland (D'Urville Island), Awarua Wetland (Southland) – wetland hydrological assessments, monitoring programme design for restoration planning.

- Otakairangi Wetland (Whangarei) - Wetland hydrological assessments and monitoring programme design as part of a wider catchment and ecosystem restoration programme.

CODE OF CONDUCT

6 I have read and agree to comply with the Code of Conduct for Expert Witnesses produced by the Environment Court and have prepared my evidence in accordance with those rules. My qualifications as an expert are set out above.

7 I confirm that the issues addressed in this brief of evidence are within my area of expertise.

8 I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

9 My evidence will address the following subjects:

- Eco-hydrological function of Kaimaumau-Motutangi Wetland (herein referred to as ‘the wetland’) based on current knowledge
- DOC’s hydrological monitoring programme and restoration goals
- Trends in water level data from the hydrological monitoring programme over the last 8 months
- Consideration of the Draft Guidelines for Ecological Flows and Water Levels referenced in the consent application
- Uncertainty in the assumptions on the wetland’s isolation from groundwater inputs

1. KAIMAUMAU WETLAND DESCRIPTION

10 The Kaimaumau/Motutangi wetland complex covers an area of some 1850 ha of which 955 ha is designated as Scientific Reserve and the remaining is Conservation Area. Scientific Reserves afford the highest level of protection of all reserves managed under the Reserves Act 1977.

11 The wetland is located on the Aupouri Peninsula and extends from just south of Houhora Heads to the mouth of the Rangaunu Harbour, a distance of almost 15 km. It is the only freshwater wetland exceeding 1000 ha in Northland and is nationally recognised for its outstanding natural values, discussed further in the evidence of Ms Shona Meyers.

12 Locally, the wetland is ranked 2nd (from 255 sites) in the Northland Region[i] (Wildlands 2011) based on a weighted ranking system that considers a total of eight attributes including size, threatened species, hydrological integrity and representativeness.

2. ECO-HYDROLOGY OF KAIMAUMAU WETLAND

13 The wetland geomorphology and hydrology has been well described in Hicks *et al*. 2001[ii].

14 The wetland has a complex mosaic of hydrological functioning, due to the interspaced sequences of sand dune ridges covering a wide area. Underneath the wetland, an iron pan is present which maintains water levels and promotes peat establishment in some areas, however for reference, its continuity has not been confirmed with field based measurements.

15 Throughout this mosaic, a variety of wetland types are present, such as:

- Fens, which may have surface and/or groundwater inputs and moderate or low levels of nutrients, but are hydrologically connected to sources other than direct rainfall. These areas often have water levels at or close to the ground surface and a mixture of vegetation species such as sedges, restiads, flaxes and rushes (i.e. *Machaerina spp*). They are wet all year round and are often important areas for rare species such as bitterns, fernbirds and black mudfish.

- Bogs, primarily fed by rainfall with low nutrient inputs that promote the development of unique vegetation and peat forming species such as *Empodisma minus*, *Gleichenia dicarpa* (tangle fern) and *Sphagnum* mosses. These areas have water tables below the ground surface. In areas subject to degradation (e.g. drainage) they are susceptible to an invasion of dryland species.

- Swamps (Johnson and Gerbeaux 2004)[iii] characterised by surface, rain and groundwater inputs with higher levels of nutrients and minerals and often have greater fluctuations in their water levels. These areas are usually located near drains and streams which are regularly inundated from flooding and lead to the promotion of invasive and weedy vegetation's species, but also natives such as Flax, Raupo, Manuka and various rush species.

