WILLIAMSON
WATER & LAND ADVISORY

Water Management Plan

Ararimu Road Managed Fill

SB CIVIL

WWLA0745 | Rev. 1

13 October 2023

Ararimu Road Managed Fill

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Distribution of copies

Rev	Date issued	Issued to	Comments
1	13 Oct	SB Civil Ltd	First draft for review

Contents

1. Introduction

Williamson Water & Land Advisory (WWLA) were commissioned by N & J Wood Limited in February 2023 to provide professional planning and environmental services for the preparation of a resource consent application to authorise a new managed fill facility at 14 Beaver Road East, Bombay (the Site).

Planning and environmental services provided by WWLA included:

- Pre-application meetings and support;
- Consultation;
- Primary Site Investigations (Ground contamination);
- Fill Management Plan;
- Water Management Plan;
- Erosion and Sediment Control Plan including Chemical Treatment Plan; and
- Assessment of Effects on the Environment.

This report documents the Water Management Plan.

1.1 Report Structure

The report structure is as summarised in **Table 1**.

Table 1. Report structure.

Section	Heading	Description
1	Introduction	Provides an overview of the project and proposed managed fill development.
2	Current Site Hydrology Setting	Describes the hydrological setting and catchment characteristics at present conditions (i.e., prior to development).
3	Proposed Water Management Plan	Details the proposed water management plan approach.
4	Assessment of Effects	An assessment of effects on catchment hydrology associated with the proposed managed fill development and water management plan.

1.2 Site Overview

The site is located at 1618 Ararimu Road, Papakura.

The site covers 40.4 ha, with a central gully running approximately north to south. The land is classified as a rural/lifestyle block. A stand of mature pines is located in the south-eastern corner of the site.

Eight small wetlands are found on site, and are covered in detail in the Ecological Effects Assessment[1] report. These eight wetlands were classified as poor to moderate ecological condition.

[1] RMA Ecology. 2023. Ararimu Road Managed Fill, Papakura, Auckland – Ecological Effects Assessment. Report prepared for SB Civil. Job 2307.

Map Title:
Location Overview

Project:
Ararimu Road Managed Fill

Client:
SB Civil Ltd

Legend

- Road
- Drain
- Ephemeral Stream
- Intermittent Stream
- Permanent Stream
- Property Boundary
- Wetland

Data Provenance
Aerial imagery and land parcels from Land Information New Zealand

Drawn by: Josh Mawer
12/10/2023

Layout Name
Figure 1 - Location overview

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Figure 1.

1.3 Description of Proposed Fill Development

The project comprises the construction and operation of an approximately 1,559,000 m^3 fill for the disposal of managed fill material. The proposed site cut/fill plan is presented in **Figure 2**.

The overall project will include:

- A gravel access road constructed on Ararimu Road to the managed fill area.
- Bulk earthworks to construct the fill areas across an area of approximately 100,000 m^2.
- Establishment of ancillary infrastructure; including a site office, parking area, and weighbridge.
- Construction of a new accessway and installation of new culverts.

