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Vineway Limited
Via email

Attention: Andrew Allsopp-Smith

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Delmore Subdivision: Response to Council's Questions Regarding Wetland Hydrology

1. Introduction

Williamson Water & Land Advisory (WWLA) has prepared this hydrological advice note to support Vineway Limited's (Vineway) proposed residential development Delmore, in Upper Orewa, Auckland ("the Site").

The Vineway development is currently being assessed through the "Fast Track" consenting process. Auckland Council's terrestrial ecologist (R Statham) raised the following question:

> *"Culvert design is unlikely to maintain hydrology across the entire width of some wetlands. Requires finer grained analysis as to its suitability from a hydro-geomorphologist. Some crossings may better suit realignments or bridging structure(s), with sufficient height above the wetland plants to maintain habitat viability.*
>
> *Further analysis is required for culverts that impact or are immediately adjacent to wetlands e.g., Culverts 1, 3, 7, 9, 10."*

This question is denoted as Item 6 of the AC Ecology Questions, of the Further Responses Tracker. Concern around wetland drainage resulting from the removal of the existing culvert was also raised as Item 10 of the AC Streams/Wetlands Questions.

The locations of the culverts proposed as part of the development are illustrated on Drawing 3725-0-4800 (Page 1) of Appendix A.

2. Response

Our interpretation of Mr. Statham's question is that he is concerned that construction and installation of five proposed culverts (1, 3, 7, 9, and 10) will result in concentrated flow through the centre of the culvert, and that the side margins of the wetlands immediately downstream of these culverts will thus not receive flow. There is also potential concern regarding wetland dewatering during the removal of the existing culverts, and presumably until the bed within the embedded depth of the new culvert forms.

Each of the five culverts are reviewed and our hydrological response provided below.

2.1 Culvert 1

Culvert 1 is located on a straight reach, in a well-defined channel. The culvert has been designed to span 1.3 times the width of the stream bed and will be embedded by 25% of the height. The culvert will be installed at the average grade (slope) of the reach to be culverted.

It is expected that a natural bed will form within the embedded culvert that will reach an equilibrium state, tying in wetland material upstream and downstream of the culvert.

The channel is well defined, with a low point down the central axis that runs through the centre of the wetland. Flow discharged through the culvert will continue to flow through the central axis, as occurs at present. There will be no change in flow distribution across the wetland downstream.

As the channel is incised and flanked by higher elevation topography to both the north-west and south-eastern sides, the thalweg provides a control on groundwater levels (i.e., the water table is at, or near the surface, along the channel when groundwater levels are high (i.e., winter)). The installation of an embedded culvert will cause a temporary, localised lowering of the groundwater table, as illustrated by the schematic in **Figure 1**.

Using Culvert 1 as an example, the culvert will be embedded below the natural ground by ~0.5 m (25% of the 2.0 m high culvert). A 4.8 m long, D200 riprap apron will be installed at both the upstream and downstream ends of the culvert, tying back into the existing ground levels.

The embedded culvert will essentially create a localised drawdown either side of the culvert, lowering water levels by the embedment depth (0.5 m in this instance). Maximum drawdown will occur immediately upstream and downstream of the culvert, and decrease with increasing distance away, depending on the topographical profile upstream and downstream. This effect will only be temporary until a new natural bed has established within the culvert, tying back into natural ground (as illustrated by the 'Reinstated Ground' in **Figure 1**).

The bed will begin to re-establish within the culvert with the first rainfall event post construction. The bed will progressively develop and continue to build up through deposition over time. It is anticipated it will take in the order of 1-5 years for the bed to fully re-establish within the culvert – dependant on climatic conditions (i.e., intensity of storm events that generate erosion upstream, which is then deposited within the culvert).

Immediately following construction, there will be no wetland vegetation present within the culvert, or over the riprap aprons. Therefore, while there will be localised drawdown in these locations, there will be no wetland vegetation present in the location of maximum potential impact.

Surface water contributions and direct rainfall to the wetland (both upstream and downstream of the culvert) will remain unimpeded, hence not resulting in a total cutoff of water supply to the wetland.

Any effects on wetlands are considered to be a 'temporary impairment' only, and will not result in a loss of wetland. The 'temporary impairment' is a result of the temporary lowering of the groundwater level immediately adjacent to the culvert, with the effect rapidly decreasing in an exponential manner with distance from the culvert i.e. the greatest temporary impairment effect will be experience adjacent to the culvert.