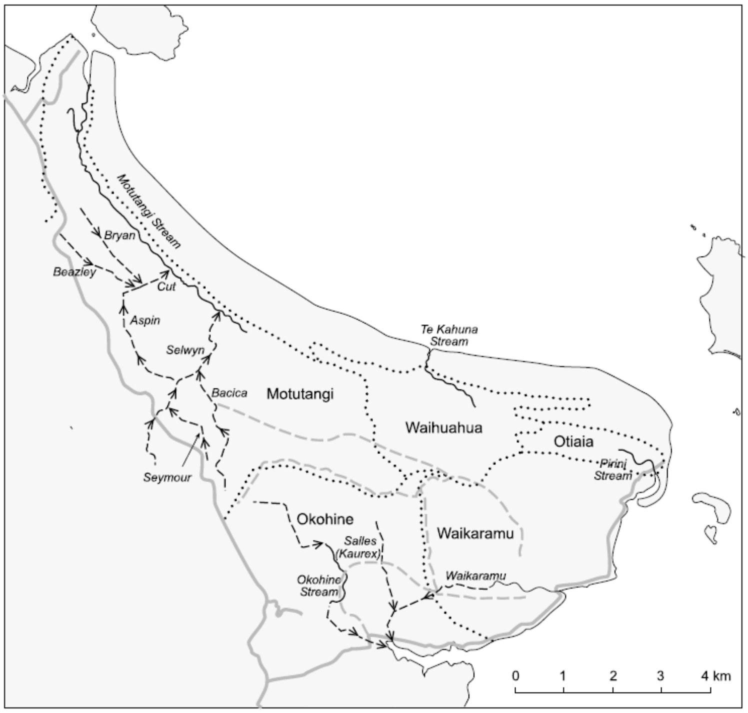


Figure 1. Kaimaumau Wetland complex stream and drainage network (Hicks *et al.* 2001).

16 These wetland types above can be subject to degradation from drainage, such as the Selwyn, Bacica and Seymour drains in **Figure 1**). Changes in water sources, including a decline in groundwater, will also effect wetland hydrology and lead to dryland plant invasion. Some of the dryland invasive species include Manuka, *Hakea sericea, Acacia longifolia* (Sydney golden wattle) and common Gorse. Once established, these species can further contribute to peat degradation due to increased water uptake lowering water levels and oxidising peat.

3. KAIMAUMAU WETLAND HYDROLOGICAL MONITORING PROGRAMME AND RESTORATION GOALS

17 The wetland falls under DOC's national freshwater Stretch Goal: 50 freshwater ecosystems are restored; from mountains to the sea. The stretch goals provide a 10-year focus for the organisation, and are considered nationally significant in terms of achieving the Department's goals to protect and enhance natural heritage for the benefit of all New Zealanders (DOC 2016)[iv].

18 Jacobs were engaged by DOC in 2017 to undertake a study of the Kaimaumau-Motutangi Wetland complex. The purpose of the study was to assess potential drainage impacts from the Selwyn, Bacica and Seymour drains (see **Figure 1**) and characterise the local hydrological functioning of this area of the wetland.

19 The goals of the Department of Conservation are to suitably understand the wetland hydrological condition, and use this

information to inform long term restoration goals that will reduce drying of the wetland and promote new development of peat and native vegetation growth in appropriate areas, and to protect rare and threatened species (refer evidence of Shona Myers).

20 Following scoping site visits and ground truthing with Jacobs and DOC staff, nine water level monitoring sites were selected (see **Figure 2**). Six of these were positioned along two transects of significant interest that were identified due to:

- The presence of a large standing water body and unique vegetation species such as *Machaerina* rushes and small raupo stands, and a water table at or above the surface (Transect 1). This location also has significant lateral drainage out of the wetland into the drain, visibly flowing at numerous locations. A large standing water body is evident in **Figure 2**, which runs for up to 3.5 km to the East (crossing into the Waihuahua area in **Figure 1**), with no obvious surface water inputs.

- The presence of a bog/peatland which has invasion of shrubland vegetation species and a water table below the ground level. Dryland vegetation invasion decreases with increasing distance perpendicular to the drain (Transect 2)**.**