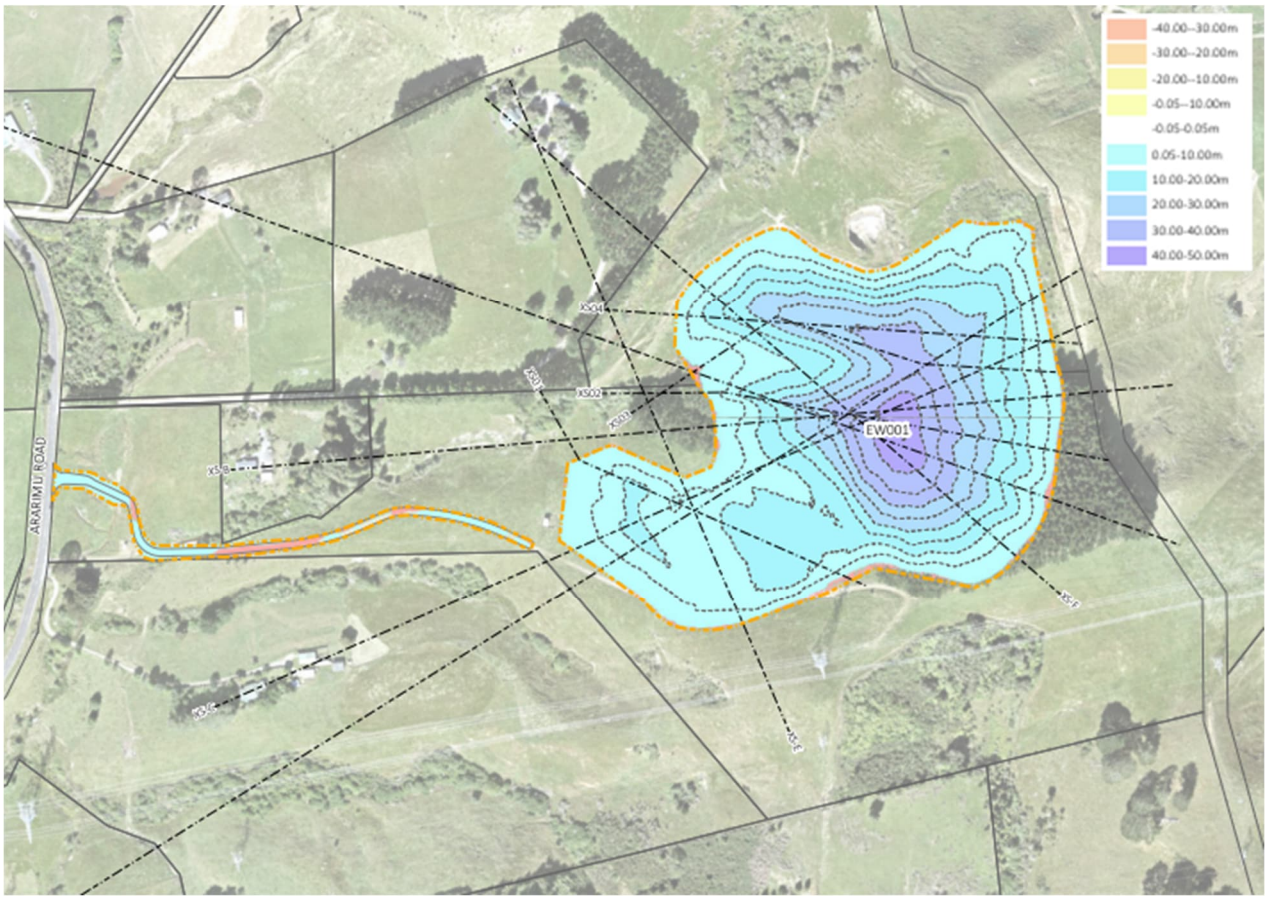


Figure 2. Proposed fill development. (From CivX Cut and Fill Drawings Package).

