



technical memorandum



TO	Pukerua Property Group LP	FROM	Jacob Howarth
		DATE	2 October 2026
RE	Mount Welcome – Offset Wetland Hydrological Assessment		

1.0 Introduction

1.1 Background

Pukerua Property Group LP (PPG) is seeking fast-track consent for a residential subdivision near Pukerua Bay, known as Mount Welcome. The Mount Welcome site is located at 422 State Highway 59.

The original application included what the Applicant considers to be the preferable stormwater design, which included ecological offsetting within stormwater detention devices, where existing natural wetlands already occur in the Taupo and Kakaho West catchments. During the fast-track consenting process it has become clear that the various regulators would prefer that the stormwater and ecological functions remain separate, so the Applicant has identified a series of alternative offset wetlands within the Kakaho East catchment, which forms part of the upper Kakaho Stream catchment (see Figure 1 for location).

This memorandum includes a high-level hydrological assessment of the proposed offset wetlands, to understand whether the hydrological setting of these areas can sustain wetland conditions in the long term. It builds on the existing hydrological understanding developed for the wider Mt Welcome site (PDP, 2025).

1.2 Aim

The specific aims of this memorandum are to:

- ✧ Assess the hydrological setting of the proposed offset wetland areas;
- ✧ Develop a conceptual hydrological model for the proposed offset wetlands;
- ✧ Undertake a high-level water balance assessment of the proposed wetlands; and
- ✧ Assess whether the proposed offset wetlands are hydrologically feasible.

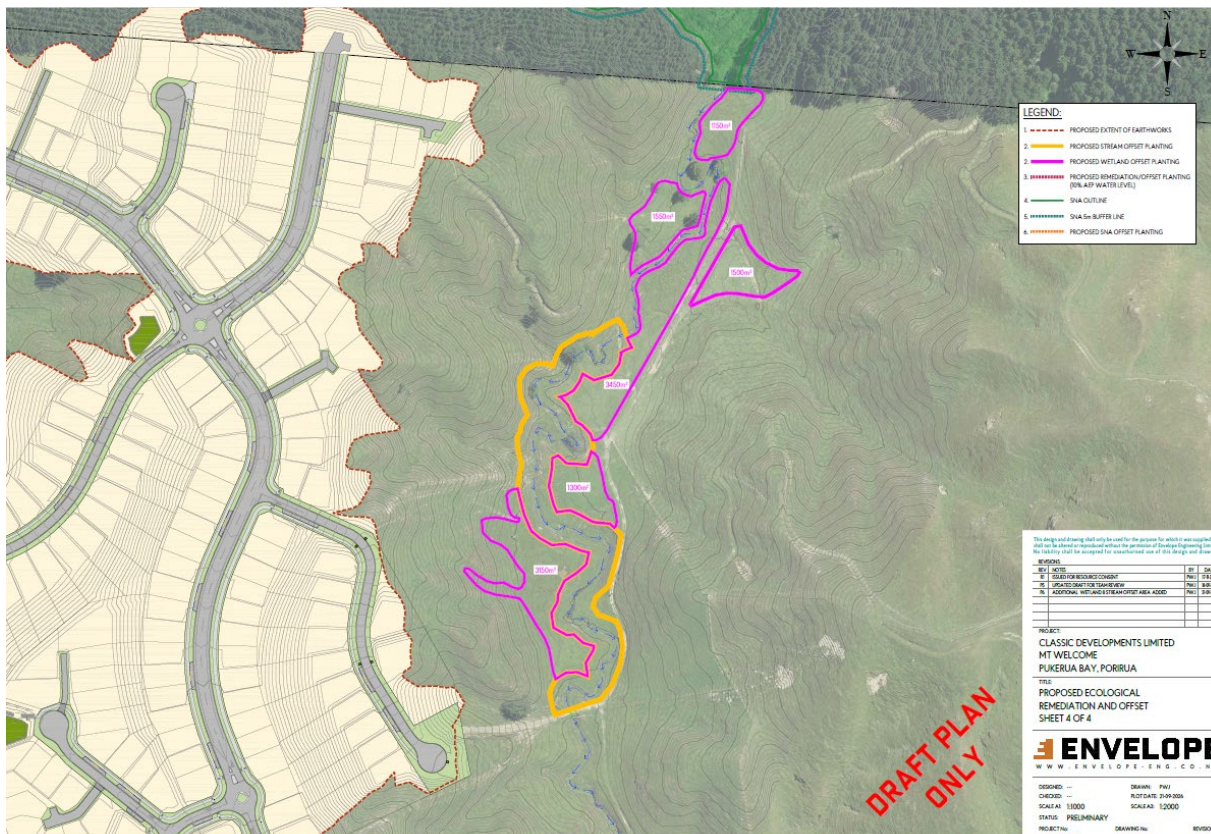


Figure 1: Alternative Additional Wetland Offset Areas, in pink (Envelope Engineering drawing 1753-020SK9204-P6)

2.0 Site Description

A desktop assessment was undertaken using the available information for the proposed offset wetland areas and wider Mount Welcome site. The key aspects of the hydrological setting are summarised below.