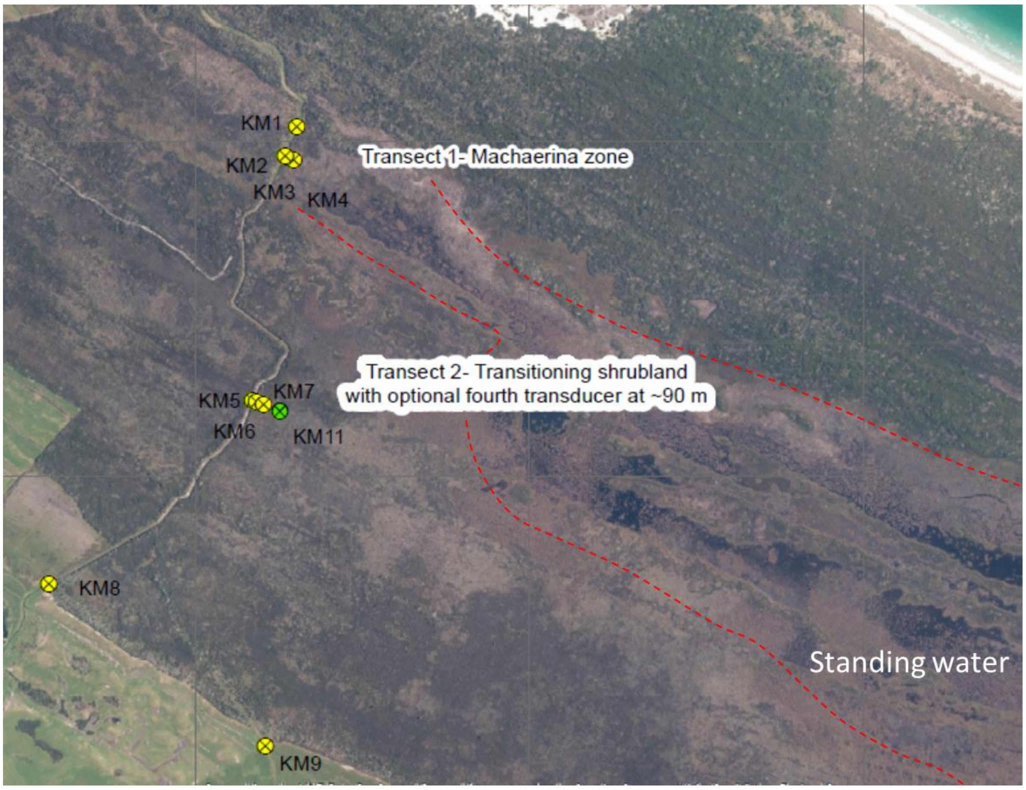


Figure 2. DOC water level monitoring sites in the Kaimaumau-Motutangi wetland and standing water to the east of KM4.

4. TRENDS IN WATER LEVEL MONITORING DATA FROM KAIMAUMAU-MOTUTANGI OVER THE LAST 8 MONTHS

21 Water level monitoring began at all sites on 27 June 2017. The most recent download of data was collected on 10 March 2018, providing ~8 months of 30-minute water level records.

22 Daily rainfall at the wetland has been sourced from the Northland Regional Councils Waihopo Rainfall Station at Kimberley Road, ~16 km NW of the monitoring transects.

23 Analysis of water level records has been presented for two sites, KM4 (**Figure 3**) and KM7 (**Figure 4**). KM4 is located on Transect 1 within the saturated zone, and is ~30 m from the drain. KM7 is located on Transect 2, and is ~30 m from the drain.

24 The water levels in **Figure 3** and **Figure 4** are presented with an arbitrary datum which has been estimated while sites are awaiting surveying. The purpose of these figures are to present the water level fluctuations and variations over the duration of the monitoring period.

25 **Table 1** presents the water level ranges for each of these sites over ~8 months of monitoring.

Table 1. Water level range at KM4 and KM7 over ~8 months of monitoring (June 2017 to March 2018).

Site Name	Max WL (m)	Min WL (m)	Range in WL (m)
KM4	8.19	7.94	0.25
KM7	7.64	7.11	0.53