2. Current Site Hydrology Setting

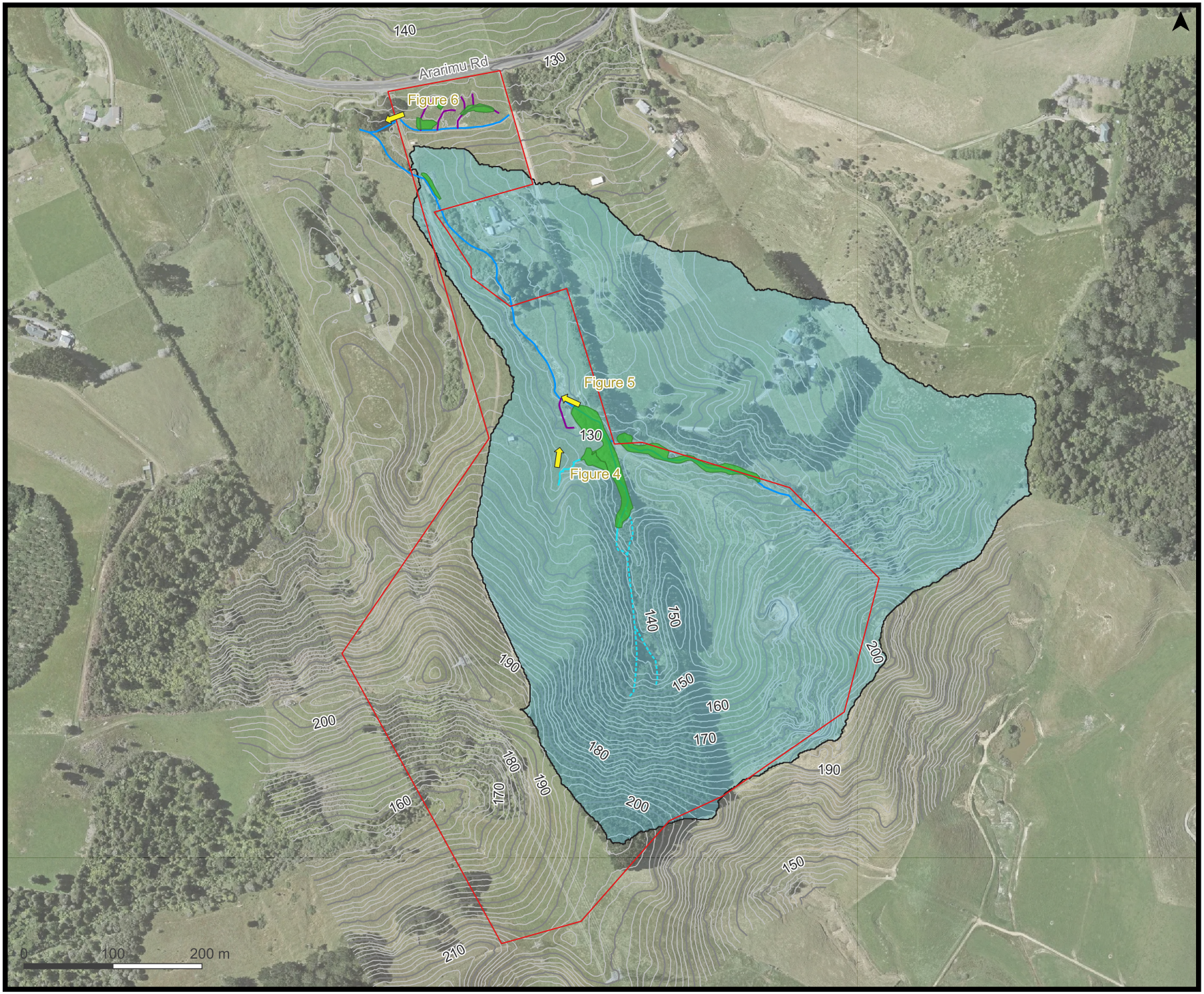
This section provides a high-level review of the sites current hydrological setting.

2.1 Site and Catchment Characteristics

An overview of the topographic and drainage features of the site are displayed in **Figure 3**.

The site largely comprises a single gully system, running generally south to north. The headwaters of the gully are characterised as ephemeral watercourses. The watercourse becomes a permanent flowing stream where the two larger gully fingers converge. A wetland is located at the confluence of the two streams.

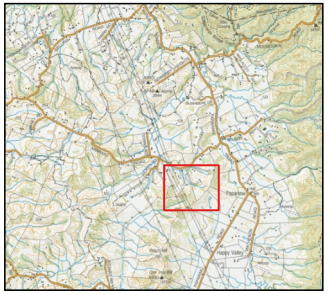
The topography is moderately steep (0.3 m/m) in the headwaters, whereas the gully floor is of low slope (0.02 m/m).