2.1 Topography and Catchment Setting

Mount Welcome is characterised by steep greywacke hills dissected by a series of incised gullies and valley systems. The proposed offset areas follow the valley floor and associated drainage features, where surface runoff from the surrounding hillslopes naturally converges and flows towards the Kakaho East Stream.

Streams within the gullies at the site are predominantly ephemeral and respond rapidly to rainfall, reflecting the steep topography and low permeability of the underlying geology. However, the stream adjacent to the offset areas in the Kakaho East catchment is perennial, albeit with relatively low flow rates, due to the larger upstream catchment and localised groundwater contribution.

2.2 Geology, Soils and Groundwater

The regional geological map indicates that the offset wetland areas are underlain by greywacke bedrock of the Rakaia Terrane (Begg & Johnston, 2000). Localised alluvial, colluvial, and scree or poorly sorted gravel deposits occur elsewhere within the eastern part of the wider Mount Welcome site and may also be present in this area. Geotechnical investigations identified weathered greywacke bedrock at shallow depth across most of the site, while minor colluvium and peat deposits up to approximately 1.5 m thick were encountered within some gullies (ENGEO Limited, 2022). The presence of peat indicates conditions capable of retaining water and supporting wetland development are present in parts of the site.

No regional aquifer is identified beneath the site. Groundwater is likely to occur within fractures and weathered horizons within the greywacke, with shallow groundwater also present locally within valley-floor deposits. Seepages observed in the lower parts of the gully systems indicate that shallow groundwater may contribute to the proposed wetlands.

2.3 Climate

In the absence of site-specific climate data, rainfall has been taken from the nearest Greater Wellington Regional Council rain gauge at Taupo Stream at Whenua Tapu. The available record indicates average annual rainfall of approximately 1,040 mm/year, with the lowest rainfall generally occurring between February and May. Potential evapotranspiration has been taken from the Paraparaumu Aero climate station and indicates an annual average of approximately 936 mm/year (PDP, 2025).

3.0 Water Balance Assessment

3.1 Conceptual Model

The proposed offset wetlands are located within the upper segment of the large Kakaho East catchment. Their hydrology is expected to be supported by direct rainfall, hillslope runoff, shallow subsurface flow pathways and localised groundwater seepages that associated with weathered greywacke horizons and valley floor sediments.

A conceptual model was developed for the proposed offset wetlands to understand their hydrology. It was based on the desktop investigation and the Mt Welcome Hydrological Assessments (PDP, 2025). A water balance assessment was then undertaken and is presented below.

Wetlands have water inputs from precipitation (P), and groundwater and surface water inflows. Water outputs occur as evapotranspiration (ET), groundwater discharge and surface water outflows. These are summarised in the water balance equation:

$$(P + Q_{in} + G_{in}) - (ET + Q_{out} + G_{out}) = \Delta S$$

Where P = precipitation, Q_{in} = surface water inflows, G_{in} = groundwater inflows, E = evaporation, Q_{out} = surface water outflows, G_{out} = groundwater outflows and ΔS = change in storage (Campbell & Jackson, 2004).

On an annual basis, change in storage must be negligible for wetlands to retain their hydraulic function. Groundwater contributions were not quantified because insufficient information is available to estimate their magnitude but given the limited extent of the valley floor area and associated alluvial deposits, it is reasonable to assume that the groundwater inflows are approximately equal to the groundwater outflows annually. The assessment therefore focuses on rainfall, evapotranspiration and surface water flows. On this basis the equation can be simplified to:

$$(P + Q_{in}) = (ET + Q_{out})$$

The catchment upstream of the proposed wetlands was delineated from LiDAR-derived topography using a point immediately downstream of the wetland complex as the catchment outlet. The wetland area was excluded from the contributing catchment area to avoid double-counting rainfall inputs.

The assessment is based on the following assumptions:

- ✧ Long-term average climatic conditions are representative of average hydrological behaviour;
- ✧ Change in wetland storage is negligible over an annual cycle;
- ✧ Groundwater inputs and outputs are approximately equal annually;

- ✧ Scaled discharge derived from the Kakaho West catchment is representative of the offset wetland contributing catchment; and
- ✧ Existing drainage pathways supplying the wetlands remain intact.