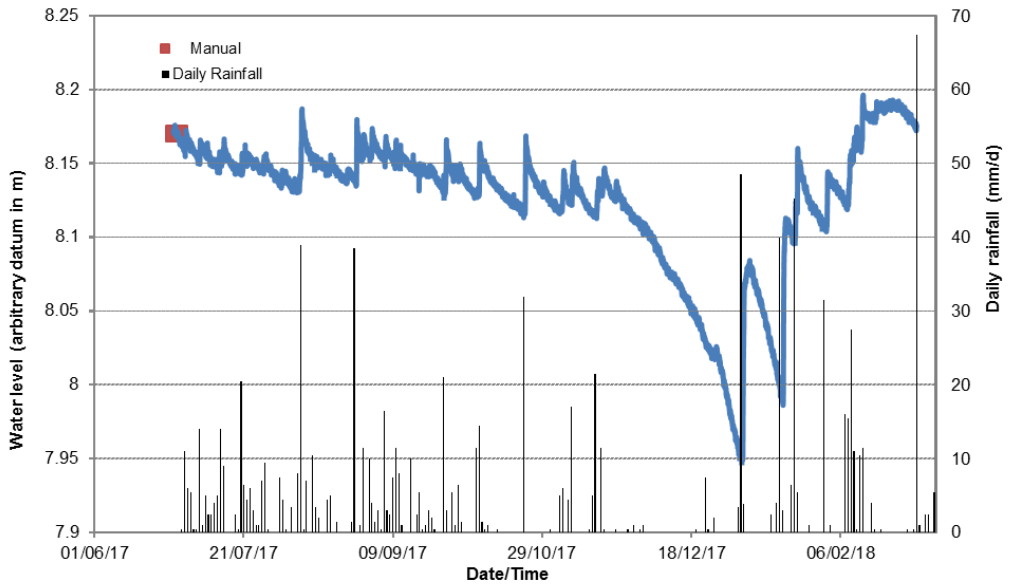
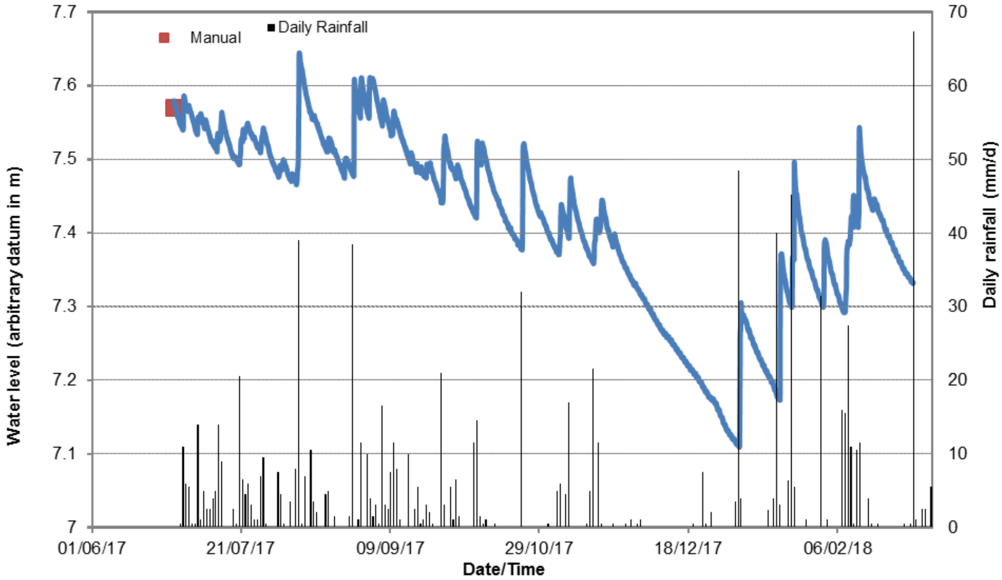


Figure 3. KM4 water levels and daily rainfall in Transect 1.



26 Examination of the Waihopo Road daily rainfall data against NIWA long term monthly averages for Kaitaia was undertaken for the last three months of 2017 (October to December), when a large part of the North Island was subjected to significantly low rainfall. Over this period in 2017, ~155.5 mm of rainfall fell at the wetland, while the typical average rainfall total would be ~265 mm (Chappell 2013)[v]. This represents a ~41% decrease from three-month average rainfall totals.

27 **Figure 3** and **Figure 4** show similar responses in water levels to rainfall. However, the saturated zone (KM4, Transect 1) has a low fluctuation in water levels of ~25 cm over 8 months, while the successional peatland in Transect 2 has a variation of ~53 cm (see **Table 1**).

28 The water level fluctuations of between 0.4–0.6 m in Transect 2 is more typical for a peatland fed by rainfall and corresponds with annual ranges exhibited in other restiad bogs (i.e. Whangamarino wetland restiad bog fluctuated 0.63 m over a year in Blyth *et al.* 2012)[vi]**.**

29 The water level fluctuations in Transect 1 however are smaller and buffered by the large standing water body. Only a ~0.2 m decline in water levels was observed over the three-month period from October to December.