Map Title:
Hydrological Features

Project:
Ararimu Road Managed Fill

Client:
SB Civil Ltd



Legend

- Photograph Location
- Ephemeral Stream
- Intermittent Stream
- Permanent Stream
- Drain
- 2 m Contour
- 10 m Contour
- Property Boundary
- Wetland
- Surface Water Catchment

Data Provenance
Aerial imagery and land parcels from Land Information New Zealand

Drawn by: Josh Mawer
12/10/2023

Layout Name
Figure 3 - Hydrological features

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Figure 3.

Figure 4. Photo of the wetland.

Figure 5. Photo of the stream near the wetland.

Figure 6. Photo of the stream further downstream.

2.1.1 Local Soils

SMap Online indicates the higher elevation ridges at the southern extent of the site predominately comprise of Orthic Granular Morrinsville soil. These soils are clayey soils formed from strongly weathered volcanic rocks or ash. Generally, these soils are moderately well drained with low vulnerability of water logging. SMap Online does not extend to cover the remaining areas of the site.

The Landcare Research Fundamental Soils Layer indicates the majority of the site comprises Opaheke clay loam soil. These soils occur on elevated ridges and plateaux interspersed by various alluvial soils in valley bottoms. The parent material of these soils is greywacke weathered to "rotten rock."

2.1.2 Local Geology

The GNS Qmap dataset indicates the southern half of the site is underlain by greywacke (basement Eastern Province) sedimentary rock. The northern half of the site is indicated to be underlain by Holocene river deposits (sand, silt, mud, and clay with local gravel and peat beds).

2.2 Conceptual Site Hydrology

This section details the conceptual understanding of the hydrology and hydrological functioning of the site under existing (i.e., prior to the proposed fill development) conditions. Understanding the fundamental hydrological features and processes is prudent in order to develop an appropriate water management plan.

2.2.1 Surface Water

The main surface water catchment of the site comprises an area of 0.3 km^2 – 30 ha (**Figure 3**). Conceptually, the site surface water hydrology is fairly simple. The majority of the site drains from south-east to north-west. The topography is relatively steep in the headwaters, and surface water is only present for a short duration

during and after rainfall on these slopes (i.e., ephemeral). The watercourse becomes a permanent stream where the headwater "fingers" converge, and groundwater emerges in-stream on the gully floor, as further detailed in **Section 2.2.2**.