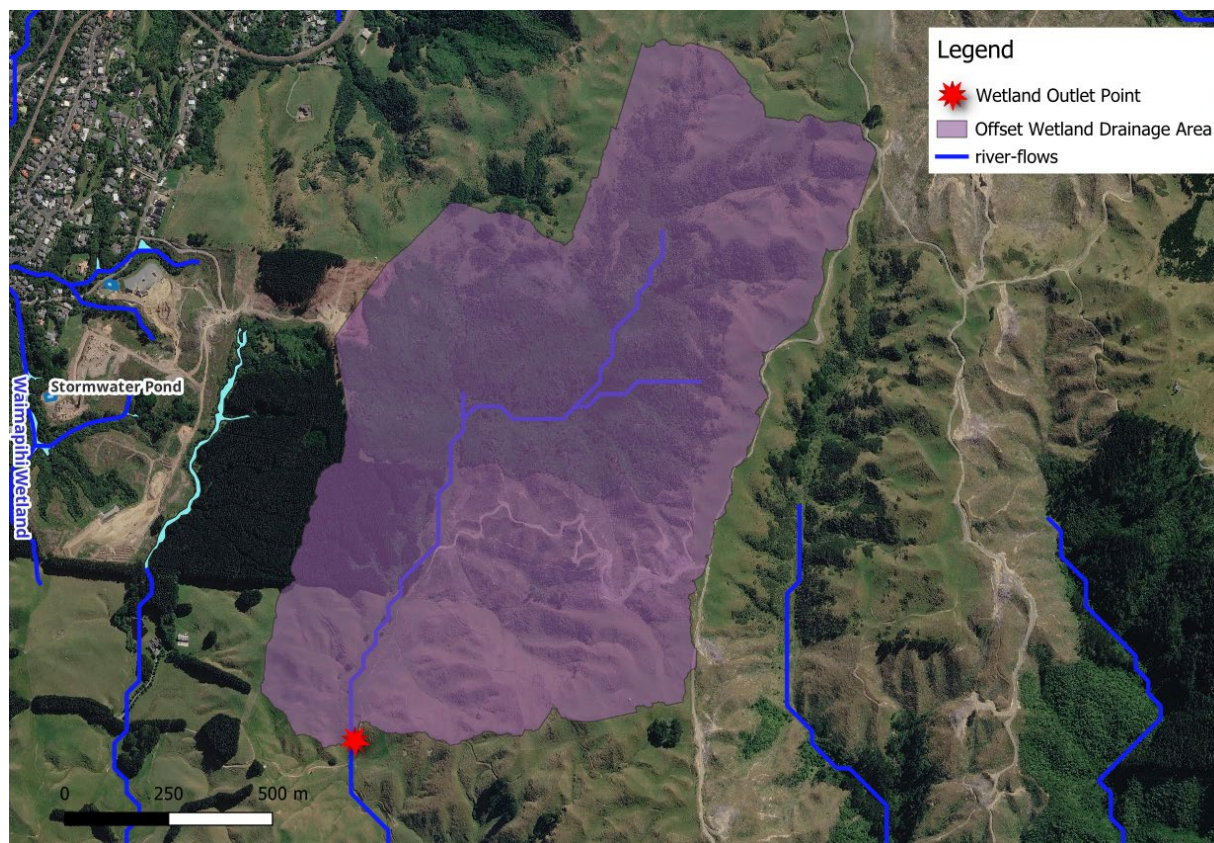


Figure 2: Contributing catchment used for the water balance assessment

Table 1: Data used in Water Balance Assessment

Parameter	Description	Source
P	Annual average precipitation directly onto the wetland area: $P = R \times A_w$. Where R = annual rainfall and A_w = combined wetland area.	Rainfall from GWRC, as described in Section 2.5 Area provided by Envelope Engineering and verified by BlueGreen Ecology
ET	Annual potential evapotranspiration from the wetland area: $ET = PET \times A_w$. PET is considered a reasonable estimate of wetland evapotranspiration.	PAT from Paraparaumu Aero, as described in Section 2.5 Area provided by Envelope Engineering and verified by BlueGreen Ecology

Table 1: Data used in Water Balance Assessment

Parameter	Description	Source
Q_{in}	Surface water inflow from the contributing catchment. No discharge data is available for Kakaho East, so the modelled mean daily discharge from the Kakaho catchment (1,732 m ³ /day) was converted to an annual specific discharge and applied to the contributing catchment: $Q_{in} = \frac{Q_K \times 365}{A_K} \times A_c$. Where Q_K = Kakaho mean daily discharge, A_K = Kakaho catchment area (837,170 m ²) and A_c = contributing catchment area.	PDP (2026), Table 3 (baseline)
Q_{out}	Annual surface water outflow from the wetlands, calculated as the residual term in the annual water balance: $Q_{out} = P + Q_{in} - ET$	Calculated
G_{in}, G_{out}	Assumed to be roughly equal so calculated	–

3.2 Water Balance Results

The proposed offset wetlands have a combined area of approximately 12,100 m² and have an upstream catchment of approximately 1.49 million m². This results in a catchment-to-wetland area ratio of approximately 119:1.