30 Given these results, this data suggests two possibilities:

- The standing water body to the east of the Selwyn drain (see **Figure 1**) and Transect 1 has a significant amount of storage capacity to hold rainfall and maintain water levels in the wetland even during a sustained three-month period of below average monthly rainfall, or:

- This water body has an additional source of water (i.e. groundwater) that is providing a constant source of inflow to the wetland. This may be possible through artesian upwellings in areas of dis-continuity within the iron pan, and could be located in parts of the wetland that are physically in-accessible and yet to be characterised by scientific studies.

5. CONSIDERATION OF THE DRAFT GUIDELINES FOR ECOLOGICAL FLOWS AND WATER LEVELS

31 NRC 2017[vii] S42A officers report compares the Scenario 2 (proposed abstraction) water level effects on the wetland to the proposed National Environmental Standards on Ecological Flows and Water Levels, which is supported by the Draft Guidelines for Selection of Technical Methods (MFE 2008[viii]). The MFE 2008 methods outline the required assessments necessary to determine flow and water level effects for sites of various natural significance.

32 Comment 146 of the S42A report outlines that "*the potential risk of ecological change may be defined as low where there is less than 0.2 metre change in median water level… Given the assessment provided and the likeliness of limited hydraulic connectivity between the deep groundwater and the wetland, it is considered unlikely that the proposed extraction will result in this threshold being exceeded.*

33 Williamson 2018[ix] states in paragraphs 120 to 122 that the ecological flow changes are <10% of MALF and that the degree of hydrological alteration is also considered to be low.

34 The basis of both these assumptions is on the unlikely connection of groundwater to the wetland and that the 0.2 m drawdown is unlikely under proposed abstractions. It is worth noting, that Scenario 2 has drawdown of up to 0.6 m in some locations, and that a water level change >0.3 m is considered to be a high degree of hydrological alteration in the MFE 2008 guidelines (see **Table 2**).

35 Review of **Table 2** shows a wetland significance is the first requirement to determine level of assessments. Based on section 3.1.b in MFE 2008, assessment of a significance is determined from many approaches, namely national or regional rarity, DOC databases of important wetland sites and condition. Northland Regional Council contracted Wildlands (2011) to undertake a ranking of the most important regional wetlands. Kaimaumau/Motutangi Wetland was ranked:

- No. 1 (of 10) for the Aupouri Ecological District
- No. 2 (of 20) for freshwater wetlands on dunes
- No. 2 (of 255) for all freshwater wetlands in Northland.

36 Based on the assessment above, I would characterise Kaimaumau Wetland as a high sensitivity site in **Table 2.**

37 Depending on the degree of hydrological alteration which is uncertain (as discussed in **Section 6**), a 'low' change in water levels (as defined by NRC 2017 and Williamson 2018) would require a detailed local investigation and wetland hydrological condition and modelled changes, species-environment models and habitat assessments. If the alteration was moderate (>0.2 m water level changes), then a full eco-hydrological assessment is required, including groundwater/surface water interactions.

38 In my opinion, it is not appropriate to assess the degree of hydrological alteration as 'low' based on the information the applicant has provided.

Table 2. Required assessment methods for water levels and ecological flows in wetlands (sourced from MFE 2008).

Degree of hydrological alteration	Wetlands : Significance of values		
	Low	**Medium**	**High**
Low ***(< 20 cm change)***	Historical water level records Expert panel Remote delineation of site and catchment Wetland record sheet (MfE methodology)	Historical water level records Expert panel Remote delineation of site and catchment Wetland record sheet (MfE methodology)	Detailed local delineation Wetland hydrological condition assessment and model change (MfE methodology) Species-environment models Habitat assessment Water quality modelling
Medium ***(20–30 cm change)***	Historical water level records Expert panel Remote delineation of site and catchment Wetland record sheet (MfE methodology)	Detailed local delineation Wetland hydrological condition assessment and model change (MfE methodology) Species-environment models Habitat assessment Water quality modelling	Full ecohydrological assessment Groundwater /surface water interaction Process-based water quality models Microtopographic survey
High ***(> 30 cm change)***	Detailed local delineation Wetland hydrological condition assessment and model change (MfE methodology) Species-environment models Habitat assessment Water quality modelling	Full ecohydrological assessment Groundwater /surface water interaction Process-based water quality models Microtopographic survey	Full ecohydrological assessment Groundwater /surface water interaction Process-based water quality models Microtopographic survey

6. UNCERTAINTY IN ASSUMPTIONS ON THE WETLANDS ISOLATION FROM GROUNDWATER INPUTS

39 The WWA 2017a[x] consent application describes the effects on the Kaimaumau Wetland in Section 3.3.2. Under Scenario 2 (proposed abstraction), there is potential to have mean annual low flow discharges reduced by up to 7%, and 5-year low-flow discharges by 11%. This is stated as having <u>minor</u> impacts on wetland flows.