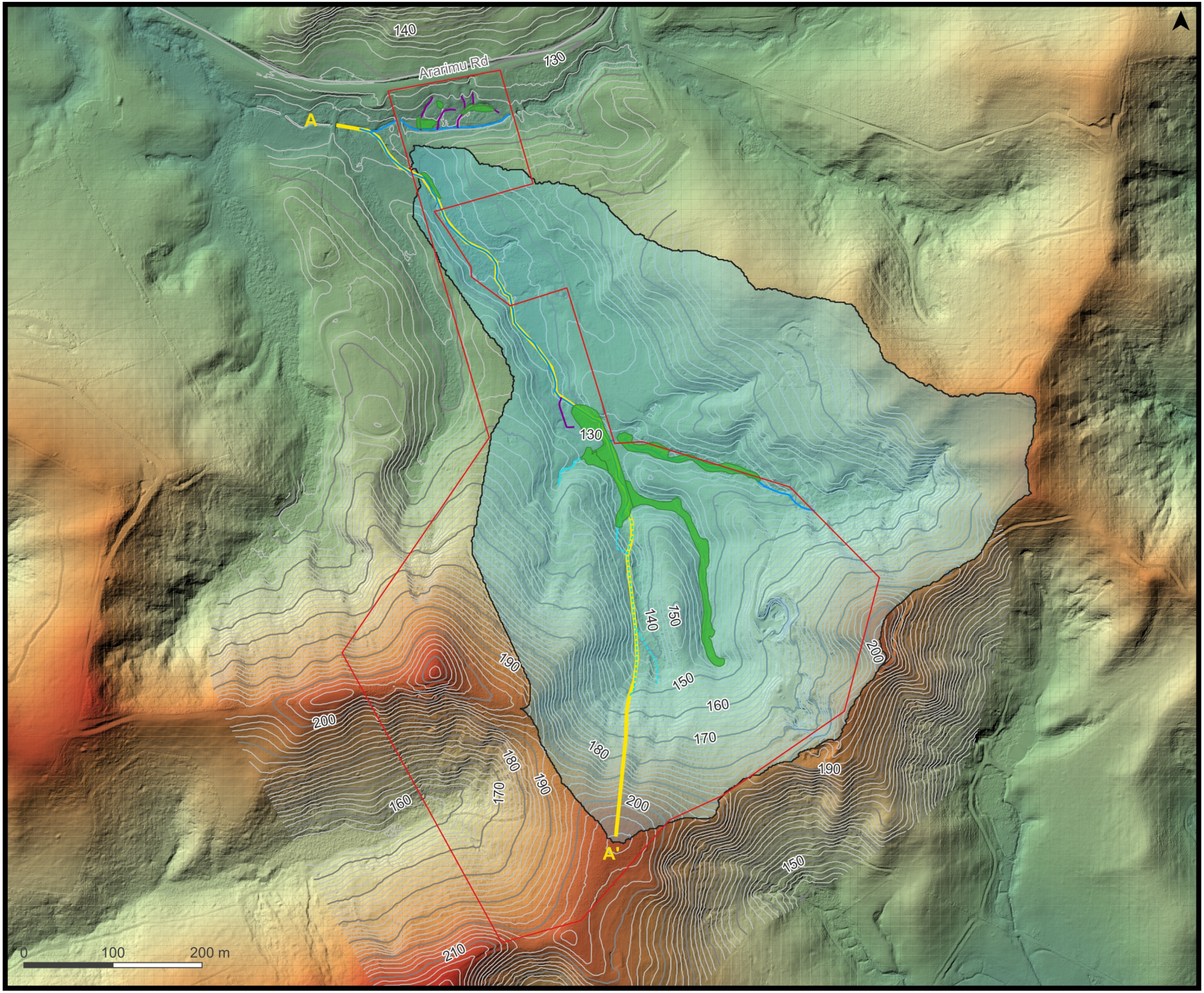
2.2.2 Groundwater

The groundwater table is typically located beneath the ground surface across the majority of the site. The exception for this is the lower reach of the stream along the central gully floor – where the groundwater table is expressed at the surface (as a seep / spring), at least during the winter / wet periods.

The location of the groundwater table is illustrated through a conceptual hydrogeological cross-section along the profile indicated as A-A' on **Figure 7**.

The resulting cross-section is illustrated in **Figure 8**. The average groundwater level was mapped on this cross-section using hydrogeological inference based on local topography, with the permanent stream channel providing a control on groundwater level.

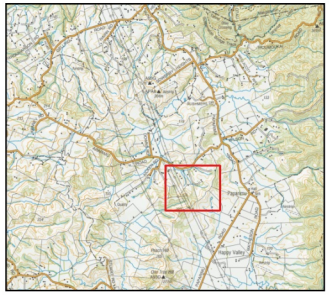
The cross-section indicates local groundwater generally flows south-east to north-west, and follows the topography. The groundwater table intersects the ground surface near the head of the wetland, and is likely providing the sustaining flow of water to this wetland.



Map Title:
Topography and Cross-section Location

Project:
Ararimu Road Managed Fill

Client:
SB Civil Ltd



Legend

- Cross-section
- Ephemeral Stream
- Intermittent Stream
- Permanent Stream
- Drain
- 2 m Contour
- 10 m Contour
- Property Boundary
- Wetland
- Surface Water Catchment

Elevation (m)

225

100

Data Provenance
DEM and land parcels from Land Information New Zealand

Drawn by: Josh Mawer
16/10/2023

Layout Name
Figure 7 - Topography anad Cross-section Location

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Figure 7.