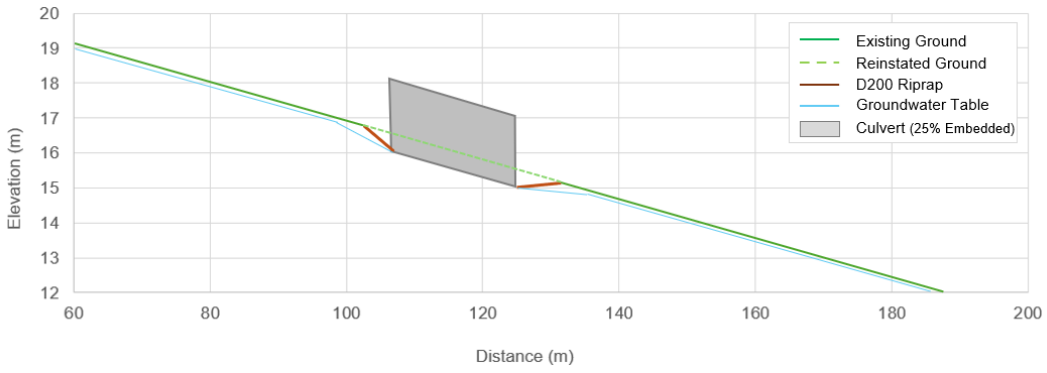

Figure 1. Conceptual schematic of temporary culvert dewatering.

2.2 Culvert 3

Culvert 3 is located approximately 12 metres downstream of a wetland. There are no wetlands located directly downstream of the culvert itself.

As there are no wetlands downstream, the question regarding maintaining hydrology across the entire width of the wetland is not relevant to this culvert.

A temporary drawdown in upstream groundwater levels will occur (as described for Culvert 1) and will likely extend into Wetland 3. We reiterate, this will result in a 'temporary impairment' only, until a new bed has established within the culvert. Surface water flows to the wetland from the catchment upstream will remain unimpeded.

2.3 Culvert 7

Culvert 7 is located within a wetland near the headwaters of a small catchment. A wetland is located both upstream and downstream of the proposed culvert location.

The proposed culvert is a single 6.0 m wide by 2.0 m high box culvert, installed at a gradient similar to that of the natural reach. A riprap apron will be constructed along the downgradient end of the culvert. The riprap apron provides both erosion protection and distribution of flow. Flow through the culvert will be dispersed through the riprap, rather than discharging through a central point. This will ensure flow is maintained across the width of the wetland immediately downstream. Overtime, as a natural bed forms within the embedded culvert, the flowpath will establish a new dynamic equilibrium, and continue to convey flow downstream.

A temporary drawdown in groundwater levels will occur (as described for Culvert 1), and the radius of drawdown will extent into the wetland both upstream and downstream of the culvert. We reiterate, this will result in a 'temporary impairment' only until a new bed has established within the culvert, and will not result in a loss of wetland.

There is no existing culvert at this location, so there will be no effects associated with removal of culverts.

2.4 Culvert 9

Culvert 9 is proposed to replace the existing 225 mm diameter concrete culvert located under the access track at this location. A wetland is present immediately upstream. The invert of the existing culvert controls the standing water level within the wetland upstream. There is no wetland present immediately downstream.

The existing culvert is proposed to be replaced by a new 4.0 m wide, 3.0 m high culvert, that on average will be embedded by 25% of the height. The upstream invert of the culvert will be set to the invert of the existing culvert to maintain the control on upstream water level. This will ensure there is no permanent dewatering of the upstream water levels and wetland.

Temporary dewatering of the wetland upstream could occur during the period from when the existing culvert is removed, until the new culvert is completed in place. This will be mitigated through the use of a temporary weir and diversion channel to maintain standing water levels during construction.

Surface water flows to the wetland from the catchment upstream will remain unimpeded.

2.5 Culvert 10

Culvert 10 is located approximately 40 metres north-west of Culvert 9. A wetland is located immediately upstream of Culvert 10, and another 8 m downstream. There is no culvert presently at this location.

A 6.0 m wide by 2.0 m high box culvert is proposed at a grade matching the existing topography. The culvert will be embedded by 25%. A riprap apron will be constructed along the downgradient end of the culvert. The riprap apron provides both erosion protection and distribution of flow. Flow through the culvert will be dispersed through the riprap, rather than discharging through a central point. This will ensure flow is maintained across the width of the wetland immediately downstream. Overtime, as a natural bed forms within the embedded culvert, the flowpath will establish a new dynamic equilibrium, and continue to convey flow downstream.

A temporary drawdown in groundwater levels will occur as described for Culvert 1. We reiterate, this will result in a 'temporary impairment' only until a new bed has established within the culvert, and will not result in a loss of wetland.

3. Summary Statement on Potential Effects

In our opinion, the proposed culverts have been appropriately designed to minimise and avoid potential effects on wetland hydrology. Two avenues of potential affects were reviewed; 1) concentration of flow (i.e., not maintaining flow across the width of wetland downstream), and 2) dewatering due to culvert embedment.

Where wetlands are located immediately downstream, riprap aprons at the culvert outlet will aide in spreading flow laterally, and prevent a channelised discharge (i.e., maintain flow across the width of the wetland downstream).

Potential effects on wetlands associated with the embedment of new culverts are considered to be a 'temporary impairment' only, and will not result in a loss of wetland or hydrological functioning. A natural bed will be re-established within the culverts over time, effectively returning the hydrological conditions to those of the present.

4. Closure

Please contact the undersigned if you have any queries in relation to this assessment.

Yours sincerely,

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