40 Correspondingly, a reduction in flows would also reduce wetland water levels, further exacerbating drainage and residual fire impacts and directly impacting DOC's conservation goals for the wetland. The modelled drawdown in water levels presented in WWA 2017b Figure 30 indicate that under the proposed abstraction (Scenario 2), shallow aquifer drawdown of 0.2 m could occur across a large portion of the wetland, with localised drawdown of up to 0.6 m east of Srhoj Road near the Honeytree proposed groundwater bores. This is supported by NRC 2017.

41 I question the reliability of the Scenario 2 shallow aquifer water level drawdowns, as Figure 5 in WWA 2017b shows the piezometers used for the calibration of the groundwater model are concentrated in the north of the model domain, with no calibration sites around the wetland. There is potential for the simulated impacts to be greater than 0.2–0.6 m (Figure 30). This is further discussed in evidence from Mr Timothy Baker.

42 Should a reduction in water levels in the wetland occur, this will continue to promote dryland invasion of peatlands by weeds and dryland shrub species. This is further addressed in evidence from Ms Shona Meyers.

43 WWA 2017a states that the groundwater model likely exaggerates the effects at the surface, as it does not capture the separation of the shallow and deep aquifer from the hardpan (iron pan). Thus the flow and water level reductions simulated under Scenario 2 are considered as conservative. This assumption assumes continuity of the hardpan below the wetland, which currently has not been verified.

44 WWA 2017b[xi] Section 2.3 describes the hydrogeological conceptualisation of the Kaimaumau Wetland and references Hicks *et al*. 2001. In summary, this section states:

- The wetlands hardpan as being a flow barrier to both upward and downward movement of groundwater.

- The presence of an artesian aquifer beneath the wetland, from which recharge by groundwater could be possible when the buried hardpans are eroded or breached, of which there is currently no evidence of this occurring.

- That if this groundwater-surface water connection was occurring in the wetland, groundwater extraction from the shellbed aquifer may reduce up-flows to the wetland and thus impact on the water levels and flows within the wetland. For this reason, a radon isotope study was undertaken.

45 WWA 2017a summarises that the radon study shows it is unlikely there is a connection of groundwater to the surface drains or the wetland itself. This is further described in Section 2.3.1 and Figure 3 within WWA 2017b, and NRC 2017 states the reporting officer concurs with this assessment.

46 Evidence from Mr Timothy Baker discusses radon sampling in more detail, however a high level review of the sampling sites show only one sample was retrieved within the wetland to the South East, at Salles Upstream. **Figure 2** identifies the standing water body within the centre of the wetland, which would be the most likely source for artesian groundwater sources. This area has not been sampled as part of the Radon investigation, and its highly likely no field investigations have been conducted here (including Hicks *et al.* 2001) due to the limited access and presence of the ‘standing water

body'. See **Figure 5** for more detail of the sampling sites in the radon Study.