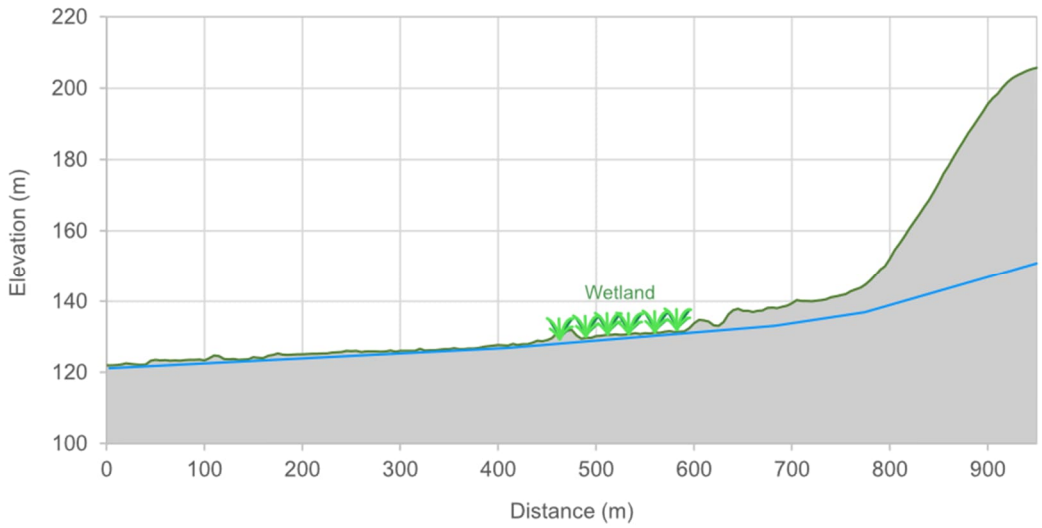


Figure 8. Conceptual hydrogeological cross-section.

2.3 Indicative Flow Rates

The surface watercourses within the site are small, and as far as we are aware no hydrological monitoring data (e.g., water level or flow) exists within these catchments. NIWA's NZ River Maps[2] web application was utilised to provide insight into representative streamflow statistics. The NZ River Maps provides estimates of key streamflow statistics in ungauged catchments based on a Random Forest Regression method, as detailed in Booker and Woods (2014)[3].

Estimates for the downstream extent of the catchment (near Ararimu Road) were pro-rated (scaled) based on catchment area from the statistics indicated on NIWA's NZ River Maps, and tabulated in **Table 2**.

Table 2. Indicative streamflow statistics.

Parameter	Flow
Area (km^2)	0.302
Mean Annual Low Flow (L/s)	2.8
Median Flow (L/s)	8.2
Mean Flow (L/s)	14.0

[2] https://shiny.niwa.co.nz/nzrivermaps/
[3] Booker, DJ., Woods, RA. 2014. Comparing and combining physically-based and empirically-based approaches for estimating the hydrology of ungauged catchments.