The assessment indicates that approximately 1.08 million m³/year of surface water is available from the upstream catchment, while annual wetland evapotranspiration losses are estimated to be approximately 11,300 m³/year.

Table 2: Summary of Hydrological Feasibility Assessment

Parameter	Value
Combined wetland area (m ²)	12,100
Contributing catchment area (m ²)	1,435,381
Catchment: wetland area ratio	119 : 1
Rainfall falling directly on wetlands (m ³ /year)	12,584
Annual evapotranspiration from wetlands (m ³ /year)	11,326
Estimated annual surface water inflow (m ³ /year)	1,083,913
Rainfall over contributing catchment (m ³ /year)	1,492,796
Catchment rainfall required to offset evapotranspiration	0.8%
Notes: - Results represent long-term average annual conditions. - Direct rainfall falling on the wetlands was excluded from the catchment rainfall requirement calculation, making the result conservative.	

Approximately 0.8% of the rainfall falling across the contributing catchment would be required to offset evapotranspiration losses from the wetlands.

The results indicate that the wetlands occupy a relatively small area within a large upstream catchment and that the volume of water available to the wetlands substantially exceeds the volume required to sustain wetland water losses.

4.0 Feasibility Assessment

4.1 Existing Hydrological Function

The proposed offset wetlands are located within existing valley-floor drainage features where runoff from surrounding hillslopes naturally converges. The presence of peat deposits and local seepages indicates that portions of these areas already retain water and exhibit characteristics commonly associated with wetland environments.

The current landscape setting therefore appears consistent with areas capable of supporting wetland hydrological processes and the establishment of offset wetlands in this area is feasible.

4.2 Offset Wetland Hydrological Function

The water balance assessment indicates that the proposed offset wetlands are hydrologically feasible and capable of being sustained under the existing catchment setting. However, at present parts of the proposed area are not wetlands so it will be necessary to design the offset wetlands to ensure they are functional. This could be achieved by using a combination of the following measures:

- ✧ Fencing to reduce the impacts of cattle grazing on the wetland areas and encourage plant growth;
- ✧ Lowering some of the slightly higher areas of the proposed wetland offset to be consistent with the existing wetland areas;
- ✧ Minor diversion of a portion of flow from the stream under moderate and high flow conditions into the wetland areas; and
- ✧ Regrading the profile of some of the wetland areas to cause a natural reduction in flow rates and slower movement of water through the wetland system.

It is noted that hydrological conditions are expected to vary seasonally and periods of reduced stream flow are likely during drier parts of the year, particularly between February and May when rainfall is lower and evapotranspiration is higher. During these periods, portions of the wetland margins may experience seasonal drying. Such behaviour is typical of many valley-floor wetlands and does not necessarily indicate failure of wetland function. This can be managed by the measures noted above and a suitable wetland planting plan.

This assessment is intentionally high level and is based on long-term average climatic conditions. Surface water inflows have been estimated using scaled discharge data from the neighbouring Kakaho West catchment and groundwater contributions have not been quantified. While these assumptions introduce uncertainty, they are considered appropriate for a feasibility-level assessment.

Based on the available information, sufficient water is available within the contributing catchment. Provided the wetland areas are designed and graded to retain water, the hydrological conditions are considered suitable to support wetland development.

5.0 References

- Begg, J., & Johnston, M. (. (2000). *Geology of the Wellington Area. 1:250,000 geological map 10*. Institute of Geological and Nuclear Sciences Limited.
- Campbell, D.I. & Jackson, R.J. 2004. Hydrology of wetlands. *Freshwaters of New Zealand* (ed. by J. Harding, P. Mosley, C. Pearson and B. Sorrell). New Zealand Hydrological Society Inc., New Zealand Limnological Society Inc., Christchurch, New Zealand.
- ENGEO Limited. (2022, August 11). *Preliminary Geotechnical Investigation - Mount Welcome Station, Pukerua Bay, Porirua*.
- Pattle Delamore Partners Limited. (2025) *Mt Welcome Hydrological Assesment. Prepared for Pukerua Property Group LP*.
- Pattle Delamore Partners Limited. (2026) *Mount Welcome Fast Tack – Response to reviewer comments. Prepared for Pukerua Property Group LP*.

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Prepared by

PP 

Jacob Howarth

Hydrogeologist

Reviewed and approved by



Katy Grant

Technical Director – Water Resources