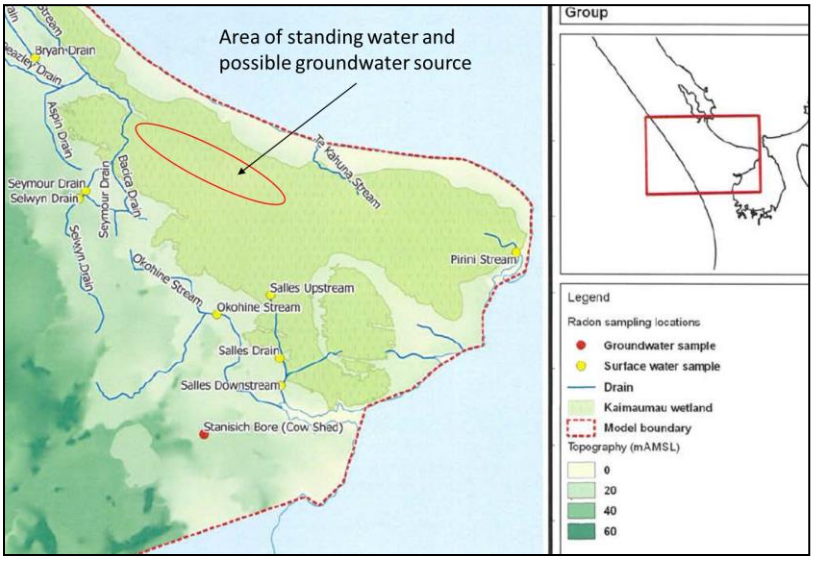


Figure 5. Radon sampling locations and indicative area of standing water and potential artesian groundwater source (adapted from WWA 2017b).

47 Based on the evidence presented above that it appears the wetland maybe connected to groundwater, then the application for this water take identifies that there could be an effect on wetland water levels and flows, and in my opinion the effects could be considered to be greater than minor.

48 Evidence presented by Williamson, 2018 states in paragraph 125 (b) that fens are minerotrophic and develop over centuries to bogs. The location of the fens (i.e. Transect 1) is stated to be a zone where surface water from the Selwyn, Seymour and Bacica Drains pass through the wetland, and that the vegetation change at this location is due to surface water and rainfall influences only.

49 In my opinion, this statement is incorrect. **Figure 2** and water levels in **Figure 3** identify the standing water body, from which there is no evidence of surface water sources. Water is draining from east to west at this location, into the drain. Under large floods, the drain may be overtopped, however if this was to occur it would most likely be at the inlet of the wetland, near the confluence of the Bacica and Seymour Drains, ~1.2 km upstream of Transect 1 (see **Figure 1**).

50 In addition, the drain is excavated regularly to maintain conveyance, for the purpose of reducing flooding in upstream farmland. The channel is straight with a noticeable gradient, typically 3 m wide and on the true right, a berm >3 m above the drain bed has built up over time from repeated excavations. If flooding was to occur, the true left of the drain is open and of lower elevation, and would be more prone to flood inundation.

51 Analysis of the drain logger at KM2 (Transect 1) shows the water levels in the drain fluctuated 1.18 m over an 8-month period.

Through winter when rainfall and water levels are greatest, the fluctuation in the drain is a maximum of 0.66 m. Flooding into the wetland would be represented by a flattening of the hydrograph peaks as water overtopped the banks, which is not exhibited in **Figure 6**, despite the two peak daily rainfalls of 48.5 and 67.5 mm over this period.

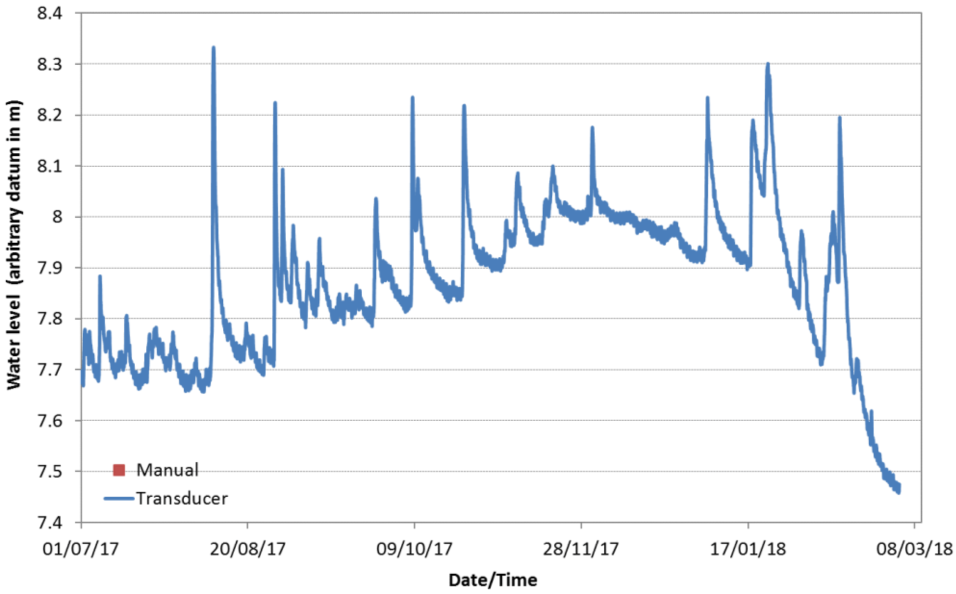


Figure 6. KM2 drain water levels over 8 months (July 2017 to March 2018).