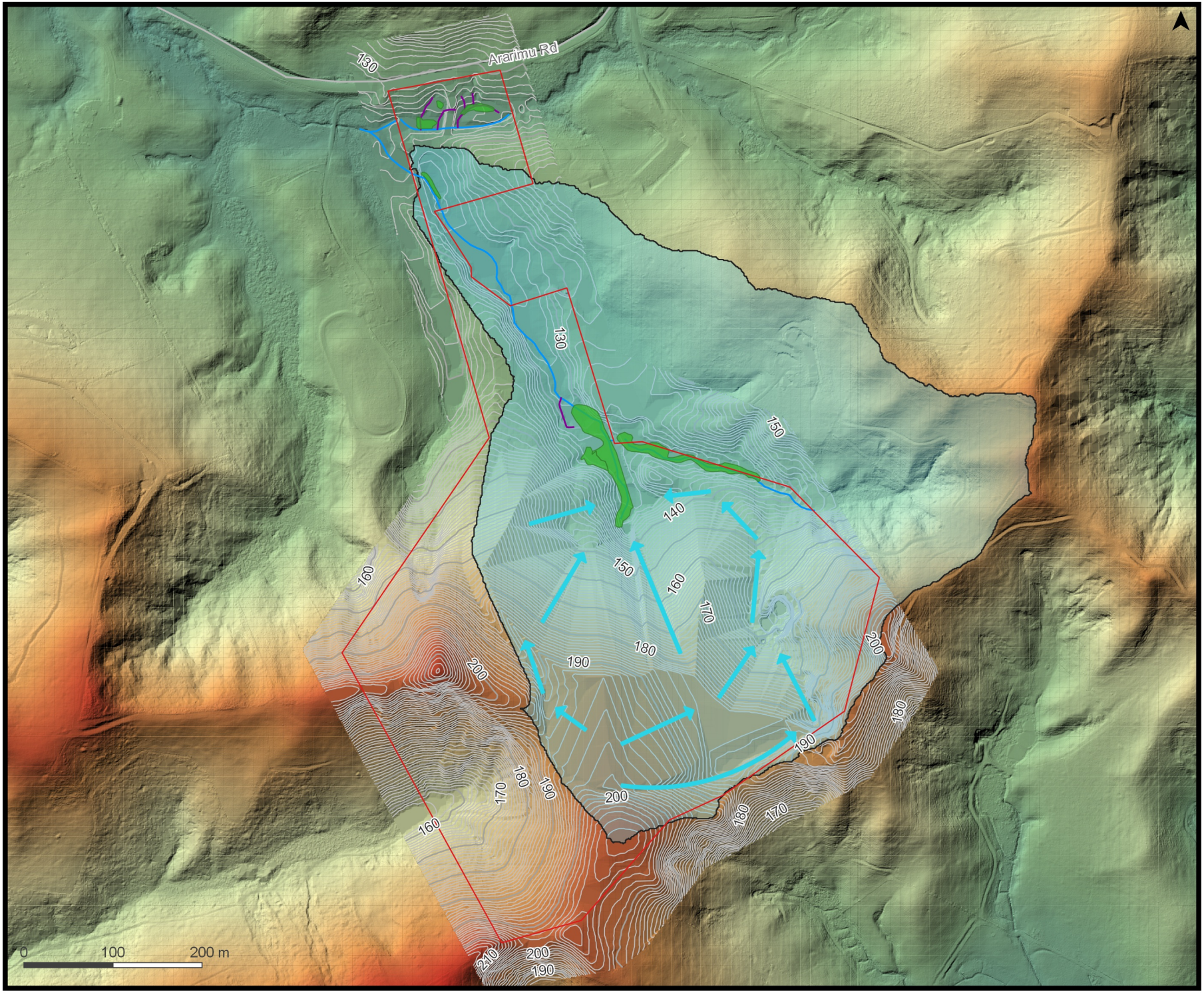
3. Proposed Site Water Management Plan

3.1 Overview

This section detailed the proposed site Water Management Plan (WMP). The objectives of the WMP are to:

- Maintain surface water flows to the wetland; and
- Maintain groundwater flows to the wetland.

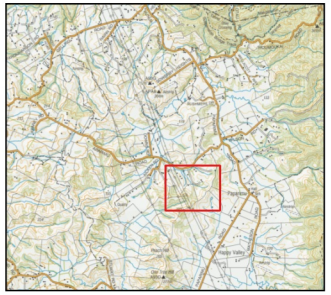
A schematic overview of the water management plan is presented in **Figure 9**. Key features of the water management plan are described below separately for surface water and groundwater features / processes.



Map Title:
Water Management Plan

Project:
Ararimu Road Managed Fill

Client:
SB Civil Ltd



Legend

- Indicative Flow Direction
- Permanent Stream
- Drain
- Property Boundary
- Wetland
- Surface Water Catchment

Topographic Contour
- 1 m
- 10 m

Elevation (m)
- 225
- 100

Data Provenance
Aerial imagery and land parcels from Land Information New Zealand

Drawn by: Josh Mawer
14/09/2023

Layout Name
Figure 9 - Water Management Plan

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Figure 9.

3.1.1 Surface Water

The construction of the managed fill will raise the land surface by a maximum of approximately 40-50 m, with the highest elevation located at the southern extent of the fill (i.e., the head of the fill). The fill will be sloped so that surface water runs off via overland flow. Indicative flow paths / directions are illustrated on **Figure 9**.

A key design requirement of the proposed managed fill surface (i.e., the final land surface design) was that it does not change the overall surface water catchment area or location. Therefore, surface water flows to the wetland at the foot of the fill are maintained.

3.1.2 Groundwater

As detailed in the Geotechnical Assessment Report[4], formal underfill drainage will be required to manage groundwater pressures at the contact between the current ground surface and the overlying managed fill.

The Geotechnical Assessment Report recommends subsoil drainage consisting of 110 mm to 160 mm diameter Nexus Hiway perforated pipe (or similar), in a filter sock, surrounded by drainage aggregate, wrapped in a geofabric throughout the gully floor. The subsurface drainage design will be finalised prior to commencing gully infilling as it is likely changes will need to be made to the extent of drainage as foundation development works progress. It is noted the drains will need to terminate at the upstream extent of the wetland, to ensure groundwater flows to the wetland, rather than underneath.

Additional piping my also be required to intercept seepage points observed during construction.

The drains will collect any artesian groundwater at the base of the fill and convey this to the downgradient toe of the managed fill, where it will discharge as groundwater baseflow into the natural stream habitat. Thus the groundwater collection system will maintain groundwater baseflows into the wetland system, and further downstream.

[4] Baseline Geotechnical. 2023. Geotechnical Assessment Report. Ararimu Road – Proposed Managed Fill. BGL000170. Report prepared for SB Civil Limited.

4. Assessment of Effects

This section details the assessment of hydrological effects associated with the proposed managed fill and associated Water Management Plan.

4.1 Hydrological Processes

4.1.1 Surface Water

The final fill landform surface was designed to ensure there were no changes to the extent of the existing surface water catchment. As illustrated on **Figure 9**, the extent of the surface water catchment remains identical to the current catchment extent (**Figure 3**). Therefore, from a closed water balance perspective, there is no change from current conditions. The managed fill may be of lower permeability than the natural ground, and hence promote surface runoff.

4.1.2 Groundwater

As detailed in **Section 3.1.2**, drainage will be constructed below the managed fill to manage groundwater pore pressures at the interface of the land surface and fill above. The presence of these drainage features will prevent the mounding (i.e., raising) of groundwater under the fill surface.

The drainage will ensure the ground below is permeable, and maintain groundwater flow downgradient to the wetland. The subsoil drainage will terminate upstream of the wetland, and thus will not result in a drawdown of groundwater levels at the wetland.

4.1.3 Combined Surface Water and Groundwater Flow

Under current conditions (i.e., before the fill development), the watercourse that runs down the central gully becomes a permanently flowing stream at approximately the location of the wetland. As the surface water catchment does not change and subsoil drainage will be in place to maintain groundwater flow, there will be no more than minor change to the flow regime of the existing permanently flowing reach downstream of the managed fill toe.

4.2 Flow to the Wetland

As detailed in **Section 4.1.3**, there will be no more than minor changes to the combined surface water and groundwater flow downstream of the managed fill toe. Therefore, flow to the wetland is maintained, and the managed will not result in the complete, or partial drainage of the wetland.