7. CONCLUSION

52 The wetland is a nationally significant site, and has a restoration goal that the Department of Conservation instigated in June 2017 with the establishment of a hydrological monitoring programme.

53 Kaimaumau/Motutangi is ranked No.2 of 255 for wetlands of significance in the Northland Region (Wildlands 2011).

54 Significant areas of the wetland are peatlands and are fed by rainfall as their sole hydrological inputs, however a large portion near the centre of the wetland is saturated with standing water that may be present due to external groundwater inputs from artesian heads.

55 Currently, in my opinion, there is uncertainty around the connectivity of the wetland to artesian groundwater sources, particularly in the areas identified in **Figure 2** and **Figure 5**, and characterised with low water level fluctuations of only 25 cm over 8 months at KM4 (**Figure 3**). This area of standing water is expansive, and if abstraction reduces groundwater recharge to the wetland then the

impacts would be over a wide area and may lead to significant, degrading changes in ecological values.

56 The current groundwater modelling and consent application do not prove the continuity (or dis-continuity) of the hard pan below the wetland, that could isolate groundwater upwelling. Nor does Radon sampling sufficiently address potential groundwater sources due to inadequate sampling within the wetland.

57 The proposed abstraction scenario (Scenario 2) shows water level drawdown of 0.2 m and up to 0.6 m in certain areas of the wetland. Under the MFE 2008 draft guidelines, arguably this site of high significance requires a more focussed investigation to prove groundwater-surface water interactions and to better understand the eco-hydrology of the wider wetland.

58 Therefore, I believe further investigation is required to address uncertainty around groundwater connectivity, which should include:

- additional radon sampling at a number of locations within the standing water body, which would be necessary due to the uncertainty around where the groundwater upwelling could be occurring.

- water balance modelling of the wetland, using accurate LIDAR survey information to develop stage storage data (coupled with ground truthing). This model would need to be calibrated to water levels and flow at KM1 (drain) and water levels at KM4 and KM7. Flow gauging would need to be undertaken to develop rating curves at KM1 and potentially KM8, to develop daily flow timeseries of inflows and outflows. This model could help verify if rainfall recharge is sufficient to maintain the water levels at KM4 and the large standing water body present throughout the year.

- local groundwater investigations around and within the wetland, described further in evidence from Timothy Baker.

59 Until these investigations occur and the uncertainty relating to the potential for significant hydrological adverse effects is addressed, it is my opinion that this application is declined.

James Blyth
19 March 2018

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[i] Wildlands Consultants, 2011. Ranking of Top Wetlands in the Northland Region. Stage 4 – Ranking for 304 Wetlands. Prepared for Northland Regional Council, Report No. 2489.
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[iv] DOC, 2016. Statement of Intent 2016-2020.

[v] Chappell, P.R, 2013. The Climate and Weather of Northland. NIWA Science and Technology Series, Number 59, ISSN 1173-0382.
[vi] Blyth, J.M., Campbell, D.I. & Schipper, L.A, 2012. Utilizing soil indicators to explain historical vegetation changes of a peatland subjected to flood inundation. *Ecohydrology*, DOI:10.1002.1247.
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[viii] MFE, 2008. Draft Guidelines for the Selection of Methods to Determine Ecological Flows and Water Levels. Prepared by Beca Infrastructure Ltd.
[ix] Williamson, J, 2018. Statement of Evidence for the Motutangi-Waiharara Water User Group. 12 March.
[x] WWA, 2017a. Irrigation Water Supply Groundwater Take Consent Application. Motutangi Waiharara Water User Group. WWWA0026.
[xi] WWA, 2017b. Motutangi-Waiharara Groundwater Model Factual Technical Report – Modelling. Motutangi Waiharara Water User Group. WWWA0026